EXHIBIT C

TECHNICAL REQUIREMENTS

[see attached]

DOWNTOWN TUNNEL/MIDTOWN TUNNEL/MLK EXTENSION PROJECT

The Technical Requirements

Comprehensive Agreement Exhibit C

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Introduction

The Virginia Department of Transportation (VDOT) and Elizabeth River Crossings, LLC (ERC) has formed a public-private partnership to design, construct, operate and maintain the Downtown Tunnel, Midtown Tunnel and the Martin Luther King Extension (DTT/MTT/MLK). This partnership is viable through the Public-Private Transportation Act ratified by Virginia's legislature in 1995. Below is an aerial of the Project area highlighting the focus locations:

Background

The Technical Requirements were originally developed in April 2010 to act as a guide for further development of the document. 4

Numerous meeting were conducted to discuss each section of the Technical Requirements. The document presented here is the outcome of the agreements determined at those meetings. 4

Scope

This document, contained herein represents a part of the Comprehensive Agreement and is referenced throughout the Agreement as Exhibit C. This document is divided into sections that follow the logical development and operation of the Project. Sections included are:

- Design and Construction Requirements,
- Public Information and Communications,
- Project Management, and
- Operations, Maintenance, and Tolling.

Intent

VDOT and ERC have worked together to develop a document that will serve as Exhibit C of the Comprehensive Agreement and reflect the minimum Project requirements in effect during the Term of the Project. 4

Design Principles

The Design shall be governed by the following principles:

a. Safety for all travelling patrons will be achieved by early consideration of all reasonably foreseeable hazards and mitigating them to the extent as far as reasonably practicable. 2

b. Minimum operating, energy and maintenance costs, achieved by the use of long life, high reliability, energy efficient items with minimum maintenance requirements.

c. Minimize lane closure periods for maintenance and or construction. Locating as much of the tunnel plant as possible outside the tunnel bores, and designing any plant accessed via the tunnel for rapid repair or replacement.

d. Visual and aesthetic appearance, both external and internal, in particular, all mechanical and electrical systems concealed from sight as practical, landscaping and aesthetic treatments included throughout the Project area.

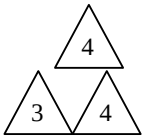
f. All M&E systems shall incorporate sufficient fault resilience, in the form of backup systems or redundancy, to ensure that in the event of a single fault event (including consequential faults) the tunnel is able to continue operating normally.

i. Accessibility for maintenance and ease of the element replacement.

Hierarchy of Documents

The hierarchy of documents is to provide guidance on precedence of matters that are in conflict with different standards. The below listing is considered the hierarchy of documents for the Technical Requirements in the event there are conflicts with different standards:

A. Tunnel

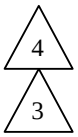


1. Comprehensive Agreement
2. These Technical Requirements
3. Deleted
4. VDOT Standards
5. AASHTO Standards
6. ASTM Standards
7. NRC
8. ASHRAE
9. ASME

B. Non Tunnel

1. These Technical Requirements
2. Special provision copied notes
3. Special provisions
4. Standards and specifications listed in Section 3.5.2
5. Reference documents listed in Section 3.5.2
6. Standard Drawings (calculated dimensions, unless obviously incorrect, will govern over scaled dimensions)

C. Buildings



1. Bureau of Capital Outlay Management (BCOM) – Guide for Construction and Professional Services Manual
2. The Virginia Uniform Statewide Building Code

DOWNTOWN TUNNEL/MIDTOWN TUNNEL/MLK EXTENSION PROJECT

The Technical Requirements

Comprehensive Agreement Exhibit C

Section 1

Design and Construction Requirements

TECHNICAL REQUIREMENTS
Exhibit C

1 Design and Construction Requirements

1.1 General Statement of Scope

A. The Project shall be designed and constructed pursuant to the design criteria and specifications set forth in the Technical Requirements.

B. All Work shall comply with Good Industry Practice, Federal (including but not limited to the Federal design standards set forth in 23 CFR 625), State, municipal, and jurisdictional agency requirements, including those listed in Section 3.5.2, unless otherwise expressly stated in the Agreement.

C. Where the Work to be performed does not meet minimum American Association of State Highway and Transportation Officials (AASHTO) standards and specifications, the Concessionaire shall submit a design exception, pursuant to Virginia Department of Transportation's (VDOT) Instructional and Informational Memorandum on design exceptions, (using LD-440 format). The design exceptions approved by VDOT and FHWA as of the Agreement are set forth in Attachment 1G of the Technical Requirements.

D. Where the Work to be performed meets or exceeds minimum AASHTO design criteria, but does not meet VDOT's minimum standards and specifications, the Concessionaire shall submit a design waiver (using LD-448 format).

E. The Concessionaire shall be solely responsible for acquiring design exceptions and design waivers. VDOT's concurrence to a Concessionaire request design exception does not guarantee Federal Highway Administration (FHWA) concurrence. Previously submitted design exceptions and design waivers are subject to reevaluation if additional information becomes available that was not known at the time of initial submittal or conditions change that were used in the analysis of the original design exception or design waiver and, in either case, such additional information or changed conditions materially affect the premise on which the original design exception or design waiver at issue was based.

F. The Concessionaire shall ensure that the condition of existing buildings, structures, roadways, sidewalks, paths, trails, lighting and signal equipment, or other property that is to remain is not affected by the performance of the Work. The Concessionaire shall perform appropriate property pre-condition surveys and associated monitoring, and shall repair any damage determined to be directly caused by the Work.

G. Permanent structures shall be as defined in Section 1.14.2.A. 2

H. The parapet and barrier walls on bridges must conform to Section 410 of the 2007 VDOT Road and Bridge Specifications. Concrete barrier may be precast in the tunnel from start of boat section to start of boat section. If concrete precast barrier walls are used within the tunnel limits, they shall be continuous and be installed such as to maintain zero (0) deflection. 2 2

I. The Concessionaire shall ensure that areas impacted by the Work are subject to continual and un-interrupted removal of rubbish, scrap material, and debris. Work sites shall have a neat, safe and orderly appearance at all times. Within 30 days after Final Completion, or other such timeframe as may be agreed to by both parties, the Concessionaire shall remove its construction equipment, materials and debris from the Project Right of Way and other property adjacent to the Project.

J. When removal of mailboxes and newspaper boxes is made necessary by construction operations, the Concessionaire shall place them in temporary locations so that access to the boxes will not be impaired. Prior to Final Acceptance of each Project Asset, boxes shall be placed in their permanent locations as agreed with VDOT, upgraded to current criteria, and left in as good condition as when found.

K. The Concessionaire shall preserve property and improvements along the boundary lines of and adjacent to the Work unless the removal or destruction is absolutely required and consistent with the Construction Documentation. The Concessionaire shall use suitable precautions to prevent damage to such property. For property damage the Concessionaire is responsible under the Agreement, the Concessionaire shall restore property to a condition similar or equal to that existing before such damage was done by repairing, rebuilding, or restoring, as may be directed by VDOT, or making settlement with the property owner.

L. Limited access control will be determined in accordance with Federal and State requirements as set forth in the Standard Documents in Section 3.5.2 for all new ramp locations and any modifications to existing ramp locations. Where the Work cannot meet the Federal or State requirements, a design exception must be submitted in accordance with Section 1.1.E above.

1.2 Inspection of Work

1.2.1 Inspection of Work

A. The Concessionaire is responsible for quality control and quality assurance in accordance with VDOT's *Minimum Requirements for Quality Assurance & Quality Control on Design-Build & Public-Private Transportation Act Projects – August 2008*. All stages, materials, and details of the Work are subject to independent inspection by VDOT. VDOT shall be allowed access to all parts of 2

the Work on and offsite and shall be furnished such information and assistance by the Concessionaire in accordance with the Agreement. VDOT shall have ready access to machines and plant equipment used in processing or placing materials in accordance with the Agreement.

B. The Concessionaire shall keep VDOT informed of planned operations in accordance with the requirements of the Agreement and notify VDOT 48 hours prior to any construction involving critical inspection points as identified in the quality control plan.

C. If materials are used or work is performed without following the relevant Quality Management System Plan (QMSP), VDOT may require the Concessionaire to remove and replace the work or material, at no additional cost to the Project.

D. If an inspection reveals that Work has not been properly performed, the Concessionaire shall immediately inform VDOT of its schedule for correcting such Work and the time when an inspection of the corrected Work can be made.

E. Geotechnical Construction Engineer – The Concessionaire shall employ a geotechnical construction engineer who shall be responsible for providing written certification to the Quality Assurance (QA) manager that all geotechnical related work and materials are in conformance with the Technical Requirements and the Approved for Construction (AFC) documentation. During construction, the geotechnical construction engineer and/or his/her qualified inspector shall inspect the adequacy of the geological subgrades conditions for support of shallow foundations prior to placement of reinforcing steel and footing concrete. The geotechnical construction engineer or representative shall be present during installation of all deep foundations to confirm the work has been done in accordance with the Technical Requirements, prior to installation of tunnel segments, U-Walls and all other non-tunnel structures or foundations. For pavements, embankments and approach abutments, the geotechnical construction engineer and/or his or her qualified inspector shall determine suitability of the subgrade for pavement, embankment and approach abutments support in accordance with the Technical Requirements, prior to placement of the pavement aggregate base course material and embankment fill or construction of the approach abutment. Any modifications in the design as a result of these inspections must first be approved in writing by the geotechnical design engineer (described further in Section 1.4). The geotechnical construction engineer must be a licensed Professional Engineer in the State and have at least 10 years of geotechnical engineering construction management experience with similar size and type of projects. Concessionaire shall submit at least three projects with points of contact to verify experience.

F. Marine Work Inspection Access

The Concessionaire shall provide a powered water transport vehicle to allow VDOT personnel access to all marine work. The water vehicle and operator shall be provided at the time of furnishing the Project Office and shall be available until Final Acceptance of the Project Asset that includes all marine work. 3

It is intended that this vehicle be the same as used and owned/leased by the Concessionaire for normal Project marine construction operations. The Concessionaire will provide contact information to VDOT for scheduling inspection trips. Safe boarding and de-boarding locations will be provided on the Project site adjacent to the Work.

1.3 Environmental

1.3.1 Environmental Documentation

A. The Concessionaire shall comply with and ensure that the environmental commitments and all conditions of Governmental Approvals made in the National Environmental Policy Act (NEPA) documentation referenced in Table 1.3.1A are implemented during final design and/or construction as appropriate. The Concessionaire will provide documentation to VDOT as each environmental commitment and/or condition of a Governmental Approval is implemented.

Table 1.3.1A

Downtown Tunnel National Fire Protection Association (NFPA) work	Programmatic Categorical Exclusion (5/13/09)
Midtown Tunnel NFPA work	Programmatic Categorical Exclusion (5/13/09)
Rt. 58/Midtown Tunnel (Pinners Point)	Final Environmental Impact Statement (FEIS) (11/8/96) and Record of Decision (3/17/97)
Rt. 58/Midtown Tunnel (Pinners Point)	Record of Decision (7/9/07)
Martin Luther King Freeway Extension	Environmental Assessment/Finding of No Significant Impact (2/26/09)
Brambleton Interchange Intelligent Transportation System (ITS)	Programmatic Categorical Exclusion (5/22/09)

B. If the Concessionaire becomes aware of new information or identifies previously unknown impacts that may have a bearing on environmental impacts or the

Concessionaire proposes changes to the Project scope and/or footprint, the Concessionaire shall initiate consultation immediately with VDOT to determine the need to reevaluate the NEPA documentation or prepare a supplemental Environmental Impact Statement (EIS). Consultation with VDOT will also be initiated by the Concessionaire prior to requesting major approvals from the Federal Highway Administration. VDOT shall be responsible for reevaluating the NEPA documentation, preparing any supplemental EISs and coordinating with FHWA. The Concessionaire shall provide VDOT with engineering and technical information in support of any NEPA reevaluation at the time the change or new information is presented to VDOT.

C. Prior to right of way authorization for total and partial takes, the Concessionaire shall provide VDOT with a completed PM-130 form and right of way plans (reviewed as per Section 3.6 Right of Way). VDOT shall perform the right of way reevaluation review to determine the right of way to be acquired is consistent with the NEPA documentation. If VDOT / FHWA determine the plans are not consistent with the NEPA documentation, the Concessionaire shall revise the plans until they are consistent, or provide VDOT with engineering and technical information to support VDOT's preparation of a reevaluation of the NEPA documentation for FHWA approval. VDOT shall provide copies of all right of way reevaluation reviews to the FHWA.

D. Prior to issuance of the AFC Documents, the Concessionaire shall provide VDOT with a completed PM-130 form and plans. VDOT will perform the Environmental Certification review and Plans, Specifications, and Estimates (PS&E) reevaluation review and determine if plans are consistent with the NEPA documentation and all environmental commitments. If VDOT / FHWA determine the plans are not consistent with the NEPA documentation, the Concessionaire shall revise the plans until they are consistent, or provide VDOT with engineering and technical information to support VDOT's preparation of a reevaluation of the NEPA documentation for FHWA approval. VDOT will provide copies of all Environmental Certification reviews and PS&E reevaluation reviews to the FHWA.

E. The Concessionaire is responsible for compliance with Applicable Law for potential staging and disposal areas outside the Project limits. The Concessionaire shall also be responsible for obtaining a property owner agreement for potential areas outside the existing State right of way. Any such potential locations within the existing State Right of Way shall require the Concessionaire to obtain a Land Use Permit from VDOT.

1.3.2 Water Quality Permits

A. The Concessionaire shall be responsible for any determinations, delineations, coordination, applications, mitigation, avoidance measures, acquisitions, and administration of required State and Federal water quality permits and permit modifications required for construction of the Project. The Concessionaire shall be responsible for compliance with pre-construction, construction-related, and post-construction permit conditions. Any compensation required to address impacts to streams and wetlands which arises from a failure on the part of the Concessionaire to comply with all relevant permits to its Work shall be the responsibility of the Concessionaire. In addition to the foregoing, fines or delays which arise from the negligent acts or omissions of the Concessionaire in relation to its responsibilities over the water quality permit or other regulatory violations by Concessionaire in the performance of its Work shall be the responsibility of the Concessionaire. 1

B. The Concessionaire shall be listed as the "permittee" in all cases. These permits, and any permit modifications, shall be obtained by the Concessionaire, copies provided to VDOT, and verified by the VDOT project manager prior to the issuance of a Notice to Proceed for the applicable Construction Segment. 4

1.3.3 Hazardous Materials Investigation

Section 1.3.3 shall be read in conjunction with the Comprehensive Agreement, and both shall set forth the Concessionaire's responsibilities for the management of Hazardous Substances.

A. Studies performed by VDOT have identified potential Hazardous Substances within the O&M Boundaries. These studies are available to the Concessionaire upon request. At a minimum, the Concessionaire shall perform a Phase I Environmental Site Assessment for the HERC/Boiler Cleaning and Specialty Corp and the Murro Chemical sites in accordance with the American Society for Testing Materials (ASTM) Method E-1527-05. The Concessionaire shall cause further studies and evaluations to be performed and submit a summary of findings to VDOT. 2

B. The Construction Hazardous Materials Management Plan shall include:

1. Copies of any environmental site assessments undertaken; and

2. Detailed recommendations for further study or site evaluation, where such studies or evaluations are considered necessary to determine impacts to the Project from identified or suspected contamination.

For any property proposed for acquisition and determined to have environmental impairments from Hazardous Substances, the Concessionaire shall include, within

the Construction Hazardous Materials Management Plan, the appropriate plan for containment, management, mitigation, and/or remediation of any Hazardous Substances impacted by the Project. The plan shall be submitted to VDOT for review and comment.

C. Following the acquisition and vacation of properties or prior to tunnel renovation activities, the Concessionaire shall perform asbestos inspections and if necessary, shall perform asbestos abatement in accordance with VDOT's asbestos inspection procedures and asbestos abatement specifications. The Concessionaire shall perform abatement of asbestos-containing materials and asbestos project monitoring in accordance with all Applicable Law, as well as the applicable Standard Documents in Section 3.5.2. 2

D. The Construction Hazardous Materials Management Plan shall include a Spill Prevention, Control, and Countermeasure (SPCC) plan as required by regulation, which shall have been reviewed by VDOT prior to the initiation of oil storage activities.

E. The Concessionaire shall retain copies of all property studies, documents prepared for containment, management, mitigation and/or remediation, asbestos-related records and any other construction–related Hazardous Substances records in the Construction Hazardous Materials Management Plan and updates. The final updated plan shall be submitted to VDOT following completion of construction activities.

1.3.4 Environmental Monitoring

A. The Concessionaire shall be responsible for daily monitoring of compliance with all applicable Environmental Laws. Should any non-compliant item(s) be identified by the Concessionaire, immediate and continuous corrective action shall be taken by the Concessionaire to bring the item(s) back into compliance. Notification of this circumstance shall be provided immediately by the Concessionaire to VDOT.

B. VDOT reserves the right to perform quality assurance monitoring of the Project to determine whether the Concessionaire is in compliance with environmental commitments to Governmental Authorities.

1.3.5 Environmental Stipulations

The Concessionaire shall be responsible to make an affidavit which stipulates that any facility used in the performance of the Agreement is not listed on the Environmental Protection Agency's (EPA) List of Violating Facilities pursuant to 40 C.F.R. 15.20 (unless the Concessionaire confirms that the Project is exempt under the Clean Air Act as

amended (42 U.S.C. 1857, et seq., as amended by P.L. 91-604), the Federal Water Pollution Control Act as amended (33 U.S.C. 1251 et seq. as amended by P.L. 92-500), Executive Order 11738, and regulations in implementation thereof (40 C.F.R., Part 15)).

1.3.6 Erosion and Siltation

A. The Concessionaire shall comply with VDOT's Erosion and Sediment Control (ESC) Standards and Specifications (including IIM-LD 11.26).

B. The Concessionaire shall exercise temporary and permanent measures, throughout the Term, to control erosion and prevent or minimize siltation of rivers, streams, lakes, and impoundments. ESC measures will be installed in accordance with applicable Standard Documents in Section 3.5.2.

C. ESC measures shall be applied to erodible material exposed by any activity associated with construction, including local material sources, stockpiles, disposal areas, and haul roads. Temporary measures shall be coordinated with the Work to ensure effective and continuous erosion and siltation control. Permanent erosion control measures and drainage facilities shall be installed and operational as the Work progresses before temporary measures are removed.

D. The Concessionaire shall have, within the limits of the Project during all land disturbing activities, an employee certified by VDOT in ESC who shall inspect erosion and siltation control devices and measures for proper installation and deficiencies immediately after each rainfall, at least daily during prolonged rainfall, and weekly when no rainfall event occurs. Deficiencies shall be corrected immediately. Such employee shall also be certified through the Department of Conservation and Recreation Inspection Certification Program.

E. Failure on the part of the Concessionaire to maintain appropriate erosion and siltation control devices in a functioning condition may result in VDOT notifying the Concessionaire in writing of specific deficiencies. The Concessionaire shall correct or take appropriate actions to correct the specified deficiencies within 24-hours after receipt of such notification. 2

1.3.7 Air Pollution

A. The Concessionaire shall comply with the provisions of the Agreement and the State Air Pollution Control Law and Rules of the State Air Pollution Control Board, including notifications required therein.

B. Burning shall be performed in accordance with all applicable local Laws and ordinances and under the constant surveillance of watchpersons. Care shall be taken so that the burning of materials does not destroy or damage property or

cause excessive air pollution. The Concessionaire shall not burn rubber tires, asphalt, used crankcase oil, or other materials that produce dense smoke. Burning shall not be initiated when atmospheric conditions are such that smoke will create a hazard to the motoring public or airport operations. Provisions shall be made for flagging vehicular traffic if visibility is obstructed or impaired by smoke. At no time shall a fire be left unattended.

C. Asphalt mixing plants shall be designed, equipped, and operated so that the amount and quality of air pollutants emitted will conform to the Rules of the State Air Pollution Control Board. Emission standards for asbestos incorporated in the EPAs National Emission Standards for Hazardous Air Pollutants apply to the demolition or renovation of any institutional, commercial, or industrial building, structure, facility, installation, or portion thereof that contains friable asbestos.

1.3.8 Noise Mitigation

A. Noise Walls

1. The Concessionaire shall provide permanent noise mitigation in compliance with the Virginia State Noise Abatement Policy and Norfolk and Portsmouth requirements as applicable.

2. The final noise mitigation design will utilize the design year traffic volumes defined in the final design traffic report and associated noise levels.

3. The Concessionaire shall present all feasible and reasonable noise walls as "noise walls under consideration" on design plans at the public hearing(s).

4. Upon completion of the final design noise analysis, the Concessionaire shall schedule a meeting with the Joint FHWA/VDOT Noise Abatement Committee (NAC). The findings will be presented to the NAC for final determination of which barriers will be constructed. The Concessionaire shall prepare and mail letters "certified return receipt" to impacted citizens for barriers that are being carried through construction. VDOT shall prepare a concurrence letter outlining the results of the NAC meeting for VDOT's Chief Engineer and FHWA. Upon completion of the public survey, VDOT shall prepare a second concurrence letter documenting the results if necessary.

5. All noise walls should be named as presented within the Noise Abatement Design Report (NADR).

6. Final Design Documentation shall not be submitted for VDOT's review until after the NAC has met and provided its recommendation to the Chief Engineer and to FHWA for review and concurrence has been received. All noise walls recommended for construction and concurred with by the Chief Engineer and FHWA are included in the scope of the Construction Project and shall be constructed by the Concessionaire. This includes barriers with conditions, as long as those conditions have been met.

7. Prior to submitting a noise wall plan for VDOT's review, the Concessionaire shall have the noise consultant that completed the NADR review the plan set and certify that the proposed design meets the noise abatement requirements. This certification shall be included in the plan set when it is submitted to VDOT for review.

8. If deviations in the horizontal or vertical alignment of a noise wall are proposed following concurrence from the Chief Engineer or FHWA, then the Concessionaire shall be responsible to ensure that additional documentation is provided with the plan set when the set is submitted to VDOT for review. This shall include a plan and profile view of the roadway with the alignments of the NAC–recommended noise wall and the proposed design. The Concessionaire shall include with the plan set a justification of the deviation. The revised NADR chapter for the noise wall for which modification is requested will be submitted with this additional information.

9. The VDOT Noise Abatement Section Manager's written comments of the noise wall deviation will be required before VDOT continues its review of AFC Documents. △4

10. A key plan shall be clearly labeled to show the location of the ground-mounted combo wall (noise wall on retaining wall) and bridge-mounted noise barriers.

11. Plan view shall provide the alignment of the noise wall with the roadway plan view.

12. Profiles of the noise wall alignment shall include the noise attenuation line and the existing and proposed elevation. If combo walls or bridge-mounted barriers are present along the alignment, the pattern of the line will be different so that all lines can be distinguished.

13. Ground mounted noise walls shall be precast concrete with a sound absorptive finish on the roadway side. Structure mounted noise walls shall

be lightweight material with a sound absorptive finish on the roadway side.

14. The height of the noise walls shall meet but not exceed the elevation of the noise attenuation line depicted on the plans except that the height may be exceeded as may be minimally necessary to "step" panels due to changes in grade at wall locations.

15. The finish and color of the noise walls (both roadway and landowner sides) shall be determined by VDOT and the Concessionaire.

16. Noise wall posts shall be consistent with the Concessionaire's aesthetics plan.

17. The Concessionaire shall be responsible for performing subsurface investigations to locate existing utilities so as to avoid utility conflicts with the noise wall construction.

18. Stations of the roadway and noise wall shall be included on both the plan and profile views.

19. Noise walls should be designed with as little easement or right of way behind them as is required for maintenance behind the walls. Access may be provided by access doors for personnel. Gaps may be provided in the walls with a 3:1 ratio of barrier overlap.

20. Noise walls shall have a minimum setback from the back of the barrier of at least one foot. The area between the barrier and wall will be filled to prevent debris from collecting in the area.

21. Noise wall design shall be coordinated with first responders to ensure acceptable access to fire hydrants and other emergency equipment.

22. General notes shall be included on construction plans that state the following:

    a. "Noise walls shall be designed and constructed in compliance with this Section 1.3.8.A of the Technical Requirements and Section 519 of the *Road and Bridge Specifications*."

    b. "Noise walls shall be designed and constructed in accordance with the roadway cross-sections in the AFC plans." 2

c. "Noise walls shall be designed and constructed in accordance with the soil parameters included in the Final Geotechnical Report." 2

d. "Access doors size and location shall be agreed upon between VDOT, First Responders and Concessionaire prior to fabrication." 2

B. Construction Noise

1. The Concessionaire's operations shall be performed so that exterior noise levels meet local noise ordinances.

2. The Concessionaire shall be responsible for obtaining local noise ordinance variances prior to scheduling of night time operations pursuant to Section 3.11 (Third Parties and Permitting). 2

3. Equipment shall in no way be altered so as to result in noise levels that are greater than those produced by the original equipment. When feasible, the Concessionaire shall establish haul routes that direct Project construction and support vehicles away from developed areas and ensure that noise from hauling operations is kept to a minimum.

4. These requirements are not applicable if the noise produced by sources other than the Concessionaire's operation at the point of reception is greater than the noise from the Concessionaire's operation at the same point.

1.3.9 Historic Properties

A. Project effects on historic and archaeological properties listed on or eligible for listing on the National Register of Historic Places (jointly referred to as "historic properties") for the Midtown Tunnel, Downtown Tunnel and Martin Luther King Freeway Extension portions of the overall Project were addressed in accordance with Section 106 of the National Historic Preservation Act (16 U.S.C. 470f). The Concessionaire shall reference for detailed information the Environmental Assessment (EA), Revised EA/Finding of No Significant Impact (FONSI), Section 4f Evaluation, and various technical reports containing detailed information on historic properties for Martin Luther King Freeway Extension.

Project	Effects on Historic Properties
Midtown Tunnel (Revised Record of Decision (ROD))	Adverse Effect (mitigated during previous construction)
Midtown Tunnel NFPA	No Effect
Downtown Tunnel NFPA	No Effect
Martin Luther King Freeway	Adverse Effect/Programmatic Agreement

Extension (EA/FONSI)	

B. VDOT shall conduct Section 106 technical studies and consultation to support any NEPA reevaluations necessary for this Project or any of its components. The Concessionaire shall be responsible for all work necessary to conclude Section 106 and carrying out any associated commitments for Project modifications not requiring NEPA reevaluation and in accordance with this Section 1.3.9.K. The Concessionaire shall provide VDOT copies of all technical reports and correspondence among the Concessionaire, the Virginia State Historic Preservation Office (VA SHPO), and other consulting parties, prepared pursuant to this requirement.

C. For all portions of the Project except the New MLK Extension, the Concessionaire shall be responsible for all activities involving the discovery of historic properties during construction. The Concessionaire shall immediately notify VDOT and halt all construction work involving construction or subsurface disturbance in the area of the resource and in surrounding areas where additional subsurface remains or cultural resources can reasonably be expected to occur. The Concessionaire shall be responsible for carrying out any technical studies and/or consultation in accordance with 36 CFR 800.13(b). The Concessionaire shall provide VDOT copies of all technical reports and correspondence among the Concessionaire, the VA SHPO, and other consulting parties prepared pursuant to this requirement.

D. A Programmatic Agreement (PA; pursuant to 36 CFR Part 800, regulations implementing Section 106 of the National Historic Preservation Act) was executed on December 12, 2008 for the New MLK Extension. This PA includes specific stipulations covering the treatment of known historic properties; future identification, assessment of effects, and treatment of historic properties located within drainage, stormwater management, and wetland mitigation areas; treatment of gravesites; and treatment of previously unidentified archaeological sites discovered during Project construction. The PA is included as Attachment 3B to this Section 1.3. The obligations of VDOT and the Concessionaire to fulfill the requirements of the PA are set forth below. The Concessionaire shall provide supporting documentation to VDOT evidencing fulfillment of its obligations at the appropriate phase of Project development for each.

E. VDOT shall fulfill the requirements of Stipulation I (Treatment of the Cottage Place Neighborhood Historic District) and Stipulation III.C (Historical Highway Marker for Mount Calvary Cemetery Complex) of the PA.

F. The Concessionaire shall fulfill the requirements of Stipulation II of the PA (Treatment of Calvary Baptist Church) including: (1) performing an inspection of the Calvary Baptist Church prior to construction; (2) performing seismic

monitoring at the church to document vibration levels before and during construction; (3) performing an inspection of the property after construction has been completed; (4) payment of claims for damage to the church will be in accordance with the PA; (5) completion of any resulting repairs to the church. The manner in which the Concessionaire shall fulfill these obligations in the manner described below:

1. The Concessionaire shall perform inspections of the Calvary Baptist Church and document its physical condition prior to the commencement of any construction activity, within 48 hours of any period in which peak particle velocity within the Calvary Baptist Church as measured by a seismograph exceeds 1.25 inches per second or the equivalent vibration frequency level (as shown in Figure 1 at 4VAC25-40-880.C), and within 60 days after construction has been completed. These inspections shall be performed by a licensed structural engineer and a licensed historic architect. The historic architect shall meet the Secretary of the Interior's *Professional Qualification Standards* in historic architecture (48 FR 44738-44739).

   The Concessionaire shall provide a copy of a draft pre-construction inspection report to VDOT and Calvary Baptist Church a minimum of 45 days prior to initiation of construction for review and comment. The Concessionaire shall provide a final copy of the pre-construction inspection report to VDOT, Calvary Baptist Church, and the VA SHPO prior to the commencement of any construction activity. The Concessionaire shall provide a copy of a draft post-construction inspection report to VDOT and Calvary Baptist Church for review and comment within 90 days after construction has been completed. The Concessionaire shall provide the final copy of the post-construction inspection report to VDOT, Calvary Baptist Church, and the VA SHPO within 135 days after construction has been completed.

2. The Concessionaire shall conduct seismic monitoring of Calvary Baptist Church to document vibration levels before and during construction. Prior to commencing construction the Concessionaire shall submit a plan for the seismic monitoring program to VDOT for review and comment. The seismic monitoring program shall allow the Concessionaire to fulfill the requirements of Section 1.3.9.F.3. The Concessionaire shall provide VDOT a report on the results of the seismic monitoring program within 60 days of completion of construction.

3. Within 48 hours of any period in which peak particle velocity within Calvary Baptist Church as measured by a seismograph exceeds 1.25 inches per second or the equivalent vibration frequency level (as shown in

Figure 1 at 4VAC25-40-880.C), the Concessionaire shall notify VDOT and inspect the church for changes in its condition. Within 48 hours of the inspection, the Concessionaire shall review the results of the inspection with VDOT and Calvary Baptist Church, and VDOT and the Concessionaire shall jointly determine if any actions to modify or mitigate the impact of the Concessionaire's construction activities are necessary.

4. The Concessionaire shall be responsible for damages to Calvary Baptist Church resulting from Project construction activities. VDOT must approve any decision by the Concessionaire to refuse a claim for damages submitted by Calvary Baptist Church. If repairs are made to Calvary Baptist Church to resolve a claim for damages, the Concessionaire shall ensure that any resulting repairs to historic materials, design, and/or workmanship are completed in a manner consistent with The Secretary of the Interior's Standards for the Treatment of Historic Properties. The Concessionaire shall provide VDOT, the VA SHPO, and Calvary Baptist Church with a copy of the proposed scope of work and/or repair plans for review and comment. If no comments are received from these parties within 30 days of receipt of the scope of work and/or repair plans, the Concessionaire may proceed to implement the proposed scope of work and/or repair plans. The Concessionaire shall notify VDOT, the VA SHPO, and Calvary Baptist Church of the completion of any such repairs within 30 days following completion.

G. The Concessionaire shall design the Project to avoid the boundaries of the Potter's Field site (44PM0062) and the Mount Calvary Cemetery Complex by shifting the southern portion of the Interstate 264 interchange to the west (as per Stipulation III A of PA). The Concessionaire shall not allow any Project-related ground-disturbing activities, including vehicle traffic and storage or staging of construction materials, to occur within the boundaries of these two historic properties. The Concessionaire shall not design the Project to span the Potter's Field site.

H. The Concessionaire shall provide VDOT, the VA SHPO, the City of Portsmouth, and the African-American Historical Society of Portsmouth the opportunity to review and comment on the preliminary and final plans for those portions of the Project in the vicinity of the Potter's Field site (44PM0062) and the Mount Calvary Cemetery Complex. The Concessionaire shall take into consideration any comments received from VDOT, the VA SHPO, the City of Portsmouth, and the African-American Historical Society of Portsmouth within 30 calendar days of receipt of Project plans in ensuring that the Project avoids all disturbance to the Potter's Field site (44PM0062) and the Mount Calvary Cemetery Complex.

I. Prior to the commencement of any construction activity the Concessionaire shall erect a temporary chain link fence around the western boundary of the Potter's Field site (44PM0062) and the adjacent portion of the Mount Calvary Cemetery Complex in accordance with the VDOT *Road and Bridge Specifications* (2007), Section 242.02 (as per Stipulation II B of PA). The Concessionaire shall erect a temporary safety fence along the northern boundary of the Mount Calvary Cemetery Complex where it is adjacent to Interstate 264 in accordance with the VDOT *Road and Bridge Specifications* (2007), Section 242.02(a) (12). The location of these boundaries shall be provided by VDOT.

J. The Concessionaire shall maintain these fences for the duration of Project construction. No vehicles, no construction activities, and no storage or staging of construction materials shall be allowed within the perimeter of the fences. Upon completion of construction of the Project, the Concessionaire shall remove these fences and dispose of them off the Project site.

K. The Concessionaire shall assume all the obligations assigned to VDOT in Stipulation IV of the PA. This stipulation, in brief, requires the identification and treatment of affected historic properties within the Areas of Potential Effects (as defined at 36 CFR §800.16(d)) for any drainage, stormwater management, and wetland mitigation areas determined during final design of the Project and located outside of the Area of Potential Effects for Alternative E – Option 4 as described in the report titled *Cultural Resource Survey: Archaeological and Architectural Surveys, Route 58, Martin Luther King Freeway Extension Project, City of Portsmouth, Virginia* (prepared for VDOT by McCormick Taylor, November 2007) and depicted in this report in Figures 1A and 1B. The Concessionaire shall provide VDOT copies of all technical reports and correspondence among the Concessionaire, the VA SHPO, and other consulting parties prepared pursuant to the requirements of this stipulation.

L. The Concessionaire shall assume all obligations assigned to VDOT in Stipulation VII of the PA (Human Remains). Additionally, the Concessionaire shall immediately notify VDOT if human remains and associated funerary objects are encountered by the Concessionaire or its agents during design or construction of the Project.

M. If a previously unidentified archaeological site is discovered during ground disturbing activities associated with construction of the Project, the Concessionaire shall immediately notify VDOT and halt all construction work involving subsurface disturbance in the area of the resource and in surrounding areas where additional subsurface remains can reasonably be expected to occur. The Concessionaire shall then fulfill the obligations assigned to VDOT in Stipulation VIII of the PA (Post-Review Discoveries of Archaeological Properties).

N. The Concessionaire shall ensure that all work it performs to fulfill the PA obligations assigned to it under the Agreement meets the requirements of Stipulations V (Professional Qualifications) and VI (Preparation and Review of Documents) of the PA.

O. VDOT shall retain all rights and obligations assigned to it as a signatory party to the PA under Stipulations IX (Dispute Resolution), X (Amendments and Termination), and XI (Duration). The Concessionaire shall work cooperatively with VDOT in meeting VDOT's obligations under these three stipulations.

1.4 Geotechnical

1.4.1 Geotechnical Design

A. Geotechnical Design Engineer – This individual shall be responsible for ensuring that geotechnical investigations, analysis and recommendations that are necessary for the design and construction of the Project are performed in accordance with the Technical Requirements. The geotechnical design engineer shall coordinate with the design manager to ensure that relevant geotechnical design and construction considerations have been properly considered in the design and included in the work plans, specifications, copied notes, and constructability reviews for the Project. This individual shall have a minimum 10 years of geotechnical engineering experience and expertise working in the region and/or in areas of similar geologic settings with similar project features for this Project. The geotechnical design engineer shall be a licensed Professional Engineer in the Commonwealth of Virginia.

B. The Concessionaire shall collect appropriate data for geotechnical evaluation of proposed and existing tunnels and non-tunnel structures, dredging and dewatering design and operations, permanent and temporary shoring, embankments, soil cuts, culverts, bridge and retaining wall structures, noise walls, stormwater management facilities, minor structures including drainage pipes, pavement structures and any other earth-supported structures or elements of highway and tunnel design and construction. The Concessionaire shall be responsible for obtaining any Governmental Approvals required for any borings needed in performance of the Concessionaire's geotechnical investigation for this Project. The Concessionaire shall complete laboratory tests in accordance with pertinent ASTM or AASHTO standards and analyze the data to provide design and construction requirements. Soils and materials tests shall be performed by a laboratory, accredited by the AASHTO Accreditation Programs (AASHTO Materials Reference Laboratory (AMRL) and Cement and Concrete Reference Laboratory (CCRL)), for each test it conducts for the Project. Due to the complexity of the Project, multiple individual design reports and design

memoranda submissions developed for individual work will be acceptable in lieu of a full Geotechnical Design Report (GDR) encompassing the entire Project. If desired, the Concessionaire shall submit individual reports and memoranda in advance of final design packages for related future work to VDOT for review and comment. VDOT shall not be responsible for confirming Concessionaire's geotechnical assumptions in VDOT's review or comments. The geotechnical report shall, at a minimum, include a description of the Project or individual work entailed including anticipated loads, a description of the subsurface conditions, summary of field and laboratory test results, options evaluated with a summary justifying the recommendations, and calculations supporting the evaluations and recommendations.

C. All boreholes left open while unattended by the drill crews shall be clearly marked and barricaded or otherwise secured to avoid possible injury or damage to the public. All boreholes shall be adequately backfilled to avoid settlement. Borings in contaminated areas, paved areas such as pavements or sidewalks, or other areas likely to be traversed by the public shall be backfilled with grout.

D. The Concessionaire shall provide VDOT records of all subsurface explorations and describe the soils encountered and their depth limits, in accordance with the requirements outlined in Chapter 3 of VDOT's *Manual of Instructions for Materials Division, Section 700.04(c)* of the 2007 *Road and Bridge Specifications*, and the current AASHTO Load and Resistance Factor Design (LRFD) *Bridge Design Specifications*, Customary U.S. Units, fourth Edition 2007 and VDOT modifications. The geotechnical investigations for the tunnel shall be performed to meet the minimum requirements set forth in the Standard Documents in Section 3.5.2. The geotechnical investigation plan(s) shall be developed in compliance with the requirements included by the Hampton Roads District Materials Engineer. The Concessionaire shall provide electronic copies of all subsurface explorations in accordance with the boring log template available on the website address included in Chapter 3 of VDOT's *Manual of Instructions for Materials Division*. The electronic files shall be provided by a certified Professional Geologist or a suitably qualified registered Professional Engineer in the Commonwealth of Virginia, in gINT© software. Upon request, VDOT will provide its gINT and ACCESS file structures for the Geotechnical Database Management System.

E. The Concessionaire shall incorporate reliability assessments in conjunction with standard analysis methods for slope stability analyses. An acceptable method for evaluation of reliability is given by Duncan, J.M. (April 2000) Factors of Safety and Reliability in Geotechnical Engineering, Journal of Geotechnical and Geoenvironmental Engineering, American Society of Civil Engineers (ASCE), Discussions and Closure August 2001. A suitable design will provide a probability of success equal to or greater than 99%. The Concessionaire may

propose to identify specific, non-critical features, and alternative methods for evaluating variability of subsurface conditions, reliability and minimum factors of safety, prior to submission of its design calculations and drawings.

F. The Concessionaire shall provide VDOT geotechnical design and construction memoranda and/or reports that summarize pertinent subsurface investigations, tests, and geotechnical engineering evaluations and analysis. The submittals shall be made at least 21 days in advance of the submittal of any final AFC documents that are dependent upon the geotechnical evaluation and design recommendations included in these geotechnical memorandums and/or reports. Technical specifications for construction methods that are not adequately addressed in the Standard Documents in Section 3.5.2 shall be provided by the Concessionaire as part of the final AFC Documents. Prior to submittal of any AFC Documents the Concessionaire's geotechnical design engineer shall review the AFC Documents to assure that they have appropriately incorporated the geotechnical components. Evidence of this review shall be submitted with the final AFC Documents. The quality control-quality assurance documents shall document how each specific geotechnical recommendation or requirement is addressed in the AFC Documents, and shall reference the drawings that incorporate the pertinent results. All geotechnical work shall be completed to satisfy the Performance Requirement as set forth in Section 4.4.1. 4 2

G. The Concessionaire shall minimize differential settlements of the approach to the tunnel and bridges for new construction and when applicable provide construction recommendations to address soil-structure interaction to accommodate the unique construction methods applied to this Project. All geotechnical work shall be completed to satisfy baseline and post-construction contract Performance Requirements as set forth in Section 1.4.3.

H. The Concessionaire shall design and construct pavements, subgrades, and embankments to meet the following criteria:

1. Long term settlements will not be a detriment to achieve and maintain the post-construction Performance Requirements for overall ride quality and localized roughness of the pavements nor exceed the grade tolerances of pavement sections of approach slabs, bridge decks, and tie-ins to the Project;

2. Settlement will not impede positive drainage of the pavement surface especially within the travel lanes at all times nor subject the roadway to flooding; and,

3. Settlement will not result in damage to adjacent or underlying structures, including utilities.

I. The Concessionaire shall apply the Additional Substructure and Foundation Criteria (Section 1.4.3) when analyzing settlement and foundations (bridges, retaining walls and other structures). In summary, Section 1.4.3 outlines two options for managing settlement of structures: (i) limit total settlement to ½" and subsequently limit the need for a refined analysis of the superstructure and substructure; or (ii) allow the Concessionaire to design the structure for its estimates of elastic, consolidation, and secondary settlement (total settlement) and subsequently communicate the total and differential settlement in a the general note to the Design Documentation. In either case, a general note shall be placed on the Design Documentation which communicates the amount of settlement evaluated and accommodated by the structure. Specific general note language, along with notes to the designer, is set forth in Section 1.4.3. In either case the total vertical and/or differential settlements of the proposed structures shall not exceed the Performance Requirement included in Section 1.4.3 for pavements and of the bridge decking. In addition, angular distortion between adjacent bridge foundations greater than 0.008 radians in simple span and 0.004 radians in continuous span structures is not permitted unless first reviewed by VDOT.

1.4.2 Slope Design

Cut and fill slopes shall be no steeper than 2H: 1V, unless supported by an engineering analysis based on site-specific field investigation and/or site-specific laboratory strength testing. Slopes steeper than 2H: 1V must be reviewed by VDOT. All cut and fill slopes shall be designed to be stable for the interim construction stages, for the end-of-construction condition, and for design-life conditions.

The following factors of safety are to be used with limit equilibrium methods of analysis to identify factors of safety for representative sections of all soil cut and soil embankment fill slope areas higher than 10 feet, and/or where slopes are supporting on, or are supported by, retaining structures. The factors of safety listed in Table 1.4 are valid for subsurface investigations performed in accordance with Chapter III of VDOT's Materials Division's *Manual of Instructions* or for site-specific investigation plans reviewed by VDOT's Hampton Roads District Materials Engineer. Approval of site-specific investigation plans with reduced boring frequency may require higher factors of safety.

Table 1.4 Minimum Factors of Safety for Soil Cut/Fill Slopes		
Soil Slope analysis parameters based on:	Factor of Safety	
	Involves Structure or Critical Slope[1]	Non-Critical Slope
In-situ or lab. tests and measurements[2,3]	1.5	1.3
No site specific tests	N/A[3]	1.5

1. A critical slope is defined as any slope that is greater than 25' in height, affects or supports a structure, or whose failure would result in significant cost for repair, or damage to, private property
2. Site specific in-situ tests include both groundwater measurements and standard penetration testing (SPT) but may also include cone penetration testing (CPT) or dilatometer testing (DMT)
3. Parameters for critical slopes involving structures must be based on specific laboratory testing
4. Problem soils (very soft and/or loose soils or heavily over-consolidated soils), shall be analyzed using shear strength parameters determined from appropriate laboratory strength tests
5. Minimum requirements for soil types consistent with the parameters used in slope analyses shall be specified on the Design/Construction Documents.

1.4.3 Settlement of Structures

A. The Concessionaire shall design foundations (bridges, retaining walls, pipes and other structures) such that the maximum post-construction foundation settlement shall be in accordance with the following requirements:

B. Plans shall incorporate one of the following General Notes.

The foundations for this structure have been designed to limit differential and total settlement to ½". The total settlement (STOT) is defined as the arithmetic sum as follows: STOT = Elastic Settlement + Consolidation Settlement + Secondary Settlement. The superstructure and substructure elements above the footings have not been specifically analyzed or designed to accommodate total or differential settlement.

OR

This structure has been analyzed and designed to accommodate settlement as noted below:

Total Settlement of (__)" has been accommodated. The total settlement (STOT) is defined as the arithmetic sum as follows: STOT (__)" = Elastic Settlement (__)" + Consolidation Settlement (__)" + Secondary Settlement (___)". In addition, Differential Settlement of (__)" between adjacent substructure units and (__)" within a single unit has been accommodated.

In order to facilitate the selection of the specific values for the General Note, the following Notes to Designer are provided:

The following restrictions are placed on Settlements:

1. For beam and slab bridges conforming to superstructure types a, e, f, g, k, i as defined in Table 4.6.2.2.2 of the AASHTO LRFD *Bridge Design Specifications*, fourth Edition, 2007 with 2008 Interims: when total settlement and differential settlement are limited to ½" no additional analysis is required.

2. During construction and after all settlements have occurred the bridge structure (consisting of the superstructure, substructure and associated elements in the load path) must meet all structural capacity requirements for all loading combinations requiring such analysis. In addition, the structure must meet all structural capacity requirements for all load combinations for the listed differential settlement.

3. The bearings and substructure shall be designed to accommodate increases or decreases in loads due to total or differential settlement shown on the plans (Ref AASHTO 3.4.1; 3.12.6).

4. Creep and/or shrinkage may only be used to offset settlement effects when it occurs CONCURRENTLY with settlement, and the designer is responsible for determining time rate of settlement and creep. [For instance, if all settlement is elastic (instantaneous), creep cannot be used to offset loads imposed].

5. Joint rotations and Bearing rotations due to settlement shall be considered in addition to all tolerances for rotations due to live load effects or for constructability.

6. In no case shall anticipated settlements (or rotations due to settlement) cause the structure to encroach on horizontal, vertical or navigation clearance envelopes.

7. Settlements which change super elevation shall not reduce super elevation below the minimum specified by AASHTO for the roadway design speed

and roadway type, nor shall they negatively impact the performance of the deck or approach paving.

8. Settlements which change profile grade shall not:

   a. Increase spread of drainage beyond limits specified in AASHTO.

   b. Change performance or maintainability of utilities.

   c. Introduce a low spot on the bridge.

   d. Negatively impact rideability provisions.

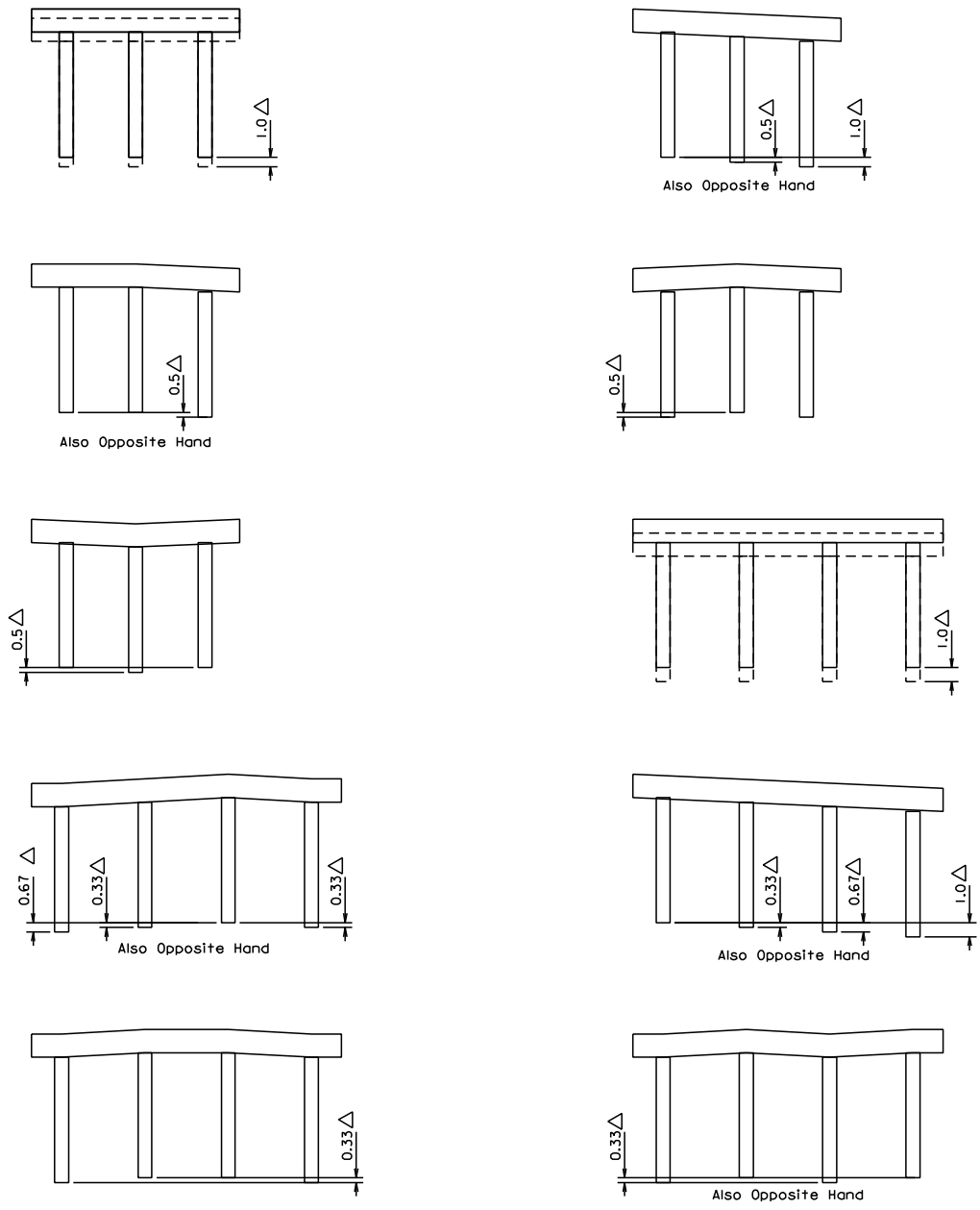
9. Coordinate predicted/expected settlement of the approach embankments and bridge structure to comply with contract rideability requirements.

10. The structure must be capable of carrying an additional future wearing surface equal to the magnitude of the total anticipated settlement placed uniformly from curb to curb and abutment to abutment. All parapets and railings shall accommodate the additional layer of surfacing with no modification or reduction in crash test level after construction.

11. Jacking and shimming shall not be allowed to correct differential settlement except as noted in the original design plans.

12. Settlements shall be treated as a load condition with $\gamma SE = 1.0$ for all AASHTO indicated groups.

    When differential settlement at a single substructure unit is anticipated, both the superstructure and substructure shall be analyzed by accounting for the differential deflection. For continuous footings, settlement may be considered to be linear along the long axis of the footing. For isolated footings, in addition to the linear distribution of settlement, adjacent footings shall be analyzed for a linear proportion of the differential settlement at each footing (for a 3 column pier with 2 equal spaces, 50%, for a 4 column pier with 3 equal spaces, 33 % of the total pier differential shall be used at each column).



Examples of Possible Settlement patterns to clarify differential settlement proportioning as it is intended to be be considered as part of settlement analysis (Patterns are selected for illustrative purposes, the pattern selection is not all inclusive, designer is responsible for determining Critical Pattern)

1.5 Materials

1.5.1 Rights for and Use of Materials Found on Project

The Concessionaire may use in the Project any materials found in the excavation that comply with the Standard Documents in Section 3.5.2 and otherwise comply with Good Industry Practice. The Concessionaire shall replace at its own expense with other acceptable material the excavation material removed and used that is needed for use in embankments, backfills, approaches, or otherwise. The Concessionaire shall not excavate or remove any material from within the construction limits that is not within the grading limits, as indicated by the slope and grade lines.

1.5.2 Samples, Tests, and Cited Specifications

The responsibility for quality control, quality assurance, and ensuring compliance with applicable specifications and testing requirements lies with the Concessionaire. The Concessionaire's QMSP shall outline the procedures for quality assurance, quality control, and compliance with the Technical Requirements. VDOT, at its discretion, may conduct testing and audits.

1.5.3 Material Delivery

The Concessionaire shall advise VDOT at least two weeks prior to the delivery of any material from a commercial source which could adversely impact roadway and/or river traffic if not properly scheduled/coordinated. Other material deliveries shall be noted topics in Project site meeting agendas. Upon delivery of any such material to the Project, the Concessionaire shall confirm that the material meet the requirements of the Technical Requirements and, if so, shall provide VDOT with one copy of all invoices (prices are not required).

1.5.4 Plant Inspections

If the Concessionaire elects to use materials from a plant that is part of VDOT's materials QA program wherein VDOT inspects materials at the source, the following conditions shall be met: △2

A. VDOT shall have the cooperation and assistance of the Concessionaire and producer of the materials.

B. VDOT shall have full access to parts of the plant that concern the manufacture or production of the materials being furnished.

C. The Concessionaire shall provide sufficient notice to VDOT of its intent and shall be responsible for obtaining copies of VDOT's plant inspection reports.

1.5.5 Storing Materials

A. Materials shall be stored in a manner so as to ensure the preservation of their quality and fitness for the Work. When considered necessary by the Concessionaire's Quality Assurance Manager or VDOT, materials shall be stored in weatherproof buildings on wooden platforms or other hard, clean surfaces that will keep the material off the ground. Materials shall be covered when directed by VDOT. Stored material shall be located so as to facilitate its prompt inspection. Portions of the Project right of way may be used for storage of material and equipment and for plant operations. However, equipment and materials shall not be stored within the clear zone of the travel lanes open to traffic.

B. Additional required storage space shall be provided by the Concessionaire. Private property shall not be used for storage purposes without the written permission of the owner. Copies of the written permission shall be furnished to VDOT. Upon completion of the use of the property, the Concessionaire shall furnish to VDOT a release signed by the property owner indicating that the property has been satisfactorily restored.

C. Chemicals, fuels, lubricants, bitumens, paints, raw sewage, and other harmful materials as determined by the Concessionaire's Quality Assurance Manager or VDOT shall not be stored within any floodplain unless no other location is available and only then shall the materials be stored in a secondary containment structure(s) with an impervious liner. Also, any storage of these materials in proximity to natural or man-made drainage conveyances or otherwise where the materials could potentially reach a waterway if released under adverse weather conditions, must be stored in bermed or diked area or inside a container capable of preventing a release. Double-walled storage tanks shall meet the berm/dike containment requirement except for storage within flood plains. Any spills, leaks, or releases of such materials shall be addressed in accordance with the Agreement. Accumulated rain water may also be pumped out of the impoundment area into approved dewatering devices.

1.5.6 Handling Materials

Materials shall be handled in a manner that will preserve their quality and fitness for the work. Aggregates shall be transported from storage to the work in vehicles constructed to prevent loss or segregation of materials.

1.5.7 Unacceptable Materials

Materials that do not conform to the Technical Requirements shall be considered

unacceptable. Such materials, whether in place or not, will be rejected and shall be removed from the site of the Work. If it is not practical for the Concessionaire to remove rejected material immediately, the Concessionaire will mark the material for identification. Rejected material whose defects have been corrected shall not be used until approval has been given by Elizabeth River Crossings LLC (ERC) Quality Assurance/Quality Control (QA/QC) with VDOT concurrence. 1

1.5.8 Materials Furnished by VDOT

A. The Concessionaire shall furnish all materials required to complete the Work except those specified to be furnished by VDOT.

B. Material furnished by VDOT will be delivered or made available to the Concessionaire at the points specified in the Agreement.

C. After receipt of the materials, the Concessionaire shall be responsible for material delivered to it, including shortages, deficiencies, and damages that occur after delivery, and any demurrage charges except for existing assets, and subject to reasonable inspection by engineer.

1.5.9 Local Material Sources (Pits and Quarries)

A. Local material sources, other than active commercial sand and gravel and quarry operations, opened by the Concessionaire or its subcontractors shall be concealed from view from the completed roadway and any existing public roadway. Concealment shall be accomplished by selectively locating the pit or quarry and spoil pile, providing environmentally compatible screening between the pit or quarry site and the roadway, or using the site for another purpose after removal of the material, or restoration equivalent to the original use (such as farm land, pasture, turf, etc.).

B. Should the Concessionaire wish to source construction materials from (non-commercial) new pits or quarries the Concessionaire shall furnish VDOT a statement signed by the property owner in which the property owner agrees to the use of their property as a source of material for the Project. Upon completion of the use of the property as a material source, the Concessionaire shall furnish VDOT a release signed by the property owner indicating that the property has been satisfactorily restored. This requirement will be waived for commercial sources, sources owned by the Concessionaire, and sources furnished by VDOT.

C. Local material pits and quarries that are not operated under a local or State permit shall not be opened or reopened without authorization by VDOT. The Concessionaire shall prepare a site plan, including the following:

1. The location and approximate boundaries of the excavation;

2. Procedures to minimize erosion and siltation;

3. Provision of environmentally compatible screening;

4. Restoration;

5. Cover vegetation;

6. Other use of the pit or quarry after removal of material, including the spoil pile;

7. The drainage pattern on and away from the area of land affected, including the directional flow of water and a certification with appropriate calculations that verify all receiving channels are in compliance with Minimum Standard 19 of the Virginia Erosion and Sediment Control Regulations;

8. Location of haul roads and stabilized construction entrances if construction equipment will enter a paved roadway;

9. Constructed or natural waterways used for discharge;

10. A sequence and schedule to achieve the plan and;

11. The total drainage area for temporary sediment traps and basins shall be shown. Sediment traps are required if the runoff from a watershed area of less than three acres flows across a disturbed area. Sediment basins are required if the runoff from a watershed area of three acres or more flows across a disturbed area. The Concessionaire shall certify that the sediment trap or basin design is in compliance with Good Industry Practice and the Standard Documents in Section 3.5.2. Once a sediment trap or basin is constructed, the dam and all outfall areas shall be immediately stabilized.

D. The Concessionaire's design and restoration shall be in accordance with Good Industry Practice.

1.5.10 Disposal Areas

A. The Concessionaire shall obtain the necessary rights to property to be used as an approved disposal area. An approved disposal area is defined as that which is owned privately, not operated under a local or State permit.

B. Prior to utilizing a disposal area for non-dredge material, the Concessionaire shall submit a site plan. The plan shall show:

1. The location and approximate boundaries of the disposal area;

2. Procedures to minimize erosion and siltation;

3. Provision of environmentally compatible screening;

4. Restoration;

5. Cover vegetation;

6. Other use of the disposal site;

7. The drainage pattern on and away from the area of land affected, including the directional flow of water and a certification with appropriate calculations that verify all receiving channels are in compliance with Minimum Standard 19 of the Virginia Erosion and Sediment Control Regulations;

8. Location of haul roads and stabilized construction entrances if construction equipment will enter a paved roadway;

9. Constructed or natural waterways used for discharge;

10. A sequence and schedule to achieve the plan and;

11. The total drainage area for temporary sediment traps and basins shall be shown. Sediment traps are required if the runoff from a watershed area of less than three acres flows across a disturbed area. Sediment basins are required if the runoff from a watershed area of three acres or more flows across a disturbed area. The Concessionaire shall certify that the sediment trap or basin design is in compliance with Good Industry Practice and Standard Documents in Section 3.5.2. Once a sediment trap or basin is constructed, the dam and all outfall areas shall be immediately stabilized.

C. Disposal areas shall be cleared but need not be grubbed. The clearing work shall not damage grass, shrubs, or vegetation outside the limits of the area and haul roads thereto. After the material has been deposited, the area shall be shaped to produce a stable slope long term and to minimize erosion and siltation of nearby streams and landscaped in accordance with the plan for such work. The Concessionaire's design and restoration shall conform to the requirements of the Agreement, including Good Industry Practice.

D. The Concessionaire shall furnish VDOT a statement signed by the property owner in which the owner agrees to the use of their property for the deposit of material from the Project. Upon completion of the use of the property as an approved disposal area, the Concessionaire shall furnish VDOT a release signed by the property owner indicating that the property has been satisfactorily restored. This requirement will be waived for commercial sources, sources owned by the Concessionaire, and sources furnished by VDOT.

1.6 Drainage

1.6.1 Drainage Design

A. The drainage design shall include but not be limited to enclosed storm sewer systems, curb inlets, stormwater management systems for water quality, stormwater pump stations**,** manholes, junction boxes, culverts, headwalls, channels, ditches, bridge drainage assemblies and structures that remove and transport runoff or convey stream flows.

B. The Concessionaire shall design and install new drainage facilities and will be permitted to use existing drainage systems, in accordance with Standard Documents in Section 3.5.2.

C. The Concessionaire will assemble and review all available data, studies, and development plans impacting the Project corridor for use in preparing the drainage design. The Concessionaire shall perform a hydrologic analysis within the limits of the Project and extend the analysis to include all offsite areas that will drain through or impact the Project.

D. All existing drainage facilities within the Project right of way that are impacted by the Concessionaire's activities and that the Concessionaire intends to leave in place shall be evaluated and verified to have adequate hydraulic capacity for ultimate land use conditions. The Concessionaire shall verify the structural adequacy of the existing drainage facilities which the Concessionaire intends to leave in place for continued use which will be subjected to additional embankment, and/or live loading.

E. The Concessionaire shall provide new stormwater management facilities and remove or improve any existing stormwater management facilities in accordance with applicable Standard Documents in Section 3.5.2.

F. The Concessionaire shall design and construct all permanent and temporary erosion and sediment control measures in accordance with applicable Standard Documents in Section 3.5.2.

G. The Concessionaire shall use, as a minimum, 15" pipe for the drainage systems within the roadway, except within the limits of the tunnel. The minimum size for culverts in the interstate system shall be 24-inches.

H. No inlet structure or portion thereof shall be located in the roadway surface of the travel way.

I. Prior to the commencement of the construction Work, the Concessionaire shall determine all existing drainage facilities the Concessionaire intends to utilize and leave in place for continued use (pursuant to Section 1.6.1.D). Within the Project Right of Way, the Concessionaire shall perform such activities as may be necessary to cause such facilities to be completely clean and free of debris and silt prior to commencement of construction Work on or near such existing drainage facilities. The Concessionaire shall be responsible for cleaning any debris or silt accumulation caused by performance of the construction Work.

J. As part of the Work and in accordance with Good Industry Practice, the Concessionaire may tie in or connect new drainage assets it is designing and constructing to existing drainage assets present along the I-264 Corridor as of the Agreement Date. If there is an existing drainage asset the Concessionaire desires to tie in or connect to, but is prevented from doing so because of physical damage to such existing drainage asset not caused by or attributable to the Concessionaire's activities, the Concessionaire shall repair the existing drainage asset so it can perform the proposed tie-in or connection. Any such repair work shall be completed in accordance with the Standard Documents in Section 3.5.2. Compensation for such repairs shall be in accordance with the requirements set out in the Agreement. The foregoing provision shall not apply if the hydraulic or structural loading of any existing drainage asset is verified to be inadequate, as determined pursuant to Section 1.6.1.D, as a result of the Concessionaire proposed tie-in or connection. In that case, the Concessionaire shall, at its sole cost and expense, replace and/or repair the existing drainage asset at the proposed tie-in or connection (in accordance with the Standard Documents in Section 3.5.2 in order to accommodate the proposed tie-in or connection.

K. All existing culverts, storm sewer, and drainage appurtenances to be abandoned shall be removed or filled and plugged with flowable fill.

L. See Section 1.14.3.D for bridge deck drainage requirements.

M. For all permanent structures, the bridges, hydrology, hydraulics, and scour requirements shall be in accordance with the Standard Documents in Section 3.5.2, including but not limited to AASHTO Load and Resistance Factor Design *Bridge Design Specifications* (the more stringent requirements shall govern).

N. During the construction of the Project, the Concessionaire shall provide for positive drainage of all roadway facilities open to construction traffic. Construction activities shall not redirect or add drainage run-off to a private property.

O. Shore protection for structures shall be designed in accordance with the Standard Documents in Section 3.5.2.

P. Adequate outfall, Minimum Standard 19 (MS-19) assessments shall be performed at all outfall locations in accordance with the Standard Documents in Section 3.5.2. Any existing outfall intended to be used by the Concessionaire, but found to be inadequate shall be improved or proven adequate in accordance with the Standard Documents in Section 3.5.2 or the flow shall be attenuated to such a degree as necessary to enable the outfall to become adequate. All necessary improvements to inadequate existing outfalls shall be at the cost of the Concessionaire, and shall be subject to VDOT review and comment prior to commencement of construction activities.

Q. Stormwater pump stations shall be designed in accordance with the Standard Documents in Section 3.5.2.

R. At locations where the vertical alignment of the roadway creates a sag condition in either a depressed roadway section, tunnel, or roadway section utilizing concrete barriers, and ponded water on the roadway can only be removed through the drainage system, a 50-year storm frequency and the actual time of concentration should be used as the design criteria for the drop inlets, pipe system, and stormwater pump stations.

1.6.2 Stormwater Pollution Prevention Plan, Virginia Stormwater Management Program General Permit for the Discharge of Stormwater from Construction Activities, Stormwater Management and Erosion and Sediment Control Plan

A. Concessionaire Stormwater Pollution Prevention Plan. The Concessionaire shall develop and provide for VDOT's review and comment a conceptual Stormwater Pollution Prevention Plan (SWPPP) prior to applying for the Virginia Stormwater Management Program (VSMP) and prior to any land disturbing activities. A SWPPP identifies potential sources of pollutants which may reasonably be expected to affect the stormwater discharges from the construction site and any off site support areas and describes and ensures implementation practices which will be used to reduce pollutants in such discharges. The SWPPP is comprised of, but not limited to, the Erosion and Sediment Control (ESC) Plan, the Stormwater Management Plan (SWMP), and related specifications and standards contained with the Agreement and shall be required for all land-disturbing activities that

disturb 10,000 square feet or greater, or 2,500 square feet or greater in Tidewater, Virginia. Land-disturbing activities that disturb 1 acre or greater, or 2,500 square feet or greater in an area designated as a Chesapeake Bay Preservation Area, require coverage under the Department of Conservation and Recreation's VSMP General Permit for Stormwater Discharges from Construction Activities (VSMP Construction Permit). Where applicable, VDOT will apply for and retain coverage under the VSMP Construction Permit for those land disturbing activities for which it has control. The required contents of a SWPPP for those land disturbance activities requiring coverage under the VSMP Construction Permit are found in Section II D of the General Permit section of the VSMP Regulations (4VAC50-60-1170). While a SWPPP is an important component of the VSMP Construction Permit, it is only one of the many requirements that must be addressed in order to be in full compliance with the conditions of the permit. The Concessionaire shall be responsible for reading, understanding, and complying with all the terms, conditions and requirements of the permit and the SWPPP, including the following:

1. Project Implementation Responsibilities. The Concessionaire shall be responsible for the installation, maintenance, inspection, and, on a daily basis, ensuring the functionality of all erosion and sediment control measures and all other stormwater and pollutant runoff control measures identified within or referenced within the SWPPP, plans, specifications, permits, and elsewhere in the Agreement, including these Technical Requirements. The Concessionaire shall take all reasonable steps to prevent or minimize any stormwater or non-stormwater discharge that will have a reasonable likelihood of adversely affecting human health or public and/or private properties.

2. Certification Requirements. In addition to satisfying the personnel certification requirements contained herein, the Concessionaire shall certify its activities by completing, signing, and submitting Form C-45 VDOT SWPPP Contractor and Subcontractor Certification Statement to VDOT at least seven days prior to commencing any Project related land-disturbing activities, both on-site and off-site.

3. SWPPP Requirements for Support Facilities. The Concessionaire shall develop ESC Plan(s) and SWPPP(s) for submission and acceptance by VDOT prior to usage of any on-site or off-site support facilities, including borrow and disposal areas, construction and waste material storage areas, equipment and vehicle storage and fueling areas, storage areas for fertilizers or chemicals, sanitary waste facilities, and any other areas that may generate a stormwater or non-stormwater discharge related to performance of the Work. Such plans shall document the location and description of potential pollutant sources from these areas and shall

include a description of the controls to reduce, prevent and control pollutants from these sources including spill prevention and response. The Concessionaire shall submit such plans and documentation as specified herein to VDOT and, upon review and comment, they shall immediately become a component of the SWPPP and VSMP Construction Permit (where applicable) and shall be subject to all conditions and requirements of the VSMP Construction Permit (where applicable) and the Agreement, including these Technical Requirements.

4. Reporting Procedures

a. Inspection Requirements. The Concessionaire shall be responsible for conducting inspections in accordance with the requirements herein. The Concessionaire shall document such inspections by completion of Form C-107 (a) and (b), Construction Runoff Control Inspection Form and Continuation Sheet, in strict accordance with the directions contained within the form.

b. Unauthorized Discharge Requirements. The Concessionaire shall not discharge into State waters sewage, industrial wastes, other wastes or any noxious or deleterious substances nor shall otherwise alter the physical, chemical, or biological properties of such waters that render such waters detrimental for or to domestic use, industrial consumption, recreational or other public uses.

c. Notification of non-compliant discharges. The Concessionaire shall immediately notify VDOT upon the discovery of or potential of any unauthorized, unusual, extraordinary, or non-compliant discharge from the land disturbing activity. Where immediate notification is not possible, such notification shall be not later than 24 hours after said discovery.

d. Detailed report requirements for non-compliant discharges. The Concessionaire shall submit to VDOT within five days of the discovery of any actual or potential non-compliant discharge a written report describing details of the discharge to include its volume, location, cause, and any apparent or potential effects on private and/or public properties and State waters or endangerment to public health, as well as steps being taken to eliminate the discharge. A completed Form C-107 (a) and (b) shall be included in such reports.

B. Changes, Deficiencies and Revisions.

1. Changes and Deficiencies. The Concessionaire shall report to VDOT when any planned physical alterations or additions are made to the land disturbing activity or deficiencies in the Project plans or the Agreement, including these Technical Requirements are discovered that could significantly change the nature or increase the quantity of the pollutants discharged from the land disturbing activity to surface waters.

2. Revisions to the SWPPP. Where site conditions or construction sequencing or scheduling necessitates revisions or modifications to the ESC plan or other any other component of the SWPPP for the land disturbing activity, such revisions or modifications and shall be documented by the Concessionaire on a designated plan set (Record Set). Such plans shall be kept on the Project site at all times and shall be available for review upon request.

C. The Concessionaire shall prepare a post-construction SWMP for the entire Project. Plans shall be prepared in accordance with the Standard Documents in Section 3.5.2 and submitted to VDOT for its review and comment. The ESC Plan and SWMP shall be kept current over the operating period.

1.7 Roadway Design

1.7.1 General Requirements

Concessionaire will prepare the final geometric design of the roadway elements in accordance with Good Industry Practice. Functional classifications for roadways and specific design criteria on the Project are to be developed per Section 1.7 and the Standard Documents in Section 3.5.2.

A. The design speed for the New MLK Extension and other roadway segments shall meet or exceed the values shown in the Design Criteria for the MLK Freeway Extension provided as Attachment 1C. 2

B. The I-264 ramp shoulders shall meet the widths shown in the Design Criteria for the MLK Freeway Extension (Attachment 1C). Shoulder width pavement shall be adequate for safe operations and other shoulder functions such as support of the pavement edge. Existing shoulders and medians on I-264 will not be upgraded or altered except as required to accommodate ramp tie-ins.

C. In areas of asphalt pavement widening, the Concessionaire shall overlay the entire surface area of new pavement and one lane width of existing pavement to a point at least 100 feet before and after the limits of widening. 3

1.7.2 Roadway Design Criteria

Roadway Design Criteria for the MLK Freeway Extension is provided in Attachment 1C. Roadway Design Criteria for the Midtown Tunnel is provided in Attachment 1D. 2

1.8 Pavement

1.8.1 General

A. The Concessionaire shall develop pavement sections for residential and commercial roadways in accordance with VDOT's *Pavement Design Guide for Subdivision and Secondary Roads in Virginia.* The Concessionaire shall develop pavement sections for primary roads in accordance with the *Manual of Instructions for Materials Division* (Chapter VI of Pavement Evaluation and Design).

B. Pavements shall be designed to meet the Performance Requirements included in the Standard Documents in Section 3.5.2 and 4.4 Performance Requirements in the Technical Requirements.

C. All roadways shall be designed to ensure positive drainage on the pavement surface and within the pavement structure, including connecting to existing or any new sub drainage systems.

D. Any pavement reconstruction on arterials or local streets or other roadways adjacent to and crossing the Project that are affected by the construction activities of the Project shall match the existing pavement type. An information sheet of existing as planned pavement sections within the Project corridor is included in Section 1.8.2. Reconstructed pavement sections shall be designed in accordance with the standards referenced in this section. The Concessionaire shall design tie-in work to avoid differential settlement (bump at the tie-in) between the existing and new surface in accordance with the Performance Requirements.

E. The Concessionaire's plans, typical sections, profiles and cross-sections shall include the appropriate elements identified as a result of the drainage analysis/design and the pavement design. This shall include, but is not limited to, underdrains, stormwater inlets and pipes, and pavement sections reflecting the elements identified in the Concessionaire's final pavement design.

F. The area surrounding pavements shall be graded to direct surface water away from paved areas. Any utility excavations or excavations for storm drains within

pavement areas shall be backfilled with compacted structural fill in accordance with applicable sections of the *Road and Bridge Specifications*.

G. The Concessionaire shall submit to VDOT for its review, 21 days before the submittal of associated final Design Documentation, a pavement design report that documents the assumptions, considerations, and decisions contributing to the Concessionaire's proposed pavement design, including the following: 4

1. Pavement design details by location, including structural layer materials, general specifications, and thicknesses;

2. Relevant pavement evaluation data (structural and functional) and condition information on adjacent roads;

3. Relevant geotechnical data and drainage requirements to verify the pavement design(s);

4. Design criteria used in determining the pavement design(s), including annual average daily traffic, percentage heavy vehicles, cumulative traffic loading, pavement material strength factors, and pavement design life; and

5. Design calculations documenting the pavement design(s) in accordance with the specified design methodology.

1.8.2 Existing Pavement Design Sections

Project No.: 0058-965-108, PE101
(UPC #76642)
MLK and MLK Connecter

Below are various mainline, shoulder, ramp and loop pavement sections with references to the original construction plans under which they were built. These sections do not include any possible mill and/or overlay data (Note: Harbor Drive was milled and overlaid in 2008). The information provided below is to serve as a reference and possible aid to the Concessionaire in determining the Project's pavement design and shall not be a guarantee of present day conditions.

Reference **PN: 0264-124-071, C501**
I-264 from Victory Blvd. to Des Moines Ave.
(No traffic data indicated on plan sheets)

Mainline

Surface:	I-30 @ 80lbs. /yd² (1.5")
Intermediate:	H-2 @ 140lbs. /yd² (2.0")
Base:	H-3 (1) 7.50"
Prime Coat:	@ 0.40 gals/yd²
Sub-base "A":	Material Grading I…6.00:"
Sub-base "B":	Cement Treated CBR-20 @ 8%...6.00"

Paved Shoulder

Seal:	@ 0.25 gal/yd² Type AE-2 with #78 Stone @25lbs./yd²
Base:	H-3(1) @ 325 lbs./yd²
Prime Coat:	@ 0.40 gal/yd²
Cement Treated Sub-base:	(Select Type II, Min. CBR-20) @ 8%... 6.00"

Reference PN; 0264-124-071, C502
I-264 from Des Moines Ave to Washington Street (Tunnel Entrance)

	From: Des Moines Ave. To: Effingham Street	**From: Effingham Street To: Washington Street**
ADT (1962)	18,760	14, 200
ADT (1984)	78,790	56,090
DHV	7,880	5,610
D (%)	36 / 64	36 / 64
T (%)	7.5	7.5
V(MHP)	60	--

Mainline and paved shoulder typicals are the same as indicated for PN: 0264-124-071, C501 except "Sub-base A" is identified as "Sub-base Material Modified"

Ramps and Loops

Surface:	I-3 @ 80 lb. /yd² (1.5")
Intermediate:	H-2 @ 140 lbs./yd.² (2")
Base:	H-3(1)…7.50"
Prime Coat:	@ 0.40 gals/yd.²
Sub-base "A":	Material Grading I…6.00"
Sub-base "B":	Cement Treated, Select Type II,

Min. CBR-20 @ 8% by volume…6.00”

Reference **PN: 0264-122-104, C501**
I-264 from Des Moines Ave to West Portal (EB) Tunnel

	From: Des Moines Ave. To: Effingham Street	From: Effingham Street To: Crawford Street
ADT (1978)	40,790	28,315
ADT (200)	75,800	58,600
DHV	8,000	5,500
D (%)	55/45	53/47
T (%)	4	4
V(MHP)	60	50

The Project is a later trench widening of existing I-264, and referenced the existing pavement section as follows:

Existing Surface courses:	3.50”±
Existing Base Course:	7.50”±
Existing Sub-base Material:	6.00” ± (unidentified)
Existing Cement Treated Sub-base:	6.00” ± (unidentified)

Mainline Widening

Surface:	165 lbs./yd.^{2} (1.50”) Type S-5 AC
Base:	8.00” Type B-3 AC
Sub-base:	7.50” of aggregate base material Type II, Size No. 21-A or 22.
Cure Coat:	CSS-1h or RC-250 @ 020 gal/yd.^{2}
Cement Stabilized:	Select Type II, Min. CBR-20 @ 7% by volume (6.00”)

Ramps and Loops

Seal Coat:	CRS-2 or CMS-22h @ 0.30 gal/yd^2
Surface:	165 lbs./yd.^{2} (1.50”) Type S-5 AC
Base:	3.00” Type B-3 AC
Sub-base:	Minimum 10.00” and variable of aggregate base material Type II, Size No. 21-A or 22

Paved Shoulders *(Ramps, Loops, and Mainline)*

Seal Coat:	CRS-2 or CMS -22h @ 0.30 gal/yd.^{2}
Base:	3.00” Type B-3 AC

Sub-base: Minimum 10.00" and variable of aggregate base material Type II, Size No. 21-A or 22.

Reference: Second Elizabeth River Tunnel and Approaches Contract #4
Elizabeth River Tunnel Commission

Existing MLK Pavement Section

(No traffic data provided in plans.)

Surface: 2.00" of Type I-3 AC placed in two (2) lifts.
Base: 7.00" of Type H-3(2) AC placed in three (3) lifts.
Sub-base: 12.00"minimum of Select Borrow

Note: Same design was utilized for ramps and Harbor Drive. However, UD-1 underdrains may have been installed on Harbor Drive beneath the CG.

MLK Paved Shoulder

6.00" of "soil aggregate" with prime/seal treatment CI-"A" on Select Borrow with option to install UD-1's beneath shoulder at mainline EP (no indication that underdrains were installed).

When reviewing these sections, please note the following:

1.)	Asphalt Concrete Types	Notes
	S-5	Surface course AC
	I-3	Used as both surface and intermediate AC
	H-2	Used as both intermediate and base AC
	H-3	Base Course AC
	B-3	Base Course AC
	BM-3	Base Course AC
2.)	"Sub-base Material Grading 1" = Aggregate 21-A or 22	
3.)	At the time these sections were in use • Shoulders and riding surfaces were commonly "sealed" • Sub-base aggregates were commonly "primed"	

1.9 Traffic Engineering

The Concessionaire shall be responsible for the design and construction of the Project signing, pavement markings, roadway and sign lighting, and traffic signals.

1.9.1 Pavement Markings and Markers

A. The Concessionaire shall provide and maintain pavement markings and reflective pavement markers as provided by this Section and meeting the Standard Documents in Section 3.5.2.

B. All limited access facilities shall have Type B, Class VI pavement markings and snow plowable raised pavement markers installed.

C. Contrast pavement markings shall be installed on all white lines installed on hydraulic cement concrete surfaces.

D. All pavement markings that shall be installed on roadways that will be maintained by other agencies shall meet the requirements of that agency.

E. Type D, Class III Temporary Pavement Markings shall be used for all temporary pavement markings on this Project. Temporary pavement markings and markers are not to be placed on the final surface course.

1.9.2 Signing

A. The Concessionaire shall design, fabricate, install and maintain all new guide, supplemental, route marker, regulatory and warning signs required for this Project as provided for by this Section and meeting the Standard Documents listed in Section 3.5.2. The Concessionaire shall also modify all existing signs requiring message modification.

B. The Concessionaire shall prepare a Signing Roll Plan (Roll Plan) and present the plan for review and comment by VDOT. The Roll Plan shall include proposed sign locations and messages for all guide signs, toll signing, typical regulatory and warning sign applications, proposed locations for relocating existing signs, and proposed locations for new structures. The Roll Plan shall also display signing, both existing (to remain) and proposed, for all mainlines, ramps and interchanges, as well as for the arterial streets, frontage roads, and any other roadways that contain signing that is affected by the Project. The Concessionaire shall also provide for modification or removal of any signage outside of the limits of the Project that is no longer appropriate or pertinent. The Roll Plan shall also include the locations of all proposed and existing Dynamic Message Signs (DMS). The Roll Plan features shall include but are not limited to, the existing and proposed roadway alignments, right of way, utilities, baseline of construction (including stationing), and existing topography at the tie-in points of the roadway limits of work. The proposed pavement markings shall also be shown on the Roll Plan. Submittal of the Roll Plan to VDOT may occur during final design.

C. The Concessionaire shall be responsible for planning, coordination and obtaining Governmental Approvals, if required.

D. All mainline and interchange guide signs shall be installed overhead, either on overhead or cantilever structures.

E. The Concessionaire shall not relocate existing overhead or cantilever sign structures without VDOT's concurrence.

F. Deleted 3

G. The limits of directional signage for the Project for which the Concessionaire is responsible are set forth in the O&M Boundaries.

H. The Concessionaire shall be responsible for coordination with VDOT or the pertinent local agencies or jurisdictions in order to install directional signage, including, without limitation, obtaining all applicable Governmental Approval.

I. The Concessionaire shall provide the necessary guide, warning and regulatory signs for the Project.

J. The Concessionaire shall maintain all existing signs during construction, unless they are to be removed permanently or have been replaced as required by the Project. For any existing signs that require relocation due to construction, the Concessionaire shall present pertinent details – such as sign designs, mounting details, locations etc. – for VDOT's review and comment, prior to relocation.

K. With review and comment from VDOT, the Concessionaire shall modify or remove existing signs and structures that are rendered inaccurate, ineffective, confusing or unnecessary.

L. The Concessionaire shall identify all existing signage impacted by the Project, including signs and associated sign structures that are outside the physical limits of roadway construction. For modifications (including adding, deleting or modifying sign panels which are of greater face area and weight to those currently on the structure) to any existing overhead/cantilever sign structure affected by the Project, the Concessionaire shall provide comprehensive structural analysis for VDOT's review and written comment prior to the commencement of design. To assist with the structural analysis, VDOT will provide (if available) existing inspection reports, structural information, shop drawings, and foundation calculations to the Concessionaire for each existing sign structure identified by the Concessionaire. Where recent inspection records and original design plans are available, and the proposed sign panel layout does not impose higher loads on the

existing structures, VDOT agrees that the Concessionaire may elect to reuse the existing structure without providing a complete structural analysis. All sign and structure modifications shall be in accordance with the Standard Documents listed in Section 3.5.2 and the VDOT Chief Engineer's memorandum dated July 24, 2008 (Attachment 3C).

VDOT will review the structural analysis provided by the Concessionaire for each sign structure to determine whether or not the existing structure and/or sign can be modified as proposed. If it is determined by engineering analysis, reviewed by VDOT that modification to the existing sign structure and/or signs are not structurally acceptable, the Concessionaire shall provide new signs and structures, in accordance with Standard Documents listed in Section 3.5.2, to replace the existing sign structures and signs.

M. Signs shall incorporate high intensity reflective sheeting material, in accordance with ASTM D4956 Type IX and X and FHWA-HRT-08-026.

N. Post Interchange Distance Signs shall be installed on the Project in accordance with the Standard Documents.

O. The Concessionaire shall place milepost and intermediate markers at 0.2 mile intervals on the right side of the roadway facing traffic for new controlled-access roadways and interchange ramps.

P. The milepost and intermediate markers shall be designed according to the Manual on Uniform Traffic Control Devices (MUTCD) Standard 2E-54, Enhanced Reference Location Signs.

Q. In situations where integrated directional signs exist the Concessionaire shall coordinate with VDOT and their vendor concerning the Integrated Directional Sign Program (IDSP).

R. For signing along the Mainline, except within the tunnel, all guide signs, DMS, and supplemental guide signs shall be installed such that 800 foot spacing is maintained between signs. In areas where the 800 foot spacing cannot be maintained the Concessionaire shall obtain a design waiver/exception from VDOT to reduce the spacing.

1.9.3 Traffic Signals

A. The Concessionaire shall design, supply and construct all necessary temporary and permanent traffic signals and related infrastructure for the Project as provided by this Section and meeting the Standard Documents in Section 3.5.2.

B. The Concessionaire shall design the Project to include new and modifications to existing and proposed traffic signal installations meeting the design requirements of the maintaining agency.

C. The Concessionaire shall provide communications between all new permanent signals for the Project and the maintaining agency's traffic signal system. The communications medium shall be compatible with the maintaining agency's communication system or plan and approved by the agency.

D. The Concessionaire shall maintain or provide communications between all existing and temporary signals within the Project throughout construction.

E. New traffic signals on the Project shall be integrated with existing traffic signals using the following approach:

1. The Concessionaire shall design, program, adjust controller timings, test, and commission the new signalized intersections for coordinated operations matching the maintaining agency's existing coordination plans.

2. VDOT or the maintaining agency will test and commission the local signalized intersection for network operations with existing traffic signal system and will re-time network signals, as needed, to accommodate network demand.

F. The Concessionaire shall keep the existing signalized intersections within the rights of way functional during the construction of the Project. If signals must be shut down, the Concessionaire shall provide temporary signals or appropriate traffic controls. VDOT will not permit any temporary signal shut down without written justification.

G. For each phase defined in the maintenance of traffic (MOT) Plan and traffic control plans (TCP), the Concessionaire shall develop signal timing plans for the Project and roadways designated as detours and submit the plans to VDOT. The Concessionaire shall implement, test, and adjust signal timings to prevailing conditions. The Concessionaire shall develop signal timing plans for all peak and non-peak periods which may require more than eight plans.

H. The Concessionaire shall install and be responsible for all aspects of temporary and permanent traffic signal installation to include but not be limited to design, obtaining permits, installation, rehabilitation of disturbed areas, and acquiring power and communication connections.

I. Conductor/communication cables shall be placed in buried conduit, embedded conduit, and bridge-mounted conduit.

J. The Concessionaire shall not open trench any existing pavement for the installation of conduit, except in areas that will be overlaid or rebuilt. For overlays over trench areas, the new pavement section shall match the existing pavement section.

1.10 Fences and Barriers

A. The Concessionaire shall be responsible for securing the Work and providing all temporary fencing necessary to ensure the safety of the work force and members of the public.

B. The Concessionaire shall perform a safety risk analysis to determine whether fencing should be used to separate the noise wall erection work zones from adjacent properties and, if such analysis shows that fencing is required, the Concessionaire shall provide temporary six-foot-high (minimum) chain link security fencing at any such locations.

C. Glare screens or extended height barriers will be installed on all concrete median barriers.

D. Except for temporary fencing, all chain link fabric, posts, rails and other associated hardware for fences, including these items on permanent structures, shall be black vinyl-coated and the details for fences shall be in accordance with the Standard Documents in Section 3.5.2.

1.11 Aesthetics

3

1.11.1 Agency Coordination

A. City of Portsmouth

1. City of Portsmouth design references:

1

a. Uptown D2 District Form Based Code

b. City of Portsmouth Master Transportation Plan

2. Six (6) segments (A-H) of the Project corridor within its boundaries are to receive aesthetic treatments. These are:

a. Segment A: from the Midtown Tunnel to London Boulevard (major gateway)

i. Concessionaire shall discuss location and installation of gateway features, such as primary monument-style gateway and way finding signage

b. Segment B: from London Boulevard to High Street (urban area adjacent to a historic residential neighborhood)

i. Light fixtures should be lower in height and consist of Dominion-style lighting.

ii. Concrete sidewalks can be used. All sidewalk widths shall be 5 feet.

iii. On west side of MLK freeway extension, Concessionaire shall consider connecting MacArthur Avenue to Queen Street to re-establish and maintain residential block pattern in lieu of a cul-de-sac.

iv. Deleted 4

v. Deleted 4

vi. If MSE wall construction is used to elevate grade from London Boulevard, the MSE wall needs to run fully to High Street and create a vertical face abutment. Sloped sides from High Street to abutment are undesirable. Examples of styles and color of MSE walls follow this section in 1.11.3.

c. Segment C: High Street Bridge (gateway from Historic Downtown area to fast-growing Midtown area)

i. Provide cohesive vision to frame the right of way, reflect the appearance of the city.

ii. It is desirable for the High Street Bridge to exhibit a gateway visual effect. Considerations for arching facia features should be given.

d. Segment D: from High Street to Turnpike Road (mixed use and future Transit Oriented Design hub) 4

i. Light fixtures should be lower in height and consist of Dominion-style lighting.

ii. On west side of MLK freeway extension, the Concessionaire shall consider connecting King Street to County Street to re-establish and maintain block pattern and urban grid in lieu of a cul-de-sac.

iii. On east side of MLK freeway extension, the Concessionaire shall consider connecting King Street to County Street to re-establish and maintain block pattern and urban grid in lieu of a cul-de-sac.

iv. Concessionaire shall minimize distance between through lane and off-ramps.

e. Segment E: Bridge over Turnpike Road (urban area)

i. Light fixtures should be lower in height and consist of Dominion-style lighting.

ii. Bridge structure will follow the same type set by preceding structure from High Street.

f. Segment F: from Turnpike Road to Interstate 264 (major gateway)

i. The Concessionaire shall discuss location and installation (at the City's cost) of gateway features, such as primary monument-style gateway and way finding signage.

ii. Lighting should be maximized underneath the MLK where appropriate. High pressure sodium (HPS) fixtures should be considered. 4

iii. Light fixtures should be lower in height in the vicinity of Dale Homes, the residential units on South Street, and along the south side of Interstate 264. Lights should consist of Dominion-style lighting.

iv. Ramp termination treatment will be consistent with the overall theme of the adjacent bridge structure, i.e. concrete barriers, embedded steel with guardrail attached, warning signage and landscaping enhancements. Ramp termination treatment will be shown on the Design Development and Detailed Design Plans and submitted for VDOT review and comment. 4

g. Seeding, shrubs (& shrub beds) will be designed by a registered Landscaping Architect (LA) licensed to practice landscape architecture in the Commonwealth of Virginia. All shrubs and/or floral arrangements genus types will be compatible and be able to thrive in the environment of the Hampton Roads area. 4

h. All Stormwater Detention Basins scheduled for inclusion on this Project are to be:

i. Considered for implementation within the Right of Way 4

ii. Surrounded by Black Vinyl coated chain link fence with a landscaped perimeter with the exception of Pond 14 4

iii. Tree planting and genus shall be in accordance with the street tree list following this section in 1.11.4.

3. Concept sketches are shown in Attachment 1E and listed below. 4

a. High Street Gateway – May 25, 2011 (2 pages)

b. Turnpike Road Area – June 3, 2011

c. Illustrative Elevations – May 25, 2011

d. Enlargements – July 12, 2011

e. Site Furnishings – May 25, 2011

B. City of Norfolk

1. City of Norfolk Design references

a. City of Norfolk Design Standards

b. Ghent Design Guidelines

c. City of Norfolk Design Review Committee (advisory only)

2. General aesthetic design requirements:

a. Provide cohesive vision to frame the right-or-way, reflect the appearance of the city.

b. Match materials and construction of existing sidewalks/trails for extensions of same per city design standards and guidelines.

c. Enhanced front façade/landscape integration for any vertical walls (noise walls or MSE walls).

d. Provide an area for installation of a "Welcome to Norfolk" sign exiting the Norfolk portal (eastbound traffic). This area should be located in the median.

3. Concept sketches are shown in Attachment 1F and listed below. 4

a. Norfolk Portal Landscaping – June 21, 2011

1.11.2 Deleted 4

1.11.3 Deleted 4

1.11.4 Tree List

A. Street Tree List

(Large Canopy Trees – mature height above 70 feet)

Acer rubrum	Red Maple
Betula nigra	River Birch
Celtis occidentalis	Common Hackberry
Cercidiphyllum japonicum	Katsura Tree
Fraxinus Americana 'Autumn Purple'	White Ash
Fraxinus excelsior	Blue Ash
Fraxinus pennsylvanica 'Marshall's Seedless'	Green Ash
Ginkgo biloba	Ginkgo (male only)
Gleditsia triacanthos var. inermis	Thornless honey locust
Liquidambar styracifolia	Sweetgum
Platanus acerifolia 'Bloodgood'	London Plane tree
Platanus occidentalis	Sycamore
Quercus acutissima	Sawtooth Oak
Quercus coccinea	Scarlet Oak
Quercus falcata	Southern Red Oak
Quercus muhlenbergii	Chinquapin Oak
Quercus palustris	Pin Oak
Quercus phellos	Willow Oak

Quercus rubra	Red Oak
Quercus velutina	Black Oak
Sophora japonica 'Regent'	Japanese Pagoda Tree
Tilia Americana	Basswood / American Linden
Tilia cordata 'Greenspire'	Greenspire Littleleaf Linden
Tilia euchlora	Crimean Linden
Tilia tomentosa	Silver Linden
Ulmus hollandica 'Groenveldt'	Groenveldt Elm
Ulmus parvifolia	Chinese / Lacebark / Drake Elm

B. Public Space Trees

In addition to the above trees, the following trees may be placed within Dooryards, Squares or Civic Greens.

Acer palmatum cultivars	Japanese Maple
Cerus canadisis	Redbud
Cornus florida cultivars	Dogwood
Cornus kousa	Kousa Dogwood
Lagerstroemia indica	Crepe Myrtle
Magnolia spp.	Magnolia
Malus spp. (improved varieties)	Crabapple
Prunus spp.	Flowering Cherry and Plum
Taxodium distichum	Bald Cypress
Acer nigrum	Black Maple
Carya illinoinensis	Pecan
Carya laciniosa	Shellbark Hickory
Carya ovata	Shagbark Hickory
Ilex vomitoria	Yaupon Holly
Juglans nigra	Black Walnut
Liriodendron tulipifera	Tulip Poplar
Pistacia chinensis	Chinese Pistache
Taxodium ascendens	Pond Cypress
Zelkova serrata	Japanese Zelkova

1.12 Lighting

A. The Concessionaire shall preserve all existing lighting assets along I-264; Rte. 58, Rte. 337, in the Existing Midtown Tunnel and Existing Downtown Tunnels, at both tunnel portal entrances on the Norfolk and Portsmouth tunnel approaches and at Brambleton Avenue and Hampton Boulevard interchange, throughout the construction of the Project in order to avoid a diminution of the existing lighting conditions for a period of more than 14 days. The Concessionaire may accomplish

this by staging its construction operations to ensure the repair or replacement of existing lighting assets impacted by the Work is completed within 14 days of such assets being taken out of service or otherwise impacted so as to cause a diminution of the existing lighting conditions. If the necessary repair or replacement of an existing lighting asset cannot be completed within the 14 day period, the Concessionaire shall provide, prior to the expiration of the 14 day period, temporary lighting equipment until the completion of the repair or replacement Work.

B. High mast lighting shall not be allowed within one quarter mile radius of residential areas.

C. Deleted

D. The Concessionaire shall provide lighting within the Project Right of Way, and on approaches as required and design the Project to include new, modifications to, or improvements of, the roadway and tunnel and tunnel facility lighting systems impacted by the Project to the extent noted below.

1. New or modified lighting shall be provided at the entry and exit connections to the New MLK Extension and the New Midtown Tunnel and approaches from the Norfolk and Portsmouth landside.

2. New lighting shall be provided for the New Midtown Tunnel facilities. New or modified lighting at the Existing Midtown Tunnel will be provided within five (5) years after Final Acceptance of the Existing Midtown Tunnel.

3. Under-bridge lighting shall be provided as necessary for new MLK Extension and I-264 Interchange, London Boulevard, and High Street and MLK Extension bridge structures where the structures form an overpass or underpass on the Project.

4. Continuous lighting along I-264.

5. At the ramp intersections with arterial streets as required by the local maintaining agency.

6. The Concessionaire, at its sole cost and expense, shall provide any and all lighting required as mitigation for any design exception, or design waiver.

E. The Concessionaire shall design lighting in accordance with the Standard Documents in Section 3.5.2.

1. Lighting is required where independent grade separated bicycle or pedestrian crossings are impacted or constructed. 2

1.13 Bicycle and Pedestrian Facilities

A. The Concessionaire shall design and construct the Project to allow for the existing pedestrian and bicycle facilities of the Elizabeth River Trail in Norfolk to cross the Project right of way within the project limits. The Concessionaire shall also design and construct the Project to accommodate the required space needed for planned pedestrian and bicycle facilities within the Project limits as defined by City of Portsmouth's Master Plan (finalized January 2010).

B. All new facilities and modifications to existing facilities will be designed in accordance with the Standard Documents in Section 3.5.2. 2

C. The Elizabeth River Trail is built on an old railroad right of way which traverses the portal of the Existing Midtown Tunnel and shall be continued across the New Midtown Tunnel Portal. The Concessionaire shall coordinate with VDOT's District Bicycle Pedestrian Coordinator and local jurisdictions on the design of the existing or planned facility.

D. All pedestrian signal displays shall be countdown signals. Pedestrian pushbuttons shall be a minimum of 5.0 cm (2 in) across in one dimension and shall contrast visually with their housing or mounting. All pushbuttons must be compliant with American with Disabilities Act Accessibility Guidelines and in accordance with the Standard Documents in Section 3.5.2.

E. Pavement designs for sidewalks and paths shall include a minimum four inch layer of Aggregate Base Material Type 1, Size 21 B, or comply with site and subsurface conditions, whichever is greater.

F. Bicycle and pedestrian signing shall be installed per the MUTCD. The Concessionaire shall provide replacement bike markings only where existing markings are provided.

G. All existing pedestrian and bicycle facilities shall be maintained throughout construction until permanent facilities can be fully opened, unless otherwise approved by VDOT. Facilities, such as Elizabeth River Trail, may be detoured during construction. Any temporary pedestrian or bicycle facility closure request shall be submitted in writing to VDOT for approval. The pedestrian bridge over I-264 can be closed for 9 months to facilitate replacement, provided the detour route is maintained and adequate detour signage is installed, maintained throughout the closure period. 2 3

H. The Concessionaire shall design and provide drainage, if needed, for any new independent pedestrian or shared use path bridge. Drainage scupper grates on the bridge should preferably be located within the 2' shoulder of the path.

1.14 Structures and Bridges

1.14.1 Deleted

2

1.14.2 Definitions

A. Permanent Structures

1. Permanent structures include but are not limited to bridges, retaining walls, sound walls, bridge class culverts, sign structures, lighting structures, support maintenance buildings and system equipment structures, toll gantries, control rooms, ventilation facilities, crash houses, and technical shelters.

3

2. A "bridge class culvert" is defined as follows:

a. A culvert having an opening measured along the center of the roadway of more than 20 feet between undercopings of abutments or spring lines of arches, or extreme ends of openings for multiple boxes; it may also include multiple pipes, where the clear distance between openings is less than half of the smaller contiguous opening; or other culverts that may be defined as a bridge class culvert in accordance with National Bridge Inspection Standards, the Code of Federal Regulations (23 CFR 650.3), and/or

b. As defined in the current edition of IIM-S&B-27.6. – Safety Inspections.

2

1.14.3 Design

A. Design Standards

1. All new bridges and bridge replacements shall be designed in accordance with AASHTO Load and Resistance Factor Design (LRFD) *Bridge Design Specifications* fourth edition, current interims and VDOT Modifications. All new and existing culverts and retaining walls, including modifications, shall be designed to AASHTO Standard Specifications for the Design of Highway Bridges or AASHTO LRFD and VDOT modifications, as determined by the Concessionaire. All other structures shall be designed to the appropriate Standard Documents in Section 3.5.2.

2

All railings (e.g., cast-in-place concrete median barriers, parapets, and barrier walls) on bridges and structures shall be designed as follows:

a. For structures designed in accordance with AASHTO LRFD, the railings shall be designed to AASHTO LRFD;

b. For structures, including modifications to existing structures and bridges, designed in accordance with AASHTO Standard Specifications for Highway Bridges, the railings shall also be designed to satisfy all the requirements set forth in National Cooperative Highway Research Program Report No. 350; and

c. All railings shall be in accordance with VDOT's standards details in Vol-V-Part 3 of the *Manual of the Structure and Bridge Division* unless VDOT has granted a design waiver or design exception (as applicable).

2. All permanent support buildings and associated structures shall be designed in accordance with the Virginia Uniform Statewide Building Code. The Virginia Department of General Services' Bureau of Capital Outlay Management (BCOM) will have jurisdiction and authority for design review and construction inspection for these installations. The Concessionaire will follow all requirements as set forth in BCOM's Guide for Construction and Professional Services Manual. 4 3

3. If a structure or bridge is designed to AASHTO LRFD, the Concessionaire still is required to comply with VDOT's *Manuals for the Structure and Bridge Division*. Should any such manual not be in accordance with AASHTO LFRD, then the Concessionaire shall implement a modified version of the requirement such that it is in compliance with AASHTO LRFD (subject to VDOT's review and comments).

4. For mechanically stabilized reinforced earth walls, the Concessionaire also shall design and detail such walls to satisfy the requirements of Article 11.10.2.2 of AASHTO LRFD regardless of the specification used to design the walls.

B. Details and Drawings for Permanent Structures

1. All details and drawings should be in accordance with Vol-V-Part 3 of the *Manual of the Structure and Bridge Division*. The Concessionaire may propose deviations from VDOT's current standards, subject to VDOT approval. Should any such details not be available, the Concessionaire

shall implement a modified version of the requirement such that it is in compliance with AASHTO LRFD.

2. Required guidelines for steel box pier caps and steel box girders shall be in accordance with the Standard Documents in Section 3.5.2.

3. Low permeability concrete shall be used for the entire structure including deep foundation units. Testing requirements may be waived by VDOT if the structure is not subject to freeze/thaw cycles.

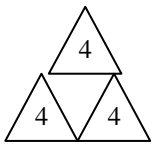
4. On the plans, all deep foundation units shall be numbered.

5. Any repairs and/or modifications to existing bridges or structures shall be engineered and details submitted to VDOT as a plan package for review and comment.

6. Retaining walls associated with any bridge, located within a distance of 20 feet beyond the end of approach slab/sleeper pad, shall be included with the bridge plan package. Retaining walls beyond the limits set forth above shall be submitted as separate plan packages.

7. To the extent as practical, expansion joints in deck slabs shall be minimized. The use of continuous span units and jointless bridge design technologies shall be used as outlined in the VDOT *Manual of the Structure and Bridge Division*, Volume V-Part 2 (VDOT office practices).

C. 60% Bridge Plan Submission



1. The Concessionaire shall submit a 60% plan for each permanent structure (new bridge, bridge replacement, and bridge widening).

2. 60% plans must be submitted to VDOT prior to any final bridge design submittal, and at other appropriate times pursuant to VDOT's concurrent engineering process. VDOT shall not review any final design submittals until the 60% plan has been submitted to VDOT. The commencement of the final design prior to the review of the 60% plan by VDOT shall be done solely at the risk of the Concessionaire.

3. Deleted

D. Final Plans (Stage II) Submission

1. The Stage II bridge submittal shall conform to plan requirements in VDOT's Manual of the Structure and Bridge Division, Volume V-Part 2 Design Aids/Typical Details. 2

2. Bridge Deck Drainage

   a. The Concessionaire shall follow the requirements set forth in the Standard Documents in Section 3.5.2 except as noted below.

   b. Lateral runs of pipe shall be hidden, not embedded or recessed, and coordinated with the architectural design of the bridge. The pipes and downspouts shall facilitate ease of maintenance of the deck drainage system.

   c. All pipes shall be a minimum eight inch diameter, and have a slope to promote self-cleaning velocities, and clean-outs.

   d. Downspouts and/or drainage pipes shall not be embedded in bridge piers, abutments or other such substructure units.

   e. Steel downspouts and pipe reducers shall be ASTM A53, Schedule 40, seamless, and galvanized inside and out.

   f. In addition to the requirements mentioned here, the bridge deck drainage must meet the requirements of AASHTO LRFD.

1.14.4 Modifications to Existing Structures and Bridges

A. If the Concessionaire modifies structural elements of any existing bridge, then the Concessionaire shall provide a design and plan set for the new work and the connections to the existing structure that is consistent with the Standard Documents, including, but not limited to, VDOT Structures and Bridge Manuals, VDOT Instructional and Informational Memorandum's (I&IMs) and AASHTO Standards. 3

1.14.5 Toll Gantries

A. The design for the structures, toll gantries, and supports for the violation enforcement, traffic management system (TMS) and tolling system roadside equipment will accommodate the following:

   1. Toll and enforcement equipment dead loads and performance requirements;

2. Natural frequency requirements; and

3. Applicable live loads.

B. The vertical deflection of the toll gantry will not exceed the equipment manufacturer's desirable design specification.

1.14.6 Barrier Protection of Structures

A. Barrier Protection of Structures shall satisfy the requirements of AASHTO LRFD, including the requirements of Article 3.6.5 of AASHTO LRFD. This requirement shall also apply to all existing bridges and structures where lanes are added or shoulder widths are reduced or do not meet current standard.

B. The above requirement shall be extended for following situation: Columns of straddle bent piers shall always be protected by structurally independent, crashworthy ground mounted 54.0-in high barriers in accordance with Article 3.6.5.1 of the AASHTO LRFD. Barriers shall have a minimum of 1'-0" clearance from the face of the column to back face of the barrier.

1.14.7 Railroad Coordination

A. The bridge shall be designed to satisfy the requirements of the following, and where these requirements are not in agreement, the Concessionaire shall satisfy the more stringent requirement.

1. *Manuals of the Structure and Bridge Division*, VDOT;

2. Requirements of the owner of the railroad;

3. The American Railway Engineering and Maintenance-of-Way Association; and

4. AASHTO LRFD.

B. The Concessionaire is responsible for obtaining any required approvals from the owner of the facility.

1.14.8 Post Construction

A. Safety and Acceptance Inspection for Bridges, Tunnel Facilities, Culverts, Overhead Sign Structures, and High Mast Lighting Poles. △3

1. A Substantial Completion inspection is required before accepting the structure. When feasible, it is suggested that the Substantial Completion inspection be held simultaneously with the Safety Inspection,

   a. Substantial Completion inspections will be conducted, in accordance with the Comprehensive Agreement and the Standard Documents in Section 3.5.2. Representatives of the Concessionaire shall be in attendance during the inspection. As described for Safety Inspections, the Concessionaire is responsible for providing traffic control measures and access to all structure elements necessary for performing the inspection.

   b. This inspection shall be performed by VDOT. 1

   c. As-built drawings, record documents, and shop drawings shall be provided in accordance with the Technical Requirements.

   d. Upon completion of this inspection, a letter from VDOT will be prepared, recommending acceptance or specifying any deficiencies, including incomplete work, which must be resolved before the structure is accepted. If a structure is not accepted, the Concessionaire shall fix the deficiencies and notify VDOT by submitting a letter certifying that the deficiencies have been corrected. Depending on the severity of the deficiencies, as judged by VDOT, another inspection may be performed or acceptance may be immediately recommended. 1

2. A Safety Inspection is required before any bridge or tunnel is opened to traffic.

   a. This inspection serves as the initial inspection of the structure. Data about location, date completed / open to traffic, alignment, description, horizontal / vertical clearances, streams, structure element description and condition, and traffic safety features will be gathered.

   b. The Concessionaire shall ensure that all structural elements are accessible for inspection of all structures. This requirement may dictate that the Concessionaire provide:

      i. Man-lifts, barges, remote operated vehicles, bucket trucks, under-bridge inspection vehicles, boats, or other equipment necessary to inspect the structure; and

ii. Plans, personnel, and equipment to implement traffic control measures.

c. The inspection shall be performed by VDOT. As-built drawings will be provided in accordance with the Technical Requirements. 1

d. In most cases, the structures must be substantially complete (i.e. roadway, curbs, and slopes on the approaches and underneath the structure are already in place) before the inspection will be performed.

3. VDOT will complete the Safety Inspection and a Final Acceptance Inspection. VDOT will complete the inspection during the period specified below. 1

a. If only a single bridge is to be inspected, VDOT will complete the inspection within a four week period from the date of receipt of written notice from the Concessionaire. Inspection of tunnel facilities will be completed within an eight week period from the date of receipt of written notice. 1

b. Furthermore, if multiple bridges are to be inspected during a given one month period, the period for the completion of the inspection will be four weeks plus an additional week per bridge to be inspected.

4. Acceptance of a bridge, culvert, overhead sign structure, or high mast light pole will require a Safety Inspection and a Final Acceptance Inspection, which shall be completed by VDOT. 1

B. Load Ratings

1. The Concessionaire shall perform a structure load rating for the new bridges, bridge replacements, bridge widening, and all modified bridges (e.g. sound wall additions, railing replacements, etc.).

2. The analysis shall be in accordance with VDOT's Structure and Bridge Division Instructional and Informational Memorandum (I&IM) Number S&B-27.6 (or latest revision), except that the concessionaire shall use the AASHTO's *Manual for Bridge Evaluations*, first Edition (2008) and 23CFR650 Subpart C – *National Bridge Inspection Standards* (NBIS), Subsection 650.301. 2

3. The Concessionaire shall perform load ratings on bridge superstructures using the Load and Resistance Factor Rating method for NBIS rating for the AASHTO HL-93 design loading, the blanket permit vehicle (90K and 115K) and Virginia's Legal Load vehicles as specified in the Structure and Bridge Division's I&IM Number S&B-27.6. 2

4. All load ratings for structures other than steel curved girders/beams shall be performed using the As-Built drawings and BRIDGEWare VIRTIS software. The model in VIRTIS shall be grid model. Horizontally curved bridges with curved longitudinal steel members shall be evaluated using DESCUS software with rating capability. All other load ratings shall be generated by hand calculations or by use of software compatible to VDOT methods.

5. The Concessionaire shall prepare and deliver to VDOT two copies of the load rating report for each structure. Each report shall contain a completed copy of VDOT's current load rating summary sheet (SB502) referencing the controlling structural element(s) sealed and signed by a Professional Engineer licensed in the State, rating assumptions, pertinent analysis calculations, and VIRTIS, DESCUS or other approved computer input as appropriate. In addition, a CD-ROM containing the load rating input files for VIRTIS, DESCUS, or other approved computer programs shall be delivered to VDOT with the report.

C. As Built Documentation (Refer to Section 1.20). 1

1.15 Tunnel Performance Requirements – Civil

1.15.1 Flood Protection

A. The Work shall maintain the existing flood protection provisions as a minimum. The Concessionaire shall coordinate the design, construction and operation of the Work in accordance with FHWA *Technical Manual for the Design and Construction of Road Tunnels – Civil Elements* (Publication No. FHWA-NHI-10-034, June 2010 Draft Version) and with the United States Army Corps of Engineers (USACE) and any other relevant authorities.

B. The Project road shall not, by restricting the flow of flood water, or reducing the areas currently available for flood storage, exacerbate the risk of flood of the Work or the surrounding areas.

C. The top of the tunnel protection layer shall be below the level of the existing Elizabeth River channel bed. The profile of the existing river bed shall be 4

confirmed by bathymetric survey prior to submission of the Design Development and Detailed Design.

D. Deleted 3

E. Flood protection shall be provided on the Norfolk Portal of the New Midtown Tunnel. The existing flood gate on the Norfolk portal of the existing tunnel shall continue to be maintained in an operable state. Any alternative to flood gates shall be subject to VDOT's review and comment. 3

F. Flood mitigation measures shall be determined by the Concessionaire, but at a minimum shall meet Extreme High Water Level (EHWL) requirements and all State and Federal Law and the Standard Documents. Flood mitigation measures shall be submitted as part of the Design Development and Detailed Design. 4

G. The EHWL used in the design of flood protection measures shall be calculated by the Concessionaire and will be included in Design Development and Detailed Design. The EHWL shall be the water level with the probability of being exceeded no more than 0.002 times in one year (the 500 year flood level). The flood protection shall be designed for wave heights corresponding to the same return period. 4

H. The Concessionaire shall maintain flood protection features throughout the Term, taking into account the global stability of the flood protection features. The height of levees, embankments or revetments shall take into account long term settlements, and an appropriate allowance for freeboard, which will be determined by the Concessionaire.

I. The Work shall be protected from inundation by flooding at all stages of construction. In the temporary condition, once tunnel elements have been immersed, at least three bulkheads shall be left in place. 4

J. Drainage cut offs shall be provided at the tunnel portals to prevent surface water runoff from entering the tunnel. Drainage sumps shall be provided at the tunnel portals, and the tunnel low point. Pumps shall be provided in the sumps to remove the liquid collected.

K. The sumps shall be designed with sufficient operational redundancy to meet the drainage requirements with one of the pumps not operating.

L. Flood protection at the Portsmouth Portal of both the new and existing Midtown Tunnels shall consist solely of providing for a sufficient height for the approach retaining walls (EL 13.5 for the new tunnel and EL 13.1 for the existing tunnel). 3 4

1.15.2 Groundwater

A. No permanent dewatering provisions shall be permitted, i.e. groundwater lowering below the long term mean ground water level. The approach structures shall not be terminated below the long term mean sea, or mean groundwater level.

B. Any temporary dewatering systems shall be designed and constructed so as to secure a dry and stable excavation at all times. The excavation shall be protected from uplift, erosion and deterioration. 2

C. The Concessionaire shall identify any potential impact the temporary or permanent works may have on the groundwater quality, and mitigate these effects. The Work to be considered shall include but shall not be limited to:

1. The casting basin temporary dewatering and construction;

2. Temporary dewatering and construction of the approach ramp; and

3. Placement of the tunnel, backfill, reinstatement of the river bed and the long term situation after reinstatement of the river bed.

D. If groundwater quality and/or elevation is potentially affected by the Work, the Concessionaire shall establish a baseline for monitoring groundwater quality and/or elevation. The Concessionaire shall define a suitable monitoring program and shall obtain the acceptance of the relevant authorities for the monitoring program.

E. The Concessionaire shall verify assumptions in respect of any dewatering system designed to lower groundwater elevation proposed with regard to draw down or permeability of soils by carrying out pumping tests and in-situ permeability tests.

F. The effect of any dewatering on adjacent structures shall be assessed and documented by the Concessionaire. Ground movements shall not cause damage to adjacent structures.

G. The design of the permanent structure shall account for any effects caused by uplift or ground movement in the temporary condition.

H. Provisions shall be made to prevent the flow of groundwater/river water through the backfill materials along the tunnel and into the approach areas. The Concessionaire shall take into consideration any increase in hydraulic connectivity which may result from the temporary or permanent works.

I. Where practicable, any structures subject to buoyant forces should be designed to resist uplift through the weight of the structure alone. Any uplift restraint devices such as tension piles or ground anchors used to prevent instability or control unacceptable movement of the structure shall be sturdy and durable for the design life of the tunnel. The Concessionaire shall submit details with the Design Development and Detailed Design. The submission shall include details of the proposed arrangement, calculations to justify the structural and geotechnical design, details of any geotechnical investigations undertaken to verify the design assumptions, and details of the means by which durability will be assured. 4

1.15.3 Disaster Recovery

A. During the design life, the tunnel may be subjected to extreme actions such as flooding, sunken ship loading, fire, explosion and earthquake. Measures shall be taken in design to ensure the stability of the structure until disaster recovery measures can be implemented, and that in the long term, the tunnel remains serviceable.

B. The Concessionaire shall consult with the relevant authorities (e.g. FHWA, VDOT, USACE, Federal Emergency Management Agency (FEMA), and Department of Homeland Security (DHS)) and prepare the necessary documentation, such as a Safety Response Plan, and an Emergency Response Plan.

C. Loads shall be determined by the Concessionaire for all extreme events and be documented in the Design Development and Detailed Design. 4

D. The loading applied by a sunken ship resting on top or alongside the tunnel shall be accounted for in the Concessionaire's design. The static equivalent loadings considered should be a concentrated load and uniformly distributed load, calculated with reference to the FHWA *Technical Manual for the Design and Construction of Road Tunnels – Civil Elements*, June 2010.

E. For the sunken and grounding ship load, the foundation design shall ensure that the maximum allowable settlement of the tunnel, taking into account the maximum joint openings, the internal traffic clearance profile and pavement requirements are not exceeded. The period prior to salvage of the vessel shall be assessed by the Concessionaire and documented in the Design Development and Detailed Design. The minimum period shall be one month unless demonstrated otherwise. 4

F. The tunnel shall be able to resist an incident causing accidental flooding. The foundation design shall ensure that the maximum allowable settlement of the tunnel, taking into account the maximum joint openings, the internal traffic

clearance profile and pavement requirements, is not exceeded. The period until dewatering is to be assessed by the Concessionaire and documented in the Design Development and Detailed Design. The minimum period shall be one month unless demonstrated otherwise. 4

G. Deleted 4

H. The Concessionaire shall consider the risk of explosion in the tunnel based on the types of goods that may be transported through it and shall design the tunnel for an appropriate intensity of explosion loading. This aspect of the design shall be documented in the Design Development and Detailed Design. The explosion load shall be considered as a static load acting over the full area of the internal cross section, and over an arbitrary length. The concrete structure and joint gaskets shall not be damaged as a result of this loading. 4

I. The Concessionaire shall take into account seismic loadings, or demonstrate that such loadings are not significant in the design. With reference to AASHTO LRFD, the importance category of the tunnel is defined as Critical. Watertightness shall not be compromised and repairs should be of a minor nature and not require long term closure of the tunnel to implement. The Concessionaire shall document the proposed design approach in the Design Development and Detailed Design. 4

1.15.4 Tunnel Protection Layer

A. The tunnel rock protection should be below the depth of the channel maintained by dredging, with allowance for dredging tolerance.

B. The stone protection and transition layers shall be designed by the Concessionaire to provide protection for propeller scour. The Concessionaire shall carry out any investigations required to determine the hydrographic design criteria. These criteria shall be reflected by the Concessionaire in the Design Development and Detailed Design. 4

C. The tunnel protection layer shall extend for the full width of the tunnel and backfill as necessary to meet the following requirements:

1. Protect the immersed tunnel and structural backfill from scour induced by ship's propellers;

2. Be designed to protect the immersed tunnel from damage caused by falling anchors, sunken or grounding ships and maintenance dredgers; and

3. Be detailed to ensure that dragging anchors break free from the layer before reaching the tunnel.

D. The Concessionaire shall maintain the required depth of tunnel protection throughout the Term. The Concessionaire shall survey the tunnel protection layer periodically as defined below and provide documentary evidence to VDOT that the depth of protection is in place.

E. The Concessionaire shall produce a maintenance strategy with reference to *Coastal Engineering Manual (CEM) EM 1110-2-1100*, USACE (2003).

F. The Concessionaire shall propose the frequency of surveys, based on a developing knowledge of the dominant deterioration mechanism, and submit proposals to VDOT for review and comment. Surveys should be carried out following significant events such as ship grounding, or severe storm, or current events in excess of design current.

G. The Concessionaire shall produce As-Built records including the results of a bathymetric survey carried out immediately post construction in order establish a baseline for future surveys.

1.15.5 Trial Casting

A. Trial castings shall be carried out to represent the immersed tube tunnel and the cut & cover tunnel. The trial casting shall be undertaken using the actual construction methods and equipment i.e. batch plants, pumps etc. and performed by operators and staff who shall be involved in the permanent Work production. For the cut & cover tunnel trial casting the Concessionaire, at risk, can implement the trial casting at the proposed final location. If the trial casting is deemed acceptable, then it may be incorporated into the permanent works. If the trial casting is deemed unacceptable, then the casting will be removed at the Concessionaire's expense. 4

B. A trial casting of the tunnel section shall be conducted at least two months in advance of the actual tunnel production. It is recommended that a program for the trial casting (including the number of in-situ tests and the location of coring) shall be submitted to VDOT for review a minimum of 21 days before trial castings are performed. 4 4

C. The trial casting shall comprise typical structural parts of the tunnels and be sufficient to demonstrate the efficiency of the casting, cooling and curing methods. As a minimum, the trial casting shall comprise 50% of cross section including dividing wall; the length of the trial casting in the longitudinal direction is to be agreed with VDOT, but shall not exceed the designed length between the 2

construction joints, for the longest segment pour envisaged. All elements of the trial casting shall be full sized and not scaled such that they are representative of the intended permanent works structure.

D. The trial casting shall demonstrate that the performance requirements are fulfilled simultaneously, and should be sufficient to demonstrate and validate:

1. Measures to control early age cracking (concreting sequence, curing and cooling methodology); and

2. Concreting and grouting procedures at all joints (immersion, segment and construction).

E. The trial casting structure shall be equipped with instrumentation to monitor concrete temperature against time. The temperature monitoring system and/or alternative process shall be the same as the system used for tunnel production. Each trial casting shall be evaluated (i.e. back-analyzed) to demonstrate that the evolution of measured temperatures correlates with those predicted by analysis. A report shall be submitted to VDOT for review a minimum of 21 days before execution of the corresponding permanent structure. 4

F. Pre-testing of concrete 2

1. Deleted 2

2. The software used for temperature and stress analysis and the design of measures to prevent early age cracking must be appropriate and proven for this application, using a well-documented computer program based on the Finite Element Method. The software shall have suitable precision to model small time steps in the early stages of concrete maturity.

3. Temperature simulations shall be based on documented values for the adiabatic heat development for the actual concrete and documented values for the conductivity of formwork and insulating materials. Simulation of stresses shall be based on documented transient (time/age dependant) material properties of the material actually used.

4. Based on stress analysis the Concessionaire shall establish limiting temperature differences for each structural element to control the hardening process of the concreting works. Unless otherwise determined by the stress analysis, the following limits are recommended: 4

a. For structural elements which are restrained by neighboring elements, a maximum temperature difference between the mean

4

temperature of the newly cast element and the mean temperature of previously cast elements shall be defined. The difference shall not exceed 59°F;

b. For all structural elements, a maximum temperature difference between the mean temperature of the element and the temperature at the surface of the element shall be defined. The difference shall not exceed 59°F; 4

c. The maximum temperature of the concrete shall not exceed 149°F in the central part of the structural element.

G. Pre-testing of the injection of cast-in cooling pipes, if used, shall be performed for all types of pipes used. The length of the pipe shall, as a minimum, be of the same length as the maximum length used in production.

H. If the trial casting does not achieve the required quality, the Concessionaire shall submit details of their proposed changes to tunnel production. A further trial casting may be required to demonstrate that the revised procedures satisfy the requirements.

1.15.6 Stability

A. The Concessionaire shall establish criteria to ensure the stability of tunnel elements during floatation, transport and immersion. The principles and parameters, and standards adopted by the Concessionaire shall be documented in the Design Development and Detailed Design. 4

B. The calculation of stabilizing loads for the immersed tunnel and approach structures shall only take into account dead load, temporary ballast water (where used). In determining the mass of the tunnel element, only the following items shall be considered:

1. Structural concrete;

2. Structural steel;

3. Cast-in-place items and prestressing;

4. Ballast concrete;

5. Elevated walkways; and

6. Soil vertically above any 'toes' (projection of the base slab beyond the external walls) up to tunnel roof level.

C. Minimum and maximum densities for dead loads and hydrostatic loads for calculation of the overall stability shall be taken as 5% and 95% quartiles, respectively.

D. The self weight of structures shall be determined from the maximum density or the minimum density, whichever creates the most unfavorable effect for the construction elements under consideration.

E. The hydrostatic load shall be determined from the maximum density or the minimum density, whichever creates the most unfavorable effect for the construction elements under consideration. The effects of variations of salinity and turbidity shall be taken into account.

F. The concrete density used in the design shall be based on testing of trial mixes, and it shall be monitored by in-situ testing during construction in accordance with QA/QC procedures.

G. The weight of backfill and stone protection over the tunnel roof, and the effect of internal friction from trench backfill, shall not be taken into account. Partial factors of 1.0 shall be applied to the self weight of the structure and the uplift load of the water. For soil vertically above the toes, a partial factor of 0.9 shall be applied.

H. All other load effects which may increase the uplift during the temporary and permanent stages shall be taken into account by the Concessionaire.

I. For the temporary stage, with an immersed tunnel element resting on the bottom of the trench, the minimum factor of safety against uplift, defined as the ratio between the total factored stabilizing load and the total factored uplift load, shall be 1.025. Where ballast water is used to maintain negative buoyancy, a maximum water density of 62.4 lb/ft^3 shall be used. The Concessionaire shall submit details of the temporary stability at all stages of construction, which shall include equipment and sequence proposed for the ballast exchange, as part of the Preliminary and Detailed Design.

J. For the permanent stage, the minimum factor of safety against uplift for each immersed tunnel element shall be 1.06. In the case of an immersed tunnel constructed in segments, the factor of safety between two segment joints shall be at least 1.04.

K. After the immersed tunnel element has been placed on the bottom of the trench, horizontal stability in the temporary condition shall be ensured by appropriate sequencing of the placing of fill alongside the element.

L. The calculations for the cut and cover tunnels, service buildings and approach ramps shall consider a case with a high ground water level with a minimum factor of safety against uplift of 1.10, and a case with extreme high groundwater level with a minimum factor of safety against uplift of 1.03.

M. Resistance to uplift using restraint devices such as ground anchors, tension piles or the like that rely on friction shall include a factor of safety appropriate to the restraint system and ground conditions. The Concessionaire shall propose this factor of safety.

1.15.7 Tunnel Foundation

A. The design of the tunnel and the approach ramp structures shall take into account the settlement (both total and differential) of each individual element of the structures, and the interaction between the elements. The effects of settlement are to be quantified at the Design Development and Detailed Design stage and mitigated where necessary to ensure the satisfactory performance of the tunnel in relation to the following: 4

1. Traffic clearance envelope;

2. Pavement performance;

3. Design of joint seals;

4. Design of structural connections at joints; and

5. Design of drainage and ducting.

B. The Concessionaire shall submit a Method Statement for information to support the design, and to document the procedures, plant and equipment to be used to install the tunnel foundation.

C. The tunnel and ramp structures shall be founded on suitable material. Unsuitable material below the base of the trench should be removed and backfilled or improved as necessary. The possibility that over-dredging may be required should be considered when selecting the dredging equipment.

D. The Concessionaire shall undertake any ground improvement necessary to achieve the performance criteria. The effectiveness of any proposed ground

treatment shall be verified by a suitable program of verification testing. Any assumptions with regard to the performance of the ground improvement and how these assumptions are to be verified shall be documented with the Design Development and Detailed Design. The methods used for the testing shall be in accordance with standards and requirements to be proposed by the Concessionaire.

E. The tunnel shall be analyzed based on the expected foundation conditions. The design shall consider potential variations in the thickness of the foundation taking into account likely dredging tolerances, and where applicable, tolerances on the surface profile prior to immersion (uneven or lack of support). The assumptions adopted in the design shall be documented in Preliminary and Detailed Design. 2

F. The Concessionaire shall consider the risk of the loss of foundation material into the substrate, and if significant, measures shall be taken to prevent the loss.

G. If sand jetting or sand flow techniques are used for the foundation of the immersed tunnel, the analysis shall include for the transfer from temporary supports to in service supports.

H. The Concessionaire's design shall take into account the effects of settlement or heave. Measures shall be taken by the Concessionaire to ensure that ground movement is prevented or is substantially complete before the issuance of Substantial Completion or Final Acceptance.

I. Where new construction imposes loads or stress changes on any existing buildings, embankments, pavements, structures, utilities or the ground supporting such elements, appropriate measures shall be taken by the Concessionaire to prevent differential settlement or damage.

J. Pavement sections shall be developed in accordance with VDOT's *Manual of Instructions for Materials Division* (Chapter IV of Pavement Evaluation and Design) and shall meet the requirements as set forth in the Standard Documents in Section 3.5.2

K. The Concessionaire shall document expected ground movements and movements of all tunnel structures in reports submitted to VDOT as part of the Preliminary and Detailed Designs. This shall include movements that are expected to occur during construction, residual movements post construction and total movements. The analysis used to derive the estimates shall be consistent with the actual construction schedule (timing and sequence of work), and the material and methods to be used.

L. In the calculation of settlement, the Concessionaire shall take into account the interaction between the soil and structures, and shall include any proposed ground improvement.

M. Movements of the tunnel shall not compromise pavement requirements stated in Section 1.15.7.J. If estimated movements calculated at the design stage are likely to exceed limiting criteria for pavement performance during the design life, the Concessionaire shall undertake the following: 4

1. Design ground improvement to the tunnel foundation to limit movements;

2. Document that sufficient tolerance exists within the tunnel clearance envelop to allow the roadway alignment to be adjusted by pavement overlay to accommodate estimated total and differential movements; or

3. Submit proposals to VDOT as part of the Design Development and Detailed Design. 4

N. Settlement of the new and existing tunnels, and approach structures shall be monitored and reported throughout construction.

O. The procedures and provisions for monitoring the interval between surveys shall be documented in the Detailed Design. Survey shall commence no later than one month before the start of construction of the approach structures, or the immersion of the first tunnel element, whichever is earlier.

P. Monitoring of settlements should continue post construction until 90% of the total settlement has occurred. The estimate of total settlement should be based on extrapolation of measured data. The Concessionaire shall consult with VDOT for the discontinuance of monitoring.

1.15.8 Protection of Existing Tunnel

A. The objective of the design and construction of the New Midtown Tunnel with respect to the Existing Midtown Tunnel should be that the construction of the New Midtown Tunnel shall have minimal impact on the Existing Midtown Tunnel, to the extent that there will be:

1. Minimal disruption to normal operations of the Existing Midtown Tunnel;

2. Minimal increase in the level of ongoing maintenance of the Existing Midtown Tunnel;

3. Minimal repair required to any component of the Existing Midtown Tunnel structure, internal fittings and fixtures or Mechanical and Electrical (M&E) systems; and

4. Minimal new leakage in the Existing Midtown Tunnel or any adverse change to the conditions of existing leakage or seepage in the Existing Midtown Tunnel.

B. Movement criteria will be identified in the Concessionaire's Phase 2 Work Package ID D01040303 Preliminary Instrumentation and Monitoring Plans & Recommendations (Proposed Tunnel). For events, behavior or movements not covered by the agreed movement criteria, VDOT and the Concessionaire shall also mutually agree to appropriate performance criteria.

C. Condition Inspection

1. Prior to construction the Concessionaire shall undertake a baseline structural condition inspection of the Existing Midtown Tunnel to record defects. The inspection shall be carried out in accordance with FHWA *Highway and Rail Transit Tunnel Inspection Manual*. Inspection of the structure shall be carried out by experienced qualified engineers who are able to identify signs of distress within the structure.

D. Baseline Survey

1. A seasonal survey shall be conducted by the Concessionaire in advance of construction operations to monitor movement of the major structural elements of the Existing Midtown Tunnel in the summer and winter to establish a baseline range of movement of the major structural elements. The scope of the seasonal survey should be sufficient to identify minor changes or movements in the major features and/or critical structural elements of the Existing Midtown Tunnel.

2. Survey points established for the baseline survey should be suitable to be used for subsequent surveys required during construction.

E. Design

1. The Concessionaire's design shall demonstrate that ground movements associated with the construction works will have minimal impact on the existing tunnel, as required above. The design shall include analysis using advanced ground modeling techniques using finite element methods and shall take account of each stage of construction. It shall also account for the durations when ground support may be reduced due to dredging works

and any time dependent behavior of soils (i.e. ground movements in response to changing loading patterns and intensities through the construction of the Project and in-service). A number of representative sections through the New Midtown Tunnel and Existing Midtown Tunnel shall be examined to understand the behavior along the length of the tunnel and establish the critical areas of the Work. Analysis shall include both the immersed tunnel section and the approach tunnels and ramps. Protective works, if required to control ground movements, shall be included in the modeling.

2. Should the outcome of the design analysis show that the Existing Midtown Tunnel is subject to increased stress or strain as a result of the Work, the existing structure shall be subject to a structural analysis of sufficient detail to determine if the new loading or ground movements cause overstress to any structural element, and whether the new loads are acceptable or whether preventative measures are required.

3. Assumptions on material properties, geometry, and loss of materials as a result of corrosion or deterioration in strength due to condition or defects shall be fully documented as part of the structural analysis. Where practicable the Concessionaire shall undertake sampling and testing to obtain missing data required for the analysis. Where it is not practicable to obtain missing data, assumptions shall be documented. 2

F. Monitoring of the Existing Midtown Tunnel

1. The Concessionaire shall install a suite of monitoring instrumentation in the Existing Midtown Tunnel to capture the following information:

   a. Vertical settlement along the length of the tunnel at regular intervals and tunnel element by tunnel element;

   b. Horizontal movement at any point along the tunnel;

   c. Rotation of the tunnel structure evidenced by settlement to one side of the structure relative to the other; and

   d. Distortions at the immersion joint positions such as opening and closing or rotation evidenced by differential opening or closing at the top or bottom of the structure.

2. Suitable survey equipment shall be installed on or near the temporary Support of Excavation (SOE) system to monitor ground movements in the

zone between the Existing Midtown Tunnel and the dredging works to identify lateral ground movement, settlement or slope instability.

3. Survey of the existing tunnel shall be carried out in real-time during critical construction operations, and in particular, during the bulk dredging works. Remote sensor equipment shall be installed as necessary for this purpose.

4. The Concessionaire shall establish trigger levels from their design analysis works related to the expected ground movements, such that any exceeding of the predicted movements can be immediately notified by the survey team to the nominated persons in the construction team with responsibility for implementing action response plans.

5. Action response plans shall be agreed ahead of the start of construction works and have acceptance from VDOT and any affected third parties or authorities, such as the Coast Guard, who may have to be notified or assist with any emergency response action being undertaken.

6. Personnel with the appropriate qualifications and authority to implement response plans shall be on 24 hour call during critical construction operations.

7. Survey results shall be made available without encumbrance or delay to VDOT's supervision team. The results shall be subject to daily review of the Concessionaire and the construction supervisor during critical phases of the works.

1.15.9 Joint Design

A. All joints shall be designed to be watertight without the need for replacement and maintenance during the design life.

B. All joint materials and components shall be protected against the detrimental effects of spilled liquids and against a fire in the tunnel.

C. The details developed for the immersion joints and the movement joints shall be able to accommodate the assumptions made in design concerning the transfer horizontal and vertical shear forces, prevent lateral and vertical differential movements, and shall have the ability to accommodate whatever assumptions have been made regarding temperature, drying shrinkage, settlement, creep, and any other movements which may occur for all relevant limit states to be defined by the Concessionaire. 3

D. Immersion joints shall have a double barrier against leakage, obtained by the application of a Gina-type gasket and an Omega-type seal. Manufacturers' literature in support of the Concessionaire's proposals shall be submitted to VDOT with the Design Development and Detailed Design. 4

E. The design of the Gina-type gasket and Omega-type seal shall take into account the long term relaxation of the Gina-type gasket material and the construction tolerances of the supporting steel frames, along with the proposed method of tunnel installation and related tolerances.

F. The compression of the Gina-type gasket shall always be larger than the minimum compression necessary to provide the required sealing pressure as derived from test results with the actual gasket type and maximum water pressure.

G. The compression of the Gina-type gasket shall always be 0.4 inch less than the maximum compression capacity and 0.4 inch more than the minimum compression necessary to provide the required sealing pressure.

H. The Omega-type seal and its fixing shall be watertight under the maximum sea level conditions with an overall safety factor of 2.5. Following installation, and before completion of the immersion joint, the Omega-type seal shall be pressure tested for leakage to the maximum design water pressure anticipated.

I. Movement joints for water retaining structures shall have a double barrier against leakage. 3

J. Construction joints for water retaining structures shall have a double barrier against leakage. 3

K. The systems for achieving watertightness at movement and construction joints must have proven successful applications under similar conditions. Alternative systems to those described herein above may be proposed, but will be subject to VDOT review and comment. The Concessionaire shall document proposals for achieving watertightness as part of the Design Development and Detailed Design. 3 4

L. All components requiring maintenance shall be easily accessible for monitoring, inspection, maintenance and replacement. Provisions shall be made for testing and inspection of the watertightness of the immersion joints. The maintenance concept shall be documented as part of the Design Development and Detailed Design. 4

1.15.10 Durability

A. The durability of all materials shall be appropriate to their actual use in the construction and in the actual environment to which they are exposed. The Concessionaire shall carry out the necessary subsurface investigations and testing (in situ and laboratory) to confirm this environment.

B. The design life shall be to code except where a target life for durability or performance has been chosen, in which case the design life shall be taken as 120 years. The Concessionaire shall document how durability will be achieved in the Design Development and Detailed Design. 4

C. The Concessionaire shall document the loadings, load combinations and load factors to be used in the design, which shall be submitted as part of the Design Development and Detailed Design. In the absence of sufficient and reliable statistical data in relation to environmental effects (e.g. water density, water level variation), the assumptions adopted by the Concessionaire must be clearly conservative. 4

D. Concrete

1. The design of the concrete mixes for all buried structures shall take into account the chemical composition of the soil and groundwater.

2. The application of a waterproofing membrane, the impregnation or coating of concrete surfaces, the addition of corrosion inhibitors etc. shall not be taken as justification for a relaxation of the primary requirements for durability (cover, maximum chloride diffusivity).

3. The maximum water/binder ratio shall not exceed 0.42. The minimum water/binder ratio should be selected to limit the adverse effects of autogeneous shrinkage on early age cracking.

4. The chloride diffusivity of the concrete at a concrete age of 28 maturity days shall not exceed 1000 Coulombs. The diffusivity shall be determined by Virginia Test Method 112 and ASTM C 1202. In case of Pulverized Fly Ash (PFA) contents exceeding 20% by weight, the given requirement with regard to the diffusion coefficient shall be related to testing at 56 maturity days. With ground granulated blast furnace slag (GGBS) as cement replacement, testing at 56 maturity days may be performed in case that compliance with the required chloride diffusivity cannot be demonstrated at 28 maturity days. 2 2 1

E. Prestressed Concrete

1. Structures with permanent prestressing shall be based on no tensile stress in the concrete in any Serviceability Limit State combination.

2. In the case of segmental construction, temporary longitudinal prestressing of the tunnel elements shall ensure a minimum compressive stress of 44 pounds per square inch (psi) in the joints between segments.

F. Reinforcement

1. Reinforcement may be ordinary carbon steel, galvanized, epoxy coated or stainless steel.

G. Steelwork

1. All parts of partially embedded fixings for temporary works and fixings for mechanical and electrical installations which are left in the concrete shall be stainless steel, galvanized, epoxy coated or other means to inhibit corrosion. Provision shall be made to prevent electrolytic corrosion of dissimilar metals.

2. Steel end frames at immersion joints including metal attachments should be capable of maintaining structural integrity and watertightness for 120 years.

1.15.11 Watertightness

A. The tunnel and approach structures including service buildings below groundwater level shall be watertight. The following watertightness criteria shall be achieved:

Case	Category	Description
In-situ and prefabricated concrete structures including immersed tube tunnel	A	Free of all visible leakage or seepage [2)]
Diaphragm walls [1)] Secant piles [1)]	B	Leakage shall be restricted to damp patches on the concrete face and at construction joints. Jetting of water will not be acceptable. Prior to construction of an inner lining, total inflow over a given area

		of structure shall not exceed 0.38 fl oz/ft^2 per day overall and 0.75 fl oz/day on any individual square foot.

[1)] Where diaphragms walls/secant piles are used, an additional inner concrete lining shall be constructed to achieve the required watertightness Category A inside the tunnel and to provide appropriate drainage paths.
[2)] For purposes of determining whether the Concessionaire has achieved Final Acceptance of the New Midtown Tunnel, if the New Midtown Tunnel experiences visible water leakage and/or water seepage, the requirements set forth in FHWA Technical Manual for Design and Construction of Road Tunnels – Civil Elements, June 2010 shall apply.

B. Tunnel elements may be one of the two following forms:

1. Segmental – tunnel elements are formed by a series of match-cast concrete segments with segment joints in between which allow expansion, contraction and full articulation. Reinforcement is discontinuous across segment joints. Concrete shall be watertight and segment joints shall contain double protection against leakage. Segments should be temporarily prestressed together for the floatation, transportation and immersion processes.

2. Monolithic – tunnel elements are formed from continuous concrete cast in sections but with construction joints with full continuity of reinforcement such that each element acts as a single structure with no articulation along its length. Concrete shall be watertight but may also be protected by the application of an external watertight membrane.

C. For the water-retaining parts of the tunnel and approach ramps early age cracking resulting in through-section cracks shall not be allowed. Such cracks may be caused by restraint to deformations due to combination of thermal movements, early shrinkage, creep and settlements.

D. The provision of a waterproofing membrane will not be considered as mitigation for the presence of through-section cracks in the tunnel concrete. If a membrane is proposed, the system applied to the walls and roof should be spray applied, with a suitable lap joint with the system used to protect the base. The Concessionaire shall document its suitability and long term performance by proven successful applications under similar conditions in the Design Development and Detailed Design. The successful application shall be evidenced by records from practical applications or test results. 4

E. The Concessionaire shall, through temperature and stress analysis, document that the planned risk of early-age cracking at the water-retaining parts of the tunnel and approach ramps shall be acceptable for the full range of ambient climatic and weather conditions that may occur during hardening. Details of the Concessionaire's proposals in respect of watertight construction shall be well documented and submitted for VDOT review and comment at least 21 days before the trial casting. 4

F. All leaking cracks occurring in internal surfaces of the tunnels and approach ramps shall be sealed by the Concessionaire.

G. Shutter ties through the external walls should be avoided. If the Concessionaire proposes to use shutter ties that will penetrate external walls of watertight structures, the method and materials for reinstatement should be documented in the Design Development and Detailed Design, and the efficacy of the proposals demonstrated as part of the full scale trial cast. VDOT shall not be obligated to accept the principle of shutter ties. 4

1.15.12 Fire Protection

A. The fire temperature versus time curves to be applied in the structural design, including joints, shall be selected in accordance with National Fire Protection Association (NFPA) 502.

B. The design shall ensure that the structural capacity not be exceeded during or after a fire. In addition, watertightness shall be maintained, no permanent deformations shall occur, and any damage shall be repairable. Special attention shall be paid to the possibility that the strength of concrete may be lower after cooling than during the fire.

C. Tunnel fire protection shall comply with the requirements of the NFPA 502 *Standard for Road Tunnels, Bridges and Other Limited Access Highways*.

D. Calculations of temperature distribution on the internal surfaces of the walls and slabs during a fire shall be determined by model calculations, and the results shall be summarized in a report which shall be submitted with the Design Development and Detailed Design. 4

E. Fire protection material and fastenings shall be designed to withstand a uniformly distributed suction pressure of at least 63 lbs/ft² under unheated conditions. The design shall ensure that the fire protection will stay in place during a fire.

1.15.13 Drainage

A. The minimum road gradient, to ensure adequate drainage, shall be 0.5%.

B. Drainage sumps and pumping stations shall be sited at the lowest point of the tunnel sag curve (low point sump) and near the tunnel portals (ramp sumps).

C. Underground drainage systems shall be watertight within the specified design life, taking into account the construction methods to be used and relative movements across joints.

D. Except for the mid-point drainage sumps, manholes and inspection chamber access covers related to the drainage system shall be located away from the roadway. Mid-point sumps access covers shall be securely locked and located out of the wheel track zones.

E. The contents of the low point sump shall be discharged into an impounding sump at the portal, which shall meet Virginia's water quality requirements prior to disposal off site.

F. The tunnel openings and generating systems shall be designed to provide protection against a 500 year storm event including storm surge and wind driven surge in accordance with the Standard Documents in the Basis of Design and Design Criteria. 2

1.15.14 Marine Fill

A. The Concessionaire's design of the marine works and evaluations of the hydrographic conditions shall be carried out by suitably experienced specialists. The design shall be submitted to VDOT as part of the Design Development and Detailed Design.

B. The river bed level and profile after backfilling of the tunnel will be in accordance to the Project environmental permit requirements.

C. The Concessionaire shall carryout pre- and post-construction bathymetric and topographical surveys of the area affected by the Work. The zone within the river shall be resurveyed one year after completion of the Work.

D. Locking fill and structural backfill, defined as fill placed immediately adjacent to the tunnel structure and beneath the protection and filter layers, shall be placed on either side of the immersed tunnel. The locking fill and structural backfill shall be free draining granular material, with the specification and dimensions of it being determined by the Concessionaire. The structural backfill shall be protected by a transition layer placed between the back fill and the tunnel protection layer, if

required. Ordinary backfill outside of the zones described need not be free draining.

1.15.15 Design Review and Comment

A. The Design Review Process shall be as described in the Agreement.

B. Deleted

C. Deleted

D. Detailed Design should include sufficient information for VDOT to determine whether the Project requirements have been satisfied, and should include a comprehensive set of drawings to illustrate the design. The scope and coverage of the submission(s) should be agreed with VDOT in advance. The Detailed Design submission should include, but is not limited to the following reports:

1. Deleted

2. Deleted

3. Ground Movement Report (including impact on existing tunnel);

4. Deleted

5. Durability Assessment (including watertightness) Report;

6. Concrete Mix Design Report;

7. Early Age Crack Control Report;

8. Deleted

9. Deleted

10. Deleted

11. Deleted

12. Deleted

13. Outline Maintenance Strategy Report (including WLC, residual life, asset management);

14. Deleted

15. Security Plan;

16. Operations Plan (including details of Operations Buildings); and

17. Safety Response and Emergency Response Plans.

E. In relation to the submission of geotechnical design and construction memoranda and/or reports that summarize pertinent subsurface investigations, test, and geotechnical engineering evaluations and analysis, the requirements as set forth in Section 1.4.1 shall apply.

F. Deleted 4

G. The Concessionaire shall submit a Detailed Design to VDOT for verification that the design is in conformance with the Technical Requirements. Staged submissions can be made, but submissions must contain sufficient information for the proposals to be considered. The Detailed Design should be submitted and reviewed in advance of commencement of construction of any part of the Work described in the submission. 1

H. Deleted

1.15.16 Design Reference Documents 4

A. The following design references shall be used: 4

1. *Technical Manual for the Design and Construction of Road Tunnels – Civil Elements* (Publication No. FHWA-NHI-09-010, June 2010 Version). 4

2. For the design of tunnel rock protection, actions from ship propellers shall be calculated using *The Rock Manual* (Document GC683, second edition), CIRIA London and *Propeller Induced Scour* (Doc. RR2250) by M.J.Prosser published by the BHR Group (The Fluid Engineering Centre, United Kingdom, Tel 44 (0)1234 750 422), or alternative standard(s) agreeable to VDOT.

3. For the design of tunnel rock protection, the rock size shall be selected using USACE Hydraulic Design Criteria Sheet 712-1 *Stone Stability* or alternative standard(s) agreeable to VDOT.

4. The penetration of a falling anchor in concrete or rock layer shall be estimated using *Concrete Structures Under Impact and Impulsive*

Loading, *Synthesis Report*, Bulletin d'Information No. 187, Comité Euro-International du Beton (CEB), 1988, or alternative standard(s) agreeable to VDOT.

1.15.17 Methods Statements

A. The Concessionaire shall produce Method Statements to support the tunnel design. The Method Statements shall be submitted to VDOT, for information, during the Detailed Design, and as part of the pre-construction planning process. Method Statements addressing the following aspects of construction are required as a minimum:

1. Concrete works;
2. Concrete placement and curing (separate MS for immersed tunnel structure, cut and cover structure, ramp structure);
3. Temporary prestressing;
4. Crack injection;
5. Marine works;
6. Dredging;
7. Maintenance dredging of tunnel trench;
8. Placing of tunnel foundation;
9. Float up and transportation of tunnel elements;
10. Immersion of tunnel elements;
11. Sourcing, suitability and placing of tunnel backfills and protection;
12. Ballast exchange; and
13. Formation of the closure joint.

1.15.18 Provisions for Maintenance and Access

All components requiring maintenance shall be easily accessible for monitoring, inspection, maintenance and replacement. Provisions shall be made for testing and inspection of the water tightness of the immersion joints. If ordinary carbon steel is

used for reinforcement, readily accessible provisions for monitoring the condition of the structure shall be provided. The method of collecting, logging and processing data shall be reviewed by VDOT.

1.15.19 Existing Midtown Tunnel and Existing Downtown Tunnels Refurbishments

A. Technical Requirements for the Existing Midtown Tunnel and Existing Downtown Tunnels will be developed by the Concessionaire based on the assessment conditions reports that will be produced by the Concessionaire following detailed surveys of the Existing Midtown Tunnel and Existing Downtown Tunnels.

B. The Concessionaire shall apply the requirements of the FHWA Tunnel Management System after the rehabilitation of the Existing Midtown Tunnel and Existing Downtown Tunnels.

C. The Concessionaire shall prepare a set of Technical Requirements for the Existing Midtown Tunnel and Existing Downtown Tunnels that take into account the existing condition of the Existing Midtown Tunnel and Existing Downtown Tunnels and the necessary Rehabilitation Work that may be required to enable efficient operation of the Existing Midtown Tunnel and Existing Downtown Tunnels throughout the Term and to meet the handback requirements at the end of the Term.

D. The requirements shall recognize VDOT's objective to upgrade all tunnels to be in compliance with NFPA 502. If there are any aspects of the Existing Midtown Tunnel or Existing Downtown Tunnels that cannot be upgraded to these standards due to physical constraints of the tunnels the Concessionaire shall clearly document these areas and agree on the appropriate Technical Requirements with VDOT. Design exceptions shall be identified in accordance with VDOT procedures to seek VDOT review and comment. 4

E. The Technical Requirements shall be based on the inspections and surveys undertaken and recorded by VDOT, and on further inspections, surveys and tests to be undertaken by the Concessionaire. The Concessionaire shall undertake sufficient survey, testing and inspection to enable a comprehensive set of Technical Requirements documents to be prepared.

F. The Technical Requirements shall include:

1. Design requirements for design of finishings to be installed and for the Rehabilitation Work to be undertaken.

2. Program of further survey and testing to be undertaken to verify the current condition and enable planning or remedial works and ongoing maintenance.

3. QA/QC requirements for inspection and testing during construction.

4. Classification of defects such that action can be determined and records maintained throughout the Term.

5. Preparation of traffic management plans at local and District level during the refurbishment works for review by VDOT.

6. Proposed standards for the Rehabilitation Work.

7. Documentation for operation and maintenance.

G. The Concessionaire shall endeavor to achieve consistency in approach to design and construction and consistency in the quality of the works between the new Midtown Tunnel and the Existing Midtown Tunnel and Existing Downtown Tunnels. 2

1.16 Tunnel Performance Requirements – M&E

1.16.1 General 1

A. The purpose of this section is to provide an outline of the mechanical and electrical requirements that VDOT should ensure are included in the technical provisions that are being prepared by the Concessionaire for the New Midtown Tunnel between Portsmouth and Norfolk.

B. General criteria relating to the design principles, methodology and review process are described.

C. The systems proposed for inclusion in the New Midtown Tunnel are:

1. Tunnel ventilation;

2. Tunnel lighting (normal and emergency);

3. Tunnel drainage (at portals and low point);

4. Firefighting equipment (fire detection, fire hydrants, fire suppression);

5. Tunnel panels (including fire extinguishers, telephones, alarms);

6. Emergency signage (emergency exit signs, variable message signs);

7. Traffic monitoring and control systems (closed-circuit television (CCTV), lane control, over height vehicle protection); 2 4

8. Communications systems (fixed and mobile telephones, radio); 3

9. Supervisory Control and Data Acquisition (SCADA) system for M&E plant monitoring and control system;

10. Electrical power supplies and distribution (alternative supplies from Portsmouth and Norfolk networks); and

11. Standby power supplies (generators and uninterruptible power source (UPS)).

D. These minimum standards for the Tunnel Mechanical and Electrical Works are established for public safety and to ensure the Work meet VDOT's requirements when the tunnel is handed back to VDOT at the end of the Term. These requirements do not relieve the Concessionaire, its designers, contractors, agents and the like from any legal, quality or other obligations relating to the design, construction and operation of the Project.

E. Review and Comments Process

1. Design Development Review (60%) 2

a. The M&E Systems submission shall include sufficient additional detail of the ventilation, fire suppression and drainage systems to enable the principal dimensions of the tunnel structure to be fixed.

b. Documentation submitted as part of this Design Development and Detailed Design Submission shall include at a minimum: 4

i. An outline description of all M&E systems, with sufficient drawings to illustrate the proposed locations and arrangement of equipment. 2

ii. Basis of design, including input data, the Standard Documents and performance requirements.

iii. Details of any new options considered, with benefits.

c. The Concessionaire shall submit the Design Development and Detailed Design Plan for VDOT review and comment, at a notional level of completion of 60% (the precise % completion may be proposed by the Concessionaire). The purpose of this submission is to provide initial detail of all systems to be installed in the tunnel and show the design is coordinated between systems and the civil engineering works. The submissions shall also demonstrate compliance with the Agreement and the requirements for fire life safety and of the First Responders, and that O&M requirements have been fully considered. 4

d. The reports, drawings and design packages to be submitted at this stage shall be agreed with VDOT to include, but not be limited to:

i. Sufficient information to demonstrate that the proposed ventilation, fire suppression and drainage plant will be capable of satisfying the agreed design criteria.

ii. Any design assumptions and agreed departures from these Design Requirements.

iii. Records of requirements agreed with third parties, including principles for evacuation and fire fighting.

iv. Operational Risk Assessment Report.

2. Detailed Design Review (90%) 2 2 1 4

a. Upon completion of detailed design, all relevant drawings and specifications, cable schedules together with all relevant supporting calculations, shall be during a 21 day VDOT review and comment return period for conformance to the Technical Requirements and the approved Design Quality Management Plan.

b. Design packages shall be submitted for review by VDOT under the following headings, or as agreed with by VDOT: 1

i. Tunnel Ventilation and Control System (including emergency egress/maintenance corridor ventilation, calculations and computational fluid dynamics (CFD) modeling);

ii. Tunnel Normal and Emergency Lighting and Control System (including calculations);

iii. Drainage Sumps Equipment (including pumping plant, ventilation, fire suppression, control systems and all relevant calculations);

iv. Tunnel Fire Safety Equipment (including fire detection, fire suppression, fire pumps, standpipe system and hydrants, fire cabinets, portal fire panels and all relevant calculations);

v. Emergency Escape Doors and Emergency Exit Signs;

vi. CCTV System;

vii. A Traffic Control System (including lane control signals, tunnel closure equipment, information signs, changeable message signs, over height vehicle protection and all associated control equipment); 4

viii. Communications Systems (including fixed and mobile telephones, radio and voice alarm); 4

ix. SCADA System (including data network and all associated operator interfaces);

x. High Voltage (HV) Power Systems (including incoming supplies, HV switchgear, transformers, cables and grounding);

xi. Low Voltage (LV) Distribution System (including switchgear, cabling and raceways, lightning protection and grounding);

xii. Standby Power (including standby generators, fuel storage, and cooling and exhaust systems, UPS and batteries); and

xiii. Plant and Equipment Rooms (including lighting, heating, ventilation, cooling, small power outlets, security systems, fire alarms and fixed fire extinguisher systems).

3. Refer to Section 1.16.16 of these Requirements. The methodologies for tests listed in Section 1.16.16.B.1 and 1.16.16.B.2 shall be submitted for review and comment by VDOT at least 21 days in advance of the planned dates for the tests. Full test reports in accordance with Section 1.16.16.B.3 shall be submitted for VDOT review and comment within two weeks of completion of the respective tests. 4

F. Consultations

1. The consultation process outlined in this section shall continue throughout the design period to ensure that all affected parties are made fully aware of the development of the design of the tunnel and its facilities and that their comments and requirements are taken into consideration in the equipping and operating of the tunnel. The primary focus of the consultations shall be on operational and safety issues as listed below:

    a. All meetings shall be convened and recorded by the Concessionaire. Prior to commitment to detailed design of the principal safety related systems, the Concessionaire shall prepare a Summary Report confirming the agreement in the meetings of all Fire Life Safety Committee (FLSC) participants to the design of the tunnel and its systems and the proposed means of operation and emergency response.

    b. Meetings shall be held with the City of Portsmouth and City of Norfolk Fire and Rescue Services to discuss: 2

        i. Proposed tunnel design and facilities for dealing with fires, spillages and road traffic accidents.

        ii. Fire Department procedures, roles and responsibilities.

        iii. Radio communications requirements (STARS).

        iv. Training requirements.

    c. Meetings shall be held with the Virginia State Police to discuss: 2

        i. Proposed tunnel design and facilities for traffic management, closures, diversions and road traffic accidents.

        ii. OCC facilities to be provided.

        iii. Police emergency response, roles and responsibilities.

        iv. Radio communications requirements (STARS).

        v. Training requirements.

    d. Combined First Responders Workshop to discuss:

i. Co-ordination of emergency response plans, roles and responsibilities.

ii. Co-ordination of radio communications requirements (including STARS).

iii. Requirements for rendezvous and triage areas.

iv. Risk Assessment Report.

v. Proposals for emergency exercises.

G. Design Principles

1. The M&E Design shall be governed by the following principles:

a. Because of the risk of flooding from high-water events, critical power supply and control equipment shall be located above the established Project flood elevation.

b. In accordance with VDOT Rules and Regulations Governing the Transmission of Hazardous Materials through Bridge-Tunnel Facilities, trucks carrying Hazardous Substances in Categories 1.1, 1.2 and 1.3 (explosives), 2.3 (poison gas), 4.3 (dangerous when wet) and 6.1 (PGI inhalation hazard) will be excluded from the tunnel. Materials in categories 2.1 (flammable gas), 3 (flammable), 5.1 (Oxidizer), 5.2 (organic peroxide) and 8 (corrosive) may not be carried in bulk.

c. Bicycles, pedestrians and animals will not be allowed in the tunnel.

H. Reliability and Availability

1. All items of electrical and mechanical plant shall be designed to perform reliably in the intended application. All systems and equipment proposed for use shall have a proven track record of reliable service in a similar application and should be designed to meet performance levels in Section 4.1.1. 2

I. Reference Documents 4

1. The whole of the M&E works shall be designed to comply with the requirements and recommendations of the following standards, regulations and specifications, as relevant:

a. NFPA 70 – *National Electric Code*, 2008;

b. NFPA 101 – *Life Safety Code*, 2009;

c. NFPA 502 – *Standard for Road Tunnels, Bridges and Other Limited Access Highways*, 2011;

d. Institute of Electrical and Electronics Engineers (IEEE) *National Electrical Safety Code* (NESC), 2008;

e. FHWA *Technical Manual for Design and Construction of Road Tunnels*, June 2010;

f. FHWA *Highway and Rail Transit Tunnel Inspection Manual*, 2005 Edition;

g. FHWA *Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual*, 2005 Edition; and

h. American National Standards Institute (ANSI)/American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)/Illuminating Engineering Society of North America (IESNA) 90.1-2007 *Energy Standard for Buildings*.

i. ANSI/IESNA RP-22-05 *American National Standard Practice for Tunnel Lighting*. 2

J. Protection Against Environmental Conditions

1. All parts of the tunnel electrical and mechanical installations, including fasteners and support systems, shall be suitable for use under all reasonably foreseeable conditions in the environment in which they are installed.

2. Conditions to be considered shall include, but shall not necessarily be limited to, the following, as appropriate:

a. Ambient temperature;

b. Humidity;

c. Immersion in water;

d. Accumulations of ice or snow;

e. Tunnel washing;

f. Vibration; and

g. Electromagnetic interference.

3. All parts of the tunnel electrical and mechanical installations, including fasteners and support systems, shall be adequately protected against corrosion before, during and after installation for the duration of their design life. Materials, paint systems and protective finishes shall be appropriate to the operating environment and shall be designed to inhibit the spread of corrosion should the protective layer be damaged. Suitable measures shall be taken to avoid direct contact between dissimilar metals exposed to the atmosphere.

4. Equipment installed within the tunnel shall be designed to minimize the accumulation of dust and moisture on exposed surfaces, and, unless stated otherwise, shall have an ingress protection rating equivalent to IP65 as defined in ANSI/International Electrotechnical Commission (IEC) 60529. 2

5. All protective finishes shall be capable of repair on site to an equivalent level of durability and corrosion protection equivalent to the original finish, in accordance with the manufacturers' recommendations, following mechanical or other damage.

K. Compatibility

1. The M&E design shall take into account the need for coordination and compatibility between systems, so that no item of equipment will interfere with the correct operation of another.

2. The design shall consider the impact of reasonably foreseeable external influences, such as weather conditions, the passage of traffic and the use of portable and mobile radio equipment, and ensure that no such influences have an adverse effect on operation of the tunnel electrical and mechanical equipment.

L. Tunnel Supervision

1. The Concessionaire shall provide an OCC equipped to provide centralized control and monitoring of the Downtown/Midtown Tunnel systems. 4

2. In this context the term OCC means the control room and associated equipment rooms, which may be within the existing OCC building or in a new building. Consideration shall also be given to the co-location of the toll supervision facility with the OCC.

3. Systems supervised from the OCC shall include a traffic control system, the SCADA system for M&E plant monitoring and control, CCTV and communications.

4. Supervision of tunnel M&E systems shall be from a dedicated SCADA operator interface, emergency telephone console and CCTV monitoring position in the OCC.

1.16.2 Tunnel Ventilation

A. Design Reference Documents

1. In addition to complying with the Reference Documents listed in Section 1.16.1.I, the tunnel ventilation system shall be designed in accordance with Section 6.5 of the Midtown Tunnel (MTT) Design Criteria.

B. Design Criteria

1. General

a. The design of the ventilation system shall assume a maximum permitted traffic speed through the tunnel of 35 miles per hour (mph), the likelihood of congestion at peak periods, and an external wind pressure ranging between zero and 0.4 lb/ft^2 across the tunnel portals in either direction.

b. The tunnel will only be operated in bi-directional traffic mode under exceptional circumstances, for example when the Existing Midtown Tunnel is closed for maintenance. It is recognized that under such circumstances the ventilation system would not be effective in the case of a fire and it will be necessary to institute special operating measures to provide for the safe use of the tunnel.

c. Noise levels at any point in the tunnel, under normal operating conditions, measured at a height of 5 feet above the road surface, shall not exceed NR85, as defined in International Organization for Standardization (ISO) 1996-1:2003, when the ventilation system is running at full power in the absence of traffic. 4

d. The ventilation design shall minimize the risk of recirculation of smoke or exhaust fumes between the portals of the Existing Midtown Tunnel and New Midtown Tunnel.

e. The Design Development and Detailed Design Submission shall demonstrate that the proposed ventilation system will be capable of satisfying the following design criteria. 4

2. Control of Air Quality

a. The following air quality parameters shall be continuously monitored. The ventilation system shall be designed and automatically controlled to maintain air quality below the following thresholds under all reasonably foreseeable traffic conditions, including bi-directional traffic flow under emergency or maintenance operations:

i. Carbon monoxide (CO) see 1.17.4.B.2.b below

ii. Nitrogen dioxide (NO2) 4.0 parts per million (ppm)

iii. Obscuration:

a). Free-flowing traffic ≤ 0.002 per ft

b). Congested traffic ≤ 0.003 per ft

b. Provision shall be made for continuous monitoring of CO under stationary traffic conditions to ensure that the following exposure times are not exceeded:

i. 120 ppm for 15 minutes;

ii. 65 ppm for 30 minutes;

iii. 45 ppm for45 minutes; and

iv. 35 ppm for 60 minutes.

Fresh air requirements shall be calculated on the basis of predicted vehicle emissions for the year 2020, taking into consideration the likely spread of vehicle ages, standards of maintenance and traffic speeds.

3. Fire and Smoke Control

a. The ventilation system shall be designed to control heat and smoke from a fire following the NFPA Ultra-fast growth curve to a 100 megawatt (MW) peak heat release rate.

b. The effectiveness of the proposed design and compliance with the design requirements shall be demonstrated at an early stage in the design by computer modeling using suitable CFD software to identify any possible deficiencies.

c. The fans shall be designed to move air in the direction of traffic flow during normal operation of the tunnel. The fans shall be reversible and individually controlled to enable performance to be optimized during reverse traffic flow and emergency conditions.

d. The design shall be determined by the longitudinal air velocity required in the tunnel to control backlayering from the design fire at any point in the tunnel.

e. Design for compliance with NFPA 502 shall allow for the eventuality that all fans within a zone extending 300 ft downwind from the fire location will be rendered inoperative by a fire, that fans upwind of the fire are operating in relatively cool air and that all fans downwind will be operating in air at elevated temperatures.

f. Fans shall be located to generate adequate ventilation for the clearance of vehicle emissions across the whole of the tunnel cross-section with no pockets of still air, and to provide for ease of removal and re-installation.

g. The CFD model shall demonstrate that, for a design fire at any point in the tunnel, and subject to the stated traffic conditions, backlayering of smoke is controlled and a tenable region is established to allow evacuation up stream of the fire without the longitudinal airflow exceeding the limit permitted by NFPA 502 Section B.2.4. As a minimum, the CFD modeling shall simulate the system performance for the following fire scenarios: 3

i. Fire location 100 yd in from the entrance portal, unidirectional traffic, tunnel clear ahead of the fire.

ii. Fire location 100 yd before the exit portal, unidirectional traffic, tunnel filled with traffic behind the fire.

iii. Fire at the tunnel mid-point, unidirectional operation, one lane filled with traffic.

h. The calculation methods and formulae applied in the CFD model shall be checked and verified by an appropriately qualified independent checker.

4. Control

a. Air quality sensors strategically located in the tunnel shall alert the operator when air quality levels fall below the thresholds stated above.

b. The direction and velocity of air flow through the tunnel shall be monitored to enable the OCC Operator to check that the air flow is neither insufficient of excessive.

c. The OCC Operator shall have the means to override the control of individual ventilation fans at any time via the SCADA system.

d. Provision shall be made for the system to be controlled manually from a local control position, for use when the tunnel is closed to traffic for inspection, maintenance or repairs and automatic control of the ventilation is either not possible or insufficient to maintain the required levels of air quality.

e. The ventilation control system shall respond appropriately to the smoke control requirements for a fire at any given location, in accordance with a smoke control strategy to be reviewed by VDOT and the First Responders.

f. Since it is highly probable that the OCC Operator will become aware of the existence of a small fire, either by observation of an incident on CCTV or by emergency telephone, provision shall be made for the OCC Operator to call up and activate the appropriate ventilation plan by manually entering the location of a fire, or suspected fire, into the SCADA system.

g. All tunnel ventilation fan motors shall be continuously monitored for winding temperature and bearing vibration. If excessive temperature or vibration is detected, an alert shall be raised via the SCADA system. However, in neither case should the motor be

shut down automatically, since motors must be allowed run to destruction in the event of a serious fire.

5. Emergency Egress/Maintenance Corridor

a. The emergency egress/maintenance corridor shall be independently supplied with fresh air from outside the tunnel and pressurized to minimize the ingress of smoke when up to three emergency doors are opened while the tunnel ventilation system is operating in fire and smoke control mode.

b. At no time shall the air velocity at any point in the corridor exceed 36 ft/s.

1.16.3 Tunnel Lighting and Controls

A. Design Standards

1. In addition to complying with the Reference Documents listed in Section 1.16.1.I.1, the tunnel shall be lit in accordance with the recommendations of ANSI/IESNA RP-22-05 *American National Standard Practice for Tunnel Lighting*. 4

2. Emergency Lighting shall be provided in accordance with NFPA 502.

B. Design Criteria

1. The tunnel lighting design shall be based on the following criteria:

a. Design traffic speed shall be in accordance with the Design Criteria for the Midtown Tunnel. 2

b. Threshold zone luminance to be determined by the equivalent veiling luminance method as described in RP-22-05 Section 6.4.2 in the *American National Standard Practice for Tunnel Lighting*.

c. Light sources to be energy-efficient types.

d. Emergency lighting average illuminance 1 ft-candle (10 lux) on the road surface, max-min uniformity ratio ≤ 40:1 (as NFPA 502:2010, Section 12.6), minimum duration 1½ hours.

2. Particular attention shall be given to minimizing the impact on drivers' vision of low morning sun conditions in mid-summer and low evening sun in mid-winter.

C. Wiring and Connections

1. Half of the roadway luminaires shall be fed from the 'A' incoming supply and half from the 'B' supply, to ensure that if either the 'A' or the 'B' supply fails approximately 50% of the roadway lighting will be maintained throughout the whole length of the tunnel. 3

2. Luminaires designated for emergency lighting shall be fed via separate distribution boards from UPS to NFPA 70 Article 700 Class I Type 60.

3. All wiring emanating from the lighting distribution boards shall be in fire rated cable meeting the requirements of NFPA 70 Article 700 and NFPA 502 Section 11.3.2.1. Final connections to luminaires shall be via fire rated junction boxes with fused connections and non-fire-rated flexible cables to plug-and–socket connections on luminaires. (It is accepted that luminaires and small plugs and sockets cannot be fire rated and may be lost in a fire, but through wiring shall be protected to reduce the risk of loss of lighting beyond the fire-damaged area).

D. Control

1. The lighting control system shall incorporate the following features:

a. Fully automatic switching of daytime lighting in response to external luminance as measured by two luminance photometers at each end of the tunnel.

b. Fully automatic switching from daytime to night-time lighting, based on an internal solar clock, with cycling of lamps to equalize burning hours.

c. Automatic detection and isolation of failed photometers.

d. Alarming of control system faults (including loss of communication with luminaires) and failure of complete lighting power supply circuits.

e. Override to increase or decrease tunnel lighting from the lighting control panel.

f. Links to the SCADA system to permit remote indication of system status and alarms, and to increase and decrease lighting.

1.16.4 Tunnel Drainage Pumping Plant

A. Design Standards

1. Because of the possibility of a spillage of gasoline or similar flammable liquid finding its way into the road drainage system, all drainage sumps shall be classified and electrical equipment selected in accordance with the requirements of NFPA 70.

2. The drainage system shall be designed to meet the Virginia Pollutant Discharge Elimination System (VPDES) permit requirements including all maintenance, cleaning and spillage response activities.

B. Design Criteria 2

1. The tunnel drainage pumping plant shall be designed to operate safely and mitigate flooding of the tunnel in the following events:

   a. The peak design inflow from the associated drainage system(s).

   b. The maximum design delivery of water from the fire standpipe and/or fire suppression systems.

   c. Release of the whole contents of the largest capacity road tanker permitted to use the tunnel.

   d. Continuous seepage ingress of groundwater.

2. The Concessionaire shall also consider the need to evacuate water from the tunnel approaches in the event that the tunnel flood gates on the Norfolk side are closed and the tunnel approach has been flooded by a storm event. 4

3. Pumps, pipework and valves shall be suitable for use, without damage, with all substances that may reasonably be expected to find their way into the drainage system from time to time, such as saline water, tunnel cleaning agents and small quantities of oil and gasoline.

4. All equipment located in the drainage sumps shall be designed and located for easy and safe access for cleaning, inspection, maintenance and replacement.

5. A means of interception and safe containment of polluted or harmful liquids (from tunnel washing, fire fighting or spillages) shall be provided separate from the normal discharge route.

6. All sumps directly connected to the tunnel drainage system shall be designated as Class I Division 2 hazardous areas and electrical equipment installed or specified for use within them selected accordingly. Sumps shall normally be continuously ventilated to prevent an accumulation of potentially harmful fumes.

7. The drainage system shall be designed to comply with NFPA 502 paragraph 7.12.2.

8. The switchgear and control gear associated with the pumping plant shall be located at as high a level as is reasonably practicable so that, if the tunnel should flood as a result of the above design conditions for the drainage system being exceeded, the opportunity will exist to operate the pumping plant under manual control for as long as possible.

C. Control

1. Pumps shall normally operate under fully automatic control, including duty/standby changeover and duty cycling.

2. Provision shall be made for the OCC Operator to start and stop all pumps via the SCADA system.

1.16.5 Tunnel Fire Safety Equipment

A. Tunnel Fire Suppression System

1. General

a. A fixed fire suppression system as described below shall be provided.

b. The system performance shall be validated either by data from a comparable existing system, or by full-scale tests on a mock-up of the proposed installation. See also Section 1.16.16.B.1. 2

2. Design Criteria

a. The fire suppression system shall be water or foam deluge, water mist or hybrid water mist/deluge type, and designed to operate in combination with the tunnel ventilation and fire detection systems to control and restrict the impact of the design fire(s) determined as described in Section 1.16.2.B.3.a above.

b. The design of the fire suppression system shall take into account the relevant requirements and recommendations of the following standards and guidelines:

i. The performance of the fixed fire suppression system shall be demonstrated using CFD modeling (See TR 1.16.5.A.3.a.i). The results of the system performance modeling will be validated by independent peer review. 3

ii. World Road Association (PIARC) *Technical Report 2008R07 – Road Tunnels – An Assessment of Fixed Fire Fighting Systems*.

iii. UPTUN Report R251, August 2007 – *Engineering Guidance for Water Based Fire Fighting Systems for Protection of Tunnels and Subsurface Facilities.*

c. The potential impact of a fire on the tunnel structure, equipment and occupants shall be assessed and criteria for their protection established by defining maximum temperatures at specific locations around a fire, and times for which those temperatures can be tolerated.

d. The design of the fire suppression system must take into account all factors that may affect the effectiveness of the system and the behavior of a fire in the tunnel, and the response to that fire. Any assumptions to be made should also be stated. Such data may include:

i. Tunnel geometry and construction;

ii. Ventilation plant and controls;

iii. Longitudinal airflow;

iv. Relevant fire and incident detection systems;

v. Best and worst case time delays between detection, confirmation and activation of the system;

vi. Best and worst case traffic density and composition;

vii. Range of ambient temperatures;

viii. Risk of corrosion;

ix. Evacuation procedures / timescales;

x. Emergency traffic management / timescales; and

xi. Available water supply and reservoir capacity.

3. Design Methodology

a. The Concessionaire shall design the ventilation system and fire suppression system in accordance with prevailing industry standards:

i. The fire suppression system shall be designed to be effective both with and without the ventilation system running. Computer simulation software, such as the Fire Dynamics Simulator (FDS) by NIST, shall be used to model the performance of the ventilation system while the fixed fire fighting system (FFFS) is in use. The simulations shall document that the proposed ventilation and FFFS will provide the following: 2

a). Tenable conditions for escape and fire fighting at specified distances from the fire both upwind and downwind.

b). Protection of the structure from serious damage, particularly immediately above and to the side of the fire.

c). Sufficient cooling of surrounding surfaces to prevent spread of the fire to adjacent vehicles and to limit the extent of damage.

B. Fire Standpipe Systems

1. The standpipe system shall be designed in accordance with NFPA 502.

2. Hose valves shall be provided in the tunnel and on the tunnel approach (Boat Section) ramps at intervals not exceeding 275'.

3. Hose Valves shall be housed in a stainless steel panel recessed flush into the tunnel wall or approach ramp retaining wall, and fitted with two-way valves and 2½" hose connections to a thread pattern agreed with the Portsmouth and Norfolk Fire and Rescue Services.

4. As a minimum requirement, the standpipe system shall be capable of delivering a total flow of 750 gallons per minute. If a break tank is provided, the working capacity shall be sufficient for one hour's operation at the above minimum flow rate. Fire pumps, if required, shall be to NFPA 20.

5. The standpipe system shall be configured with isolating valves located at strategic intervals to allow a section of the system to be taken out of service for maintenance or repair without affecting the availability of the remaining sections of the system.

6. Fire Department inlet connections shall be provided at Fire Department approved response locations at both tunnel portals, in accordance with NFPA 502.

7. The standpipe system may be normally wet or dry. If dry, Fire Department confirmation shall be obtained at Design Development and Detailed Design stage that the time to charge the system is acceptable. If a wet system is provided, all pipework shall be protected against freezing and equipped with a leak detection system. 4

1.16.6 Emergency Cabinets

A. Two emergency cabinets and a manual fire alarm pull box shall be provided adjacent to emergency escape doors, on the nearside wall of the road spaced to comply with NFPA 502 requirements. Each cabinet shall be housed in a low carbon, high molybdenum, austenitic stainless steel panel recessed flush into the tunnel wall. The following cabinets shall be provided:

1. Motorist Aide Call boxes

   a. Emergency motorist's telephone, height to center of handset 3' 6" above walkway level. Lifting the telephone handset shall cause the telephone to be connected automatically to the OCC.

2. Hose Valve Cabinet

   a. One portable type 2-A:20-B:C dry powder fire extinguishers, total weight of each not more than 20 lb, free-standing with handles approximately 2' 6" above walkway level. 4 2

   b. Fire hose valves as detailed in Section B.

   c. A switched and ground fault circuit interrupter (GFCI) power socket for emergency use, if required by the Fire and Rescue Services. Specification to be agreed with the Fire and Rescue Services. These sockets would be supported by the tunnel UPS system.

B. All compartment doors shall be hinged on the side nearest approaching traffic, be flush with the tunnel walls and fitted with recessed push-button catches and microswitches to signal to the SCADA system when the door is opened. This shall alert the OCC Operator and cause the immediate area to be automatically displayed on a CCTV monitor screen in the OCC. Signage shall be in accordance with NFPA 502.

C. Above every fire cabinet a permanently lit pennant sign shall be provided. Each face of the sign shall carry emergency telephone and fire extinguisher symbols and the fire cabinet location reference. Symbol height shall be 10" and white luminance 100 cd/m2.

D. The style and color of the symbols and legends on the signs shall be agreed with VDOT. Signs need to be clearly visible both when back-lit in poor ambient light and when front-lit if bright ambient light predominates.

E. A white flashing beacon shall be integrated into the sign to indicate when there is an unanswered incoming phone call.

1.16.7 Emergency Escape Doors

A. Emergency escape doors into the emergency egress corridor shall located adjacent to Emergency Points at intervals determined in accordance with NFPA502:2011 Section 7.15.6.2. Precise locations and design of doors shall be reviewed by VDOT and the City of Portsmouth and City of Norfolk Fire Marshals. 2

B. Emergency escape doors shall be minimum 1½-hour fire rated and shall open into a protected escape route leading to the open air. Open doors shall not obstruct the escape route.

C. Additional doors shall be provided at the extreme ends of the emergency egress corridor for First Responders' access. These doors shall be fitted with access control as described in Section 1.16.12.A.2.

D. All doors shall be self-closing, able to be opened from either side and fitted with alarm contacts connected to the SCADA system.

E. All doors shall be clearly marked on both sides with an agreed code to indicate the location in the tunnel. The location codes on the road side of the doors shall be large enough to be read clearly by the nearest CCTV camera, to enable it be used by the OCC Operator to identify the location of an incident.

1.16.8 Emergency Exit Signs

A. A permanently lit 'Emergency Exit' sign shall be provided above the centre of every escape door, similar in construction to the fire cabinet pennant signs described above, with additional downward illumination to highlight the door.

B. Symbol and font height shall be at least 6 inches and white contrast luminance 30 ft-Lambert.

C. The style and color of the symbols and legends on the signs shall be agreed with VDOT. Signs need to be clearly visible both when back-lit in poor ambient light and when front-lit if bright ambient light predominates.

D. Permanently lit or reflective 'Nearest Emergency Exit' signs shall be provided at intervals of not more than 82 ft along both walls of each travel lane, and at 5 ft height, with two directional arrows pointing towards the nearest door or portal in both direction, and supplementary text giving the distances to the nearest door or portal in feet.

E. Additional Emergency Exit signs shall be installed in the emergency egress corridor indicating the shortest way out and the distance to the exit.

1.16.9 Deleted entire section

△3

1.16.10 Traffic Monitoring and Control

A. Closed Circuit Television (CCTV)

1. A CCTV system suitable for general surveillance purposes shall be provided, to enable the OCC Operator to view any part of the tunnel interior, emergency escape routes and approach ramps with color, pan, tilt and zoom cameras.

2. Cameras shall be positioned so that, if one camera fails, full coverage of the tunnel interior can be obtained by use of the adjacent cameras on either side.

3. Multiple monitor screens shall be provided in the OCC. One or more screens shall cycle all the cameras at least once every 60 seconds, while at least one other shall display a single picture as selected by the OCC Operator. 2

4. An interface with the SCADA system shall be provided that will cause the view from the camera nearest to an alarm event to be displayed automatically in the OCC when certain events such as those listed below are alarmed:

   a. Opening a fire cabinet compartment door;

   b. Opening an emergency escape door;

   c. Activation of a fire alarm; and

   d. Activation of tunnel closure stop signals.

5. A real time recording feature shall be provided to permit simultaneous recording of the images from any two cameras. Recording shall commence automatically in the case of any of the events listed above. The OCC Operator shall also be able to start recording manually and stop recording at any time.

6. Every CCTV image shall include an information banner that shall include the camera's identification and location and date and time in Universal Time Co-ordinated format. The Operator shall be able to suppress this information when viewing the pictures but not amend or delete it.

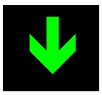
7. The CCTV system shall be capable of the future addition of up to two more monitor screens and six more cameras, over and above those necessary for coverage of the tunnel, its approaches and strategic road junctions beyond. Spare cable ducts shall also be provided for system cables as necessary.

B. Lane Control Signals

1. Light emitting diode (LED) based lane control signals shall be provided at each tunnel portal and at regular intervals through the tunnel to give the

following indications:

 Lane closed

 Lane open

2. Lane control signals shall be double aspect, suitable for use with bi-directional traffic.

3. Control of the lane control signals shall be initiated by the traffic control system, and implemented through the tunnel SCADA system.

4. Lane control signals shall be fully interlocked to prevent conflicting indications. Faulty signs or control functions shall cause the affected signs to show a blank face.

5. The signals shall be based on arrays of red and green LEDs on a black background, clearly visible in bright sunlight and dimmable to suit the full range of ambient lighting conditions.

C. Tunnel Closure

1. Traffic stop signals shall be provided to close the tunnel and prevent vehicles from entering in the event of an emergency, operated by remote control from the OCC through a compatible and interoperable system. 2 4

2. The location and the type of signals to be used shall be reviewed by VDOT.

D. Dynamic Message Signs (DMS)

1. Full matrix signs shall be provided in the tunnel at regular intervals above the travel lanes to display instructions and emergency messages to tunnel users.

2. Signs shall be located and spaced so as to be clearly visible with an unobstructed view to every driver when traffic is stationary. 2

3. Similar signs shall also be provided on the tunnel approaches.

4. The signs shall be based on arrays of white LEDs on a black background, clearly visible in bright sunlight and dimmable to suit the full range of ambient lighting conditions.

5. Provision shall be made to manually change sign text via a compatible and interoperable man/machine interface (MMI). 2 4

E. Overheight Vehicle Protection

1. Overheight vehicle detection shall be provided as part of a compatible and interoperable traffic control system. 2 4

1.16.11 Communications

A. Emergency Phones

1. An emergency telephone system shall be provided, with telephones located at all fire cabinets and portal fire panels as described in Sections 1.16.6 and 1.16.9 above.

2. The emergency telephones shall be designed so that an intelligible conversation can take place with background noise from traffic in the tunnel and the tunnel ventilation system.

3. The telephone system shall be served by two separately located telephone controllers. Each controller shall serve alternate telephones so that every other phone will be operational if one controller becomes disabled.

4. The OCC Operator shall be able to hold calls from, or call back to, any individual telephone on the system.

B. Radio Systems

1. A re-broadcasting system shall be provided by others to maintain STARS radio coverage in the tunnel of all channels required by the First Responders. 4

2. Provision shall be made for Highways Advisory Radio (HAR) messages to be broadcast within the tunnel.

C. Mobile Telephone Coverage

1. Suitable space and UPS power supplies shall be provided to enable third party cell phone service providers to install their equipment and antennas

to give full coverage of all available mobile telephone networks in the tunnel.

D. Deleted

3

1.16.12 Tunnel Security Systems

A. General

1. Intrusion Detection

a. The perimeter of all areas around the tunnel portals and OCC shall be monitored to detect and alarm any unauthorized intrusion. An alarm shall be raised at the OCC through the SCADA OCC Operator Interface with details of the location and time when an intruder is detected.

b. Security lighting and a CCTV surveillance system shall be provided to give full coverage of these areas and to enable the movements of intruders to be viewed and tracked.

2. Access Control

a. An access control system shall be provided to cover designated entry points to restricted areas and buildings. The system shall be designed to permit only authorized vehicles and personnel to enter, and shall automatically log all movements in and out of the secure areas.

b. Every designated entry point shall be provided with a telephone link to the OCC Operator, accessible from both sides of the door or gate, to enable users to request assistance.

c. The OCC Operator shall be provided with the means to override the control of individual entry points in abnormal circumstances, to allow free access by First Responders, maintenance and construction personnel.

d. A means of locally unlocking and locking access gates and doors shall be provided for use in the event of system failure.

1.16.13 Electronic Control System (SCADA System) for M&E Plant

A. General

1. The SCADA System shall consist of two separate elements:

   a. A PLC system, to control and monitor M&E plant and equipment as necessary.

   b. A SCADA system, to act as a user interface for the Tunnel PLC system.

2. The SCADA System will control and monitor elements that are part of safety related systems. Those elements shall therefore be subject to a risk analysis to determine the appropriate Safety Integrity Level (SIL), as defined in IEC 61508, to which they will be designed and operated. Unless demonstrated otherwise, a rating of SIL2 for all parts of the PLC and SCADA systems shall be applied.

3. Both the PLC and the SCADA systems shall be designed for easy expansion and future changes to software in the future.

B. PLC System

1. The tunnel SCADA System shall be based upon a PLC system with a distributed I/O architecture utilizing established proprietary hardware and programming software.

2. The PLC system shall consist of duty and standby PLCs. It shall be designed to be highly resilient and fault tolerant to maintain road user safety systems both under normal and emergency operating conditions. Detection of faults and switching from duty to standby PLCs shall be fully automatic.

3. The PLC system shall include MMIs local to the tunnel to allow the control and monitoring of safety related systems in the event of a SCADA system failure. Subject to a suitable password being provided, the MMIs shall also be available to provide engineering and maintenance data.

C. SCADA System

1. The SCADA system shall consist of the following elements

   a. Communications network;

b. Data servers;

c. OCC Operator Interface;

d. Engineering Interface; and

e. Automatic Incident Detection (AID) system interface.

2. The SCADA level communications network shall consist of a dual fault tolerant, redundant fiber optic ring topology using ring management switches at each node.

3. Communications between the OCC and the tunnel equipment shall be carried using multiple longitudinal fiber optic cores.

4. Two SCADA servers shall be provided, operating on a duty/hot standby basis and receiving, processing and logging data in parallel. Should a fault in the duty server be detected, full control of the system shall be transferred automatically and seamlessly to the standby server within 20 seconds. There shall be no loss of data and an alarm shall be raised to advise the OCC Operator that this has happened.

5. SCADA outstations shall be provided at strategic locations as required.

6. The connection of a PC to an outstation shall not interrupt the flow of data to the SCADA servers. Completion of system modifications at an outstation shall only be by the use of the highest level security password.

7. Outstation control / software modifications shall generally be made to an offline copy of the stored program on the duty SCADA server and propagated to the outstation when modifications are complete.

D. SCADA Operator Interfaces

1. At least two SCADA Operator Interfaces shall be installed, one for the Operator in the OCC, and the second for maintenance and engineering purposes local to the tunnel.

2. Each SCADA Operator Interface shall consist of a desk-mounted MMI, capable of displaying pages for traffic monitoring and control or plant monitoring and control, and a printer for outputting reports and logs.

3. The SCADA Operator Interfaces shall be provided with high definition graphical displays showing the status of M&E systems within the tunnel

and tunnel closure signs, signals and barriers. Emphasis shall be placed upon clarity of presentation and ease of use.

4. Each SCADA Operator Interface shall be user configurable to filter what is seen on the alarm screens. The means for intelligent suppression of the display of secondary alarms shall be provided.

5. Operator access shall be password controlled with four levels of authority as follows:

   a. Guest;

   b. Operator;

   c. Supervisor; and

   d. Engineer.

6. Pre-programmed help pages shall be provided, for the OCC Operator to call up during an emergency incident, listing recommended actions appropriate to the prevailing scenario, based on agreed emergency plans and alarm signals received.

7. Help pages shall be developed in consultation with the OCC Operators and the emergency services, and shall include, but not be limited to, the following:

   a. Fire in tunnel;

   b. Road Traffic Accident;

   c. Spillages;

   d. Flooding;

   e. Air Quality Alert;

   f. Normal Power Supply Failure;

   g. Standby Power Supply Failure;

   h. Tunnel Closure;

   i. Tunnel Evacuation;

j. Tunnel Ventilation Failure; and

k. Tunnel Lighting Failure.

E. Data Logging and Transfer

1. The SCADA system shall record, time stamp and categorize all faults, event signals and operator actions in event logs under one of the following three types:

   a. Alarm – those faults or events that require an immediate response either from the OCC Operator or maintenance personnel in order to maintain a safe environment for the road user.

   b. Alert – those faults or events that require a considered response either from the operator or maintenance personnel in order to maintain a safe environment for the road user.

   c. Record – those events that are part of the normal operation of the tunnel.

2. Provision shall be made to relay urgent fault alarms automatically through a telephone link, text message, email, and/or facsimile to an unspecified remote maintenance terminal. 4

3. Time stamping shall be synchronized to US Eastern Standard Time to a resolution of ±1 second or better.

4. Data storage shall be on non-volatile media to prevent loss of data in the event of server failure or switch-over.

5. The OCC Operator shall be able to enter details of incidents, with time, duration and general description, and to generate reports combining this information with selected events (e.g. road traffic accident observed, time logged, attendance requested, ventilation operated, etc).

6. The SCADA system shall provide the means to search logs and generate reports on:

   a. The frequency and duration of selected events.

   b. Power consumption and running costs of lighting, ventilation and drainage plant, linked to plant usage.

c. Air quality, linked to weather and traffic conditions and ventilation usage.

1.16.14 Electrical Power Supplies

A. Incoming Power Supplies

1. Power for the tunnel systems shall be supplied from two independent incoming high voltage supplies, designated 'A' and 'B', each normally supporting approximately 50% of the total electrical load. The 'A' and 'B' supplies shall be taken from the Portsmouth and Norfolk distribution networks respectively, to minimize the risk of common point failure.

2. Lighting and ventilation systems shall be split approximately 50/50 between the 'A' and 'B' supplies so that if one supply fails, only 50% of the system capacity will be disrupted.

3. Cabling, transformers and switchgear associated with 'A' and 'B' supplies shall be physically segregated to the extent possible and reasonable.

4. If either supply should fail, or equipment needs to be temporarily taken out of service for inspection, maintenance or repair, provision shall be made for the whole of the tunnel electrical load to be transferred to the alternative supply until normal operation can be restored.

5. Switchgear controlling interconnecting cables between the 'A' and 'B' substations shall be interlocked to prevent through feeding between the Portsmouth and Norfolk supply networks.

B. Standby Supplies

1. Standby generation shall be provided with sufficient fuel feed and/or fuel storage capacity to support essential tunnel systems for three days continuous operation to maintain traffic flow under emergency conditions. NFPA identifies those systems that are identified as essential. Refueling points shall be located at ground level away from the tunnel and plant rooms. If the designer opts to utilize a Natural Gas fired generator, fuel will be obtained and metered from the local distribution system. A day tank or other storage type tank to satisfy the three continuous days operation will be at the discretion of the designer, after weighing the risks associated with a Natural Gas shut down during the emergency incident. 3 2

2. At no time shall failure of a supply or switching operations involve an increased risk to tunnel users or interruption of normal operation of the tunnel.

3. Essential systems shall be fed via UPS, so that during switching intervals, generator start-up and in the event of failure of the standby generators, supplies to the following will be maintained seamlessly for at least 30 minutes: 2

   a. Emergency lighting and escape signage.

   b. Fire detection and alarm systems.

   c. Power outlets in fire cabinets.

   d. Radio, telephone and public address systems.

   e. CCTV and incident detection systems.

   f. SCADA Plant monitoring and control system.

   g. The traffic control system specified in Section 1.16.1.E.2.b.vii.

4. The UPS shall be fed from an emergency bus, which shall automatically switch between alternate power supplies in the event of a power interruption.

5. Standby generators shall be sized to support continuously the essential emergency load that may be imposed by the tunnel electrical systems, including recharging the UPS batteries. 3

6. Under no circumstances shall air for cooling or combustion purposes be drawn from the tunnel.

C. Cable and Wiring

1. All sub-main and final sub-circuit cabling and wiring in the tunnel road space shall be protected from fire, either by the use of fire rated cables to NFPA 70 Article 700 or 708 as appropriate, or by being enclosed in fire protected ducts to give an equivalent level of fire performance.

2. All cables buried in the ground or passing through the structure shall be enclosed in ducts, with 25% spare ducts left empty for unspecified future use.

3. Where it is not possible to obtain suitable fire rated versions of exposed cables required for instrumentation, data transmission or communications equipment in the tunnel, resilience to fire shall be provided by alternative means, such as duplication by alternative routing.

4. Final connections to equipment that will not be expected to continue operating under direct impingement of fire may be made in cables with a fire rating similar to that of the equipment served. In such instances, suitable precautions shall be taken to ensure the continued functioning of equipment not directly involved in the fire.

1.16.15 Tunnel Support Buildings

A. Secure buildings shall be provided adjacent to the tunnel to contain the electrical and mechanical plant and equipment associated with the power supplies and ancillary systems necessary for operation of the tunnel.

B. Separate rooms shall be provided for HV and LV equipment.

C. Office and washroom facilities shall be provided for use by maintenance personnel. These may be shared with the Existing Midtown Tunnel if it is practical to do so.

D. Where required by code, rooms shall be provided with normal and emergency lighting, anti-condensation heating, fresh air ventilation and small power sockets for maintenance use. Fire alarm, intruder alarm and access control systems shall also be provided, with remote alarms relayed to the OCC Operator via the SCADA system.

E. If lead-acid batteries are selected for the UPS, ventilation to the battery room shall be provided by a duty/standby fan arrangement to ensure continuous ventilation at all times and to prevent any accumulation of hydrogen gas from the batteries.

F. Rooms containing heat-emitting or heat-sensitive equipment shall be provided with cooling by fresh air or air conditioning as appropriate.

G. All rooms will be protected per the Virginia State Building Code.

1.16.16 Testing and Commissioning

A. Testing

1. Testing shall be designed to verify that the equipment and installations

comply with the Technical Requirements. Testing shall verify that installation is in accordance with the Technical Requirements and that performance of all systems, both in isolation and in conjunction with other systems, is in accordance with the Technical Requirements.

2. VDOT shall be given the opportunity to witness any or all tests at their discretion, and will provide the Concessionaire with a list of tests that VDOT would like to witness. The Concessionaire will provide an agreed amount of notice before the date of all tests to enable VDOT to make the necessary arrangements to attend.

B. On Completion

1. VDOT will verify that the completed systems conform to the functionality, performance and safety requirements, as in accordance with the Technical Requirements.

2. Specific performance tests shall include, but not necessarily be limited to:

a. Tunnel ventilation;

i. Air velocity and uniformity;

ii. Noise levels; and

iii. Efficiency of smoke extraction.

b. Tunnel lighting;

i. Luminance levels.

c. Drainage pumping plant;

i. Pump discharge flow and pressure.

d. Fire suppression system;

i. End-to-end time for detection, alarm, location and confirmation of a fire, with a reasonable allowance for any human intervention;

ii. Times to charge the system.

iii. Time to establish full operation of the system; and

iv. Rate of water consumption under full availability and pump failure conditions.

e. Fire hydrants;

i. Flow and pressure.

f. Deleted 4

g. EC and traffic control systems.

i. Comprehensive functional tests.

3. For each test, a test report shall be provided to include the following:

a. Test methodology;

b. Relevant codes or standards;

c. Specific details of the equipment or system tested;

d. Full record of measurements taken, with locations;

e. Evidence of calibration of test equipment;

f. Applicable acceptance criteria;

g. Test results; and

h. Any further actions or re-testing required.

1.17 Tunnel Design Criteria

Tunnel Design Criteria is provided in Attachment 1D.

1.18 Tolling and Traffic Management System

The Concessionaire shall provide a tolling and traffic management system consistent with the Agreement, including Good Industry Practice. The tolling and traffic management systems may be separate and independent so long as they meet the requirements herein. 4

1.18.1 Existing Intelligent Transportation System Infrastructure

A. Pursuant to the terms of the Agreement, the existing VDOT Intelligent Transportation System (ITS) infrastructure and telecommunication system to the extent that spare capacity is available within, along, or adjacent to the Project corridor, will be made available for use by the Concessionaire or its agents or subcontractors in order to support the tolling and traffic management systems.

B. Maintenance activity for/on fiber optic cable and/or duct bank including junction/splice pits jointly occupied by the Concessionaire and VDOT, if any, shall be subject to a joint agreement between the Concessionaire and VDOT.

1.18.2 Business and Toll Operating Model

A. The business and toll operating model shall comply with the requirements of the Agreement.

B. A facility or facilities shall be provided to support traffic management, incident response, maintenance, and tolling operations, including handling of services directly related to the operation and maintenance of the tolled facility network.

C. Tolling equipment shall be installed to detect the presence of a transponder for users on the tolled facilities by means of E-Z Pass-compliant (or any successor to E-Z Pass used on other State Highways) transponder detection equipment.

D. Transponders that shall be read will be E-Z Pass compliant (or any successor to E-Z Pass used on other State Highways), either issued by VDOT or by another member of the Interagency Group (IAG).

E. Toll pricing shall be in accordance with the Agreement.

F. A violation enforcement system (VES) shall be implemented to enable the detection and enforcement of violators. Enforcement will follow practices established on similar systems and shall be in compliance with the requirements of the Agreement. Enforcement may include manual processes, video enforcement, or integrating customer service, technology and operational performance elements.

1.18.3 Systems Integration and Protocols

A. The Concessionaire shall implement a system engineering approach, consistent with Federal Rule 940, in the development of systems and their associated interfaces. The system engineering approach shall address the following items where applicable:

1. System architecture;

2. System specification;

3. Interface identification;

4. Interface specification;

5. Interface control;

6. System integration; and

7. Configuration management.

B. The Tunnel Facilities Control Room shall be required to interface to Eastern Region Operations (ERO) Advanced Traffic Management System (ATMS) at the ERO TOC. 3

C. The Concessionaire shall develop and maintain Project architecture in conformity with the ERO ITS architecture. The Project architecture shall document all interconnects and information flows between the Toll Facility OC and the existing ERT Traffic Control Rooms; and interconnects to other transportation and emergency management agencies.

D. The Concessionaire shall prepare a Rule 940 checklist for planned ITS infrastructure for submission to FHWA via VDOT's ERO TOC.

E. The Concessionaire shall ensure that such standards, protocols, and interfaces are present in the Toll Facility OC Central Control Computer System (CCCS), so as to make the TMS and ERT tunnel traffic control system interoperable with ERO ATMS, in accordance with the Interface Specification and including any mutually agreed revisions during the Operations.

1.18.4 Tolling System and TMS Design Documentation

The following tolling system and TMS design documentation shall be prepared and submitted to VDOT by the Concessionaire:

A. Tolling Concept of Operations which shall describe the intended behavior and functionality of the tolling system and TMS and their operational interaction with ERO ATMS.

B. Technical Specifications - shall be a document or documents that specify the technical design of the integrated sub-systems that will comprise the tolling system and TMS and its interfaces.

C. Interface Specification (Attachment 3D) – shall be the physical and logical architecture of system interface between the Toll Facility OC ITS and ERO ATMS.

D. Process Definition Deliverable or other agreed document - shall set out the business processes relating to the tolling system and TMS (subject to intellectual property (IP) regulations, and the requirements of the Agreement) and the processes for interacting with the appropriate VDOT system and/or other systems as documented in the Concept of Operations.

E. Test Strategy - shall establish the principles of, and the Concessionaire's approach to, the testing of the tolling system and TMS and their interfaces, including the test stages and processes.

F. Security Plan - shall be a document (or part of another document) that sets out how the security of the tolling system and TMS, including the subsystems, communication links, roadside equipment, and Toll Facility OC shall meet the relevant requirements for enforcement evidence and that data are held securely and only accessible to authorized personnel.

G. Disaster Recovery Plan - shall be a document (or part of another document) that sets out the procedures to be adopted in the event of failure of the tolling system and/or TMS.

1.18.5 Design of the Tolling System

A. A tolling system shall be provided to impose, charge, collect, use, and enforce payment of tolls in accordance with the Agreement.

B. The tolling system is to comprise the following equipment and/or systems:

1. Tolling system roadside equipment; and

2. Tolling system equipment and/or subsystems.

C. The tolling system roadside equipment is to comprise:

1. Transponder detection equipment; and

2. Control equipment.

D. Access to the tolling system overhead and roadside equipment shall be provided such that it does not jeopardize the safety of the technician or the operations of any lanes.

E. The tolling system shall have a transponder transaction performance as set forth in Section 4.4, for properly fitted and operating transponders, excluding signal attenuation due to metallic wind screen or similar.

F. The Concessionaire shall provide toll charge transaction information in compliance with an interface specification to be developed between the Concessionaire and VDOT or other toll transaction account management services provider.

G. The Concessionaire shall develop interface file format and transfer protocols for the transmission of toll transaction data and related information in cooperation with VDOT and in accordance with an interface specification to be developed and the Electronic Toll Collection (ETC) Agreement.

H. Communication between the tolling system roadside equipment and the Toll Facility OC will be via the fully redundant network.

1.18.6 Design of the Vehicle Enforcement System

A. A vehicle enforcement system (VES) shall be provided that detects vehicles that do not have a transponder or a valid transponder.

B. The VES is to comprise:

1. VES equipment; and

2. Control equipment.

C. When tolls for any toll section are suspended, there shall be a means to suspend vehicle enforcement.

D. The VES roadside equipment shall have an in service availability (ISA) as set forth in Section 4.4.

1.18.7 Design of the Technical Shelters

A. The Concessionaire shall provide suitable technical shelters housing electrical cabinets for the tolling system and TMS equipment as required.

B. The technical shelters shall be equipped with the following provisions:

1. Heating, ventilating and air conditioning (HVAC) systems as required to support installed equipment;

2. Fire detection; and

3. Intrusion detection.

C. Each service panel for the technical shelters shall be equipped with telemetry equipment that reports, for the main power and each branch circuit, the current flow and any tripped breakers.

D. The telemetry shall be powered by an uninterruptible power source to enable the telemetry to communicate for the first 20 minutes after a power failure.

E. Service panels feeding technical shelters shall be equipped with a backup generator sized to accommodate the attached electrical load, including DMS connected to the service panel.

1.18.8 Traffic Operations Center

A. The Concessionaire shall provide a Traffic OC that complies with Applicable Laws to accommodate equipment and personnel for the operation of the facility. 2

B. The Concessionaire shall obtain building permits and other Governmental Approvals required for the construction and occupancy of the Traffic OC. 2

C. The Concessionaire shall procure any zoning variances required for the property to be used for the Traffic OC.

D. The Concessionaire shall provide a Traffic OC with the following amenities: 2

1. Offices;

2. Meeting rooms;

3. A control room with a video wall;

4. A computer equipment room, with raised computer floor or an equivalent means of distributing cables;

5. Restrooms, showers, change room, and lockers;

6. External and internal access security system;

7. HVAC systems;

8. Fire detection and alarm system;

9. Emergency and backup power;

10. Maintenance management rooms and storage; and

11. Adequate surface areas for employee and visitor vehicle parking within the constraints of the property boundaries and the remaining site space following the deduction of the building footprint.

E. All offices and rooms shall be accessible to all employees and visitors in accordance with the requirements of Applicable Law.

1.18.9 Traffic Management System

A. A traffic management system (TMS) shall be provided that meets the requirements of the Agreement and enables the Concessionaire to monitor and manage traffic flow on roadways within the O&M Boundaries. 3

B. Any ERO ATMS related equipment that may be in conflict with proposed Concessionaire equipment will be left as is and untouched.

C. The TMS must allow the Concessionaire to:

1. Support response to emergency situations on the Toll Facility Network in the shortest possible timeframe;

2. Optimize the traffic flow on the Toll Facility Network;

3. Control flow, and any regulatory DMS, on and approaching the Toll Facility Network;

4. Detect and manage traffic incidents effectively, through a comprehensive incident management system, to mitigate the impacts of incidents and prevent secondary incidents occurring;

5. Provide credible and timely driver information about travel times, traffic conditions and incident situations, and provide timely and accurate toll prices to motorists related to Toll Facility Network;

6. Provide an interface with ERO ATMS in accordance with the Interface Specification (Attachment 3D);

7. Support provision of driver aid to motorists in vehicles that have stopped on the Toll Facility Network;

8. Permit ERO TOC to control DMS via the Toll Facility OC CCCS in accordance with the Agreement;

9. Provide for the control and monitoring of TMS components and subsystems through a modern and comprehensive computer-based control facility using graphical user interface (GUI); and

10. Monitor facilities, plant, and equipment.

D. The TMS is to comprise the following equipment and/or systems:

1. TMS roadside equipment; and

2. TMS equipment and/or systems located in the Toll Facility OC.

E. The TMS roadside equipment is to include:

1. DMS for the lanes to provide toll and driver information (T&DI) and general traffic management information;

2. Pan tilt-zoom (PTZ) CCTV cameras to provide video surveillance;

3. Traffic monitoring sensors to provide traffic volume, lane occupancy, and speed data;

4. Lane control devices; and

5. At all access points.

F. The TMS Toll Facility OC based equipment and/or systems are to comprise of:

1. An AID subsystem;

2. A CCTV subsystem; and

3. A CCCS.

G. The CCCS shall have an ISA of at least 99.995% and the CCCS (redundant components) of at least 99.9%.

H. The type and format of DMS messages must comply with the requirements of MUTCD, VDOT ERO Master Concept of Operations for DMS, guidance published by FHWA, and/or VDOT published standards as appropriate.

I. The TMS roadside equipment shall have an ISA as set forth in Section 4.4.

J. Equipment cabinets shall be provided for the TMS roadside equipment at appropriate locations along the alignment and within the Project Right of Way.

K. Existing VDOT-owned TMS roadside equipment that may be taken over by the Concessionaire will be removed or integrated into the new TMS system.

1.18.10 Closed Circuit Television Video Coverage

A. Dedicated CCTV cameras shall be provided for the following functions:

1. Surveillance of the Project's incident detection and response limits as described in the O&M Boundaries, including roadways, bridges, tunnels, approaches and interchanges AID on the Project.

B. CCTV video coverage must be provided by PTZ CCTV cameras mounted on poles to enable Toll Facility OC operators and VDOT operators to observe traffic along every section of the corridor within the Project Right of Way at all hours of the day and in all weather conditions normally encountered in Virginia, consistent with reported visibility restriction (i.e., during snow storms, fog, etc.). The video provided must be stable, jitter-free, and suitable for video-based AID.

C. The Concessionaire shall replace VDOT's cameras that are disturbed by the Work.

D. Dedicated cameras shall be provided for surveillance of the Project's incident detection and response limits as described in the O&M Boundaries or to enable video-based AID under Toll Facility OC operator control.

E. CCTV line-of-sight distances shall provide for full CCTV coverage without image degradation.

F. All cameras installed for VDOT by the Concessionaire shall meet the requirements of VDOT camera specifications.

G. The video surveillance system must enable the identification of the number and vehicle types involved in an incident at all locations within the surveillance area.

H. The video provided must be stable at all zoom settings when viewing objects up to one mile away.

1.18.11 Video-based Automatic Incident Detection

A. For selected locations, the Concessionaire shall implement video-based AID for the Project's incident detection and response limits as described in the O&M Boundaries. This shall be at locations where:

1. The risk of traffic incidents is expected to be higher than average, and

2. Rapid detection of incidents is required for special reasons, such as near critical infrastructure.

B. The video-based AID system should be capable of:

1. Detecting 95% of incidents involving stopped vehicles, slow vehicles, and slow traffic that are within the field of view of a fixed CCTV camera or other equipment as specified; 2

2. Detecting pedestrians on the roadway; and

3. Detecting incidents and providing an alarm to the tunnel control room in less than 30 seconds.

C. Upon the detection of an incident, the AID system must record the video at a rate of at least five frames per second for a period of 60 seconds.

1.18.12 Closed Circuit Television Communications Standards

A. CCTV communications standards shall be MPEG-4 at 4Mbps or H.264, or a mutually agreed equivalent. Video performance requirements will be based on a minimum requirement of D1 resolution as defined by NTSC, a 30–frames-per-second video image and no pixilation upon panning or tilting of the camera. Final video rates/formats are to be agreed to before activating the system.

B. Each location will be capable of providing multiple video streams, with the ability to configure each stream independently.

C. All equipment used will be able to be managed using Telnet, Web-based GUI, and/or local port command-based interface.

D. Each location shall be able to combine video and data (to be used for PTZ) in the same unit.

1.18.13 Traffic Monitoring Sensors

E. Traffic monitoring sensors shall be installed to monitor and report in real time traffic volume, lane occupancy and speed data at key locations along the roadway (outside of the tunnels). In addition to such sensors, the Concessionaire shall employ fixed camera-based software to detect incidents inside the tunnels. 2

F. Information collected on the project by the ITS will be made available to VDOT.

1.18.14 DMS

A. The T&DI DMS for the tolled facility shall be located prior to each entry to the tolled facility and will display sufficient information to allow drivers to make appropriate decisions on whether to use the tolled facility. The T DMS and DI DMS will be independent roadside elements and likewise independently connected to, and managed by, the Toll System and the Traffic Management System respectively. The information to be displayed will be selected prior to final design following behavioral studies and market research. 2 3

B. DMS shall be installed at suitable distances from the tolled facility entrance at locations shown on the approved Signing Roll Plan to support motorist decision making and orderly movement of traffic. Static signs (in lieu of DMS) may be utilized at the Concessionaire's discretion as long as they meet the information requirements. 3 4

C. The Concessionaire shall reference ERO's DMS Master Plan to avoid over-populating signs and to seek co-gantry opportunities.

D. The T&DI DMS shall have the following minimum features:

1. Full graphics monochrome LED display providing a minimum of three lines of text;

2. Deleted 3

3. Capability to display toll price; 3

4. Capability to display travel time information;

5. Capability to display traffic management information, including warning and recommended diversions;

6. Advanced fault detection and reporting; and

7. Conformance to the National Transportation Communications for ITS Protocol (NTCIP) or other industry protocol agreed with VDOT.

E. If communication with the Toll Facility OC CCCS is lost and the T&DI DMS has no reported errors, the T&DI DMS shall display a user-defined graphic/message.

F. DMS shall be installed on the Project to provide traffic management information to motorists.

G. The traffic management DMS shall have the following minimum features:

1. Full graphics monochrome LED display providing a minimum of three lines of text;

2. Capability to display traffic management information, including warning and recommended diversions;

3. Advanced fault detection and reporting; and

4. Conformance to the National Transportation Communications for ITS Protocol (NTCIP) communications protocol or other industry protocol agreed with VDOT.

H. The DMS must not display erroneous information due to a fault with the sign or the loss of pixels.

1.18.15 TMS Availability

A. An ISA of at least 99.99% is required for the calculation of accurate travel time on tolled lanes. 3

B. All other TMS functions, unless noted otherwise, must have an ISA of at least 99.9%.

C. In cases where redundancy is provided, the system must switch between redundant components seamlessly (without impact to operator functionality). The system must also provide the capability to manually switch between redundant devices to support software upgrades/reversion and maintenance procedures.

1.18.16 Communications Infrastructure

A. The existing communications infrastructure must remain in place or be replaced in kind, as specified in the Standard Documents in Section 3.5.2.

B. VDOT will provide one conduit from its existing infrastructure inventory in, along, or adjacent to the Project, to the extent available, to the Concessionaire for telecommunications fiber installation.

C. If spare conduits in existing VDOT duct banks are not available, then the Concessionaire shall provide and install, duct banks, telecommunications conduit and fiber capacity in, along, or adjacent to the Project where communications infrastructure does not currently exist, in order to satisfy the project requirements. 3

D. Design, construction, and installation of the telecommunications infrastructure shall be consistent with ERO TOC Communications Master Plan.

E. Communications cables will be placed in buried conduit, embedded conduit, or bridge- mounted conduit. Conductor cables will be placed in buried conduit, embedded conduit, or bridge-mounted conduit and shall be in separate conduit and related appurtenances.

1.18.17 Existing VDOT TMS Roadside Equipment

A. Existing VDOT TMS roadside equipment or third-party TMS roadside equipment installed under permit with VDOT includes the following equipment located within the Project Right of Way:

1. Weather stations;

2. DMS for the existing lanes to provide general traffic management and regulatory information;

3. CCTV cameras; and

4. Traffic monitoring sensors.

B. The Concessionaire shall relocate existing VDOT TMS roadside equipment located within the Project Right of Way that is affected by construction, including power and communication service to the equipment, and shall ensure that loss of functionality is minimized.

C. Any third-party TMS roadside equipment located within the Project Right of Way that is affected by construction, including power and communication service to

the equipment, shall be relocated by the third-party equipment owner under the direction of VDOT. The Concessionaire shall provide notification of disturbance of equipment three weeks prior to commencing such activities.

D. VDOT will remain responsible for the operations and maintenance of the existing and relocated VDOT TMS roadside equipment as further set forth in the O&M Boundaries.

E. Third-party equipment owners shall remain responsible for the operation and maintenance of their existing and relocated TMS roadside equipment.

1.18.18 Power

A. The Concessionaire shall install and connect power service for the tolling system and TMS equipment for the Project.

B. The power supply for the tolling system, ITS, lighting and TMS equipment shall be separately metered from roadway lighting, traffic signals, and VDOT equipment. At VDOT's sole discretion, new tolling system and TMS equipment may be connected to existing VDOT electrical service panels.

1.18.19 Interface with the Hampton Roads Region ATMS

A. Deleted

2

B. Deleted

C. The tolling system and TMS shall not cause any unscheduled interruption or adverse affect to the continued functioning of the ERO ATMS or the operations supporting it.

D. The ERO ATMS shall not cause any unscheduled interruption or adverse affect to the continued functioning of the tolling system and TMS or the operations supporting it.

E. The tolling system and TMS shall be capable of being electrically (and, where relevant, optically) and mechanically isolated from the ERO ATMS.

F. The Concessionaire shall:

1. Deleted

2

2. Work with VDOT and its subcontractors to construct, test, and operate all specified interfaces; and

3. Prepare and document the designs which may include but not be limited to the following: 2

   a. The content of the data to be exchanged;

   b. The format of the data to be exchanged;

   c. The static data which are required to decipher the meaning of the data exchanged;

   d. The bearer protocols to be used;

   e. Any sequencing constraints or assumptions;

   f. Error handling measures;

   g. Measures to ensure data integrity;

   h. The nature of testing and the associated test data to be used; and

   i. Any other information necessary for the interface to operate correctly.

4. The tolling system and TMS shall have a mechanism to control the rate of transmission of messages/file to the ERO ATMS, with such mechanism being mutually agreed to and in accordance with the Interface Specification (Attachment 3D). 2

5. If the interface to the ERO ATMS is unavailable, the tolling system shall be able to store all records for an agreed period of up to five days on secure media and transmit them to the ERO ATMS once the interface is restored.

1.18.20 Data Processing Capacity

The Concessionaire shall ensure that the tolling system and TMS have sufficient data processing capacity.

1.18.21 Alarm Reporting

The tolling system and TMS shall have the capability to monitor the status of all relevant components and to raise alarms in the event of component failure, performance

degradation, or any other potential issues that might adversely affect the operation or performance of the tolling system and TMS.

1.18.22 Security

A. The Concessionaire shall prepare and submit no later than six months prior to the Existing Project Assets Tolling and O&M Work Commencement Date.

B. The Security Plan shall embody the following key principles for the protection of data:

1. Integrity: Data shall be protected from being corrupted by unauthorized changes, whether by system error, human error, or intentional alteration. Data shall only be modified by authorized users according to defined privileges and procedures.

2. Confidentiality: Data shall be protected from unauthorized disclosure. Access to systems shall be restricted to authorized users with privileges appropriate to the confidentiality of the data.

3. Availability: Data shall be prevented from being lost or becoming inaccessible. Authorized users shall be able to gain access to information to which they are privileged whenever they are authorized to do so.

1.18.23 Disaster Recovery

A. The Concessionaire shall prepare and submit no later than six months prior to the Existing Project Assets Tolling and O&M Work Commencement Date a disaster recovery plan for the Project operations, which shall, at a minimum, include the following:

1. Mitigate any adverse impact on the tolling system and its operation and/or TMS, in any circumstances where the ability of the Concessionaire to provide the operation of the tolling system would otherwise be impaired; and

2. Make provision for action to be taken by the Concessionaire in the event of the unavailability of its premises.

B. The Disaster Recovery Plan shall identify the measures to be taken in the event of:

1. Toll Facility OC site loss;

2. Roadside equipment site loss;

3. System data loss or corruption;

4. Systems failure;

5. Failure of the communications link with the ERO ATMS;

6. Failure of the communication links between the roadside equipment and the Toll Facility OC;

7. Loss of power in the locality; and

8. Inability of staff to gain access to, or work effectively at, the Toll Facility OC.

1.18.24 Performance Recording and Reporting

The tolling system and TMS shall incorporate the necessary tools to enable the recording and reporting of performance to meet the requirements under the Agreement.

1.18.25 Testing

A. Completed systems shall be tested to verify that functionality, performance and safety are in accordance with the Technical Requirements and relevant specifications.

B. Testing and commissioning, where applicable, shall be based on the application of a systems engineering methodology such as ANSI/GEIA EIA-632. Testing and commissioning will be based on the following documents:

1. A Verification Cross Reference Index (VCRI), which will be developed and documented to establish the way in which requirements are satisfied. The VCRI shall utilize test, demonstrate, inspect and analyze as methods for acceptance;

2. A test series that shall demonstrate compliance with the performance requirements through a test plan and procedures;

3. A testing strategy document that details how the testing plan will be implemented to demonstrate conformance of the proposed solution to the various functional, technical, and performance requirements; and

4. A test plan document that describes how the testing strategy will be executed to demonstrate the various functional, technical, and performance requirements for compliance to requirements, which shall include:

   a. Test specifications for each of the test cycles;

   b. Detailed requirements traceability matrix linking each of the test series to relevant requirement(s); and

   c. Detailed test script(s) for each of the test series, including input / process / output at each of the steps so that conformance can be monitored.

C. This testing strategy shall include:

1. System design and integration overview;

2. User Acceptance Testing - to ensure that individual functions operate as defined in the requirements specification or similar documents and the complete end-to-end process is tested;

3. Factory Acceptance Testing - tests to be conducted at the supplier's premises to verify that the equipment, subsystem or system complies with the functional and performance requirements of that supplier's subcontract;

4. Site Acceptance Testing (SAT) - tests to be conducted at the point of installation (tolling point and along Project) to confirm the factory acceptance testing results, plus any omissions and/or errors noted during the factory testing; and

5. Integration Acceptance Testing - a test conducted to ensure that the complete tolling system and TMS meets the end-to-end system-level functional and performance requirements in normal operating conditions.

1.18.26 Standards

The tolling system and TMS shall be designed, implemented, maintained, repaired, and replaced in accordance with all relevant standards as set forth in the Standard Documents in Section 3.5.2.

1.18.27 VDOT Testing and Integration Obligations

VDOT will participate as necessary in the requirements for testing and integration as outlined above where such testing and integration involves VDOT's infrastructure. The Concessionaire shall schedule adequate time for notification and testing by VDOT.

1.19 Maintenance During Construction

A. In accordance with the Agreement and subject to Section 1.19.B below, the Concessionaire shall be responsible for all maintenance during the construction of the Project in accordance with the Standard Documents in Section 3.5.2 and in accordance with Paragraph 105.14 of the *Road and Bridge Specification*.

B. Where the Concessionaire's MOT Plan requires traffic to operate on intermediate asphalt surfaces, the Concessionaire shall be responsible for maintenance of these roadways, including repair of any damage caused by its operations or use by public traffic.

C. In accordance with the Agreement, the Concessionaire shall maintain and operate the facility within the O&M Boundaries.

1.20 As Built Records

A. On completion of the construction Work, the Concessionaire shall provide to VDOT the Record Documents and Manuals, in accordance with the Standard Documents in Section 3.5.2, which shall consist of two hard-copy sets, one electronic file of each plan in .tif format or .pdf format, and one electronic file in MicroStation .dgn format of the final construction plans.

B. The As-Built documents will be organized and indexed to facilitate easy retrieval of information and will be certified by the Concessionaire to reflect the actual condition of Project at the end of the construction of the Project.

C. Record Documents

1. Design criteria and calculations and specifications;

2. Design and check certificates;

3. Testing and Commissioning Records; and

4. 'As built' record drawings.

D. Manuals

1. OCC Operator's Handbook. This shall contain an outline of the layout, functioning and control of the tunnel systems and equipment, in sufficient detail to provide the OCC Operators with a level of understanding of the facilities appropriate to their duties. The handbook shall also include details of procedures for supervision and operation of the tunnel under normal, emergency and maintenance conditions.

2. First Responders' Handbook. Similar in many respects to the OCC Operator's Handbook, this shall contain an outline of the layout, functioning and control of the tunnel systems and equipment, to provide First Responders with a general understanding of the tunnel and its operation, with particular emphasis on facilities available to assist them when attending an emergency and any unusual features that they should be aware of. The handbook shall also include details of access routes and key contacts.

3. Equipment Operation and Maintenance Manuals. These manuals shall contain all information needed for engineering and maintenance staff to understand the design and equipment of the tunnel and to maintain, repair and replace all parts of the tunnel mechanical and electrical systems.

4. Plant maintenance, inspection and replacement schedules. These shall be based on the recommendations of the manufacturers and suppliers of the installed equipment and the available opportunities for access to the tunnel as agreed between the Concessionaire and VDOT.

1.21 Surveys

A. The Concessionaire shall preserve all survey control monuments established by VDOT and will notify VDOT as soon as it is known that a monument is in a position that will interfere with new construction or with Concessionaire activities. If a monument is disturbed, or cannot be preserved in place, the Concessionaire shall set the new monument in accordance with the Standard Documents in Section 3.5.2.

B. All surveying work throughout the term of the Agreement shall be performed by the Concessionaire in accordance with VDOT's *Survey Manual*.

C. The Concessionaire is responsible for examination and verification of any data made available by VDOT.

D. The Concessionaire shall make available to VDOT hard copy and electronic files of all survey data, for existing and new conditions and infrastructure, which at a minimum include:

1. Survey control data;

2. Digital Terrain Model (DTM) and Construction Cross-Sections: Compatible to VDOT's current DTM format;

3. Horizontal and Vertical Control for Bridges: Certified plats, field notes, coordinates, and computations will be furnished by the Concessionaire prior to the Concessionaire beginning work on these structures;

4. Pipes, Culverts, Ditches and Related Appurtenances: Existing, newly installed control and as built survey data for existing and new pipes, culverts and ditches which at a minimum include horizontal and vertical controls, type, size, materials and inlet/outlet control, catch basins and manhole and other related infrastructure; and

5. Road right of way: Existing, newly constructed/installed control and as-built survey data for right of way cross section showing roads, lanning, shoulders, access and egress ramps and connections, embankments, utilities, drainage and all infrastructure within the road right of way, and for areas where connecting roads and infrastructure are impacted by the Work. The survey interval shall not be farther than 100-foot intervals. The data prepared by the Concessionaire shall include coordinates, type, size, material and references.

E. The Project Right of Way shall be staked by the Concessionaire in areas where Work shall occur if no limited access fence is present prior to the start of the Project. Right of way stakes shall be placed at a minimum of 100-foot intervals on each side of the roadway or as directed by VDOT and the stakes shall be marked with both the station and offset back to centerline. All final boundary stakeouts shall be performed by the Concessionaire.

F. Final right of way monumentation will be performed by the Concessionaire in accordance with the following:

1. RM-1: The Concessionaire shall furnish and shall be responsible to install RM-1 right of way monuments in accordance with the Road and Bridge Standards.

2. RM-2: The Concessionaire shall furnish and shall be responsible to install RM-2 right of way monuments and optional locator posts, including the required caps, in accordance with the Road and Bridge Standards.

G. VDOT will determine a reasonable alternative form of permanent monumentation to be used if RM-1 or RM-2 monuments are unsuitable for marking the Right of Way at various locations.

H. The Concessionaire will indicate this alternative monument usage on the final As-Built plan in accordance with VDOT's *Survey Manual*. Electronic data files along with paper sketches and drawings will be furnished by the Concessionaire. All electronic data files furnished by the Concessionaire will be in the format of VDOT's current computer hardware and software.

I. Additional surveying work and supplemental layout work shall be performed by the Concessionaire as needed to successfully complete the work. The Concessionaire shall provide and protect construction benchmarks within the construction limits. Construction benchmarks shall be located not farther than 500 feet apart for the total length of the Project. Construction benchmarks that are disturbed during construction operations shall be reestablished by the Concessionaire. All drawings, field notes, and computations from such survey work performed by the Concessionaire shall be submitted to VDOT as defined in the Concessionaire's Project Development Plans.

1.22 Security

1.22.1 General Requirements

A. Subject to the requirements of the Agreement, the Concessionaire shall adhere to the intent of VDOT policy on critical infrastructure information and sensitive security information (CII/SSI) to the extent such information is directly related to the Concessionaire's performance of its obligations under the Agreement. The Concessionaire shall ensure that relevant CII/SSI is protected and not disclosed to unauthorized persons. The Concessionaire shall ensure that all personnel having access to CII/SSI for the Concessionaire and all subcontractors have completed the non-disclosure forms in Attachment 3E.

B. VDOT may request fingerprint-based criminal history background checks on contractors working on specific structures or functions.

C. The Concessionaire shall review with VDOT any information that should be designated as CII/SSI as specific design details become available. Any requirements for security review or other inspections will be mutually agreed to with VDOT.

1.23 Railway-Highway Provisions

If the Concessionaire's Work requires hauling materials across the tracks of a railway, it shall make arrangements with the railway for any new crossing(s) required or the use of any existing crossing. Charges made by the railway company for the construction or use of new or existing crossings and their subsequent removal and for watchperson or flagger service at such crossings shall be reimbursed by the Concessionaire directly to the railway company under the terms of their own arrangements before Final Acceptance of the applicable Project Asset.

Work to be performed by the Concessionaire in construction on or over the railway right of way shall be performed at times and in a manner that will not interfere unnecessarily with the movement of trains or traffic on the railway track. The Concessionaire shall use care to avoid accidents, damage, or unnecessary delay or interference with the railway company's trains or other property. If any interruption of railway traffic or fouling of railway track is required by the Concessionaire's actions, it shall obtain prior written approval from the railway company.

The Concessionaire shall conduct operations that occur on or over the right of way of any railway company fully within the rules, regulations, and requirements of the railway company and in accordance with the requirements of any agreements made between VDOT and railway company that are made a part of the Agreement. The Concessionaire shall furnish the VDOT project manager a copy of all agreements between the railway and the Concessionaire. In compliance with Federal Railroad Administration regulations and as determined by the railway company, Concessionaire's employees that require Roadway Worker Protection training shall be provided same at the Concessionaire's expense.

A. Flagger or Watchperson Services: Flagger or watchperson services required by the railway company for the safety of railroad operations because of work being performed by the Concessionaire or incidental thereto will be provided by the railway company. The cost for such services will be borne by the Concessionaire.

   No work shall be undertaken on or over the railway right of way until the watchpersons or flaggers are present and in authority at the Project site. The Concessionaire shall continuously prosecute the affected work to completion to minimize the need for flagger or watchperson services.

B. Approval of Construction Methods on Railway Right of Way: The Concessionaire shall submit to VDOT a plan of operations showing the design and method of proposed structural operations and shall provide VDOT a copy of railway company's approval before performing any work on the railway company's right of way unless otherwise indicated in the railroad agreement. The plan shall be clear and legible, and details shall be drawn to scale. The plan shall show, but not be limited to, the following:

1. Proximity of construction operations to tracks;

2. Depth of excavation with respect to tracks;

3. Description of structural units;

4. Vertical and horizontal clearances to be afforded the railroad during installation and upon completion of excavation;

5. Sheeting and bracing; and

6. Method, sequence and schedule of operations.

Any review of or comment on the plan of operations by VDOT shall not relieve the Concessionaire of any liability under the Agreement. The Concessionaire shall arrange the work so as not to interfere with the railway company's operation except by agreement with the railway company.

C. Insurance: In addition to insurance or bonds required under the terms of the Agreement, the Concessionaire shall carry insurance covering operations affecting the property of the railway company as required by the any agreements between the Concessionaire and the railway company related to the Project. The original railroad protective liability insurance policy and certificate of insurance showing insurance carried by the Concessionaire and any Contractor shall be submitted to the railway company for approval and retention.

Neither the Concessionaire nor any Contractor shall begin any work affecting the railway company until the railway company has received the insurance.

Notice of any material change in or cancellation of the required policies shall be furnished VDOT and the railway company at least 30 days prior to the effective date of the change or cancellation. The insurance shall be of the following kinds and amounts:

1. Concessionaire's public liability and property damage insurance: The Concessionaire shall furnish evidence to VDOT with respect to the operations to be performed that he carries regular Concessionaire's public liability insurance. The insurance shall provide for a limit of at least the dollar value specified in the Agreement for all damages arising out of bodily injuries to or the death of one person, and subject to that limit for each person, a total limit of at least the dollar value specified in the Agreement for all damages arising out of bodily injuries to or death of two or more persons in any one occurrence, and regular Concessionaire's property damage insurance providing for a limit of at least the dollar value

specified in the Agreement for all damages arising out of bodily injury to or destruction of property in any one occurrence, and subject to that limit per occurrence, a total or aggregate limit of at least the dollar value specified in the Agreement for all damages arising out of injury to or destruction of property during the policy period. The Concessionaire's public liability and property damage insurance shall include explosion, collapse, and underground damage coverage. If the Concessionaire subcontracts any portion of the Work, it shall secure insurance protection in its own behalf under the Agreement's public liability and property damage insurance policies to cover any liability imposed on it by Law for damages because of bodily injury to, or death of persons and injury to, or destruction of property as a result of work undertaken by the Contractor. In addition, the Concessionaire shall provide similar insurance protection for and on behalf of any Contractors to cover their operation by means of separate and individual Concessionaire's public liability and property damage policies. As an alternative, the Concessionaire shall require each Contractor to provide such insurance in its own behalf.

2. Railroad protective insurance and public liability and property damage: The policy furnished the railway company shall include coverage for contamination, pollution, explosion, collapse, and underground damage. The policy shall be of the type specified hereinafter and shall be expressed in standard language that may not be amended. No part may be omitted except as indicated hereinafter or by an endorsement that states an amendment or exclusion of some provision of the form in accordance with the provisions of a manual rule. The form of the endorsement shall be approved as may be required by the supervising authority of the State in which the policy is issued. Several parts of the requirements and stipulations specified or inferred herein may appear in the policy in such sequence as the company may elect.

   a. For a policy issued by one company:

      (NAME AND LOCATION OF INDEMNITY COMPANY), a _____ Insurance Company, herein called the (Type of Company) Company, agrees with the insured named in the Declarations made a part hereof, in consideration of the payment of the premium and in reliance upon the statements in the Declarations made by the named insured and subject to all of the terms of his policy.

      For a policy issued by two companies:

(NAME AND LOCATION OF INDEMNITY COMPANY) and (NAME AND LOCATION OF INDEMNITY COMPANY), each a _____ Insurance Company, herein called (Type of Company) the Company, severally agree with the insured named in the Declarations made a part hereof, in consideration of the payment of the premium and in reliance upon the statements in the Declaration made by the named insured and subject to all of the terms of this policy, provided the named Indemnity Company shall be the insured with respect to Coverage _____ and no other and the named Insurance Company shall be the insurer with respect to Coverage _____ and no other.

b. Insuring agreements:

i. Coverages: Coverage A—Bodily injury liability: To pay on behalf of the insured all sums that the insured shall become legally obligated to pay as damages because of bodily injury, sickness, or disease including death at any time resulting there from (hereinafter called bodily injury) either i sustained by any person arising out of acts or omissions at the designated job site that are related to or are in connection with the work described in Item 6 of the Declarations; or ii sustained at the designated job site by the Concessionaire, any employee of the Concessionaire, any employee of the governmental authority specified in Item 5 of the Declarations, or any designated employee of the insured, whether or not arising out of such acts or omissions.

Coverage B—Property damage liability: To pay on behalf of the insured all sums the insured shall become legally obligated to pay as damages because of physical injury to or destruction of property, including loss of use of any property because of such injury or destruction (hereinafter called property damage) arising out of acts or omissions at the designated job site that are related to or are in connection with the work described in Item 6 of the Declarations.

Coverage C—Physical damage to property: To pay for direct and accidental loss of or damage to rolling stock and other contents, mechanical construction equipment, or motive power equipment (hereinafter called loss) arising out of acts or omissions at the designated job site that are related to or are in connection with the work described in Item 6 of the Declarations; provided such property is owned by the named

insured or is leased or entrusted to the named insured under a lease or trust agreement.

ii. Definitions: *Insured* includes the named insured and any executive officer, director, or stockholder thereof while acting within the scope of his duties as such.

Concessionaire means the Concessionaire designated in Item 4 of the Declarations and includes all Subcontractors of the Concessionaire but not the named insured.

Designated employee of the insured means i any supervisory employee of the insured at the job site; ii any employee of the insured while operating, attached to, or engaged on work trains or other railroad equipment at the job site that is assigned exclusively to the Concessionaire; or iii any employee of the insured not within i or ii who is specifically loaned or assigned to the work of the Concessionaire for prevention of accidents or protection of property, the cost of whose services is borne specifically by the Concessionaire or governmental authority.

Contract means any contract or agreement to carry a person or property for a consideration or any lease, trust, or interchange contract or agreement respecting motive power, rolling stock, or mechanical construction equipment.

iii. Defense and settlement supplementary payments: With respect to such insurance as is afforded by this policy under Coverages A and B, the Company shall defend any suit against the insured alleging such bodily injury or property damage and seeking damages that are payable under the terms of this policy, even if any of the allegations of the suit are groundless, false, or fraudulent. However, the Company may make such investigation and settlement of any claim or suit as it deems expedient.

In addition to the applicable limits of liability, the Company shall pay i all expenses incurred by the company, all costs taxed against the insured in any such suit, and all interest on the entire amount of any judgment therein that accrues after entry of the judgment and before the Company has paid or tendered or deposited in court that part of the judgment that does not exceed the limit of the Company's liability thereon; ii premiums on appeal bonds required in any such suit and

premiums on bonds to release attachments for an amount not in excess of the applicable limit of liability of this policy, but without obligation to apply for or furnish any such bonds; iii expenses incurred by the insured for first aid to others that shall be imperative at the time of the occurrence; and iv all reasonable expenses, other than loss of earnings, incurred by the insured at the Company's request.

iv. Policy period and territory: This policy applies only to occurrences and losses during the policy period and within the United States, its territories or possessions, or Canada.

c. Exclusions: This policy does not apply to the following:

i. liability assumed by the insured under any contract or agreement except a contract as defined herein

ii. bodily injury or property damage caused intentionally by or at the direction of the insured

iii. bodily injury, property damage, or loss that occurs after notification to the named insured of the acceptance of the work by the governmental authority, other than bodily injury, property damage, or loss resulting from the existence or removal of tools, uninstalled equipment, and abandoned or unused materials

iv. under Coverage Ai, B, and C, to bodily injury, property damage, or loss, the sole proximate cause of which is an act or omission of any insured

v. under Coverage A, to any obligation for which the insured or any carrier as his insurer may be held liable under any workers' compensation, employment compensation, or disability benefits Law or under any similar Law; provided that the Federal Employer's Liability Act, U.S. Code (1946) Title 45, Sections 51-60, as amended, shall for the purpose of this insurance be deemed not to be any similar Law

vi. under Coverage B, to injury to or destruction of property owned by the named insured or leased or entrusted to the named insured under a lease or trust agreement

vii. under any liability coverage, to injury, sickness, disease, death, or destruction i with respect to which an insured under the policy is also an insured under a nuclear energy liability policy issued by the Nuclear Energy Liability Insurance Association, Mutual Atomic Energy Liability Underwriters, or Nuclear Insurance Association of Canada or would be an insured under any such policy but for its termination upon exhaustion of its limit of liability; or ii resulting from the hazardous properties of nuclear material and with respect to which any person or organization is required to maintain financial protection pursuant to the Atomic Energy Act of 1954 or any Law amendatory thereof or the insured is (or had this policy not been issued would be) entitled to indemnity from the United States or any agency thereof under any agreement entered into by the United States, or any agency thereof, with any person or organization

viii. under any Medical Payments Coverage or any Supplementary Payments provision relating to immediate medical or surgical relief or to expenses incurred with respect to bodily injury, sickness, disease, or death resulting from the hazardous properties of nuclear material and arising out of the operation of a nuclear facility by any person or organization

ix. under any liability coverage, to injury, sickness, disease, death, or destruction resulting from the hazardous properties of nuclear material if i the nuclear material is at any nuclear facility owned or operated by or on behalf of an insured or has been discharged or dispersed there from; ii the nuclear material is contained in spent fuel or waste at any time possessed, handled, used, processed, stored, transported, or disposed of by or on behalf of an insured; or iii the injury, sickness, disease, death, or destruction arises out of the furnishing by an insured of services, materials, or parts for equipment in connection with the planning, construction, maintenance, operation, or use of any nuclear facility; if such facility is located in the United States, its territories or possessions, or Canada, this exclusion applies only to injury to or destruction of property at such nuclear facility

x. under Coverage C, to loss attributable to nuclear reaction, nuclear radiation, or radioactive contamination or to any act or condition incident to any of the foregoing

As used in exclusions vii, viii, and ix, the following definitions apply: *Hazardous properties* include radioactive, toxic, or explosive properties. *Nuclear material* means source material, special nuclear material, or byproduct material. *Source material, special nuclear material, and byproduct material* have the meanings given them in the Atomic Energy Act of 1954 or in any Law amendatory thereof. *Spent fuel* means any fuel element or fuel component (solid or liquid) that has been used or exposed to radiation in a nuclear reaction. *Disposable material* means material containing byproduct material and resulting from the operation by any person or organization of any nuclear facility included in the definition of nuclear facility under i or ii below. *Nuclear facility* means

i. any nuclear reactor

ii. any equipment or device designed or used for separating the isotopes of uranium or plutonium; processing or utilizing spent fuel; or handling, processing, or packaging waste

iii. any equipment or device designed or used for the processing, fabricating, or alloying of special nuclear material if at any time the total amount of such material in the custody of the insured at the premises where such equipment or device is located consists of or contains more than 25 grams of plutonium or uranium 233 (or any combination thereof) or more than 250 grams of uranium 235

iv. any structure, basin, excavation, premises, or place prepared or used for the storage or disposal of waste (includes the site on which any of the foregoing is located, all operation conducted on such site, and all premises used for such operations) *Nuclear reactor* means any apparatus designed or used to sustain nuclear fission in a self-supporting chain reaction or to contain a critical mass of fissionable material. With respect to injury to or destruction of property, *injury* or *destruction* includes all forms of radioactive contamination of property.

d. Conditions: The following conditions, except conditions iii through xii, apply to all coverages. Conditions iii through xii apply only to the coverage noted there under.

i. Premium: The premium bases and rates for the hazards described in the Declarations are stated therein. Premium

bases and rates for hazards not so described are those applicable in accordance with the requirements of the manuals used by the company. The term *contract cost* means the total cost of all work described in Item 6 of the Declaration. The term *rental cost* means the total cost to the Concessionaire for rental or work trains or other railroad equipment, including the remuneration of all employees of the insured while operating, attached to, or engaged thereon. The advance premium stated in the Declarations is an estimated premium only. Upon termination of this policy, the earned premium shall be computed in accordance with the Company's rules, rates, rating plans, premiums, and minimum premiums applicable to this insurance. If the earned premium thus computed exceeds the estimated advance premium paid, the Company shall look to the Concessionaire specified in the Declarations for any such excess. If less, the Company shall return to the Concessionaire the unearned portion paid. In no event shall payment or premium be an obligation of the named insured.

ii. Inspection: The named insured shall make available to the Company records of information relating to the subject matter of this insurance. The Company shall be permitted to inspect all operations in connection with the work described in Item 6 of the Declarations.

iii. Limits of liability, Coverage A: The limit of bodily injury liability stated in the Declarations as applicable to "each person" is the limit of the Company's liability for all damages (including damages for care and loss of services) arising out of bodily injury sustained by one person as the result of any one occurrence. The limit of such liability stated in the Declarations as applicable to "each occurrence" is (subject to the provision respecting each person) the total limit of the Company's liability for all such damage arising out of bodily injury sustained by two or more persons as the result of any one occurrence.

iv. Limits of liability, Coverages B and C: The limit of liability under Coverages B and C stated in the Declarations as applicable to "each occurrence" is the total limit of the Company's liability for all damages and all loss under Coverages B and C combined arising out of physical injury to, destruction of, or loss of all property of one or more persons or organizations, including the loss or use of any property

attributable to such injury or destruction under Coverage B, as the result of any one occurrence. Subject to the provision respecting "each occurrence", the limit of liability under Coverages B and C stated in the declaration as "aggregate" is the total limit of the Company's liability for all damages and all loss under Coverages B and C combined arising out of physical injury to, destruction of, or loss of property, including the loss or use of any property attributable to such injury or destruction under Coverage B.

Under Coverage C, the limit of the Company's liability for loss shall not exceed the actual cash value of the property, or if the loss is a part thereof, the actual cash value of such part, at time of loss, nor what it would then cost to repair or replace the property of such part thereof with other of like kind and quality.

v. Severability of interests, Coverages A and B: The term *the insured* is used severally and not collectively. However, inclusion herein of more than one insured shall not operate to increase the limits of the Company's liability.

vi. Notice: In the event of an occurrence or loss, written notice containing particulars sufficient to identify the insured and also reasonably obtainable information with respect to the time, place, and circumstances thereof and the names and addresses of the injured and of able witnesses shall be given by or for the insured to the company or any of its authorized agents as soon as is practicable. If a claim is made or a suit is brought against the insured, he shall immediately forward to the Company every demand, notice, summons, or other process received by him or his representative.

vii. Assistance and cooperation of the insured, Coverages A and B: The insured shall cooperate with the Company and upon the Company's request attend hearings and trials and assist in making settlements, securing and giving evidence, obtaining the attendance of witnesses, and conducting suits. Except at his own cost, the insured shall not voluntarily make any payment, assume any obligations, or incur any expense other than for first aid to others that shall be imperative at the time of an accident.

viii. Action against Company, Coverages A and B: No action shall lie against the Company unless as a condition precedent thereto the insured shall have fully complied with all the terms of this policy, nor until the amount of the insured's obligation to pay shall have been finally determined either by judgment against the insured after actual trial or by written agreement of the insured, the claimant, and the Company. Any person or organization or the legal representative thereof who has secured such judgment or written agreement shall thereafter be entitled to recover under this policy to the extent of the insurance afforded by this policy. No person or organization shall have any right under this policy to join the Company as a part to any action against the insured to determine the insured's liability. Bankruptcy or insolvency of the insured or of the insured's estate shall not relieve the Company of any of its obligations hereunder.

ix. Action against Company, Coverage C: No action shall lie against the Company unless as a condition precedent thereto there shall have been full compliance with all the terms of this policy nor until 30 days after proof of loss is filed and the amount of loss is determined as provided in this policy.

x. Insured's duties in event of loss, Coverage C: In the event of loss, the insured shall protect the property, whether or not the loss is covered by this policy. Any further loss attributable to the insured's failure to protect shall not be recoverable under this policy. Reasonable expenses incurred in affording such protection shall be deemed incurred at the company's request.

The insured shall also file with the Company, as soon as practicable after loss, his sworn proof of loss in such form and including such information as the Company may reasonably require and shall, upon the Company's request, exhibit the damaged property.

xi. Appraisal, Coverage C: If the insured and the Company fail to agree as to the amount of loss, either may demand an appraisal of the loss within 60 days after the proof of loss is filed. In such event the insured and the Company shall each select a competent appraiser, and the appraisers shall select a competent and disinterested umpire. An award in writing or any two shall determine the amount of loss. The insured and the Company shall each pay his chosen appraiser and shall bear

equally the other expenses of the appraisal and umpire. The Company shall not be held to have waived any of its rights by any act relating to appraisal.

xii. Payment of loss, Coverage C: The Company may pay for the loss in money, but there shall be no abandonment of the damaged property to the Company.

xiii. No benefit to bailee coverage: The insurance afforded by this policy shall not enure directly or indirectly to the benefit of any carrier or bailee (other than the named insured) liable for loss to the property.

xiv. Subrogation: In the event of any payment under this policy, the Company shall be subrogated to all of the insured's rights of recovery therefore against any person or organization. The insured shall execute and deliver instruments and papers and do whatever else is necessary to secure such rights. The insured shall do nothing after loss to prejudice such rights.

xv. Application of insurance: The insurance afforded by this policy is primary insurance. If the insured has other primary insurance against a loss covered by this policy, the Company shall not be liable under the policy for a greater proportion of such loss than the applicable limit of liability stated in the Contract bears to the total applicable limit of all valid and equitable insurance against such loss.

xvi. 3-year policy: A policy period of 3 years is comprised of three consecutive annual periods. Computation and adjustment of earned premium shall be made at the end of each annual period. Aggregate limits of liability as stated in this policy shall apply separately to each annual period.

xvii. Changes: Notice to any agent of knowledge possessed by any agent or by any other person shall not affect a waiver or a change in any part of this policy or stop the Company from asserting any right under the terms except by endorsement issued to form a part of this policy signed by *_____ provided, however, changes may be made in the written portion of the declaration by *_____ when initialed by such *_____ or by endorsement issued to form a part of this policy signed by such

*_____. [*Insert titles of authorized company representatives.]

xviii. Assignment: Assignment of interest under this policy shall not bind the Company until its consent is endorsed hereon.

xix. Cancellation: This policy may be cancelled by the named insured by mailing to the Company written notice stating when the cancellation shall become effective. This policy may be cancelled by the Company by mailing to the named insured, Concessionaire, and governmental authority at the respective addresses shown in this policy written notice stating when such cancellation shall be effective (not less than 30 days thereafter). The mailing of notice shall be sufficient proof of notice. The effective date and hour of cancellation stated in the notice shall become the end of the policy period. Delivery of such written notice either by the named insured or the Company shall be equivalent to mailing. If the named insured cancels, the earned premium shall be computed in accordance with the customary short rate table and procedure. If the Company cancels, the earned premium shall be computed pro rata. The premium may be adjusted either at the time cancellation is effected or as soon as practicable after the cancellation becomes effective, but payment or tender of unearned premium is not a condition of cancellation.

xx. Declarations: By acceptance of this policy, the named insured agrees that such statements in the Declarations as are made by him are his agreements and representations, that his policy is issued in reliance on the truth of such representations, and that this policy embodies all agreements existing between himself and the Company or any of its agents relating to this insurance.

e. For a policy issued by one company:

In witness whereof, the _____ Indemnity Company has caused this policy to be signed by its president and a secretary at _____ and countersigned on the Declarations page by a duly authorized agent of the Company.

(Facsimile of Signature) Secretary	(Facsimile of Signature) President

For a policy issued by two companies:

In witness whereof, the _____ Indemnity Company has caused this policy with respect to Coverages _____ and such other parts of the policy as are applicable thereto to be signed by its president and a secretary at _____ and countersigned on the Declarations page by a duly authorized agent of the Company.

(Facsimile of Signature) Secretary	(Facsimile of Signature) President

D. Submitting Copies of Insurance Policies: Prior to beginning construction operations on or over the railway right of way, the Concessionaire shall submit to VDOT evidence of the railway company's approval and a copy of the required insurance policies.

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The Technical Requirements

Comprehensive Agreement Exhibit C

Section 2

Public Information and Communications

TECHNICAL REQUIREMENTS
Exhibit C

2 Public Information and Communications

2.1 Public Information

2.1.1 General Requirements

The Concessionaire in collaboration with VDOT shall develop the required process and procedures for media relations and public information in the form of Public Information and Communications, which will be consistent with the Agreement. These processes and procedures will acknowledge that there are differing responsibilities for both parties depending on the status of the Project.

2.1.2 Interface and Liaison with VDOT

A. Management protocols shall be developed between the Concessionaire's project communication team and VDOT's Project Manager. These protocols shall detail:

1. A regime of regular reporting to VDOT on marketing and communication activities, current and outstanding community issues, and recent media activity.

2. Media protocols, as established, to provide clarity of responsibility in relation to media comment on particular aspects of the Project.

3. Stakeholder relations protocols, assigning responsibility for briefing and information to stakeholders on Project progress and milestones.

4. Requirements in relation to VDOT's review and comment on Project marketing, communication, and public outreach material.

5. Processes for managing communication surrounding emergency management and recovery operations.

6. Recognition that each party has a brand that it needs to promote and defend.

B. The Concessionaire in collaboration with VDOT's Project Manager will determine which party leads all meetings related to the Project.

C. Meetings and public interface required by Federal and State Law (e.g., Design Public Hearing) will be conducted in accordance with the current version of VDOT's *Policy Manual for Public Participation in Transportation Projects*. The Concessionaire will conduct additional meetings, public interface and marketing activities in accordance with the Communication Plan. These endeavors fall

outside the purpose of the Policy Manual and accordingly will not need to follow the guidelines established.

D. The Concessionaire shall collaborate with VDOT in the development of all communications and marketing strategies to ensure they are consistent with both parties' values, needs, and goals. The Concessionaire shall provide VDOT with advance copies of communications materials for review and comment prior to dissemination.

2.1.3 Project Communication Team

A. The Concessionaire shall establish a Project communication team through which all communication and public outreach activities on the Project on behalf of the Concessionaire will be coordinated.

B. The Project communication team will be established and coordinated by the Concessionaire. It may include:

1. A Public Affairs Manager who shall have responsibility for coordinating delivery of the Public Information Plan. The Public Affairs Manager will manage the relationship with VDOT and reporting on all communication and outreach activity.

2. A Public Information Manager and adequate support staff and/or consultants, responsible for community outreach and information activities during the performance of the Design-Build Work. The Public Information Manager will report to the Design-Build Contractor's functional management but will operate as a member of the Project communication team.

3. The Project communication team will develop and agree upon team protocols for communication between team members, incorporating measures related to notification and approval timeframes, media interface, and preparation of Project communication materials.

2.1.4 Construction Period Public Information and Involvement

A. The Concessionaire's and VDOT's communications team shall maintain an open dialogue with the stakeholders and communities immediately surrounding the Project with the objective of building a long-term relationship based on trust and respect. The Concessionaire will work with the communities to identify specific concerns and strategies for mitigation.

B. The Concessionaire shall prepare and implement Project Development Plans (PDPs) in accordance with Section 3.3.

2.1.5 Pre-Operations and Operations – Public Engagement and Awareness

A. The Concessionaire shall ensure that motorists are educated about the features and benefits of the Project, so that they can make an informed choice about their use of the tolled facility once open to traffic.

B. The Concessionaire shall develop a public engagement and awareness program to fit within the context of the broader Public Information and Communications Plan for the Project. It shall address but will not be limited to:

1. Education about congestion pricing.

2. Information on requirements for using tolled facilities, including transponder requirements.

3. Plans for the opening of the Project to traffic and communications that will facilitate smooth ongoing operations.

4. Interface with E-Z Pass marketing and communications, to facilitate distribution of transponders to motorists who intend to use the tolled facilities.

5. Education about driver information systems in use on the tolling pricing schemes, so motorists understand on-road sources of information that will facilitate choice and Lane Control Signals (LCS) of the Lane Use Management System (LUMS).

6. Provision of information to motorists and stakeholders to facilitate the MOT during ongoing maintenance activities. This shall include:

   a. Packaging of all MOT information, such as anticipated delays and lane closures, for provision to the Project Communication Team and to VDOT on a regular basis, to facilitate communication to the media, stakeholders, and the broader community.

   b. Communication with property owners in direct impact areas.

7. Communication with elected officials and other key stakeholders shall be managed collaboratively by Concessionaire and VDOT. Public officials and other key stakeholders may want to have direct contact with the Concessionaire and may do so, so long as VDOT is aware of the invitation

and the nature of conversations to be held. A senior member of VDOT's project team may be invited to accompany the Concessionaire to engagements of this nature. The Concessionaire does not need to communicate any activity to VDOT with elected officials or any person or body if the focus of the communication is solely a private corporate communication, including those directly related to the Concessionaire's activities related to the Project.

8. Coordination with local agencies.

9. Notification program to inform motorists and the broader community about expected traffic changes/delays.

2.2 Media Relations

2.2.1 Media Outreach

A. While there will be some overlap between the parties on some communication and outreach activities during the performance of the Design-Build Work, VDOT will serve as the sole source to the news media and community stakeholders on specific lane closures, delays, detours, and other construction impacts associated with the Project during the performance of the Design-Build Work. The Concessionaire and VDOT will ensure close coordination with each other on media outreach activities, issues, and responses, and will promote consistency with the Public Information and Communications Plan.

B. The Concessionaire shall:

1. Develop and provide to VDOT for review and approval a set of media protocols governing responsibilities and reporting in relation to contact with the media, including guidelines for information sharing, policies to promote consistent messages, and procedures specific to managing emergencies and incidents.

2. Develop and provide to VDOT for review and comment a set of media protocols within the Project team.

3. Proactively build and maintain relationships, in collaboration with VDOT, with local media.

4. Provide timely response to media inquiries and keep VDOT informed of media inquiries regarding the Project and the nature of responses that are documented as mutually agreed.

5. Provide relevant Project information to the media in a timely fashion.

6. Monitor all media coverage of the Project.

7. Provide copies of all press releases or other media materials to VDOT in advance of distribution.

2.3 Project Marketing

2.3.1 Project Branding

All public communication on the Project will be undertaken within the framework of a uniform project 'brand' to ensure consistency of the marketing and communication across all Project phases. The branding will be developed by the Concessionaire and is subject to VDOT's approval, which shall not be unreasonably withheld.

2.3.2 Market Research and Analysis

A. Communication, marketing, and public outreach activities will be designed to respond to the issues, attitudes, and attributes of the communities and market segments relevant to the Project.

B. The Concessionaire shall:

1. Conduct market research as required to guide marketing and communication activities.

2. Establish project communication benchmarks and measure and report on community awareness, attitudes, and satisfaction towards the Project.

2.4 Communities and Public Outreach

2.4.1 Integrated Public Information and Communications Plan

A. The Concessionaire shall deliver an integrated Public Information and Communications Plan that:

1. Provides an effective framework for communication between the Concessionaire and stakeholders.

2. Effectively engages the community in the design, construction, and operation of the Project to minimize negative impacts and maximize positive outcomes.

3. Builds a strong and enduring relationship with stakeholders and the community within the toll facilities catchments over the Term.

4. Identifies risks and risk management associated with the Project.

5. Develops a strong and enduring brand relationship between the community, toll facility drivers, and the owners and operators of the Project.

6. Maximizes public awareness of the features and benefits of the tolled facilities.

7. Ensures the public understands how best to use the tolled facilities and the requirements for travel on the system, including congestion pricing and paying tolls, obtaining and using transponders, and user eligibility requirements.

B. The Public Information and Communications Plan, will build on the protocol, plans and efforts agreed during the Interim Agreement phase. These shall be consistent with VDOT's goals for the Project, will be presented to VDOT for review and comment and will form the basis for all communication activities during the design and construction of the Project, as well as during the pre-operational and operational period.

C. The plan shall provide a detailed outline of communication tools and strategies to be employed during each phase of the Project development, delivery, and operation, including the matters outlined in the sections below.

D. The plan shall contain a crisis communications plan and procedures for coordination with VDOT and responsiveness to the media.

2.4.2 Stakeholder Outreach and Information

A. The Concessionaire shall develop, deliver, and operate the Project in a manner consistent with building and maintaining effective working relationships with all stakeholders in the Project's success.

B. The Concessionaire shall:

1. Develop and maintain a comprehensive stakeholder database to track and manage stakeholder communication that will be shared with VDOT's CRM system.

2. Develop and maintain the Project web site.

3. Provide web site copy to VDOT for review and input prior to posting. The web site shall at a minimum contain a graphical Project overview, contact information, plan of work for the coming month, overall Project schedule, a frequently asked questions area, and updated Project photos. The web site shall be updated as necessary throughout the duration of the Project.

4. Provide a point of contact and phone number for the public to ask questions and share concerns during the Project.

5. Develop, in collaboration with VDOT, a proactive program of stakeholder engagements to brief local stakeholders on the Project's progress, features and benefits.

6. Develop tailored marketing and communication material for relevant stakeholder groups.

7. Establish ongoing mechanisms for stakeholder information and input during the Project's operational phase, including communications surrounding enforcement technologies and strategies.

8. Establish partnerships with local groups and organizations where there is mutual benefit in supporting the Project.

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Section 3

Project Management

TECHNICAL REQUIREMENTS
Exhibit C

3 Project Management

3.1 General

A. The Concessionaire shall establish and maintain an organization that effectively manages all elements of the Project. This project management effort will be defined and guided by the Project Development Plans (PDPs), as described in Section 3.3.

3.2 Project Administration

3.2.1 General Requirements

A. The Concessionaire's management approach shall provide all components of an effective and efficient management system, including communication and reporting; documentation of the Work; supervision of Work personnel and activities; all tools, facilities, and materials; environmental protection and mitigation; safety of Work personnel; and any other management elements needed to produce and document a high-quality, safe, efficient, and operable project that complies with Good Industry Practice.

B. The Concessionaire's Contractors shall prequalify in accordance with VDOT's Contractor Prequalification Program.

C. The Concessionaire shall note and comply with the requirements of the eVA vendor system throughout the Term.

3.2.2 Project Workers

A. Each party shall notify the other party, in writing, if they believe any person employed by VDOT or the Concessionaire, or any Contractor:

1. Is not performing his or her work in a proper or skillful manner;

2. Is intemperate or disorderly; or

3. Is acting in an unsafe manner.

The party receiving the notice will immediately investigate the specifics of the notification and provide a response to the party initiating the notification and provide a response to the party initiating the notification, within 5 days, detailing a plan of action to resolve the written concerns. If the employees' actions create an unsafe environment for the Concessionaire's workers, VDOT personnel or

travelling public, the Concessionaire will immediately stop the operations to resolve safety issues in accordance with the Agreement.

3.2.3 Quality Management System

A. The Concessionaire's Quality Management System Plan (QMSP) shall meet the Standard Documents in Section 3.5, including VDOT's *Minimum Requirements for Quality Assurance & Quality Control on Design-Build & Public-Private Transportation Act Projects* – August 2008. Where appropriate, the QMSP shall also incorporate requirements from VDOT's *Manual of Instruction-Materials Division, Construction Manual, Maintenance Manual, and Inspection Manual.* 2

B. Where applicable, the QMSP shall be consistent with the relevant requirements of the current version of ISO 9001:2008. 2

C. The QMSP shall describe the system, policies, and procedures that address the Work required delivering the Project and providing documented evidence that the Work was performed in accordance with the Agreement.

D. The Concessionaire's QMSP shall include a Quality Management Plan that describes the roles of the Design-Build Contractor and the O&M Contractor in the implementation of the pertinent sections of the Concessionaire's quality management system for the Work.

E. The Concessionaire's Contractors shall adhere to the QMSP.

F. The Concessionaire will regularly audit and report to VDOT its compliance with all PDPs as part of their quality systems as described in Section 3.3 and Attachment 3A. 2

G. The Concessionaire and its Contractors will ensure that their quality records are freely and readily available to VDOT in order to enable them to monitor and establish whether the Concessionaire's obligations under the Agreement are met. 1

H. The Concessionaire may use VDOT's resources for the following construction quality control activities where VDOT routinely provides these services:

1. Offsite programmatic inspection, including supplier plant acceptance inspections; and

2. Offsite programmatic testing, including supplier plant acceptance testing.

3.2.4 Submittals

A. The Concessionaire shall coordinate, deliver, and process all submittals to VDOT as required by the Agreement. VDOT shall follow the Design Review Process as outlined in Attachment 3E. 1 3

B. The Concessionaire shall issue to VDOT and other appropriate parties electronic copies of all correspondence, minutes of meetings, and other external documents reflecting or constituting any and all communications with: 3

1. Governmental Authorities;
2. Stakeholders directly impacted by this Project including right of way issues;
3. Utilities; and
4. Railroads.

C. The Concessionaire shall provide design and construction submittals to VDOT as both hard-copy and electronic files. These documents will be deemed "received" by VDOT (thereby triggering the applicable timeframe for review) on submission of either the electronic files or hard copy of the submittal. 3 1

D. Design submittals and RFC Drawings will be submitted in .pdf format and 5 hard paper copies. 3 4

E. VDOT may request the CADD .dgn files at interim design submittals to facilitate review

F. Deleted 3

G. The Concessionaire will transfer all electronic document submittals into VDOT's Electronic Document Management System (EDMS) or through a secure website maintained by the Concessionaire. All files shall be well organized and easy to locate in accordance with Section 3.2.8 (Document Management System). The file transfer shall be conducted as follows:

1. The Concessionaire shall not include any files as attachments to e-mail messages that are greater than 10 MB. 3

2. E-mail may be used to notify VDOT of the availability of the document files, and if a file transfer protocol or SharePoint website or other type of approved electronic data storage and retrieval system is used, the e-mail must include a link to the document file to facilitate access and download.

H. Deleted

I. Deleted

J. Deleted

K. RFC documentation shall include all drawings, specifications, revisions thereto, and any other items necessary to construct the Work. All RFC documents shall be submitted to VDOT for approval and concurrence by the VDOT Chief Engineer. The Concessionaire shall ensure that the RFC documentation is sealed by a Professional Engineer licensed by the Commonwealth of Virginia.

L. The Concessionaire shall identify submittals by the complete State project and job designation numbers.

M. Where public safety is a concern, a Professional Engineer, holding a valid license to practice engineering in the Commonwealth, shall certify submittals for but not limited to falsework supporting a bridge superstructure; concrete structures and pre-stressed concrete members; lighting, signal, and pedestrian poles; sign structures; breakaway support systems; anchor bolts; and foundations.

N. Deleted

O. Deleted

3.2.5 Plans and Working Drawings

A. The Concessionaire shall furnish all plans and drawings showing such details as are necessary to give a comprehensive understanding of the Work specified. Except as otherwise shown on the plans, dimensions shown on the plans are measured in the respective horizontal or vertical planes. Dimensions that are affected by gradients or vertical curvatures shall be adjusted as necessary to accommodate actual field conditions and shall be specifically denoted on the working drawings.

B. The Concessionaire shall furnish working drawings and maintain a set for VDOT in accordance with the Agreement.

3.2.6 Accommodations for VDOT Staff during Performance of the Design-Build Work

A. The Project office complex (Command Center) shall include the following:

1. Minimum of 150 square feet per person. (Anticipate 22 Personnel at Project Peak) 3

2. The Concessionaire will make every effort to utilize the existing Pinners Point facility (152 Tunnel Facility Drive, Portsmouth, VA 23707) as the Command Center for the Project. If different, the Physical Location will be within the O&M Boundaries as identified in the Turnover Plan. Final location shall be approved by the VDOT Project Manager. Any proposed locations outside of the O&M Boundaries shall also be reviewed and approved by the VDOT Project Manager. 3

3. Minimum of 5 – 12' x 12' hard offices

4. Minimum of 17 – 8' x 8' cubicles or work areas with work surface, cabinets and drawers, and other standard items in office cubicles. 3

5. Standard office furniture (desk 60"x 34", chairs with rolling casters, rolling pad, stapler, tape dispenser)

6. 1 – 4 drawer metal fire protection file cabinet per person

7. 1 – 4 shelf bookcase per person

8. 1 dry erase board per 10 people

9. 1 Computer or laptop per person/workstation. Each computer or laptop shall have minimum of 4 GB RAM not to exceed $4,000 each. All computers or laptops shall have color monitors with minimum diagonals of 17" and mouse/keyboards will be supplied. All computers or laptops shall include, the latest software version of Microsoft Office, Adobe Acrobat Reader and Writer, Adobe Photoshop Elements and Norton Antivirus or acceptable antivirus protection. 3

10. All computer and copying equipment shall have networking and internet capabilities. All power cords, cabling and hardware is to be supplied and connected so as to provide interconnection between the computer or laptop and accessories, as well as connection to the internet. 3

11. Provide infrastructure and access capabilities to the internet

12. 1 black/white printer not to exceed $1,000 each per 4 persons. Printer shall have capabilities to print on 8.5” x 11”, 8.5” x 14” and 11” x 17” paper. Printer shall have a minimum memory of 128 MB and a printer speed of at least 52 ppm. 3

13. 1 color printer not to exceed $2,000 per 10 persons. Printer shall have capabilities to print on 8.5” x 11”, 8.5” x 14” and 11” x 17” paper. Printer shall have a minimum memory of 160 MB and a printer speed of at least 27 ppm for black and white pages and color pages. 3

14. Special software (i.e. Microstation V8, Geopack, Autocad, Primavera V6, Microsoft Project, ArcGIS, Highway Capacity Software and CORSIM) for 4 computers. All cost for special software licensing is to be borne by the Concessionaire. 3

15. 1 microwave oven minimum of 1000 watts per 20 persons

16. 1 full size refrigerator per 20 persons

17. 1 wastebasket per person

18. 1 first aid kit per 5 persons

19. 1 copy machine per 10 persons with minimum features: capable of coping 8 ½” by 11” up to 11”x 17”, sorter, automatic feed and paper selection, magnification and reduction, service contract for maintenance and drum toner replacement

20. 1 scanner/plotter/fax machine

21. Smoke detectors and fire extinguishers in accordance with local codes

22. Installation and payment of phone service available for each cubicle with answering and message services

23. Installation and payment of internet service available for each computer

24. Installation and payment of utilities to operate all field office functions

25. Minimum 22 Parking spaces readily adjacent to the office structure 3

26. Minimum 12’ x 16’ conference room with conference table and conference chairs to seat 10 people. Conference room to be supplied with a phone suitable for conducting conference calls.

27. Plan Rack for 24” x 36” drawings with 12 plan clamps

28. 4 Plan and Drafting Tables (30” x 96”) with adjustable stools

29. 10’ x 10’ Receptionist area with counter style work area

30. Water Coolers or continual supply of bottled adequate for 22 people △3

31. Office structure shall be watertight and have a robust HVAC system to maintain a constant temperature of 72 degrees Fahrenheit in all areas of the office throughout all seasonal effects.

32. Adequate lavatory facilities to account for 40 personnel both Men and Women

33. All utility (electric, gas, water, sewer, telecommunications, phone) feeds, connections, disconnections and bill payments shall be borne by concessionaire.

34. 15’ x 10’ Kitchen area with a sink and dish washing capabilities. Two lunch style tables and chairs to seat a total of 8 people

35. 10’x10’ Storage room with a door having a locking assembly. 10 spare keys shall be provided to the VDOT project manager.

36. Adequate number of windows to allow for natural light entrance per architectural standards. Windows shall have screens and the capability to open to allow the entrance of outside air. Windows shall also have locking assemblies.

37. Adequate overhead lighting in all parts of the office per Architectural standards.

38. Exterior doors shall be equipped with adequate locking assemblies. 40 spare keys shall be provided to the VDOT project manager

39. 1 – Paper shredder per 20 people

40. Bi-weekly Janitorial Services △3

41. Exterior Way Finding and Project Office Identification Signage

△3

B. The Project office complex (Command Center) shall be available from 60 days after the later of Financial Close or any LNTP or notice to proceed issued pursuant to Section 8.02 or 8.03 of the Agreement to 120 days after Final Completion.

3.2.7 Documentation Management System

A. The Concessionaire shall establish and maintain an Electronic Document Management System (EDMS) to store and record all relevant documents generated on the Project, including those records required under Applicable Law.

B. In the provision of an EDMS, the Concessionaire shall:

1. Use data systems, standards, and procedures with consistent naming and searching protocols;

2. Ensure document retention for any minimum statutory period(s);

3. Provide a secure EDMS, such that only authorized users have access and that it is protected from theft, damage, unauthorized or malicious use;

4. Provide a mechanism, mutually agreed by VDOT and the Concessionaire, for the electronic transfer of documents including metadata in standard business file format for uploading into the EDMS employed by VDOT; and 4

5. Provide VDOT with procedures for accessing all relevant documents generated under the Agreement. All electronic information submitted to VDOT shall be searchable, where possible, and legible.

C. In the relevant PDP, the Concessionaire shall describe:

1. Methods by which all documents issued and received by the Concessionaire shall be uniquely coded and retrievable in a user-friendly format;

2. The routing, filing, control, and retrieval methods for all documents; and

3. Methods to facilitate data sharing, including procedures for accessing all documents.

3.2.8 Project Meetings

A. The project manager(s) and other pertinent representatives of the parties shall meet within 10 days after the Financial Closing Date to discuss issues affecting the administration of the Work and to implement the necessary procedures, including those relating to submittals, to facilitate the ability of the parties to perform their obligations under the Agreement.

B. Within 14 days after issuance of the Design Work Notice to Proceed, the parties and their respective representatives shall conduct a pre-construction meeting to discuss the Concessionaire's planned construction operations. At the pre-construction meeting, the parties shall discuss, among other things, the sequence of the Work, scheduling, constructability issues, coordination with Governmental Authorities and Utilities, and maintenance of traffic.

C. Following issuance of the Design Work Notice to Proceed, the Concessionaire shall hold monthly progress meetings with VDOT. During such meetings, progress during the prior month, Work to be undertaken during the next month, and encountered or anticipated issues shall be reviewed, and the Concessionaire shall collect information from any Contractors responsible for Work completed during the specified duration and Work scheduled during the upcoming reporting duration. These meetings shall be attended by the Concessionaire Representative and other personnel as requested by VDOT, including relevant Contractors. The Concessionaire shall be responsible for preparing, maintaining and distributing minutes of the meetings to all attendees for review. The meeting minutes shall be provided to VDOT within three days after the monthly progress meeting. 1

D. As part of, and in conjunction with, the monthly meetings required by Section 3.2.8.C above, the Concessionaire shall provide VDOT with any proposed update of the Baseline Schedule for VDOT's review, and, if required by the Technical Requirements, approval, and a progress narrative that describes, at a minimum, the overall progress for the preceding month, a critical path analysis, a discussion of problems encountered and proposed solutions thereof, work calendars, constraints, delays experienced and any pending Time Impact Analysis (TIA), documentation of any logic changes and duration changes. The monthly progress narrative shall also include the following: 1

1. A statement by the Concessionaire that the schedule submitted is the Project Schedule;

3.2.9 Source of Supply and Quality Requirements

A. The QMSP shall describe procedures for ensuring that materials used throughout the Work conform to the requirements of the Agreement. Unless otherwise specified in the Technical Requirements, materials, equipment, and components that are to be incorporated into the finished Work shall be new. The

Concessionaire shall file a statement of the known origin, composition, and manufacture of all materials to be used in the Work, including optional or alternate items as part of the AFC Documents. The Concessionaire's statement shall be electronically submitted to VDOT by use of VDOT's Form C-25 after satisfying Concessionaire's QMSP.

B. All materials or equipment must conform to the requirements of the Agreement, and shall be furnished with valid test data required to document the quality of the material or equipment at least two weeks prior to delivery. The Concessionaire shall change the source of supply and furnish material or equipment from other approved sources if the requirements are not met and shall notify VDOT of this change, and provide the same identifying information noted in this section, prior to installation or use. Materials shall not contain Hazardous Substances or be furnished from a source containing toxic, hazardous or regulated solid wastes. 1

3.2.10 Invoicing

A. The invoices will be a mutually agreed-upon format, and include a reasonable level of back-up documentation. Such invoices shall include the following:

1. The project number;

2. A letter from VDOT's project manager verifying the total amount of costs set forth in the invoice, the timeframe such costs were incurred;

3. Back-up documentation for vouchers for more than $500.00 (the voucher back-up documentation will include the paperwork retained by VDOT for audit purposes); and

4. Back-up documentation including the production of VDOT's timesheets, as housed in VDOT's financial system.

3.3 Project Development Plans

3.3.1 General

A. The Concessionaire shall provide Project Development Plans (PDP) as defined in this section, and detailed in Attachment 3A to this Exhibit D. Such PDPs shall address the activities of the Concessionaire and shall not obligate VDOT to perform any activity unless defined in the Agreement.

B. VDOT's right to review and approve the PDPs is set forth in Attachment 3A. 1

C. The PDPs shall meet the requirements of the Agreement. Further information regarding the development of the PDPs is noted in the following sections and in Attachment 3A. Each PDP shall be developed by the Concessionaire to comply with the following:

1. The scope, goals and objectives of the plan is clearly stated and detailed descriptions of items is provided;

2. The plan is fully compliant with the Agreement;

3. Applicable codes, standards, specifications, and regulatory requirements, are stated;

4. The plan is consistent with ISO principles;

5. Each plan is consistent and links to other relevant PDPs;

6. The requirements for submission, review and acceptance by VDOT is as described in Attachment 3A; 1

7. The plan identifies individuals responsible for ensuring that required activities are planned, reviewed, implemented and controlled, and their progress monitored by qualified professionals;

8. The resources and particular competencies required for defined roles and activities for successful execution of the plan are stated, including the need for staff training;

9. The requirements for records are established, including maintenance of records, record retention, retrieval, and disposal;

10. Documents and data are controlled and responsibility for review and approval assigned;

11. Procedures for updates and revisions to the plan are stated;

12. The requirements for reviews, quality management, adequacy and effectiveness of the plan are stated and flow through to PDP revision procedures;

13. The plan clearly indicates that the Concessionaire has full responsibility for the plan and all quality control and quality assurance activities;

14. Quality control and assurance procedures and internal audit procedures are clearly stated, including the processes for identifying and controlling non-conformances;

15. Recording and reporting procedures are in place to address conformance, non-conformance, corrective actions and preventative actions, and are made available for audits and reported regularly; and

16. The plan is developed and updated to facilitate external audits, including those performed by VDOT and/or FHWA. 1

3.3.2 Project Development Plans

A. The PDPs the Concessionaire will prepare, implement, update and/or coordinate are:

1. Concessionaire Management Plan;

2. Document Management Plan;

3. Quality Management System Plan;

   a. Design Quality Management Plan; and

   b. Construction Quality Management Plan.

4. Project Management;

5. Environmental Management Plan;

6. ROW Acquisition and Relocation Plan;

7. Utilities Plan;

8. Maintenance of Traffic Plan;

9. Public Information and Communications Plan;

10. DBE/SWaM Plan (Construction Period);

11. Health, Safety, and Security Plan;

12. Operations and Maintenance Plan; and

13. Life Cycle Maintenance Plan (Operating Period).

B. The Concessionaire shall produce and maintain up-to-date documentation showing its internal quality reviews and results of compliances, non-compliances, and corrective actions taken.

C. VDOT may audit and monitor the activities described in the PDPs to assess the Concessionaire's compliance. 1

D. Material assumptions and procedures contained in the PDPs shall be of an auditable nature.

E. The PDPs and updates shall be made available to VDOT in electronic format. 1

3.3.3 Project Development Plan Updates

A. The Concessionaire shall update and improve the effectiveness of its PDPs as per the terms of the Agreement and have mechanisms in place to monitor progress and identify opportunities for improvement.

3.3.4 Submission Timetable

A. The PDPs will be developed in accordance with the milestones defined in Section 3.4.1 (Project Schedules) and Attachment 3A of this Exhibit D.

B. PDPs must be reviewed and approved by VDOT before implementation and following changes that materially affect the prosecution of the Work. 1

3.4 Schedules 3 4

3.4.1 Project Schedules

A. Purpose, Format, and Content of the Project Schedule:

1. The Project Schedule shall be generated and developed in general compliance with the guidelines of the VDOT Post-Award Scheduling Guide Release 2 – July 14, 2008 and as further specified herein..

2. The purpose of the Project Schedule is to ensure that adequate planning, scheduling, and resource allocations occur to provide a reasonable and executable baseline work plan, baseline activity costs and baseline resource data, and continuous monitoring and reporting for Work performed and remaining. The Baseline Schedule and the monthly updates to the Project Schedule shall be used for coordinating the Work,

monitoring the progress of Work performed, identifying Work to be performed, and evaluating changes.

3. The Project Schedule shall consist of the approved Initial Baseline Schedule, the approved Baseline Schedule, the monthly Project Schedule Updates as further described in Section 3.4.3 (e) herein below, and the As-Built Schedule.

4. The Initial Baseline Schedule and accompanying Exhibits are the Concessionaire's initial plan for the design and construction of the Project and shall be submitted to VDOT for review and approval prior to incorporation in the Comprehensive Agreement. This schedule shall be used to monitor performance of the Work until the Baseline Schedule is approved by VDOT pursuant to Section 3.4.2 below. VDOT shall have 21 days to review Project Schedule submittals to ensure compliance with the Technical Requirements. Project Schedule submittals found to be incomplete or materially deviating from the Technical Requirements may be returned for revision and resubmission without further technical review.

5. VDOT shall review submittals of the Project Schedule for conformance with these Technical Requirements, the applicable provisions in the Comprehensive Agreement, and good planning and scheduling practices.

B. General Requirements:

The Project Schedule shall:

1. Include an adequate number of activities, sufficient to ensure adequate planning of the Work and to permit monitoring and evaluation of progress and perform the analysis of potential time impacts.

2. Provide a sufficient level of detail with respect to management and oversight of the Project consistent with the guidelines noted in the VDOT Post-Award Scheduling Guide;

3. Ensure that design activities identify AFC Documents.

4. Apply the Critical Path Method ("CPM") of network calculation to generate the Project Schedule (the critical path shall be based on the longest network path through the Project) and prepare the Project Schedule using the Precedence Diagram Method ("PDM") to establish relationships and interdependencies between the individual activities required to complete the Project; Total Float criteria are not acceptable for

identifying or representing the Critical Path. The switch in Primavera Project Management shall be set to longest path in any schedule calculations and graphical representations. The Concessionaire shall take care to distinguish between the critical path and near critical paths.

5. Ensure that activity identification numbers, textual descriptions, and codes are consistently applied in the Project Schedule and are unique for each specific activity.

6. Divide all Work through Final Completion into activities with appropriate logic ties to show the Concessionaire's overall approach to sequencing, include logical relationships between activities reflecting the Concessionaire's actual intended sequence of Work, logically tie all activities to avoid open ends, and the Project Schedule shall not use imposed constraint dates to begin or complete any activity unless such dates are called for specifically in the Agreement or are mutually agreeable to the parties. The Project Schedule shall have a single start and a single completion point. Activities shall be used in lieu of lags where an activity is appropriate, i.e. use a concrete curing activity in lieu of a 7 or 28 day lag to achieve strength for a subsequent activity.

7. Avoid the use of non typical relationships that cannot be shown to demonstrate a true dependency. Use of relationships and lags to position an activity at certain dates will not be permitted

8. Show the Project milestones including commencement of design Work, the anticipated issuance of Design Work Notice to Proceed, Construction Segment Notice to Proceed and the Scheduled Substantial Completion Date; The following milestones shall be included in the Project Schedules:

   a. Execution of the Comprehensive Agreement

   b. Financial Close

   c. Milestones should be included for significant components of work that are critical to the start of key subsequent activities and will assist with managing the Project Schedule. Milestones may consist of key design submissions required prior to the start of fabrication; completion of dredging; key permitting required for start of construction activities; completion of tunnel fabrication; major traffic changes; and other items required for the successful management of the Project and high priority items required for public relations needs.

d. Milestones shall be added to the Project Schedule at VDOT's request and as needed by the Concessionaire.

e. Milestones shall be added to the Project Schedule at VDOT's request and as needed by the Concessionaire.

9. Show phasing of the Work as detailed in the plans, subcontractor work, procurement, fabrication, delivery, installation, testing of materials and equipment, commissioning of systems, and any long-lead time orders for major or significant materials and equipment.

10. Each activity in the Baseline Schedule shall be allocated an estimated cost/planned value. The Work Breakdown Structure (WBS) and cost loading shall be organized and cost distributed consistent with the estimate prepared during the Interim Agreement phase and reconciled to the final agreed to estimate Design-Build Contract Price (the "Estimate"). The WBS shall be complete and address 100% of the Project scope at all levels of the WBS.

11. Include a well organized WBS, the development of which is based on a deliverable-oriented methodology that captures all the Project activities. The WBS shall include, as a minimum, the four (4) work streams, D-Groups, and bid items.

12. The Initial Baseline Schedule shall include all activities with early start days prior to 180 days after Financial Close, broken down into Work Packages and deliverables generally completed in not less than one but no more than 30 days (unless such deliverable is a procurement, design or other non-construction activity).

13. Depict the required coordination with and work to be performed by other Contractors, Utility Owners, Governmental Authorities, engineers, architects, Contractors, and suppliers;

14. Identify Regulatory Approvals required and the dates by which such approvals are necessary;

15. Incorporate the ROW Acquisition and Relocation Plan; and

16. Include with each submission of the Project Schedule, the following:

a. Include two sets of compact disks containing an electronic working copy of the Project Schedule in Primavera

proprietary exchange format (XER) file format. Each submission shall have a unique file name to indicate the type and order of submission. Each compact disk shall be labeled to indicate the type of submission, file name, and schedule data date.

b. A narrative progress report of the Project Schedule consistent with Section III.7 of the VDOT Post-Award Scheduling Guide. The narrative shall indicate, at a minimum, the Concessionaire's plan of operation for meeting the interim milestones and the Scheduled Substantial Completion Date, an evaluation of the critical path, a discussion of Project-specific issues encountered since the last submission as such issues relate to the schedule, proposed solutions thereof, work calendars, constraints, delays experienced, and the status of any submitted or pending Time Impact Analyses, float consumption, documentation of any logic changes, duration changes, resource changes or other relevant changes. The report shall identify the Baseline Schedule in effect at the data date of the current update and the preceding Schedule Update for that period.

c. Time-scaled logic diagram indicating the critical path, early start and early finish dates, total float, grouped by WBS , and sorted by early start and then total float.

C. For each occurrence of Major Maintenance or Concessionaire Project Enhancement, the Concessionaire shall follow the principles above for the preparation and approval of a Project Schedule relating to such Work and will perform progress monitoring and reporting.

D. The scheduling software employed by the Concessionaire shall be compatible with VDOT's scheduling software. The Concessionaire's scheduling software must have the capability to import and export data in the Primavera proprietary exchange format (XER). As of the Agreement Date, VDOT's scheduling software is the latest version of Primavera's Project Management software (currently P6 version 7.1). Any changes in scheduling software will be mutually agreed upon by all parties.

E. Float available in the Project Schedule, at any time, shall not be considered for the exclusive use of either VDOT or the Concessionaire. During the course of the Work, any float generated due to the efficiencies of either party is not for the sole use of the party generating the float; rather it is a shared commodity to be reasonably used by either party. A Project Schedule showing work completing in less time than the applicable Scheduled Substantial Completion Date, and accepted by VDOT, will be considered to have project float. Project float will be

a resource available to both VDOT and the Concessionaire. Delays caused by the VDOT resulting in the Concessionaire failing to complete by such a date earlier than the applicable Scheduled Substantial Completion Date shall not be grounds for a delay claim nor will the Concessionaire begin to accrue liquidated or actual damages for failure to meet such a date earlier than the applicable Substantial Completion Date. No time extensions will be granted unless a Delay Event occurs which impacts the critical path of a Project Asset, consumes all available float or contingency time, extends the work beyond the Substantial Completion Date as defined by the Agreement, and is it is determined that responsibility for the Delay Event resides with VDOT. Float sequestering techniques will not be an acceptable practice in Scheduling on this Project. VDOT reserves its right to have the Concessionaire demonstrate the calculation of its durations and costs based on quantities, resource loading, and productivities.

3.4.2 The Baseline Schedule

A. Within 60 days of the Financial Closing Date, the Concessionaire shall submit to VDOT for its review and approval a proposed Baseline Schedule, which shall include the Concessionaire's detailed plan for design and construction of the Project. The Concessionaire shall develop its proposed Baseline Schedule from the Initial Baseline Schedule. The Concessionaire shall submit to VDOT six hard copies (printed on 11" by 17" paper) of its proposed Baseline Schedule, along with two sets of CD's containing an electronic version of the proposed Baseline Schedule created in the Primavera proprietary exchange format (XER).

B. The Concessionaire shall address any and all comments received from VDOT on the proposed Baseline Schedule until VDOT approves the proposed Baseline Schedule. Upon approval by VDOT, the proposed Baseline Schedule will become the Baseline Schedule.

C. The Baseline Schedule shall utilize similar WBS and activity coding as the Initial Baseline Schedule.

D. The Baseline Schedule shall be cost- loaded to an activity-level consistent with the Estimate. The cost-loading shall include direct costs used in the Estimate.

E. The resource-loading shall be provided via the Baseline Schedule narrative as supported by the HCSS generated equipment report.

F. Activities in the Baseline Schedule shall be assigned project-specific activity codes. Activity codes shall not be used in lieu of a WBS.

G. The Baseline Schedule shall include all major activities of the Work in sufficient detail to enable VDOT to monitor and evaluate design and construction progress from the Financial Closing Date through Final Completion.

H. The Baseline Schedule shall include separate activities for major submittals proposed by the Concessionaire, together with appropriate activities for VDOT's review or approval, provided that such review and/or approval times by VDOT shall be no less than the time provided for such reviews in the Agreement.

I. The Baseline Schedule shall be resource-loaded, via the narrative, broken down into work packages and deliverables generally completed in not less than one but no more than 20 working days (unless such deliverable is a procurement, design or other non-construction activity), with dollar value (price) of each activity identified. The total cost loaded into the Baseline Schedule shall be equal to the total of the direct costs in the Design-Build Contract. Project overhead costs and Project-wide costs not applicable to a specific activity should be identified and addressed in the Baseline Schedule narrative. No activity on the critical path shall have duration greater than 20 working days. Critical resources should be identified in the Project Schedule narrative.

3.4.3 Monthly Progress Reports and Project Schedule Updates

A. The Project Schedule shall be current, reflecting actual progress ending on the last day of each calendar month and shall be kept current and submitted as a component of the Monthly Progress Report consistent with Section V of the VDOT Post-Award Scheduling Guide.

B. The Monthly Progress Report shall describe the work performed since the previous update as well as the Concessionaire's plan for accomplishing the remaining Work only if changed from the Project Schedule Update. It shall describe the current status of the Project and any deviations from scheduled performance as well as the causes and effects of the deviations. It shall also describe any progress deficiencies or schedule slippages against the Project Schedule in effect on the data date for the current Schedule Update, as well as any actions taken or proposed to avoid or mitigate the progress deficiencies or schedule slippages.

C. Monthly Progress Reports shall have a reporting period ending on the last day of each calendar month and shall be submitted on or before the 7th of the month following the reporting period. The Monthly Progress Report shall be submitted in accordance with this section for VDOT's review and comment.

D. VDOT will notify the Concessionaire of comments within five business days of receipt of an acceptable submission.

E. Project Schedule Updates:

1. Concessionaire shall update the Project Schedule monthly to reflect actual progress to date and to forecast progress going forward (the Project Schedule Updates). The Concessionaire will not be required to provide updates of any cost or resource information in the Project Schedule Update. The Project Schedule Update shall be submitted as an attachment to the Monthly Progress Report. The last day of the reporting period shall be the status date or data date used to calculate the schedule. Project Schedule Updates shall comply in all respects with the Project Schedule requirements set forth in this Section 3.4.

2. The approved Initial Baseline Schedule will be the basis for Project Schedule Updates until such time as the Baseline Schedule is approved by VDOT. Thereafter the Baseline Schedule shall be the basis for Project Schedule Updates.

3. Project Schedule Updates shall depict activities that have started, are on-going, or have completed during the reporting period as of the new data date; show actual start dates for activities that have started; and actual finish dates for completed activities.

4. Project Schedule Updates shall depict remaining duration for on-going activities. Remaining duration for unfinished activities shall be based on the amount of time required to complete the remaining work as of the new data date.

5. Activity relationships for the remaining activities shall be modified as necessary to correct out-of-sequence progress for on-going activities or to reflect the Concessionaire's current plan for completing the remaining Work.

6. Changes to the Project Schedule shall be documented in the Monthly Progress Report. Such changes include: additional, revised or deleted activities, durations, calendar assignments, lag, or logic ties.

7. If a Project Recovery Schedule is required pursuant to Section 3.4.5A, then the Project Recovery Schedule will be included in the monthly update..

8. Upon achieving Final Completion, the Project Schedule Update submitted and approved with the final Monthly Progress Report will be identified by the Concessionaire as the As-Built Schedule.

3.4.4 Revisions to the Baseline Schedule

A. The Concessionaire may revise the Baseline Schedule. In such an event, the Concessionaire will submit a revised Baseline Schedule to VDOT for review and approval. Once approved, this revision shall then become the Baseline Schedule. 1

B. VDOT may elect to require revisions to the Baseline Schedule by the Concessionaire. VDOT will make such requests in writing. The Concessionaire shall make such revisions within seven days after receiving VDOT's request. The Concessionaire may request in writing from VDOT an additional five days to complete such revisions. Once approved, this update shall then become the Baseline Schedule. At no time shall the Concessionaire continue to reflect an item of non-concurrence from VDOT in the updates to the Baseline Schedule. If the Concessionaire objects to VDOT's request for revisions, the Concessionaire may refer the matter to dispute resolution pursuant to Article 21 of the Agreement.

C. In the event of a Delay Event for which VDOT grants relief to the Concessionaire in accordance with the terms of the Agreement, the Baseline Schedule shall be revised and submitted to VDOT for approval in accordance with Section 3.4.2 above.

3.4.5 Project Recovery Schedule

A. Whenever the Project Schedule shows any Scheduled Substantial Completion Date having 90 days (or 10% of the time remaining to achieve the applicable Scheduled Substantial Completion Date, whichever is less), of negative float or more, the Concessionaire shall submit a Project Recovery Schedule to VDOT for approval. Project Recovery Schedule submittals shall include a list of all activities changes, and an accompanying narrative explaining the nature of the changes (the "Project Recovery Schedule").

B. Once a Project Recovery Schedule is reviewed and approved by VDOT, with no exceptions, it shall become the Baseline Schedule and shall also be used as the basis for subsequent Monthly Progress Reports. The Concessionaire shall archive all approved Project Schedules.

3.4.6 Time Impact Analysis (TIA) for Proposed Extensions of Time

All parties agree to address schedule issues as quickly and as contemporaneously as possible.

The following shall apply if a Time Impact Analysis (TIA) is required under the Technical Requirements:

A. The TIA shall be based on the date on which the alleged Delay Event is determined to have occurred, or, in the event of a proposed Change Order, the date on which the implementation of such Change Order is proposed to be commenced. In the event that the Concessionaire perceives that a Delay Event has occurred, such Delay Event Notice shall be provided in accordance with the requirements of the Agreement.

B. The TIA shall show the current status of the Work using the most recent Project Schedule Update prior to the initiation of the events in question. The time computation of all affected activities shall be shown in the TIA along with a demonstration of steps used to mitigate impacts.

C. Each TIA shall include a fragmentary network (fragnet) demonstrating how the Concessionaire proposes to incorporate the impact into the most recent Project Schedule Update prior to the initiation of the events in question. A fragnet is defined as the sequence of new activities and/or activity revisions, and logic relationships, that are proposed to be added to the existing schedule to demonstrate the influence of impacts to the schedule. The fragnet is subject to the same requirements for activities including resource information for added scope and assignment of activity codes and assignment to the appropriate WBS structure, existing or amended. In the event of an alleged Delay Event, the Concessionaire shall demonstrate the calculation of its durations based on quantities, resource loading, and productivities for both the fragnet activities and the affected and impacted activities. The fragnet shall identify the predecessors to the new activities and demonstrate the impacts to successor activities. The Concessionaire shall insert the fragnet into the most recent Project Schedule Update prior to the initiation of the alleged Delay Event, run the schedule calculations, and submit the impacted schedule in accordance with this section. The Concessionaire shall include a narrative report describing the effects of new activities, resources and relationships to Agreement milestones and the applicable Scheduled Substantial Completion Date with each TIA.

D. The Concessionaire shall not be entitled to any extension of the applicable Scheduled Substantial Completion Date automatically as the result of an activity delay. All parties recognize that certain events will not affect the existing critical activities or cause non-critical activities to become critical, thereby not causing any effect on the applicable Scheduled Substantial Completion Date. No extension of time will be granted without demonstration to VDOT of merit for the time extension.

E. All TIA or requests for extension of time shall also address concurrent and predecessor delays in the determination of excusable/ inexcusable and compensable/noncompensable events.

F. VDOT reserves its right to identify and generate fragnets for inclusion in the Project Schedule should it become aware of the Concessionaire-caused delays.

G. Two copies of each TIA report together with an electronic file (in XER file format) of the Project Schedule impact analysis shall be submitted to VDOT for its review in accordance with Article 13 of the Agreement.

H. Upon approval, a copy of the TIA signed by VDOT will be returned to the Concessionaire and incorporated into the next update to the Baseline Schedule.

I. The approved TIA related to a Change shall be incorporated into, and attached to the applicable Change Order.

J. A disapproved TIA will be returned to the Concessionaire with appropriate comments for revisions or VDOT's basis for rejection of the alleged Delay Event. Should Concessionaire disagree with VDOT's assessment of Delay Event, Concessionaire may pursue recourse in accordance with provisions established in Article 21 of the Agreement.

3.5 Standard Documents

3.5.1 General Requirements

A. The Work shall conform to the Standard Documents in Section 3.5.2. Where the Concessionaire's design requires design methods or construction procedures not covered by Section 3.5.2 of the Technical Requirements, the Concessionaire shall obtain VDOT's approval before using such methods or procedures. 4

B. Subject to the provisions of the Agreement, Work carried out after Final Completion shall comply with applicable Federal and State Laws and VDOT's Standard Documents noted in Section 3.5.2.

C. When a provision of "Division 1 – General Provisions" of the *2007 Road and Bridge Specification* is applicable, Section 3.5.3 of the Technical Requirements shall apply.

3.5.2 Standard Documents

The design and construction work for the Project shall be performed in accordance with the applicable Federal and State Laws, Standards, Specifications and Reference 4

Documents to include, but not limited to the documents listed herein. The Concessionaire shall meet or exceed the minimum design standards and criteria.

The standards, special provisions and reference guides applicable during the performance of the Design-Build Work shall be the version of those documents as noted herein below or those in effect as of the Agreement Date, whichever is the most current as of the Agreement Date, including all supplements, errata, revisions and interims. Following Final Completion, all subsequent design and construction must meet the standards current at the time the Work is performed.

Groupings of standards are for ease of reference only and it is the responsibility of the Concessionaire to ensure that all relevant standards and specifications have been applied.

Standards and Specifications

General

VDOT Construction Manual (2005)

VDOT Post Construction Manual (Updated July 2009)

VDOT Construction Inspection Manual (April 2008)

VDOT's Minimum Quality Control & Quality Assurance Requirements for Design-Build & Public-Private Transportation Act Projects August 2008

VDOT Traffic Engineering Design Manual (2006)

VDOT Right of Way and Utilities Division Manuals, Vol. I (July 1999) and II (November 2003)

VDOT Land Use Permit Manual

VDOT Policy Manual for Public Participation in Transportation Projects (Revised January 2010)

VDOT Instructional & Information Memorandums (I&IM) All Divisions, as of January 7, 2010

VDOT Traffic Engineering Memoranda, August 1, 2007

VDOT - Hampton Roads Region Advanced Traffic Management System

VDOT - Limits of Operation and Maintenance of Traffic

VDOT Road and Bridge Standards, Vol. 1 and Vol. 2 (2008), including all revisions as of January 7, 2010

VDOT Road and Bridge Specifications (2007), including all revisions as of January 7, 2010

VDOT 2005 Virginia Work Area Protection Manual

VDOT Mobility Management Division Memoranda

VDOT Appraisal Guidelines

Americans with Disabilities Act Accessibility Guidelines for State and Local Government Facilities

Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities dated July 23, 2004 and amended August 5, 2005.

Transportation Research Board Highway Capacity Manual (2000)

Virginia Construction Code, 2003

VDOT Manual of Instruction for Material Division to include all associated memorandum included on VDOT Materials website.

VDOT CADD Manual (Version 2009)

VDOT State Noise Abatement Policy

ISO 9001 Quality Management Systems 2000

AASHTO Guide for Park-and-Ride Facilities, 2nd Edition

AASHTO Guide for the Development of Bicycle Facilities (3rd Edition)

AASHTO Guide for Planning, Design, and Operation of Pedestrian Facilities (2004)

Virginia Uniform Statewide Building Code

CSX Transportation Design and Construction Standard Specifications, General and Special Conditions, June 1, 2002

CSX Transportation Public Project Information for Construction and Improvement Projects that may involve the Railroad, May 08, 2009

American Railway Engineering and Maintenance-of-Way Association for railroad engineering with particular attention to Chapter 1, Part 1, Roadbed; and Chapter 28, Clearances.

Federal Railroad Administration regulation 49 CFR 214, Railroad Workplace Safety

Title 49 Code of Federal Regulations - Part 24 – Uniform Relocation Assistance and Real Property Acquisition Policies Act.

Roadway Design

VDOT Policy for Integrating Bicycle and Pedestrian Accommodations

VDOT Road Design Manual, Vol. I (all revisions as of January 7, 2010)

AASHTO A Policy on Geometric Design of Highways and Streets (2004)

AASHTO Roadside Design Guide, Third Edition, 2006 (updated chapter 6)

AASHTO: A Policy on Design Standards Interstate System, Jan 2005

Access Board's Revised Draft Guidelines for Accessible Public Rights of Way dated November 23, 2005

Pavement Design

VDOT Guidelines for 1993 AASHTO Pavement Design, Revised – May 2003

VDOT Pavement Design Guide for Subdivision & Secondary Roads in Virginia (Revised 1996 and 2000 Superpave Mix)

AASHTO Guide for Design of Pavement Structures (Rigid Pavement and Flexible Pavement) (1993 Edition)

Demolition, Renovation, and Site Clearance

VDOT Asbestos Project Monitoring and Clearance Air Monitoring Procedures, dated September 16, 2003

VDOT Special Provision for Inspection of Structures for Asbestos Containing Materials (ACM) on Design-Build Projects, June 22, 2009

Virginia Department of Transportation Special Provision for Asbestos Removal for Road Construction Demolition Projects, March 18, 2009

VDOT Special Provision for Asbestos Removal and NESHAP Related Demolition Requirements for Structures on Design-Build Projects, June 22, 2009

VDOT Specifications for Asbestos Removal in Occupied Buildings

VDOT Special Provision Copied Note for Demolition of Structures not Requiring Asbestos Removal, June 25, 2009

Geotechnical

VDOT Requirements for the Preparation of Alternate Retaining Wall Plans (03-06-08)

VDOT Requirements for General Notes for Alternate Retaining Wall Plans (03-06-08)

AASHTO LRFD Bridge Construction Specifications, 2nd Edition (2004, including the 2006, 2007 and 2008 Interims)

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AASHTO LRFD Bridge Design Specifications, 4th Edition, 2007; 2008 and 2009 Interim Specifications; and VDOT Modifications (VDOT IIM-S&B-80)

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Guide Specifications and Commentary for Vessel Collision Design of Highway Bridges, 2nd Edition

Guide Specifications for Bridges Vulnerable to Coastal Storms

Guide Specifications for Design of FRP Pedestrian Bridges, 1st Edition, 2008

AASHTO Guide Specifications for Seismic Isolation Design, 2nd Edition and 2000 Interim

Guide Specifications for Design and Construction of Segmental Concrete Bridges, 2nd Edition, 2003 Revisions

Guide Specifications for Design of Pedestrian Bridges, 1st Edition, 1997

AASHTO Guide for Protective Screening of Overpass Structures, 1990

AASHTO Guide Specifications for Structural Design of Sound Barriers, 1989; 1992 and 2002 Interims

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AASHTO Guide Specifications - Thermal Effects in Concrete Bridge Superstructures, 1st Edition, 1989

AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals, 1994 Edition

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AASHTO Fracture Critical Non-Redundant Steel Bridge Members Current Spec. with all Interim Specifications

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AASHTO Manual for Bridge Evaluation, 1st Edition, 2008

AASHTO Movable Bridge Inspection, Evaluation, and Maintenance Manual, 1st Edition

AASHTO Construction Handbook for Bridge Temporary Works, 1st Edition, 1995; 2008 Interim Revisions

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23CFR650 Subpart C – National Bridge Inspection Standards (NBIS), Subsection 650.301 or the latest revision(s)

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FHWA Road Tunnel Design Guidelines, July 2004 (for reference only)

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Highway & Rail Transit Tunnel Maintenance & Rehabilitation Manual, 2005 Edition

Best Practices for Implementing Quality Control and Quality Assurance for Tunnel Inspection, Prepared for T-20, October 2009

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Stage I Report Template

For culverts and rehabilitation and/or widening of existing structures:

AASHTO Standard Specifications for Highway Bridges, LRFD 4th Edition, 2007 with 2008, 2009 Interims and VDOT Modifications

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Drainage

VDOT 2002 Drainage Manual (including current Errata Sheets and revisions as of January 7, 2010)

VDOT Hydraulic Design Advisories as of January 7, 2010

Virginia Erosion and Sediment Control Handbook (Third Edition – 1992), Department of Conservation and Recreation

Virginia Stormwater Management Handbook, Vol. I and II (First Edition – 1999), Department of Conservation and Recreation

US Army COE, Hydrologic Modeling System (HEC HMS)

Virginia, Erosion and Sediment Control Law and Regulations, FY 2009

Virginia Storm Water Act

Virginia Storm Water Management Law and Regulations

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General Permit for Discharges of Stormwater from Construction Activities, General Permit No. VAR10

FHWA Hydraulic Engineering Circulars (HEC)/HDS, latest edition/revisions as of January 7, 2010

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US Army COE, Coastal Engineering Manual HEC – 25, 2008

Traffic Control Devices and Lighting

USDOT FHWA Standard Highway Signs (2004)

Manual of Uniform Traffic Control Devices, 2009 Edition, dated December 2009

The Virginia Supplement to MUTCD (2005)

AASHTO Guide for Roadway Lighting Design (2005)

National Fire Protection Association NEC Standards, 2008

VDOT Traffic Calming Guide for Local Residential Streets, 2002

ANSI/IESNA RP-8-2000 – Practice for Roadway Lighting

IESNA RP-19-01 Roadway Sign Lighting

* Traffic control devises and lighting not owned and operated/maintained by VDOT Hampton Roads District may be subject to additional standards/specifications. Additional jurisdictions include but are not limited to:

City of Portsmouth

City of Norfolk

Miscellaneous

VDOT Survey Manual (January 2009)

VDOT Guardrail Installation Training Manual (GRIT) January 2007

U.S. Green Building Council's Leadership in Energy and Environmental Design

i. Green Building Design and Construction Reference Guide, 2009 Edition
ii. Green Interior Design and Construction Reference Guide, 2009 Edition
iii. Green Building Operations and Maintenance Reference Guide, 2009 Edition

iv. United States Environmental Protection Agency/Department of Energy's "Energy Star" rating

Tunnel Operations Standards

National Fire Protection Association (NFPA) Standards

National Electrical Safety Code (NESC), 2008

ASHRAE 90.1-2004/2006 IECC or equivalent

IESNA RP-22-05 IESNA Recommended Practice for Tunnel Lighting

ITS

Institute of Electrical and Electronics Engineer (IEEE) 802.3 Local and Metropolitan Area Networks

National Electric Manufacturers Association (NEMA) TS-4 Hardware Standards for Dynamic Message Signs (DMS) with NTCIP Requirements

IEEE 1512-2006 - IEEE Standard for Common Incident Management Message Sets for Use by Emergency Management Centers, IEEE 1512.1-2006 – IEEE Standard for Common Traffic Incident Management Message Sets for Use by Emergency Management Centers

National Transportation Communications for ITS Protocol (NTCIP)

Hampton Roads Region Operations ITS Architecture (www.vdot-itsarch.com)

Hampton Roads Region Operations Incident Management Plan

Hampton Roads Region Operations Telecommunications Plan

Special Provisions

General

Virginia Department of Transportation Special Provision for Elastic Inclusion, June 24, 2007.

Virginia Department of Transportation Special Provision for Quality Assurance/Quality Control for the Construction of Deep Foundation Systems for Design-Build and PPTA Contracts, November 10, 2009

Virginia Department of Transportation Guide Special Provision for Drilled Shafts for Design-Build and PPTA Contracts, November 18, 2009

Virginia Department of Transportation Special Provision for Reinforced Earth Walls**,** July 5, 2007

Virginia Department of Transportation Special Provision for Density Control of Embankments and Backfill, Revised – November 26, 2006

Virginia Department of Transportation Special Provision for Wave Equation Analysis for LRFD for Design-Build and PPTA Contracts, November 18, 2009

Virginia Department of Transportation Special Provision for T-Wall Retaining Wall System for Design-Build and PPTA Contracts, November 18, 2009

Virginia Department of Transportation Special Provision for Mechanically Stabilized Earth Walls (Concrete Panel Facing) for Design-Build and PPTA Contracts, November 18, 2009

Virginia Department of Transportation Special Provision for Mechanically Stabilized Earth Walls (Modular Cantilever Facing) for Design-Build and PPTA Contracts, November 18, 2009

Virginia Department of Transportation Special Provision for Mechanically Stabilized Earth Walls (Segmental Block Facing) for Design-Build and PPTA Contracts, November 18, 2009

Virginia Department of Transportation Special Provision for Dynamic Pile Testing for Friction Piles *for LRFD* for Design-Build and PPTA Contracts, November 18, 2009

Virginia Department of Transportation Special Provision for Dynamic Pile Testing for Friction Piles for Design-Build and PPTA Contracts, November 18, 2009

Virginia Department of Transportation Special Provision for Dynamic Pile Testing for End Bearing Piles *for LRFD* for Design-Build and PPTA Contracts, November 18, 2009

Virginia Department of Transportation Special Provision for Dynamic Pile Testing for End Bearing Piles for Design-Build and PPTA Contracts, November 18, 2009

Virginia Department of Transportation Special Provision for Section 514 - Field Offices for Design-Build and PPTA Contracts, April 30, 2010

Virginia Department of Transportation Special Provision for Design-Build Tracking (DBT) Numbers – February 8, 2008

Virginia Department of Transportation Special Provision for Reflection Cracking Retardant Material (English Units) (June 9, 1998)

Virginia Department of Transportation Special Provision for Sealing Cracks in Asphalt Concrete Pavement or Hydraulic Cement Concrete Pavements (Prior to Overlay) (June 10, 1998)

Virginia Department of Transportation Special Provision for Undersealing Portland Cement Concrete Pavement (January 3, 1995)

100

Virginia Department of Transportation Special Provision for Use of Domestic Material, July 9 2002 (S102C0B)

Virginia Department of Transportation Special Provision for Section 1051.10 Construction Stakes, Lines and Grades, July 9 2002 (S105A0B)

Virginia Department of Transportation Special Provision for Section 107.19 Railway-Highway Provisions, January 14, 2008 (S107I00-0708)

Virginia Department of Transportation Supplemental Division 1 General Provisions, September 9, 2009 (SS1D006-0909)

Virginia Department of Transportation Special Provision for Section 107. – Legal Responsibilities, 2007

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Virginia Department of Transportation Special Provision for Low Permeability Concretes, December 2, 2002 (S217A0B)

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Virginia Department of Transportation Special Provision for Flowable Backfill, July 9, 2002 (S302A0B)

Virginia Department of Transportation Special Provisions for Section 301 – Clearing & Grubbing (November 15, 2006)

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Virginia Department of Transportation Special Provision for Removal or Connection of Asbestos Cement Pipe, November 7, 2005 (S500A1B)

Virginia Department of Transportation Special Provision Copied Notes c504b0b – Section 504 – Sidewalks, Steps, and Handrailings, January 12, 2005

Virginia Department of Transportation Special Provision for Micro Tunneling for DB Projects dated September 14, 2009

Virginia Department of Transportation Special Provision for Jack and Bore for DB Projects dated October 13, 2009

S704E01 – Type B, Class VI Pavement Line Marking 11-21-08

Special Provision Copied Notes (SPCN)

SPCN c100ai02-0609 General Project Requirements, Supplemental Specifications (SSs), Special Provisions (SPs) and Special Provision Copied Notes (SPCNs) (available on VDOT's web site)

SPCN c100b01-0908 Labor (available on VDOT's web site)

SPCN c105hf1-0309 Section 105.06 Subcontracting (available on VDOT's web site)

SPCN c211gg0-0609 Warm Mix Asphalt Pavement (available on VDOT's web site)

SPCN c223ag1-0309 Section 223 Steel Reinforcement (available on VDOT's web site)

SPCN c315gg0-0609 Warm Mix Asphalt Pavement (available on VDOT's web site)

SPCN for PG 76-22 Asphalt Cement Adjustment – Design-Build Projects (Included in RFP Information Package – CD-ROM), dated October 7, 2009

Supplemental Specifications

SS1D005-0909 Supplemental Division 1 – General Provisions

SS21101-0609 Supplemental Section 211 – Asphalt Concrete

SS21402-0908 Supplemental Section 214 – Hydraulic Cement

SS21501-0908 Supplemental Section 215 – Hydraulic Cement Concrete Admixtures

SS21701-0609 Supplemental Section 217 – Hydraulic Cement Concrete

SS22401-0908 Supplemental Section 224 – Castings

SS22601-0609 Supplemental Section 226 – Structural Steel

SS23802-0308 Supplemental Section 238 – Electrical & Signals Components

SS31502-0609 Supplemental Section 315 – Asphalt Concrete Pavement

SS40501-0609 Supplemental Section 405 – Prestressed Concrete

SS51202-0909 Supplemental Section 512 – Maintaining Traffic

SS51401-0609 Supplemental Section 514 – Field Office

SS70003-0608 Supplemental Section 700 – General

SS70102-0109 Supplemental Section 701 – Traffic Signs

SS70301-0109 Supplemental Section 703 – Traffic Signals

Reference Documents

FHWA-IF-99-025 Drilled Shafts – Construction Procedures and Design Methods, August 1999

FHWA Geotechnical Engineering Circular No. 2 - Earth Retaining Systems, FHWA-SA-96-038, 1996

FHWA Geotechnical Engineering Circular No. 4 - Ground Anchors and Anchored Systems, FHWA-IF-99-015, 1999

FHWA Geotechnical Engineering Circular No. 5, Evaluation of Soil and Rock Properties dated April 2002

FHWA Geotechnical Engineering Circular No. 7 - Soil Nail Walls, FHWA-IF-03-017, 2003

FHWA Permanent Ground Anchors, Volume 1, Final Report, FHWA-DP-90-068, 1991

FHWA Permanent Ground Anchors, Volume 2, Field Demonstration Project Summaries, FHWA-DP-90-068, 1991

FHWA Manual for Design & Construction of Soil Nail Walls, FHWA-SA-96-069R, 1999

FHWA Soil Nailing Field Inspectors Manual-Soil Nail Walls, FHWA-SA-93-068, 1993

FHWA The Osterberg Cell for Load Testing Drilled Shafts And Driven Piles, FHWA-SA-94-035, 1994

AASHTO (1988) Manual on Subsurface Investigation

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Load and Resistance Factor Design (LRFD) For Highway Bridge Superstructures (April 2007), FHWA-NHI-08-048

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LFRD for Highway Bridge Substructures and Earth Retaining Structures (Jan 2007), FHWA-NHI-05-095

Ground Improvements Reference Manual Volume I, FHWA-NHI-06-019

Ground Improvements Reference Manual Volume II, FHWA-NHI-06-020
Earth Retaining Structures (RM), FHWA-NHI-07-071

Micropile Design and Construction Reference Manual (December 2005), FHWA-NHI-05-039

Mechanically Stabilized Earth Walls And Reinforced Soil Slopes - Design And Construction Guidelines (March 2001), FHWA-NHI-00-043

VDOT Clearance Chart (08-18-03)

VDOT Conductor Cable and Conduit Sizes (08-18-03)

VDOT Preliminary Sub Example

VDOT Rest in Walk pedestrian phasing (01-13-05)

VDOT Right Turn overlap phasing (01-13-05)

VDOT Right of way Diagrams (01-13-05)

VDOT Side street split phasing (01-13-05)

VDOT Signal Control Justification (08-18-013)

VDOT Signal Plan Update (01-13-05)

VDOT Hampton Roads Signal Symbols (08-18-03)

VDOT Signal Timing Submission Process (08-18-03)

VDOT Span Wire Design Notes (08-18-03)

VDOT Telespar Sign Supports (01-13-05)

VDOT Hampton Roads Timing Template-170 format (01-3-05)

VDOT Design Notes (08-18-03)

American Water Works Association Standards

FHWA Hydraulic Design Series No. 1, Hydraulics of Bridge Waterways, 1978

FHWA Hydraulic Design Series No. 2, Highway Hydrology, 2002

FHWA Hydraulic Design Series No. 3, Design Charts for Open Channel Flow, 1961

FHWA Hydraulic Design Series No. 4, Introduction of Highway Hydraulics, 2001

FHWA Hydraulic Design Series No. 5, Hydraulic Design of Highway Culverts 2005

FHWA Hydraulic Design Series No. 11, Design of Riprap Revetment, 1989

USDA, NRCS, Urban Hydrology for Small Watersheds, TR-55, June 1986

VDOT Stormwater Management Handbook

ITE TMDD - Traffic Management Data Dictionary and Message Sets for External TMC Communication (TMDD and MS/ETMCC)

Communications & Outreach Protocol, January 2011 – VDOT / ERC (under development)

VDOT DBE Program, March 15, 2007

Virginia Department of Transportation critical infrastructure information and sensitive security information (CII/SSI) policy, February 3, 2006 (Version 6)

Virginia Department of Transportation Department Policy Memorandum Manual, DPM 1-25 January 1, 2009

3.5.3 Amendments to Division 1 of the 2007 Road and Bridge Specification

Pursuant to Section 3.5 of the Technical Requirements, Division 1 of the *2007 Road and Bridge Specifications* shall not apply to the Project and is superseded by the Agreement and the Technical Requirements. For the Concessionaire's convenience, this Section 3.5.3 provides cross-references between Division 1 and the corresponding provisions of

the Agreement or the Technical Requirements (as applicable). Where sections of Division 1 are referenced in Section 3.5.2, the Concessionaire shall refer to the corresponding provisions of the Agreement or the Technical Requirements identified in this Section.

Notwithstanding the information in this Section, nothing in this Section shall relieve the Concessionaire from complying with the requirements of the Agreement and the Technical Requirements.

Division 1 Section	**Section of the Agreement or Technical Requirements**
101.01	See Exhibit A of the Agreement
101.02	See Exhibit A of the Agreement
102.01	See Section 3.2 of the Technical Requirements
102.02	Not applicable
102.03	Not applicable
102.04	See Section 8.02 of the Agreement
102.05	Not applicable
102.06	Not applicable
102.07	Not applicable
102.08	Not applicable
102.09	Not applicable
102.10	Not applicable
102.11	See Section 3.2 of the Technical Requirements
102.12	Not applicable
103.01	Not applicable
103.02	Not applicable
103.03	Not applicable
103.04	Not applicable
103.05	See Section 17.01 of the Agreement
103.06	Not applicable
103.07	See Section 17.01 of the Agreement
103.08	See Article 18 of the Agreement
103.09	Not Applicable
104.01	See Section 25.07 of the Agreement
104.02	See Section 14.03 of the Agreement
104.03	See Sections 8.01 and 14.01 of the Agreement
105.01	See Sections 8.03 of the Agreement
105.02	See Section 3.2 of the Technical Requirements
105.03	See Section 10.07 of the Agreement and Section 3.2 of the Technical Requirements
105.04	See 25.02 of the Agreement
105.05	See Section 3.2 of the Technical Requirements

105.06	See Section 24.02 of the Agreement and Section 1.2 of the Technical Requirements
105.07	See Section 3.11 of the Technical Requirements
105.08	See Section 3.7 of the Technical Requirements
105.09	See Section 3.11 of the Technical Requirements
105.10	See Section 3.2 of the Technical Requirements
105.11	See Section 3.1 of the Technical Requirements
105.12	See Section 3.5 of the Technical Requirements
105.13	See Section 1.22 of the Technical Requirements
105.14	See Section 3.9 of the Technical Requirements
105.15	See Section 1.1 of the Technical Requirements
105.16	See Section 1.1 of the Technical Requirements
105.17	See Section 1.2 of the Technical Requirements
105.18	See Section 8.11 of the Agreement and Section 1.2 of the Technical Requirements
105.19	See Article 14 of the Agreement
106.01	See Section 1.2 of the Technical Requirements
106.02	See Section 1.5 of the Technical Requirements
106.03	See Section 1.5 of the Technical Requirements
106.04	See Section 1.5 of the Technical Requirements
106.05	See Section 1.5 of the Technical Requirements
106.06	See Section 1.5 of the Technical Requirements
106.07	See Section 1.5 of the Technical Requirements
106.08	See Section 1.5 of the Technical Requirements
106.09	See Section 1.5 of the Technical Requirements
106.10	See Section 1.5 of the Technical Requirements
106.11	See Section 1.5 of the Technical Requirements
106.12	See Article 14 of the Agreement
107.01	See Sections 3.01 and 25.12 of the Agreement
107.02	See Section 8.06 of the Agreement
107.03	See Sections 3.01 and 25.12 of the Agreement
107.04	See Section 8.05 of the Agreement
107.05	See Section 18.04 of the Agreement
107.06	See Article 15 of the Agreement
107.07	See Section 25.10 of the Agreement
107.08	See Section 1.1 of the Technical Requirements
107.09	See Section 3.7 of the Technical Requirements
107.10	See Section 3.7 of the Technical Requirements
107.11	See Section 3.8 of the Technical Requirements
107.12	See Section 3.13 of the Technical Requirements
107.13	See Article 24 of the Agreement and Exhibit AA
107.14	See Section 24.01 of the Agreement and Exhibit AA
107.15	See Section 24.03 of the Agreement and Exhibit F

107.16	See Sections 1.3 of the Technical Requirements
107.17	See Section 3.13 of the Technical Requirements
107.18	See Section 3.2 of the Technical Requirements
107.19	See Section 1.24 of the Technical Requirements
107.20	See Section 3.11 of the Technical Requirements
107.21	See Section 3.8 of the Technical Requirements
108.01	See Article 8 of the Agreement
108.02	See Section 3.8 of the Technical Requirements
108.03	See Section 8.07 of the Agreement and Section 3.4 of the Technical Requirements
108.04	See Article 13 of the Agreement
108.05	See Section 10.07 of the Agreement
108.06	See Section 8.10 of the Agreement
108.07	See Article 19 of the Agreement
108.08	See Article 20 of the Agreement
108.09	See Sections 8.09 of the Agreement
108.10	See Article 20 of the Agreement
109.01	Not applicable
109.02	Not applicable
109.03	Not applicable
109.04	Not applicable
109.05	See Section 3.14 of the Technical Requirements
109.06	Not applicable
109.07	Not applicable
109.08	Not applicable
109.09	Not applicable
109.10	Not applicable

3.5.4 Interpretation of Standard Documents

A. VDOT standards are interpreted using the following guidelines. The standard drawings, the specifications, supplemental specifications, special provisions, special provision copied notes, and supplementary documents listed in Section 3.5.2 are part of the Technical Requirements. A requirement occurring in one shall be as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete Project. In case of a discrepancy, the following order of precedent shall apply, with the highest governing item appearing first and the least governing item appearing last:

1. Technical Requirements;

2. Design Criteria and Basis of Design;

3. Special provision copied notes;

4. Special provisions;

5. Supplemental specifications;

6. Standards and specifications listed in Section 3.5.2;

7. Reference documents listed in Section 3.5.2; and

8. Standard Drawings (calculated dimensions, unless obviously incorrect, will govern over scaled dimensions).

B. The Concessionaire shall not take advantage of any obvious or apparent error or omission in the Agreement. If the Concessionaire discovers an error or omission in the Agreement, it shall immediately notify VDOT. The Concessionaire shall then make such corrections necessary for fulfilling the intent of the Agreement.

C. References to existing standards or manuals shall be deemed to include revisions or replacements as of the Agreement Date, subject to the terms of the Agreement.

3.6 Right of Way

A. The Concessionaire shall provide certain right of way (ROW) acquisition services for the Project. ROW acquisition services shall include the preparation of ROW plans, title examinations, appraisal, appraisal review, negotiation, relocation assistance and advisory services, closings, and legal services. The Concessionaire shall coordinate and determine required right of way for utility relocations and coordinate preparation of all required easement agreements, right of way plans and documentation for acquisition and vacation of existing property rights. All appraisers and acquisition firms shall be selected from VDOT's pre-approved lists. VDOT will retain authority for approving just compensation, relocation benefits, and settlements. VDOT must issue a Notice to Commence Right of Way acquisition to the Concessionaire prior to any offers being made to acquire property. VDOT must also issue a Notice to Commence Construction to the Concessionaire once the property has been acquired prior to commencing construction on the property. The required right of way plans and documentation will be reviewed by VDOT and, as required, FHWA.

B. The Concessionaire shall carry out its responsibilities in accordance with the following requirements:

1. The Concessionaire shall acquire property in accordance with all applicable Federal and State Laws, including but not limited to the

Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended (the "Uniform Act), and Titles 25.1 and 33.1 of the 1950 Code of Virginia, as amended. The acquisition of property shall follow the guidelines as established by VDOT and other State and Federal guidelines that are required and VDOT's *Right of Way and Utilities Division Manuals, Vol. I and II*, as amended.

2. VDOT will designate a hearing officer to hear any Relocation Assistance appeals. VDOT agrees to assist with any out of State relocation by persons displaced within the rights of way by arranging with such other State(s) for verification of relocation assistance claim.

3. The Concessionaire shall submit a project-specific ROW Acquisition and Relocation Plan for VDOT's review and comment.

4. The Concessionaire shall submit, as part of the ROW Acquisition and Relocation Plan, procedures for handling ROW Acquisitions and relocations to VDOT for review and comment before beginning ROW activities. These procedures must show the Concessionaire's methods, including the appropriate steps and workflow required for title reports, appraisals, and review of appraisals, negotiations, acquisition, relocations and parcel closings. The Concessionaire shall have the same authority for administrative settlements as established for VDOT's Regional Right of Way Manager in the VDOT Right of Way Division Manual. These procedures must include 21 days for VDOT to review and comment just compensation, relocation benefits, and administrative settlement.

5. The Concessionaire shall have access to, and use VDOT's Right of Way and Utilities Management System (RUMS) to manage and track the acquisition process. When required, all entries made into RUMS shall be made weekly to accurately reflect current project status. VDOT's standard forms and documents, as found in RUMS, shall be used to the extent possible. Any changes to the forms and documents must be approved by VDOT. Within 15 days after Financial Close, VDOT will commence provision of training and technical assistance to the Concessionaire in the use of RUMS.

6. The Concessionaire shall provide a current title examination (no older than 60 days) for each parcel at the time of the initial offer to the landowner. Each title examination report shall be prepared by a VDOT-approved title company, in accordance with VDOT's *Right of Way and Utilities Division Manuals, Vol. I and II*, as amended, and shall include title insurance commitment. Should the Concessionaire select a law firm to certify title examinations, the certifying attorney shall provide evidence of

professional liability insurance. VDOT reserves the right to determine if the professional liability insurance coverage is sufficient. If any title examination report has an effective date that is older than 60 days, an update is required before making an initial offer to the landowner.

7. The Concessionaire shall prepare appraisals and appraisal reviews in accordance with VDOT's appraisal guidelines. The appraiser shall be on VDOT's approved fee appraiser list.

8. The Concessionaire shall provide appraisal reviews complying with technical review guidelines of VDOT's appraisal guidelines. The reviewer shall be on VDOT's approved fee appraiser list. VDOT will review the Concessionaire's appraisal waiver, appraisal, and appraisal review for each parcel, and shall have the decision of final approval of each appraisal and just compensation offer.

9. The Concessionaire shall make direct payments of benefits to property owners for negotiated settlements, relocation benefits, and payments to be deposited with the court. Payment documentation is to be prepared and submitted with the Acquisition Report (Form RW-24). VDOT will process vouchers and issue State warrants for all payments and send to the Concessionaire, who will be responsible for disbursement.

10. Concessionaire shall prepare, obtain execution of, and record documents conveying title to such properties to the Commonwealth and deliver all executed and recorded general warranty deeds to VDOT. For all property purchased in conjunction with the Project, title will be acquired in fee simple, except that, with VDOT's prior written concurrence, permanent easements may be acquired in lieu of fee simple interest for the construction, maintenance, and use of items such as noise walls, retaining walls, storm drainage structures, and earthen slopes. All property shall be conveyed to "Commonwealth of Virginia, Grantee" by a VDOT-approved general warranty deed, free and clear of all liens and encumbrances except encumbrances expressly permitted in writing by VDOT in advance. All easements, except for private utility company easements, shall be acquired in the name of "Commonwealth of Virginia, Grantee." Private utility company easements will be acquired in the name of each utility company, except when the use of eminent domain is necessary.

11. The Concessionaire shall use its best efforts to settle claims with landowners. Such efforts do not require the Concessionaire to make an offer to the property owner in excess of "just compensation". VDOT shall make the ultimate determination in each case as to whether settlement is appropriate or whether the filing of a condemnation action is necessary.

The Concessionaire shall not request the filing of a certificate until the landowner has been given a minimum of 45 days to consider the offer or terminate the negotiations. If, despite the Concessionaire's best efforts, it is unable to reach a settlement with any landowners, VDOT will handle any necessary condemnation proceedings.

12. The Concessionaire shall be responsible for all contacts with landowners for ROW -related issues, prior to initiation of condemnation proceedings by VDOT. The Concessionaire shall provide documentation of all contact with property owners (including participants and organizations), a summary of discussions, agreed items, follow-on activities, and copies of items distributed, including but not limited to appropriate and timely documentation in the Acquisition Report (Form RW-24).

13. Once access is gained by the Concessionaire to acquired ROW, Concessionaire shall use reasonable care in determining whether there is reason to believe that the property may contain concealed or hidden waste or other materials or hazards that may require remedial action or treatment. VDOT shall be notified of the presence of such materials within Three (3) Business Days of such discovery. In no event shall an offer to acquire any interest in such property be made in advance of and without written concurrence from VDOT.

14. During the acquisition process and for a period of three years after the later of Final Completion or the Commonwealth has indefeasible title to the property, all Project documents and records not previously delivered to VDOT, including all costs of acquisition of ROW, and all documents and records necessary to determine compliance with the Laws relating to ROW Acquisition and the costs of relocation of Utilities shall be maintained and made available by Concessionaire to VDOT for inspection or audit.

C. The Concessionaire shall be responsible, at its sole expense, for demolishing and disposing of all existing buildings from the ROW and permanent and temporary easements, as necessary. All such work shall comply with Good Industry Practice and these Technical Requirements.

D. The Concessionaire shall exercise care to minimize impacts and damages to property, businesses, and residences, including noise, vibrations, temporary traffic patterns, and clearing of tree buffers. The Concessionaire shall address public, business, and government comments in coordination with VDOT within 21 days of receipt; however, the responsibility to coordinate, address and/or respond to the comments shall be the Concessionaire's. Where requested, the Concessionaire shall provide stakeout and marking of existing property lines and impacts.

E. Right of way for temporary highways, diversion channels, sediment and erosion control features or bridges required by the Technical Requirements will be planned, designed and provided by the Concessionaire.

F. Prior to right of way authorization, requirements listed in Section 1.3.1 C – Environmental Documentation shall be performed and completed.

3.7 Utilities

3.7.1 General Requirements

A. The coordination, design, and relocation of all Utilities shall comply with these Technical Requirements, the Standard Documents Section 3.5.2 (including *Right of Way and Utilities Division Manuals, Vol. I and II*), and the requirements, standards and preferences of impacted Utility Owners.

B. The Concessionaire shall be responsible for coordinating and resolving any conflicts arising from such coordination, the Project construction with all Utilities in the area to determine if they may be affected (including VDOT's fiber optic cables and conduits) and protect those utilities that will not be directly affected, in accordance with the Utilities Plan. The Concessionaire shall develop and maintain a utility tracking report as part of the Utilities Plan. The Concessionaire shall be responsible for coordinating the work of its Contractors and the various Utilities.

C. If the Concessionaire desires the temporary or permanent adjustment of Utilities for Concessionaires' benefit, it shall conduct all negotiations with the Utility Owners and pay all costs in connection with the adjustment at no additional cost to the Project.

D. The Concessionaire shall be responsible for utility designations, utility locates (test holes), conflict evaluations, cost responsibility determinations, utility relocation designs, utility relocations and adjustments, utility reimbursement, determination of existing utility easements and the inclusion of such easements on plans, replacement land rights acquisition, and utility coordination required for the Project. The Concessionaire is responsible for coordinating all necessary utility relocations and adjustments to occur. The Concessionaire shall coordinate with each affected Utility Owner to determine those relocation costs that are the Concessionaire's responsibility and those relocation costs that are the responsibility of the Utility Owner.

E. The Concessionaire shall submit a Utilities Plan for VDOT to review and approve to insure conformance with VDOT's policies and procedures. 1

F. The Concessionaire shall initiate early coordination with all Utilities located within the Project ROW and shall jointly host with VDOT a utility informational meeting with all the affected utility companies. The Concessionaire and VDOT will review the Utility Relocation Plan and Estimate before any work is done by a utility company. The Utility Relocation Plan from the Concessionaire shall incorporate each Utility Owner's plan and shall transcend the Project limits (or appropriate area) and responsibilities. The authorization of this plan and estimate by the Concessionaire shall allow the utility companies to perform any relocation and (or) adjustments as necessary within the Project ROW or their respective utility easements. 2

G. A utility field inspection will be conducted with all Utility Owners within the Project by the Concessionaire. Invitees will be provided with advance copies of plans, UT-9 forms, test hole data, schedule information, and proposed agreements. The Concessionaire shall provide meeting minutes for each utility field inspection.

H. The Concessionaire shall use a Master Utility Agreement (MUA) similar to that utilized by VDOT (provided for in VDOT's *Utility Relocation Policies and Procedures Manual*) to establish the general framework for addressing the utility issues within the Project affecting a Utility Owner. The two-party agreement between the Concessionaire and the utility company shall set forth the terms and conditions under which the utility work will be performed, and shall adhere to VDOT's *Utility Relocation Policies and Procedures Manual*.

I. VDOT will provide reasonable assistance in negotiations with Utility Owners as requested by the Concessionaire.

J. The Concessionaire shall be responsible for ensuring continuity of utility services impacted by its construction or operations; when a utility service interruption is necessary, the timing of and duration of the interruption shall be approved by the affected Utility.

K. The Concessionaire shall ensure that utility work is conducted in accordance with the relevant agreements and VDOT's land use permit.

L. When the Concessionaire is responsible for performance of the construction of the utility work, the Concessionaire shall coordinate with the Utility Owner to obtain temporary construction easements or agreements.

M. The Concessionaire will utilize Good Industry Practice to eliminate and minimize utility attachments on bridges. A bridge attachment request will be provided for review and comment by VDOT for each proposed utility bridge attachment. 1

Tunnel facilities should have no other utility attachments other than those for tunnel operation and services, unless there are existing utility facilities attached to the existing tunnels which will need to be relocated or as mutually agreed by the Concessionaire and VDOT. Plan and estimates shall be provided for all utility relocations and approved by VDOT prior to authorization of any utility work. Plan and estimates will adequately address support of excavations adjacent to roadways and potential settlement.

N. The Concessionaire shall request that all contracts with Utility Owners will include As-Built drawings as a deliverable. VDOT will issue an as-built permit to the Utility Owners within 21 days of receipt of As-Built Drawings.

O. The Concessionaire shall be responsible for ensuring the appropriate abandonment or removal of all abandoned utilities within the Project ROW, where the necessity for abandonment is caused by the Work.

P. For all utilities for which the Concessionaire shall be required to design the utility relocation or adjustment, Concessionaire shall comply with all design guidelines, standards, and submittal requirements of the Utility Owner, and shall submit for review all drawings and specifications in accordance the schedule and format of the Utility Owner's, and shall make any and all changes as required by the Utility Owner. Concessionaire shall utilize qualified and certified Professional Engineers to design all utility improvements and in absence of Owner guidelines, standards or preferences shall utilize commercially reasonable engineering judgment and practice.

Q. Upon completion of all construction, the Concessionaire shall certify that all utilities in conflict have been relocated and all reimbursement claims have been satisfied to VDOT's project manager.

3.7.2 Concessionaire's Responsibility for Utility Property and Services

A. At points where the Concessionaire's operations are on or adjacent to the properties of any utilities, including railroads, and damage to which might result in expense, loss, or inconvenience, work shall not commence until arrangements necessary for the protection thereof have been completed. The Concessionaire shall cooperate with owners of utilities so that:

1. Removal and adjustment operations may progress in a timely, responsible, and reasonable manner; and

2. Duplication of adjustment work may be reduced to a minimum, and services rendered by those parties will not be unnecessarily interrupted.

B. If any utility service is interrupted as a result of accidental breakage or of being exposed or unsupported, the Concessionaire shall promptly notify the proper authority and shall cooperate fully with the authority in the restoration of service. If utility service is interrupted, repair work shall be continuous until service is restored.

C. The Concessionaire shall comply with all requirements of the Virginia Underground Utility Damage Prevention Act (the Miss Utility law). The Concessionaire shall wait a minimum of 48 hours after notifying the Miss Utility notification center before commencing excavation work. The Concessionaire may commence excavation work after 48 hours only if confirmed through the Ticket Information Exchange (TIE) System that all applicable utilities have either marked their underground line locations or reported that no lines are present in the Work vicinity. The Concessionaire shall wait an additional 24 hours before commencing excavation operations if any utility operators have failed to respond to the TIE within the first 48 hours. The Concessionaire shall wait to commence excavation work five business days after an approved request for markings is submitted for VDOT-owned utilities or in accordance with Applicable Law for all other utilities. All known utilities shall be protected by the Concessionaire during excavation operations.

D. The Concessionaire shall reasonably seek to determine whether other utilities are present in addition to those notified by Miss Utility and shall afford those additional utilities equivalent notification protocol.

3.7.3 Restoration of Work Performed by Others

A. VDOT may construct or reconstruct any utilities within the limits of the Project ROW or grant a permit for the same at any time during the Term of the Agreement. Prior to construction, reconstruction or issuance of a permit, VDOT shall coordinate with Concessionaire if work is within Project ROW, so as not to materially impact Concessionaire's Work.

B. The Concessionaire shall receive all permit requests, review all permits, perform all coordination, and be the primary authority for allowing the permit. VDOT or any City within the Project ROW can issue the permit once they have written authorization from the Concessionaire.

C. If a utility company under permit by VDOT or VDOT constructs, reconstructs or permits another contractor to conduct utility work within the Project ROW, VDOT needs to coordinate with Concessionaire and is responsible for restoration of impacted area.

3.8 Work Restrictions

3.8.1 General Requirements

A. The Concessionaire shall compile and submit to VDOT a Traffic Management Plan (TMP) in accordance with VDOT's Instructional and Information Memorandum IIM-LD-241.5 (Work Zone Safety and Mobility) and TED 351.3 on Work Zone Speed Analysis will be adopted for Maintenance of Traffic (MOT) on the Project. No construction shall occur until VDOT's comments have been successfully addressed. 1 4

B. MOT development shall be consistent with the Agreement, including these Technical Requirements.

C. The Concessionaire shall develop an MOT Plan in accordance with the requirements of Section 3.3 (Project Development Plans).

D. The Concessionaire shall maintain traffic consistent with the MOT Plan.

3.8.2 Limits of Operation

A. The Concessionaire is advised that its general operations may proceed seven days a week, 24 hours a day, during the performance of the Design-Build Work except as may be modified herein.

B. The Concessionaire shall provide VDOT's project manager a weekly work zone plan of all closures (road, lane, shoulder, etc.) on the Wednesday prior to the next week's planned work activity.

C. The lane closure approval and coordination process shall conform to the requirements of the ERO ATMS and the Concessionaire will be required to complete the Lane Closure Request forms and submit in accordance with ATMS requirements.

3.8.3 Temporary Roadway Closures

A. Lane and Shoulder Closures on roadways managed by local governments - The Concessionaire shall comply with the requirements set forth by the locality.

B. Lane and Shoulder Closures on roadways managed by VDOT- The Concessionaire shall comply with the *Limits of Operation and Maintenance of Traffic* document maintained by the ERO TOC Operations Manager.

C. Lane closures or work that impacts traffic flow will not be permitted on holidays from noon the day before a holiday until noon the day after a holiday, unless approved by VDOT. When a holiday falls on a Friday, lane closures are not permitted from noon on Thursday to noon on Monday. When a holiday falls on Monday, lane closures are not permitted from noon on Friday to 6:00 AM on Tuesday. Further, because the Thanksgiving Day holiday occurs on a Thursday, work will not be permitted from noon on Wednesday until 6:00 AM on the following Monday. Existing Midtown Tunnel lane closures can happen each day 8:00 PM to 5:00 AM daily Sunday through Thursday. Lane closures for the Downtown Tunnel Eastbound can happen each day 8:00 PM to 5:00 AM daily Sunday through Thursday. Lane closures for the Downtown Tunnel Westbound can happen 8:00 PM to 5:00 AM daily Sunday through Thursday. 2 4

D. Existing Downtown Tunnels and Existing Midtown Tunnel full and lane closures (Eastbound or Westbound) can occur on weekends commencing Friday 8:00 PM to Monday 5:00 AM. Detour routes for full closures must be established and signed appropriately per MOT Plans. No tunnel closures can occur on any holiday weekends and at no time may an Existing Downtown Tunnel and Existing Midtown Tunnel be closed concurrently. Tunnel closures during municipal events listed below will require approval on a case by case basis. 2 4 3

E. For the purposes of these Technical Requirements, the term "holiday" herein shall apply to New Year's Day, Martin Luther King Jr. Day, President's Day, Easter, Memorial Day, Independence Day, Labor Day, Columbus Day, Veteran's Day, Thanksgiving Day, and Christmas Day. Local special events will include:

DATE	EVENT	LOCATION
04/30/11	NATO Festival	Town Point Park
04/30/11	NATOFEST Parade	Downtown
06/10-12/11	Annual Norfolk Harborfest / OPSAIL	Town Point Park
11/13/11	Norfolk Half Marathon - St. Paul's Blvd/Granby Street/ Little Creek Road/Hampton Blvd/Brambleton Avenue/Boush Street/ ending at TPP	Town Point Park
11/19/11	Grand Illumination Parade	Downtown

2 3

Note 1: All of the events listed for 2011 are annual events and will occur in future years around the same time period. 3

Note 2: The future dates for the Marathon (full marathon starting is 2012) are:

November 10-11, 2012
November 9-10, 2013
November 8-9, 2014
November 7-8, 2015

Note 3: The Grand Illumination Parade always takes place annually on the third Saturday in November.

Note 4: As of 1/20/11 – there has been no confirmation as to whether or not there will be an Afr'Am Festival. In the past this event has taken place the weekend before Memorial Day at Town Point Par.
Note 5: I-264 lane closures may be allowed, provided that VDOT and the local municipality concur that the special event will not be impacted by adverse traffic patterns of the lane closure. Also upon application to VDOT and the local municipality, work restrictions regarding times and dates may be waived. 3

F. Subject to the provisions of 3.8.1 and an approved hurricane evacuation plan, the outside lanes of I-264 (Eastbound and Westbound) may be closed for extended periods of time to complete the widening and tie-ins associated with the New MLK Extension work as follows: 4

1. At least 2-full width lanes of traffic must be maintained at all times
2. The duration of each lane closure must not exceed 18 months
3. A full work-zone length closure is permissible from November 1 to July 31 for both Eastbound and Westbound
4. Westbound lane closures must be limited to 1800 ft during August, September and October. Eastbound lanes may be closed the full work-zone length during August, September and October.
5. A work-zone speed reduction will not be permissible

3.8.4 Concessionaire Proposed Closures

A. At VDOT's sole discretion and concurrence, the Concessionaire may submit a request to Work outside the stated lane hours by providing adequate justification (including traffic analyses) demonstrating the viability of the request.

B. For non-emergency related maintenance, the Concessionaire shall forward to VDOT, for approval, a tunnel closure plan, Concessionaire is to relay reason for the tunnel closure, an alternatives analysis determining why the tunnel needs to be closed, times/dates and locations of the closure, detour routes and MOT plans. 2

3.8.5 Night Work

A. Work occurring after sunset and before sunrise will be considered nighttime operations. Vehicles operating on the pavement of a closed roadway or travel lane shall display four-way flashers or rotating amber beacons at all times. Vehicles using headlights, except for rollers and vehicles retrieving channelizing devices, shall travel facing in the same direction as adjacent traffic in order to avoid glare and confusion to drivers.

B. The Concessionaire shall maintain a supply of emergency flares for use in the event of unanticipated situations such as traffic accidents, equipment breakdowns, failure of lighting equipment, etc.

C. Illumination Requirements. Tower-mounted luminaries, whether fixed, portable, trailer mounted, or equipment-mounted, shall be of sufficient wattage and/or quantity to provide the required level of illumination and uniformity over the area of operation.

D. The uniformity of illumination, defined as the ratio of the average illumination to the minimum illumination over an area requiring an indicated illumination level, shall not exceed 5:1. Illumination levels on approach roadways should be increased sequentially to prevent motorists from becoming disoriented by rapid changes from full dark to very bright conditions. Existing street and highway lighting shall not eliminate the need for the Concessionaire to provide adequate lighting. Consideration will be given to the amount of illumination provided by existing lights in determining the wattage and/or quantity of lights to be provided. In the event of any failure of the lighting system, nighttime operation(s) shall be discontinued until the required level of illumination is restored.

1. Level I (5 foot-candles). Level I illumination shall be provided for all areas of general construction operations to include all work operations by Concessionaire' personnel, including work zone traffic control set-up and operations, staging, excavation, cleaning and sweeping, spoil disposal, landscaping, planting and seeding, layout and measurements ahead of the actual work, borrow areas, spoil areas, and truck cleanout areas. Level I illumination shall be provided at the area of lane and/or road closure tapers continuously, including the setup and removal of the closure tapers.

2. Level II (10 foot-candles). Level II illumination shall be provided for flagging stations, asphalt paving, milling, and concrete placement and/or removal operations, including bridge decks.

3. Level III (20 foot-candles). Level III illumination shall be provided for pavement or structural crack filling, joint repair, pavement patching and repairs, installation of signal equipment or other electrical/mechanical equipment, and other tasks involving fine details or intricate parts and equipment.

E. Glare Control. All lighting shall be designed, installed, and operated to avoid glare that affects traffic on the roadway. The Concessionaire shall locate and aim lighting fixtures to provide the required level of illumination and uniformity in the work zone without the creation of objectionable glare.

F. The Concessionaire shall provide shields, visors or louvers on luminaries as necessary to reduce objectionable levels of glare. As a minimum, the following requirements shall be met to avoid objectionable glare on roadways open to traffic in either direction:

1. Tower-mounted luminaries shall be aimed either generally parallel or perpendicular to the roadway.

2. Luminaires shall be aimed such that the angle between the center of the beam axis and the vertical mounting pole is no greater than 45 degrees.

3. No luminaries shall be permitted that provide a luminous intensity greater than 20,000 candelas at an angle of 72 degrees above the vertical.

4. Except where prevented by overhead utilities or structures, towers shall be extended to their full working height when in use to reduce glare and provide uniform illumination.

G. The Concessionaire shall furnish and place warning signs to alert approaching motorists of lighted construction area(s). These warning signs shall be four feet (1200 mm) x four feet (1200 mm). The Concessionaire's vehicles used on the Project shall be provided with amber flashing lights that shall be in operation while in the work area. The Concessionaire's equipment shall be provided with a minimum of three square feet of reflective sheeting that is visible to approaching motorists. The Concessionaire shall provide personnel with ANSI Class II reflective vests, which shall be worn at all times while the workers are within the work area. The Concessionaire shall provide a light meter to demonstrate that the minimum light intensity is being maintained.

H. The Concessionaire shall provide sufficient fuel, spare lamps, and generators to maintain the lighting of the work site. The Concessionaire shall utilize padding or shielding or locate mechanical and electrical equipment to minimize noise generated by lighting operations. Noise generated by portable generators shall comply with all applicable Law.

I. The Concessionaire shall provide sufficient uniformed law enforcement officers with a marked law enforcement vehicle equipped with a blue flashing light for all interstate, primary and major secondary roadway nighttime work that is performed within the travel lanes.

3.8.6 Size and Weight Limitations

A. Hauling or Moving Material and Equipment on Public Roads: The Concessionaire shall comply with legal size and weight limitations in the hauling or moving of material and equipment on public roads unless the hauling or moving is covered by a hauling permit or is within the Project Right of Way.

B. The Concessionaire shall be liable for damage that results from the hauling or moving of material and equipment.

C. Furnishing Items in Component Parts of Sections: If the size or weight of fabricated or manufactured items together with that of the hauling or moving vehicle exceeds the limitations covered by hauling permit policies and other means of transportation are not available, permission will be given to furnish the items in component parts of sections with adequately designed splices or connections at appropriate points. Permission for such adjustments shall be requested in writing, and concurrence in writing shall be secured from VDOT prior to fabrication or manufacture of the items. The request shall state the reasons for adjustment and shall be accompanied by supporting data, including working drawings where necessary.

3.8.7 Use of Explosives

A. Explosives shall be stored and used in a secure manner in compliance with Good Industry Practice. Prior to prosecuting the Work, the Concessionaire shall conduct an on-site review of the work involved and develop a plan of operations for performing excavating work. Where feasible, the Concessionaire shall explore other means of loosening and or reducing the size of the excavation without blasting. When blasting becomes necessary, the Concessionaire's plan of operations shall include a blasting plan detailing the blasting techniques to be used during excavation operations requiring the use of explosives. Both plans shall be submitted to VDOT for review prior to commencing blasting operations.

B. Explosives shall be purchased, transported, stored, used, and disposed of by a Virginia Certified Blaster in possession of a current criminal history record check and commercial driver's license with hazardous materials endorsement and a valid medical examiner's certificate.

C. The Concessionaire shall be responsible for damage resulting from the use of explosives. The Concessionaire shall notify each property and Utility Owner having a building, structure, or other installation above or below ground in proximity to the site of the Work of its intention to use explosives. Notice shall be given sufficiently in advance of the start of blasting operations to enable to owners to take steps to protect their property. The review of the Concessionaire's plan of operations, blasting plan, and notification of property owners shall in no way relieve the Concessionaire of its responsibility for damage resulting from its blasting operations.

3.9 Maintenance of Traffic

3.9.1 General Requirements

A. The Concessionaire shall comply with pertinent requirements for maintenance of traffic (MOT) for the Work. The Concessionaire is responsible for safety of work zones. The Concessionaire shall appoint a single point of contact to address MOT and safety requirements.

B. Work zone information shall be shared with VDOT's Eastern Region Operations (ERO) Advanced Traffic Management System (ATMS). Data sharing protocols shall be defined in the Traffic Management Plan and shall be reviewed by VDOT.

C. The Concessionaire shall provide a MOT Engineer to perform the following:

1. Coordinate implementation of regional Transportation Management Plan as developed by VDOT;

2. Oversee the design and implementation of the MOT Plans; and

3. Coordinate MOT activities with the Public / Community Outreach staff and VDOT.

D. The MOT Engineer shall be a Professional Engineer registered in the Commonwealth of Virginia who has at least 5 years of MOT design and implementation experience or an individual demonstrating a minimum of 10 years experience in managing MOT design and implementation of similar project complexity.

E. The Concessionaire shall undertake appropriate traffic analyses for all MOT phase and stages in order to minimize traffic impacts.

3.9.2 Maintenance of Traffic during Construction

A. The MOT Engineer or designee shall be continuously available for MOT related activities during construction until Final Completion and elimination of all construction traffic control.

B. The Concessionaire shall conduct all work necessary to provide safe and efficient MOT during construction, including provisions for the movement of people, goods, and services through and around the Project while minimizing impacts to pedestrians, local residents, businesses, and commuters.

C. The construction activities will be performed in accordance with the Traffic Management Plan.

D. Existing VDOT Intelligent Transportation System (ITS) devices in the Project lanes shall remain operational throughout all of construction, unless replaced with temporary devices, until permanent ITS devices are fully operational. These ITS devices include:

1. Closed-circuit television (CCTV) cameras;

2. Dynamic message signs (DMS);

3. Ramp metering;

4. Detection;

5. Mile markers;

6. The existing reversible gate system; and

7. Weather stations.

E. Existing detection (traffic sensors) shall remain in place during construction activities, unless replaced with temporary devices. Replacement detection shall be installed, operational, integrated, and collecting data immediately upon taking in-pavement detection out of service.

F. The Concessionaire, at its sole cost and expense, shall be required to provide a uniformed law enforcement officer with a marked law enforcement vehicle equipped with a blue flashing light during set-up and take-down of all daytime intersection closures involving two or more lanes of traffic, as required in the Standard Documents.

G. Detour plans shall be developed by the Concessionaire and presented to VDOT for review and comment. The Concessionaire shall coordinate detour plans local, State and Federal agencies (as applicable) and submit and update the MOT Plan in advance of any planned detour activity. The Concessionaire shall be responsible for all planning, consultation and coordination with impacted parties, design, implementation and monitoring, and maintenance of detours-whether within or outside the Project Right of Way. The provision of detours and marking of alternate routes will not relieve the Concessionaire of the responsibility for ensuring the safety of the public or from complying with any requirements of the Agreement.

H. Unless a design exception or design waiver is granted, the geometric design for temporary roadways and temporary traffic control shall be designed, at a minimum, to the existing posted speed limit.

I. During any suspension of Work, in accordance with the Agreement, the Concessionaire shall temporarily open to traffic such portions of the Project and temporary roadways as mutually agreed by the Concessionaire and VDOT.

J. Certified flaggers shall be provided in accordance with the requirements of the *Virginia Work Area Protection Manual* (VWAPM). Flaggers shall be able to communicate to the traveling public in English while performing the job duty as a flagger at the flagger station. Flaggers shall use sign paddles to regulate traffic in accordance with the requirements of the VWAPM. Flagger certification cards shall be carried by flaggers while performing flagging duties. Flaggers found not to be in possession of their certification card shall be removed immediately from the flagging site. Further, flaggers performing duties improperly will have their certifications revoked.

K. Connections with roads and public and private entrances shall be kept in a reasonably smooth condition at all times. Stabilization or surfacing material shall be applied to connections and entrances.

L. The Concessionaire shall schedule construction operations so that continuous access is provided to all affected roads and properties unless otherwise approved by VDOT. Connections or entrances shall not be disturbed by the Concessionaire until necessary. Once connections or entrances have been disturbed, they shall be maintained and completed as follows:

1. Connections that had an original paved surface shall be brought to a grade that will smoothly and safely accommodate vehicular traffic through the intersection, using pavement. Connections that had an original unpaved surface shall be brought to a grade that will smoothly and safely accommodate vehicular traffic through the intersection, using either the required material or a temporary aggregate stabilization course that shall be placed as soon as practicable after connections are disturbed.

2. Closures to mainline connections shall be minimized during construction. If there are delays in prosecution of work for other connections, connections that were originally paved shall have at least two lanes maintained with a temporary paved surface. Those that were not originally paved shall be maintained with a temporary aggregate stabilization course.

3. Mainline access/egress connections shall have all lanes open during construction unless otherwise agreed with VDOT. Other entrances shall be

graded concurrently with the roadway with which they intersect. Once an entrance has been disturbed, it shall be completed as soon as is practicable, including placing the required base and surface course or stabilization. If the entrance must be constructed in stages, such as when there is a substantial change in the elevation of the roadway with which it intersects, the surface shall be covered with a temporary aggregate stabilization course or other suitable salvaged material until the entrance can be completed and the required base and surface or stabilization course can be placed.

M. When the Concessionaire elects to complete the rough grading operations for the entire Project or exceed the length of one full day's surfacing operations, the rough grade shall be machined to a uniform slope from the top edge of the existing pavement to the ditch line.

N. When the surface is to be widened on both sides of the existing pavement, construction operations involving grading or paving shall not be conducted simultaneously on sections directly opposite each other. The surface of pavement shall be kept free from soil and other materials that might be hazardous to traffic. Prior to opening of new pavement to traffic, shoulders shall be roughly dressed for a distance of three feet from the edge of the paved surface.

O. Where the Concessionaire places obstructions such as suction or discharge pipes, pump hoses, steel plates or any other obstruction that must be crossed by vehicular traffic, they shall be bridged in accordance with plans submitted by the Concessionaire and reviewed by VDOT. Traffic shall be protected by the display of warning devices both day and night. If operations or obstructions placed by the Concessionaire damage an existing traveled roadway, the Concessionaire shall repair damages, and if necessary, cease operations to do so.

P. Where existing hydraulic cement concrete pavement is to be patched, the operation of breaking and excavating old pavement shall extend for a distance of not more than two miles. Patching shall be coordinated with excavating so that an area of not more than one-half mile in which excavated patches are located shall be left at the end of any day's work. Necessary precautions shall be taken to protect traffic during patching operations.

Q. The Concessionaire shall construct, maintain, and remove temporary structures and approaches necessary for use by traffic. After new structures have been opened to traffic, temporary structures and approaches shall be removed. The proposed design of temporary structures shall be submitted to VDOT prior to beginning construction of the structure. 1

3.10 Reporting

A. The Concessionaire shall prepare and provide to VDOT regular reports as more fully described below. All reports prepared by Concessionaire shall include, at a minimum, those items shown below in a format mutually agreed to with VDOT and sufficient to allow VDOT to meet its regulatory reporting responsibilities.

B. During the performance of the Design-Build Work, the Concessionaire's weekly report shall include the following:

1. Specific construction schedule activities, including location of the work for the week concluding and the upcoming week;

2. Any proposed roadway or waterway closures;

3. Rolling 3-week forward-looking inspection notice, which shall include the fabrication schedule and planned construction activities; and

4. MOT weekly update, regarding any scheduled lane closures and identification of work areas for the ensuing two weeks.

C. During the performance of the Design-Build Work, the Concessionaire's monthly report shall include the following:

1. Specific construction activities and deliverables planned for the next reporting period;

2. A progress narrative that describes, at a minimum, the overall progress for the preceding month, a critical path analysis, a discussion of problems encountered and proposed solutions thereof, any pending TIAs, float consumption;

3. Identification of activities requiring VDOT/FHWA input or assistance;

4. Action items/outstanding issues;

5. A work breakdown structure level 1 or level 2 design and construction schedule;

6. Project cost data as required by public funding agreements;

7. Quality management reporting, as defined within the Concessionaire's QMSP, including quality inspection reports and daily inspection reports;

8. A statement by the Concessionaire that the schedule submitted is the Project Schedule;

9. Any changes to work including Notices of Intent, Work Orders, Change Orders, Liquidated Damages, Force Account work and any disputes;

10. Nonconformance reports and resolution reports;

11. Right of way acquisition activities;

12. Environmental compliance activities;

13. DBE/SWaM quarterly usage;

14. Safety activities; 1

15. Digital photographs in format acceptable to VDOT of the progress of the Project; and

16. A summary of any outstanding issues, any Delay Events, or Compensation Events that have occurred or are anticipated and the measures adopted (or to be adopted) to overcome such issues.

D. During the performance of the O&M Work, the Concessionaire's quarterly O&M report shall be mutually agreed by the Concessionaire and VDOT and may include the following:

1. Planning and implementation of operations, including work plans for the future periods;

2. Roadway operations;

3. Incident response;

4. Routine maintenance activities;

5. Customer service log, detailing complaints or requests, and their disposition;

6. O&M inspections;

7. Long-term participation SWaM goal;

8. A summary of issues related to Performance Points during the reporting period;

9. Quality management activities; and

10. Performance timeliness.

E. During the performance of the O&M Work, the Concessionaire's annual report shall include the following:

1. Summary of quarterly issues and trends as required for VDOT's reporting to FHWA; and

2. Annual budget(s), as required by the Agreement.

F. The Concessionaire Management Plan shall describe the proposed formats, means of distribution, and recipients of the reports.

G. The Concessionaire shall maintain at all times, at its office, a minimum of one hard-copy complete set of all reports shown above, for the previous six months only. All reports shall be available to VDOT for inspection and audit. Additional reports may be required, by mutual consent of the parties, and the reports listed above may also be deleted by mutual consent of the parties.

3.11 Third Parties and Permitting

3.11.1 Permitting

A. The Concessionaire shall coordinate in its dealings with Government Authorities and other entities having interests in the Project, with assistance from VDOT as reasonably requested. All permitting will be the responsibility of the Concessionaire unless otherwise required by Law. The Concessionaire shall provide copies of all permits and permit modifications to VDOT upon receipt.

B. Concessionaire will be responsible for all costs associated with compliance with any ordinance and applicable Law or any violations to Applicable Law attributed to the activities of the Concessionaire in accordance with the Agreement.

3.11.2 Third Parties

A. The Concessionaire shall give the Work the constant attention necessary to facilitate quality and progress and shall fully cooperate with VDOT and FHWA. If any portion of the Project is located within the limits of a municipality, military installation, or other federally owned property; the Concessionaire shall cooperate

with the appropriate officials and agents in the prosecution of the Work to the same extent as with VDOT.

B. The Concessionaire shall coordinate its activities with other contractors working in the area, facilitated by VDOT as applicable. The Concessionaire's work program and schedule shall consider and coordinate with the work of other contractors involved with adjacent work including maintenance within and around the Project Right of Way.

3.11.3 Fire Hydrants

A. No Work shall be undertaken around fire hydrants, as required by local first responder guidelines, until provisions for continued service have been approved by the local fire authority.

B. When the Concessionaire's Work requires the disconnection of "in service" fire hydrants, the Concessionaire shall notify the locality's fire department or communication center prior to disconnection, as required by the local fire department. In addition, the Concessionaire shall notify the locality's fire department or communications center after reconnection of such hydrants, as required by the local fire department.

3.11.4 Construction In, Over and/or Adjacent to Navigable Waters

A. The Concessionaire shall be responsible for obtaining a permit from the U.S. Coast Guard for the anticipated construction activities that cross a waterway and/or within the water channel under the jurisdiction of the U.S. Coast Guard.

B. Prior to starting demolition or construction operations the Concessionaire shall attend a coordination meeting with VDOT and the U.S. Coast Guard to present its planned operations and the potential impacts those operations may pose to water traffic. The Concessionaire shall, in consultation with the U.S. Coast Guard, establish the proper protocol for emergency closures and be governed accordingly. The protocols shall be confirmed in writing with VDOT and the U.S. Coast Guard and incorporated in the Project Development Plans.

1. Activities subject to Coast Guard regulation under the Permit. Following the U.S. Coast Guard coordination meeting, the Concessionaire shall incorporate its proposed schedule of operations as part of its Baseline Schedule. The Concessionaire shall be responsible for complying with all procedures, submittals, and schedule requirements set forth in the permit.

2. Activities that require channel closures or restrictions. In addition to the submittal of its proposed schedule of operations as described above, Concessionaire shall submit plans that comply with the Coast Guard Permit for falsework, cofferdams, dredging operations, floating equipment, fabricated tunnel segments and other obstructions to the channel or channels to VDOT for review. The Concessionaire's attention is directed to the possibility that advance notification for consideration of approval may vary depending on the type and duration of proposed closures, the time of year for requested closure(s), and location of existing public oyster bed grounds, bridge(s) and waterway(s) involved, and the impact to entities served along or through the waterway(s).

C. VDOT shall review and provide written comments, if applicable, to the Concessionaire within 21 days following receipt of the Concessionaire's plans. The Concessionaire shall incorporate VDOT's comments and submit its plans to VDOT and to the U.S. Coast Guard. The Concessionaire may not commence activities that require channel closures or restrictions without the prior written approval the U.S. Coast Guard. The Concessionaire shall be responsible for complying with all operational requirements that the U.S. Coast Guard may place on the Concessionaire as conditions of approval.

D. In addition, the Concessionaire shall request and obtain U.S. Coast Guard approval in writing before commencing any operations that deviate from the Concessionaire's schedule of operations when these operations interfere or have the potential to interfere with navigation of water traffic outside of timeframes previously approved by the U.S. Coast Guard.

E. Notices shall be sent to the U.S. Coast Guard, Fifth District Bridge Office (OBR), 431 Crawford Street, Portsmouth, VA 23704-5004. Payment of any penalty or fine that may be levied by the U.S. Coast Guard for Concessionaire violations of bridge regulations found in 33 CFR Parts 115, 116, 117 and 118 shall be the responsibility of the Concessionaire.

3.11.5 Other Permitting for Construction In, Over and/or Adjacent to Navigable Waters

A. The Concessionaire shall be responsible for obtaining any other permits required by other State and Federal agencies including but not limited to the U.S. Army Corps of Engineers, the Virginia Department of Environmental Quality, and the Virginia Marine Resources Commission for the anticipated construction activities that cross a waterway and/or are otherwise under the respective agency's jurisdiction.

B. Prior to starting demolition or construction operations the Concessionaire shall organize and attend coordination meeting(s) with VDOT and the respective agencies to present its planned operations and the potential impacts those operations may pose. The Concessionaire shall, in consultation with the agency(s), establish the proper protocol for permit compliance and conditions for work stoppage and be governed accordingly. The protocols shall be confirmed in writing with VDOT and the agency(s) and shall be incorporated in the Project Development Plans. VDOT and agency approval is required prior to commencement of construction activities.

3.12 Emergency Services

3.12.1 Liaison

The Concessionaire shall comply with VDOT requirements for participation in industry and statutory initiatives regarding emergency services.

3.12.2 Emergency and Extraordinary Services

A. The Concessionaire's response to emergencies and extraordinary circumstances as part of the Project shall be in accordance with the Agreement and the *Commonwealth of Virginia Emergency Operations Plan Volume 5* and shall ensure that:

1. Safety of motorists, pedestrians and workforce personnel shall be the primary objective for all decisions and actions;

2. Clearance of a travel lane for emergency response vehicles shall be by the most expedient route within the facility (in such circumstances, the decision of VDOT or the emergency services in charge shall govern);

3. Military vehicles acting in an emergency response capacity or in defense of the sovereign homeland of the United States of America shall be given free and unrestricted access to the facility; and

4. The Concessionaire shall participate in emergency exercises conducted by Governmental Authorities.

B. During special events that have significant impact on traffic flow, the Concessionaire shall designate a responsible party in charge to work with the VDOT District Public Information Manager (or designee) and ERO Incident Management Coordinator to develop traffic management plans for the event.

3.13 Safety

3.13.1 General Requirements

A. VDOT and the Concessionaire recognize that in every circumstance, activity, and decision related to the Project, safety of the public, VDOT personnel, and Concessionaire personnel is the primary concern. Ensuring and maintaining safety on the Project shall supersede any and all other objectives.

B. The Concessionaire shall designate a full-time project safety officer for the Term. The Safety Officer shall ensure that designated project personnel can be contacted by VDOT and emergency services personnel at all times.

3.13.2 Construction Safety and Health Standards

A. Compliance with construction safety and health standards is a condition of the Agreement, and shall be made a condition of each subcontract entered into pursuant to the Agreement. The Concessionaire and any Contractor shall not require any worker employed in performance of the Agreement to work in surroundings or under working conditions that are unsanitary, hazardous, or dangerous to their health or safety, as determined under construction safety and health standards promulgated by the U.S. Secretary of Labor in accordance with the requirements of Section 107 of the Contract Work Hours and Safety Standards Act.

B. The Concessionaire shall comply with the Virginia Occupational Safety and Health Standards adopted under the Code of Virginia and the duties imposed under the Code. Any violation of the requirements or duties that is brought to the attention of the Concessionaire by VDOT or any other person shall be immediately abated.

C. Unless otherwise determined unsafe or inappropriate in accordance with Occupational Health and Safety (OSHA) regulations, all Concessionaire personnel shall comply with all applicable safety requirements including but not limited to the following,:

1. Hard hats shall be worn while participating in or observing all types of field Work when outside of a building or outside the cab of a vehicle, and exposed to, participating in or supervising construction.

2. Respiratory protective equipment shall be worn whenever an individual is exposed to any item listed in the OSHA standards as needing such protection unless it is shown that the employee is protected by engineering controls.

3. Adequate eye protection shall be worn in the proximity of grinding, breaking of rock and/or concrete, while using brush chippers, striking metal against metal or when working in situations where the eyesight may be in jeopardy.

4. A safety vest shall be worn by all exposed to vehicular traffic and construction equipment.

5. Standards and guidelines of the current *Virginia Work Area Protection Manual* shall be used when setting, reviewing, maintaining, and removing traffic controls.

6. Flaggers shall be certified in accordance with the Virginia Flagger Certification Program.

7. No person shall be permitted to position themselves under any raised load or between hinge points of equipment without first taking steps to support the load by the placing of safety bar or blocking.

8. All electrical tools shall be adequately grounded or double insulated. Ground Fault Circuit Interrupter (GFCI) protection must be installed in accordance with the National Electrical Code (NEC) and current Virginia Occupational Safety and Health (VOSH) agency. If extension cords are used, they shall be free of defects and designed for their environment and intended use.

9. No person shall enter a confined space without training, permits, and authorization.

10. Fall protection shall be required whenever an employee is exposed to a fall six feet or greater.

D. Concessionaire shall not impact any height restrictions at any overpasses through the use of but not limited to containment systems, false decking, etc.

DOWNTOWN TUNNEL/MIDTOWN TUNNEL/MLK EXTENSION PROJECT

The Technical Requirements

Comprehensive Agreement Exhibit C

Section 4

Operations, Maintenance, and Tolling

TECHNICAL REQUIREMENTS
Exhibit C

4 Operations, Maintenance, and Tolling

4.1 Inspection Requirements

4.1.1 General Requirements

A. The Concessionaire shall employ or shall cause the O&M Contractor to employ trained and competent personnel to plan and implement a program of inspections of the O&M Work. This program shall achieve the following:

1. Provide for the continuing safety of the O&M Work for users;

2. Prioritize Defects requiring immediate and urgent attention because they are likely to create a hazard or serious inconvenience to users;

3. Identify other Defects to be included for repair within the Concessionaire's annually recurring maintenance and repair program (e.g., Life Cycle Maintenance Plan);

4. Responsiveness to reports or complaints received from stakeholders;

5. Take account of Incidents and Emergencies affecting the O&M Boundaries;

6. Monitor the effects of extreme weather conditions; and

7. Collate data to monitor performance of the entire project and to establish priorities for future maintenance operations.

B. The Concessionaire shall require personnel performing inspections of road pavements and structures to be certified as inspectors in accordance with Standard Documents in Section 3.5.

C. All structures, as defined by National Bridge Inspection Standards (NBIS), shall be inspected in accordance with the NBIS of the Code of Federal Regulations, 23 Highways – Part 650 and Structure IIM 27.6. The Concessionaire shall make available all inspection reports within two weeks of completion of the inspection report to the VDOT Hampton Roads District Bridge Engineer.

D. Concessionaire will be subject to the Performance Requirements in Attachment 4A.

4.1.2 Inspection Frequency

A. The Concessionaire shall establish inspection procedures and carry out inspections so that:

1. All Defects that present a hazard are identified, documented, and repaired such that the hazard is mitigated within the time scales set out in Attachment 4A; and

2. All other Defects are identified, documented, and repaired within the time scales set out in Attachment 4A.

B. The periods stated in Attachment 4A shall be deemed to be periods from the time the relevant Defect was first identified by or brought to the attention of the Concessionaire.

C. The Concessionaire shall consider all reports and complaints on the condition of the Assets received from all sources and investigate and respond as appropriate. The Concessionaire shall record these as O&M Records, together with details of all relevant inspections and actions taken in respect of Defects, including temporary protective measures and repairs. These records shall be made available to VDOT upon request.

4.1.3 Safety Inspections

The record of a safety inspection shall include details of the weather conditions, road surface condition, and any unusual features related to the method of inspection.

4.1.4 Environmental Inspections

The Concessionaire shall perform inspections of the tunnels and other Project facilities in accordance with the applicable regulatory requirements to determine compliance with all applicable environmental regulations and document the findings and follow-up corrective actions for regulatory violations. The Concessionaire shall also accomodate periodic environmental compliance asessment inspections performed by VDOT by providing access to all facilities, records, personnel, etc. and shall implement corrective actions for any identified regulatory violations.

4.1.5 General Inspections

A. The Concessionaire shall perform general inspections in accordance with the O&M Plan so that the repairs of all material Defects are included in planned programs of Work.

B. O&M Records in respect of general inspections shall include details of the manner of inspection (e.g., center lane closure or shoulder), the weather conditions, and any other unusual features of the inspection. These reports shall be made available for VDOT inspection upon request.

4.2 Maintenance Requirements

4.2.1 General Obligations

The Concessionaire shall operate and maintain within the O&M Boundaries pursuant to the Agreement, including Good Industry Practice.

4.2.2 O&M Data Management

A. Prior to Substantial Completion of each Project Asset, the Concessionaire shall implement a computer-based Maintenance Management System (MMS) to record inventory, failures, repairs, maintenance activities, inspections performance, communications, and notifications of Incidents and Defects. The Concessionaire shall enter all of the Assets into the MMS with Asset Identifications (IDs) consistent with those descriptions and units of measure used by VDOT. The inventory shall, where appropriate, include separate records for subcomponents of each Asset. All information shall be recorded in a consistent manner and shall be searchable by individual attributes.

B. The MMS shall include relevant condition information with respect to each Asset, including at a minimum location, equipment nomenclature, serial number, name, date of installation, technician ID, type of failure, date and time of failure, date and time of response to the site and date and time returned to service, preventive mainteannce work, schedule work, work repair code, failure and repair history, Asset Residual Life, and statistical data on Mean time Between Failure (MTBF) and Mean Time to Repair (MTTR). Residual Life means the calculated duration that any Asset of the Project, subject to the type of routine maintenance of the Asset which is normally included as an annually recurring cost in highway maintenance and repair budgets, will continue to comply with any applicable Performance Requirement or standard after the end of the

Term, as per the terms of the Agreement, before Major Maintanence is required, determined through the application of Residual Life methodology and residual life inspections. The MMS shall be configured to report work by function code, Asset (or subcomponent), reference marker, crew and unit of measure.

C. Defects and responses to Defects shall be recorded on the MMS within seven days of them coming to the attention of the Concessionaire or action being taken. All other recording requirements shall be recorded on the MMS within 15 days of completion or occurrence of the relevant activity.

D. The Concessionaire shall ensure that the MMS is capable of generating the information required to demonstrate achievement of the Performance Requirements for each Asset.

E. The Concessionaire shall provide VDOT access to the MMS at all times for the purposes of auditing the accuracy of the Concessionaire's O&M Records. Such access shall require advance notice from VDOT to the Concessionaire.

F. The MMS shall be kept updated and operational throughout the O&M Work.

G. The MMS data shall be provided to VDOT in a format (database type, level of detail, arrangements of data, etc.) agreed to amongst the parties. The data shall be updated and provided to VDOT on a quarterly basis. The Concessionaire shall provide information on specific queries within 3 business days when requested to do so by VDOT.

H. MMS data system shall be compatible with and interoperable with, VA Traffic, Work Order Requests, Asset Management System, etc.

4.3 Operations Requirements

4.3.1 General

The facilities will be supervised from a 24-hour manned operations control center located in the OCC, the precise location to be determined.

4.3.2 Data Collection

The Concessionaire shall provide traffic volume and classification data collected at the toll gantries in compatible format to VDOT's data collection system.

4.3.3 Incident Management

A. The Concessionaire shall provide sufficient equipment and personnel to support incident and emergency management operations on the facility 24 hours a day, seven days a week, 52 weeks per year. The Concessionaire shall take necessary action using appropriate resources to handle any and all traffic control needs to ensure the safety of the incident scene and traveling public and to minimize the potential for pollution of watercourses or groundwater.

B. The Concessionaire shall coordinate with ERO TOC and other first responder community stakeholders in developing the incident management plans and when carrying out incident management operations.

C. Where structural damage to a structure in the facility is suspected, the extent of damage and condition of the structure shall be evaluated, documented, and reported by a bridge/structural engineer with the following qualifications:

1. A Professional Engineer, licensed in the Commonwelath of Virginia;

2. Meets the qualifications to be a “Team Leader” in accordance with the requirements of Article 650.307 of the National Bridge Inspections Standards, 23 CFR 650.3; and

3. Has extensive experience with in-service bridge inspection, emergency bridge inspection, maintenance, repair and rehabilitiation of bridges, structural evaluations, and load ratings.

The above mentioned bridge/structural engineer shall be available to advise on temporary repairs and/or shoring that may be needed to provide safe clearance of the Incident or Emergency. Unless necessary to protect the safety of the public, the Concessionaire shall not remove any vehicle or other item that may assist the incident or emergency investigation until authorized to do so by the relevant law enforcement agencies.

D. The Concessionaire shall re-open the facility once appropriate safety and traffic management measures have been completed in accordance with Good Industry Practice and any issues related to Hazardous Substances have been mitigated in accordance with Good Industry Practice.

E. The Concessionaire must ensure that procedures are in place for public/agency notifications, incident management, ensuring the safety of motorists, handling of hazardous waste, and coordination with VDOT, police and other emergency personnel with respect to emergency Incidents and occurrences.

F. The Concessionaire shall identify a management-level, on-call "duty officer" consistent with VDOT's Duty-Officer Policy.

4.3.4 Traffic Management – Identification of Incidents

Performance requirements for identification of Incidents are set out in Section 4.4.

4.3.5 Driver Information (Project)

The in-service availability (ISA) for T&DI for DMS (each sign) shall be as specified in Section 4.4. The ISA for traffic management DMS shall be as specified in Section 4.4.

4.3.6 Waste Disposal and Use of Hazardous Substances

The Concessionaire shall:

A. Dispose of, or cause the disposal of, all waste, residue, debris, materials and supplies (including paints, herbicides, and chemicals), grass and foliage clippings, dead animals, and all other waste materials produced or generated, in accordance with applicable regulatory requirements and Good Industry Practice;

B. Use, contain, store and dispose of all Hazardous Substances employed in connection with its activities during the performance of the O&M Work in accordance with the applicable requirements of the Agreement, including Good Industry Practice;

C. Assume responsibility, subject to direction from emergency responders taking responsible charge of an Incident, and in accordance with the applicable requirements of the Agreement, including applicable regulatory requirements and Good Industry Practice, for the cleanup, removal, transportation, storage, or disposal of any Hazardous Substances spills or releases;

D. Assume responsibility for the operations, maintenance, repairs and as necessary the replacement of all known underground and above ground

storage tanks within the O&M Boundaries and shall re-register any regulated tanks with the Virginia Department of Environmental Quality with the Concessionaire identified as the tank "Operator";

E. Assume responsibility as the permittee for compliance with the VPDES permit for the industrial minor discharge from tunnel washing/stormwater management and shall accept transfer of the permit from VDOT. The Concessionaire shall meet applicable VPDES MS-4 requirements; and

F. Develop an Operations Hazardous Materials Management Plan to address – at a minimum – the requirements under 4.3.6 A through F. The Plan shall also outline the process for the Environmental Inspections under 4.1.4 and standards for the management of hazardous materials records and other documentation.

4.4 Performance Requirements

4.4.1 General

A. The baseline Performance Requirements are set out in Attachment 4A.

B. All Incidents that occur within the facility are to be detected and classified within five minutes of occurrence.

C. Traffic management messages that contribute to the safety of motorists and road workers are to be applied within five minutes of the detection and classification of an Incident or the identification of deteriorated road conditions.

D. All incident information (including the character and severity of the Incident) is to be passed to VDOT within five mintues of the Concessionaire determining the incident classification.

E. The Concessionaire shall use the program of inspections supplemented by the Maintenance Management System to demonstrate compliance with the Performance Requirements Baseline Tables and shall report for each Asset, its performance in meeting all applicable criteria and Timeliness Requirements in the quarterly O&M report in a format to be agreed between the Concessionaire and VDOT prior to the commencement of O&M Services. Performance also shall be summarized in an end-of-year report, as outlined in Section 3.10.

F. The Concessionaire shall set forth as part of the O&M Plan, reviewed and updated as necessary, a document describing the means by which it

intends to demonstrate achievement of the Performance Requirements. This shall be consistent with Attachment 4A, the Performance Requirements Baseline Tables, and Good Industry Practice.

G. The Project shall be subject to VDOT's Maintenance Rating Program (MRP), or subsequent updated or replacement program. The Concessionaire shall use the MRP to verify performance of each Asset against the criteria set out in the Performance Requiements Baseline Tables. The Concessionaire shall include in the end of year report outlined in Section 3.10, a summary of the results of annual assessments in a format to be agreed between the Concessionaire and VDOT.

4.5 Major Maintenance and Handback Requirements

4.5.1 Introduction and Handback Evaluation Plan

A. The purpose of this document is to set out Major Maintenance and Handback Requirements along with Residual Life Requirements for the Project.

B. This document describes the criteria to be used for handback from Concessionaire to VDOT at the end of the Term.

C. The Concessionaire shall handback all equipment, real estate, facilities, tools, computers, software, spares, office supplies, office equipment, furniture and vehicles that were purchased to support the direct O&M Work of the Project unless disposed of during Term as a function of the equipment's useful life expiring. The Concessionaire shall submit to VDOT, a complete inventory listing all facilities, equipment, vehicles, tools, etc., that were purchased or leased to support the direct O&M Work. The inventory listing shall indicate whether each Asset is leased or purchased. The inventory listing should include the following:

1. Facilities: Date of Construction, Cost of Construction, Site Plans, Utility Plans, Maintenance Records and Supporting Service Contracts, and Condition Reports.

2. Equipment: Date of Purchase or Lease, Cost of Purchase or Lease, Procurement Source and Records to include any and all Warranties, if leased, actual Lease Agreement, and Maintenance Records.

3. Vehicles: Date of Purchase or Lease, Cost of Purchase or Lease, Procurement Source and Records to include any and all

Warranties, if purchased the Title, if leased, actual Lease Agreement, and Maintenance Records.

4. Real Estate: Date of Purchase, Cost of Purchase, any and all Deeds and all applicable records to include Surveys and Utility installations.

5. Tools and Spares: Date of Purchase, Cost of Purchase, Source and Records to include Warranties and, Maintenance Records.

6. Computers and Software: Date of Purchase, Cost of Purchase, Source, and all License Agreements.

7. Office Supplies, Office Equipment, Office Furniture: Date of Purchase, Cost of Purchase, Source, and Records.

D. The Concessionaire shall submit to VDOT 12 months prior to the date of transfer, a list of the current editions of all applicable fire life safety codes (NFPA, FHWA, etc.) standards that are in effect at that time. The Concessionaire shall also provide access to the facilities, reports on the conditions of the Assets and coordinate with VDOT such that VDOT can determine requirements to meet any applicable standards during the handback period.

E. The Concessionaire shall prepare a Handback Evaluation Plan that will be used to determine the condition, performance and Residual Life of the Assets. The Plan shall be submitted to VDOT at a minimum of five (5) years prior to the end of the Term. The Plan shall identify the testing, evaluation, and calculation methods that are to be utilized during the condition assessment and the calculation of the Residual Life of all Assets. The Plan shall include all of the pertinent tests, inspections, processes, and evaluations required to verify and demonstrate to VDOT that all equipment and systems function as intended and meet the applicable codes and standards of the Technical Requirements and meets the Residual Life Requirements as specified in this document. The Concessionaire shall update the Plan as needed to reflect changes in condition of the Assets or evaluation methodology determined following an inspection of the Assets by VDOT. 2

F. The Concessionaire shall transfer the facility and equipment necessary for the operation of the facility to VDOT in a safe, fully functioning and operable condition that has been verified through demonstration testing conducted by the Concessionaire and witnessed by VDOT or its designee. The detailed requirements of the demonstration testing are included

herein. The determination of the Residual Life shall be determined through the use of the Concessionaire's Plan that consists of thorough inspection and evaluation of the Project facilities, all of which are to be witnessed by VDOT or its designee.

4.5.2 Major Maintenance and Life Cycle Maintenance Plan

A. The Concessionaire shall perform Major Maintenance as and when necessary so that all Assets are capable of meeting the appropriate Performance Requirements when subject to ordinary maintenance and so that any Defects which may affect the long term performance of the Project are repaired to prevent undue deterioration of any Asset. Major Maintenance is defined as an activity intended to repair, restore or replace an Asset that no longer functions, is obsolete or does not conform to current federal or state mandates for performance. The Concessionaire's Life Cycle Maintenance Plan, as approved by VDOT, shall define those project work elements considered as Preventive, Ordinary and Major Maintenance.

B. In order to properly identify and plan for Major Maintenance throughout the Term, the Agreement describes the requirements for a Life Cycle Maintenance Plan to be prepared by the Concessionaire to include a description of all Major Maintenance expected to be undertaken during the following five-year period.

C. In addition to the requirements set forth in the Agreement, the Concessionaire shall submit the following as components of the Life Cycle Maintenance Plan:

1. The Concessionaire's proposals for Major Maintenance, including the estimated timing and nature of work that the Concessionaire proposes during each period and possible triggers that may initiate Major Maintenance.

2. The estimated service life of each Asset (being the expected period that each Asset is expected to meet the Performance Requirements when first constructed and installed, subject to normal wear and tear and subject to standard programs of ordinary maintenance)

3. The Residual Life of each Asset.

4. A brief description of any Major Maintenance anticipated to be performed before the end of the Asset's service life, including reasons why this work should be performed at the proposed time,

methods, resources required, traffic management proposed and the impact on tunnel availability.

5. The team organization, key roles and responsibilities including details of contractors and suppliers, if available, needed to perform Major Maintenance.

6. How the Concessionaire will meet the Asset inventory requirements associated with Major Maintenance.

7. The Life Cycle Maintenance Plan should be updated annually to reflect current conditions of the Assets.

8. Provide an annual pavement deterioration assessment.

D. The Life Cycle Maintenance Plan updates during the last five years of the Term will be subject to additional oversight by VDOT. The Plan shall utilize the Residual Life Methodology and testing requirements set forth below.

4.5.3 Residual Life Methodology and Inspections

A. General Requirements

1. The Concessionaire shall prepare and submit to VDOT for approval, a Residual Life Methodology, five (5) years before the end of the Term. The inspection requirements and Residual Life Methodology requirements are identified below.

2. The Residual Life Methodology shall contain the evaluation and calculation criteria to be adopted for the calculation of the Residual Life of each Asset at the end of the Term. The scope of any Residual Life testing shall be included together with a list of all independent certified testing organizations used by the Concessionaire and approved by VDOT or its designee.

3. VDOT, or its designee, may verify the inspection results by attending the Concessionaire's inspections, performing separate inspections, and/or conducting spot checks.

4. VDOT's concurrence of the Residual Life Methodology, including the scope and schedule of inspections, shall be required before commencement of residual life inspections.

5. Appendix A is provided with this document identifying Residual Life Methodology and requirements for non-tunnel items associated with the tunnel construction.

B. The Residual Life Methodology and associated inspections shall have the following components:

1. Road Pavements;

a. Inspection Requirements - Pavement inspections shall be undertaken by independent testing organizations as mutually agreed by Concessionaire and VDOT. Inspections shall provide a continuous or near-continuous record of Residual Life in each lane. Where the inspection method does not provide a continuous record of Residual Life, the number of valid measurements in each 0.1 mile section shall be sufficient to give a statistically valid result. Inspections shall be repeatable to an agreed level of accuracy and inspection contracts shall include an agreed proportion of inspections to verify accuracy. Inspections shall include ride quality, skid resistance, crack analysis, index summary and rutting, and visual distresses as outlined in VDOT's *"A Guide to Evaluating Pavement Distress Through the Use of Digital Images"*, dated April 2006.

b. Residual Life Methodology Requirements – The Residual Life Methodology for road pavements shall be capable of calculation of Residual Life for each 0.1 mile section.

2. Tunnel Structures – General;

a. Inspection Requirements - Inspections of structures shall be undertaken by independent testing organizations as mutually agreed by Concessionaire and VDOT. Inspections shall follow the latest published inspection guidelines (as they apply at the relevant date that the testing is undertaken) recognized by VDOT. A close examination shall be made of each structure. Nondestructive tests shall be undertaken appropriate to the type of structure. These shall include the measurement of chloride and carbonation profiles from surface to reinforcement and/or tendon level, and the in-situ strength testing of concrete elements. Testing of steel structures shall include the depth of

corrosion and/or the measurement of remaining structural thickness for hidden and exposed parts. Representative samples of weld shall be tested for cracking at key areas of structural steelwork. It is noted that not all parts of the tunnel structures are accessible for visual inspection. The Concessionaire shall propose selected intrusive surveys or removal of internal finishings such as cladding or fire protection materials, or propose alternative methods to obtain the required information for residual life evaluation.

b. Residual Life Methodology Requirements – The Residual Life Methodology for structures shall:

i. Draw on historical asset maintenance records, inspection and test histories for each structure;

ii. Take account of VDOT and FHWA records of other structures with similar characteristics;

iii. Include an assessment of load rating capacity of the road slab based on the original structural design calculations, the As-Built drawings and results of load deflection tests where appropriate; and

iv. Take account of any trends in asset deterioration to determine the rate of deterioration and to predict the future condition of individual elements and the entire structure.

3. Tunnel Structures – Specific;

a. Inspection Requirements:

i. If cover plates are used at immersion joints all plates shall be removed to enable visual inspection of the omega seals and clamping bars and bolts. Torque levels shall be tested at a representative number of bolts. If reinforced concrete infill panels are used at immersion joints, inspection shall be undertaken with remote camera equipment using access points provided in the concrete infill in order to make a visual inspection of the condition of omega seals, clamping bolts and bars;

ii. The Concessionaire shall check for the presence of water in immersion joints in the void between the omega-type seals and gina-type gaskets and in the void above the omega-type seal in the base of the tunnel. If water is detected it should be evacuated and the rate of refill determined. Inspection shall be carried out in winter months and shall therefore be planned in good time relative to the anticipated handback date. If leakage is detected the Concessionaire shall include remedial works in the Life Cycle Maintenance Plan to manage or rectify as appropriate;

iii. Chloride profiles shall be measured and plotted from the surface of the concrete to the reinforcement level at key areas of reinforced concrete and prestressed concrete. A representative number of measurements shall be taken along the length of the tunnel. The Concessionaire shall propose a program of testing for this purpose. For the new tunnel, embedded corrosion probes shall be used to validate this information;

iv. Representative samples of critical welds that are accessible shall be tested for cracking by non-destructive methods at key areas of structural steelwork;

v. All surfaces of the tunnel structure, including approach tunnels and ramp structures shall be subject to detailed examination for leakage, spalling, discoloring, rusting or staining. Such Defects shall be accurately recorded through surface mapping, including their position, measurements and characteristics;

vi. Inspection of surface Defects shall be carried out in sufficient time to enable repairs to be undertaken within the last five (5) years of the Term;

vii. The surface defect survey should review all previous Defects encountered during the initial construction of the new tunnel and as identified on taking over the existing tunnel. It shall also review all Defects that may have arisen throughout the concession period in either tunnel structure, whether repaired or not. The current condition of all such Defects shall be considered as part of the residual life assessment; and

viii. Bathymetric survey shall be used periodically to verify the rock protection cover to the tunnel has not been removed through scour.

b. Residual Life Methodology Requirements:

i. The Residual Life Methodology for the tunnel shall draw on historical asset maintenance records, inspection and test histories and life cycle and durability analysis;

ii. Protective coatings to inaccessible steelwork shall be assumed to have deteriorated based on accessible steelwork of a similar nature to estimate the Residual Life;

iii. The settlement behavior of the tunnel over the duration of the concession shall be considered and a future forecast of settlement be made to determine the impact on the tunnel structure and joint performance;

iv. If tension anchors are used in tunnel approaches the Concessionaire shall document the assumptions made on the performance of the corrosion systems applied. Reasonably accessible anchors shall be tested during the last year of the concession to establish their integrity and load carrying capacity; and

v. If cathodic protection systems are employed with consumable items such as sacrificial anodes, the rate of consumption shall be assessed and the need for replacement determined.

4. Buildings and Enclosed Facilities (Structural Elements);

a. Inspection Requirements - Inspections for buildings and enclosed facilities shall comply with Good Industry Practice. The inspection scope and depth shall be determined by the inspecting organization but as a minimum shall be based upon FHWA requirements.

b. Residual Life Methodology Requirements – The Residual Life Methodology for buildings shall draw on historical asset maintenance records, inspection and test histories and

life cycle and durability analysis for each building and maintenance facility.

5. Building Mechanical Equipment (Plumbing and HVAC);

   a. Inspection Requirements - Inspection scope and depth shall be determined by the inspecting organization but as a minimum shall be based upon FHWA requirements and manufacturer's inspection requirements.

   b. Residual Life Methodology – Shall draw on historical inspection, maintenance and rehabilitation records for system components, including life cycle and durability analysis.

6. Building Mechanical Equipment (fire systems);

   a. Inspection Requirements - Inspection scope and depth shall be determined by the inspecting organization but as a minimum shall be based upon FHWA requirements, manufacturer's inspection requirements and applicable NFPA Standards. Inspection shall be undertaken by a qualified Fire Protection Engineer or person(s) having a National Institute for Certification in Engineering Technologies (NICET) Level III certification.

   b. Residual Life Methodology – Shall draw on historical inspection, maintenance and rehabilitation records for system components, including life cycle and durability analysis.

7. Building Electrical Systems;

   a. Inspection Requirements - Inspection scope and depth shall be determined by the inspecting organization but as a minimum shall be based upon FHWA requirements, manufacturer's inspection requirements and applicable NFPA Standards. Inspection of electrical systems shall be undertaken by qualified individuals (InterNational Electrical Testing Association (NETA) or equivalent for electrical, NICET for fire alarm, other) and performed in accordance with NFPA 70B, as a minimum.

b. Residual Life Methodology - Shall draw on historical inspection, maintenance and rehabilitation records for system components, including life cycle and durability analysis.

8. Drainage;

a. Inspection Requirements - Inspection of storm sewer systems shall include CCTV inspection of all buried pipe work and cast-in pipe work, gullies, and sumps within the tunnel. Groundwater level monitoring at selected locations may be required to provide assurance for groundwater interceptor drains. Inspection of stormwater management systems to include ditches, stormwater basins, etc.

b. Residual Life Methodology - shall draw on historical asset maintenance records, inspection and test histories for each element of the drainage system. The Concessionaire shall include a methodology to determine the Residual Life of filter drains designed to intercept groundwater.

9. Earthwork Slopes;

a. Inspection Requirements - For embankment and cut slopes a risk based inspection procedure shall be adopted following Good Industry Practice. Deformation monitoring will be required to provide assurance of the required Residual Life.

b. The Residual Life Methodology shall draw on historical asset maintenance records, inspection and test histories for each element.

10. Ancillary items (beams, barriers, signals, fences, curbs, gutters)

a. Inspections of all ancillary items shall be undertaken by personnel having adequate training on modes of failure, risk assessment and observational skills.

b. The Residual Life Methodology shall draw on historical asset maintenance records, inspection and test histories for each ancillary element.

4.5.4 Major Maintenance for Handback

A. The Concessionaire shall prepare enhanced annual updates to the Life Cycle Maintenance Plan during the last five (5) years of the Term taking into account the results of the Residual Life Methodology and associated inspections and testing described above.

B. The results of the annual inspection of each Asset during the final five (5) years of the Term shall be submitted to VDOT for review by the Concessionaire. The Concessionaire shall provide an interpretation of these results and a predicted Residual Life of each component of the Project as set forth in Attachment 4B. The test results and interpretations shall be used by the Concessionaire to update the Life Cycle Maintenance Plan so that it contains an accurate description of the Major Maintenance necessary to meet the specified Residual Life Requirements.

C. The Concessionaire shall estimate the Residual Life of each Asset based on:

1. The Concessionaire's reasonable expectations respecting the manner of use, levels of traffic, and wear and tear.

2. The results of the Project inspections described above.

3. The assumption that the Asset will continue to be subject to ordinary maintenance conforming to the Performance Requirements throughout its service life.

D. The Life Cycle Maintenance Plan for each of the five (5) years before the end of the Term shall include, in addition to any other requirements specified in the Agreement:

1. The Concessionaire's calculation of Residual Life for each Operations and Maintenance Project Asset calculated in accordance with the Residual Life Methodology and taking into account the results of the inspections set forth above.

2. The estimated cost of the Major Maintenance needed for each component of the Project so that, at the end of the Term, each component will achieve its specified Residual Life.

E. In addition to the annual inspection, the Concessionaire shall undertake a specific handback inspection to verify that all maintenance activities identified as required to meet the Residual Life Requirements have been

satisfactorily undertaken. The timing and coverage of this inspection shall be set out in the Life Cycle Maintenance Plan.

F. Confirmation shall be obtained from the Concessionaire, at handback, that all record drawings, operating and maintenance manuals, data sheets and inspection and maintenance records are complete and up-to-date.

G. Confirmation shall also be obtained that the stock of spare parts is complete, in good condition and up-to-date in accordance with the inventory contained in the *Operations and Maintenance Manual*.

H. Prior to handback, all mechanical and electrical systems and equipment shall be subjected to thorough visual inspection of all accessible parts and performance testing to assess the following:

1. That the systems are complete and free from material Defects.

2. That the systems and equipment are performing in accordance with the design requirements, or as subsequently agreed with VDOT.

3. The estimated Residual Life before replacement is necessary.

I. If the Residual Life cannot be determined by inspection or testing, then other methods may be used as proposed by the Concessionaire and accepted by VDOT or its designee.

J. The inspection and testing shall take place sufficiently in advance of the handback date for any remedial action, necessary to achieve compliance with the Agreement, to be complete prior to handback.

4.5.5 Residual Life Requirements at Handback

Minimum Residual Life Requirements at Handback are specified in Attachment 4B Residual Life Table.

4.6 Tolling Requirements

4.6.1 General

The tolling system shall be operated and maintained by the Concessionaire to fulfill its obligations under the Agreement and in a manner such that ensures Performance Requirements are met. Prior to the end of the Term, the Concessionaire shall provide training to VDOT on the operation of the tolling system.

4.6.2 Performance Requirements

A. Roadside equipment shall have an ISA as specified in Section 4.4. This shall exclude scheduled downtime and loss of power outside the Concessionaire's control.

B. The tolling system shall have an ISA as specified in Section 4.4, excluding scheduled downtime and loss of power.

C. The accuracy of transponder records shall be as specified in Section 4.4; i.e, the data supplied are complete and relate correctly to the transponder detected for properly fitted and operating transponders, and excluding non-normal operation due to signal attenuation from a metallic wind screen or similar.

D. The accuracy of payment claim records shall be as specified in Section 4.4; i.e., the data supplied are complete and relate correctly to the payment due for the trip, the displayed prices, and the transponder to which it relates.

E. Records shall be transmitted to VDOT in the IAG specification format, or as otherwise agreed between VDOT and the Concessionaire, except where VES manual quality control checks have not been completed.

F. Tag status files are to be loaded and distributed through the system and utilized for each tag transaction to ensure images are recorded for the correct vehicles. This should be completed within one hour of receipt from VDOT, (in accordance with the ETC Agreement) 99% of the time, subject to receipt of a confirmed accurate tag status file from VDOT.

G. The tag number captured from a tag shall be recorded with accuracy as specified in Section 4.4. This is subject to the transponder supplier Performance Requirements.

H. The Concessionaire shall maintain a regular policy and reporting procedure for tracking, cataloging and addressing customer complaints regarding improper or incorrect charges generated by the toll system. The policies and procedures shall contain an agreed method by which the Concessionaire and VDOT can determine whether any error in question occurred in the toll system or at VDOT's CSC. Any unusual increase or anomaly in the number or type of complaints shall be investigated within 7 days after the end-of-month report and the results reported to VDOT

including the results of toll system maintenance checks and corrective actions.

I. Accuracy for correctly assigning the transponder to the correct vehicle and therefore license plate, to be as specified in Section 4.4 for properly fitted and operating transponders, and excluding non- normal operation due to signal attenuation from to a metallic wind screen or similar.

4.6.3 Transactions

A. The Concessionaire shall ensure that, at all times, variable message signs along the facility display accurate information about toll rates and other travel information. Upon notification of the display of an incorrect toll amount, the Concessionaire shall reconcile or audit the data transmission within one business day to identify any and all other customer accounts that may have been impacted by the incorrect signage.

B. The Concessionaire shall comply with standards applicable to the retention of and use of customer records pursuant to Applicable Law, including § 33.1-56.4 of the Code of Virginia.

4.6.4 Roadside Tolling Equipment Support and Maintenance

The Concessionaire shall support and maintain all roadside tolling equipment and infrastructure installed related to the facility operations.

4.6.5 Information Technology Support and Maintenance

The Concessionaire shall carry out information technology service management in accordance with the Agreement, including Good Industry Practice.

4.6.6 Anti–virus Scanning and Protection

A. The Concessionaire shall maintain a constantly updated anti-virus and protection procedure to protect the tolling system from viruses and other destructive devices, and to manage the impact of virus attacks including transmission to the ERO ATMS or other VDOT or third- party systems.

B. The Concessionaire shall immediately notify VDOT of any infection by computer virus or similar destructive devices upon identification.

4.6.7 Interfaces

The Concessionaire shall continuously monitor all interfaces for the tolling system. The monitoring should include availability, throughput, performance,

buffer usage, queue lengths, hardware status, system alarms and warnings, and any other diagnostic data provided by the Concessionaire's implementation of the interfaces.

4.6.8 System Back-up and Recovery

A. The Concessionaire shall provide data security for the tolling system. Data security shall include the following:

1. Backup of all software and configuration following each release of, or change to, the system, including any disaster recovery site;

2. Daily back-up of all new/changed data held on the tolling system;

3. Removal of the media used for the daily back-up to a secure offsite location within 24 hours (or other agreed timeframe); and

4. Storage of one month of the data back-ups in a secure offsite location.

B. Backups shall not affect the tolling system's ability to capture, store or process detection data.

4.6.9 System Failure

A. The Concessionaire shall notify VDOT immediately on becoming aware of any event or the likely event of any system failure that results in a critical element of the tolling system not functioning, or that results in or is likely to result in an unacceptable impact on the public, VDOT, or a third party.

B. VDOT will notify the Concessionaire immediately of any event or the likely event of any system failure that results in a critical element of the ERO ATMS not functioning, or that results in or is likely to result in an unnacceptable impact on the public, the Concessionaire, or a third party.

C. Where the relevant system failure affects or may affect a third party, VDOT, or its agents, the Concessionaire shall provide VDOT with all necessary assistance in resolving the relevant system failure by cooperating fully and expeditiously with the third party, VDOT, or its agents, as appropriate.

D. Where the relevant system failure was caused by VDOT or its agents, VDOT will provide the Concessionaire with all necessary assistance co-

operation in resolving the relevant system failure, by cooperating fully and expeditiously with the third party or Concessionaire, as appropriate.

4.6.10 Reporting

The Concessionaire shall report on the performance achieved against each of the Performance Requirements in each reporting period, in accordance with Section 3.10 (Reporting).

END OF THE TECHNICAL REQUIREMENTS

DOWNTOWN TUNNEL/MIDTOWN TUNNEL/MLK EXTENSION PROJECT

The Technical Requirements

Comprehensive Agreement Exhibit C

Attachment 1A

Basis of Design MLK

TECHNICAL REQUIREMENTS
Exhibit C

Final Basis of Design for

New MLK Extension

D 0101040704rev2

Submitted To:

SKW Constructors
809 S. Military Highway
Virginia Beach, VA 23464

October 20, 2011

Prepared By:

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6161 Kempsville Circle, Suite 110
Norfolk, VA 23502

TUNNEL VISION
MIDTOWN | MLK | DOWNTOWN

Table of Contents

1 General

The purpose of the documentation provided herein is to establish the Basis of Design for the New MLK Extension (MLK) component of the Project. The information provided herein serves as documentation of the starting assumptions in developing the design for the Project, so that assumptions of each discipline are coordinated and interface properly. Relevant codes and standards specific to the MLK and used to develop the Design Criteria may be included. The Basis of Design is a "living document" that may evolve as necessary to meet specific needs of the Project and the specific desires and needs of the Contractor.

The Final Basis of Design is issued as Revision 0. Any subsequent modifications to the Final Basis of Design will be submitted to SKW for review and approval, and issued with the subsequent Revision Number.

Consultant - Shall be defined as PB Americas, Inc. and all subconsultants and vendors under direct contract to PB Americas, Inc., necessary for design of the project.

Contractor - Shall be defined as a joint venture consisting of Skanska USA Civil Southeast, Inc.; Kiewit Construction Company; and, Weeks Marine, Inc.

The MLK *Design Criteria* and *Basis of Design* cover the MLK extension from London Boulevard south to the I-264 Interchange, and along I-264 from the western end of the project to approximately 500 feet east of Des Moines Avenue.

All relevant codes and procedures as stated in the Design Criteria will be followed for each discipline. The codes and procedures will be applied to carry forward the chosen alignment (Alternate E, Option 4) as defined in the Interchange Justification Report (IJR), and modified as listed in Section 9.2 of this Basis of Design. The Level of Service (LOS) to be provided will be in accordance with the IJR.

Codes and order of precedence for roadway design:

High Design Criteria
- ↓ VDOT *2007 Road and Bridge Specifications*
- ↓ VDOT *Instructional and Informational Memoranda* current on January 7, 2010.
- ↓ VDOT 2005 *Road Design Manual*
- ↓ VDOT *Drainage Manual*, rev 4/10
- ↓ VDOT *2008 Road and Bridge Standards*
- ↓ AASHTO *Green Book*, 5th ed.
- ↓ FHWA 2009 *MUTCD*

Low VDOT 2005 *Work Area Protection Manual*

Codes and order of precedence for bridge design:

High AASHTO Standard Specifications for Highway Bridges, LRFD 4th Edition, 2007 with 2008, 2009 Interims and VDOT Modifications

↓ Virginia Department of Transportation (VDOT), Structures Design Manual (Design Aids and Typical Details, Vol V, Part 2), Current Edition

Low Virginia Department of Transportation (VDOT), Road and Bridge Specifications, 2008

The goal for the operational levels of service for the design year will be LOS D for freeways and signalized intersections within the project limits.

2 Not Used

3 Civil

MLK Extension Preliminary ROW Plans

Phase 2 Design will update the information developed in the existing right-of-way plans to a level of effort sufficient to establish a final construction cost. The alignment has been defined in the Interchange Justification Report as Alternate E, Option 4. Option 4 provides a flyover ramp at Frederick Boulevard and eliminates the Des Moines Avenue Interchange. South Street access to I-264 WB is also eliminated.

3.1 Survey

a. The survey data will include all primary stormwater outfall locations from existing facilities within the Project area.

b. The survey has been completed in accordance with VDOT's *Survey Manual* and reference documents.

3.2 Utilities

a. Utility Relocations will be designed to minimize the acquisition of property and to avoid conflicts with existing storm drainage systems and other existing utilities.

b. Existing utility data (type, size, & location) will be presented on the Project base mapping. In addition, utility easements will be identified and presented on the Project base mapping.

3.3 Stormwater and Drainage

a. The Consultant will develop preliminary hydrologic and hydraulic (H&H) plans and reports covering the area along I-264 from the Ramp EN terminus west of Frederick Boulevard to the east side of Des Moines Avenue and along the MLK Extension from I-264 to the south side of London Boulevard.

b. The hydraulic design will be developed in sufficient detail to determine the need, location and sizing of stormwater detention facilities and the location of all primary stormwater outfall locations from proposed facilities.

c. The Consultant will establish contact with VDOT's Hydraulics Section and the City of Portsmouth to coordinate the location of any such detention facilities and determine permitting requirements.

d. Design will be in accordance with VDOT's April 2010 *Drainage Manual*.

e. Design will be coordinated with information provided to the Consultant under Item 3.2 above.

f. It is assumed that the project does not include any drainage design facilities having Q_{100} > 500cfs.

g. No Conditional Letter of Map Revisions (CLOMRs) for modification to any floodway boundary are expected to be needed on this project.

3.4 Right-of-way Plans

a. Plans will delineate the right of way and right-of-way acquisition areas, temporary construction easements, utility easements, limited access, permanent drainage easements, other permanent easements, etc.

b. The Consultant will coordinate this effort with VDOT, the City of Portsmouth and Project surveyor.

c. Geometric design will be in accordance with the recommendations in the [2007] *Interchange Justification Report* and VDOT's current design standards as specified in the Project Design Criteria. See Section 1 for list of applicable codes and order of precedence.

d. Draft Sequence of Construction (SOC) plans will be prepared by the Consultant as part of Item 3.4. The SOC Plans will be developed in accordance with VDOT *Work Area Protection Manual*, dated 2005 and FHWA's 2009 *Manual on Uniform Traffic Control Devices, and VDOT IIM LD-241.4*.

3.5 Roadway Lighting System

The exterior roadway lighting system design shall comply with the latest applicable codes, regulations, and standards. All roadway lighting fixtures and pole placements, along with elevations, must account for light trespass.

3.5.1 Lamps and Ballasts

In general, high pressure sodium lamps will be used for mainline roadways and multi-lane ramps. Lower wattage lamps shall be used where mounting heights are severely restricted such as on local streets or ramps. As a rule, the design is to utilize the fewest lamp types possible throughout the Project.

3.5.2 Luminaires – IESNA Distribution Types

Luminaires with IES Type I, II, III or IV, and full cut-off classifications for lateral and vertical light distribution/control shall be used for this Project. Additional shielding may be required to control light trespass where main line roadways parallel or cross multi-level ramps are located close to the right of way.

4 Geotechnical

See 9.6

5 Not Used

6 Not Used

7 Not Used

8 Not Used

9 MLK Structures

MLK Bridges – Main Line and Ramps

Phase 2 Design will carry forward the information developed in the existing Stage I plans to a level of effort sufficient for the Contractor to establish preliminary quantities for a construction cost estimate. The alignment has been defined in the Interchange Justification Report as Alternate E, Option 4. Option 4 provides a flyover ramp at Frederick Boulevard and eliminates the Des Moines Avenue Interchange. South Street access to I-264 WB is also eliminated.

9.1 Design Criteria (Loads, Forces, Materials)

a. Loads, Forces and Material properties are defined in the Design Criteria Document.

9.2 Alignment

a. Alignment is defined as Alternate E, Option 4 with the following exceptions:

- Minor adjustments to the horizontal alignment will be made to accommodate the newly discovered cemetery near the I-264 Interchange.

- Additional minor adjustments will be made to accommodate utilities, clearance criteria and CSX Railroad.

- A design exception will be required at London Boulevard to accommodate the substandard ramp geometry. Design will proceed with existing ramp geometry.

- The proposed SPUI Interchange at High Street will not be advanced.

9.3 Bridges

9.3.1 Span Arrangements

a. Spans will be made continuous where practical to eliminate expansion joints on the bridge.

b. Continuous span units will be limited to a practical length to use strip seal expansion joints. Long expansion movements will be avoided to avoid the use of finger joints.

c. Joints will be armored due to a high design volume of truck traffic.

9.3.2 Superstructures

a. VDOT's Prestressed Bulb-Tee (PCBT) sections will be used where practical for the entire alignment.

b. Concrete girders, when used, will be placed on short chords when used on a curved alignment. The span lengths will be set based on a minimum overhang on the inside of the curve and a maximum allowed overhang on the outside of the curve. See Design Criteria Section 9.3 for maximum and minimum limits for deck overhangs.

c. Steel girders will be investigated when spans longer than 130 ft. are required or when complex framing is required to accommodate on and off ramps to mainline. Details for girders will be in conformance with VDOT Standard Practice and the "Guidelines for Design Details" published by AASHTO/NSBA Steel Bridge Collaboration. A span unit comprised of multiple continuous spans will not contain both steel and concrete girders.

d. Bridge decks will consist of reinforced concrete slabs with stay-in-place metal forms.

9.3.3 Substructures

a. Pier types will either be hammerhead or multi-column bents founded on footings with prestressed concrete piles.

b. Abutments will be MSE Wall type on a single row of piles where practical. A single row of piles will only be used for full integral abutments. The effects of down drag (fill settlement) will be considered in the design approach. Stem abutments along with MSE will also be considered and evaluated for cost during the conceptual design phase.

9.3.4 Bridge Widening and or Modification

a. I-264 WB over CSX Railroad and I-264 EB over Des Moines Avenue will be widened. Details will be determined in Type, Size and Location Study.

b. Pedestrian Bridge over I-264 will need to be modified or replaced due to the widening of I-264 in this vicinity. Details will be determined in the Type, Size & Location Study.

9.4 Retaining / Sound Walls

a. Retaining walls will be MSE where practical and will be designed by the MSE Wall Vendor. The Consultant will provide the geometric layout, design criteria and all pertinent requirements for Vendor's use.

9.5 Miscellaneous Structures

A. Signing and lighting supports, and traffic control structures (signal pole/ITS) will be designed as either bridge mounted or stand alone with foundations. Design will be in accordance with current VDOT policy regarding attachment to structures.

9.6 Geotechnical Parameters

- Geotechnical design parameters will be developed utilizing data collected from the various geotechnical explorations (i.e. test borings, CPT and DMT soundings) as well as the proposed laboratory testing.
- Site specific design parameters will be developed for:
    - Bridge Foundations:
        - Shear strength of the foundation soils for evaluation of the vertical and lateral resistance for driven pile foundations, pile tip grades, and downdrag loads on the piles.
        - Compressibility of the foundation soils for evaluation of pile settlement.
    - Embankment Fills including Bridge Approach Fills:
        - Shear strength of the foundation soils to evaluate slope stability and possible deep foundation alternatives for pile-supported embankments.

- Compressibility of the underlying soils to evaluate the magnitude and time rate of settlement for fills with and without wick drains and/or surcharge loads.

- Earth Retaining Walls including MSE Walls:
  - Shear strength of the foundation soils to evaluate external stability for retaining walls (bearing, sliding and overturning).
  - Compressibility of the underlying soils to evaluate the magnitude and time rate of settlement.
  - The lateral strength and deformation characteristics of the soils behind the permanent retaining walls and temporary support of excavation.
- Pavements, Sound Walls, Signs, Storm Water Management Facilities, Culverts, etc.
  - Shear strength and compressibility for design of pavements and minor structures.

All information gathered during exploration, along with design parameters and recommendations will be submitted in the final Geotechnical Report.

DOWNTOWN TUNNEL/MIDTOWN TUNNEL/MLK EXTENSION PROJECT

The Technical Requirements

Comprehensive Agreement Exhibit C

Attachment 1B

Basis of Design Midtown Tunnel

TECHNICAL REQUIREMENTS
Exhibit C

Final Basis of Design for the New Midtown Tunnel

D 0101040703rev3

Submitted To:

SKW Constructors
809 S. Military Highway
Virginia Beach, VA 23464

October 20, 2011

Prepared By:

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Table of Contents

1 General

The purpose of the documentation provided herein is to establish the Basis of Design for the New Midtown Tunnel (MTT2) component of the Project. The information provided herein serves as documentation of the starting assumptions in developing the design for the Project, so that assumptions of each discipline are coordinated and interface properly. Relevant codes and standards specific to the MTT2 and used to develop the Design Criteria may be included. The Basis of Design is a "living document", which may evolve as necessary to meet specific needs of the Project and the specific desires and needs of the Contractor.

The Final Basis of Design is issued as Revision 0. Any subsequent modifications to the Final Basis of Design will be submitted to SKW for review and approval, and issued with the subsequent Revision Number.

It should be noted that a variety of Stakeholders will have formal and informal input during the design process, and that such input may result in scope changes. All potential scope changes are to be referred to the Project Manager for resolution before work begins. The following organizations are expected to have a role during the design process:

- VDOT and their GEC
- FHWA
- Cities of Norfolk and Portsmouth
- Permitting and Regulatory Agencies such as USCG, USACE, DEQ, NMFS, etc.
- ERC (developer) and SKW (contractor)

2 Environmental - Not Used

3 Civil

3.1 Survey

- Digital base mapping will be provided for the Project area and used for the design development.
- The survey data will include all primary stormwater outfall locations from existing facilities within the Project area.
- Existing utility data (type, size, & location) will be presented on the Project base mapping. In addition, utility easements will be identified and presented on the Project base mapping.
- Vertical Control will be North American Vertical Datum 1988 (NAVD88)

3.2 Utilities

- The Project will be designed to avoid (or minimize) utility relocations.
- Utility Relocations will be designed to minimize the acquisition of property and to avoid conflicts with existing storm drainage systems and other existing utilities.

- The Project will be designed to relocate the existing 42-inch HRSD Sanitary Sewer that crosses the Elizabeth River just north of the proposed location of MTT2.
- The existing 30-inch City of Norfolk Raw Water Main that crosses the Elizabeth River in the immediate vicinity of the proposed location of MTT2 will be relocated as part of the Project.

3.3 Stormwater and Drainage

- The Consultant will develop preliminary hydrologic and hydraulic (H&H) plans and reports for the eastbound approach to the MTT, located within the City of Portsmouth, and the interchange of US 58 / Brambleton Avenue / Hampton Boulevard interchange area, located within the City of Norfolk.
- The hydraulic design will be developed in sufficient detail to determine the need, location and sizing of stormwater detention facilities and the location of primary stormwater outfall locations from proposed facilities.
- The Project will include a flood mitigation project to minimize the potential for flooding from the existing open storm channel located within the interchange area on the City of Norfolk approach.
- The Project will consider various options to reduce flooding potential on the City of Portsmouth approach, excluding the installation of flood gates for the new and existing MTT.
- The Project will be designed to minimize the contributory area and thus the volume of runoff directed towards existing portal pump stations. The Project will be designed to maximize the positive discharge of gravity systems to outlet above the mean high water
- The Project will include best management practices (BMPs) to address stormwater quality for pump station outfalls and gravity system outfalls per the requirements of the Virginia Stormwater Management Program (VSMP) Permit Regulations as administered by the Virginia Department of Conservation and Recreation.

3.4 Roadway Design Plans

- The roadway functional classification will affect the basic elements of design including the development of the horizontal and vertical alignments and the typical roadway section. The design speed of the facility, the design year peak hour level of service, and the design vehicle are all taken into consideration in design of the roadways. A design year of 2032 is assumed for the Project.
- The tunnel roadway approaches will be designed to include a truck inspection station and means to divert vehicles that fail the inspection.
- The tunnel approach roadways will be designed to include low-speed cross-overs to provide for bi-directional operation of either the existing MTT or MTT2, during emergencies.
- The access road to the existing tunnel operations building will be relocated as part of the Project. The relocated access road will intersect the Elizabeth River Trail at an at-grade intersection.
- The Project includes a bridge structure to convey the Elizabeth River Trail over the tunnel “boat” section on the westbound approach. The Project will be designed to minimize the duration of temporary closures of the Elizabeth River Trail. The Project will consider temporary alternative routes for the Elizabeth River Trail.
- The Project will maintain access to Port property via the westernmost access road crossing near the existing tunnel portal.

- The Project will be designed to minimize earth disturbance and the placement of roadway fills. The Project will be designed to minimize permanent and temporary impacts to adjacent properties and to maintain access to adjacent properties.

4 Geotechnical

4.1 Subsurface Investigation

A subsurface investigation consisting of 24 soil borings, 25 CPT soundings 2 DMT soundings and 2 piezometers is being performed for this current phase of work. This investigation was performed to supplement the existing information obtained from previous investigations primarily due to the curved alignment and the proposed relocation of the City of Norfolk water line. Subsequent to the field investigation, laboratory testing will be performed, which is expected to consist of strength and compressibility testing, as well as various index testing to aid in the classification of soils and to empirically derive various soil properties to be used in the design and analysis of various aspects of the project.

During the design development, Geotechnical Reports will be issued that will further clarify the Basis of design for elements affected by soil properties and test results as the data become available. The Geotechnical Reports will supersede guidance given in the Basis of Design.

4.2 Dredge Slopes

Dredged slopes will be designed to account for the variation in various subsurface strata and the varying slope/existing structure geometry, and will be analyzed utilizing conventional methods, as well as a reliability-based approach. Slopes could include benching and the slopes could vary based upon the results of the slope stability analyses.

4.3 Settlement Issues

It is anticipated that the tunnel invert will traverse through subsurface strata with differing stiffness and compressibility parameters. Because of such, settlement of the tubes will be evaluated with respect to the tunnel geometry, various loading conditions and the specific subsurface conditions beneath each tube.

Any fill placed which causes a net downward force on the soft alluvial materials will likely cause significant settlement of the ground surface and the effect of this on existing structures will be evaluated, and protection measures, if necessary, will be implemented.

4.4 Support of Excavation

It is expected that Support of Excavation systems will be required for the construction of the boat and cut-and-cover sections, as well as for portions of the immersed tunnel sections where it will be desired to limit the amount of excavation or where it will be necessary to protect existing structures. These systems will be designed to account for all pertinent soil and water pressures, as well as surcharge pressures from construction equipment or existing structures, among other features. In addition, protection of existing structures/facilities will be accounted for in the design of these systems.

4.5 Finite Element/Difference Modeling – Soil/Structure Interaction Analyses

FE/FD modeling is expected to be used in the design and analysis of various aspects of this project. The FE/FD software to be used will be dependent on the purpose of soil-structure interaction analysis. Currently, it is anticipated that the design cases involving soil structural interaction cases would include the following: (1) 2-D tunnel structural frame supported on elastic foundation, (2) tunnel structure subject to potential longitudinal differential settlements if applicable, (3) tunnel structure subject to potential transverse differential settlements if applicable, and (4) construction-induced ground deformations and their impacts to existing Mid-town Tunnel structures.

5.0 Tunnel Structural

5.1 General

The Design Basis as stated herein is a working document that will be modified as design proceeds.

5.2 Design Considerations

The design methods for the analysis as a minimum will take into account the following, where relevant:

- Design loads
- Serviceability
- Method of construction
- Work areas
- Design life
- Operation and maintenance costs
- Safety during construction and operation
- Operational speeds
- Location of railway track and other facilities
- Effect on the adjacent properties
- Considerations of Historical and Archaeological Heritage
- The geology and hydrogeology
- Removal of water due to rainfall, drainage and groundwater seepage
- Prevention of flooding, e.g., floodgates
- Availability and costs of construction equipment, workmanship and materials
- Environmental impact
- Existing constraints such as highway layout, bridges etc
- Traffic management
- Sequence of construction
- Environmental, marine and hydrographic conditions
- Stakeholder requirements
- Effect on Existing Midtown Tunnel and utilities
- Maintenance
- Planning constraints

- Aesthetics.

5.3 Starting Assumptions

5.3.1 Basis of the Design Calculations

The basis of the calculations upon which the detailed designs are to be completed must be stated together with the assumptions upon which such calculations are based. The following shall be included:

- A list of all the standards, codes and design information used for each calculation
- Where proprietary computer software is used for analysis, a short description of the software modeling methods and reliability.

Personal or in-house software and design spreadsheets shall only be used if they have undergone a documented and rigorous validation by staff authorized to carry out such work. Such software can only be used with supervisor approval. Computer analyses that both mimic hand calculations and are checked do not require the validation stated above.

A list of all pertinent design input parameters for immersed tunnel segments are listed below.

The specified project datum to be used is NAVD88 and the unit of measure shall be English (Imperial) units. Stationing and the horizontal coordinate system shall be consistent throughout the project. NAVD88 datum for the project is assumed to be set at 1.64[1] feet above Mean Lower Low Water at the tunnel location. Note that tunnel drawings for the Existing Midtown Tunnel are based on MLW as known in 1960[2].

In addition to the water levels given in Design Criteria Table 3.1.5, water level by extrapolation with a probability of being exceeded once in 5 years is 6.8 ft and once in 120 years is 9.7 ft (both including 2 ft for waves, sea level rise, etc). Mean sea level trend is currently 1.75 ft rise in 120 years.

Generally, the tunnel elements are to be designed for permanent loadings, and then checked for effects imposed on the structures during float-out, tow, ballasting, and immersion. Construction loadings will be developed in concert with the Contractor, and any strengthening or revision to the permanent elements required as a result of temporary construction loads will be agreed to with the Contractor prior to proceeding.

5.3.2 Tunnel Roadway Parameters

- Roadway parameters: 2 lanes, each lane 12 ft wide
- Shoulder width : 2 ft left side and 2 ft right side
- Roadway minimum slope: 1% cross slope
- Walkway height: 2’-8”
- Walkway loading 100 psf

[1] NAVD88 datum at Sewells Point is 1.64 ft above MLLW; at Money Point 1.58 ft. The wide Norfolk Harbor Channel extends almost to the Project location; hence NAVD88 datum is assumed 1.64 ft above MLLW. This data is based on the epoch 1983-2001. For other parameters at Sewells Point, refer to http://www.tidesandcurrents.noaa.gov/data_menu.shtml?stn=8638610%20Sewells%20Point,%20VA&type=Datums

[2] This is about 32 years earlier than the Sewells Point data epoch; sea level change in 32 years is about +0.5 ft.

- Barrier type: VDOT “F” Shape
- Vertical vehicle clearance height: 16’-6”
- Vertical sign clearance height (above vertical vehicle clearance): 2ft average.
- Road surfacing thickness: 3” nominal
- Vehicular Live Load: AASHTO HL-93 loading or Alternative Military Loading (see Article 3.6.1.2 of AASHTO LRFD Specifications)

5.3.3 Second Midtown Tunnel Roadway Profile

	Station	Elevation	Vertical Curve Length
PVI	81+97.93	9.810	400
PVI	103+31.69	-84.070	140
PVI	109+69.63	-87.26	200
PVI	113+99.57	-85.11	140
PVI	129+67.80	-14.99	100

Start Boat Section	80+75.90
Southwest Portal	87+75.90
Start Immersed Tunnel	90+01.50
End Immersed Tunnel	127+60.78
Northeast Portal	129+15.80
End Boat Section	136+15.80

Immersed tunnel element lengths 4 @ 332.55, 3 @ 355.96, 4 @ 340.30.

5.3.4 Shipping Channel

USN Deepening MCON P-879 Contract[3], Norfolk Harbor Channel Deepening, dredges the channel to 48 ft [Chart Datum, MLLW] for CVN transit to and from the shipyard. P879 should have been awarded in February 2011. The 48ft includes the over dredge depth, 47+1 ft.

Dredging Depth below NAVD88	49.64 feet including over dredge.
Dredging tolerance (over dredge)	1 ft.
Maximum vessel weight	110,000 tons (fully laden)
Anchor mass	18 tons
Anchor chain breaking load	800 tons

[3] Email from Vachet, Wendy L CIV NAVFAC MIDLANT, AM [wendy.vachet@navy.mil] dated Thu 1/20/2011 10:01 AM.

Sunken vessel load[4] 1,500 lb/ft²

Dredging depths as specified by the Corps of Engineers are relative to Mean Lower Low Water (MLLW). Water depth is adequate for *CVN 68 Class* and *Nimitz Class Aircraft Carriers*[5], since they use the channel. The minimum water depth required to operate carriers in inner channels and turning basins on the way to and at piers at home ports is between 49 and 50 feet depending on harbor salinity. Due to the reduced displacement when visiting shipyards, the minimum water depth required to operate carriers in inner channels and turning basins on the way to and at piers at shipyards is between 46 and 47 feet depending on harbor salinity[6].

"To safely move through the channel, a carrier needs six feet of water clearance from the bottom. Currently, there is only about two feet of clearance at low tide between Lambert's Point Deperming Station and Norfolk Naval Shipyard. The project is looking at taking the channel down to 50 feet in and around the deperming station, and down to a depth of 47 feet from the deperming station down to the shipyard[7].

The Navy announced on Wednesday, Sept. 9, 2009, its decision to deepen approximately five miles of the Norfolk Harbor Channel in the Elizabeth River. This action will allow the continuous safe and expeditious travel of aircraft carriers to and from the Norfolk Naval Shipyard and the Lamberts Point Deperming Station[8].

Norfolk Harbor Deepening Project Draft Environmental Impact Statement (DEIS) Notice of Availability was published in the Federal Register 1/16/2009.

5.3.5 Scour Protection

The current velocity for design of scour protection of permanent works shall have an annual probability of 1%.

5.3.6 Egress Corridor Parameters

- Emergency egress
  - minimum width – 5.5 ft,
  - minimum height – 10 ft.

5.3.7 Structural Parameters

Maximum and Minimum Material Densities shall be based on 95% and 5% results of actual measurements. Densities for reinforced concrete shall be based on calculated reinforcement quantities. Pending results of actual tests, the following material densities may be used for structural analyses:

Material	Minimum (lb/ft³)	Maximum (lb/ft³)
Unreinforced Concrete	145	148
Grout	137	140
Structural Steel (actual)	490	490

[4] Tunnel ship design data includes Nimitz-class vessels and is obtained from Ted Williams Tunnel design criteria Article 11.3.3.
[5] Nimitz-class aircraft carriers, which are as long as 1,092 feet and displace as much as 97,000 tons, can draw 38 feet of water, according to Norman Polmar's "Ships and Aircraft of the U.S. Fleet." http://hamptonroads.com/node/156321
[6] http://www.wbdg.org/ccb/NAVFAC/INTCRIT/fy97_01.pdf
[7] http://www.navy.mil/search/display.asp?story_id=26020
[8] http://blog.portofvirginia.com/my-blog/2009/09/navy-announces-dredging-project-in-the-elizabeth.html

Material	Minimum (lb/ft³)	Maximum (lb/ft³)
Soil Backfill (Saturated)	120	130
Locking Stone Ballast	125	142
Rock Protection	150	160
Asphalt	150	150

- Protection concrete to roof waterproofing, minimum thickness: 3”
- Poisson’s ratio, •, shall be taken as 0.20.
- Earth pressure lateral earth pressure coefficient:
  - At rest: 0.5
  - active: 0.3
  - ultimate passive: 2.7

Water Salinity[5] (ppt)	Minimum	Mean	Maximum
Sparrows Point (Swan Pt)	0.0	3.3 to 9.9	16.0
Wimcomico River (mid tow)	8.2		20.5
Chesapeake Bay Bridge	0.0	5.5 to 12.1	17.0
Ocean water	32.0	35.0	37.0
Midtown Tunnel	17.4		26.5

For flotation design purposes, a salinity level of 0 ppt and a specific gravity of 1.000 shall be used (say 62.4 lb/ft³). To prevent flotation, an extreme salinity of 35 (say 64 lb/ft³) shall be used[9]. which may vary with depth, and turbidity (the concentration of suspended solids can significantly increase the density). Since specific gravity for a given salinity varies with temperature, the following table should be used with caution. Additional field investigations to verify site-specific salinity and density vary with the seasons will be undertaken by SKW during final design.

Approximate Water Density	Minimum (lb/ft³)	Mean (lb/ft³)	Maximum (lb/ft³)
Sparrows Point (Swan Pt)	62.4	62.6 to 62.9	63.1
Wimcomico River (mid tow)	62.8		63.3
Chesapeake Bay Bridge	62.4	62.7 to 63.0	63.2
Ocean water	63.8	64.0	64.1
Midtown Tunnel	63.2		63.6

5.3.8 Concrete Design

For the immersed tunnel and other tunnel structures below ground, a minimum specified cylinder compressive strength of not less than 6,000 psi shall be used.

For analysis of the immersed tunnel, member stiffness shall be based on gross EI values for all members. Axial loads coexistent with effects of other load effects shall be taken into account for the design of reinforcement. Locked-in stresses from prior conditions shall be superimposed upon subsequent conditions. Stainless steel and epoxy coated reinforcement shall not normally be used.

[9] Over a 45-day period 24Apr2000 to 8Jun2000 at Sewell’s Point, surface salinity varied between 13 and 24, and at depth between 19 and 30.

Provisions shall be made for stresses and movements, thermal gradient (TG), resulting from air temperature variation from 32 degrees F to 87 degrees F. Unless more detailed analysis is undertaken, this may be assumed to be a difference through an external concrete surface of approximately 18 degrees F (i.e. ±9°F).

The expected temperature rise and fall (TU) and the coefficients of thermal expansion shall be taken as follows:

- Concrete
  - Temperature Rise 25 degrees F.
  - Temperature Fall 35 degrees F.
  - Coefficient of Expansion = 0.0000060/degree F.
- Structural Steel (for bridges and other exposed steel structures)
  - Temperature Rise 40 degrees F.
  - Temperature Fall 90 degrees F.
  - Coefficient of Expansion = 0.0000065/degree F.

5.3.9 Geotechnical Parameters

- Geotechnical design parameters will be developed utilizing data collected from the various geotechnical investigations as well as the proposed laboratory testing.
- Site specific design parameters will be developed for:
  - The immersed tube foundation soils
    - compressibility of the foundation bed and the underlying soils when unloaded and loaded (rebound and compression)
    - Strength of the underlying soils to analyze the allowable bearing pressures
    - The difference in vertical and horizontal compressibility characteristics of the soils between tunnel elements
  - The cut-and-cover and u-section foundation soils
    - compressibility of the underlying soils when unloaded and loaded (rebound and compression)
    - Strength of the underlying soils to analyze the allowable bearing pressures
    - The difference in vertical and horizontal compressibility characteristics of the soils between the interface elements (i.e., immersed tube / cut-and-cover interface)
  - The strength and lateral pressure characteristics of the various tunnel backfills
  - The strength and deformation properties of the dredged slope soils
  - The permeability characteristics of the soils beneath the dewatered excavations
  - The lateral strength and deformation characteristics of the soils behind the temporary support of excavation
  - The lateral strength and deformation characteristics of the soils behind the permanent u-section walls and cut-and-cover walls.
  - The elastic and plastic properties of the soils surrounding the existing tunnel, existing utilities and other adjacent structures for the purpose of analyzing the effect of the proposed construction on these structures.
  - Foundation soils for ancillary structures such as ventilation buildings and other surface facilities

5.3.10 Provisions for Openings, Ducts, Utilities and Services

Flood mitigation measures shall at a minimum meet Extreme High Water Level (EHWL) requirements and all State and Federal Applicable Standards. [TR 1.15.1.F]

The EHWL shall be the water level with the probability of being exceeded no more than 0.002 times in one year (the 500 year flood level). The flood protection shall be designed for wave heights corresponding to the same return period. [TR 1.15.1.G]

- Final Design Water Parameters
  - Final design water and flood elevations
  - Design current for fill and slope protection
  - Design waves for slope protection

5.3.11 Construction Related Design Parameters

- Construction tolerances incorporated
- Fabrication facility assumptions
- weights of marine equipment and.
- Tow-out assumptions
  - Keel clearance over the fabrication facility sill
  - Weights and capacity of marine equipment
  - Method of handling elements
  - Permissible draft
  - Minimum freeboard
  - Stability
  - Water density
  - Wave height
  - Access snorkel
- Long tow assumptions
  - Weights and capacity of marine equipment
  - Method of handling elements
  - Permissible draft
  - Minimum freeboard
  - Stability
  - Water density
  - Wave conditions, parameters and source
- Immersion assumptions
  - Weights and capacity of marine equipment
  - Method of handling elements
  - Immersion rig design lift capacity
  - Stability
  - Water density
  - Current

6 Tunnel Systems

6.1. Tunnel Lighting System

6.1.1 Basic Requirements

This Section establishes the basic design requirements for the approach roadways, tunnels (approaching, passing through, and exiting), and tunnel ancillary space lighting system for the Project. The design should simplify the visual task of approaching the tunnel, be glare free, uniform, and organized in a logical manner. The luminaires should serve as a visual guide to lead the motorist's eye along the road. The tunnel lighting shall be designed to provide adequate daytime illumination in the entrance portion of the tunnels, so that motorists can drive a vehicle safely and efficiently at the design speed conditions.

Overall, the design criteria is based on a lighting concept symmetrically placed across the cross-section using fluorescent and high pressure sodium light sources, and possibly light – emitting diode, contained in linear and point source water-tight fixture housings.

The lighting design for the tunnel, approach, and ancillary spaces shall comply with the latest applicable codes, regulations and standards of ANSI/IESNA, CIE, AASHTO, NFPA, AND UL, as further delineated in the Design Criteria. The tunnel and approach lighting is designed on the basis of unidirectional travel from Norfolk to Portsmouth.

6.1.2 Design Approach

The calculation methodology of the tunnel lighting system shall be based on ANSI/IES RP-22, Tables 2 & 3 for preliminary design, and the equivalent veiling luminance (Lseq) method utilizing a minimum safety factor of 4.1 for final design. The objective is to utilize the most beneficial luminance level to ensure driver visibility while controlling initial cost.

When developing the luminance criteria for lighting a tunnel entrance, ANSI/IES Standards divide the tunnel into separate zones to accommodate the proper adaptation of the human eye. These zones are called; "Approach", "Threshold", "Transition", and "Interior". The length of each zone and the lighting requirements for each zone correlate to the curve of eye adaptation. This curve relates speed to visibility by transforming the rate of eye adaptation, to the safe sight stopping distance (SSSD) established by AASHTO. The current standards suggest that one SSSD for the threshold followed with a 10 second transition shall provide enough time for a driver to adapt to the tunnel's interior environment.

Overall, the combined length of the threshold and transition zones shall be no greater than 3 times the safe sight stopping distance (SSSD), and shall follow the eye adaptation curve defined in ANSI/IES RP-22-05. Electronic and hard copy lighting calculations shall be provided supporting the Lseq evaluation and the proposed design levels. (For purpose of the calculations, the surface reflectance for the tunnel should be no less than 65% for the walls and ceilings, 10% for R1 type pavement, and 7% for R3 type pavement.)

Immediately following the threshold zone is the daytime interior zone which extends for the remainder of the tunnel downstream. The daytime interior zone luminance level with medium traffic volume (greater than 24,000 AADT) shall be 7 candelas per square meter (cd/m2) with a uniformity not exceeding 3 to 1 (average to minimum). The nighttime

luminance level shall be uniform throughout the entire length of the tunnel and provide an average luminance level of 2.5 cd/m2.

There is general agreement among authorities that the eye's natural ability to quickly adjust to an increasing level of illumination precludes the need for providing a higher light level at the exit portal. Consequently, the interior zone illumination levels shall be extended to the exit portal.

In order to simplify the visual task approaching and exiting the tunnel, the entrance approach and exit approach lighting should provide for one-third of the nighttime tunnel luminance in order to maintain good visibility and guidance.

6.1.3 Design Parameters

The parameters that influence the selection of the lighting fixture hardware are: light loss factors (LLF); luminaire efficiency and distribution; reflectance of the interior surfaces; and tunnel geometry.

Light loss factors are adjustments that are made in order to adjust the lighting calculations to anticipated field conditions. This overall adjustment is dependent on a series of recoverable and non-recoverable factors which will affect the lighting systems operation from the time the system is first turned on, through the life of the system. These factors should be included in all calculations; utilizing established formulas (refer to ANSI/IES RP-22).

6.1.4 Tunnel Lighting Control System

Illuminating a tunnel roadway to its highest level of lighting is only necessary during bright and sunny days. Otherwise, considerations should be incorporated into the design to save energy whenever possible.

A luminance sensor, lighting contactors, controller, and a controller cabinet are the necessary components of a lighting control system. A luminance sensor (L20 type meter shall be used) measures the luminance of the portal in the direction of traffic. The sensor sends an analog signal to the controller and the corresponding output level is switched on or off using the lighting contactors, depending on the frequency received.

The tunnel lighting system shall be designed to operate automatically and maintain a predetermined ratio of outdoor luminance to threshold and transition zone luminance for each roadway, under all weather conditions, during daytime operating hours. The system shall prohibit response to sudden and short duration (less than 15 minute) light level changes and shall respond only to steady and long duration (more than 15 minutes) changes.

The controller shall also incorporate the ability to monitor up to 3 luminance sensors (similar to above) located throughout each tunnel bore, to monitor the maintained luminance level. When any of the luminance meters sense that the lighting level is less than a specified set point, the system shall provide an alert identifying need for maintenance to the lighting fixtures.

6.1.5 Tunnel Lighting Fixture Circuiting

Fixtures on opposite sides of the tunnel shall be supplied by separate panel boards. These separate panel boards shall, in turn, be connected to switchgear busses normally energized from alternate electrical services A and B. Luminaires shall be connected to alternate phases of the circuit to ensure that if one phase is lost, only 33 percent of the

total lighting fixtures served by the three phase circuit are affected; also that loads are balanced. To prevent the tunnel from being cast suddenly into complete darkness by simultaneous loss of power from all utility power sources, selected fixtures in a row of luminaires on the nighttime level circuit, as determined by NFPA 502, shall be connected to a UPS (uninterruptible power supply) system.

6.1.6 Tunnel Lighting Fixtures

A combination system utilizing both linear fluorescent (and possibly light – emitting diode), and high intensity discharge (HID) point sources are to be used. The luminaires used shall provide the necessary luminance/control while physically staying outside the dynamic traffic envelope. All luminaires within the tunnel must be watertight and corrosion resistant to protect their interiors from periodic high-pressure (100 psi) wash downs of the tunnel environment (walls and ceiling). All luminaires used within the tunnel areas must be UL listed for wet locations and for direct spray applications. Manufacturers chosen to supply tunnel roadway luminaires must have a successful history for use within vehicular roadway tunnels. Where appropriate, dissimilar metals must be separated by appropriate insulators to minimize corrosion potential.

6.1.7 Tunnel Egress Stairwells, and Ancillary Spaces

In tunnel emergency egress passageways and ancillary spaces, fixtures shall be surface or pendent mounted and suitable for wet locations. Fixtures shall be provided with 1/8-inch thick acrylic lenses and shall operate two 4000K T8 fluorescent lamps.

Circuiting for egress stairwells shall be designed in accordance with requirements of the National Electrical Code. Control for each area shall be from respective panel board only.

Exits within the tunnel will be clearly identified by dedicated emergency exit lighting that will help vehicle occupants find the exits when necessary during an emergency. This supplemental lighting provided at the exits will light the door and surrounding surfaces to a much higher level than the interior of the tunnel, providing the necessary demarcation. This lighting is in addition to the exit markings, strobe lights, and directional signs.

The emergency lighting system shall be designed to maintain the required level of illumination throughout the means of egress, and shall be in accordance with NFPA 502. The system shall utilize a selected number of lighting fixtures provided as part of the general illumination, and be connected to a UPS system.

Exit sign lighting fixtures shall be provided to illuminate the designated egress passageways, including the entrance to stairways. Exit sign lighting fixtures shall be wet location, wall or bracket mounted at a mounting height visible to all occupants within the occupied spaces. Exit sign lighting fixtures shall be single or double face with 8-inch red stenciled letters. Directional arrows shall be provided as required. Exit sign lighting fixtures shall be connected to the UPS system.

6.1.8 Tunnel Fixed Message Sign Lighting

All ceiling mounted, non-internally illuminated signs located in tunnels shall be externally illuminated using either the luminance or illuminance methods in accordance with the following criteria:

Luminance*	-	96 candelas per square meter minimum
Illuminance	-	40 lms/ft^2 (400 lux) minimum

* - 65 percent maintained reflectance

The maximum to minimum uniformity ratio on the sign face shall not exceed 4 to 1. The maximum illumination gradient produced on the sign face shall be 2 to 1.

Fixtures shall be located so that they do not interfere with sign visibility for drivers of any type of vehicle.

6.2 Traffic Surveillance and Control System (TSCS)

6.2.1 Closed Circuit Television (CCTV)

A CCTV system for tunnel and approach roadways shall be provided for general surveillance purposes to enable the OCC operator to view any part of the tunnel interior, emergency escape routes and approach ramps. Generally cameras will have pan, tilt and zoom (PTZ) capability and be NEMA 4X rated. Dome type cameras shall be used within the tunnel and approaching roadways.

Cameras shall be positioned so that if one camera fails, full coverage of the tunnel interior may be obtained by the use of the adjacent cameras on either side.

SCADA system interfaces shall allow the nearest camera to an alarm event to be displayed automatically at the OCC through the use of presets. The alarm event shall be captured through an automatic real time recording feature for at least two cameras capturing alarm events simultaneously. The OCC operator shall be able to manually start and stop the recording feature.

Each camera image shall have informational banner with identification, location, date and time in universal time coordinated format.

Cameras shall also be provided to monitor the interior of the egress corridor.

At the OCC, there shall be multiple monitors and recording facilities to assure adequate redundancy in the system. One or more screens shall cycle all the cameras at least once every 60 seconds, while at least one of the other displays a single picture selected by the OCC operator as a “spot” monitor. System shall be scalable and expandable to allow future addition of cameras or monitors.

6.2.2 Lane Control Signals

Lane Control Signals shall be located along the tunnel walls and over the roadway at the tunnel portal approaches at regular intervals to indicate the status of each travel lane as either opened or closed, through the use red and green symbols on black background suitable for the full range of ambient lighting conditions where located.

Each lane use signal head shall be independently controlled to indicate the status of each lane and shall be fully interlocked to prevent any possible conflicting indications, with fault conditions at a signal head to show a blank face.

Signal heads shall be double aspect light emitting diode (LED) displays suitable for use with bidirectional traffic.

The LUS System shall be monitored and controlled from both the remote operations control room and the local on-site operations control room.

Traffic stop signals shall be provided to close the tunnel and prevent vehicles from entering in the event of an emergency.

6.2.3 Overheight Vehicle Protection (OVP)

The OVP system shall detection height shall be based on AASHTO required vertical clearance within the tunnel. The OVP system shall locate receiver/transmitter pairs along the roadway such that the paths between each transmitter-receiver pair shall be parallel such that the beams between the pairs shall define a plane parallel to the detection height.

The OVP system shall operate in conjunction with other TSCS components. In the event of an interruption of the beams crossing the roadway in the appropriate sequence, the detector controller shall activate a downstream message, and an audible alarm and strobe light shall warn the driver of the overheight vehicle and provide instructions. An alarm shall also be generated at the Operations Control Center.

6.2.4 Dynamic Message Signs (DMS)

Full matrix signs shall be provided in the tunnel and tunnel approaches at regular intervals above the travel lanes to display instructions and emergency messages to motorists.

The signs shall be based on arrays of white LEDs on a black background, visible in bright sunlight and dimmable to suit the full range of ambient lighting conditions.

Sign messages shall be remotely programmable by the OCC operators through the TSCS system.

6.3 Not Used

6.4 Power Distribution

6.4.1 Incoming Medium Voltage (MV) Supplies

6.4.1.1 Redundant Supplies

Power for the tunnel systems shall be supplied from two independent incoming medium voltage supplies, designated ‘A’ and ‘B’, each capable of supporting the entire electrical load, but normally supporting approximately 50% of the total electrical load. The ‘A’ and ‘B’ supplies shall be taken from the Portsmouth and Norfolk distribution networks respectively, to minimize the risk of common point failure.

6.4.1.2 Load Splitting

The total electrical load, including the lighting and ventilation systems, shall be split approximately 50/50 between the ‘A’ and ‘B’ supplies so that if one supply fails, only 50% of the system capacity will be initially (momentarily) disrupted.

6.4.1.3 Cable Segregation

Cabling, transformers and switchgear associated with ‘A’ and ‘B’ supplies shall be physically segregated to the maximum practicable extent.

6.4.1.4 Alternative Supplies

If either supply should fail, or equipment needs to be temporarily taken out of service for inspection, maintenance or repair, provision shall be made for the whole of the tunnel electrical load to be transferred to the alternative supply until normal operation can be restored.

6.4.1.5 Switchgear Cabling

Switchgear controlling interconnecting cables between the 'A' and 'B' substations shall be interlocked to prevent through feeding between the Portsmouth and Norfolk supply networks.

6.4.1.6 Secondary Distribution System

The secondary distribution system shall operate at 480Y/277 Volts, in a main-tie-main configuration utilizing double – ended switchgear, electrically interlocked to prevent paralleling.

6.4.2 Standby Power Systems

The standby power systems shall consist of standby generators, switchboards, transfer switches, fuel supply and storage, accessories, and wiring as required to provide standby power to the following loads, as a minimum.

- Selected tunnel, utility room, egress corridor and egress stair lighting*
- Flood gates
- Tunnel drainage system
- Storm water pump stations
- Fire protection pumps
- Minimum tunnel ventilation (25% of installed capacity)
- Traffic surveillance and control system (TSCS) equipment*
- Communications such as radio, telephone and public address, supervisory control and data acquisition (SCADA), and fire detection and alarm systems*
- CCTV and incident detection
- Illuminated escape signage*
- Selected building lighting*
- Selected receptacles in fire cabinets, switchgear rooms, generator rooms, mechanical rooms, control rooms, rest rooms, stairways, maintenance shops, and offices.

*- Systems also provided with battery-supported UPS for which standby power will provide long term back-up.

System design shall be based upon ANSI/IEEE Standard 446 and the criteria defined herein.

UPS units shall be connected to draw power from a standby source if normal power fails. Standby generators shall be located in or at the buildings at each end of the tunnel. Standby power switchboards may be located in the same room as the generators, such room to be provided with adequate ventilation and relatively dust free air. Transfer switches shall be located where it is most advantageous based upon access for operation, economic reasons, and other governing factors.

6.4.2.1 Standby Generator Units

Standby generators shall be diesel engine-driven. Generator output shall be 480/277 Volts, 60 Hertz, three phase, four wire, and kW capacity as determined by the design calculations.

In general, one standby generator at each building should be sufficient to supply the load. If two or more standby generators/building is required, consideration should be given to the advantages and disadvantages of parallel operation.

If Natural Gas from the local utility distribution system is considered as the emergency fuel source, the Designer shall consider the risks of an interruption in the gas flow during emergency operation. Regardless of fuel type, if storage tanks are used sufficient tank storage or continuous commercial fuel supply (such as natural gas) shall be provided at each location to support 3 days of continuous operation, including 2 days under emergency loading. Storage tanks shall conform to all City, County, and Commonwealth of Virginia regulations. The system shall conform to NFPA 30 and NFPA 37.

The loss of normal power at the automatic transfer switch shall cause the associated standby generator(s) to start up automatically and assume the load if the normal power interruption continues. Where required, loads shall be arranged for sequential starting.

Automatic transfer switches shall be mechanically held, electrically operated by a single-solenoid mechanism energized from the source to which the load is to be transferred. Automatic transfer switches shall include neutral poles with "make-before-break" operating characteristics.

6.4.2.2 Standby Switchboards

480/277 Volt standby switchboards shall be indoor type, metal-enclosed, self-supporting structure. Switchboards shall be of compartmentalized design with individually mounted devices in the distribution sections.

6.4.2.3 Uninterruptible Power Supplies (UPS)

UPS units shall provide uninterruptible electrical power to designated loads. The following are typical loads that are connected to UPS systems:

- Traffic surveillance and control system (TSCS) equipment
- Communications, supervisory control and data acquisition system, and fire detection and alarm systems
- Selected tunnel, utility room, egress corridor and egress stair lighting
- Illuminated escape signage
- Selected building lighting

The UPS units shall be designed to operate "on line" such that when normal power fails, the batteries will provide power for a designated period through the inverter output. If a UPS malfunctions, a static switch shall automatically connect the load directly to the normal supply while simultaneously opening the inverter-output circuit breaker. A maintenance by-pass shall be provided to manually transfer the load to the normal supply for routine service or maintenance of the UPS.

6.4.3 Circuit Conductors

- All sub-main and final sub-circuit conductors within the tunnel road space shall be protected from fire, either by the use of fire rated cables adhering to NFPA 70 Article 700 or 708 as appropriate, or by being enclosed within fire protected ducts.

- All cables buried in the ground or passing through the structure shall be enclosed in ducts, with 25% spare ducts left empty for unspecified future use.

- Where it is not possible to obtain suitable fire rated versions of exposed cables required for instrumentation, data transmission or communications equipment in the tunnel, resilience to fire shall be provided by alternate means, such as duplication by alternate routing.

- Final connections to equipment that will be not be expected to continue operating under direct impingement of fire may be made in cables with fire rating similar to that of the equipment served. In such instances suitable precautions shall be taken to ensure the continued functioning of equipment not directly involved in the fire.

6.4.4 Supervisory Control and Data Acquisition (SCADA) System

A comprehensive supervisory control and data acquisition (SCADA) system shall be established to permit monitoring and controlling of key elements throughout the facility, including any remotely located equipment or facilities, from the OCC.

The architecture of the SCADA system shall employ a fail-safe topology. Each programmable logic controller (PLC) shall be designed with a redundant “hot-standby” configuration, capable of seamless transfer of data upon failure of the main processor. Additionally the programmable logic controller shall be equipped with redundant power supplies.

The SCADA system shall employ a universal remote input/output network protocol, allowing different network devices the ability to communicate with the programmable logic controller. Remote input/output (RIO) cabinets shall be distributed throughout the facility in order to minimize hardwire cable runs between field devices and the SCADA system. Each remote input/output cabinet shall be designed to accommodate the required number of points for the digital input (DI), digital output (DO), analog input (AI), and other data modules as needed.

The design of major mechanical and electrical equipment shall incorporate provisions for communication, control, and indication, via normally-open and normally-closed contacts, transducers, and auxiliary relays, to provide control/indication.

System shall consist of communications networks, servers and operator interfaces. The communications network shall consist of dual fault tolerant, redundant fiber optic ring topology with management switches at each node.

Servers shall be provided operating on a hot standby basis.

Operator interfaces shall be provided at the remote OCC and local to the tunnel, with different levels of system access protected by password for “guest”, “operator”, “supervisor” and “engineer”. System shall also handle and manage data logging and transfer for alarms, alerts and record keeping for historical purposes.

6.4.5 Fire Alarm and Detection System

A fire alarm and detection system shall be provided for the tunnel and support buildings in compliance with NFPA 72 and 502.

The tunnel shall be provided with manual pull stations located along the roadway at intervals complying with NFPA 502. The tunnel shall also have a linear heat detection system capable of monitoring each lane. The linear heat detection system shall be a subsystem to the main fire alarm control panel.

The support buildings and other ancillary areas such as pump rooms shall be provided with automatic detection means such as heat and smoke detectors, along with pull stations. Annunciation of a fire condition shall be through horn/strobes in these areas only.

The tunnel fire suppression system shall have a monitoring connection to the main FACP.

The main FACP shall be an addressable type, with the use of intelligent devices, or in areas not environmentally suitable, the use of conventional devices with monitor modules located in hospitable environments.

6.5 Tunnel Ventilation

6.5.1 Introduction and Purpose

The tunnel ventilation system shall be designed to provide a safe environment for motorists. This objective shall be achieved by the following:

- Preventing the dangerous accumulation of vehicle-emitted pollutants (i.e., carbon monoxide, CO, and oxides of nitrogen, NOx)
- Maintaining visibility in the tunnel by preventing the accumulation of haze-producing pollutants.
- Providing life/safety support during a vehicle fire incident in a tunnel.

6.5.2 Standards and References

The design of road tunnel ventilation systems will be required to conform to the latest issues of the following standards and references:

- National Fire Protection Association - Standard for Road Tunnels, Bridges, & Other Limited Access Highways (NFPA 502)
- American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) – Enclosed Vehicular Facilities
- Air Movement and Control Association (AMCA) Standard 250, Laboratory Methods of Testing Jet Tunnel Fans for Performance
- Air Movement and Control Association (AMCA) Standard 301-06, Methods for Calculating Fan Sound Ratings from Laboratory Test Data
- Environmental Protection Agency (EPA) Requirements for Highway Projects

- Governing EPA and Federal Highway Administration Ambient Air Quality Regulations
- Virginia Department of Transportation document entitled “Rules and Regulations Governing the Transportation of Hazardous Materials through Bridge – Tunnel Facilities”

6.5.3 Design Considerations

During normal tunnel operations, the tunnel length, the traffic density, and the direction of traffic movement (i.e., uni-directional vs. bi-directional) are some of the key factors in determining whether the ventilation requirements can be achieved by passive means (e.g., the piston action airflow generated by the moving vehicles) or whether mechanical ventilation is required.

The tunnel length is also a key factor in determining the need for mechanical ventilation during emergency operations, since it affects the egress time from the tunnel and the number of motorists that could be exposed to the hazards of a fire.

The installed ventilation system capacity is typically determined by the requirement for smoke control during a tunnel fire incident (emergency operations). The ventilation requirements during normal tunnel operation (i.e., non-fire conditions) are significantly less and will be determined by the prevailing traffic conditions.

6.5.4 Design Assumptions

6.5.4.1 Tunnel Configuration

The New Midtown Tunnel is proposed as a two-cell, two-lane concrete immersed tube with minimal cut-and-cover structure at the portals. The total length will be approximately the same as the Existing Midtown Tunnel (4,200’+/-). The new tunnel will have two 12’ wide travel lanes with 2’ wide shoulders each side. The vehicle clearance envelope height will be 16’-6” above the roadway. One cell will serve the roadway and the second cell will include an emergency egress corridor along the right travel lane and utility space.

6.5.4.2 Project Traffic Operation Modes

Two different variations of traffic operation have been identified as a requirement for the Midtown Tunnel crossings using the available lane capacity of both the Existing Midtown Tunnel and the New Midtown Tunnel when it becomes available. The two traffic operational modes are as follows:

- Normal – Two travel lanes in the eastbound direction operated through the Existing Midtown Tunnel and two travel lanes in the westbound direction operated through the New Midtown Tunnel.
- Evacuation (Reversible) – All four available lanes (existing and proposed tunnel) operated in a single direction to facilitate options for emergency evacuation route planning by state and regional planners.

6.5.5 Ventilation System Concept

A longitudinal system using reversible jet fans is proposed for the New Midtown Tunnel. A jet fan based longitudinal ventilation system utilizes jet fans to impart a high velocity air jet into the tunnel which induces a longitudinal flow along the length of the tunnel. The longitudinal flow in the tunnel pulls air into the entrance portal, forcing the air to flow the full length of the tunnel and discharge it at the exit portal.

This type of ventilation system is considered the most appropriate type for this project because:

- It is the most efficient system for shorter tunnels designed for uni-directional traffic.
- It has the least impact on size of the tunnel structure.
- It does not require the construction of new ventilation fan buildings.
- It is the most cost effective system to meet this tunnel's ventilation requirements.

6.5.5.1 Normal Ventilation

During normal operating conditions the tunnel is expected to self ventilate with free flowing traffic. The piston-action ventilation caused by traffic movement will be sufficient to maintain safe emission and opacity levels in the tunnels during free-flowing traffic conditions. Some of the jet fans may need to be operated to provide dilution air during heavy traffic periods, when traffic speeds fall below 10 to 15 mph, and during adverse outdoor wind conditions. The tunnels will be continuously monitored for trends in the emission levels and rising emission levels will indicate the need for more dilution air, therefore additional pairs of fans would be activated until the emission levels are at acceptable levels.

The ventilation system must be sufficient to dilute the vehicle-emitted pollutants to safe levels. The limiting pollutant concentrations during normal tunnel operations have been established jointly by the FHWA and EPA and are as indicated in Design Criteria. The guidelines are given in terms of allowable average emission concentration versus exposure time. CO is the primary pollutant of those indicated within the Design Criteria and the ventilation system response to maintain acceptable CO levels is anticipated to be sufficient to maintain acceptable levels of the remaining pollutants.

6.5.5.2 Emergency Ventilation

The tunnel ventilation system capacity is governed by the design fire heat release rate and in the event of a vehicle fire all of the fans in the tunnel roadway containing the incident would be operated to purge smoke from the tunnel in the direction of traffic. This concept permits motorists that become trapped behind the fire to safely exit the tunnel upstream of the fire, where tenable conditions are being maintained. It is anticipated that traffic downstream of the fire site would have exited the tunnel. Since a longitudinal system is only capable of generating longitudinal airflow in one direction of the tunnel at a time, it is important to recognize that this type of ventilation system is only effective for fire incidents where traffic is operated uni-directionally. The direction of air flow is reversible due to the use of reversible jet fans which supports uni-directional travel in either direction through the tunnel and in other special fire scenarios where it may be desirable to operate the fans in reverse mode.

6.5.5.3 Design Fire Size

Trucks carrying hazardous cargo, as defined in the Virginia Department of Transportation document entitled "Rules and Regulations Governing the Transportation

of Hazardous Materials through Bridge – Tunnel Facilities", will not be permitted to use the Midtown tunnels. Therefore, a single vehicle fire size could range from about 3 MW to as much as 20-30 MW which are representative of fire heat release rates from the burning of a passenger car and a bus or a large truck, respectively. However, the relatively high percentage of buses and heavy goods trucks projected to use the tunnels could result in a multi-vehicle fire. Accordingly, a design fire heat release rate of 100 MW has been selected for this project. The fire rate of growth curve for the design will be the ultrafast growth curve indicated within NFPA 502. The design fire size has been confirmed through discussions with the local authorities during the initial discussions of fire life safety design features.

6.5.5.4 Emergency Response

Since the longitudinal ventilation systems push the smoke and heat from a fire in the direction of traffic, the tunnel conditions on the downstream side of the fire site may be untenable due to the smoke and heat which could impact the emergency responder's ability to respond from the downstream side of the fire (counter flow). This is not anticipated to be a significant issue for smaller fires however it is extremely important that the development of the tunnel emergency response plans considers all potential conditions including activation of the fire suppression system.

6.5.5.5 Bi-Directional Traffic

A key assumption regarding bidirectional traffic operation in the New Midtown Tunnel is that it will be a very infrequent operational need, such as unique planned maintenance activities (i.e., repaving) or due to an emergency closure of the Existing Midtown Tunnel. Traffic restrictions such as one lane alternating, restricted speed, and controlled access are required to be implemented during these situations since the proposed ventilation system will be ineffective in a fire emergency.

6.5.5.6 Egress Corridor Ventilation

The egress corridor will be provided with a ventilation system that pressurizes the corridor in order to prevent smoke from a tunnel fire event from entering the corridor. The system shall be comprised of dedicated ventilation fans that provide fresh air to the corridor. The pressurization fans will be located in the Tunnel Support Buildings at both portals and ducted directly into the egress corridor. Control of this system will be integrated with the emergency ventilation system for the tunnel.

6.5.6. Ventilation System Design Details

The ventilation system for the Midtown Tunnel consists of a jet fan based longitudinal ventilation system comprised of fans mounted to the tunnel ceiling along the left lane side of the tunnel spaced at approximately 300 foot intervals over the length of the immersed tube structure portion of the tunnel. Within the cut-and-cover portion at both ends of the tunnel, a bank of four jet fans will be mounted in roof niches directly over the travel lanes. The jet fans shall be reversible to permit longitudinal flow in either direction.

The ventilation system capacity will be determined via CFD analysis and the fans will be sized appropriately to manage conditions in the tunnel for normal and fire emergencies.

The jet fan units will be rated for high temperature operation as they are mounted in the tunnel and will be exposed to elevated temperatures in the event of a vehicle fire. In accordance with NFPA 502, the fans, their motors, and all related components that are

exposed to the air stream must be able to remain operational for a minimum of 1 hour in an air stream temperature of 482 F. The design of the ventilation system shall include redundancy to allow for the loss of a fan due to heat damage during a fire incident.

External wind conditions can have a significant effect on the operation of the longitudinal ventilation system. If the wind is acting opposite to the direction of ventilation, then the tunnel airflow will be reduced. The system design shall allow for the effect of adverse wind acting on the exiting portal.

Fan operation during normal tunnel operations will be determined primarily on the basis of the carbon monoxide (CO) level in the tunnel. The tunnels will be continuously monitored for CO at a suitable number of locations. In addition, the relatively large percentage of diesel powered trucks and buses anticipated passing through the tunnel and the steep tunnel grade will require the monitoring of oxides of nitrogen (NOx) and the opacity of the tunnel air (i.e., haze) to ensure a safe level of visibility. The monitored data will be transmitted to Operations Control Center.

6.5.7 Critical Velocity

Longitudinal ventilation systems control smoke by producing a sufficient air velocity along the roadway to force smoke movement downstream away from the section of a tunnel most likely occupied by trapped motorists which is upstream of the fire site. The minimum air velocity required for smoke control is referred to as the critical velocity, i.e. that velocity which controls reverse flow or back-layering of smoke. The magnitude of the critical velocity is a function of the design fire heat release rate (i.e., fire size), the tunnel dimensions and the tunnel grade. The air flow induced in the tunnel must be sufficient to overcome the various resistances to flow (including vehicles in the tunnel, tunnel grade, adverse winds, etc), while also exceeding the critical velocity.

6.5.8 Operations

Operation of the ventilation system during normal traffic conditions will be automatic based on pre-set level indications received from the environmental monitoring systems described in Paragraph 6.5.6, above. In addition, high and high-high alert/alarm indications regarding the monitored environmental conditions will be sent to the Operations Control Center.

The proposed ventilation system shall be designed so as to minimize operator interaction or decision making which can lead to a delayed or incorrect response during a fire emergency. The operation control software shall be preprogrammed to operate the system in the appropriate mode based upon the identification of the fire location.

6.5.9 Maintenance

Consideration shall be given to the clearances required for normal maintenance as well as replacement of the fans and attenuators. The fan installations will be coordinated with other elements so as to provide the spatial requirements necessary to remove and replace the jet fans.

Maintenance of jet fans typically requires a lane closure to perform any inspection, rebalancing or initial diagnostic work at the fans. Any major work typically requires the fan to be removed so it can be repaired in a shop. A spare fan will be provided such that the problem fan can be removed and replaced with the spare fan. After the removed fan has been repaired it would then become the spare.

Any special procedures, tools, or equipment required to perform routine maintenance or replacement shall be described or detailed as appropriate in the Operations and Maintenance manuals. Detailed maintenance procedures must be developed to identify the specific tasks and steps necessary to complete various maintenance activities.

6.6 Tunnel Standpipe and Fixed Fire Suppression Systems

6.6.1 Introduction and Purpose

This Section establishes the basis of design for the tunnel fire standpipe and fixed fire suppression systems, including a manual standpipe systems and Fixed Fire Suppression Systems (FFSS) in the New Midtown Tunnel.

An FFSS will be used to prevent the spread of fire and limit a fire incident to the initial fuel source. A standpipe system will also be provided to allow fire fighters to apply water directly onto the fire. In addition, portable multi-purpose fire extinguishers will be conspicuously located and easily accessible throughout the tunnel.

6.6.2 Standards and References

The following codes standards and guidelines serve as the basis for the design of the tunnel fire suppression systems:

- National Fire Protection Association (NFPA 502 – Standard for Road Tunnel, Bridges, and Other Limited Access Highways
- National Fire Protection Association (NFPA) 14 – Standpipe Systems
- National Fire Protection Association (NFPA) 13 – Sprinkler Systems
- National Fire Protection Association (NFPA) 25 – Standard for the Inspection, Testing and Maintenance of Water Based Fire Protection Systems

The design of the tunnel standpipe and fixed fire suppression systems will adhere to these and other relevant NFPA requirements unless dictated otherwise by the local Authority Having Jurisdiction (AHJ) on matters of fire protection and life safety.

6.6.3 Design Considerations

6.6.3.1 FFSS Type

FFSS systems within road tunnels will be open-nozzle deluge type. Operation of the FFSS system will be manual from the Operations Control Center. Deluge zones will be sized such that water will be applied over the longest possible vehicle in the tunnel and it overlaps a boundary between zones. The water application rate shall be sufficient to prevent the spread of fire, but not necessarily extinguish, suppress or control burning. The design condition will take into account a fire fully shielded from direct overhead water spray onto the fire. Indirect water spray, i.e. that from the sides or carried in by ventilation air flows may be considered. The standpipe and FFSS will be served by individual mains in the tunnel.

6.6.3.2 Standpipe System

Standpipe systems within road tunnels are allowed by NFPA 502 to be either “wet” or “dry” meaning that the systems may be continuously kept full and pressurized or remain empty until needed. Dry standpipe systems are most commonly used in climates

subjected to freezing conditions and must be capable of being fully charged by a reliable water source in less than ten minutes. This requirement may be waived with the concurrence of the AHJ if it can be shown that the estimated fill time will still result in water being available to fire fighters before they would arrive at the hose valve location. Wet systems shall be designed such that water temperatures not fall below 40 deg.F. The tunnel standpipe system will be a Class 1 system designed to maintain a flow of 750 gallons/minute delivered to the three most remote hose valves at a residual pressure of 100 pounds per square-inch (psi) to the outlet of the most physically remote hose connection valve. A fire department pumper pressure boost of 150 psi will be included in the determination of residual pressure

6.6.3.3 Hose Connection Valves

Special consideration will be given to the location and placement of hose connection valves within the tunnel. It is important to locate the valves so that they are conspicuous and convenient yet still adequately protected from damage. Fire hoses will not be provided.

6.6.3.5 Water Supply

NFPA 502 requires provision of a water supply capable of sustaining the combined FFSS and standpipe system demand for one hour. Storage tanks, municipal waterworks or private water services are all acceptable provided that they have an adequate flow rate and residual pressure and are of an acceptable integrity and reliability. The fire department standpipe connections shall be located such that they are accessible by responding fire department apparatus and within 100 feet of a fire hydrant or other approved water supply.

6.6.4 Standpipe System Design Assumptions

The design requirements indicated in this section shall apply to the fire standpipe system:

- Separate Standpipe and FFSS mains will originate at the water service entrance in the Tunnel Support Buildings at both portals and then run the full length of the tunnel.
- The standpipe system shall be valved in a manner to allow sectionalizing of the system for maintenance purposes without taking down the entire system.
- Hydraulic analysis will be performed to confirm that the design flow can be maintained for one hour in accordance with NFPA 502.
- Fire department hose connection stations in each tunnel will be spaced in accordance with NFPA 502.
- Each hose connection station will consist of two 2-½ inch hose valves and a 20-pound multi-purpose fire extinguisher in an alarmed protective enclosure.
- Pressure reducing hose valves will be installed at hose connections where residual pressure exceeds 100 psi.
- Conspicuous identification signage will be developed for the components of the standpipe system.
- As a minimum, identification signage will be affixed to all fire department connections and hose stations.
- Signs will be permanently marked and will be constructed of weather-resistant metal or rigid plastic materials.

6.7 Pumping & Drainage Systems

6.7.1 Introduction and Purpose

Tunnel drainage systems are typically designed to be independent of inflow from sources outside the tunnel. To the extent practical, the open approaches at exit and entrance portals are provided with cut-off drains designed to intercept and prevent stormwater accumulation from entering the tunnel.

The tunnel drainage system for the New Midtown Tunnel will be comprised of two independent drainage systems; a portal drainage system and a tunnel drainage system. A portal drainage system will be provided at each of the tunnel portals to intercept, collect and discharge stormwater that accumulates along the approach roadways outside of the tunnel portals and prevents it from entering inside of the tunnel. The tunnel drainage systems will be provided to collect and discharge water inflow that occurs within the tunnel primarily from tunnel washing, use of fire suppression systems, and the normal seepage that can be expected with an underground/underwater structure. In addition the tunnel drainage systems must be designed in accordance with NFPA 502 so as to minimize the propagation of a flammable fuel spill.

6.7.2 Standards and References

The following codes standards and guidelines serve as the basis for the design of the tunnel drainage systems:

- National Fire Protection Association (NFPA) 502 – Standard for Road Tunnel, Bridges, and Other Limited Access Highways
- National Fire Protection Association (NFPA) 70 – National Electric Code
- Federal Highway Administration, Highway Engineering Circular (HEC) 12 – Drainage of Highway Pavement

6.7.3 Design Considerations

The stormwater collected at the tunnel portals is considered to be clean and therefore is not subjected to treatment. The tunnel drainage effluent can be considered to consist of water contaminated with tunnel washing detergents, particulates and minor oily waste that are not legally permitted to be discharged through an open outfall. Therefore, road tunnel drainage discharge is normally connected to a sanitary or industrial wastewater sewer system under special permit to ensure proper treatment. The local Utility will be contacted for their permit and treatment requirements, including whether or not they require separate discharges for roadway water and other discharges.

6.7.4 Design Capacity

The proposed tunnel drainage system shall be designed to collect and discharge effluent based on a capacity equal to largest anticipated contributor which is typically from the fire fighting systems plus a safety factor. The proposed portal drainage systems will be designed to collect and discharge stormwater based upon a 100year storm event.

6.7.5 Pumping Station Locations

The profile of the proposed tunnel alignment indicates that the low point occurs at about the middle of the tunnel. The low point pump station will be designed to discharge to a transfer pumping station located within or adjacent to one of the Tunnel Support Buildings. From there the system will be connected to a local municipal sewer that is legally permitted for industrial waste disposal.

6.7.6 Collection System Piping

The collection system in the tunnel and portal areas will consist of cast iron grated drop inlets designed for 20 ton (minimum) truck loading (HS-20) and spaced at a maximum of 75 foot intervals to minimize propagation of a fuel spill and to allow for pipe cleaning between inlets. The drop inlets will connect to a main drainpipe embedded below the roadway slab that will convey all water to the pump stations.

The portal elevations and tunnel longitudinal profile allows the collection system to operate by gravity. The minimum super elevated cross-slope of 1-percent requires inlets along only one side of the roadway. Miscellaneous drains from walkway gutters, egress corridor, ancillary spaces and electrical pull boxes will drain directly to the road surface only when occurring on the low side the roadway super elevation. Miscellaneous drains occurring on the high side of the roadway super elevation will be piped directly to the main drain to prevent water from sheeting onto the roadway.

6.7.7 Pumps

Pumps will be non-clogging, centrifugal type. Pumps will be sized so that adequate capacity will be available should any one pump become out of service due to planned or unplanned maintenance/repair. The pumps will be automatically operated and the operational sequence will be sequenced to equalize run times. The pump control system will ensure minimum run time of pumps to prevent frequent cycling. A local control panel will be provided at the pump station. The local control panel will be housed in a secure, designated room located adjacent to the pumps and easily accessible for maintenance purposes. The pump control panel will be linked so as to communicate key operational data/status remotely to the Operation Control Center.

6.7.8 System Classification

Since the potential exists for collection of petroleum based fuels and oils within the drainage system, the portal and tunnel pump stations, including all components and equipment, shall be designed to comply with the requirements of the National Electrical Code (NFPA 70) for a Class I, Division II type hazard location.

6.7.9 Hydrocarbon Monitoring

A hydrocarbon monitoring system within each pump station will be provided to detect unsafe vapor levels. Upon detection of unsafe levels within either the sumps, wet well or pump rooms, an alarm will be sent to the Operation Control Center and the pumps will be automatically turned off allowing the tunnel operator to determine the source and level of contamination. A ventilation system will be provided to purge unsafe vapors from the pump station spaces.

6.7.10 Pump Station Access

Portal pump stations shall be designed to be accessible from the Tunnel Support Buildings with equipment access directly to outdoors. The tunnel low point pump station shall be designed with sufficient accessibility for removal of equipment and cleaning and maintenance of the sumps within the confinements of the tunnel.

6.7.11 Settling and Discharge

Settling of sediments and solids within the tunnel drainage effluent is necessary prior to discharge. This is accomplished by the provision of sumps sized to provide enough holding capacity to adequately separate heavy particles under design flow conditions prior to discharge. The tunnel low point pump station will discharge to a transfer pump station located at one of the Tunnel Support Building. The transfer pump station will

house the necessary settling tank/purge tank or other pre-treatment equipment that may be necessary. An additional set of pumps at the transfer pump station will be used to discharge the tunnel effluent to the permitted municipal sanitary/wastewater sewer system. Sectional valves and cleanouts shall be provided on the force mains between the Low Point Pump Station and the Portal Pump Station to allow for sections of the force main to be periodically drained and flushed of sediments.

6.7.12 Tunnel Drainage System Design Assumptions

The sources of inflow to a tunnel that will be considered are as follows:

- The quantity of water resulting from tunnel washing can vary in the range of 150 to 500 gpm depending on the maintenance equipment used.
- Water inflow from a fire-fighting event is determined from the fire design flow.
- In the case of a fuel spill, the pumps may be shut down so as to contain the spill within the pump station in order that it may be collected and legally disposed of as hazardous material.
- Normal amounts from structural seepage (< 1 gallon/minute/1,000 feet of tunnel) and rainwater carried in by vehicles. Storm flow that may breach portal cut-off trench drains will be determined by the total accumulation of water from a 50-year rain storm with ten minute duration onto a paved area equivalent to the width of each portal approach roadway over a distance extending from the cut-off trench drain to twenty-five feet from the portal.

6.7.13 Portal Drainage System Design Assumptions

The source of inflow to the tunnel portal drainage system is from a 100 year storm event over the roadway areas served by each portal drainage system.

6.8 Communications

6.8.1 Emergency Telephones

- An emergency telephone system shall be provided, with telephones located in Motorist Aid Cabinets throughout the tunnel.
- The emergency telephones shall be directly connected to the Operations Control Center and shall be designed so that an intelligible conversation can take place with background noise from traffic in the tunnel and the tunnel ventilation system.
- The telephone system shall be served by two separately located telephone controllers. Each controller shall serve alternate telephones so that every other phone will be operational if one controller becomes disabled.
- The Operations Control Center personnel shall be able to hold calls from, or call back to, any individual telephone on the system.

6.8.2 Radio Systems

- A re-broadcasting system shall be provided to maintain STARS radio coverage in the tunnel of all channels required by the First Responders.
- Provision shall be made for Highways Advisory Radio (HAR) messages to be broadcast within the tunnel.

6.8.3 Mobile Telephone Coverage

- Suitable space and UPS power supplies shall be provided to enable third party cell phone service providers to install their equipment and antennas to give full coverage of all mobile telephone networks available in the tunnel.

6.8.4 Intrusion Detection

- The perimeter of all areas around the tunnel portals, the Tunnel Support Buildings and the Operations Control Center shall be monitored to detect and alarm any unauthorized intrusion. An alarm shall be raised at the Operations Control Center through the SCADA Operations Control Center Interface with details of the location and time when an intruder is detected.
- Security lighting and a CCTV surveillance system shall be provided to give full coverage of these areas and to enable the movements of intruders to be viewed and tracked.
- Critical Infrastructure Information (CII) and Sensitive Security Information (SSI) designations for contract documents shall be considered, evaluated, and applied to this and other system documents as necessary.

6.8.5 Access Control

- An access control system shall be provided to cover designated entry points to restricted areas and buildings. The system shall be designed to permit only authorized vehicles and personnel to enter, and shall automatically log all movements in and out of the secure areas.
- Every designated entry point shall be provided with a telephone link to the Operations Control Center, accessible from both sides of the door or gate, to enable users to request assistance.
- The Operations Control Center personnel shall be provided with the means to override the control of individual entry points in abnormal circumstances, to allow free access by First Responders, maintenance and construction personnel.
- A means of locally unlocking and locking access gates and doors shall be provided for use in the event of system failure.

6.8.6 Surveillance Closed Circuit Television (CCTV)

A CCTV system shall be provided to allow surveillance coverage of the facility and all controlled access areas, as defined in Section “Intrusion Detection”.

6.9 Tunnel Flood Gate Basis of Design

6.9.1 Introduction and Purpose

This Section establishes the basis of design for the flood gate systems for the Norfolk portal of the New Midtown Tunnel. The purpose of the flood gates is to seal the tunnel and to prevent surge tides from entering.

6.9.2 Standards and References

The following codes standards and guidelines serve as the basis for the design of the flood gate systems:

- Crane Manufacturer's Association of America; CMAA-70 Specifications for top running bridge and gantry-type multiple girder electric overhead traveling cranes-No. 70
- American Association of State Highway and Transportation Officials; AASHTO LRFD Movable Highway Bridge Design Specifications, 2nd Edition, 2007.

6.9.3 Design Considerations

6.9.3.1 Flood Gate Arrangement

The gates shall be designed to withstand the conditions associated with a flood elevation of 13' (NAVD 88). The gates shall be designed to fully close and properly seal in rainy conditions with a maximum of 6 inches of flowing water beneath them. This flowing water condition is for the gate design and not the sizing of the drainage system.

The gates shall be designed to operate with local operator interfaces for normal operations. All associated components shall be interlocked to insure proper sequence of operation. A flood gate enclosure shall be positioned directly above each flood gate to enclose the operating system, allow normal maintenance, and to provide environmental protection.

The design of the flood gate systems shall consider: the gates, gate slots, gate enclosures, hoist systems, dogging devices, electric power & control systems, embedded and surface mounted parts, tunnel ceiling panels beneath the gates, and tunnel wall panels covering the gate slots.

6.9.3.2 Flood Gate Structures

The Portal Flood Gate structures will house the flood gates and hoisting equipment at the Norfolk portal. Provision shall be made for removal and replacement of the gates, through removable panels on the roof or by other means.

The mechanical and electrical systems will be designed to support the flood gate equipment included within the facilities.

The roof of the Flood Gate Structure shall be made accessible by means of a wall mounted ladder and hinged roof hatch from the interior of the structure. This ladder may also serve as access to a hoisting equipment catwalk.

6.9.4 Flood Gate System Design Assumptions

The design requirements indicated in this section shall apply to all flood gate systems:

- Fixed- axle wheels provided with self-lubricated bearings
- Negatively buoyant gates
- No stress increase shall be allowed for the maximum flood design condition
- Lowered under a balanced head condition, except as noted above
- Design loads shall be in accordance with AASHTO Movable Bridge and/or CMAA-70 Code
- Suitable concrete in the area of gate in contact with the roadway to ensure proper gate bearing and impact loads and finished to ensure a watertight seal
- Seal thickness and durometer to account for the maximum and minimum pressures at the bottom and top of the gates, respectively, with the bottom seal

accounting for the deteriorated roadway surface resulting from normal traffic even for slightly rainy conditions when there will not be an applied lateral water pressure against the gates
- Salt water marine environment accounted for in all material and component selections
- Gate leakage shall not exceed a rate of 0.1 gal/min/lin ft. of seal perimeter for maximum flood condition
- All hoist cables shall be in accordance with AASHTO movable bridge code or Department's approved alternative
- Electric hoist motors
- Hoist drum brakes capable of supporting total gate load
- Fleet angles shall not exceed 5 degrees
- Each gate system shall operate using a primary (from the utility grid) or secondary power source (from the diesel generators)
- Gate enclosures provide an enclosed area for operations and maintenance, including painting of the gates, and shall be sized accordingly. Major gate maintenance (i.e. due to significant fire damage) may require removal of the gates
- Guides shall be made of stainless steel
- Seals shall be natural rubber
- Gates shall be located behind fire rated ceiling panels.
- Gate controls shall be from a local panel in the Gate House, and shall be interlocked to prevent accidental operation.
- Gate machinery and controls shall be connected to the Emergency Generator system.

6.10 Not Used

7 Tunnel Support Buildings

7.1 Introduction

This section outlines the basis for design of the following buildings associated with the Midtown Tunnel project:

- Tunnel Support Buildings near each portal housing flood gate equipment, electrical switchgear, equipment, pump rooms, and stairs;
- Generator enclosure structure;
- Truck inspection booth located in the gore between the ramp from Hampton Boulevard and Claremont Street;

7.1.1 Codes, Standards, Guidelines and References

Tunnel support buildings will be designed in compliance with the codes, standards, references and guidelines listed in the Design Criteria document. In the case of a conflict between codes or other design criteria, the requirements of the more stringent criteria shall apply unless otherwise directed by VDOT.

7.1.2 Performance Requirements

Tunnel support buildings will be designed to provide a complete functional system that meets the following performance requirements:

- Provide functionality, durability, ease of maintenance, safety, and aesthetics
- Design for 50-year design-life of tunnel support buildings
- Design for a finished floor elevation at elevation 13' (NAVD 88) for Tunnel Support Buildings, Generator House, and Flood Gate Structures.

7.2 Architectural / Structural

Allowable height and area, and construction type of the buildings will be in conformance with the USBC (IBC 2006). Minimum IBC construction type will be Type II-B Non-combustible.

7.2.1 Truck Inspection Booth

The new Truck Inspection Booth building will be a small pre-fabricated structure located in the gore between the ramp from Hampton Boulevard and Claremont Street. The building will be designed to accommodate office space and storage needs for personnel performing inspections on trucks using the new tunnel facility.

7.2.2 Generator House

Electrical backup power generators will be covered and/or enclosed and secured by the new Generator House structure. A metal canopy structure is envisioned to keep the generators dry; whether the structure will also provide complete exterior wall enclosure will be determined during the schematic design phase of the project. The structure will accommodate the intake/exhaust requirements and security requirements of the generators and associated equipment.

7.2.3 Tunnel Support Buildings

Tunnel Support Buildings will be provided near each of the two tunnel portals. Each facility will be designed to house tunnel egress stairs, rooms for flood gate equipment (Norfolk side only), storm water pumps, communications systems, and rooms for electrical switchgear. No personnel spaces are intended to be included in the facilities. It is anticipated that the facilities will be located over the tunnel, near the portal. The functions of the Tunnel Support buildings may be spread over several buildings as required by site or operational constraints. The facilities will be the most visible vertical elements of the tunnel facility. Exterior materials and architecture of the facilities will be designed to complement and blend with the exposed portions of the tunnel and portals.

7.3 Mechanical Systems Design

This Section discusses the design of the mechanical systems for the Tunnel Support Buildings of the Project. Mechanical Systems include the heating, ventilating, air conditioning, plumbing, fire protection and drainage.

7.3.1 General

The design of the mechanical systems will be comply with the criteria specified in the Midtown Tunnel Design Criteria document. Mechanical systems will be designed in accordance with all applicable ASHRAE Standards, NEC Standards, NFPA Standards and the applicable codes of the Commonwealth of Virginia. Other standards included by reference are also applicable, and the most stringent requirement will govern where differences exist.

The design of the mechanical systems will place an emphasis on energy conservation and reduction of energy consumption.

7.3.2 Environmental Design Criteria

The following outdoor ambient design conditions will be used are based on the Climatic Design Information provided by the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Handbook Fundamentals, 2009, for climatic data recorded at the Norfolk International Airport. The data assumes 0.4% summer and 99.6% winter annual frequency occurrences.

- Summer design dry bulb temperature - 94°F
- Summer design wet bulb temperature - 74°F
- Winter design dry bulb temperature - 21°F

Summer season air conditioned spaces:

- Control Rooms - 72°F db 45% RH
- Electric Rooms - 104°F db 50% RH
- Battery Rooms - 88°F db 50% RH
- Equipment, storage and janitor rooms - 104 °F db
- Day and Conference Rooms - 78°F db 50%RH
- Corridors, toilet, locker rooms - 78°F db 50%RH

Summer season ventilated spaces:

- Vehicle Spaces – based on outdoor ambient conditions
- Pump stations - . based on outdoor ambient conditions
- Flood gate rooms - based on outdoor ambient conditions

Winter season:

- Control Rooms 70°F 45% RH
- Electric Rooms 55°F
- Battery Rooms 55°F
- Equipment, storage and janitor rooms - 55°F
- Day and Conference Rooms - 70°F
- Corridors, toilet, locker rooms - 78°F 50%RH
- Vehicle Spaces – 55°F
- Pump stations - . 55°F

- Flood gate rooms - 55°F

7.3.3 HVAC System Descriptions

7.3.3.1 Truck Inspection Booth

For the truck inspection booth in the gore between the ramp from Hampton Boulevard and Claremont Street air conditioning will be provided for enclosed occupied spaces and any x-ray or security equipment as necessary. If vehicle areas are enclosed ventilation and CO/NOX detection systems will be provided for such spaces.

7.3.3.2 Generator House

The Generator houses will not be conditioned. Cooling and heating for the generators will be provided as integral systems by the generator supplier. If remote fueling systems are required they will be included in the generator house design documents.

7.3.3.3 Tunnel Support Buildings

Enclosed spaces of the Tunnel Support Buildings at each tunnel portal will be ventilated and heated in conformance with the prevailing codes and criteria. Indoor design temperatures will take into account the heating and cooling requirements of the switchgear and equipment located in the enclosed spaces.

7.4 Structural Design

Tunnel Support Buildings will be designed according to the ASCE 7, Minimum Design Loads for Buildings and Other Structures. Categories of loading include dead load, live load, wind, snow and seismic. Design will take into account a long service life of the structures. The design loads calculated from the standard, ASCE 7, have 2% annual probability to be exceeded, or a 50-year recurrence.

DOWNTOWN TUNNEL/MIDTOWN TUNNEL/MLK EXTENSION PROJECT

The Technical Requirements

Comprehensive Agreement Exhibit C

Attachment 1C

Design Criteria MLK

TECHNICAL REQUIREMENTS
Exhibit C

Final Design Criteria for New MLK Extension

D 0101040604rev2

Submitted To:

SKW Constructors
809 S. Military Highway
Virginia Beach, VA 23464

October 21, 2011

Prepared By:
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Alexandria, VA 22312

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TUNNEL VISION
MIDTOWN | MLK | DOWNTOWN

Table of Contents

1 General

The purpose of the documentation provided herein is to establish Design Criteria for the New MLK Extension (MLK) component of the Project. Relevant codes and standards specific to the MLK are identified and presented for each discipline. The Design Criteria is submitted for formal review and approval by VDOT. The approved Design Criteria will be used to design the Project.

This Final Design Criteria document was issued as Revision 0. Any subsequent modifications to the Final Design Criteria will be submitted to VDOT for review and approval, and issued with the subsequent Revision Number.

Where Design Exceptions or Design Waivers are desired from the VDOT standards, policies, and IIMs current at the time of the Interim Agreement date, the Concessionaire will prepare formal Requests for Design Exceptions and formal Requests for Design Waivers. Any deviations between the design criteria and those standards, policies, and IIMs are the responsibility of the Concessionaire.

New traffic signals and the existing signals needing modifications will be designed in accordance with the City of Portsmouth signal design standards, criteria, or guidance. In the absence of local guidance, VDOT standards will be used. The signal design will meet the minimum MUTCD criteria. The signage will be designed in accordance with MUTCD standards, the Virginia Supplement to the MUTCD, and VDOT Road and Bridge Standards. Signage within the City of Portsmouth's jurisdiction will also adhere to the City's requirements above and beyond the VDOT and MUTCD requirements.

2 Not Used

3 Civil

3.1 Stormwater, Drainage, and Pump Stations

The Summary Tables on the following pages document stormwater design criteria for the New MLK Extension. The criteria noted will be used to design stormwater collection and conveyance systems, and stormwater retention facilities. Stormwater facilities will be designed using procedures outlined in the VDOT Drainage Manual, 2002 (Revised April 2010).

MARTIN LUTHER KING EXTENSION

Engineer: Robert Cade, PE
Consultant: Parsons Brinckerhoff

Drainage Design Criteria Summary

References: VDOT Drainage Manual, Virginia Stormwater Management Handbook, Virginia Erosion and Sediment Control Handbook

Drainage Design Storms and Allowances

Roadway	Classification	Minimum Design Speed	Travelway Inundation Exceedance Probability	Culverts		Open Channels				Storm Sewer Pipes		Storm Sewer Drop Inlets******							
						Roadside Ditches		Drainage Channels				Design Intensity (in/hr) *******				Maximum Spread Width (ft)			
				Design Storm (yr)		Design Storm (yr)		Design Storm (yr)		Design Storm (yr)		With Shoulder		Without Shoulder		With Shoulder		Without Shoulder	
				Capacity	Outlet Protection	Capacity	Lining	Capacity	Lining	Shoulder	No Shoulder	On Grade	Sag	On Grade	Sag	On Grade	Sag	On Grade	Sag
Route 58	Principal Arterial	50	2%	25	25	10	2	10	2	25	10	7.67	7.67	4 (6.5 check)	4 (6.5 check)	Shoulder Width +3	Shoulder Width +3	1/2 drive lane + gutter	1/2 drive lane + gutter
Interstate 264	Interstate	55	2%	50	50	10	2	10	2	25	25	7.67	7.67	7.67	9.55	Shoulder Width	Shoulder Width +3	1/2 drive lane + gutter	1/2 drive lane + gutter
MLK Extension	Principal Arterial	50	2%	25	25	10	2	10	2	25	10	7.67	7.67	4 (6.5 check)	4 (6.5 check)	Shoulder Width	Shoulder Width +3	1/2 drive lane + gutter	1/2 drive lane + gutter
Tunnel***	Principal Arterial	40	2%	25	25	10	2	10	2	25	10	7.67	9.55	4 (6.5 check)	4 (6.5 check)	Shoulder Width +3	Shoulder Width +3	1/2 drive lane + gutter	1/2 drive lane + gutter
Interchange Ramps	Ramps	Varies	2%	50	50	10	2	10	2	25	10	7.67	7.67	4 (6.5 check)	4 (6.5 check)	Shoulder Width +3	Shoulder Width +3	1/2 drive lane + gutter	1/2 drive lane + gutter
Local Streets	Local	20	10%	10	10	10	2	10	2	10	10	4 (6.5 check)	4 (6.5 check)	4 (6.5 check)	4 (6.5 check)	Shoulder Width +3	Shoulder Width +3	1/2 drive lane + gutter	1/2 drive lane + gutter

Outlet Protection

Velocity Range (fps)	Outlet Protection
0-6	EC-3 Type B
6-8	EC-1 Class AI
8-14	EC-1 Class I
14-19	EC-1 Class II
<19	Special Design

Ditch Linings

Velocity Range (fps)	Manning's 'n'	Type of Lining
0-3	0.03	Bare Earth
3-4	0.05	EC-2
4-7	0.05	EC-3 Type A
7-10	0.05	EC-3 Type B
>10	0.04-0.045	Riprap
>10	0.015	Concrete

24-hr Rainfall

Project Site****	
Year	Depth (in)
1	2.97
2	3.61
5	4.66
10	5.56
25	6.88
50	8.01
100	9.27

Rainfall Distribution

Modified Rational Method

Pump Station Capacities

When designing for stormwater conveying to a pump station, total volumes should be taken into account with respect to the design storm.

Tidal Elevations

(Adding 2' for Sea Level Increase)*****

Storm Year	Elevation	Datum
10 - Year	EL 7.50*	(NAVD 88)
50 - Year	EL 8.90*	(NAVD 88)
100 - Year	EL 9.60*	(NAVD 88)
500 - Year	EL 10.90*	(NAVD 88)
Ultimate Storm	EL 14.10**	(NAVD 88)

Tailwater Elevations

(VDOT DM APPENDIX 6I-1)
(Adding 2' for Sea Level Increase)*****
TW = EL 2.70 (NAVD 88)

* Flood Insurance Study, City of Norfolk, Virginia; Federal Emergency Management Agency (September 2009)
** Flood Plain Information, Coastal Flooding, Portsmouth, Virginia; US Army Corps of Engineers (February 1973)
*** The tunnel is defined as the tunnel itself as well as the portions of the roadway that drain in the direction of the tunnel portals.
**** NOAA Atlas 14, Project Co-ordinates: 36.825 N, 76.336 W
***** NOAA Sewells Point station long term trend 1927 to 2006 = 1.46'/century, rounded up to 2'
****** Inlets located in sags require double slot lengths and where inlet and storm drain is the only means of water escaping the inlets and pipe system shall be analyzed using the 50-year storm.
******* Intensities of "actual" include using a minimum Tc of 5 minutes per VDOT standard. This is a conservative number, but also a minimum per VDOT DM.

MARTIN LUTHER KING EXTENSION

Engineer: Robert Cade, PE
Consultant: Parsons Brinckerhoff

Drainage Design Criteria Summary (Continued)

References: VDOT Drainage Manual, Virginia Stormwater Management Handbook, Virginia Erosion and Sediment Control Handbook

City of Norfolk Rainfall Intensities (in/hr)

	Time of Concentration (minutes)								
Design Storm Year	5	10	15	20	25	30	40	50	60
2	5.85	4.67	3.91	3.38	2.98	2.67	2.23	1.92	1.69
5	6.80	5.50	4.65	4.05	3.60	3.25	2.73	2.37	2.10
10	7.67	6.17	5.23	4.57	4.08	3.70	3.14	2.75	2.46
25	8.71	7.05	6.01	5.29	4.75	4.33	3.71	3.28	2.95
50	9.55	7.65	6.52	5.75	5.18	4.74	4.10	3.65	3.32
100	10.08	8.07	6.88	6.08	5.50	5.05	4.39	3.92	3.57

Rational Method 'C' Values

Description of Area	Runoff Coefficients
Paved and Roofed Areas	0.9
Industrial/ Commercial	0.80-0.90
Apartments and Townhomes	0.65-0.75
Schools	0.50-0.60
Residential - lots up to 10000 SF	0.40-0.50
Residential - lots up to 12000 SF	0.40-0.45
Residential - lots up to 17000 SF	0.35-0.45
Residential - lots 1/2 acre or more	0.30-0.40
Parks, Cemeteries & Unimproved Areas	0.20-0.35
Cultivated Areas	0.50-0.70
Pasture	0.35-0.45
Lawns	0.25-0.35
Forest	0.20-0.30
Side Slopes	0.40-0.70
Unpaved Shoulder/Ditch Areas	0.35-0.50

Intensity Variables

Norfolk, Virginia			
i=b/((Tc+d)^e)			
Year	b	d	e
2	60.83	11.25	0.84
5	64.03	11.50	0.80
10	51.92	9.25	0.72
25	47.96	8.25	0.66
50	39.29	6.00	0.59
100	37.10	5.25	0.56

Correlation Factors

Storm Year	Cf1
25	1.10
50	1.20
100	1.25

1 - Cf x C must be less or equal to 1

Temporary Drainage

VDOT DM and VA E&S Manual shall be used in evaluation of temporary drainage situations

3.2 Road Design

The Summary Table on the following pages documents road design criteria for the New MLK Extension. The criteria noted will be used to establish roadway geometrics as part of road plan development. Road design will be accomplished using procedures outlined in the Basis of Design document.

DESIGN CRITERIA TABLE
DTT/MTT/MLK EXTENSION
VDOT PROJECT NUMBER 0058-965-107, P101
October 19, 2011

ROADWAY INVENTORY AND MINIMUM DESIGN CRITERIA

	I-264 Design Criteria	**RTE. 58/MLK EXTENSION** Design Criteria	**LOCAL STREETS**** Design Criteria	**RAMPS A, B, C, N, S & SE** Design Criteria	**OTHER RAMPS** Design Criteria
Roadway Classification (sub class)	Urban Principal Arterial (Freeway)	Urban Principal Arterial (Freeway)	Urban Local (Streets with Curb & Gutter)	Interchange Ramp	Interchange Ramp
Geometric Design Standard	GS-5	GS-5	GS-8	GS-R	GS-R
Terrain	Level	Level	N/A	N/A	N/A
Minimum Design Speed (mph)	55	50	20	25	35
Minimum Radius	964'	760'	U 127' or ULS 92'	171'	350'
Maximum Grade (%)	4	4	8	7	6
Minimum Grade (%)	0.5	0.5	0.5	0.5	0.5
Minimum Stopping Sight Distance	495'	425'	125'	155'	250'
Crest Minimum K	114	84	7	12	29
Sag Minimum K	115	96	17	26	49
Superelevation Standard (TC)	TC-5.01R	TC-5.01R	TC-5.01U or TC-5.04ULS	TC-5.01R	TC-5.01R
Minimum Lane Width	12'	12'	10'	12' (• 2 lanes) 16' (1 lane, R>250') 18' (1 lane, R•250')	12' (• 2 lanes) 16' (1 lane)
Minimum Number of Lanes	3 Each Direction	2 Each Direction	2	1	1
Left Shoulder (paved width)	N/A	6'*	N/A	3' (Sum of lt. & rt. Shldr. 10' min.)	3' (Sum of lt. & rt. Shldr. 10' min.)
Left Shoulder (Total width- no GR)	N/A	6'*	N/A	6'	6'

Left Shoulder (Total width – w/ GR)	N/A		N/A		N/A		9'		9'
	I-264		**RTE. 58/MLK EXTENSION**		**LOCAL STREETS****		**RAMPS A, B, C, N, S & SE**		**OTHER RAMPS**
Right Shoulder (paved width)	12'		10'		N/A		6' (Sum of lt. & rt. Shldr. 10' min.)		6' (Sum of lt. & rt. Shldr. 10' min.)
Right Shoulder (Total width- no GR)	14'		12'		N/A		8'		8'
Right Shoulder (Total width – w/ GR)	17'		15'		N/A		11'		11'
Type of Curb	N/A		N/A		CG-6		N/A		N/A
Buffer Strip Width	N/A		N/A		4'		N/A		N/A
Minimum Sidewalk Width	N/A		N/A		5'		N/A		N/A
Minimum Width Behind Sidewalk	N/A		N/A		1' Without Railing, 2' With Railing		N/A		N/A
Slope Standard	CS-4 or CS-4B		CS-4 or CS-4E		2:1		2:1		2:1
Minimum Clear Zone from Edge of Traveled Lane	Foreslopes: 22' Backslopes: 16'		Foreslopes: 20' Backslopes: 14'		10'		10'		10'
Minimum Horizontal Clearance, CL of RR Track to Face of Pier	18'		18'		N/A		N/A		18'
Minimum Vertical Clearance	Under: 16' - 6" Over RR: 23' Over Arterials: 16'-6" Over Locals: 14'-6"		Under: 16' - 6" Over RR: 23' Over Arterials: 16'-6" Over Locals: 14'-6"		Under: 14' - 6"		Over Locals: 14'-6"		Over RR: 23' Over Arterials: 16'-6" Over Locals: 14'-6"
ADT Existing (2010)	68000		0		3000-5000		0-5500		0-5000
ADT Projected (2032)	96500		19100		6000-8000		1900-6500		1000-6000
Truck Percentage	6%		6%		1-3%		2-3%		2-3%
Design Hourly Volume, DHV	6542		1557		600		116-503		100-500
Directional Split	56%		64%		60%		N/A		N/A

NOTES:
*-6' SHOULDER IS USED SINCE MLK EXTENSION IS MOSTLY ON STRUCTURE
**-CASSELL AVENUE, COLUMBUS AVENUE, COUNTY STREET, KING STREET, MACARTHUR AVENUE, TREXLER AVENUE

4 Geotechnical

4.1 MLK Extension:

The proposed subsurface investigation for the New MLK Extension during the Interim Agreement phase will consist of about 70 soil borings, 8 cone penetrometer soundings (CPTs) and 7 dilatometer soundings (DMTs). Twelve previous borings drilled by Marshall Miller & Associates under subcontract to VDOT for environmental purposes in 2010 will also be used in the Interim Agreement evaluation. During the Term, additional borings will be performed in order to reduce uncertainty and risk for the construction and to gather additional information needed for final design that was not collected during the Interim Agreement phase.

4.1.1 Soil Borings (VDOT MOI, Chapter 3)

Sufficient borings will be performed to classify the subsurface conditions and evaluate the engineering properties of the respective soil strata. The borings will be performed utilizing hollow-stem auger or mud rotary drilling techniques with casing expected to extend through the fill materials, soft alluvial materials, and wherever necessary for the soil boring to be stable during drilling operations. Undisturbed samples will be recovered in soft soil deposits for subsequent strength and compressibility testing. Split spoon samples with Standard Penetration Testing will generally be obtained continuously from the existing ground surface to 10 feet below the existing ground surface and at 5-ft intervals thereafter.

All boreholes left open while unattended by the drill crews shall be clearly marked and barricaded or otherwise secured to avoid possible injury or damage to the public. All boreholes shall be adequately backfilled to avoid settlement. Borings in contaminated areas, paved areas such as pavements or sidewalks, or other areas likely to be traversed by the public shall be backfilled with grout.

Data from the investigation will be presented on Standard VDOT soil boring logs. Soil classifications will be in general conformance with ASTM D 2487. The soil borings will be logged full-time by a geotechnical engineer or geologist.

4.1.2 In-Situ Testing (VDOT MOI, Chapter 3)

CPTs and DMTs will be utilized to supplement the borings and soil laboratory testing performed and to properly classify the subsurface conditions and determine the engineering properties of the respective strata. The soundings will be pre-augered through any fill materials where obstructions are encountered or will be offset a short distance and re-sounded. In particular, the CPT and DMT soundings will be used to evaluate shear strength parameters for soils that are difficult to sample and test in the laboratory such as saturated sand and silt. The results of the DMT soundings will also

be used to estimate the over consolidation ratio for clay soils along with shear strength and constrained modulus.

4.1.3 Materials Laboratory Testing (VDOT MOI, Chapter 3)

Pertinent laboratory tests will be performed to assist in the classification of the soils encountered and to provide data as to the engineering properties of the respective soils. Laboratory testing will be performed in general accordance with pertinent VTM, ASTM or AASHTO specifications. Soil and materials tests will be performed by Schnabel's laboratory which is accredited by the AASHTO Accreditation Programs (AMRL and CCRL) for each test conducted for the Project, unless otherwise approved by VDOT.

4.1.4 Testing and Disposal of Contaminated Cuttings

There are no known areas of contamination at the site of the New MLK Extension in areas outside the limits where previous environmental studies have been completed. We plan to monitor the drilling process for potential environmental concerns and will screen the boreholes and samples for volatile organic vapors as needed. We will make recommendations for testing and disposal of contaminated cuttings if needed. These recommendations will be according to appropriate VDEQ requirements.

5 Not Used

6 Not Used

7 Not Used

8 Not Used

9 MLK Structures

MLK Bridges – Main Line and Ramps

All new bridges and bridge replacements shall be designed in accordance with the latest editions of AASHTO Standard Specifications with Interims and VDOT Modifications, VDOT Specifications and VDOT Structures Design Manual.

9.1 Minimum Design Criteria

A. American Association of State Highway and Transportation Officials (AASHTO), "LRFD Bridge Design Specifications", 4th Edition, 2007 with 2008, 2009 Interims and VDOT Modifications (IIM-S&B-80.2).

B. Virginia Department of Transportation (VDOT), “Road and Bridge Specifications”, 2007.

C. Virginia Department of Transportation (VDOT), “Structures Design Manual (Design Aids and Typical Details Volume V, Part 2)”, Current Edition.

D. American Association of State Highway and Transportation Officials and American Welding Society (AASHTO/AWS), D1.5M/D1.5, 2008 “Bridge Welding Code” with 2009 Interims.

E. All cast-in-place concrete median barriers, parapets and barrier walls shall be designed in accordance with AASHTO LRFD, VDOT Modifications and in accordance with the Manual of Structure and Bridge Vol-V-Part 3 and all requirements set forth in National Cooperative Highway Research Program Report No. 350.

F. Mechanically Stabilized Earth Walls (MSE) shall be designed to satisfy the requirements of Article 11.10.2.2 of AASHTO LRFD.

9.2 Modifications to Existing Bridges

Modifications to existing bridges shall be evaluated for their impacts on the live load carrying capacity. Modifications to an existing bridge shall not result in the bridge requiring a posting for live load.

A. If the current live load carrying capacity is above HL93, then the live load carrying capacity of the bridge after modifications shall be equal to or greater than HL93.

B. If the current live load carrying capacity is less than HL93, then the live load carrying capacity of the bridge after modifications shall not be less than the live load carrying capacity of the existing bridge.

9.3 Design Details

A. Steel structures shall be detailed in accordance with VDOT Structure and Bridge Division IIM-80.2 and AASHTO/NSBA Steel Bridge Collaboration, Guidelines for Design Details.

B. For concrete girders used on a curved alignment, the girders will be placed on a chord between substructure units. The minimum deck overhang width from edge of deck to edge of top flange will be maintained at a minimum of 6 inches. The maximum deck overhang width from centerline of girder to edge of deck will not exceed 0.3 x interior girder spacing. The deck and overhang will be designed using the Strip Method.

9.4 Materials

A. Structural Steel shall be ASTM A709 Grade 50W. The use of weathering steel shall be in compliance with FHWA Technical Advisory T5140.22. HPS 50W, 70W &100/100W shall not be used without approval. Steel in bearings and sole plates may be Grade 36.

B. Low permeability concrete shall be used for the entire length of structure. Testing requirements may be waived if the structure is not subject to freeze/thaw cycles. Strength of concrete, design details and concrete cover will be in accordance with IIM-S&B-80.2.

C. Foundations will use prestressed concrete piles. Design details will be in accordance with IIM-S&B-80.2.

DOWNTOWN TUNNEL/MIDTOWN TUNNEL/MLK EXTENSION PROJECT

The Technical Requirements

Comprehensive Agreement Exhibit C

Attachment 1D

Design Criteria Midtown Tunnel

TECHNICAL REQUIREMENTS
Exhibit C

Final Design Criteria for New Midtown Tunnel

D 0101040603rev3

Submitted To:

SKW Constructors
809 S. Military Highway
Virginia Beach, VA 23464

October 21, 2011

Prepared By:

PB Americas, Inc.
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TUNNEL VISION
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Table of Contents

1 General

The purpose of the documentation provided herein is to establish Design Criteria for the New Midtown Tunnel (MTT2) component of the Project. Relevant codes and standards specific to the MTT2 are identified and presented for each discipline. Unless noted otherwise, the version of all codes and standards in effect on January 7, 2010 and cited in these Criteria would apply.

The Final Design Criteria is issued as Revision 0. Any subsequent modifications to the Final Design Criteria will be submitted to VDOT for review and approval, and issued with the subsequent Revision Number.

Where Design Exceptions or Design Waivers from the current approved criteria are desired, the Consultant will prepare formal Request for Design Exceptions and formal Request for Design Waivers. Such will be submitted formally to VDOT for review and approval.

Efforts have been made to conform this Design Criteria to the rest of the Technical Requirements. In the event that a conflict still exists, the Design Criteria shall be the governing document for the design.

2 Environmental - Not Used

3 Civil

3.1 Stormwater, Drainage, and Pump Stations

Summary Tables 3.1.1 through 3.1.9 documents stormwater design criteria for the MTT2 Component of the Project. The criteria noted will be used to design stormwater collection & conveyance systems, stormwater retention facilities, and stormwater pump stations. Stormwater facilities shall be designed using procedures outlined in the VDOT Drainage Manual, 2002, (Revised April 2010).

3.2 Survey

The Surveys shall be in accordance with the VDOT Survey Manual, reference documents and guidelines.

3.3 Road Design

Table 3.3.1 on the following page documents road design criteria for the MTT2 component of the Project. The criteria noted shall be used to establish roadway geometrics as part of road plan development. Road design shall be designed using procedures outlined in the VDOT Road Design Manual, 2005, with current revision.

The following is a list of references used in developing the Project roadway design criteria:

- VDOT Road Design Manual, Volumes 1 and 2, (Copyright 2005)
- AASHTO – A Policy on Geometric Design of Highways and Streets (2004)
- AASHTO – Roadside Design Guide (2006)
- VDOT Road and Bridge Specifications (2007), including the Revisions to the Road and Bridge Specifications
- VDOT Road and Bridge Standards (2008), including all revisions as of October 2009
- Virginia Storm Water Management Handbook (First Edition, 1999 Vols. 1 & 2)
- Virginia Erosion and Sediment Control Regulations (1998)
- VDOT Instructional & Informational Memorandum (I&IM)
- VDOT Policy for Integrating Bicycle and Pedestrian Accommodations
- VDOT Drainage Manual (2002), Revised April 2010
- FHWA Technical Manual for Design and Construction of Road Design – Civil Elements, Draft 2010
- VDOT Work Area Protection Manual
- AASHTO Traffic Engineering Design Manual
- FHWA Transportation Highway Capacity Manual
- Manual on Uniform Traffic Control Devices
- AASHTO Guide for Roadway Lighting
- IESNA RP-19-01

MIDTOWN TUNNEL

Engineer: Robert Cade, PE

Consultant: Parsons Brinckerhoff

Drainage Design Criteria Summary – Table 3.1.1 (see Notes after Table 3.1.2)

References: VDOT Drainage Manual, Virginia Stormwater Management Handbook, Virginia Erosion and Sediment Control Handbook

Roadway	Classification	Minimum Design Speed	Travelway Inundation Exceedence Probability	Culverts		Open Channels				Storm Sewer Pipes		Storm Sewer Drop Inlets							
						Roadside Ditches		Drainage Channels				Design Intensity (in/hr) *******				Maximum Spread Width (ft)			
				Design Storm (yr)		Design Storm (yr)		Design Storm (yr)		Design Storm (yr)		With Shoulder		Without Shoulder		With Shoulder		Without Shoulder	
				Capacity	Scour	Capacity	Lining	Capacity	Lining	Shoulder	No Shlder	On Grade	Sag	On Grade	Sag	On Grade	Sag	On Grade	Sag
Route 58	Principal Arterial	50	2%	25	25	10	2	10	2	25	10	7.67	7.67	4 (6.5 check)	9.55	Shoulder Width +3	Shoulder Width +3	1/2 drive lane + gutter	1/2 drive lane + gutter
Interstate 264	Interstate	55	2%	50	50	10	2	10	2	25	25	7.67	7.67	7.67	9.55	Shoulder Width	Shoulder Width +3	1/2 drive lane + gutter	1/2 drive lane + gutter
MLK Freeway	Principal Arterial	50	2%	25	25	10	2	10	2	25	10	7.67	7.67	4 (6.5 check)	9.55	Shoulder Width	Shoulder Width +3	1/2 drive lane + gutter	1/2 drive lane + gutter
Tunnel***	Principal Arterial	40	2%	25	25	10	2	10	2	25	10	7.67	9.55	4 (6.5 check)	7.67	Shoulder Width +3	Shoulder Width +3	1/2 drive lane + gutter	1/2 drive lane + gutter
Interchange Ramps	Ramps	Varies	2%	50	50	10	2	10	2	25	10	7.67	7.67	4 (6.5 check)	4 (6.5 check)	Shoulder Width +3	Shoulder Width +3	1/2 drive lane + gutter	1/2 drive lane + gutter
Local Streets & Minor Arterials	Local	20	10%	10	10	10	2	10	2	10	10	4 (6.5 check)	4 (6.5 check)	4 (6.5 check)	4 (6.5 check)	Shoulder Width +3	Shoulder Width +3	1/2 drive lane + gutter	1/2 drive lane + gutter

Table 3.1.2 Outlet Protection

Velocity Range (fps)	Outlet Protection
0-6	EC-3 Type B
6-8	EC-1 Class AI
8-14	EC-1 Class I
14-19	EC-1 Class II
<19	Special Design

Table 3.1.3 Ditch Linings

Velocity Range (fps)	Manning's 'n'	Type of Lining
0-3	0.03	Bare Earth
3-4	0.05	EC-2
4-7	0.05	EC-3 Type A
7-10	0.05	EC-3 Type B
>10	0.04-0.045	Riprap
>10	0.015	Concrete

Table 3.1.4 24-hr Rainfall

Project****	
Year	Depth (in)
1	2.97
2	3.61
5	4.66
10	5.56
25	6.88
50	8.01
100	9.27

Table 3.1.5 Tidal Elevations

Rainfall Distribution (Adding 2' for sea level increase)*****

Modified Rational Method	10 - Year	EL 7.50*	(NAVD 88)
	50 - Year	EL 8.90*	(NAVD 88)
	100 - Year	EL 9.60*	(NAVD 88)
	500 - Year	EL 10.90*	(NAVD 88)
	Ultimate Storm	EL 14.10**	(NAVD 88)

Pump Station Capacities

When designing for stormwater conveying to a pump station, total volumes should be taken into account with respect to the design storm.

Tailwater Elevations

(VDOT DM APPENDIX 6I-1)

(Adding 2' for sea level change)

TW = EL 2.70 (NAVD 88)

* Flood Insurance Study, City of Norfolk, Virginia; Federal Emergency Management Agency (September 2009)
** Flood Plain Information, Coastal Flooding, Portsmouth, Virginia; US Army Corps of Engineers (February 1973)
*** The tunnel is defined as the tunnel itself as well as the portions of the roadway that drain in the direction of the tunnel portals.
**** NOAA Atlas 14, Project Co-ordinates: 36.825 N, 76.336 W

***** NOAA Sewells Point station long term trend 1927 to 2006 = 1.46'/century, rounded up to 2'

****** Inlets located in sags require double slot lengths and where inlet and storm drain is the only means of water escaping the roadway shall be analyzed using the 50-year storm.

******* Intensities of "actual" include using a minimum Tc of 5 minutes per VDOT Standard. This is a conservative number, but also a minimum per VDOT DM.

Table 3.1.6
City of Norfolk Rainfall Intensities (in/hr)

Time of Concentration (minutes)									
Design Storm (yr)	5	10	15	20	25	30	40	50	60
2	5.85	4.67	3.91	3.38	2.98	2.67	2.23	1.92	1.69
5	6.80	5.50	4.65	4.05	3.60	3.25	2.73	2.37	2.10
10	7.67	6.17	5.23	4.57	4.08	3.70	3.14	2.75	2.46
25	8.71	7.05	6.01	5.29	4.75	4.33	3.71	3.28	2.95
50	9.55	7.65	6.52	5.75	5.18	4.74	4.10	3.65	3.32
100	10.08	8.07	6.88	6.08	5.50	5.05	4.39	3.92	3.57

Table 3.1.7
Rational Method 'C' Values

Paved and Roofed Areas	0.9
Industrial/ Commercial	0.80-0.90
Apartments and Townhomes	0.65-0.75
Schools	0.50-0.60
Residential - lots up to 10000 SF	0.40-0.50
Residential - lots up to 12000 SF	0.40-0.45
Residential - lots up to 17000 SF	0.35-0.45
Residential - lots 1/2 acre or more	0.30-0.40
Parks, Cemeteries & Unimproved Areas	0.20-0.35
Cultivated Areas	0.50-0.70
Pasture	0.35-0.45
Lawns	0.25-0.35
Forest	0.20-0.30
Side Slopes	0.40-0.70
Unpaved Shoulder/Ditch Areas	0.35-0.50

Table 3.1.8
Intensity Variables

Norfolk			
i=b/((Tc+d)^e)			
Year	b	d	e
2	60.83	11.25	0.84
5	64.03	11.50	0.80
10	51.92	9.25	0.72
25	47.96	8.25	0.66
50	39.29	6.00	0.59
100	37.10	5.25	0.56

Table 3.1.9
Corr. Factors

Storm	C_{f*}
25 - Year	1.10
50 - Year	1.20
100 - Year	1.25

* Cf x c must be less than or equal to 1

DESIGN CRITERIA TABLE

DTT/MTT/MLK EXTENSION

VDOT PROJECT NUMBER 0058-965-107, P10

June 1, 2011

ROADWAY INVENTORY AND MINIMUM DESIGN CRITERIA

	RTE. 58/MTT APPROACHES	**RTE. 58/MTT APPROACHES**	**RTE. 58/MTT TUNNEL**	**RAMP N**	**RAMPS B&P**
	Design Criteria	Design Criteria	Design Criteria	Design Criteria	
	(see note 3)	(see note 3)	(see note 3)		
Roadway Classification (sub class)	Urban Principal Arterial (with Shoulder)	Urban Principal Arterial (with Curb and Gutter)	Urban Principal Arterial (with Shoulder)	Interchange Ramp	Interchange Ramp
Geometric Design Standard	GS-5	GS-5	GS-5	GS-R	GS-R
Terrain	Rolling	Rolling	Rolling	Rolling	Rolling
Minimum Design Speed (mph)	40	40	40	30	20
Minimum Radius	563’	563’	563’	251’	108’
Maximum Grade (%)	8	8	6	7	7
Minimum Grade (%)	0.5	0.5	0.5	0.5	0.5
Minimum Stopping Sight Distance	305’	305’	305’	200’	125’
Crest Minimum K	44	44	44	19	7
Sag Minimum K	64	64	35 (see note 4)	37	17
Superelevation Standard (TC)	TC-5.04ULS	TC-5.04ULS	Constant 1 %	TC-5.01R	TC-5.01R
Minimum Lane Width	12’	12’	12’	16’	18’
Minimum Number of Lanes	2 Each Direction	2 Each Direction	2 Each Direction	1	1
Left Shoulder (paved width)	4’	N/A	2’	4’	3’
Left Shoulder (Total width- no GR)	10’ (see note 2)	N/A	2’	6’	6’
Left Shoulder (Total width - w/ GR)	13’ (see note 2)	N/A	2’	9’	9’

Right Shoulder (paved width)	8’		N/A		2’	8’	7’
Right Shoulder (Total width- no GR)	10’		N/A		2’	11’	11’
Right Shoulder (Total width – w/ GR)	13’		N/A		2’	11’	11’
Buffer Strip Width	N/A		4’		N/A	N/A	N/A
Minimum Sidewalk Width	N/A		5’		N/A	N/A	N/A
Minimum Width Behind Sidewalk	N/A		1’		N/A	N/A	N/A
Slope Standard	CS-3 or CS-3B		2:1		N/A	CS-3 or CS-3B	CS-3 or CS-3B
Minimum Clear Zone from Edge of Traveled Lane	10’		8’		N/A	7’	7’
Minimum Horizontal Clearance, CL of RR Track to Face of Pier	N/A		N/A		N/A	N/A	N/A
Minimum Vertical Clearance	16' - 6"		16' - 6"		16’-6”	N/A	N/A
ADT Existing (2010)	(see note 1)		(see note 1)		(see note 1)	(see note 1)	(see note 1)
ADT Projected (2035)	(see note 1)		(see note 1)		(see note 1)	(see note 1)	(see note 1)
Truck Percentage	(see note 1)		(see note 1)		(see note 1)	(see note 1)	(see note 1)
Design Hourly Volume, DHV	(see note 1)		(see note 1)		(see note 1)	(see note 1)	(see note 1)
Directional Split	(see note 1)		(see note 1)		(see note 1)	(see note 1)	(see note 1)

NOTES:

1 – Traffic volumes to be provided at completion of Traffic Study (Phase 2 Deliverable)
2 – 8 foot paved and 11 foot graded shoulders in graded median locations
3 – Roadway Typical Section to transition at tunnel portal locations
4 – Sag K value is based on driver comfort value (AASHTO p.274), not headlight sight distance as the tunnel is always lit.

4 Geotechnical

Applicable Codes and Standards:

- AASHTO LRFD Bridge Design Specifications, 4th Edition, 2007; 2008 and 2009 Interim Specifications; and VDOT Modifications (VDOT IIM-S&B-80)
- FHWA Manual For the Design & Construction of Road Tunnels
- FHWA-NHI-10-016 Drilled Shafts – Construction Procedures and LRFD Design Methods, May 2010
- FHWA Geotechnical Engineering Circular No. 2 - Earth Retaining Systems, FHWA-SA-96-038, 1996
- FHWA Geotechnical Engineering Circular No. 4 - Ground Anchors and Anchored Systems, FHWA-IF-99-015, 1999
- FHWA Geotechnical Engineering Circular No. 5, Evaluation of Soil and Rock Properties dated April 2002
- FHWA Geotechnical Engineering Circular No. 7 - Soil Nail Walls, FHWA-IF-03-017, 2003
- FHWA Permanent Ground Anchors, Volume 1, Final Report, FHWA-DP-90-068, 1991
- FHWA Permanent Ground Anchors, Volume 2, Field Demonstration Project Summaries, FHWA-DP-90-068, 1991
- FHWA Manual for Design & Construction of Soil Nail Walls, FHWA-SA-96-069R, 1999
- FHWA Soil Nailing Field Inspectors Manual-Soil Nail Walls, FHWA-SA-93-068, 1993
- FHWA The Osterberg Cell for Load Testing Drilled Shafts And Driven Piles, FHWA-SA-94-035, 1994
- ASSHTO (1988) Manual on Subsurface Investigation
- Load and Resistance Factor Design (LRFD) For Highway Bridge Superstructures (April 2007), FHWA-NHI-08-048
- Load and Resistance Factor Design (LRFD) for Highway Bridge Substructures (April 2007), FHWA-NHI-08-036
- Load and Resistance Factor Design (LRFD) For Highway Bridge Superstructures (April 2007) Examples, FHWA-NHI-08-049
- LFRD for Highway Bridge Substructures and Earth Retaining Structures (Jan 2007), FHWA-NHI-05-095
- Ground Improvements Reference Manual Volume I, FHWA-NHI-06-019
- Ground Improvements Reference Manual Volume II, FHWA-NHI-06-020
- Earth Retaining Structures (RM), FHWA-NHI-07-071
- Micropile Design and Construction Reference Manual (December 2005), FHWA-NHI-05-039
- Design and Construction of Mechanically Stabilized Earth Walls andReinforced Soil Slopes, FHWA-NHI-10-024 (Volume 1) and 10-025 (Volume 2), November, 2009
- NAVFAC DM 7.1
- NAVFAC DM 7.2

4.1 Explorations and Field Investigations

Appropriate geotechnical data will be collected for the evaluation of all proposed and existing tunnels and non-tunnel structures, dredging, permanent and temporary shoring, embankments, soil cuts, culverts, bridge and retaining wall structures, noise walls, storm water management facilities, minor structures including drainage pipes, pavement structures and any other earth-supported structures or elements of highway and tunnel design and construction.

All records of subsurface explorations will be provided to VDOT in general accordance with the requirements outlined in Chapter 3 of VDOT's Manual of Instructions for Materials Division, Section 700.04(c) of the 2007 Road and Bridge Specifications, and the current AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 4th Edition 2007 and the Department modifications. Electronic copies of all subsurface explorations will be provided to VDOT in accordance with the VDOTs standard boring log template. The electronic files shall be provided by a certified Professional Geologist or a suitably qualified registered Professional Engineer in the Commonwealth of Virginia, in gINT© software.

The proposed investigation for the New Midtown Tunnel during the Interim Agreement phase will consist of approximately 25 Cone Penetrometer Tests (CPT), 24 soil borings, 2 Dilatometer Tests (DT) and 2 Piezometers. This investigation will supplement previous investigations performed for the referenced project by VDOT in 2008, by Fugro under subcontract to VDOT in 2008, by Marshall Miller & Associates under subcontract to VDOT in 2008, and by various entities in the 1950's and 1960's for the design and construction of the first Midtown Tunnel. During the Term, additional borings may be performed, if deemed necessary by the Engineer of Record (EOR), in order to reduce uncertainty and risk for the construction or to gather additional information needed for final design that was not collected during the IA phase.

4.1.1 Soil Borings

Sufficient borings shall be performed to properly classify the subsurface conditions and determine the engineering properties of the respective strata. The borings will be performed utilizing mud rotary drilling techniques with casing expected to extend through the fill materials, soft alluvial materials, and wherever necessary for the soil boring to be stable during drilling operations. Undisturbed samples will be recovered in soft soil deposits for subsequent strength and compressibility testing. Split spoon samples with Standard Penetration Testing will generally be obtained continuously from the existing ground surface to 12 feet below the existing ground surface and at 5-ft intervals thereafter for land borings, and at 5-ft increments throughout for the marine borings. Depending on the water depth, the marine borings will be performed from a jack-up barge or from a spud barge.

All boreholes left open while unattended by the drill crews will be clearly marked and barricaded or otherwise secured to avoid possible injury or damage to the public. All boreholes will be adequately backfilled to avoid settlement. Borings in contaminated areas, paved areas such as pavements or sidewalks, or other areas likely to be traversed by the public shall be backfilled with grout.

Data from the investigation will be presented on Standard VDOT soil boring logs. Soil classifications will be in general conformance with ASTM D 2487, USCS symbology and Burmister narrative descriptions. The soil borings will be logged and supervised full-time by a geotechnical engineer or geologist.

4.1.2 Cone Penetration Testing

CPTs will be utilized to supplement the borings performed and to properly classify the subsurface conditions and determine the engineering properties of the respective strata.

The land soundings will be pre-augered through any fill materials where obstructions are likely to be encountered. The marine soundings will be advanced through a drill casing installed from the barge to below the mudline so that the CPT rods are supported to prevent buckling of the rods.

4.1.3 Laboratory Testing

Pertinent laboratory tests will be performed to assist in the classification of the soils encountered and to provide data as to the engineering properties of the respective soils. Laboratory testing will be performed in general accordance with relevant ASTM or AASHTO standards. Soils and materials tests will be performed by a laboratory accredited the AASHTO Accreditation Programs (AMRL and CCRL) for each test conducted for the Project, unless otherwise approved by VDOT. It is expected that strength and compressibility testing will be performed, as well as various index tests to aid in the classification of soils and determining soil parameters for design. In addition, chemical tests will be performed to evaluate the various soils' propensity for corrosion, resistivity, sulfate attack and chloride attack, among other reasons, where applicable.

4.2 Geotechnical Engineering and Report

4.2.1. Excavation/Trenching Stability/Slopes

Cut and fill slopes for the tunnel will be analyzed based on soil strength parameters derived from the field and laboratory testing. All cut and fill slopes will be designed to be stable for the interim construction stages, for the end-of-construction condition, and for design-life conditions.

The following factors of safety in Table 4.2.1 are to be used with limit equilibrium methods of analysis to identify factors of safety for representative sections of all soil cut and soil embankment fill slope areas higher than 10 feet, and/or where slopes are supporting on, or are supported by, retaining structures.

Table 4.2.1 - Minimum Factors of Safety for Soil Cut/Fill Slopes

Soil Slope analysis parameters based on:	Factor of Safety	
	Involves Structure or Critical Slope[1]	Non-Critical Slope
In-situ or lab. tests and measurements[2,3]	1.5	1.3
No site specific tests	N/A[3]	1.5

1. A critical slope is defined as any slope that is greater than 25' in height, affects or supports a structure, or whose failure would result in significant cost for repair, or damage to, private property
2. Site specific in-situ tests include both groundwater measurements and SPT testing but may also include CPT or DMT
3. Parameters for critical slopes involving structures must be based on specific laboratory testing and/or in-situ soil testing
4. Problem soils (very soft and/or loose soils or heavily over-consolidated soils), shall be analyzed using shear strength parameters determined from appropriate laboratory strength tests or appropriate in-situ testing.
5. Minimum requirements for soil types consistent with the parameters used in slope analyses shall be specified on the Design/Construction Documents.

4.2.2 Settlements and Bearing Capacity

Settlements of the proposed structures or of any existing structures impacted by the proposed construction will be evaluated and will consider, at a minimum, the elastic settlement, the consolidation settlement and the secondary settlement. The total settlement and the differential settlements of structures and surrounding ground will be analyzed. Settlement of the tunnel elements will be evaluated individually and will account for the three-dimensional loading effects imparted by the tunnel elements during construction and for various in-service conditions. Unload and reload of the soils will be evaluated based on laboratory testing and historical data/experience of this type of construction in these type of soils. It is expected that a combination of finite element modeling and conventional elastic theory/consolidation analyses will be performed to evaluate the tunnel settlements. The required bearing capacity and settlements will be evaluated such that the structure can be designed to accommodate the anticipated settlement.

4.2.3 Impact on Existing Facilities

The proposed construction will be designed such that the affect to any existing structure will be minimized and so that the future performance of any said structure will not be compromised. In any case in which this is not possible, such as in the case of the 30-inch force main that is proposed to be relocated, the structure will be protected, altered or relocated such that the same performance requirements will be equal to its original condition.

4.2.4 Foundation Soil Treatment

Ground improvement will be utilized where applicable for reasons such as limiting settlement or lateral movement, as a groundwater cutoff, or to increase the strength of the soil if necessary. It may be utilized where it provides technical and economic advantages for the project.

4.2.5 Fill

Locking fill, standard fill and structural fill will be used in various aspects of the project. This fill will be engineered, if necessary, such that it will provide the requisite engineering parameters for the design and construction of the proposed structures.

4.2.6 Support of Excavation

Support of excavation will be utilized where applicable to provide a safe workplace for the construction of the proposed structures and to protect the existing structures. They will be designed to withstand the pertinent soil, water and surcharge pressures and will take into account the movement of existing structures.

4.2.7 Earth Pressure

Earth pressures for the proposed and existing structures will be developed based on actual site-specific soil conditions encountered.

4.2.8 Groundwater

The cut-and-cover and boat sections of the proposed tunnel will be dewatered during construction by methods that will not adversely impact the surrounding groundwater regime. Such methods may include the use of impermeable excavations in which deep well points outside of the tunnel that adversely impact the groundwater quality or elevation are not necessary. Adjacent structures will be considered in the design of any construction activities which cause an alteration of the groundwater.

Provisions shall be made to prevent the flow of groundwater / river water through the backfill materials along the tunnel and into the approach areas, taking into consideration any increase in hydraulic connectivity which may result from temporary or permanent works. [TR 1.5.2.H]

4.2.9 Soil-Structure Interaction

Soil-structure interaction will be accounted for in the design of the tunnel section as well as the effect of the proposed construction on the existing tunnel. Computer programs which utilize finite element or finite difference algorithms will be utilized to “model” critical construction stage and elements.

5 Tunnel Structural

The Design Criteria form the design requirements that are fundamental to the design and which are relatively fixed. It is intended to be a working document that will be revised if necessary. It is anticipated that it will at least be updated prior to Final Design. Changes to the content herein will require approval by SKW Constructors (SKW) and ultimately will require approval by Virginia Department of Transportation (VDOT). These design criteria should be read in conjunction with the Design Basis where values corresponding to the Design Criteria are stated.

The Design Criteria document establishes the criteria to guide the Preliminary Engineering (PE) and Final Design (FD) of the New Midtown Tunnel. This is one of the documents that will be the vehicle for engineers and designers to follow during the entire design process. These requirements set out the minimum requirements for the Tunnel Civil Works to ensure the Works are of adequate standard to be handed back to VDOT in due course and for the safety of the public users.

These criteria provide a uniform basis and framework for defining the project structurally. They are intended as expressed requirements to direct the project designers. As such, these criteria shall be used as the basis for New Midtown Tunnel design except where specific characteristics make such application impractical. Project designers are expected to be fully familiar with the requirements as defined by these Design Criteria. They will be required to reflect the intentions of these documents in the design and identify conditions or developments that may require modification of these documents.

The material contained in the following sections provides a uniform basis for design and can be expected to undergo refinement and expansion during PE and FD.

These criteria serve as guidelines and do not substitute for engineering judgment and sound engineering practice. Specific exceptions may apply in special cases. The designers are responsible for identifying any necessary departure from the criteria contained in this document, and bringing it to the attention of the Discipline Manager. Once accepted any changes to the criteria must be reviewed and approved by VDOT prior to use in the design. Any changes of criteria, additions to the criteria, and other questions must be submitted in writing to VDOT and follow established project change control procedures.

This Section 5 covers structural design criteria for the New Midtown Tunnel project permanent works, i.e.:

- Surface structures at tunnel approaches
- Retaining walls at tunnel approaches
- Boat section approaches to tunnel (boat sections)
- Cut-and-cover tunnel
- Immersed tunnel
- Buildings associated with tunnel.
- Flood gates at Norfolk tunnel portal.

The following elements are not included in this Design Criteria document:

- Real estate acquisition
- Construction management
- Construction criteria

5.1 Design Codes and Standards

5.1.1 General

The current edition of the applicable codes, standards, manuals, guidelines, specifications, etc., that are defined by this section of the criteria and published by January 7, 2010, shall be used for the design of all structures associated with the New Midtown Tunnel project except as specified herein.

These codes are to be used in accordance with the requirements that are specified by the individual owner, or operating agency, that has possession of the structure that is being designed, modified, or rehabilitated as a part of the New Midtown Tunnel project, i.e. VDOT.

The order of precedence of Standards and Codes relating to design, except where otherwise stated, is the Final Design Criteria for the New Midtown Tunnel, Final Construction Requirements for the New Midtown Tunnel, minimum standards set by the standards and codes specifically referred to in the text, US standards and codes, VDOT standards and codes, local authority standards and codes of practice.

If a conflict exists between designated codes, the requirements of the more stringent code shall apply unless otherwise specifically directed by the owner or agency for that structure.

Concrete barrier may be precast in the tunnel from start of boat section to start of boat section. If concrete precast barrier walls are used within the tunnel limits, they shall be continuous and be installed such as to maintain zero (0) deflection. [TR 1.1.H].

5.1.2 Acronyms

Commonly used acronyms are given below:

AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
ABA	Architectural Barriers Act
ACI	American Concrete Institute
ADA	Americans with Disabilities Act
AISC	American Institute of Steel Construction, Inc
ANSI	American National Standards Institute
API	American Petroleum Institute
ASCE	American Society of Civil Engineers
ASD	Allowable Stress Design
ASME	American Society of Mechanical Engineers

ASTM	American Society of Testing and Materials
ATC	Applied Technology Council
AWS	American Welding Society
BOCA	Building Officials and Code Administrators
BHRA	British Hydraulic Research Association
CEM	Coastal Engineering Manual
CIRIA	Construction Industry Research and Information Association
FHWA	Federal Highway Administration
ITA	International Tunnelling Association
MCEER	Multidisciplinary Center for Earthquake Engineering Research (formerly the National Center for Earthquake Engineering Research)
MDE	Maximum Design Earthquake
NFPA	National Fire Protection Association
NRC	National Research Council
ODE	Operating Design Earthquake
OHSA	Occupational Health and Safety Administration or the Occupational Health and Safety Act
PCI	Prestressed Concrete Institute
PIARC	Permanent International Association of Road Congresses - World Road Assoc.
RCSC	Research Council on Structural Connections, c/o AISC
TMS	The Masonry Society
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
VDOT	Virginia Department of Transportation
VCC	Virginia Construction Code

5.1.3 Codes

ACI 318-08	Building Code Requirements for Structural Concrete and Commentary
ACI 530-05 / ASCE 5-05 / TMS 402-05	Building Code Requirements for Masonry Structures, and Commentary
AISC	Code of Practice for Steel Buildings and Bridges
ASME A17.1	Safety Code for Elevators and Escalators Handbook
AWS D1.1	Structural Welding Code for Steel
AWS D1.5	Bridge Welding Code
IBC	International Building Code,
NFPA 101	Life Safety Code
NFPA 502	Standard for Road Tunnels, Bridges, and Other Limited Access Highways
VCC	Virginia Construction Code
USBC	Virginia Uniform Statewide Building Code

5.1.4 Manuals, Specifications and Standards, etc.

	Idriss, I. M. and Sun, J. I., " A Computer Program for Conducting Equivalent Linear Seismic Response Analyses of Horizontally Layered Soil Deposits", Center for Geotechnical Modeling, Department of Civil and Environmental Engineering, University of California at Davis, 1992.
AASHTO	LRFD Bridge Design Specifications
AASHTO Thermal Effects in Bridges	Guide Specifications - Thermal Effects in Concrete Bridge Superstructures, 1st Edition, 1989
AASHTO	Technical Manual for Design and Construction of Road Tunnels – Civil Elements September 2010 Edition
ACI 201.2R-01	Guide to Durable Concrete.

ACI 305R-99	Hot weather concreting.
ACI 308.1-98	Standard Specification for Curing Concrete Recommended Practice for Curing Concrete.
ACI 308R-01	Guide to Curing Concrete
ACI 531.1-05 / ASCE 6-05 / TMS 602-05	Specification for Masonry Structures, and Commentary
ACI 315	Details and Detailing of Concrete Reinforcement
ACI SP-66(04)	ACI Detailing Manual-2004
ADA AG	ADA and ABA Accessibility Guidelines for Buildings and Facilities
AISC	Steel Construction Manual 13th Edition
ANSI/AISC 341-05	Seismic Provisions for Structural Steel Buildings
ANSI/AISC 360-05	Specifications for Structural Steel Buildings.
ASCE 37-02	Minimum Design Loads on Structures during Construction
ASCE 7-10	Minimum Design Loads for Buildings and Other Structures.
ASTM	American Society for Testing and Materials.
ATC-32-1	Improved Seismic Design Criteria for California Bridges: Resource Document
CEM 2008	U.S. Army Corps of Engineers (USACE) Coastal Engineering Manual EM 1110-2-1100 http://140.194.76.129/publications/eng-manuals/
CIRIA	The Rock Manual. The use of rock in hydraulic engineering (second edition) (C683)
FHWA	Highway and Rail Transit Tunnel Inspection Manual.
FHWA`	Highway & Rail Transit Tunnel Maintenance & Rehabilitation Manual
FHWA-HI-99-012	Training Course in Geotechnical and Foundation Engineering: Geotechnical Earthquake Engineering - Participants Manual, 1999
FHWA-NHI-00-043	Mechanically Stabilized Earth Walls and Reinforced Soil Slopes Design and Construction Guidelines, 2000

FHWA-NHI-99-025	Earth Retaining Structures, 1999
FHWA-SA-96-069R	Manual for Design & Construction of Soil Nail Walls, 1999
Green Building Council	Leadership in Energy and Environmental Design Reference Guides
ITA Fire Guidelines	Guidelines for Structural Fire Resistance for Road Tunnels, Working Group No. 6 Maintenance and Repair, May 2004
ITA State-of-the-Art-Report, First Edition	State-of-the-Art Report, first edition, International Tunnelling Association Immersed and Floating Tunnels Working Group, Pergamon, 1993
ITA State-of-the-Art-Report, Second Edition	State-of-the-Art Report, second edition, International Tunnelling Association Immersed and Floating Tunnels Working Group, Pergamon, 1997
MCEER-97-0022	Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils, edited by T.L. Youd and I.M. Idriss, 12/31/97
MCEER-98-0005	Screening Guide for Rapid Assessment of Liquefaction Hazard at Highway Bridge Sites, by T. L. Youd, 6/16/98.
Monograph 7	Wang, J., “Seismic Design of Tunnels – A Simple State-of-the-Art Design Approach”, 1991 William Barclay Parsons Fellowship, Parsons Brinckerhoff, 1993.
NRC-65-1972	Expansion Joints in Buildings Technical Report
OSHA	Occupational Safety and Health Administration regulations
PCI: 2004	Design Handbook - Precast and Prestressed Concrete, 6th Edition
PEOSHA	Public Employees Occupational Safety And Health Act
Propeller Induced Scour	M. J. Prosser, BHRA, Fluid Engineering Centre, Cranfield, c1986. ISBN: 0900337184; phone +44-1234 750 422
RCSC 2004	Specifications for Structural Joints using ASTM-A-325 or A-490 Bolts
USACE	Hydraulic Design Criteria Sheet 712-1 Stone Stability
VDOT	Clearance Chart (08-18-03)

VDOT	Manual of Instructions for Materials Division (Chapter IV of Pavement Evaluation and Design): Non-Tunnel Technical Requirements, including Attachment 1.5a and Attachment 4.4.

5.1.5 Design Standards

Unless modified herein the various structures for the New Midtown Tunnel Project shall be designed according to the following design standards unless design exceptions have been obtained:

- Surface Structures at Tunnel Approaches and buildings associated with the Tunnel not otherwise covered by Section 7.0 of this Design Criteria shall be designed to ACI 318-08 and AISC Steel Construction Manual, 13th Edition;
- Retaining Walls and U-Sections (Boat Sections) at Tunnel Approaches to AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 4th Edition, 2007 with 2008 and 2009 Interim Specifications and VDOT Modifications (IIM-S&B-80) and relevant recommendations in AASHTO Technical Manual for Design and Construction of Road Tunnels - Civil Elements, September 2010;
- Boat sections, Cut-and-cover and immersed tunnels shall be designed to AASHTO Technical Manual for Design and Construction of Road Tunnels - Civil Elements, September 2010, referencing AASHTO LRFD Bridge Design Specifications.

5.1.6 Design Life

The design life of the tunnels, retaining walls, and marine structures shall be 120 years where such an option is provided by codes.

Fixed facilities (structures and buildings) shall be designed for continued operation over a minimum period of 50 years before complete refurbishment and renovations are necessary due to wear and tear and obsolescence.

Major fixed system equipment (such as substation gear, flood gates, shop machinery and ventilation equipment) shall be designed for a minimum of 30 years before complete replacement becomes necessary, assuming that approved maintenance policies and procedures are followed on an established time cycle.

5.1.7 Maintenance and Protection of Existing Structures

Structures, utilities and facilities not scheduled to be removed shall be protected from damage during the work of this contract. Protection measures may include, but are not limited to, measures noted below. For the Existing Midtown Tunnel structures, settlement or movement shall be limited such that it does not imperil the structural integrity of the tunnel. Specific movement criteria shall be developed and submitted to VDOT for approval.

The method, extent and detail of the analyses for the Existing Midtown Tunnel may require analyses of soil/structure interaction, structural behavior, and the effects of differential stiffness of the subsoil and pile support. Lateral ground support, ground improvement or partial removal of existing fill may be required to ensure negligible damage. The applicable requirements of TR Section 1.15.8 shall be fulfilled.

For any individual existing building, if subject to settlement or movement from cut-and-cover or boat section excavations, settlement shall be limited. Methods of analysis should use parameters from recent case histories and methods based on the works of Clough and O'Rourke[1] and Peck[2]. The buildings shall not suffer damage greater than "slight" as defined by:

- Cracks are easily filled; redecoration may be required; several slight fractures inside building; exterior cracks may be visible; some repointing may be required for weather-tightness; doors and windows may stick slightly.

5.1.8 List of Key Data Sources

Key design information to be used when appropriate shall be obtained from the following:

- Federal Requirements
- Corps of Engineers
- NOAA
- Coast Guard
- U.S. Navy
- Port Authority
- VDOT
- City of Norfolk
- City of Portsmouth
- Local utility companies including power, telephone, water and sewerage
- Topographical maps of the area
- Meteorological data
- Archaeological data
- SKW
- Site Data
- Geological data
- Information about adjacent structures
- Geotechnical Design Parameters
- Seismic Studies (Site Response Analysis, Liquefaction Analysis)

5.1.9 Drainage

The intended purpose of drainage is to provide for the design life of the tunnel a system of pipes, channels, sumps, pumps and control systems for the safe and reliable collection, pumping and disposal of liquids that might otherwise collect.

No inlet structure or portion thereof shall be located in the roadway surface of the travel way. [TR 1.6.1.H]

Drainage cut offs shall be provided at the tunnel portals to prevent surface water runoff from entering the tunnel. Drainage sumps shall be provided at the tunnel portals and the

[1] Clough G.W. & O'Rourke, T.D. 1990. *Constructed Induced Movements of In-situ walls*. Proc. ASCE Specialty Conference, Cornell. ASCE Geo Special Publication 25

[2] Peck, R.B. 1969. *Deep excavation and tunneling in soft ground*. Proceedings of 7th International Conference on Soil Mechanics and Foundation Engineering, Vol.1, pp. 225-290.

tunnel low point. Pumps shall be provided in the sumps to remove the liquid collected. [TR 1.15.1.J]

5.1.10 Stray Current Corrosion Control

Although stray current corrosion control is not currently required, mitigation against potential future stray current corrosion may, at some point, be aqdded to the scope of work. Any future corrosion control system shall be designed to mitigate the potential effects of stray currents. Specifically with respect to the immersed and cut-and-cover tunnels:

- electrical continuity of the reinforcement cage within each reinforced concrete immersed tunnel element shall be ensured;
- connections shall be provided to enable electrical bonding of the reinforcement across isolation joints;
- facilities for joining any or all of the connections shall be provided.

5.2 Loads and Forces

5.2.1 General

Unless noted otherwise, the general loads contained in this chapter refer to the loads and forces for the purpose of designing the structures included in this project.

During the design life, the tunnel may be subjected to extreme actions such as flooding, sunken ship loading, fire, explosion and earthquake. Measures shall be taken in design to ensure the stability of the structure until disaster recovery measures can be implemented, and that in the long term, the tunnel remains serviceable. [TR 1.15.3.A]

5.2.2 Loads

The following permanent loads are applicable to the design of cut-and-cover and immersed tunnels and their below-ground approach structures (boat section or ramps):

DC = Dead Load: This load comprises the self weight of the structural components as well as the loads associated with nonstructural attachments. Nonstructural attachments can be signs, lighting fixtures, signals, architectural finishes, waterproofing, etc. [These items have essentially well defined weights.]

DW = Dead Load: This load comprises the self weight of wearing surfaces and utilities. Utilities in tunnels can include power lines, drainage pipes, communication lines, water supply lines, etc. Wearing surfaces can be asphalt or concrete. [The weights of these items are generally less well defined, may be removed or replaced, and have different load factors.]

EH = Horizontal Earth Pressure Load. At-rest pressures shall be used in the design of cut-and-cover and immersed tunnels during the permanent condition. Cut-and-cover tunnel structures and the immersed tunnel structure shall also be checked for the design case where the maximum vertical load is applied on the roof of the tunnel and active pressure on the sides of the tunnel. EH and EV (as defined below) are related. Reasonable values shall be taken to bracket probable situations.

- For immersed tunnels, this load is generated by fill material on the sides and any protection layer located above the fill. The properties of the fill material shall be well defined.
- For structures other than immersed tunnels, the information required to calculate this load is derived from the geotechnical data obtained from the subsurface investigation program.

EL = Accumulated locked-in force effects resulting from the construction process, including secondary forces from any post-tensioning.

ES = Earth surcharge load.

- For immersed tunnels, this is interpreted as the vertical earth load due to siltation over and adjacent to the structure that occurs above the original design fill level. The design fill level includes scour protection (rock blanket) where provided; note that siltation might take place within the protection layer. The thickness of siltation may be limited by maintenance dredging. The allowance for siltation should be made based on knowledge of the siltation rates (supported by records) or a suitably conservative assumption.
- For other structures, this is the vertical earth load due to fill over the structure that was placed above the existing ground level or 400 lbs/ft² as described in Section 5.5.1 of the FHWA Tunnel Design Manual, whichever is greater.

EV = Vertical pressure from the dead load of the earth fill and any protection layer thereon. This vertical earth shall include fill and protection layer over the structure up to the design fill line for immersed tunnels or up to the existing ground level for other structures. The properties of the fill material shall be well defined.

WA_P = Permanent Water Load. This load represents the permanent hydrostatic pressure expected outside an immersed tunnel structure. Immersed tunnel structures are detailed to be watertight. Therefore, the hydrostatic pressure associated with Mean Sea Level (MSL) is considered to be permanently and constantly applied to the structure. Hydrostatic pressure acts normal to the surface of the tunnel. The design shall take into account the specific gravity of the water, which can be saline and may contain suspended matter.

Transient loads that are applicable to cut-and-cover and immersed tunnels and their below-ground approach structures are defined as follows:

CL = Construction Load: These loads are not explicitly defined in the AASHTO LRFD Specifications, but must be considered when designing tunnels. They include loads imposed when the tunnel element is constructed, launched and transported. Transporting loads such as loads imposed when towing the elements, wave action on a floating element, current loads when the element is being outfitted, moored or placed, the loads imposed when the element is floating and concrete is placed in or on the element, and wind on the exposed parts.

CR = Creep.

CT = Vehicular Collision Force: This load shall be applied according to AASHTO LRFD to individual components of the structure that could be damaged by vehicular collision. Typically, walls are very massive or are protected by redirecting barriers

so that this load need be considered only under very unusual circumstances. It is preferable to detail structural components so that they are not subject to damage from vehicular impact.

CV = Vessel Collision Force: Design of an immersed tunnel to resist ship anchor impact is defined in 5.2.3. Another category of this load is a sinking ship coming to rest over an immersed tunnel. The intensity of uniformly distributed loading from a sunken ship shall be determined by methods such as that outlined in Chapter 6 of the State-of-the-Art Report, 2nd Edition, International Tunnelling Association Immersed and Floating Tunnels Working Group, Pergamon, 1997. Refer to 5.2.4 for guidelines for computing ship sinking loads for Extreme Events II and III. Anchor impact shall not be combined with the ship sinking effect. Settlements resulting from sunken ship shall be taken into account.

EQ = Earthquake. Seismic load shall be considered in areas where seismic activity is expected. Seismic loads to be applied include the hydrodynamic pressure during earthquake, if applicable, earthquake loads during shaking and post-earthquake loads due to deformations such as post-liquefaction settlements. A performance-based three-level design earthquake approach shall be adopted for the immersed tunnel.

- Extreme Event 1 shall be based on the most severe seismic event anticipated at the location
- Extreme Event II shall be based on a realistic design basis earthquake occurring once in a period equal to about three times the design life.
- Extreme Event III and Construction Strength I combinations shall consider a smaller earthquake as a static load to be combined with the loads in Tables 11.1 and 11.2, and will typically have a return period of 5 to 10 years.

IM = Vehicle dynamic load allowance: This load can apply to the roadway slabs of tunnels. Impact loads are statically equivalent dynamic loads resulting from vertical acceleration of the live loads. The allowance for the design of the top slab of underground structures supporting roadway loading shall be determined according to AASHTO LRFD 3.6.2.2.

The depth of cover shall be measured from the top of ground or paving to the top of the underground structure.

LL = Live Load:

- Vehicular Live Load: This load can apply to the roadway slabs of tunnels and boat section approach structures and shall be applied in accordance with the provisions of Article 3.6.1.2 of the AASHTO LRFD Specifications. Unless otherwise noted, roadway live loads on structures shall be based on AASHTO HL-93 loading or an Alternative Military loading.
- Other live loads shall consist of any non-permanent loads including the weight of machinery, equipment, stored materials, pedestrians, motor vehicles, elevators, escalators or other moving objects, construction loads, and loads due to maintenance operations.
- Electrical equipment rooms, pump rooms, service rooms, storage space and machinery rooms shall be designed for loads that are consistent with their

intended use. The loads for which such rooms are designed shall be noted on the structural drawings.

PL = Pedestrian Live load. Pedestrian are typically not permitted in highway tunnels, however, there are areas where maintenance and inspection personnel will need access, areas such as ventilation ducts when transverse ventilation is used, plenums above false ceilings, and safety walks. Areas accessible by maintenance personnel shall be designed for 20 psf. These loads are transmitted to the lining through the supporting members for the described features. Where pedestrians are permitted, a design loading of 100 psf shall be used.

SE = Settlement: Allowance shall be taken of immediate settlements during the first week or so after placement of an immersed tunnel element due to compaction of the foundation material, expected long term movements due to placement of fill and subsequent movements of the underlying materials, and movements resulting from the placement and filling of adjacent immersed tunnel elements. Immediate settlement should be evaluated based on type of foundation, method of placement, placing profile and nominal depth. Lateral movements can occur in soils that are non-uniform laterally and where the soil surface is sloping. Proper preparation of the foundation and placement of the fill can minimize these effects. If excessive settlement is anticipated due to poor subsurface conditions or due to the addition of load onto the structure or changing ground conditions along the length of the tunnel, ground improvements or a pile foundation, etc., shall be used. Anticipated variations in soil properties shall be taken into account in analyses, including all relevant uncertainties and tolerances having an influence on the foundation stiffness of the tunnel.

SH = Shrinkage: Shrinkage can result in cracking. In the case of thick concrete sections, detailing and construction methods shall be employed to minimize shrinkage in order to minimize the resulting cracking. Shrinkage can also occur in the concrete placed as part of steel shell tunnel elements. The effect of this force shall be accounted for in the design or else the structure detailed to minimize the effect of shrinkage. Watertightness acceptance criteria is independent of the technical definition of shrinkage and the technical discussion of shrinkage is not to be interpreted as waiving any contractually agreed upon watertightness criteria.

SL = Support Loss: This loading is not defined in the AASHTO LRFD Specifications since it is unique to immersed tunnels. It shall include loss of support (subsidence) below the tunnel or to one side. A loss of support of not less than 30 feet of the length of an immersed tunnel element over the full width of the tunnel element shall be considered.

TG = Temperature Gradient. Below-ground concrete structures typically consist of massive members that have a large thermal lag. Combined with being surrounded by an insulating soil fill that maintains a relatively constant temperature, the temperature gradient across the thickness of the members can be measurable. This load shall be examined on a case by case basis depending on the local climate and seasonal variations in average temperatures. Article 4.6.6 of the AASHTO LRFD Specifications provides guidance on calculating this load.

TU = Uniform Temperature. This load is used primarily to size expansion joints in the structure. Frictional restraint from the backfill material shall be considered. This may have an influence on longitudinal axial forces.

WA_T = Transient Water Load. This load represents the effects on an immersed tunnel of variations in water level above and below WAp level (i.e. Mean Sea Level). Such variations can be caused by tides, storms, tsunamis, large waves, etc. For other structures, this load represents the hydrostatic load on the structure. At least the following water levels shall be considered for all structural design:

- For Strength I, the 10-year Storm elevation shown in the Summary Table in Section 3.1.1.
- For Extreme Event limit states the following apply:
  - The immersed tunnel, to resist water pressure up to elevation 13.0 (NAVD88)
  - The cut-and-cover sections, and buildings that water could enter the tunnel through shall be designed in accordance with Section 5.5.
  - The boat sections shall be designed in accordance with Section 5.6.
  - In all other cases, use the 120-year Storm elevation shown in the Summary Table in Section 3.1.1..
- For overtopping of flood defenses, the Works shall maintain the existing flood protection provisions as a minimum. [TR 1.15.1.A]

If pore water pressure relief is not provided from beneath an immersed tunnel, then passing ships, seismic events and the troughs of tsunamis and large waves can result in pore water pressure beneath the tunnel tending to lift the tunnel.

The design shall take into account the specific gravity of the water, which can be saline. Both maximum and minimum hydrostatic loads shall be used for structural calculations as appropriate to the member being designed. The specific gravity of water may vary according to depth, prevailing weather conditions, and season. The effect of suspended material shall be taken into account in determining the specific gravity of water.

Some of the loads shown in Article 3.3.2 of the AASHTO LRFD Specifications are not shown above because they are often not applicable to the design of below-ground structures as described below. They should be considered on a case-by-case basis.

BR = Vehicular Breaking Force: This load shall be applied only under special conditions where the detailing of the structure requires consideration of this load. Under typical designs, this force is resisted by the mass of the roadway slab and need not be considered in design.

CE = Vehicular centrifugal force: This load shall be applied only under special conditions where the detailing of the structure requires consideration of this load. Under typical designs, this force is resisted by the mass of the roadway slab and need not be considered in design.

DD = Downdrag: This load comprises the vertical force applied to the exterior of the structure that can result from the subsidence of the surrounding soil due to the subsidence of the in situ soil either below the bottom of the tunnel or the adjacent soils. Verify whether or not this load will apply to immersed tunnels since it requires subsidence or settlement of the material below the bottom of or adjacent

to the tunnel. For a typical immersed tunnel, the overall weight of the structure is usually less than the soil it is replacing. For example, downdrag could occur if the weight of backfill on each side of the tunnel for some subsoil conditions were to settle more than the tunnel.

FR = Friction. The structures are very stiff in the direction of thermal movement. Thermal movement is the source of the friction force. In a typical tunnel, boat section approach structure or retaining wall, the effects of friction may have an influence on longitudinal axial forces.

IC = Ice load. Since the tunnel and approach structures are not subjected to stream flow and unlikely to be exposed to the weather in a manner that could result in an accumulation of ice or icebergs, this load does not apply to the design of below-ground structures.

LS = Live Load Surcharge: This load will be generated by vehicles traveling over or adjacent to the below-ground structure. This load shall be applied only where it can feasibly occur.

WL = Wind on live load. Below-ground structures are not exposed to the environment, so they will not be subjected to wind loads except during construction.

WS = Wind load on structure. Below-ground structures are not exposed to the environment, so will not be subjected to wind loads when in service, however, when immersed tunnel elements are being towed to the tunnel site, this is a potential loading. See construction loads (CL) listed above.

Earth pressure coefficients for k_a, k_0, and maximum and minimum unit weights to be used in design, as well as modulus of subgrade reaction, shall be established from the recommendations of the Subsurface Investigation Report. At a minimum the designs for immersed tunnels, cut-and-cover tunnels, open cut and retaining wall structures, i.e. for all permanent subsurface structures, shall consider separate cases for active earth pressure, for at-rest earth pressure, and for unbalanced earth pressure consisting of active earth pressure on one side of the structure and at-rest earth pressure on the other side of the structure; loading resulting from out of balance backfilling shall be considered.

The axial compression of tunnel elements due to depth of immersion as well as temperature effects shall be taken into account in determining joint dimensions at installation. The effects of higher or lower internal air pressure in sealed tunnel elements due to variations in temperature, etc., due to compression, expansion and immersion shall be taken into account. Where the axial compression of bulkheads due to depth of immersion can occur, this must be taken into account in their design.

Loadings unique to immersed tunnels such as anchor and ship impact shall be calculated according to 5.2.3 and 5.2.4.

5.2.3 Ship Anchors

The effect of an anchor impacting the underwater tunnel structure directly or being dragged across the line of the tunnel structure shall be considered. The anchor release band and fill / protection layer system shall be designed to mitigate the loading. Rupture of any waterproofing membrane shall not occur. A dragging anchor shall not snag the

tunnel; anchor release bands shall be designed accordingly and the provision of anchor release bands has been included in the construction requirements.

The design anchor shall be selected as appropriate to shipping using or expected to use the waterway, based on the relevant section of the American Bureau of Shipping Rules.

The penetration depth of a falling anchor through tunnel roof protection material shall be estimated. The formulae given in CEB Bulletin d'Information No 187, August 1988, reproduced for reference below provide a good design method to calculate the anchor penetration depth in granular material:

Penetration Depth of a Falling Anchor through Granular Material:

$x = 10 N_{pen} d_e$ $N_{pen} = \sqrt{\frac{m_w}{E_r d_e^3}} \cdot v_i$ $d_e = \sqrt{\frac{4A}{\pi}}$ $A = 0.6 + 0.2 \frac{m_a}{1000}$	5-1

where:

x penetration depth (m)

N_{pen} penetration parameter

d_e equivalent diameter of striking area of anchor (m)

m_w mass of anchor reduced by the mass of the displaced water (kg)

m_a mass of anchor in air (kg)

E_r modulus of elasticity in the longitudinal direction of the layer (N/m^2)

v_i impact velocity of anchor (m/s)

A cross-sectional striking area of anchor (m^2)

The calculated maximum penetration depth shall not exceed 90% of the total thickness of the protection layer covering the tunnel using the 5% fractile value for E_r. The dynamic load factor (DLF) ratio of the static equivalent load on the tunnel roof to the triangular dynamic load pulse $F = m_w v_i / T_d$ may be obtained from Figure 5.2.3 below using the minimum duration of impact $T_d = x/v_i$ (where x is calculated with the 95% fractal value for E_r), and the natural period T_0 of the affected element.

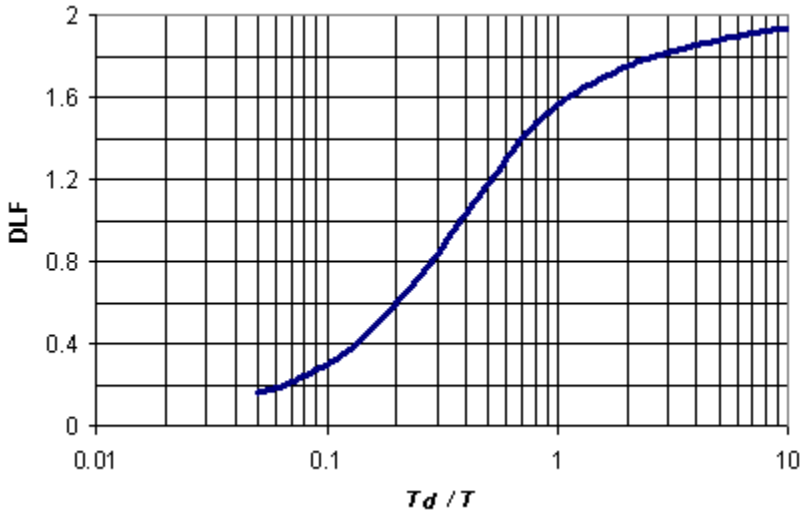


Figure 5.2.3 Graph of Dynamic Load Factor (DLF) Against Td/T

5.2.4 Ship Sinking or Grounding

The loading applied by a sunken ship resting on top or alongside the tunnel shall be accounted for in the design. The static equivalent loadings considered should be a concentrated load and uniformly distributed load [TR 1.15.3.D], calculated with reference to the AASHTO Technical Manual for the Design and Construction of Road Tunnels – Civil Elements, September 2010. Alternatively, a probabilistic approach may be used to determine an appropriate load.

Collision impact loading need not be considered within the Federal Channel; elsewhere the likelihood of a ship collision shall be determined on a case-by-case basis. Sunken ship loadings apply to Extreme Events II and III. Note that for Extreme Event II, ship sinking load shall not be combined with the design earthquake load.

For the sunken and grounding ship load, the foundation design shall ensure that the maximum allowable settlement of the tunnel, taking into account the maximum joint openings, the internal traffic clearance profile and pavement requirements are not exceeded. The period prior to salvage of the vessel shall be assessed and documented in the Preliminary Design. The minimum period shall be one month unless demonstrated otherwise. [TR 1.15.3.E]

It may be assumed that the US Navy will not permit a primary sunken ship to obstruct the dredged Federal Channel and that the ship will be removed within one week. The size of the sunken vessel shall be appropriate to the available water depth at the location considered. Discussions shall be held with the US Coast Guard, US Navy and local harbor masters to determine an appropriate size of and duration for removing a sunken vessel. In the absence of data to the contrary, it may be assumed that the primary sunken ship will exert a pressure of 1.5 ksf.

The joints shall be designed and detailed to accommodate potential joint movement and settlement due to ship sinking. The tunnel shall remain stable.

5.2.5 Fire

The tunnel structure and all critical anchorages shall be designed to resist failure due to fire in accordance with NFPA 502 [TR 1.15.12.A] and the guidelines set forth by the International Tunnel Association (ITA) document titled “Guidelines for Structural Fire Resistance for Road Tunnels”. The entire tunnel structure, inclusive of the emergency egress corridor and emergency exit stair enclosures, shall be designed to withstand the temperature rise as defined by the Rijkswaterstaat (RWS) time-temperature for a period of 120 minutes

The design shall ensure that the structural capacity is not exceeded, either during or after the fire. In addition, watertightness shall be maintained, no permanent deformations shall occur, and any damage shall be repairable. Special attention shall be paid to the possibility that the strength of concrete may be lower after cooling than during the fire. [TR 1.15.12.B]

The design shall include the specification of the fire protection measures for the the roof and to the walls of traffic ducts immediately beneath the Elizabeth River, and also elsewhere where partial loss of tunnel structure can compromise the safety of people within it or cause catastrophic flooding. The purpose of the fire protection is to limit structural damage in the event of a fire and to ensure that the tunnel can be restored more quickly to normal operation.

Calculations of temperature distribution on the internal surfaces of the walls and slabs during a fire shall be determined by model calculations, and the results shall be summarized in a report which shall be submitted with the Preliminary Design [TR 1.15.12.D]. The following constraints apply to the design of primary structural members exposed to fire whether protected by fire protection or not:

- Spalling of concrete is not permitted.
- After two hours for a harmonized hydrocarbon rate of heat release,
  - Where insulation is used, the temperature at the contact between concrete and fire-insulating material shall not exceed 716°F (380°C), and
  - The temperature in any reinforcement and structural steel required for structural integrity shall not exceed 482°F (250°C).

Fire protection material and its fastenings shall be designed to withstand a uniformly distributed suction pressure of 63 lbs/ft² under unheated conditions. The design shall ensure that any fire protection will stay in place during a fire. [TR 1.15.12.E]

5.2.6 Tsunami

The effects of a tsunami shall be considered in the design and shall not be combined with other extreme loads. A tsunami is in effect a very long period wave, usually led by the trough. Typical effects of the trough are that it reduces water level in front of sea walls without giving time for the water level behind to fall, toppling the walls towards the sea. Flood defense bulkheads shall take tsunami crest levels into account.

5.2.7 Accidental Explosion

The risk of accidental explosion in the tunnel shall be based on the types of goods that may be transported through it, and the tunnel shall be designed for an appropriate intensity of accidental explosion loading. The accidental explosion load shall be considered a static extreme load acting over the full area of the internal cross section,

and over an arbitrary length. The concrete structure and joint gaskets shall not be damaged as a result of this loading. [TR 1.15.3.H]

Dangerous goods are to be excluded from traveling through the tunnel; this will reduce the risk of accidental explosion, and the intensity of a potential accidental explosion. An appropriate design loading for accidental explosion shall be determined for the roadway portion of the tunnel. If certain types of dangerous goods are not excluded, an accidental explosion load of 2.1 ksf shall be adopted.

Damage to escape doors is permitted; the door, however, shall remain attached to the frame and not act as a projectile.

5.2.8 Flooded Tunnel

The tunnel shall be able to resist an incident causing accidental partial or complete flooding. The effects of a flooded tunnel shall not be combined with other extreme loads. The design shall ensure the stability of the structure until disaster recovery measures can be implemented, and that in the long term, the tunnel remains serviceable. Settlements resulting from flooding shall be taken into account. Settlements shall not cause joints to open and leak.

5.2.9 Seismic Loading

The Concessionaire shall take into account seismic loadings, or demonstrate that such loadings are not significant in the design. With reference to AASHTO LRFD, the importance category of the tunnel is defined as Critical. Watertightness shall not be compromised and repairs should be of a minor nature and not require long term closure of the tunnel to implement. The proposed design approach shall be documented in the Preliminary Design.

Since the horizontal spectral response acceleration at the tunnel site according to AASHTO LRFD 2010 Figure 3.10.2.1-1(cont'd) is 0.03g, seismic loading is expected to be a negligible load effect; minimum simplified requirements can be used.

5.2.10 Settlement and Heave

The design of the permanent structure shall account for any effects caused by uplift or ground movement in the temporary condition [TR 1.5.2.G]. The expected settlement or heave (total and differential) of the new tunnel shall be calculated for each stage of construction, taking the expected duration of time related effects into account. The design elevation for installation of the tunnel shall take into account foundation tolerances and expected short-term and long-term settlements and differential settlements. Satisfactory performance of the tunnel in relation to the following shall be ensured:

- Traffic clearance envelope
- Pavement performance
- Design of joint seals
- Design of structural connections at joints
- Design of drainage and ducting

Settlement and lateral movement of the existing tunnel due to construction of the new tunnel shall not cause unacceptable damage or unacceptable movement to the existing tunnel. [TR 1.4.1.H.3]

Long term settlements shall not be a detriment to achieve and maintain the post-construction Performance Requirements for overall ride quality and localized roughness of the pavements nor exceed the grade tolerances of pavement sections of tie-ins to the Project. [TR 1.4.1.H.1]Bridge Plans shall incorporate the following General Note [TR 1.4.3.B]:

> This structure has been analyzed and designed to accommodate settlement as noted below:
>
> Total Settlement of (__)" has been accommodated. The total settlement (STOT) is defined as the arithmetic sum as follows: STOT (__)" = Elastic Settlement (__)" + Consolidation Settlement (__)" + Secondary Settlement (___)". In addition, Differential Settlement of (__)" between adjacent substructure units and (__)" within a single unit has been accommodated.

5.3 Materials

5.3.1 Corrosion

The corrosion protection of non-structural steel items shall be appropriate to and correspond to the accessibility of that item for inspection and maintenance. The corrosion protection of such items shall also correspond to their expected service life and replacement cycles. Partially embedded anchors or elements shall be either stainless steel, galvanized, epoxy coated, or protected by other means to inhibit corrosion. End frames and attachments at immersion joints shall be capable of maintaining structural integrity and watertightness for 120 years.

5.3.2 Fatigue

Where fatigue design is a consideration, such as for traffic or rail loading as specified in relevant codes, the number of cycles considered shall be for the full design life. Where not otherwise required by codes and standards, at least 2,000,000 cycles shall be accommodated. In selecting materials for new structures and taking measures for durability, due account shall be taken of the generally aggressive environment in which the structures are placed. Existing structures shall be assessed for serviceability and durability relative to project requirements.

5.3.3 Reinforcement

Grade 60 carbon steel reinforcement shall be used. The use of stainless steel reinforcement as stated in VDOT IIM-S&B-80.2 Section 5 is not required within the tunnel and approach structures. Reinforcement may also be galvanized, epoxy coated or stainless steel [TR 1.15.10.F.1].

In concrete members designed to accommodate axial tension forces, no more than 50 percent of the bars shall be lapped or connected at any one section. The distance between the ends of adjacent lapped bars or connectors shall be the greater of 30 bar diameters or 1.75 feet.

Welded butt splices shall not be permitted. All bars No. 14 and above shall be mechanically coupled.

At some point, r a future cathodic protection (CP) system of the reinforcement of the tunnel and approach ramps may be added to the scope of work. This will require

making sufficient electrical connections between the rebar and embedded items to allow for the embedded steel to be electrically continuous. This may require the use of weldable rebar to facilitate welded connections.

For structures designed with permanent prestressing, the design shall be based on no tensile stresses in concrete under any Service Combination. Temporary longitudinal prestressing of segmental tunnel elementsshall be designed under Service Combination on the basis of a minimum compression of 0.0 psi at any position in a segmental joint and minimum compression 50 psi at any point in the shear keys, and under Extreme Events a minimum compression of 0.0 psi at any point in the shear keys. These are to be checked against the most unfavourable load combination during float out, temporary mooring, transportation and immersion.

5.3.4 Reinforcement Cover and Concrete Crack Width.

For reinforced concrete structures, the maximum flexural crack width value allowed is listed in Table 5.3.4. The effects of axial load coexisting with other load effects on a member may be taken into account. Calculations shall not permit through cracking.

Table 5.3.4 Allowable Maximum Flexural Crack Widths

Element	Exposure Condition	Crack Width Limit		Nominal Cover (inch)
		inch	mm	
External Walls				
External face	Extreme	0.008	0.2	3
Internal face	Very Severe	0.008	0.2	2
Internal Walls				
Tunnel	Severe	0.008	0.2	2
Buildings	Normal	0.010	0.25	1.5
Slabs and Girders				
External face	Extreme	0.008	0.2	3
Internal face	Very Severe	0.008	0.2	2
Ballast Concrete	No requirements for crack width control or cover			

Notes: A design cover of the smaller of 2 inch or the nominal cover shall be used to check the crack width. Notwithstanding the above values, the nominal cover shall not be less than that required to meet fire resistance requirements.

The minimum cover to prestressing steel shall be ¼ inch greater than that specified for ordinary reinforcement, except that it shall not be less than the diameter of the bar, tendon, the equivalent diameter for a bundle or of the duct in the case of post-tensioning; the cover shall be increased a further ¼ inch if the nominal maximum aggregate size is greater than 1½ inches. This requirement does not apply to the ends of prestressing cables.

5.3.5 Concrete

The dimensions of the tunnel elements and the density of concrete during construction shall be monitored and recorded in such a manner as to ensure that the tunnel element weight is within tolerance. Changes to the overall length of future tunnel elements and the orientation of the end faces shall be adjusted as required to ensure fit with the surveyed positions of installed tunnel elements.

The ability of concrete to resist chloride ion penetration in accordance with both Virginia Test Method 112 and ASTM C 1202 shall be based on the charge passed during the 6-hour test period which shall not exceed 1,000 coulombs [TR 1.15.10.D.4]. All structural concrete shall be low permeability concrete.

The maximum water/binder ratio shall not exceed 0.42. The minimum water/binder ratio should be selected to limit the adverse effects of autogeneous shrinkage on early age cracking. [TR 1.15.10.D.3]

The minimum compressive strength of prestressed concrete at the time of initial prestress shall be 80% of the 28-day compressive strength. For Ground Granulated Blast Furnace Cement (GGBFC) or for PFA content exceeding 20% by weight, 56-day compressive strengths may be used in lieu of 28-day strengths. The minimum 28-day compressive strengths shall be:

- Cast-in-place concrete (cut-and-cover, and boat section) 4,000 psi.
- Precast Concrete and immersed tunnel 6,000 psi
- Fill Concrete 2,500 psi.
- Compressive strength of cementitious non-shrink grout 5,000 psi.
- Prestressed concrete 6,000 psi.

5.3.6 Lateral Stability of Structures

For permanent works, precautions shall be taken to prevent potential horizontal movement of any portion of the tunnels, ramps, retaining walls and other associated structures; movements within the elastic range assumed during design are permissible. Differences in level of fill, groundwater level, or ground level on each side shall be taken into account.

5.3.7 Immersion Joints

Seals for immersion joints (joints formed below water between two immersed tunnel elements or between an immersed tunnel element and an adjacent structure) shall incorporate a Gina-type gasket as the primary (outer) seal and an Omega-type replaceable seal as a secondary (inner) seal, as supplied by Trelleborg Bakker, based in the Netherlands, or approved equal. Both seals shall have a design life at least equal to that of the tunnel. Other methods of forming the primary seal for flexible joints shall have evidence of proven performance under similar conditions and an expected life no shorter than the design life of the tunnel. Fire protection is required to protect the seals. The design of the seals shall take into account long term relaxation of the seal material and the construction tolerances of the supporting steel frames, along with the proposed method of tunnel installation and related tolerances.

Provisions shall be made for testing and inspection of the watertightness of the immersion joints. The maintenance concept shall be documented as part of the Preliminary Design. [TR 1.19.9.L]

The compression of the primary seal under all design scenarios shall always be larger than the minimum compression necessary to provide the required sealing pressure as derived from test results with the actual gasket type and maximum water pressure [TR 1.15.9.F]. The seal is required to have a capacity of at least a further 0.4 inch of compression and the design minimum compression shall be 0.4 inch greater than the compression required to maintain a seal [TR 1.15.9.G].

5.3.8 Segment Joints

Where tunnel elements are formed by a series of match-cast concrete segments with segment joints between to allow expansion, contraction and full articulation, reinforcement is discontinuous across segment joints. Segment joints, if used, shall contain double protection against leakage. Segments shall be temporarily prestressed together for the flotation, transportation and immersion processes [TR 1.15.11.B.1]. Temporary longitudinal prestressing of tunnel elements shall ensure a minimum compressive stress of 44 pounds per square inch (psi) in the joints between segments [TR 1.15.10.E.2]. The requirements for watertightness and exterior waterproofing shall apply. Segment joints shall be designed to transfer shear forces both laterally and vertically, and total movements shall be restrained not to exceed the alignment and waterproofing system tolerances.

5.3.9 Closure Joints

A closure joint (also known as a final joint) is used where the last element has to be inserted rather than appended to the end of the previous element, and is used to fill the gap that will exist at the secondary end. If a closure joint is unavoidable, options to be considered should include, but are not limited to, the terminal block, the wedge shaped block and/or the key final element method. Due allowances shall be provided in the design of the joint for potential misalignments of the adjacent tunnels and for variation in width of the gap to be closed.

The design of the closure joint and its construction shall ensure that those joints that require compression to remain watertight are not compromised.

5.3.10 Watertightness

Watertightness is defined in the Construction Criteria. In addition to waterproofing measures, the structures shall preferably be designed for waterproofing membranes but shall also be watertight as a structure without a membrane. Membranes shall be continuous where possible and combined elsewhere with hydrophilic seals, grout injection or similar to achieve a waterproof structure. A segmental immersed tunnel may be designed without an external membrane.

Notwithstanding the design requirements for watertightness, the design of drainage shall assume that the tunnel waterproofing measures will not be completely effective.

All joints in the external structure below ground or below water shall have a double barrier against leakage. [TR 1.15.9.I & J]

The design shall minimize the use of construction joints in external surfaces. Swelling rubber waterstops, either strip or gun grade materials, shall be used for all concrete construction joints and for penetrations in external surfaces. Dumbbell waterstops

products shall not be used. To prevent the penetration of water, the use of swelling rubber waterstops or approved equal is recommended for sealing construction joints between structural elements and around penetrations (e.g. pipes) through the concrete.

Water-swellable hydrophilic water-stop shall be made from a preformed elastomeric strip. The water-stop shall be stored and used according to the manufacturer's instructions. The water-stop shall:

- be free from rubber, bentonite or other inclusions;
- have an unrestrained volumetric expansion of not less than 170%;
- not deteriorate under prolonged wet/dry cycling;
- withstand a hydrostatic head of 150 feet, and
- have a hydrophilic strip placed in such a manner as to prevent premature absorption of water prior to concreting.

All expansion joints shall be detailed to be watertight and shall be designed for 150% of the anticipated movement based on the seasonal temperature changes to be experienced by the structure. Expansion joints shall contain double protection against leakage.

5.3.11 Exterior Waterproofing

All buried structures must preferably be waterproofed on the exterior (positive side) of the structure, even if at the time of construction there is no groundwater present. Exterior waterproofing systems shall be watertight and must accommodate the anticipated movement of the structure.

For structural steel membranes, an appropriate corrosion protection and monitoring system shall be used to ensure that the minimum design thickness is maintained. For single-shell and sandwich-type immersed tunnels where the outer structural steel shell also serves as a membrane for waterproofing, the shell thickness shall not be controlled by final stress requirements alone. Critical design stresses are permitted only for temporary loadings during construction, such as outfitting, towing and placing. Regardless of strength requirements, the exterior steel shell thickness shall not fall below 0.4 inches during the design life. Steel non-structural membranes shall never be less than 5/16 inch thick.

5.3.12 Corrosion Monitoring and Control

Provision for a potential future corrosion monitoring and control system may, at some point be required for the tunnel and added to the scope of work. If so, the following shall apply:

For all types of tunnel, the expected rates of corrosion for permanent exposed and unprotected steelwork during the design life shall be determined and either a sacrificial thickness of metal or protection shall be provided. Protection may include cathodic protection, preferably passive.

Each immersed tunnel element shall be provided with a corrosion monitoring system designed to enable monitoring of the corrosion condition of structural steel and/or reinforcement at or near the external surface. The corrosion monitoring system shall comprise permanent embeddable reference electrodes, reinforcement connections if relevant, reference electrode distribution boxes and monitoring facilities. In addition to

permanent reference electrodes in concrete immersed tunnels, embeddable corrosion monitoring probes shall be installed at the one third points of the immersed tunnel to monitor the ingress of aggressive chloride ions though cover concrete; the monitoring facilities for these devices shall be incorporated in the permanent reference electrode monitoring facility.

The design of the immersed tunnel elements shall provide for possible future impressed current cathodic protection of the structural steel and/or reinforcement at or near their external surface.

Each immersed tunnel element shall be electrically isolated from adjacent immersed tunnel elements and from the cut-and-cover tunnel connection structures. Utilities and pipes crossing the joints between elements and across the terminal joints shall maintain this electrical isolation. All fixings used to support metallic service pipes/ducts shall be non-metallic. Electrical isolation shall not apply to rigid joints across which an external steel plate is continuous. Each individual tunnel element shall be able to be treated as a separate entity prepared for its own cathodic protection system, which shall be able to be energized at any time in the future. This requirement applies to items to be installed in the future if and when a cathodic protection system may be required, and includes:

- anode assemblies,
- power supply (including transformer rectifiers),
- anode feed cables;
- negative return cables, and anode current distribution boards (with variable resistors).

Space within each element shall be provided for such equipment. As part of this provision, electrical continuity of the reinforcement cage within each reinforced concrete immersed tunnel element shall also be ensured.

Reinforcement connections for negative cathodic protection returns shall be provided at the internal face of the external walls. Connections shall be provided to enable electrical bonding across isolation joints in the event that circumstances arise where it would become beneficial to have certain elements or even the whole tunnel electrically continuous. To achieve this, separate connections to reinforcement and to any internal and external shell plates at each end of each element are required, together with facilities for joining any or all of the connections.

Metallic cover/fire plates fixed across immersed element joints shall be fixed to the substrate using non-metallic fixings that will remain secure in the event of a fire.. An insulating pad shall be placed at the interface between any metallic cover/fire plates if the plate is to be fixed to a metallic substrate. All other metallic connections across element joints shall be electrically isolated. This includes all service pipelines whose isolation shall be achieved by the installation of insulating gaskets at each end of the tunnel. The resistance between any cover/fire plate and a metallic substrate shall be greater than 10 ohms, measured by the four-probe method. The resistance between any cover/fire plate and the reinforcement within a concrete substrate shall be greater than 10 ohms, measured by the four-probe method.

Following welding, each connection provided for electrical bonding across isolation joints in the immersed tunnel shall be checked for continuity. The criterion shall be that the AC

resistance, measured by the four-probe method, shall be less than 0.1 ohm. Any connection failing to meet this criterion shall be re-welded.

5.3.13 Protection against Flotation

Where practicable, any structures subject to buoyant forces should be designed to resist uplift through the weight of the structure alone. Any uplift restraint devices such as tension piles or ground anchors used to prevent instability or control unacceptable movement of the structure shall be sturdy and durable for the design life of the tunnel. Details shall be submitted with the Preliminary Design. The submission shall include details of the proposed arrangement, calculations to justify the structural and geotechnical design, details of any geotechnical investigations undertaken to verify the design assumptions, and details of the means by which durability will be assured. [TR 1.15.2.I]

5.4 Immersed Tunnel

5.4.1 Load Combinations

In case of conflict with the AASHTO LRFD Specifications, the requirements of this Chapter shall govern. As shown in 5.4.1, the following 5 limit states and load combinations are selected and modified from AASHTO LRFD Specifications Table 3.4.1-1 and Section 12 to be better suited for immersed tunnel design:

- Strength I: Basic load combination for the design of immersed tunnel during normal use, under which the tunnel remains fully serviceable without damage, i.e. full performance level.
- Service I: Load combination used to check for deflection, crack control, vibration, durability, water tightness and fatigue
- Extreme Event I: Load combination used to design for most severe earthquake to ensure life safety and survivability of the structure taking progressive collapse into account. Damage can include partial failure of tunnel members which result in limited leakage and complete loss of service.
- Extreme Event II: Load combination used to design for design earthquake, ship sinking or anchor impact individually, not combined. Under such a condition the tunnel shall sustain no more than light damage and/or minor leaks, while experiencing no significant loss of service during the prosecution of repairs, i.e. partial performance level.
- Extreme Event III: Load combination used to design for a rare event for the simultaneous combination of loads shown, resulting in intermediate, repairable damage (repairable over no more than 12 months).

AASHTO LRFD Specifications Article 12.5.1 gives the limit states and load combinations that are applicable for buried structures as Service Limit State Load Combination I and Strength Limit State Load Combination I. In some cases, the absence of live load can create a governing case. For example, live load can reduce the effects of buoyancy. Refer to 5.4.4 for buoyancy check. In addition, extreme forces including earthquake, ship sinking, or anchor impact must be considered in the design of immersed tunnels. These loads are contained in the Extreme Event combinations. Other extreme events such as tsunami, accidental explosion, ice loads, vehicular collisions, flooded tunnel (fully flooded, or partially flooded) and fire shall also be addressed. These events must be

considered on a project specific basic and included in Extreme Event II load cases individually, but not simultaneously.

Structures with permanent prestressing shall be based on no tensile stress in the concrete in any Serviceability Limit State combination. In the case of segmental construction, temporary longitudinal prestressing of the immersed tunnel elements shall ensure a minimum compressive stress of 44 psi in the joints between segments.

The evaluation at serviceability limit state under normal conditions (load factor = 1.0) shall include the following conditions:

Table 5.4.1 Immersed Tunnel Permanent In-Service Load Combinations

Load Combination Limit State[a]		Strength I	Service I	Extreme Event I[b]	Extreme Event II[c]	Extreme Event III[d]
DC, WA_P, DD	Max	1.30	1.00	1.00	1.05	1.20
	Min	0.90				
DW	Max	1.50	1.00	1.00	1.05	1.20
	Min	0.65				
EH, EV, ES	Max	1.50	1.00	1.00	1.05	1.40
	Min	0.90				0.90
EL		1.00	1.00	0.00	1.05	1.00
LL, IM, CE, BR, PL, LS	Note f	1.50	1.00	0.00	0.00	1.25
WA_T		1.30	1.00	1.00	1.05	1.20
TU, *CR*, *SH*	Max	1.20	1.20	0.00	1.05	1.30
	Min	0.50	1.00			
TG		1.20	0.50	0.00	0.00	1.30
SE[e]		$\bullet_{SE}$	$\bullet_{SE}$	$\bullet_{SE}$	$\bullet_{SE}$	$\bullet_{SE}$
EQ[b,c,]		0.00	0.00	1.00	1.05	1.20
CT, CV[c,d], *IC*[c]		0.00	0.00	0.00	1.05	1.20
FR		1.00	1.00	1.00	1.00	1.00
SL[c]		0.00	0.00	0.00	1.00	0.00

Notes:

a. Load definitions, factors and combinations above are modified from AASHTO LRFD Specification (2010) specifically for design of immersed tunnel structures. Refer to Section 5.2.2 of these Criteria for details.

b. EQ used for Extreme Event I considers most severe earthquake anticipated on project specific basis (Refer to Section 5.2.2 of these Criteria).

c. EQ, CV (sinking ship or falling anchor), IC , SL and CT are considered, one at a time, in Extreme Event II. A design earthquake effect less severe than Extreme Event I is used for EQ in Extreme Event II (Refer to Section 5.2.2 of these Criteria).

d. This load case is used to check a rare event for the simultaneous combination of loads shown.

e. $\bullet_{SE}$ is considered on project specific basis. It should be determined based on the certainty that anticipated settlements can be accurately predicted.

f. For Strength I case, the load factor on vehicular-type loads shall be increased from 1.5 to 1.75 for design components where live load is the dominant transient load and may be omitted for components where this causes greater loads.

5.4.2 Loads during Fabrication, Transportation and Placement

Loads such a handling, end or side launching, transporting, incremental concrete placement during outfitting and placing, combined with environmental loads appropriate to the season, duration of use, and location, shall result in no damage. Only those extreme conditions as defined appropriate to construction shall be considered.

During fabrication, load effects caused by placement of concrete while the element is afloat or by settlements of the foundation (in case of concrete elements), and other items shall be evaluated. Some of these loads may cause locked-in stresses that must be considered together with stresses due to external loads.

Particular care must be taken during the placement of concrete while an element is afloat to ensure not only that stresses stay within limits, but also that the deflected shape due to the weight of the new concrete is within acceptable limits. At all times when the element is afloat, stresses due to waves shall be checked to ensure that all limit states are satisfied; the wave height and length used in design must be specified for each stage of construction and for towing so that measures can be taken to move the element to a place of safety when forecasts predict conditions that exceed allowable limits. If the freeboard is such that waves could run over the top of an element, this loading shall also be taken into consideration.

During transportation and while moored at the outfitting pier or elsewhere and even while in the fabrication yard, a tunnel element can be subject to wind loads that shall be considered.

The tunnel element may be suspended from lifting hooks during immersion and may be placed on temporary supports in the final location pending completion of the foundation. All limits states must be satisfied. Temporary supports if used shall be released before fill is placed. When adjacent tunnel elements are connected by shear keys or permanent horn beams, the effects due to relative differential settlements of each tunnel element during progressive filling operations must be taken into account.

Article 3.4.2 of the AASHTO LRFD Specifications provides guidance for minimum load factors to be used when investigating loads that occur during construction. The following Table 5.4.2 reflects the load combinations and load factors to be used when evaluating immersed tunnel elements for construction loads.

Table 5.4.2 Immersed Tunnel Construction Load Combinations

Load Comb. Limit State[a]	*DC, WA$_P$*	*WL EL*	*CL*	*WA$_T$*	*EQ*[b]	*WS*
Strength I	1.20	1.00	1.20	1.20	1.20	1.4
Service I	1.00	1.00	1.00	1.00	1.00	0.3

Notes:

a. Load definitions, factors and combinations above are modified from AASHTO LRFD Specification (2010) specifically for checking immersed tunnel during construction. Refer to 5.2.2 for details.
b. Construction Strength I combinations shall consider a smaller earthquake as a static load typically having a return period of 5 to 10 years.

5.4.3 Resistance Factors

Resistance factors for buried structures shall be taken as specified in Table 5..3, based on AASHTO LRFD Section 12.5.5.

Table 5.4.3 Resistance Factors for Buried Structures

Reinforced Concrete Box Structures	Cut-and-Cover and immersed	Precast Structures
Flexure	0.90	1.0
Shear	0.85	0.9

5.4.4 Buoyancy and Stability

The weight of immersed tunnel elements, including the main structure, any interior finishes and any fill present, must be designed so as to be safe and stable against movement or flotation at every stage of construction other than when flotation is required.

The minimum demand-capacity ratio (i.e. factor of safety) against uplift is defined as the ratio between the total factored stabilizing load and the total factored uplift load. Immediately after lowering into the element's final location, the negative buoyancy shall be increased, if required, to give a minimum factor of safety against flotation and overturning of 1.025 [TR 1.15.6.I]. Within a few hours of lowering and placing and ignoring assistance from adjacent elements, the minimum factor of safety against flotation and overturning shall be increased to 1.04. This factor of safety may only be reduced to a minimum of 1.025 for short periods under controlled conditions when the element is submerged in a public waterway. The Contractor may elect to use a lower factor of safety when the element is immersed in the dry-dock for initial leak checks and float-out.

Where ballast water is used to maintain negative buoyancy, a maximum water density of 62.4 lbs/cu ft shall be used [TR 1.15.6.I]. Completed immersed tunnels shall preferably have a factor of safety against flotation including any fill above the plan area of at least 1.1, and a factor of safety never less than 1.06 against flotation [TR 1.15.6.J] and overturning when fill above roof level and all removable items including surfacing are excluded. In the case of an immersed tunnel constructed in segments, the factor of safety between two segment joints shall be at least 1.04 [TR 1.15.6.J]. The calculation of stabilizing loads for the immersed tunnel shall only take into account dead load, temporary ballast water (where used), and soil vertically above the tunnel roof and toes (projection of the base slab beyond the external walls); for the minimum value, include only structural concrete, structural steel, cast-in-place items, prestressing, ballast concrete and elevated walkways [TR 1.15.6.B]. For soil vertically above the toes, a partial factor of 0.9 shall be applied [TR 1.15.6.G]. The self weight of the tunnel elements

shall be determined from the maximum density or the minimum density, whichever creates the most unfavorable effect for the construction elements under consideration [TR 1.15.6.D]. The hydrostatic load shall be determined from the maximum density or the minimum density, whichever creates the most unfavorable effect for the elements under consideration [TR 1.15.6.E]. Friction effects of overlying natural materials and fill shall not be taken into account [TR 1.15.6.G]. Where structural elements are connected, the safety against flotation shall apply to each individually.

In checking tunnel elements for stability while floating, transport and immersion [TR 1.15.6.A] due attention shall be paid to effects of variations in structural dimensions, including results of thermal and hydrostatic effects. Items to consider include:

- Sufficient freeboard for marine operations so that tunnel elements are relatively unaffected even when waves run over the top; A positive buoyancy margin exceeding 1% is recommended to guard against sinking due to variations in dimensions and densities, both of tunnel materials and of the surrounding water, and
- Cross-curves of stability shall show a factor of safety in excess of 1.4 of the area under the righting moment curve against the heeling moment curve. A positive metacentric height (static stability) exceeding 8 inch is also recommended.

The tunnel shall be released from any temporary supports onto its foundation prior to placing fill over the tunnel.

5.4.5 Vertical Alignment

The top of the immersed tunnel and any concrete or steel protection shall be no higher than the top of existing adjacent tunnel within the dredged shipping channel.

The top of the immersed tunnel protection layer shall be below the level of the existing Elizabeth River bed within the shipping channel [TR 1.15.1.C] and also below the theoretical depth of maintenance dredging, taking dredging tolerance into account [TR 1.15.4.A].

Stone protection and transition layers shall be designed to provide protection for propeller scour. The hydrographic design criteria shall be reflected in the Preliminary Design. [TR1.15.4.B]

For the design of tunnel rock protection, actions from ship propellers shall be calculated using The Rock Manual (CIRIA) and Propeller Induced Scour (Prosser), or alternative standard(s) agreeable to VDOT. [TR 1.15.16.A.2]

For the design of tunnel rock protection, the rock size shall be selected using USACE Hydraulic Design Criteria Sheet 712-1 Stone Stability or alternative standard(s) agreeable to VDOT. [TR 1.15.16.A.3]

The river bed level and profile after backfilling of the tunnel shall be in accordance to the Project environmental permit requirements. [TR 1.15.14.B]

The tunnel protection layer shall extend for the full width of the tunnel and backfill as necessary to meet the following requirements [TR 1.15.4.C]:

1. Protect the immersed tunnel and structural backfill from scour induced by ship's propellers;
2. Be designed to protect the immersed tunnel from damage caused by falling anchors, sunken or grounding ships and maintenance dredgers; and
3. Be detailed to ensure that dragging anchors break free from the layer before reaching the tunnel.

5.5 Cut-and-Cover

Unless otherwise stated in these design criteria, Cut-and-Cover Tunnels shall be designed to AASHTO Technical Manual for Design and Construction of Road Tunnels - Civil Elements, September 2010, referencing AASHTO LRFD Bridge Design Specifications.

The calculations for the cut and cover tunnels and service buildings shall consider a case with a high ground water level at the elevation shown for the 500-year flood in Table 3.1.5 with a minimum factor of safety against uplift of 1.10, and a case with extreme high groundwater level at elevation 13.0 (NAVD88) with a minimum factor of safety against uplift of 1.03 [TR 1.15.6.L]; refer to WA_T in Section 5.2.2 and Section 5.4.4 Buoyancy. Cut-and-cover structures shall also be designed to resist buoyancy during the various stages of construction.

The design of cut-and-cover tunnel structures shall consider an unbalanced lateral load condition due to possible future excavation or scour of 30% of total depth on one side of the structure. The Contractor shall, as a minimum, demonstrate by analysis that under this condition the structures will remain stable with an adequate margin of safety.

The cut and cover section of the tunnel, and associated ancillary structures, shall be protected from inundation by flooding due to breach or overtopping of the flood protection measures due to extreme high water and waves. [TR 1.15.1.D, 1.15.13.F]

5.5.1 Flood Gates

Flood gates shall be provided on the Norfolk Portal of the new Midtown Tunnel. Any alternative to flood gates shall be subject to VDOT's review and comment. [TR 1.15.1.E] Floodgates shall be designed to restrict flooding of the tunnel and adjacent egress corridor, thereby minimizing loss due to an incident involving overtopping of the external flood defenses around the portals, and to facilitate recovery from such an incident. The gates shall be so located that persons in the tunnel have access to an escape shaft or route when the gates are closed, emerging at or above elevation 13.0 (NAVD88). Hatches and egress doors at surface level shall be readily unlatched from the inside and opened by means of a key from outside. The drainage system and all ducts, cables etc., shall be designed not to allow flood water to bypass the flood gate into the interior. The flood gates shall comprise a substantial gate fabricated from steel plate and stiffening frames. The gates shall be negatively buoyant and self-draining. The gates shall be capable, with a factor of safety not less than 2.5 times the elastic limit of the material, of retaining the pressure head of water, including surges, loading it. The flood gates must be able to be closed "under flow" (while water is flowing down the approach ramps) as quickly as possible[3]. All other forces shall be assessed and considered in design. See Section 6.9 for Flood Gate systems.

[3] Design of Hydraulic Gates, by Paulo C.F. Erbisti, published by Balkema, 2004

5.5.2 Waterproofing

It is recommended that all buried structures be waterproofed on the exterior (positive side) of the structure, even if at the time of construction there is no groundwater present[4]. Exterior waterproofing systems shall be watertight and shall accommodate the anticipated movement of the structure. The detailing of penetrations shall be shown on the plans.

At boat sections, retaining walls and the ventilation structures, membranes shall be extended to the ground surface.

Invert membranes for cut-and-cover and boat section structures shall be installed on a mud mat and shall extend beyond the exterior walls to allow for lapping of the membrane after the casting of the walls. If the excavation support system forms part of the exterior walls such that the membrane cannot extend past the walls, blind side waterproofing shall be used, incorporating a fully adhered mastic, or spray coating. Panel systems and sheet blindside waterproofing, including self-adhering Bituthene and neoprene sheet, shall not be used. Spray epoxy and Polyurea coatings shall not be used within tunnels and locations where air may become stagnant due to the toxicity and flammability of the material.

In granular soils, concrete diaphragm walls (slurry walls) forming part of the tunnel or building structure shall use pure Wyoming Bentonite for the trench support to permit the formation of a mud cake to provide exterior waterproofing for the concrete diaphragm wall. The use of polymer slurry is only permissible in locations where granular soils are not present. Concrete diaphragm walls shall have plastic pipe installed in the location of the vertical wall joints to allow for injection of chemical grout if after excavation the wall joint leaks.

All expansion joints shall be detailed to be watertight and shall be designed for 150% of the anticipated movement based on the seasonal temperature changes to be experienced by the structure.

Provisions shall be made to prevent the flow of groundwater / river water through the backfill materials along the tunnel and into the approach areas, taking into consideration any increase in hydraulic connectivity which may result from temporary or permanent works. [TR 1.5.2.H]

5.6 Boat Section

The boat sections refers to the U-section structures forming the approaches and consisting of retaining walls each side structurally continuous with a slab joining the two beneath the roadway. The boat section shall be a watertight structure; no permanent dewatering provisions shall be permitted, i.e. groundwater lowering below the long term mean ground water level.

The calculations for boat sections shall consider a case with a high ground water level equal to the lower of the 500-year flood elevation shown in Table 3.1.5, or the roadway crest elevation at the end of the boat section with a minimum factor of safety against uplift of 1.10, and a case with extreme high groundwater level (EHGL) at elevation 13.0 (NAVD88) with a minimum factor

[4] Selection of construction methods should strive for complete encapsulation by waterproofing. Where rigid walls are incorporated into the structure, provision must be made for drains and other devices to keep the leakage under control. Independent internal “false” walls may be required to hide leakage and drains.

of safety against uplift of 1.03 [TR 1.15.6.L]; refer to WL_A in Section 5.2.2 and Section 5.4.4 Buoyancy.

Where diaphragms walls or secant piles are used, it shall appear to users that the required watertightness inside the boat section is achieved. The total inflow over a given area of structure shall not exceed the overall requirements and shall not exceed 0.75 fl oz/day on any individual square foot.

Boat section structures shall be designed to resist buoyancy during the various stages of construction and for the completed structure in accordance with the requirements specified herein.

The design of boat sections structures shall consider an unbalanced lateral load condition due to possible future excavation or scour of 30% of total depth on one side of the structure. Analysis is required to demonstrate that under this condition the structures will remain stable with an adequate margin of safety.

Boat sections shall be used for open-cut sections where the roadway PGL is less than the long term mean sea level or mean groundwater level [TR 1.15.2.A]. Above that level, independent reinforced concrete cantilever retaining walls may be designed. Boat sections and retaining walls shall be watertight. Boat sections may be analyzed as continuous structures on elastic foundations. If, at any location, the two walls are of unequal heights, the factor of safety against sliding shall be not less than 1.50 excluding, or 2.00 including, the passive resistance of the soil.

Wall thickness shall be designed to resist lateral earth pressure, hydrostatic pressure and surcharge effects. Grade slab thickness shall be at least 6 inches thicker than the wall thickness and shall be designed to resist uplift pressures caused by potential hydrostatic head at that location. At the last U-section segment away from the portals, a depressed approach slab shall be provided.

5.7 Protection Against Flooding

Protection shall be provided against catastrophic inundation of approaches and tunnels by floodwater due to storm water runoff and from the combined effects of water levels, storm surge, and wave effects, including tsunami. Account shall be taken of long term global rise in mean sea level and long term ground lowering. For tunnels protected by flood gates, the approach structures may be allowed to flood once water reaches the roadway crest elevation or the top of the boat section walls. In such cases, the approaches shall be designed to safely carry the additional water weight trapped in the approaches, assuming the ground water outside has returned to elevation 0.0 (NAVD88).

The height and shape of surrounding walls and the elevation of all entrances and openings to the buildings and tunnels shall be determined such that entry of water under these conditions is prevented. Calculations shall be based upon a probability of the flood defense being overtopped (including wave action) as defined by WA_T in Section 5.2.2 of this Criteria. Data may need to be extrapolated.

5.8 Miscellaneous Structures

5.8.1 Sea Walls

Sea walls shall be designed for a service life of not less than 50 years. Sea walls and sea-wall scour protection shall be designed for the maximum wave and current based on an annual probability of 1%. The wave-absorbing function of any protection shall remain intact despite damage due to maximum waves and water levels based on the EHWL used for the structure concerned (refer to WA_T in Section 5.2.2 of these Criteria). Design of protection measures shall take into account the likely formation of any vortices, including secondary (horseshoe) vortices and clapotis at vertical walls. Coastal protection shall be designed according to U.S. Army Engineer Waterways Experiment Station (WES), Coastal and Hydraulics Laboratory (CHL) Coastal Engineering Manual (CEM), 2002 or similar. Sea walls shall be designed to prevent loss of soil and fill either through or beneath the wall.

The design surcharge loads for sea walls shall be based upon the intended use of the adjoining area following construction. As a minimum, the sea wall shall be designed for any expected construction surcharge loads, as well as a minimum design surcharge load of 600 lb/ft^2. The sea wall shall be designed for lateral soil pressure assuming active earth pressure. The sea wall design shall consider differential water pressure (tidal lag) based on the type of wall used and the sea wall details. Sheeting, if used, can be designed assuming passive earth pressure on the outboard side of the wall, with a minimum factor of safety of 1.5. The sheeting shall be provided with an anchorage system, if required, with sufficient capacity to restrain lateral displacement of the sea wall. A minimum factor of safety of 2.0 shall be applied to the passive earth pressure used for the design of a deadman anchor. The anchorage system design, including corrosion protection measures, shall be consistent with the design life for the sea wall structure.

Gravity-type quay walls, if used, shall be designed as retaining walls. If the required bearing support is not available, the wall shall be founded on piles, provided the piles do not apply any load to the tunnel structures. Sea walls shall be protected against corrosion and deterioration due to exposure to the marine environment. Protection measures shall be provided consistent with the design service life for the structure. Sea wall structures shall not be connected to the tunnel structure or directly bearing on the tunnel structure. Sea walls shall be provided with fenders to protect against damage from vessel impact wherever such impact is possible. The design ship weight and impact velocity shall be based on the size of vessel capable of berthing against the wall. The sea wall shall not be used for ship berthing or mooring unless designed for such loads.

New sea walls shall be designed to tie into existing adjoining sea wall structures. New sea walls and any protection thereto shall be designed to be similar in shape to that removed.

5.8.2 Temporary Shore Protection

Slopes around casting basins, graving docks, etc., shall be stable, with damage of less than 2% of any protection layer for maximum waves and water levels based on an annual probability not exceeding 10%. The wave-absorbing function of any protection shall remain intact during construction despite damage due to maximum waves and water levels based on an annual probability not exceeding 1%.

Scour protection shall be stable during construction for maximum waves and current based on an annual probability not exceeding 10%. The extent of protection shall be sufficient to ensure insignificant damage at the edges under similar conditions.

5.8.3 Retaining Walls

Retaining walls founded on footings on soil or rock shall be designed for a minimum factor of safety of 1.5 against sliding, and a minimum factor of safety of 3.0 against overturning. In addition, retaining walls founded on soil or rock shall maintain the resultant of all forces on the base within the middle one-third and middle one-half of the footing width respectively. The maximum bearing pressure at the toe of the wall footing shall not exceed the allowable bearing capacity of the foundation soil or rock. Passive earth pressure at the toe of the wall footing shall be ignored.

5.9 Tunnel Finishes

5.9.1 Tunnel Architectural Finishes

5.9.1.1 Introduction

The tunnel architectural elements include: Approach roadway elements, including retaining walls, U-wall walls, portals, and interior tunnel finishes elements such as walls, ceilings, walkways, and egress system door way, corridors and egress stairs. The architectural elements shall be designed to serve their intended purpose and function in the tunnel environment.

5.9.1.2 Codes, Standards, Guidelines and References

The following codes standards and guidelines serve as the basis for the design:

- National Fire Protection Association (NFPA) 502, Standard for Road Tunnels, Bridges, and Other Limited Access Highways.
- National Fire Protection Association (NFPA) 101, Life Safety Code
- Virginia Department of Transportation, Facilities Design Manual
- Virginia State Building Code, most recent edition
- U.S. Occupational Safety and Health Administration (OSHA)

5.9.1.3 Design Elements

The architectural design in vehicular tunnels is primarily directed at the following:

- Creating an easily seen and unobstructed egress path to safety in the event of a fire or other emergency in the tunnel
- Helping to provide an efficient access and circulation for first responders
- Assisting in the integration of various tunnel finishes, lighting systems, egress elements, signage, and other systems into a coherent whole.
- Creating a visually unified and pleasing environment for the motorists.

The range of architectural design elements includes the following:

- Highway Architecture: Approach roadway elements, including retaining walls, U-wall walls, portals, and interior tunnel finishes elements such as walls, ceilings, walkways, and egress system door way, corridors and egress stairs.

- Tunnel finish related items including but not limited to:
  - Fire protection systems and motorist aid cabinets
  - Maintenance/Safety Walk Railings
  - Egress recesses, accesses and doors (swinging and sliding)
  - Fire alarm pull stations
  - Miscellaneous metal covers, plates and connections for utility pull boxes, illuminated exits signs, etc.
  - Signage for doors, cabinets, telephones and other elements

5.9.1.4 Design Considerations

The design considerations for the architectural elements and finishes include the following:

Aesthetic: The selection, integration, and implementation of the architectural elements shall be done with sensitivity to the existing tunnel as much as possible. The current project shall be sensitive to the existing aesthetic style and complement it in architectural features, finishes, and ornaments.

Driver Safety and Orientation: Textures, colors and patterns of roadway structures, and of tunnel ceiling, walls, and walkways shall be designed to create safe exterior and interior driving environments for the motorist and assist driver orientation. Architectural finishes shall provide lane definition, assist in the legibility of signage through sign placement, and support easy identification emergency exits to the egress corridor.

Ease of Maintenance: Selection of finish materials shall include those which are durable and economic to maintain. This includes tunnel surfaces which are easy to clean with standard tunnel wash equipment, and resist corrosion related to entry of water into the finishes and connections. Materials shall be impact resistant as far as is practical and shall be easily replaceable in the event of damage.

Graphics: The design and integration of graphics with the roadway and tunnel finishes shall provide a pleasing aesthetic experience for drivers while supporting functional requirements, including the following considerations:

- The graphics shall provide visual interest but not be a distraction to drivers. The architectural design shall provide overall integration of primary and secondary structures, their materials, and connections between them.
- The graphics shall convey information regarding orientation and the location of emergency tunnel facilities. In particular, the location of emergency egress facilities and fire protection cabinets shall be clearly identified. Specific graphics shall be developed to provide clear guidance for evacuating motorists once inside the emergency egress corridor.

Wall reflectivity: Wall reflectivity in the tunnels shall be 30% to 60% including any graphic design.

5.9.2 Tunnel Finishes

5.9.2.1 Tunnel Ceilings and Walls

Requirements for tunnel ceilings and walls shall include the following:

Finish materials and colors: Tunnel wall finishes shall be plain unfinished concrete. Tunnel ceiling shall be plain unfinished fireproofing board extending down to the base of the fillet on the walls, or 5’ below the ceiling on vertical walls.

Doors and frames for egress corridor, and egress stairs: Stainless steel, Type 316. A fire rating of 2 hours is included as part of the criteria. Doors and frames shall comply with Steel Door Institute (SDI) “Recommended Specifications: Standard Steel Doors and Frames” (SDI-100) and shall be fabricated to comply with SDI-117, “Manufacturing Tolerances, Standard Steel Doors and Frames.” Rated doors shall comply with NFPA #80 and have fire resistance characteristics which meet acceptable performance requirements when tested in accordance with ANSI/UL 10B7 and NFPA #252; labeled and listed by U.L., Warnock Hersey, or Factory Mutual approved.

Coordination with mechanical and electrical systems, including devices for concealment of conduit, fireproofing, standpipes, etc., shall be performed during preliminary design. These devices shall be designed to be lightweight and easily removable for easy access to utilities.

Maintenance walkway railings and handrails: Type 316 Stainless steel tubes or galvanized steel tubes 1½” diameter. Height shall be 3 feet-6 inch minimum.

Fire hose valve cabinets: Stainless steel, Type 316, minimum 16 gauge, with hinged doors and tamper alarm..

Signage for egress stair doors, fire hose valve cabinets, motorist aid cabinets, and other elements within the tunnel and egress system: Graphics shall comply with Fire and Life Safety Committee requirements. Material shall be porcelain enamel on steel, complying with “Specification for Architectural Porcelain Enamel on Steel for Exterior Use” – Porcelain Enamel Institute, PEI S-100(65) inorganic coating bonded to metal by fusion at temperatures above 1400 Fahrenheit.

Interior finish in tunnels, boat wall sections and all stairways shall be ASTM E84 Class A (flame spread, 25 or less; smoke development, 100 or less) throughout.

5.9.2.2 Tunnel Emergency Egresses and Stairs

Requirements for tunnel emergency egresses and stairs shall include the following:

Finish materials and colors: Walls and ceilings shall be plain unpainted concrete. Lighting Fixtures: The selection and placement of lighting fixtures shall be coordinated with the requirements of NFPA 502 and NFPA 101.

Signage/Graphics: Uniform signage and graphics shall be developed to concisely direct motorists and emergency responders within the egress corridors and exit stairways. Guardrails and handrails shall be stainless or galvanized steel.

5.9.2.3 Entrance and Exit Portals

The Midtown Tunnel has one entrance and one exit portal. The portal design theme shall be consistent with that of the overall architectural design and shall emphasize common characteristics in order to:

- Maintain a uniformity of perception in the driving experience and visually ease the transition from boat wall section to tunnel.
- Maximize the tunnel entrance recognition by the driver.
- Coordinate with Mechanical/Electrical/Plumbing systems to embed or otherwise conceal conduit, fireproofing, standpipes, etc, from the view of motorists.
- Blend in aesthetically with the U-wall sections and other tunnel ancillary structures, especially those on the surface.

The entrance portal should be instantly recognizable and shall be designed to support tunnel lighting design criteria which call for enhanced lighting levels at the threshold in order to minimize the “black hole effect”, which is the perceived contrast between the relatively dark interior of the tunnel and the bright exterior daylight. Architectural design features which support and enhance illumination of the tunnel threshold shall be incorporated.

The exit portal is seen by the driver as the transition between the relatively dark interior of the tunnel into the light exterior and are not normally viewed from the exterior except in the rear view mirror.

5.9.2.4 Boat Wall Sections

Boat wall sections are formed when both edges of open roadways run below grade. The minimum height of boat wall sections is generally established by the required datum levels for the flood risk area. The boat wall section architecture shall be consistent with the aesthetic treatment of the other elements.

Architectural requirements for the boat wall section design shall include the following:

- Design integration of the boat wall walls, and boat wall battering with the overall project design criteria.
- Coordination of lighting, lighting pilasters, and embedded utility cabinets with the overall section design.
- Design and integration of boat wall rustication strips with the overall design.
- Other ornamental graphics or elements.

The architectural integration shall maintain a uniformity of perception in the driving experience, visually ease the transition from open road to portal, and blend in with the architecture of the neighboring structures. This includes finishes and colors of the various elements.

5.9.2.5 Tunnel Egress

This section provides a system of tunnel egress criteria to:

- Protect those who use the tunnel and other related structures, including motorists, maintenance workers, and emergency personnel.
- Create the design and integration of a tunnel evacuation system with a logical and clearly marked path of egress from the tunnel, U-wall sections, and any ancillary structures to safe refuges.
- To protect roadways, structures, equipment, and ancillary buildings or spaces so as to minimize the occurrence and consequence of a fire incident.

This section outlines the general guidelines to be used for the egress considerations for the Midtown Tunnel project. Applicable codes, standards, and other sections of the project Design Criteria establish the basic design criteria for individual systems. The prevailing standard for the tunnel egresses is National Fire Protection Association Standard for Roads, Tunnels, Bridges, and Other Limited Access Highways (NFPA 502).

5.9.2.6 Egress Assumptions

Tunnels: In the event of a fire in a tunnel, traffic downstream of the fire will continue to exit the tunnel while incoming traffic is stopped.

Clearly marked egress doors shall be provided at the roadway level and lead to a 2-hour protected egress passageway.

5.9.2.7 Tunnel Occupant Load Calculations

In roadways, the normal occupant load shall be a multiple of persons per lane per 1000 feet of length.

Tunnel occupant load calculations shall incorporate the following assumptions:

- A single incident occurs in the tunnel.
- Traffic downstream of the incident continues to exit the tunnel.
- Occupants from vehicles in the immediate area of an incident may utilize available egresses to access the egress corridor.

5.9.2.8 Egress Design Criteria

The primary means of egress from the tunnel during a fire incident is assumed to be via the roadway back toward the entrance portal. An additional means of egress shall be via an NFPA compliant egress path consisting of a fire-rated corridor with egress stairs leading to an area outside the tunnel.

It is assumed that individuals who are unable to self rescue will require assistance to gain access to the egress systems and the egress stairs. This assistance is assumed to be offered by other motorists and by emergency responders as part of a specifically developed Emergency Response Plan. Areas of refuge for such individuals will supplement other parts of the egress system.

Tunnel Egress Stairways will be used to provide a continuous protected route to grade for tunnel users. Tunnel Egress Stairways shall be located near the portals and shall be integrated with emergency response locations.

- The minimum actual clear width of all tunnel stairways shall be 44 inches. Allowable projections into this clear width shall be 1.5 inches maximum for stair stringers and 3.5 inches maximum for handrails on each side.
- Areas of refuge for slower evacuees shall be provided at each stair landing. These areas shall be 22 inches in depth and extend the full width of the stairway.
- A protective building shall be provided at the top of tunnel stairways; tunnel stairways will exit to areas leading to safety as part of an overall evacuation plan. No stairway shall exit to a surface area between active roadways.
- Panic hardware shall be provided on the inside of all exit doors.
- Design minimum headroom in tunnel egress stairways shall be 6’-8”.

6 Tunnel Systems

All electrical/lighting related work shall be designed to comply with the requirements and recommendation of the following standards, regulations, and codes, as relevant:

- Manual of Uniform Traffic Control Devices (MUTCD)
- American Society of Testing and Materials (ASTM)
- American National Standards Institute (ANSI)
  - RP-8 Recommended Practice for Roadway Lighting
  - RP-22 Recommended Practice for Tunnel Lighting
- ANSI / ASHRAE / IESNA 90.1, Energy Standard for Buildings
- Association of Edison Illuminating Companies (AEIC)
- Technical Manual for Design and Construction of Road Tunnels, FHWA
- Federal Communication Commission (FCC)
- Illuminating Engineering Society of North America (IESNA)
  - Handbook HB-9, Recommended Practices RP-8, RP-19, RP-20, RP-22, RP-33, Technical Memoranda TM-3, TM-10, TM-11, TM-15 Design Guides DG-4, DG-5, DG-13
- International Electrical Testing Association, Inc. (NETA)
- National Electrical Safety Code ANSI C2 (NESC)
- National Fire Protection Association (NFPA)
  - NFPA 20 Standard for the Installation of Stationary Pumps for Fire Protection
  - NFPA 70 National Electrical Code
  - NFPA 72 National Fire Alarm Code
  - NFPA 78 Lighting Protection Code
  - NFPA 101 Life Safety Code
  - NFPA 502 Standard for Road Tunnels, Bridges & Other Limited Access Highways
  - NFPA 780 Standard for the Installation of Lighting Protection System
- Occupation Safety and Health Administration Standards (OSHA)
- Underwriters Laboratories, Inc. (UL)

Additional standards, regulations, and codes applicable to specific systems are listed under the relevant system headings.

6.1 Tunnel Lighting System

The lighting design for the tunnel, approach roadways, and ancillary spaces shall comply with the latest applicable codes, regulations, and standards of ANSI/IESNA, CIE, AASHTO, NFPA, and UL.

6.1.1 Tunnel Lighting Control System

The use of lighting controls can greatly improve the ability of the tunnel lighting system to adapt to changing daylight conditions so that when approaching and entering the tunnel, it is easier to ascertain conditions directly beyond the entrance of the tunnel. A typical lighting control scheme is depicted in the following table:

Control Level	Illumination Level as a	Sensor Setting – cd/m^2

		ON Increasing Light	OFF Decreasing Light
1	4	0 – 50	35 – 0
2	10	50 – 200	180 – 35
3	35	200 - 800	700 – 180
4	60	800 – 4,000	3,800 – 700
5	100	4,000 - Above	Up to – 3,800

A luminance sensor, lighting contactors or a solid-state switched fixture, controller, and a controller cabinet are the necessary components of a lighting control system. A luminance sensor (L_{20} type meter shall be used) measures the luminance of the portal in the direction of traffic. The controller shall also incorporate the ability to monitor up to 3 luminance sensors (similar to above) located throughout each tunnel bore, to monitor the maintained luminance level. When any of the luminance meters sense that the lighting level is less than a specified set point, the system shall provide an alert identifying need for maintenance to the lighting fixtures.

Fixtures on opposite sides of the tunnel shall be supplied by separate panel boards. These separate panel boards shall, in turn, be connected to switchgear busses normally energized from alternate electrical services A and B. Luminaires shall be connected to alternate phases of the circuit to ensure that if one phase is lost, only 33 percent of the total lighting fixtures served by the three phase circuit are affected; also that loads are balanced. To prevent the tunnel from being cast suddenly into complete darkness by simultaneous loss of power from all utility power sources, selected fixtures in a row of luminaires on the nighttime level circuit, as determined by NFPA 502, shall be connected to a UPS (uninterruptible power supply) system.

6.1.2 Tunnel Lighting Fixtures

All luminaires within the tunnel must be watertight and corrosion resistant to protect their interiors from periodic high-pressure (100 psi) wash downs of the tunnel environment (walls and ceiling). All luminaires used within the tunnel areas must be UL listed for wet locations and for direct spray applications. Manufacturers chosen to supply tunnel roadway luminaires must have a successful history for use within vehicular roadway tunnels. Clear documentation of previous experience is to be submitted, prior to approval of luminaires. Dissimilar metals used in the fixture, or between the fixture and its anchorages or conduit shall be separated by appropriate means to prevent corrosion.

6.1.3 Tunnel Egress Corridor, Egress Stairwells, and Ancillary Spaces

In the tunnel emergency egress passageway and other ancillary spaces, fixtures shall be surface or pendent mounted and suitable for wet locations. The body of the luminaire shall be constructed of either stainless steel or extruded aluminum that has a zinc rich undercoat and a polyester powder coat paint finish baked on to ensure against chipping and cracking. Fixtures shall be provided with 1/8-inch thick acrylic lenses and shall operate two 4000K T8 fluorescent lamps.

Circuiting for egress passageways shall be designed in accordance with requirements of the National Electrical Code. Control for each area shall be from respective panelboard only.

In order to make the emergency exit doors adequately visible and to familiarize the driver with their positions and geometry, the maintained average vertical illuminance at all times on the door and on an area of tunnel wall extending to 6 ft beyond the projected door frame of the emergency exit passageway or, outlining the actual opening in the tunnel wall, should be not less than four times the adjacent wall illuminance or 10 lms/ft2. The overall uniformity (average/minimum) of illuminance on this area should be not less than 2.0. The light sources used for this lighting shall have a color rendering index of Ra • 60.

The emergency lighting system shall be designed in accordance with NFPA 502 to maintain the required level of illumination throughout the means of egress. The system shall utilize a selected number of lighting fixtures provided as part of the general illumination, and be connected to a UPS system.

Exit sign lighting fixtures shall be wet location, wall or bracket mounted at a mounting height visible to all occupants within the occupied spaces. Exit sign lighting fixtures shall be single or double face with 8-inch red stencilled letters. Directional arrows shall be provided as required. Exit sign lighting fixtures shall be connected to the UPS system.

6.2 Traffic Signals and Controls

6.2.1 Closed Circuit Television (CCTV)

Cameras for tunnel and approach roadways shall generally have heavy duty pan, tilt and zoom (PTZ) capability. NEMA 4X rated. Barrel type color cameras shall be used within the tunnel and approaching roadways. Cameras shall have the following additional attributes:

- solid state design
- vandal resistant enclosure
- automatic focus lenses with auto-iris
- PTZ controllable via TSCS from the control rooms
- Auto-PTZ controllable for preprogrammed circumstances based upon SCADA system alarm inputs
- no blooming when facing headlights
- Low light black and white mode
- Digital “flipping” function

A rigid mounting of the cameras is essential to provide vibration-free images on the monitors in the control room. Where cameras must be mounted on towers, the towers and enclosures must be designed to withstand a 100 mph wind load and still maintain a usable image.

If not attached to sign support structures, cameras in the tunnel shall be located on the upper wall near the ceiling, over the maintenance walkway. An alternate location is above the center of the roadway, unless the section of roadway covered by the camera

is on a curved alignment, in which case the camera shall be placed on the outside of the curve.

The exact location of each camera shall be determined through the above criteria tempered by the presence of overpasses, signs, or other objects which may obstruct view of the target roadway area. Default PTZ orientation is to face downstream, with traffic flow. Camera placement shall permit full coverage of the tunnel interior assuming the failure of any single camera by the use of adjacent cameras on either side.

Cameras shall also be provided to monitor the interior of the egress corridor.

Multiple monitor screens shall be provided in the OCC. One or more screens shall cycle all the cameras at least every 60 seconds, while at least one other shall display a single picture as selected by the OCC Operator (TR 1.16.10.A.3).

Interface to the SCADA system shall be provided that shall cause the view from the camera nearest to an alarm event to be displayed automatically in the control rooms when certain events such as those listed below are alarmed:

- Opening of a fire cabinet door.
- Opening of a door to access the emergency egress corridor from the tunnel roadway.
- Activation of a tunnel roadway located fire emergency pull station.
- Activation of the tunnel closure stop signals.
- Motorist emergency telephone placed off hook.

Real time recording feature shall be provided to permit simultaneous recording of the images from any two cameras. Recording shall commence automatically in the case of any of the events listed above. The operator shall also be able to start recording manually and stop recording any time.

Every CCTV image shall include an information banner that shall include the camera's identification and location and date and time in Universal Time Coordinated format. Operator shall be able to suppress this information when viewing the pictures but not amend or delete it.

System shall be scalable and expandable to allow future addition of cameras or monitors.

6.2.2 Lane Control Signals

Lane Control Signals shall be located along the tunnel walls and over the roadway at the tunnel portal approaches at regular intervals to indicate the status of each travel lane.

Design and operation of the lane use signal (LUS) system shall be in conformance to the Manual on Uniform Traffic Control Devices (MUTCD), Chapter 4J. Lane-Use Control Signals, latest edition, and ITE Vehicle Traffic Control Signal Head.

Each lane use signal head shall be independently controlled to indicate the status of each lane and shall be fully interlocked to prevent any possible conflicting indications..

Signal heads shall be 12-inch high double aspect light emitting diode (LED) displays.

Each Signal head display shall provide the following indications according to the latest version of the MUTCD:

- Steady green arrow (↓) indicating vehicle traffic may travel in lane
- Steady amber (X) indicating that a lane control change is being made
- Steady red (X) indicating vehicle traffic shall not travel in or enter lane
- Blank

Interval spacing between signal heads in the tunnel shall be adjusted in areas where sight distance is restricted due to roadway alignment and/or other factors. For example, signal heads shall be more closely spaced on curves than on tangent sections within the tunnel to compensate for sight distance limitations. The specific spacing shall be computed based on horizontal and vertical curvature with the signal located outside the clearance envelope.

The LUS display sequence for a lane closure shall use a minimum of 2 amber “X” indications before 2 red “X” indications. The spacing of the LUS shall support the MUTCD and the Department‘s maintenance of traffic standards and requirements for setup distance for a “lane closure and buffer zone”. The minimum spacing of lane use signals shall be designed for a speed of 35 mph.

All LUS system equipment shall be identical at each location within the tunnel and shall be completely interchangeable.

The bottom of the lane use signal head housing shall be mounted above the established Minimum Vertical Clearance Height.

LUS location shall be coordinated with the location of other tunnel systems to ensure minimal conflicts.

Each LUS within the tunnel shall be visible from at least one CCTV camera.

The LUS display elements shall incorporate LED’s with variable output levels to ensure that the required legibility distances are maintained under all ambient light conditions, as established by the photo sensor control. All LUS shall use identical display technology.

In the blank state, under all lighting conditions including direct sunlight, the display elements shall neither emit nor reflect any discernable light.

All state changes shall be completed within 100 milliseconds of receipt from the command at the input terminals. The LUS default state in the absence of any input shall be blank.

At least 50 percent of the light output of each pixel shall be maintained within a 12 degree cone centered on the optic axis. Pixel size and spacing shall provide legibility distance of 50 feet per inch of character height within this cone.

The LUS case shall enclose the display elements and withstand a wind loading of 110 mph.

The LUS case assembly shall be rated NEMA 3S.

The LUS case assembly shall not require an external air intake for cooling and shall completely protect internal components from airborne moisture, smoke and acid components, dirt, salt, dust, pressure spray, and other contaminates.

Construction and component mounting of the lane use signal system equipment shall be installed such that no damage is caused by vibration and shock during mounting, and normal operation on mounted support structure. Equipment shall be immune to EMI

signals generated in the tunnel environment due to proximity to other tunnel electrical, mechanical and communications equipment.

The LUS System shall be monitored and controlled from both the remote operations control room and the local on-site operations control room.

Manual control of the LUS system shall also be provided at the local field controllers.

6.2.3 Overheight Vehicle Protection (OVP)

The OVP system detection height shall be based on AASHTO required vertical clearance within the tunnel. The OVP system shall locate receiver/transmitter pairs along the roadway such that the paths between each transmitter-receiver pair shall be parallel such that the beams between the pairs shall define a plane parallel to the detection height.

OVP units and structures shall be located completely outside the travelled way.

The OVP system shall operate in conjunction with other TSCS components. In the event of an interruption of the beams crossing the roadway in the appropriate sequence, the detector controller shall activate a downstream message, and an audible alarm and strobe light shall warn the driver of the overheight vehicle and provide instructions. An alarm shall also be generated at the Operations Control Center

The OVP shall not be triggered by direct sunlight, strobes, and rotating beacons, windshield reflections, fog, and snow.

The OVP enclosure shall be rated NEMA 4X.

Procedure for stopping non responsive drivers to alarm indication and enforcement of violating vehicles shall be addressed in the Incident Response Plan.

6.2.4 Dynamic Message Signs (DMS)

Full matrix signs shall be provided in the tunnel and tunnel approaches at regular intervals above the travel lanes to display instructions and emergency messages to motorists.

The signs shall be based on arrays of white LEDs on a black background, visible in bright sunlight and dimmable to suit the full range of ambient lighting conditions.

Sign messages shall be remotely programmable by the OCC operators through the TSCS system.

6.3 Testing and Commissioning

All electrical, traffic control, and communication systems shall be thoroughly tested following a formal commissioning process. This process will include the assignment of a Commissioning Agent (CxA) who is independent of the design team. The CxA will work with the team to review the design at 50% and 90% levels and provide comments that may affect the commissioning process. The CxA will also prepare the commissioning plan to include a commissioning schedule, and the following forms for each equipment and system to be commissioned: start up forms, pre-functional testing forms, functional testing forms, and integrated testing forms. These forms will be given to the trade contractors for implementation. The CxA will use a sampling process for quality

assurance during the testing and commissioning phase. During the commissioning process the CxA will develop and maintain a commissioning action log, conduct regular commissioning meetings to review the log, and then relay the issues to the project manager for resolution.

6.4 Power Distribution

6.4.1 Incoming Medium Voltage (MV) Supplies

Electrical power for the tunnel systems shall be obtained from two independent incoming medium voltage supplies, designated 'A' and 'B', one at each end of the tunnel, with tie-lines through the tunnel connecting split busses at either end via automatically operated circuit breakers. Each of these supplies shall be capable of supporting the entire load, but normally shall serve approximately half of the normal tunnel electrical load, and be arranged such that if either fails (or for maintenance purposes, taken out of service), the entire tunnel electrical load will be served from the other. Switchgear at either end shall be interlocked such that it will prevent inadvertent connection of the two supplies. Necessary cables, transformers, switches, circuit breakers, etc. of each supply shall be separated from each other to the maximum practicable extent.

6.4.2 Primary Switchgear

The switchgear assembly and all components shall be arc – flash protected, designed in accordance with the latest applicable standards of ANSI, NEMA and IEEE, and to comply with the engineering and operating requirements of the Electric Utility. The switchgear assembly shall have sufficient short circuit and impulse withstand capability, as determined from a short circuit/coordination study. Provisions shall be included in the design to accommodate the required SCADA functions to permit remote operation of selected breakers, and remote monitoring and/or alarming of electrical system conditions and breaker positions.

The switchgear shall be installed within an area of each building designated as "SWITCHGEAR ROOM". This room shall be provided with sufficient filtered air, free of moisture, to maintain the ambient temperature below a maximum of 40 degrees Centigrade (104 degrees Fahrenheit).

Primary switches, where required, shall be metal-enclosed load-interrupter type, fused or unfused as required, designed for a fault close and withstand rating as determined by system fault calculations.

Dry-type Power transformers shall be UL listed, ventilated, self-cooled/forced-air-cooled, cast coil or vacuum pressure impregnated (VPI) insulated suitable for indoor installation and step-down of the incoming medium voltage service to the required utilization level voltage. Transformers shall be located within interior rooms provided with sufficient filtered or dust free air, free of moisture, to maintain a maximum ambient temperature of 40 degrees Centigrade (104 degrees Fahrenheit). Wherever feasible, transformers should be joined to primary and secondary switchgear in unit substation configurations.

The total electrical load on this equipment, including the lighting and ventilation systems, shall be split approximately 50/50 between the 'A' and 'B' supplies so that if one supply fails, only 50% of the system capacity will be initially (momentarily) disrupted, until the transfer scheme executes, thereby supplying loads from the failed source from its alternate source.

Cabling, transformers and switchgear associated with 'A' and 'B' supplies shall be physically segregated to the maximum practicable extent.

6.4.3 480/277 Volt Switchgear

480/277 Volt switchgear shall consist of circuit breakers positioned in a metal-enclosed, free-standing enclosure together with all associated meters, relays, instrument transformers, heaters, control power transformers, breaker handling mechanism, and other accessories as required to provide a complete and operable switchgear assembly. In general, the switchgear shall be arranged for attachment to a transformer enclosure as a component of a unit substation.

The switchgear shall comply with the latest applicable standards of ANSI, NEMA and IEEE.
Provisions shall be included in the design to accommodate the required SCADA functions of remote operation of selected breakers, and remote monitoring and alarming of electrical system conditions and breaker positions.

Main and tie circuit breakers in double-ended substation alignments shall be electrically interlocked to prevent both transformers from being paralleled. Additionally, electrical interlocks shall be provided as required to fulfill operational conditions. In addition, mechanical interlocks shall be provided to ensure personnel safety under all conditions of operation and maintenance. Indoor switchgear shall be installed within an area of the building set aside for electrical switchgear and assured of a supply of filtered air, free of excessive moisture, to maintain an ambient temperature of 40 degrees Centigrade (104 degrees Fahrenheit) or less.

The total electrical load on this equipment, including the lighting and ventilation systems, shall be split approximately 50/50 between the 'A' and 'B' supplies so that if one supply fails, only 50% of the system capacity will be initially (momentarily) disrupted, until the transfer scheme executes, thereby supplying loads from the failed source from its alternate source.

Cabling, transformers and switchgear associated with 'A' and 'B' supplies shall be physically segregated to the maximum practicable extent.

6.4.4 Standby Power Systems

This section establishes the basic design criteria for providing standby power from engine generators or uninterruptable power supplies (UPS) to selected loads to ensure continued operation if all normal utility power fails. The system shall be configured such that a single point of failure shall not disable the entire standby power system.

6.4.4.1 Standby Generator Units

Standby generators shall be diesel engine-driven. Generator output shall be 480/277 Volts, 60 Hertz, three phase, four wire, and kW capacity as determined by the design calculations. Both prime mover and the generator shall be capable of operating satisfactorily while supplying a load ten percent in excess of the net continuous rated generating capacity for two continuous hours out of any 24 consecutive hours. The rated net capacity for each standby generating unit shall be defined as the gross electrical power output of the generator minus total electrical power requirements of electric motor driven engine accessories included on the engine assembly.

In general, one standby generator at each building should be sufficient to supply the load. If two or more standby generators/building is required, consideration should be given to the advantages and disadvantages of parallel operation.

If Natural Gas from the local utility distribution system is considered as the emergency fuel source, the Designer shall consider the risks of an interruption in the gas flow during emergency operation. Regardless of fuel type, if storage tanks are used sufficient tank storage shall be provided at each location to support 3 days of continuous operation including 2 days under emergency loading. Storage tanks shall conform to all City, County, and Commonwealth of Virginia regulations. The system shall conform to NFPA 30 and NFPA 37. Fuel type shall be such that exhaust emissions comply with environmental standards. The cooling system shall be designed to discharge heat outside of the building within which the standby generator is to be installed. The generators shall be provided with appropriate silencers. Exhaust shall be to the outside of the building.

The design shall provide a means for periodic testing of standby diesel-generators at a minimum load equal to at least 40 percent of the generator nameplate kW rating. Loading may be achieved either by providing for means of applying normal/standby loads to the generator output, or by operating a load-bank provided for that purpose. Diesel-driven generators shall be designed to start up and be capable of accepting applied load within 10 seconds after initiation of start-up. The prime mover shall be started electrically, drawing power from a starting battery which shall serve no other purpose than engine starting. Standby generators shall be designed to start up by either manual initiation or automatically. The loss of normal power at the automatic transfer switch shall cause the associated standby generator(s) to start up automatically and assume the load if the normal power interruption continues. Where required, loads shall be arranged for sequential starting.

Automatic transfer switches shall be mechanically held, electrically operated by a single-solenoid mechanism energized from the source to which the load is to be transferred. They shall conform to UL 1008 and rated for all classes of loads when installed in an unventilated enclosure. Accessory features shall be selected to best suit each application. The units shall be provided with manual bypass-isolation switches. Automatic transfer switches shall include neutral poles with "make-before-break" operating characteristics.

6.4.4.2 Standby Switchboard

480/277 Volt standby switchboard shall be an indoor type, metal-enclosed, self-supporting structure. Switchboard shall be of compartmentalized design with individually mounted devices in the distribution sections. It shall accommodate the various low voltage protective devices, such as molded case circuit breakers and draw-out type air circuit breakers together with all associated meters, relays, instrument transformers, control power transformers and other accessories to provide a complete and operable assembly. The switchboard shall comply with all applicable provisions of UL 891 and NEMA PB-2.

Design for the standby power systems shall include the auxiliary devices (transducers, contacts, interposing relays, etc.) necessary to interconnect the required monitoring, control and alarm functions to the SCADA system.

6.4.4.3 Uninterruptible Power Supplies

This Section establishes the basic design criteria for the application and selection of uninterruptible power supplies (UPS) for selected loads. UPS units shall provide uninterruptible electrical power to designated loads. The following are typical loads that are connected to UPS systems:

- Traffic surveillance and control system (TSCS) equipment
- Communications, supervisory control and data acquisition system, and fire detection and alarm systems
- Selected tunnel, utility room, egress corridor and egress stair lighting
- Illuminated escape signage
- Power outlets in fire cabinets
- Selected building lighting

Battery protection time shall be for 30 minutes so that supply to these systems shall be maintained seamlessly in the event of a failure of the standby generator (TR 1.16.14.B.3).

Without exception, the "normal" electrical power service to loads which are provided with UPS shall be backed-up by a "standby power system" as described under “Standby Power Systems” preceding. The UPS units shall be designed to operate "on line" such that when normal power fails, the batteries will provide power for a designated period through the inverter output. If a UPS malfunctions, a static switch shall automatically connect the load directly to the normal supply while simultaneously opening the inverter-output circuit breaker. A maintenance by-pass shall be provided to manually transfer the load to the normal supply for routine service or maintenance of the UPS.

The UPS shall be sized for the specific type of connected loads including non-linear loads in accordance with the requirements of NFPA 502 and NFPA 101. Individual dedicated UPS shall be provided for lighting, building HVAC,traffic signal equipment, and roadway traffic signal equipment. Harmonic distortion of the output wave form from the UPS shall be less than the maximum harmonic distortion acceptable to the equipment served. Each UPS storage battery shall be of the sealed, maintenance free type, and have sufficient capacity to supply rated output for the designated period following loss of "normal" power. The UPS equipment enclosure shall be suitable for the environment in which it is to be installed, recognizing that heat buildup and moisture act to diminish the reliability of a UPS unit.

UPS units shall, wherever feasible, be located in spaces which are relatively dry and adequately ventilated with clean air. This criterion must be weighed against the desirability of locating UPS units as close as possible to the load served, so as to reduce to a minimum the length and exposure of DC wiring and the UPS output wiring. Provision shall be made for the required monitoring, control and alarm functions to the SCADA system.

6.4.4.4 Roadway Raceway Systems

This section establishes the basic design criteria for raceway systems for roadways including tunnels, U-Wall Sections, open roadways, elevated highways, and associated ancillary spaces and cross passages.

The systems shall include underground and exposed raceways in roadways and also incoming and outgoing raceways from roadways to associated buildings. The raceway

systems shall consist of duct lines encased in concrete or exposed conduits, and provided with manholes, handholes or pull boxes as the means of accessibility for cable installation and subsequent maintenance. All electrical conductors within such accessible enclosures shall be completely fireproofed. The raceway systems shall consist of separated sets of duct runs for different service classifications. This will permit alternate service cable to be installed with the assurance that if one cable fails, service can be maintained on the other. The raceway system(s) shall comply with the more stringent requirements of NFPA 70, ANSI C2, all pertinent Department Manuals and Guidelines, and all applicable local codes.

6.4.4.5 Design Requirements

Duct lines shall have a continuous slope downward toward manholes, handholes, or pull boxes, and away from buildings, with a pitch of not less than three inches in 100 feet. Where grades are flat or crest between manholes, a single slope will usually require too much depth in one of the manholes. In this event, slope the ducts from the crest area to both manholes. The duct lines shall be constructed of individual conduits encased in concrete. Conduits shall be separated by a minimum concrete thickness of two inches. Reinforcement of the duct bank shall be provided where required.

Raceways shall be routed in straight lines to the maximum extent possible. Bends, where required, shall be of the long radius type, consistent with other determining factors. Include a minimum of 25 percent spare ducts for future expansion and/or required modifications. Spare ducts shall be provided with a pulling wire. Dead end ducts shall be capped and left with sufficient length to allow for future continuation.

6.4.4.6 Materials

Tunnel roadway area raceways encased in concrete shall be fiberglass reinforced epoxy (FRE) conduit. All exposed raceways in the tunnel roadway area shall be rigid galvanized steel (RGS). Exposed raceways in the utilidor, or other ancillary areas, separated from the tunnel roadway area by a fire rated barrier, may be fiberglass reinforced epoxy (FRE) conduit, or rigid galvanized steel (RGS) conduit. All life safety or emergency type circuit conductor routed in the tunnel roadway area, in exposed raceways, shall utilize 1 hour fire rated type cable systems.All conduits from manholes, handholes, and pull boxes to ancillary spaces, pump stations, and buildings shall be RGS. Final connections to the lighting fixtures and equipment shall be liquid-tight flexible metal conduit. All conduits crossing expansion joints shall be provided with suitable water-tight expansion or expansion/deflection fitting(s) and bonding jumpers. Fittings shall be suitable to be encased in concrete applications. Schedule 80 PVC conduits will be allowed only for underground installation, outside of the tunnel proper. Empty conduits shall be provided with plastic pull wire having not less than 200 pound tensile strength.

6.4.4.7 Manholes, Handholes, and Walkway Pull Boxes

Manholes, handholes and walkway pull boxes may be pre-cast or cast-in-place. Pre-cast manholes shall be of a design which, upon assembly or placement, offers integrity against water intrusion equal to that of cast-in-place manholes. Concrete for manholes, handholes and walkway pull boxes shall be designed for a minimum 28-day compressive strength of 3,000 psi. Manholes, in general, should have minimum dimensions of six feet wide, eight feet long, and six feet inside clear height. Actual

dimensions and shape shall be as required for each application. Manholes may be applied on any underground raceway system. Manholes shall be designed for a minimum of HS-20 truck loading per AASHTO.

Handholes and/or walkway pull boxes may be used for utilization voltage systems and for alarm, communications and signal systems. Handholes shall be designed for heavy duty traffic loading. Frames shall be designed to accept round covers wherever feasible, 27-1/2 inch diameter access minimum. Rectangular covers, where required, shall be equipped with flush hinges. Frames and covers shall be waterproof type designed to support heavy duty traffic loading. Covers shall have "VDOT", and the service ("POWER", "COMMUNICATIONS", etc.), cast into the upper surface. All metal covers shall be bonded to their frames.

Manholes, handholes and pull boxes shall be designed to include a full complement of hardware, e.g. racks and hooks, cable support insulators, pulling eyes, and grounding provisions, all suitably bonded. Raceways shall enter manholes, handholes and pull boxes at right angles wherever possible, and terminate in end bells. Consideration should be given to the desirability of providing a drain in each manhole, handhole and pull box. Alternatively, provide a sump pocket in each manhole. Two adjacent manholes serving different raceway systems shall be nested to the extent feasible by abutting adjacent walls.

Embedded pull boxes and junction boxes can be employed in the following roadway raceway systems:

- Low voltage systems (480/277 Volts and below)
- Alarm, communication and signal systems.

The environmental conditions for each such application shall be noted and a design shall be provided that is compatible with the expected exposure. The design of embedded pull and junction boxes shall fulfil the following requirements:

Sized to facilitate installation and removal of wires and cables, and allow for sufficient cable slack to accommodate cable expansion and contraction.

Covers shall be designed to prevent entrance of liquids that may impinge upon or collect on the cover due to tunnel wash down, splashing, or similar causes.

Covers shall be sectionalized, if necessary, to facilitate removal and replacement, with due consideration given to the location of the respective boxes and the means of access thereto.

6.4.4.8 Specific Design Calculations

The raceway systems for medium voltage cable shall be designed such that cable pulling tensions and sidewall pressures are not exceeded in any run. Calculations shall be prepared for pulling tension and sidewall pressure for each run. Where acceptable limits on tension or sidewall pressure are exceeded under certain conditions of installation, the design shall clearly indicate the installation method by which acceptable values are to be achieved; e.g.:

- Use of pulling eyes instead of pulling grips
- Pulling cable into a duct bank from a designated direction
- Shorten distance between manholes, or pull boxes

- Increase bend radius of ducts.

Cable manufacturer's stated values of maximum tension and sidewall pressure are not to be exceeded.

For installation of three single conductor cables of equal diameter, the "jam ratio" of duct inside diameter to single conductor cable outside diameter shall be considered. A ratio from 2.8 to 3.0:1 shall be avoided.

6.4.5 Supervisory Control and Data Acquisition (SCADA) System

A comprehensive supervisory control and data acquisition (SCADA) system shall be established to permit monitoring and controlling of key elements throughout the facility, including any remotely located equipment or facilities, from the OCC.

The architecture of the SCADA system shall employ a fail-safe topology. Each programmable logic controller (PLC) shall be designed with a redundant “hot-standby” configuration, capable of seamless transfer of data upon failure of the main processor. Additionally the programmable logic controller shall be equipped with redundant power supplies.

The SCADA system shall employ a universal remote input/output network protocol, allowing different network devices the ability to communicate with the programmable logic controller. Remote input/output (RIO) cabinets shall be distributed throughout the facility in order to minimize hardwire cable runs between field devices and the SCADA system. Each remote input/output cabinet shall be designed to accommodate the required number of points for the digital input (DI), digital output (DO), analog input (AI), and other data modules as needed, with an additional fifty percent (50%) spare of each point type (DI, DO, AI, etc). The remote input/output cabinet shall be housed in a NEMA 4X cabinet sized to accommodate the required number of input/output modules (including spares).

The design of major mechanical and electrical equipment shall incorporate provisions for communication, control, and indication, via normally-open and normally-closed contacts, transducers, and auxiliary relays, to provide control/indication. SCADA requirements for those items of mechanical and electrical equipment are described in those associated sections.

System shall consist of communications networks, servers and operator interfaces. The communications network shall consist of dual fault tolerant, redundant fiber optic ring topology with management switches at each node.

Servers shall be provided operating on a hot standby basis.

Operator interfaces shall be provided at the remote control room and local to the tunnel, with different levels of system access protected by password for “guest”, “operator”, “supervisor” and “engineer”. System shall also handle and manage data logging and transfer for alarms, alerts and record keeping for historical purposes.

6.4.6 Fire Alarm and Detection System

A fire alarm and detection system shall be provided for the tunnel and support buildings in compliance with NFPA 72 and 502.

The tunnel shall be provided with manual pull stations located along the roadway at intervals complying with NFPA 502. The tunnel shall also have a linear heat detection

system capable of monitoring each lane. The linear heat detection system shall be a subsystem to the main fire alarm control panel.

The support buildings and other ancillary areas such as pump rooms shall be provided with automatic detection means such as heat and smoke detectors, along with pull stations. Annunciation of a fire condition shall be through horn/strobes in these areas only.

The tunnel fire suppression system shall have a monitoring connection to the main FACP.

The main FACP shall be an addressable type, with the use of intelligent devices, or in areas not environmentally suitable, the use of conventional devices with monitor modules located in hospitable environments.

6.5 Tunnel Ventilation System

6.5.1 Introduction

The tunnel ventilation system is required to provide a safe and tenable environment for motorists in the tunnel during all expected conditions including flowing traffic, stopped traffic, and congested traffic. The tunnel ventilation system shall also be designed to mitigate the effects of smoke and heat during an incident involving a fire to facilitate the safe evacuation of motorists and fire fighting operations.

6.5.2 Codes, Standards, Guidelines and References

The following codes standards and guidelines serve as the basis for the tunnel ventilation system design:

- National Fire Protection Association (NFPA) 502, Standard for Road Tunnels, Bridges, and Other Limited Access Highways.
- American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE) Handbook, Chapter 13, Enclosed Vehicular Facilities
- Air Movement and Control Association International, Inc. (AMCA), AMCA 201 Fans and Systems
- AMCA 202 Troubleshooting
- AMCA 203 Field Performance Measurements
- AMCA 210 Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
- Air Movement and Control Association (AMCA) Standard 250, Laboratory Methods of Testing Jet Tunnel Fans for Performance
- Air Movement and Control Association (AMCA) Standard 301-06, Methods for Calculating Fan Sound Ratings from Laboratory Test Data
- Environmental Protection Agency (EPA) Requirements for Highway Projects
- Governing EPA and Federal Highway Administration Ambient Air Quality Regulations

The following references will be utilized for the tunnel ventilation system design:

- Fire and Smoke Control in Road Tunnels, PIARC
- Systems and Equipment for Fire and Smoke Control in Road Tunnels, PIARC
- Road Tunnels, An Assessment of Fixed Fire-Fighting Systems, PIARC

6.5.3 Design Requirements

A detailed engineering analysis shall determine the required installed ventilation capacity, quantity of jet fans necessary, fan duties and size and fan motor power requirements in order to meet the design criteria for normal traffic and fire emergency conditions as defined herein. The design of the ventilation system shall include redundancy to allow for the loss of system capacity due to heat damage to a single fan during a fire incident. The tunnel jet fans shall be mounted in the upper region of the tunnel and shall not be obstructed on the intake or discharge sides by other tunnel fixtures, lighting or signage.

The tunnel jet fans shall be provided with sound attenuators that reduce jet fan noise such that with all fans operating, the sound levels do not exceed 85 dBA at a height of 5 feet above the tunnel roadway for normal operating conditions and 92 dBA for emergency operating conditions. Additionally the fan and sound attenuators shall be selected such that the sound levels at the lot line of any receptor shall be in accordance with the criteria limits within the City Code for both the City of Norfolk and the City of Portsmouth. The tunnel jet fans shall be tested and rated in accordance with the latest edition of Air Movement and Control Association (AMCA) Standard 250, “Laboratory Methods of Testing Jet Tunnel Fans for Performance”. The sound power level ratings of the jet fans shall comply with the latest revision of AMCA Standard 310, “Methods for Calculating Fan Sound Ratings from Laboratory Test Data.”

The tunnel jet fans and their related components shall be designed to remain operational while exposed to an environment and an air stream minimum temperature of 482ºF for 1 hour. The fan brake horsepower curve shall not exceed 100% of the motor nameplate rating at any point along the fan curve. The fan motor shall be sized such that the density associated with winter conditions does not cause the fan brake horsepower to exceed the motor nameplate horsepower rating. Accordingly, an air density of 0.0785 lbm/ft3, shall be used for the winter conditions and represents dry air at temperature of 46ºF.

The tunnel ventilation system shall be designed to meet the following requirements:

6.5.3.1 Tunnel Traffic Configuration

- Normal traffic consisting of two travel lanes in the eastbound direction in the existing Midtown Tunnel and two travel lanes in the westbound direction in the new Midtown Tunnel.
- Evacuation traffic consisting of four travel lanes operated in a single direction to facilitate emergency evacuation route planning by state and regional planners.

6.5.3.2 Pollutant Concentrations

The tunnel ventilation system shall be designed such that the pollutant levels in the tunnel do not exceed the following criteria:

Pollutant	Limiting Value
Carbon Monoxide (CO)	120 ppm* for up to 15 minutes 65 ppm for up to 30 minutes 45 ppm for up to 45 minutes 35 ppm for up to 60 minutes
Oxides of Nitrogen (NO_x)**	
Nitric Oxide (NO)	25 ppm
Nitrogen Dioxide (NO_2)	3 ppm
Haze	K=0.005 1/meter***

* *Denotes Parts per million*

** *The main constituents of NO_x are NO and NO_2. (The NO and NO_2 limiting values are time weighted averages for an 8 hour period.)*

****K is an extinction coefficient which is a measure of the amount a light beam is attenuated.*

6.5.3.3 Design Fire Heat Release Rate

The tunnel ventilation system for the New Midtown Tunnel shall be designed based upon a design fire heat release rate of 100 Megawatts (MW) for the New Midtown Tunnel. The fire rate of growth curve for the design shall be the ultrafast growth curve indicated within NFPA 92B.

6.5.3.4 Smoke Control

The tunnel ventilation system shall be designed to control the effects of smoke and heat from a 100 MW fire to facilitate the safe evacuation of people and fire fighting operations. Critical velocity is the minimum steady state velocity of the ventilation air moving toward a fire that is necessary to control backlayering of smoke from the fire. The critical velocity calculation shall be determined in accordance with NFPA 502 Appendix C, Critical Velocity Calculations. The ventilation system analysis shall include the effects of adverse wind of 12 miles per hour acting upon the exit portal and the ventilation system design must meet the critical velocity criteria while overcoming the effects of the adverse wind at the exit portal.

The tunnel emergency egress corridor shall be equipped with a ventilation system that pressurizes the corridor so as to preclude smoke from a tunnel fire from entering the corridor. The design of the emergency egress corridor ventilation system shall take into account the tunnel pressure profile due to the operation of the tunnel ventilation system.

6.5.3.5 Portal Area Pollutant Concentrations

The tunnel ventilation system shall be designed such that the ambient pollutant levels in the area just outside the tunnel exit portal do not exceed allowable local and national ambient air quality standards.

6.5.3.6 Portal Area Noise Levels

The tunnel ventilation system shall be designed such that the fan noise levels outside the tunnel do not exceed the criteria limits specified within the City of Norfolk City Code and the City of Portsmouth City Code.

6.5.3.7 Tunnel Ventilation Control System

The tunnel ventilation control system shall be such that the jet fans can be operated and monitored remotely at both the Operations Control Center and from a redundant remote operations control location, via the tunnel supervisory control and data acquisition (SCADA) system.

- **Normal Operating Modes**

  The tunnel ventilation control system shall be programmed to operate automatically with multiple fan operating modes to efficiently maintain the tunnel pollutant levels. Time weighted average measurement data for carbon monoxide, nitrogen dioxide, and haze/visibility shall be used for monitoring and initiating the necessary ventilation system response to meet the specified carbon monoxide (CO), nitrogen dioxide (NO2), and visibility/haze levels.

- **Fire Emergency Mode**

  The tunnel ventilation control system shall be programmed with the Fire Emergency Mode(s) as necessary to mitigate the heat and smoke resulting from a design fire size at any location within the tunnel. Fans furthest from the fire site will activate first so as to initially avoid disruption of the smoke layer. The emergency ventilation control system shall be integrated with the automated operation of all required fire/life safety systems such as strobe lights, dynamic message signs, lane usage signs, portal traffic control signals, egress corridor PA system, etc.

6.5.3.8 Tunnel Air Quality Monitoring System

The tunnel environmental monitoring equipment shall consist of sensors located throughout the tunnel, to monitor and record the tunnel atmosphere/environment for carbon monoxide (CO), nitrogen dioxide (NO2), and visibility/haze. The output signals from these systems shall be incorporated in the tunnel ventilation control system and used to maintain the tunnel environmental criteria as specified. The system shall consist of multiple zones, each zone consisting of a control panel with analyzers that will connect back to a remote master panel located at the operating control room utilizing the SCADA system. Upon exceeding the preset concentrations, the ventilation system shall initiate and an alarm will be sent to the Operations Control Center to alert the operator and an automated ventilation system response will be activated. The tunnel ventilation system shall also be manually operable in response to excessive pollutant levels.. There shall be a minimum of four sampling locations in the tunnel. These sampling points shall be at equal spacing throughout the tunnel with the last point located within approximately 100 ft from the tunnel exit portals. Sampling tubing will be run from the zone control panels containing the gas sensor/analyzers to the sample points. Each zone panel and

analyzer shall be located in a protected area. The gas sampling system shall draw samples from multiple entry points and pass the gas across the sensor/analyzer. Visibility sensors shall also be provided at each air sampling location.

6.6 Tunnel Fire Fighting & Suppression Systems

6.6.1 Introduction

Fire extinguishers and the tunnel standpipe system are used to fight fires in the tunnel while the fixed fire suppression system in the tunnel is used to contain the effects of fires thereby minimizing the hazard to life and damage to the structure. This section establishes the design criteria to be used for these fire fighting and suppression systems for the new tunnel.

6.6.2 Codes, Standards, Guidelines and References

The following codes standards and guidelines serve as the basis for the design, installation, inspection, testing and maintenance of the fire protection systems:

- National Fire Protection Association (NFPA)
  - 502 Standard for Road Tunnels, Bridges, and Other Limited Access Highways, plus Addenda
  - 25 Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, plus Addenda
- American Society of Mechanical Engineers (ASME)
  - B31.1 Power Piping

6.6.3 Required Systems

The tunnel fire suppression systems shall consist of::

- Standpipe system for fire fighter use.
- Fixed Fire Suppression System (FFSS) for immediate activation by tunnel operations personnel.
- Fire Extinguishers for small fires.

6.6.4 Water Supply

The primary water supply for the fire suppression systems shall be from the municipal service. The water supply system shall be capable of supplying the system demand resulting from concurrent operation of the standpipe system and the fixed fire suppression system for a minimum of one hour. A fire pump shall be provided if it is determined that the water supply is insufficient to meet the system demand requirements. Coordinate with the supplying water and sewer Utilities to establish their requirements for piping, valves, backflow preventers, etc.

6.6.5 Piping Design

Piping systems shall be designed with appropriate flexibility at locations where the piping systems traverse changes in structure type and construction/movements joints such as the interface between cut-and-cover tunnel and immersed tube tunnel structures or any other interfaces where unequal settlement is possible.

The piping design, fabrication and installation shall comply with the requirements of ASME/ANSI B31.1 Power Piping.

6.6.5.1 Fire Pumps

Should fire pumps be necessary the fire pump shall be automatic and shall be provided in accordance with NFPA 20.

6.6.6 Identification and Signage

A signage system shall be developed for all components of the fire suppression systems as required by NFPA 502. The signage system shall be developed in conjunction with, and have final approval of, the Fire and Life Safety Committee. The fire hose connection stations, fire department connections, all valves, and all components of the fire suppression systems shall be clearly identified with signs permanently marked and constructed of weather resistant metal or rigid plastic materials.

6.6.7 Freeze Protection

- Piping systems containing water that are exposed to temperatures below 40 degrees F shall be analyzed to determine if freeze protection is required.

- Piping systems requiring freeze protection shall be protected by: heat tracing with insulation, heat, circulation or any combination thereof or other suitable means..

6.6.8 Standpipe Systems

The tunnel standpipe system shall be a Class 1 system utilizing 2-1/2 inch hose valves that are available for fire fighter use. No fire hoses are to be provided. No smaller hose valves and hose, typically available for untrained user operation shall be provided.

The standpipe system shall be designed as a network allowing any hose valve to be served from any supply connection. Each egress door location shall include one hose connection for the tunnel and it shall be located adjacent to the door. The standpipe hose connection stations shall be located on the egress corridor side of each tunnel. A drain line connecting the standpipe main to the tunnel drain system shall also be provided.

The hose connection station protective enclosure shall be constructed of 316 stainless steel and shall be of adequate size to facilitate safety and ease in connection of the fire hoses and operation of the hose valves and quick and easy removal of the fire extinguisher. The enclosure shall be alarmed such that opening of the enclosure transmits an alarm to the operations control room via the SCADA system, indicating the location and type of enclosure that has been opened.

The standpipe may be wet or dry. If a dry system is used, the fill time shall be less than ten minutes. This requirement may be waived with the concurrence of the AHJ if it can be shown that the estimated fill time will still result in water being available to fire fighters before they would arrive at the hose valve location.

6.6.8.1 Standpipe System Flow

The tunnel standpipe system shall be capable of flowing 750 gpm from the three hydraulically most remote fire hose valves.

6.6.8.2 Standpipe System Residual Pressure

The flow requirements shall be supplied at 100 psi residual pressure at the hose valve. A fire department pumper supplying a 150 psi pressure boost may be considered in demonstrating compliance with this requirement.

6.6.8.3 Maximum Residual Pressure

The maximum residual pressure shall be no higher than 175 psi. Each hose connection station shall have two 2-1/2” hose connections with an external thread in accordance with NFPA 1963 unless otherwise dictated by the responding fire departments.

6.6.8.4 Fire Hose Connection Stations

The fire hose connection stations shall consist of a protective enclosure that houses the hose valves and a 20 pound multipurpose fire extinguisher. The fire department hose connections shall be spaced such that no location in the tunnel is more than 150 feet from the hose connection. The distance between hose connection stations shall not exceed 275 feet. Hose connection stations shall be provided at each tunnel egress corridor door, providing service to the tunnel.

6.6.8.5 Fire Hose Valve

Fire hose valves shall be brass and UL listed for the intended service. If a dry system is used and UL listed valves for dry service are not available, then valves listed for wet pipe service are permissible. Pressure restricting valves are required where the residual pressure exceeds 125 pound per square inch. Pressure regulating valves are required where the residual pressure exceeds 150 pounds per square inch

6.6.8.6 Fire Department Connections

A fire department connection to the standpipe system shall be provided at both ends of each tunnel to provide the means to connect the fire department pumper. The fire department connections shall be located such that they are accessible by the responding apparatus and within 100 feet of a fire hydrant or other approved water supply. The location of the fire hydrants shall allow unimpeded access and shall be coordinated with the primary responding fire departments.

6.6.9 Fixed Fire Suppression System

The tunnel fixed fire suppression system (FFSS) shall be a deluge water spray fire suppression system comprised of multiple zones. The system shall be able to be operated remotely from the Operations Control Center. The individual zone deluge activation valves shall be capable of both remote and local operation. The fixed fire suppression system shall be independent of the fire standpipe system.

The design zone area for the FFSS shall be 100 feet long by the tunnel width. Zones shall be configured such that a fire at the edge of a zone can be fully covered by operation of adjacent zones.

6.6.9.1 Performance Requirements

The FFFS shall be classified as preventing the spread of fire. The minimum design density to accomplish this shall be 0.20 gallons of water per minute per square foot of area. This value may be reduced based on analysis showing that the objective of fire spread prevention is attained.

6.6.10 Portable Fire Extinguishers

Portable fire extinguishers shall be provided in accordance with the requirements of NFPA 502.

The fire extinguishers shall be co-located with the hose connection stations as specified, and shall be located on the egress corridor side of the tunnel.

6.6.11 Construction

The tunnel fire standpipe and fixed fire suppression systems shall be installed and constructed in a complete manner and shall include all of the components necessary to provide a complete and operable system which includes, but is not limited to, pipe, hangers, hardware, fire pumps, valves, enclosures, hardware, signage and other related equipment. The tunnel fire standpipe and fixed fire suppression systems must be installed and constructed with the requirements of other related performance specifications as applicable that are a part of these Contract Documents.

6.6.12 Commissioning

The tunnel fire standpipe and fixed fire suppression systems shall be tested in accordance with the requirements of NFPA. Coordinate all system testing with the AHJ. Submit all test procedures and test reports to the Department and the AHJ for review.

Fire department and operations personnel shall be trained in the operation of these systems.

6.7 Tunnel Drainage Systems

6.7.1 Introduction

Storm water drainage systems are required at the tunnel portals to intercept and discharge stormwater that accumulates along the approach roadways outside the tunnel portals. A separate tunnel drainage system is required to collect water flow inside the

tunnel that results from tunnel washing, operation of fire suppression systems, and normal seepage that is anticipated based upon the water tightness of the tunnel structure and to discharge the collected effluent to an appropriate receiving system. The tunnel drainage system also is necessary to prevent spills of hazardous or flammable liquids from propagating along the length of the tunnel.

Tunnel drainage effluent is considered to consist of water contaminated with detergents, particulates, and minor oily waste that are not legally permitted to be discharged through open outfall; therefore it is required to be discharged in accordance with local environmental permitting requirements. Coordination with the local utility agencies will be performed as needed to obtain the necessary permits for discharge to the system, and determine the pump station effluent treatment requirements of the receiving agency.

6.7.2 Codes, Standards, Guidelines and References

The following codes standards and guidelines serve as the basis for the design of the drainage systems:

- National Fire Protection Association (NFPA)
  - 502 Standard for Road Tunnels, Bridges, and Other Limited Access Highways, plus Addenda
  - 70 National Electric Code
- Federal Highway Administration, Highway Engineering Circular
  - 12 Drainage of Highway Pavements

6.7.3 Design Requirements

The proposed tunnel drainage system shall be designed to collect and discharge effluent based on a capacity equal to the tunnel seepage plus the greatest of washdown water, fire fighting or storm water inflow.

- Wash down water - The quantity of water resulting from tunnel washing can vary in the range of 150 to 500 gpm depending on the maintenance equipment used.
- Fire Fighting - Water inflow from a fire-fighting event is determined from the fire suppression system design flow.
- Fuel Spill - In the case of a fuel spill, the pumps would be shut down so as to contain the spill within the pump station in order that it may be collected and legally disposed of as hazardous material.

Tunnel Seepage - Normal amounts from structural seepage are generally less than 1 gallon/minute/1,000 feet of tunnel. Refer to Structural Criteria for water tightness. Stormwater Inflow – Storm water inflow shall be determined by the total accumulation of water from a 50-year rain storm with ten minute duration onto a paved area equivalent to the width of each portal approach roadway over a distance extending 25 feet outside the portal. Water inflow rate from flood gate leakage shall be considered as a separate case independent of the above inflow rates and shall not be a consideration when determining the capacity of the drainage system.

The proposed portal drainage systems shall be designed to collect and discharge storm water based upon a 100 year storm event occurring over the area served by the portal area drainage systems.

6.7.4 Drainage System Configuration

The drainage system configuration shall consist of a collection system, a pump station, and discharge piping as described herein. The basic components of the drainage collection system shall consist of grated drop inlets along the roadway piped directly to the low point pump station as well as miscellaneous gravity drains that drain onto the roadway from the maintenance walk, egress corridor, conduit gallery, gutters and pull boxes.

The drop inlet grates located along the roadway shall be securely bolted to the inlet boxes to prevent them from dislodging.

The basic components of each pump station consist of pumps, discharge piping, and all necessary controls and alarms. The discharge piping from each pump station shall serve as the path for the effluent to be pumped to a common transfer pumping station located outside the tunnel. The transfer pumping station will serve as the final location of the drainage prior its discharge to an approved sanitary or industrial wastewater sewer system and will house any pre-treatment equipment necessary to treat the tunnel drainage water to meet the requirements of the receiving sanitary sewer system. The portal pump stations are not required to provide any pre-treatment prior to discharge since this effluent is solely storm water.

6.7.5 Drainage Components and Piping Design

The roadway drainage collection system includes but is not limited to, cast iron grated roadway drop inlets, piping, manholes, junction boxes, flexible connections, and cleanouts. The roadway inlet grates shall be positively secured and fastened to the drop inlets. The grates, drop inlets and manholes shall be heavy duty and designed for a minimum of AASHTO HS-20 truck loading. The grated drop inlets shall be spaced at maximum intervals of 75 feet to accommodate cleaning between inlets. The roadway inlet grates shall be located on the low side of the roadways, or both sides of roadways with normal crown sections. The inlet box and frame shall be provided to allow for a minimum of +/-3 inch vertical adjustment and +/-2 inch horizontal adjustment. The main gravity drain pipe shall be a minimum diameter of 10 inches.

Individual gravity drains shall be provided for the maintenance walk, egress corridor, conduit gallery, gutters and electrical pull boxes or hand holes where necessary. Transverse drains shall be provided at the entrances of the egress corridor that are at or below the roadway elevation, and shall be located outside of vehicle travel lanes. Drains shall be provided in the electrical pull boxes or hand holes that are located at a low point. There shall be gravity drains located at each end of the gutters on the walkways that are adjacent to the egress corridor doorways. The miscellaneous drains located on the high side of the roadway super elevation shall be piped directly to the main drain to prevent water from traversing across the roadway. The miscellaneous drains located on the low side of the roadway super elevation may drain directly to the roadway. The miscellaneous drains shall be a minimum diameter of 3 inches.

The pump station forced discharge pipe shall serve as the means for the pump station effluent to travel from the low point pump station to the transfer pump station. Manually operated drain valves shall be provided to allow the forced discharge line to be drained for maintenance.

Means shall be provided to allow the discharge line to be flushed with clean water to prevent sediment build-up.

The piping systems shall be designed to allow for the movement of the piping systems where tunnel sections are joined and to allow for unequal settlement of individual tunnel sections, such as the interfaces between cut-and-cover tunnel and immersed tube tunnell, or any other interfaces where unequal settlement is possible.

The discharge piping design, fabrication and installation shall comply with the requirements of ASME/ANSI B31.1 Power Piping.

Piping systems containing water that are exposed to temperatures below 40 degrees F shall be analyzed to determine if freeze protection is required. Piping systems requiring freeze protection shall be protected by: heat tracing with insulation, heat, circulation, or any combination thereof or other suitable means.

6.7.6 Pump Stations

The pump stations shall be designed and constructed consisting of pumps, controls, piping, valves, fittings, atmospheric monitoring systems, ventilation, pump station control systems and other elements necessary to provide a complete and operable pumping system. The pump station configuration shall incorporate features for ease of maintenance including permanently mounted hoisting equipment to facilitate removal/replacement of the pumps and equipment. Where necessary, access manholes shall be located in the center of the travel lanes, away from the wheel track area of the travel lane and shall be designed for a minimum of 20 ton truck loading.

6.7.7 Pumps and Controls

The pump stations shall have non-clogging main pumps. Electric pump motors shall be immersible for up to two weeks and still remain operational. The pump control system shall be provided with circuit breakers, control switches, and starters.

The pump control system shall automatically operate the pumps. The operational sequence shall include rotation and sequencing functions to equalize the pump run times. Low level shall shut all pumps off to prevent the pumps from running dry. As the water level rises the lead pump shall start. If the water level continues to rise, additional pumps shall start. Starting of the last pump shall also energize a high water level alarm. The pump control system shall rotate the first “on” motor and then the remaining motors during successive stopping of the pumps.

All pump station alarms shall be both audible and visual and shall indicate locally and be transmitted to the Operation Control Center. The pump control system also shall communicate key operational status and data to the Operations Support Facility via the SCADA system.

The pump control system shall allow sufficient time between pump starts to prevent overheating the pump motors. The local pump control panel shall be stainless steel, NEMA 4X rated and shall be located in a secure designated room adjacent to the pump station, and shall be easily accessible from the walkway. The pump control system shall

be suitable for the wet environment and be electrically isolated through intrinsically safe relays.

6.7.8 Pump Station Ventilation and Hydrocarbon Monitoring

The sump areas and wet wells shall be considered hazardous locations due to the potential collection of petroleum based fuels and oils. The pump room and all components and equipment shall be designed to comply with the requirements of NFPA 502 and the National Electric Code for a Class I, Division II type hazard location.

The pump station shall be designed and constructed with ventilations system that provide a minimum of six air changes per hour to the pump room and wet well. A dedicated fan system shall be used to ventilate the pump station. The system fan shall maintain positive pressurization in the pump station areas, and shall provide relief via a duct that discharges back into the tunnel environment. The pump station ventilation system shall be constructed of 316 stainless steel material and shall be provided with motor operated bubble tight isolation dampers that automatically return to the closed position when the supply fan is off.

The ventilation system shall be controlled by a timer and a hydrocarbon based vapor detection system that includes a manual override. The hydrocarbon based vapor detection system shall be installed in the pump room and shall include hydrocarbon detectors installed in the sump pit and wet well areas. The hydrocarbon detection system shall provide an alarm in the event petroleum vapors are present. The alarm shall be annunciate locally and shall be connected to the tunnel SCADA system for remote annunciation at the Operations Control Center. The hydrocarbon detection system shall start the ventilation system upon high hydrocarbon levels and shall shut down all pumps should the pump station hydrocarbon levels exceed safe values.

6.7.9 Drainage Transfer Station (DTS)

The DTS settling basin shall be designed to be a common transfer facility to receive the effluent from the LPPS. The DTS shall consist of a settling basin and/or surge tank, pumps, controls, piping, valves, fittings, atmospheric monitoring systems, ventilation, and other elements to provide a complete and operable pumping system. The transfer station configuration shall incorporate features for ease of maintenance and include a hoist system to facilitate for removal/replacement of the pumps and equipment.

The DTS settling basin and/or surge tank shall be designed to retain the full design flow condition and be provided with a manually operated valve to facilitate draining down for cleaning.

The settling basin and/or surge tank shall be sized to provide a minimum pump run time of 5 minutes. The surge tank sizing and pump selection shall include allowances for the water that drains from the pump discharge pipe.

6.7.10 Storm Water Pump Station (SWPS)

The storm water pump station shall be designed and constructed consisting of a wet well, pumps, controls, piping, valves, fittings, atmospheric monitoring systems, ventilation, pump station control systems and other elements necessary to provide a

complete and operable pumping system. The pump station configuration shall incorporate features for ease of maintenance including permanently mounted ladders, and gasketed equipment hatches, and a hoisting system to facilitate removal/replacement of the pumps and equipment. The pump station access hatches or shall be located in accessible locations for ease of maintenance.

The SWPS wet well shall be designed to retain any inflow for a minimum of ninety seconds at full design flow condition. A bar screen shall be provided in the wet well to protect the pumps against damage from any large floating objects that may enter the system. The bar screen shall be 316 stainless steel with 2 inch by 2 inch openings and shall be sectionalized for ease of installation and removal. The bar screen shall be mounted on an incline with access from above to allow for cleaning from above. The wet well shall be provided with a manually operated valve to facilitate draining down for cleaning.

The wet well chamber shall be sized to provide a minimum pump cycle time of 10 minutes. The pump size and station capacity shall be determined in accordance with Section 3.1 of these Criteria.

6.8 Communications

6.8.1 Service and Emergency Telephones

Service telephones shall be located in fire cabinets, and also at the portal fire panels if the panels are required per the Fire Life Safety Committee. Emergency telephones located along the tunnel wall at Motorist Aid Cabinets shall be configured to automatically ring to the Operation Control Center when the handset is lifted from the cradle.

Instrument design shall allow and intelligible conversation to take place with background noise from traffic in the tunnel with the tunnel ventilation system operating.

The system shall be served by two separately located telephone controllers, with each controller serving alternate instruments so that every other instrument will be operational if one controller becomes disabled.

The operator shall be able to hold calls from, or call back to, any individual telephone on the system.

6.8.2 AM/FM/HAR and First Responders Radio Frequency Rebroadcast

The general public, through the use of their own automobile radios, shall be capable of receiving 530 - 1600 KHz AM, as well as 88 - 108 MHz FM, standard rebroadcast while travelling into and throughout the tunnel system.

The 610 KHz AM highway advisory radio (HAR) system shall be supplied with continuous program broadcasting from the Operations Control Center.

Within the tunnel, there shall be the capability of overriding all rebroadcasted frequencies, AM and FM, simultaneously with intermittent programming from the Operations Control Center.

Provision for STARS radio for First Responders radio frequency rebroadcast, and allowance for equipment space and UPS power for cellular telephone equipment for installation by third party cell phone service providers in the tunnel and support buildings shall be accommodated.

6.8.2.1 Coverage Requirements:

Above Ground: Within the Project limits, the AM traveller's information service radio system using 610 KHz shall provide signal strength in conformance with FCC rules and regulations.

Tunnel: All commercial broadcast radio stations providing signal strength at the location housing the equipment of greater than 2 mv/m2, shall be received and rebroadcast along public motorist accessible mainline lanes at a sufficient level to minimize noise and interference on all rebroadcast frequencies.

6.8.3 Intrusion Detection

The overall objective of a security system is to detect intruders and control access to selected areas. Events generated by the access control system or the intrusion detection system (AC& ID) will be transmitted to the Operations Control Center for a directed response. The AC & ID systems shall be combined to form a single fully integrated system.

Critical infrastructure information (CII) designation for contract documents shall be considered, evaluated and applied to this and other system documents as necessary.

The criteria for determining the need for installation of an intrusion detection device on any door/access way to an area is:

- Any area to which the entry by unauthorized persons could cause severe disruption/delay to operation of the tunnel.
- Any area to which the entry by unauthorized persons could result in severe personal injury to those persons.

The intrusion detection portion of the system shall be designed so that it will:

- Have a high probability of detecting any intrusions at all protected locations and shall send corresponding signals to the local intelligent field module for processing.
- Monitor the status and condition of all devices in the intrusion detection portion of the system.
- Annunciate system status, alarm, and diagnostic information using text and graphics at the local and remote operations control room locations.
- Have a minimum 25% spare capacity of detection points and indication outputs.

- Protect equipment in public accessible areas.
- Be integrated with the closed circuit television system in order to visually detect intruders upon alarm notification.

Tunnel Support Buildings shall be divided into areas for which separate detection zones shall be provided. At a minimum, each floor of a building shall be provided with a separate detection zone.

6.8.3.1 Detector Types

Intrusion detection device types and applications shall include:

- Point Detectors.
  - Tamper switches shall be used to protect:
    - Electrical load centers and switchgear
    - Local field controller cabinets
    - Dynamic message signs (DMS) controller cabinets
    - CCTV equipment cabinets or enclosures
    - Fire protection equipment cabinets and valves
    - Security panels or splice boxes
    - Telephone, radio or communications cabinets
  - Tamper loop/disconnect detectors shall be used to protect:
    - CCTV cameras (easily accessible only)
    - DMS and overheight vehicle detectors (easily accessible only)
- Volumetric Protection.
  - Motion detectors shall be used to protect building interiors to varying degrees, such that:
    - Where full coverage is required, detectors shall supply coverage of 100% of the area floor space.
    - Where general coverage is required, detectors shall supply coverage of the majority of the area floor space. Probable paths of access and flight shall be included in the detection pattern.
    - Where trapping coverage is required, selected locations are covered to detect an intruder passing through major areas or heavily traveled areas (such as hallways, lobbies, doorways, etc.).
- Dual Technology – Infrared and Microwave Motion Detectors:
  - Motion detectors shall be used along the outside of the building exterior perimeter such that:
    - Detection of intruders within a predefined area in proximity to the building exterior perimeter is possible. Use of dual technology shall only allow positive trip with intruder temperature detection within narrow beam view of motion, to avoid false alarms by wind movement or small animals.
    - Motion detection to be integrated with CCTV system to pull up view of

alarmed area on monitor

6.8.3.2 Annunciation Requirements

Annunciation for the intrusion detection portion of the system will be at the Operations Control Center.

Alarm annunciation shall include the following information, presented in an intuitive, user friendly, graphical interface:

- Location of alarm
- Address of device
- Nature of alarm (i.e. type of detection)
- Time and date
- Panel from which alarm was received
- Priority of alarm

An intrusion at the Operations Control Center shall cause an indication to be initiated at the nearest constantly manned police facility. This indication shall be both audible and visual, and easily distinguishable from fire detection system indicators.

6.8.3.3 Intrusion Detection System Coverage Requirements

The coverage requirements for buildings and roadways are as indicated below.

6.8.3.3.1 Buildings

Project buildings which include the Tunnel Support Buildings and the Operations Control Center require full perimeter protection, and varying degrees of interior protection based on the facility. Exterior entrances and key locations shall be monitored for intrusion. Full surveillance utilizing pan/tilt/zoom (PTZ) CCTV cameras with perimeter dual technology motion detectors shall be used. Building interiors for key infrastructure rooms (main substation/switchgear room, generator, emergency equipment, battery rooms) shall be protected utilizing detectors described in Section 6.8.3.1 - Detector Types.

6.8.3.3.2 Roadways

Within the tunnel roadway areas, egress corridor, egress stairs, and pump room entrances, protection shall be provided utilizing detectors described in Section 6.8.3.1 - Detector Types.

6.8.3.3.3 Other Areas

Other areas such as the perimeter of secure areas around the tunnel portals and Tunnel Support Buildings shall also be covered, utilizing appropriate dtectors described in Section “Detector Types”.

6.8.3.4 AC & ID System Head End

All field devices shall be connected to intelligent, addressable, field located, input control modules (ICMs) and dual reader interface modules (DRIMs). All intelligent field modules shall be networked together utilizing fault tolerant loops back to the main intelligent security system controller (SSC) in a fault tolerant architecture. The SSC shall be connected to the workstations, locally and remotely.

6.8.4 Access Control

The access control (AC) portion of the access control & intrusion detection (AC & ID) system shall be used to control the movement of persons through site areas, facilities, secure areas, buildings, and vehicle parking areas. Requirements of the AC portion of the system, as a minimum, are the following:

Access to any area in which equipment and/or other items are stored, for which the replacement cost is estimated to exceed 10,000.00 dollars shall be controlled by card reader.

Access to any area which is designated as "restricted" shall be controlled by card reader.

All card readers which are located "outdoors" i.e., perimeter card readers, parking lot card readers, etc. and any other card reader designated as "intercom required" shall be equipped with an intercommunication device, which shall establish bi-directional communication between these card readers and the remote and local operations control rooms.

All employee parking areas shall be provided with an entrance gate controlled by a card reader. Use passive proximity type cards with photo identification capability, card readers, electromagnetic locks, and electric door strikes.

6.8.5 Surveillance Closed Circuit Television (CCTV)

A CCTV system shall be provided to allow surveillance coverage of the facility and all controlled access areas, as defined in Section “Intrusion Detection”.

6.9 Flood Gates

6.9.1 Introduction

Tunnel flood gate systems or other approved measures such as walls or berms are required to prevent flood waters from entering the tunnel. This section establishes the design criteria to be used for the flood gate systems. See also Section 5.5.1 of this Design Criteria for structural design guidance.

6.9.2 Codes, Standards, Guidelines and References

The following codes standards and guidelines serve as the basis for the design of the flood gate systems:

- Crane Manufacturer's Association of America
  - CMAA-70 Specifications for top running bridge and gantry-type multiple girder electric overhead travelling cranes- No. 70
- Virginia State Building Code
- American Association of State Highway and Transportation Officials
- AASHTO LRFD Movable Highway Bridge Design Specifications, 2nd Edition, 2007.

6.9.3 Design Requirements

The tunnel flood gates system shall be designed to meet the following requirements:

- The gates shall be designed to fully close and properly seal in rainy conditions with a maximum of 6 inches of flowing water beneath them.
- Design loads shall be in accordance with AASHTO movable bridge and/or CMAA-70 Code
- Gate leakage shall not exceed a rate of 0.1 gal/min/linear feet of seal perimeter for maximum flood condition
- Gates shall be designed to operate in a salt water marine environment.
- The flood gates shall be designed to withstand water pressure up to elevation 13.0 (NAVD88).

6.10 Not Used

7 Tunnel Support Buildings

7.1 Introduction

This section identifies the relevant criteria documents to be used to design the following buildings associated with the New Midtown Tunnel:

- Tunnel equipment structures near each portal housing flood gate equipment, electrical switchgear, equipment, pump rooms, and stairs;
- Generator enclosure structure;
- Truck inspection booth located in the gore between the ramp from Hampton Boulevard and Claremont Street;

7.1.1 Codes, Standards, Guidelines and References

The Bureau of Capital Outlay Management (BCOM) will have jurisdiction over support buildings for the tunnel. The following codes, standards, and guidelines serve as the basis for the design of the tunnel support buildings:

Virginia Uniform Statewide Building Code (USBC)

- 2006 Virginia Construction Code (Part 1 of the Virginia Uniform Statewide

Building Code) which incorporates the 2006 International Building Code and all codes and standards referenced therein.

- Plumbing Code : Virginia USBC (2006 International Plumbing Code)
- Mechanical Code: Virginia USBC (2006 International Mechanical Code)
- Electrical Code: Virginia USBC (reference 2005 National Electrical Code)
- Energy Code: IECC 2006 (Virginia USBC)

American National Standards Institute (ANSI)

- ANSI C39.1 (1981; R 1992) Requirements for Electrical Analog Indicating Instruments

American Society of Heating, Refrigerating and Air conditioning Engineers

- ASHRAE 113 Method of Testing for Room Air Diffusion (2005)
- ASHRAE 55 Thermal Environmental Conditions for Human Occupancy
- ASHRAE 62.1 Ventilation for Acceptable Indoor Air Quality
- ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings, I-P Edition
- ASHRAE EQUIP Handbook, HVAC systems and Equipment (2004)
- ASHRAE FUN Fundamental Handbook (2009)

American Society of Civil Engineers (ASCE)

- ASCE 7-05 Minimum Design Loads for buildings and Other Structures

American Society of Mechanical Engineers (ASME)

- ASME A112.18.1 Standard for Plumbing Fixture Fittings
- ASME A112.19.2 Standard for Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals
- ASME B16.22 (2001); R 2005) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
- ASME B16.26 (2006) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
- ASME B31.1 (2007; Addenda 2008) Power Piping
- ASME B31.5 (2006) Refrigeration Piping and Heat Transfer Components
- ASME BPVC (2007) Boiler and Pressure Vessel Codes

American Society of Testing Materials (ASTM)

- ASTM A 123/A 123M (2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- ASTM A 36/A 36M (2008) Standard Specification for Carbon Structural Steel
- ASTM A 653/A 653M (2009) Standard Specification for Steel Sheet, Zinc-Coated

(Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

- ASTM A 924/A 924M (2009) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
- ASTM B 280 (2008) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

American Welding Society

- AWS A5.8/A5.8M (Errata 2004) Specification for Filler Metals for Brazing and Braze Welding
- AWS WHB-2.9 Welding Handbook; Volume Two – Welding Processes

Fuel Gas Code

- IFGC Fuel Gas Code (2006)

Institute of Electrical and Electronic Engineers

- IEEE C2 National Electrical Safety Code
- IEEE C37.17 (1997) Standard for Trip Devices for AC and General-Purpose DC Low-Voltage Power Circuit Breakers
- IEEE C37.90 (2005) Standard for Relays and Relay Systems Associated with Electric Power Apparatus
- IEEE Std383 (2003) Standard for Qualifying Class 1E Electric Cables and, Field Splices for Nuclear Power Generating Stations 2004

Manufacturers Standardization Society (MSS)

- MSS SP-69 (2003; R 2004) Standard for Pipe Hangers and Supports – Selection and Application

National Fire Protection Association (NFPA)

- NFPA 10 Standard for Portable Fire Extinguishers
- NFPA 13 Installation of Sprinkler Systems
- NFPA 70 National Electrical Code – 2005 Edition
- NFPA 80 Standard for Fire Doors and Other Opening Protectives
- NFPA 90A (2008; Errata 2009) Standard for the Installation of Air conditioning and Ventilating Systems
- NFPA 101 Life Safety code
- NFPA 502 Standard for Road Tunnels, Bridges and Other Limited Access Highways
- NFPA 780 Standard for the Installation of Lightning Protection Systems

National Electrical Manufacturers Association (NEMA)

- NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

- NEMA AB 1 (2002) Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures
- NEMA C12.1 (2008) Electric Meters; Code for Electricity Metering
- NEMA C78.23 (1995; R 2003) Standard for Incandescent Lamps – Miscellaneous Types
- NEMA ICS 6 (1993; R 2006) Standard for Industrial Controls and Systems Enclosures
- NEMA MG 1 Standard for Motors and Generators
- NEMA MG 11 Energy Management Guide for Selection and Use of Single Phase Motors
- NEMA WC 70 (2009) Standard for Non-Shielded Power Cable 2000 V or Less for the Distribution of Electrical Energy

Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

- SAE AMS 2480 (2001; Rev G; R 2006) Phosphate Treatment, Paint, Base
- SMACNA 1966 (2005) HVAC Duct Construction Standards Metal and Flexible
- SMNCNA 1987 (2006) HVAC Duct Systems Inspection Guide

Society of Automotive Engineers (SAE)

- SAE AMS 2480 (2001; Rev G; R 2006) Phosphate Treatment, Paint, Base

Underwriters Laboratories (UL)

- UL 1479 Standard for Fire Tests of Through-Penetration Fire Stops
- UL 181(2005; Rev thru Oct 2008) Standard for Factory-Made Air Ducts and Air Connectors
- UL 20 (2000; Rev thru Dec 2008) Standard for General-Use Snap Switches
- UL 467Standard for Grounding and Bonding Equipment
- UL 555(2006; Rev thru Feb 2009) Standard for Fire Dampers
- UL 96 Standard for Lightning Protection Components

7.1.2 Performance Requirements

Design and construct all structural components necessary to provide a complete functional system that meets the following performance requirements:

Provide functionality, durability, ease of maintenance, safety, and aesthetics.

DOWNTOWN TUNNEL/MIDTOWN TUNNEL/MLK EXTENSION PROJECT

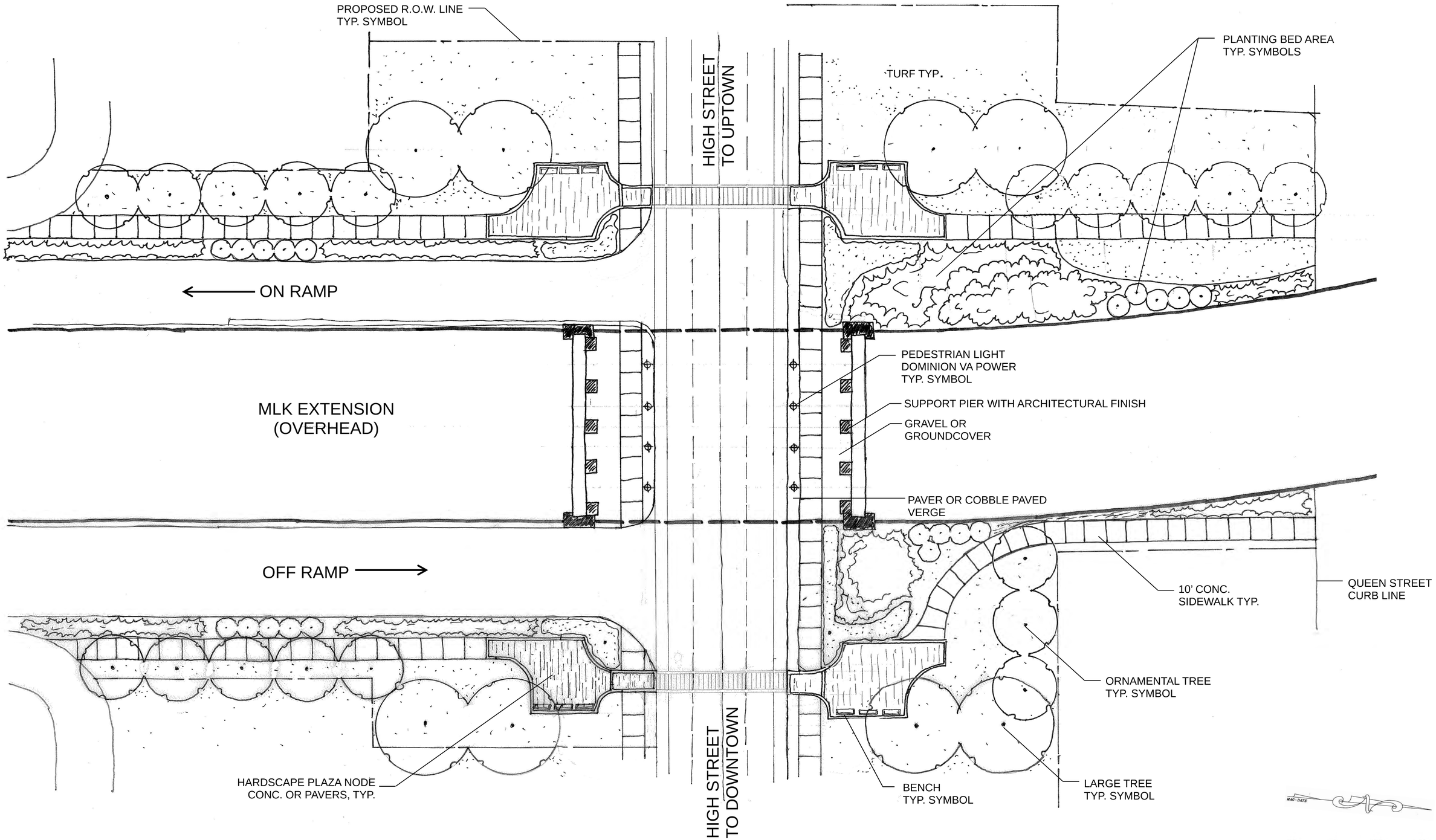
The Technical Requirements

Comprehensive Agreement Exhibit C

Attachment 1E

City of Portsmouth Concept Sketches

TECHNICAL REQUIREMENTS
Exhibit C



11003

May 25, 2011

HIGH STREET GATEWAY

Martin Luther King Extension - Portsmouth Aesthetic Treatments

ORNAMENTAL TREE
TYP. SYMBOL

SCORED
CONC.
TYP.

COUNTY ST.

CROSSWALK
TYP.

SUPPORT PIER WITH
ARCHITECTURAL FINISH

KING ST.

BUS DROP OFF/PICK-UP

POND 24

POND 25

CONC. WALK
TYP. SYMBOL

'URBAN STONE'
TYP. SYMBOL

MLK EXTENSION
(OVERHEAD)

PEDESTRIAN LIGHT
TYP. SYMBOL

RIP-RAP
TYP. SYMBOL

VIEW

BENCH
TYP. SYMBOL

OVERLOOK AREA

VIEW

TURNPIKE RD.

TURF

SEGMENTAL RETAINING WALL SYSTEM
TYP. SYMBOL @ PONDS 24 & 25
VERTICA PRO, STRAIGHT FACE BY ANCHOR
WALL SYSTEMS OR EQ.

TRANSIT STOP TO BE
COORDINATED WITH HRT
& THE CITY

CONC. PLAZA
TYP.

42" HT. ORNAMENTAL , ALUMINUM FENCE
FASTENED ATOP THE SEGMENTAL RETAINING
WALL SYSTEM, TYP.

STORMWATER POND AERATOR
CUSTOM , FUNCTIONAL ART PIECE
OR MANUFACTURED, SUBMERSIBLE SYSTEM
TYP. SYMBOL

EXISTING
CHURCH

CANOPY TREE
TYP. SYMBOL

EVERGREEN TREE
TYP. SYMBOL

COMMEMORATIVE SCULPTURE
OR ART PIECE, TYP.

MAC-DATE

25 0 25 50
12.5 12.5 37.5
SCALE: 1"=25'

11003

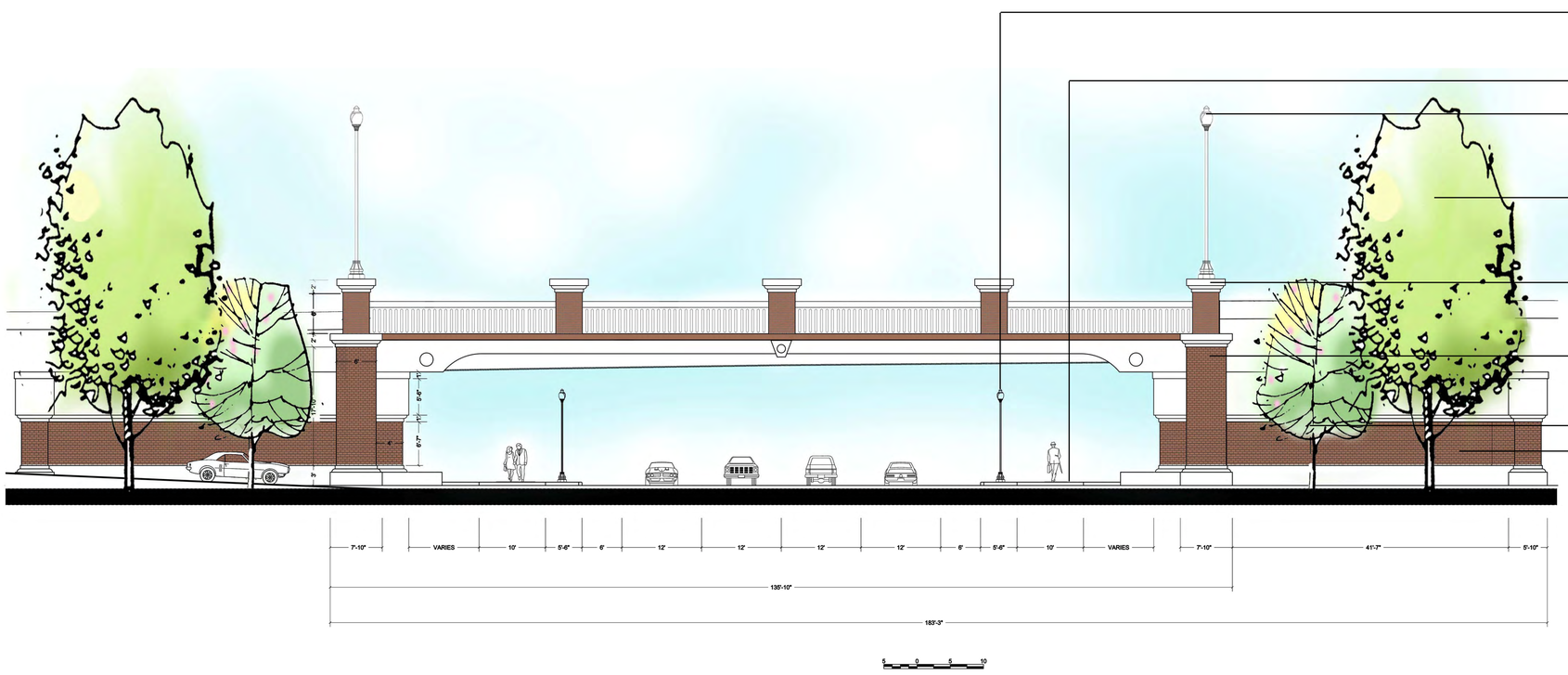
June 03, 2011

TURNPIKE ROAD AREA

Martin Luther King Extension - Portsmouth Aesthetic Treatments

PB 125 YEARS

Landscape Architecture + Planning
LAND STUDIO
Professional Corporation



PEDESTRIAN LIGHT BY DOMINION VIRGINIA POWER
www.dom.com/products/product-catalog/outdoor-lighting/detail.jsp?i=ane-acorn-fix
FIXTURE: ACORN
POLE: DECORATIVE ROUND TAPERED FLUTED COMPOSITE

CONC. WALKWAY

CUSTOM STREET LIGHT BY STERNBERG LIGHTING OR EQ.
www.sternberglighting.com
FIXTURE: PRISMATIC ACORN G943
POLE: BARRINGTON 5200
BASE: BARRINGTON 8501SS

LARGE TREE TYP. SYMBOL.

FIBERGLASS ARCHITECTURAL ORNAMENTATION, TYP.
CAPS, CORNICE & TRIM
www.edon.com or EQ.

DECORATIVE CONC. W/ BRICK FORM LINER TEXTURE
BRICK COLOR SHOULD CLOSELY MATCH COLOR RANGE OF
LAWRENCEVILLE BRICK COLONIAL #109 WHICH HAS BEEN USED
ON OTHER BUILDINGS IN DOWNTOWN PORTSMOUTH

ORNAMENTAL TREE TYP. SYMBOL.

MSE WALL W/ DECORATIVE FINISH W/ BRICK FORM LINER TEXTURE
BRICK COLOR SHOULD CLOSELY MATCH COLOR RANGE OF
LAWRENCEVILLE BRICK COLONIAL #109 WHICH HAS BEEN USED
ON OTHER BUILDINGS IN DOWNTOWN PORTSMOUTH

HIGH STREET BRIDGE FAÇADE TREATMENT— CONCEPT B

SEE ALL CALL-OUTS ABOVE, TYP.

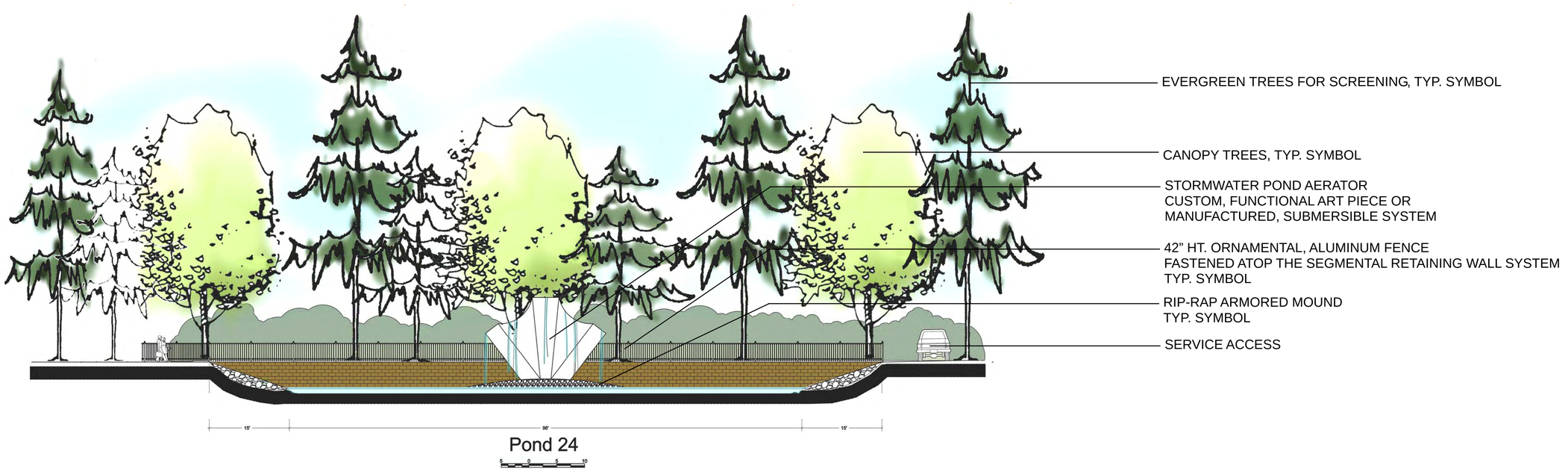
HIGH STREET BRIDGE FAÇADE TREATMENT— CONCEPT B: AREA UNDER BRIDGE

11003

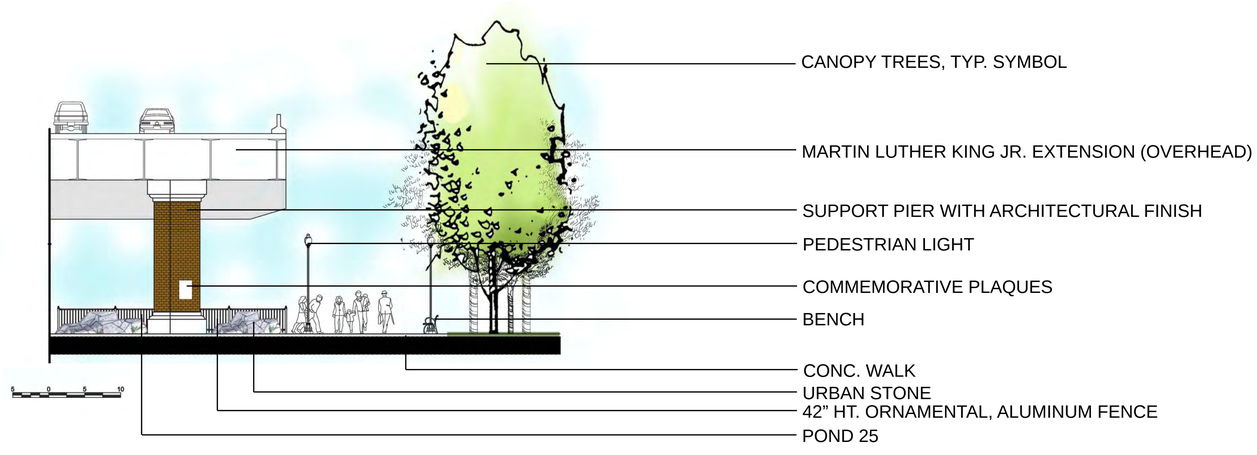
May 25, 2011

HIGH STREET GATEWAY

Martin Luther King Extension - Portsmouth Aesthetic Treatments



POND 24 OVERLOOK AREA– ELEVATION



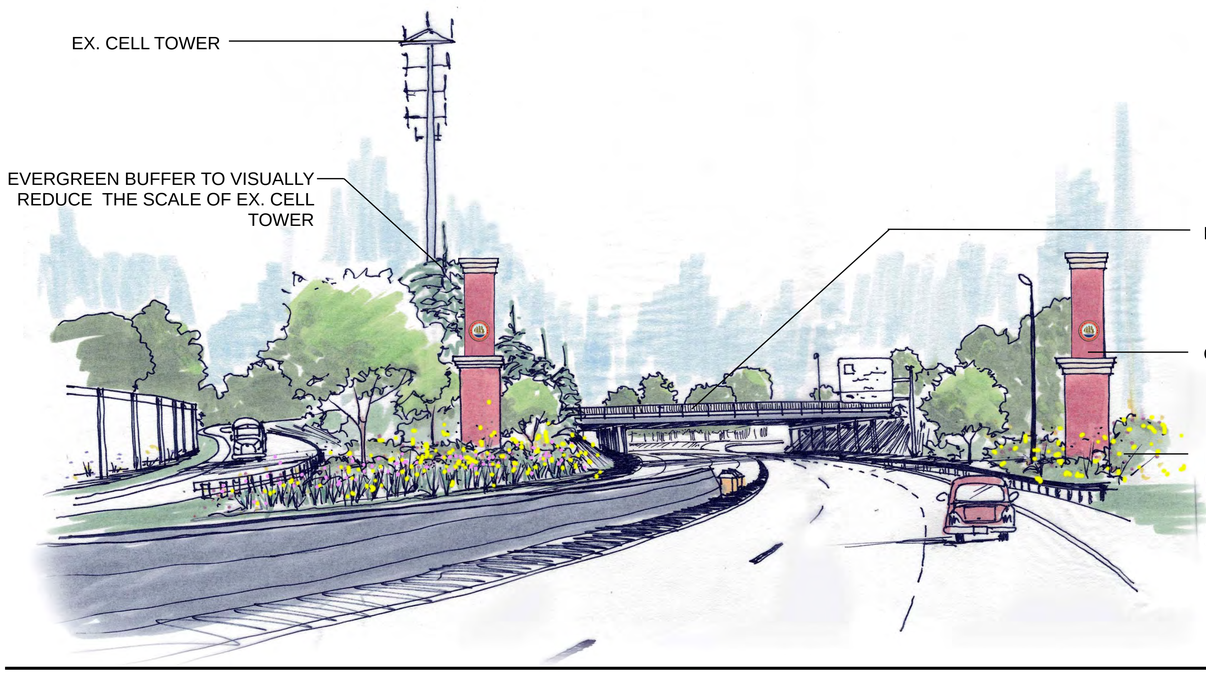
TURNPIKE ROAD– ELEVATION AT WALK ADJACENT TO POND 25

11003

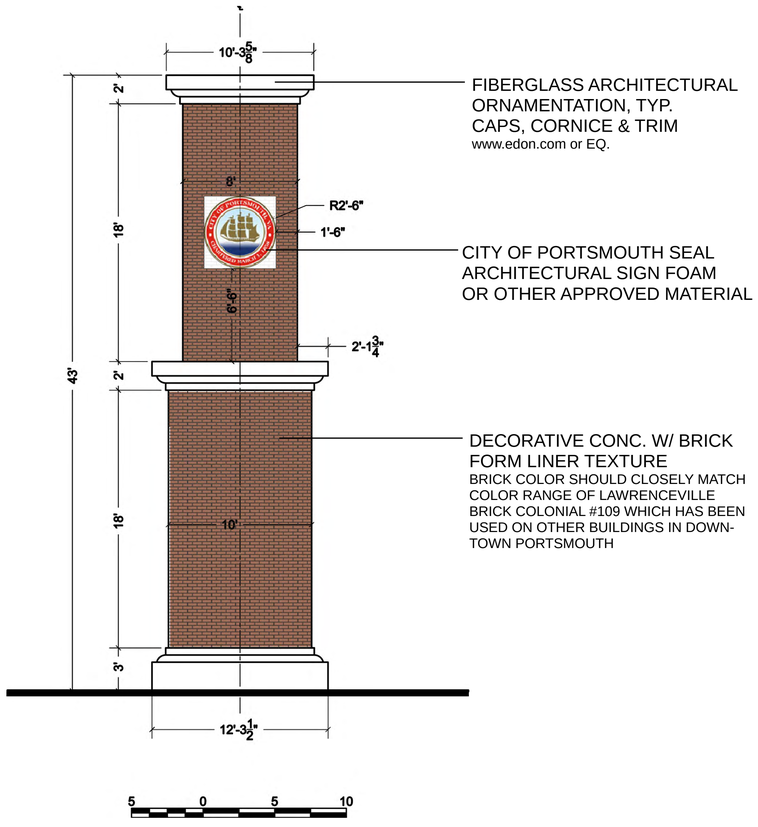
May 25, 2011

ILLUSTRATIVE ELEVATIONS

Martin Luther King Extension - Portsmouth Aesthetic Treatments



LONDON BOULEVARD GATEWAY— ILLUSTRATIVE PERSPECTIVE



LONDON BLVD. GATEWAY FEATURE — ELEVATION

11003

July 12, 2011

ENLARGEMENTS

Martin Luther King Extension - Portsmouth Aesthetic Treatments

PB 125 YEARS

Landscape Architecture + Planning
LAND STUDIO
Professional Corporation

BOTH FENCE STYLES AVAILABLE FROM:
1. MASTER HALCO www.masterhalco.com
2. MERCHANTS METALS www.merchantsmetals.com

Site Furnishings - Fencing Options

LANDSCAPE FORMS:
www.landscapeforms.com
PLAINWELL BENCH

VICTOR STANLEY:
www.victorstanley.com
STEELSITES BENCH RB-28

Site Furnishings - Bench Options

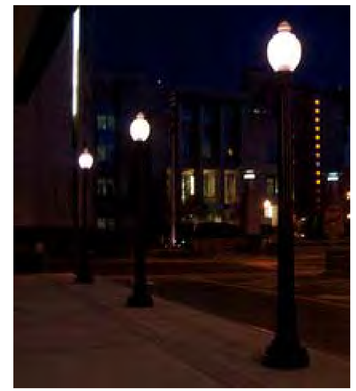
VICTOR STANLEY:
www.victorstanley.com
PRODUCTION SERIES PRS-36

VICTOR STANLEY:
www.victorstanley.com
T-SERIES T-32

Site Furnishings - Trash Receptacle Options

11003

May 25, 2011



PEDESTRIAN LIGHT BY DOMINION VIRGINIA POWER
www.dom.com/products/product-catalog/outdoor-lighting/detail.jsp?i=ane-acorn-fix
FIXTURE: ACORN
POLE: DECORATIVE ROUND TAPERED FLUTED COMPOSITE

CUSTOM STREET LIGHT BY STERNBERG LIGHTING OR EQ.
www.sternberglighting.com
FIXTURE: PRISMATIC ACORN G943
POLE: BARRINGTON 5200
BASE: BARRINGTON 8501SS

Dominion

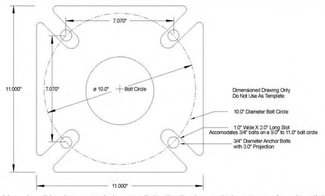
Pole - Decorative Round Tapered Fluted Composite

Fluted round tapered poles constructed of heavy duty fiberglass reinforced pigmented polyester plastic resin with a decorative base for pole top luminaires.

- Poles available directly embeded or base mounted for use with underground supply conductors only.
- Single pole top luminaire only.
- Available for use with:
  - Decorative Colonial Luminaire
  - Acorn Luminaire
  - Carlyle Acorn Luminaire
  - Decorative Acorn Luminaire
- Anchor base poles require customer provided pole foundation and anchor bolts.

Pole Specifications:

Total Length (Feet)	Base Diameter (Inches)	Base Height (Inches)	Pole Top Diameter (Inches)	Embed Depth (Feet)	Luminaire Mounting Height (Feet)	Tenon Size	Finish Color	WMIS CU Assembly	Pole Only Stock #
13	16.5	20.0	5.0	3.0	10.0	3.0" O.D. X 3.5"	Black (RAL 9005)	PFF13	50498500
15	16.5	20.0	5.0	3.0	12.0	3.0" O.D. X 3.5"	Black (RAL 9005)	PFF15	50499000
15	16.5	20.0	5.0	3.0	12.0	3.0" O.D. X 3.5"	Dark Green (RAL 9005)	PFF15GN	42062744
18	16.5	20.0	5.0	4.0	14.0	3.0" O.D. X 3.5"	Black (RAL 9005)	PFF18	50499200
18	16.5	20.0	5.0	4.0	14.0	3.0" O.D. X 3.5"	Dark Green (RAL 9005)	PFF18GN	42062745
10	16.5	20.0	5.4	A.B.	10.0	3.0" O.D. X 3.5"	Black (RAL 9005)	PFF10AB	50497900
12	16.5	20.0	5.4	A.B.	12.0	3.0" O.D. X 3.5"	Black (RAL 9005)	PFF12AB	50498100
12	16.5	20.0	5.4	A.B.	12.0	3.0" O.D. X 3.5"	Dark Green (RAL 9005)	PFF12ABGN	42062746
14	16.5	20.0	5.4	A.B.	14.0	3.0" O.D. X 3.5"	Black (RAL 9005)	PFF14AB	50498300
14	16.5	20.0	5.4	A.B.	14.0	3.0" O.D. X 3.5"	Dark Green (RAL 9005)	PFF14ABGN	42062757



Many localities have restrictions on light distribution and placement of outdoor lighting equipment.
Consult with your local government before selecting outdoor lighting equipment.

Site Furnishings - Light Fixture & Pole

SITE FURNISHINGS

Martin Luther King Extension - Portsmouth Aesthetic Treatments

PB 125 YEARS

Landscape Architecture + Planning
LAND STUDIO
Professional Corporation

DOWNTOWN TUNNEL/MIDTOWN TUNNEL/MLK EXTENSION PROJECT

The Technical Requirements

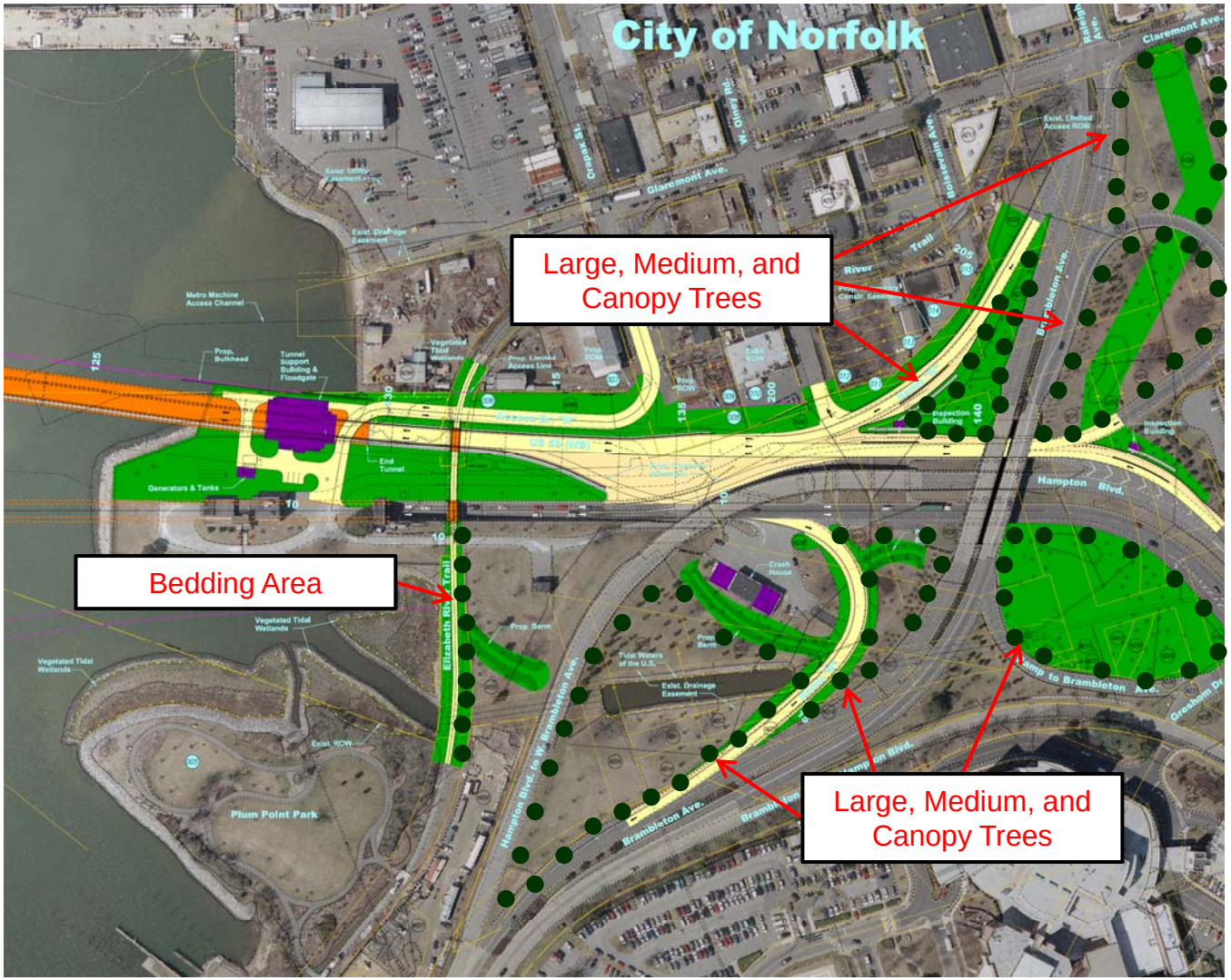
Comprehensive Agreement Exhibit C

Attachment 1F

City of Norfolk Concept Sketches

TECHNICAL REQUIREMENTS
Exhibit C

DTT/MTT/MLK Extension
Norfolk Portal Landscaping



June 21, 2011

DOWNTOWN TUNNEL/MIDTOWN TUNNEL/MLK EXTENSION PROJECT

The Technical Requirements

Comprehensive Agreement Exhibit C

Attachment 1G

Approved Design Exceptions

Design Exception Documentation

D 0103041401-1-Rev4
Design Exception 1
(Ramp A Design Speed)

Downtown Tunnel - Midtown Tunnel - MLK Expressway

Submitted To:

SKW Constructors
809 S. Military Highway
Virginia Beach, VA 23464

August 29, 2011

Prepared By:

PB Americas, Inc.
6161 Kempsville Circle, Suite 110
Norfolk, VA 23502

TUNNEL VISION
MIDTOWN | MLK | DOWNTOWN

DEPARTMENT OF TRANSPORTATION
LOCATION AND DESIGN
DESIGN EXCEPTION REQUEST

(Note: Use the Tab key to navigate and complete the Form)

To: Richard Worssam, P.E. Date: August 29, 2011
Assistant State Location and Design Engineer

From: Elizabeth River Crossings
Drop-down Selection

Subject: DESIGN EXCEPTION REQUEST - 1

Prepared by: David H. Barnes, PE (PB)

State Project Number: 0058-965-107 Federal Project Number: Unknown

County/City: Portsmouth District: Hampton Roads Funding Source: PPTA

Project Description
From: London Boulevard UPC: 76642
To: I-264

Design Exception Request For:

- ☐ Design Speed
- ☐ Horizontal Clearance* (other than "clear zone")
- ☐ Vertical Clearance*
- ☐ Bridge Width*
- ☒ Horizontal Alignment
- ☐ Vertical Alignment
- ☐ Lane Width
- ☐ Sight Distance
- ☐ Cross Slope
- ☐ Shoulder Width
- ☐ Superelevation
- ☐ Grade
- ☐ Structural Capacity*
- ☐ Interstate Access Control
- ☐ Other

* These are typically requested by the Bridge designer.

Current ADT: 2,500 Design ADT: 6,500

% Trucks: 3% Design Speed: 25 mph Posted Speed: 25 mph

Reduced Design Speed (if applicable) 20 mph Is Project on the NHS? Yes

Functional Classification: Interchange Ramp (GS-R) Min. VDOT GS Standard: R= 171' (25) R=108' (20)
Max. e =4% R=154'

Min. AASHTO Standard: (25) R=86' (20)

Existing Dimensions R=65' Requested Dimensions R=92'

Total estimated construction cost of project: $1,400,000,000
(Based on approval of this exception)

Additional cost to meet minimum AASHTO standard: $74,000,000

Background description of project: (Attach Separate Document) **See Attachment A**
(Include a description of the general characteristics of the existing highway focusing on the features relevant to the proposed exception. Provide a brief description of the adjacent highway segments, highlighting existing nonstandard features when relevant to the proposed exception as well as the title sheet, typical section sheet, applicable plan sheets, profiles and cross sections.)

Purpose and need for exception; why standards cannot be met (include any future plan to upgrade this exception to standard):
The purpose of this design exception is to request a reduction in the design speed required for Ramp A (from eastbound London Boulevard to northbound Martin Luther King Freeway). The minimum radius for 25mph design speed cannot be achieved without impacting the adjacent Calvary Baptist Church property, a historic property and building currently eligible for the National Register.

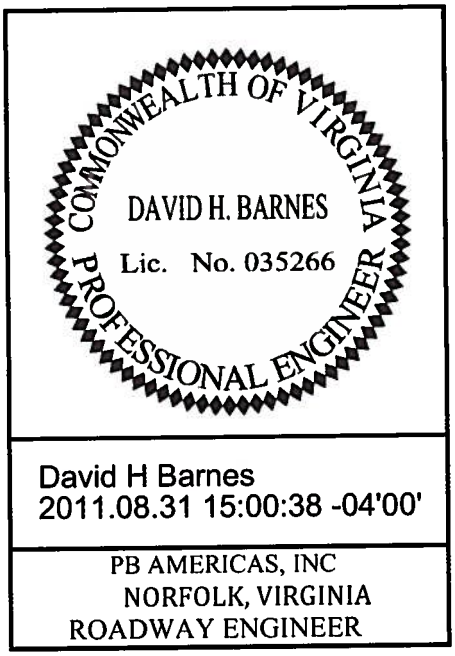
Are there any plans to improve the approach roadway within the next ten (10) years? **No.**

Accident history for the past 3 years:
See accident history under attachment A for further discussion.

Effect of design exception on safety:
The safety impacts associated with this design exception will be minimal. While the proposed geometry does not meet the design speed of 25 mph, it does increase the design speed from 15 mph to 20 mph. The existing ramp alignment has a horizontal curve with a radius of 65' (or 15mph design speed). The design speed required in the design criteria is 25 mph (or a minimum radius of 154'). See attached Exhibit 1-A 'Ramp A Alternative' depicting the layout of a horizontal curve with a 154' radius. Ramp A is proposed with a horizontal curve of 92' (or 20 mph design speed). Such is an improvement to the existing design speed and radius. The minimum radius and speeds are from the 'Greenbook' Exhibit 3-25.

Any mitigation of the substandard design element (s):
Yes. An advanced curve warning sign (W1-11), and speed advisory sign (W13-1P) for 20mph speed will be erected in advance of the curve, along with chevron signage (W1-8) within the curve. A 32" F-shape concrete barrier is also proposed at the edge of the outside shoulder through the 92' radius curve. Also, a maximum of 32' full-depth paving will be provided for Ramp A (See attachment A for further discussion).

Has the Regional Traffic Engineer reviewed the substandard design and do they agree with the proposed mitigation measures? If not, please explain.
The Regional Traffic Engineer has reviewed the design and agrees with the proposed mitigation measures.



Submitted By: David H. Barnes, P.E. (PB) Date: August 29, 2011
Consultant

Remarks:

Recommended for Approval By: R. D. C. Worrum Date: 11/3/11
Assistant State Location and Design Engineer
and

Recommended for Approval By: _____ Date: _____
State Traffic Engineer (For Crossovers Only)

Remarks:

VDOT Approval By: _____ Date: 11/3/2011
State Location and Design Engineer

FHWA Approval By: _____ Date: 11-16-2011

Remarks:

Cc: Project Manager
Project Designer
QMAC Section Manager

Design Exception Documentation

D 0103041401-2-Rev3
Design Exception 2
(Shoulder Widths)

Downtown Tunnel - Midtown Tunnel - MLK Expressway

Submitted To:

SKW Constructors
809 S. Military Highway
Virginia Beach, VA 23464

June 21, 2011

Prepared By:

PB Americas, Inc.
6161 Kempsville Circle, Suite 110
Norfolk, VA 23502

TUNNEL VISION
MIDTOWN | MLK | DOWNTOWN

LD-440
(5-17-10)
DEPARTMENT OF TRANSPORTATION
LOCATION AND DESIGN
DESIGN EXCEPTION REQUEST
(Note: Use the Tab key to navigate and complete the Form)

To: Richard Worssam, P.E. Date: June 21, 2011
Assistant State Location and Design Engineer
From: Elizabeth River Crossings
Drop-down Selection
Subject: DESIGN EXCEPTION REQUEST - 2

Prepared by: David H. Barnes, PE (PB)

State Project Number: 0058-965-107 Federal Project Number: Unknown

County/City: Portsmouth District: Hampton Roads Funding Source: PPTA

Project Description
From: London Boulevard UPC: 76642
To: I-264

Design Exception Request For:

☐ Design Speed	☐ Horizontal Clearance* (other than "clear zone")	☐ Vertical Clearance*
☐ Bridge Width*	☐ Horizontal Alignment	☐ Vertical Alignment
☐ Lane Width	☐ Sight Distance	☐ Cross Slope
☒ Shoulder Width	☐ Superelevation	☐ Grade
Structural	☐ Interstate Access Control	☐ Other
☐ Capacity*		

* These are typically requested by the Bridge designer.

Current ADT: 8,600 Design ADT: 15,200

% Trucks: 5% Design Speed: 50mph Posted Speed: 45mph

Reduced Design Speed (if applicable) _____ Is Project on the NHS? Yes

Functional Classification: Urban Principal Arterial (Freeway) Min. VDOT GS Standard: 12' - Right Shoulder 4' - Left Shoulder

Min. AASHTO Standard: 10' Right, 4' Left

Existing Dimensions approx. 8' Requested Dimensions approx. 3' (right) 2' (left)

Total estimated construction cost of project: $1,400,000,000
(Based on approval of this exception)

Additional cost to meet minimum AASHTO standard: $54,000,000

Background description of project: (Attach Separate Document) **See Attachment A**
(Include a description of the general characteristics of the existing highway focusing on the features relevant to the proposed exception. Provide a brief description of the adjacent highway segments, highlighting existing nonstandard features when relevant to the proposed exception as well as the title sheet, typical section sheet, applicable plan sheets, profiles and cross sections.)

Purpose and need for exception; why standards cannot be met (include any future plan to upgrade this exception to standard):
The purpose of this design exception is to request a reduction in the inside and outside shoulder widths. The minimum shoulder widths cannot be provided due to insufficient distance between the existing bridge piers to provide both the auxiliary lane and the required shoulders. In order to achieve the minimum shoulder widths, the London Boulevard bridge would need to be replaced (with a new bridge with increased main span length), likely resulting in a reconstruction of the interchange and the adjacent bridge over CSXT railroad. See additional information in Attachment A.

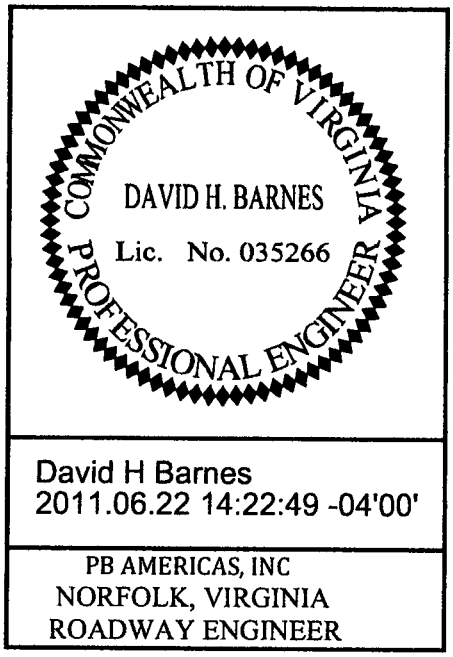
Are there any plans to improve the approach roadway within the next ten (10) years? **No.**

Accident history for the past 3 years:
See accident history under attachment A for further discussion.

Effect of design exception on safety:
The design exception will not adversely affect the safety and operational characteristics of this facility. See additional information in Attachment A.

Any mitigation of the substandard design element(s):
Delineators will be used on the 54" TL-5 concrete barrier protecting the bridge columns. Applicable warning signage for this condition was investigated, however MUTCD does not currently have standard warning signage for narrowed shoulders. The narrow outside shoulders are adjacent to auxiliary lanes. And, all of the through lanes and the auxuliary lanes are proposed at the full 12' width. Applicable shoulder taper criteria will be used for all shoulder width transitions. Enhanced delineation will be used on all barriers in the area with narrow shoulders. See additional information in Attachment A.

Has the Regional Traffic Engineer reviewed the substandard design and do they agree with the proposed mitigation measures? If not, please explain.
The Regional Traffic Engineer has reviewed the design and agrees with the proposed mitigation measures.



Submitted By: David H. Barnes, P.E. (PB) Date: June 21, 2011
Consultant

Remarks:

Recommended for Approval By: R. C. Worsham Date: 7/25/11
Drop-down Selection

and

Recommended for Approval By: _____ Date: _____
State Traffic Engineer (For Crossovers Only)

Remarks:

VDOT Approval By: _____ Date: 7/29/11
~~Drop-down Selection~~ State L&D Eng.

FHWA Approval By: Jason Kak Date: 8-22-11

Remarks:

Cc: Project Manager
Project Designer
QMAC Section Manager

ATTACHMENT A

Martin Luther King Extension
Design Exception for Substandard Shoulder Widths at the London Blvd. Bridge overpass

Background Description of project:
As described in the VDOT prepared Interchange Justification Report for I-264/Martin Luther King Freeway, "The proposed project to extend Route 58 (Martin Luther King Freeway) to I-264, with a new interchange at I-264, will provide a direct freeway-to-freeway connection from I-264 to the Midtown Tunnel between Portsmouth and Norfolk, Virginia. This new connection would improve system linkage with the recently completed Pinners Point Interchange and improve access to existing and proposed regional port facilities. The new facility would also remove over 25,000 daily vehicles, including a significant number of large trucks, from local city streets through Portsmouth, including US 17 (Frederick Boulevard), High Street, London Boulevard, and Effingham Street. Trucks currently constitute as much as 25 percent of peak hour volumes on the US 17/I-264 ramps and local streets, US 17, Turnpike Road, and Harbor Drive."

Purpose and Need of Exception:
As part of the Project, an additional northbound auxiliary lane is proposed for Ramp A acceleration and taper. There is currently insufficient distance between the existing bridge piers to provide both the auxiliary lane and the required shoulders adjacent to both the northbound and southbound auxiliary lanes. In order to achieve the minimum recommended shoulder width, the London Boulevard bridge would need to be replaced and would result in a modification to the London Boulevard/Martin Luther King Freeway interchange. Thus, a design exception is being requested for the substandard width of the shoulders adjacent to the auxiliary lanes. The southbound outside shoulder is reduced for 222 feet (station 1051+13 to station 1053+35), the southbound inside shoulder is reduced for 578 feet (station 1049+22 to station 1055+00), the northbound outside shoulder is reduced for 299 feet (station 1050+11 to station 1053+10), and the northbound inside shoulder is reduced for 578 feet (station 1049+22 to station 1055+00). For the inside shoulders, we have maintained a minimum 2' shy distance from the face of the concrete barrier. Remaining available width will be applied generally equally between the northbound and southbound outside shoulders.

Accident history for the past 3 years:
Of the completed accident reports within approximately 500' of this location, there were 4 crashes. Three were Property Damage Only (PDO) and one was Injury. 2 Angle, 1 sideswipe, 1 head-on. Two of the crashes involved lane changing, and two involved loss of control & hitting an object (jersey wall, curb on the SB off-ramp) on the left side of the vehicle.

There is no indication that there is a problem with crashes in the study area of MLK in the direct vicinity of London Blvd. One crash was located on the SB off-ramp (hit the curb on the left side of the off-ramp), which may not necessarily be attributed to mainline MLK traffic. Although the design exception limits the shoulder width, it does not affect the

travel way, and may not increase the chance for crashes. However, vehicles that have lost control will have less space for recovery and have a slightly increased chance of hitting a fixed object (for a short distance) once they have lost control.

Effect of Design Exception on Safety:

The operational impacts associated with the short segments of substandard shoulder widths adjacent to standard 12-foot travel lanes are expected to be minimal. The anticipated positive operational impacts and capacity improvements associated with providing the auxiliary lane for acceleration and transition from Ramp A will outweigh any negative operational impacts resulting from localized substandard shoulder widths.

The majority of the proposed shoulder widths throughout the project corridor comply with the minimum AASHTO shoulder width requirements. As previously noted, in order to avoid the need to relocate the bridge columns (and replace the entire bridge structure), reduced shoulder widths are required. According to Section 5.6.1 (Lateral Offset) of the 2002 AASHTO Roadside Design Guide, the shoulder width should be maintained even with barrier, but in some circumstances the shoulder width should be reduced or the barrier closer to the traveled way to protect bridge piers. Existing barriers protecting the bridge piers will be removed and 54" TL-5 concrete barriers will be installed for pier protection as part of the project. For this localized section of reduced shoulder width, it is anticipated that for safety and comfort, motorists will generally avoid using the reduced shoulders for refuge and opt for the wider shoulders for emergency stopping. The segments of reduced shoulder will primarily serve a physical and visual buffer between the edge line and the adjacent shoulder barrier wall rather than service as a refuge area.

Design Exception Documentation

D 0103041401-4-Rev4
Design Exception 4
(Terminal Spacing between Ramp SW and Frederick Boulevard)

Downtown Tunnel - Midtown Tunnel - MLK Expressway

Submitted To:

SKW Constructors
809 S. Military Highway
Virginia Beach, VA 23464

September 27, 2011

Prepared By:

PB Americas, Inc.
6161 Kempsville Circle, Suite 110
Norfolk, VA 23502

TUNNEL VISION
MIDTOWN | MLK | DOWNTOWN

LD-440
(5-17-10)
DEPARTMENT OF TRANSPORTATION
LOCATION AND DESIGN
DESIGN EXCEPTION REQUEST
(Note: Use the Tab key to navigate and complete the Form)

To: Richard Worssam, P.E. (Drop-down Selection) Date: September 27, 2011

From: Elizabeth River Crossings (Drop-down Selection)

Subject: DESIGN EXCEPTION REQUEST - 4

Prepared by: David H. Barnes, PE (PB)

State Project Number: 0058-965-107 Federal Project Number: Unknown

County/City: Portsmouth District: Hampton Roads Funding Source: PPTA

Project Description
From: London Boulevard UPC: 76642
To: I-264

Design Exception Request For:

☐ Design Speed	☐ Horizontal Clearance* (other than "clear zone")	☐ Vertical Clearance*
☐ Bridge Width*	☐ Horizontal Alignment	☐ Vertical Alignment
☐ Lane Width	☐ Sight Distance	☐ Cross Slope
☐ Shoulder Width	☐ Superelevation	☐ Grade
Structural	☐ Interstate Access Control	☒ Other
☐ Capacity*		

* These are typically requested by the Bridge designer.

Current ADT: 37,000 Design ADT: 46,500

% Trucks: 6% Design Speed: 60mph Posted Speed: 55mph

Reduced Design Speed (if applicable) _____ Is Project on the NHS? yes

Functional Classification: Urban Principal Arterial (Freeway) Min. VDOT GS Standard: _____

Min. AASHTO Standard: Ramp Spacing = 2000'

Existing Dimensions n/a Requested Dimensions Ramp Spacing = 1,450'

Total estimated construction cost of project: $1,400,000,000
(Based on approval of this exception)

Additional cost to meet minimum AASHTO standard: n/a

Background description of project: (Attach Separate Document) **See Attachment A**
(Include a description of the general characteristics of the existing highway focusing on the features relevant to the proposed exception. Provide a brief description of the adjacent highway segments, highlighting existing nonstandard features when relevant to the proposed exception as well as the title sheet, typical section sheet, applicable plan sheets, profiles and cross sections.)

Purpose and need for exception; why standards cannot be met (include any future plan to upgrade this exception to standard):
The purpose of this design exception is to request a reduction in the ramp terminal spacing between ramp SW and existing ramp from westbound I-264 to northbound Frederick Blvd. The location of the ramp gore areas are constrained by the proposed horizontal geometry of the MLK Extension and the existing physicial distance between the proposed MLK Extension and the Frederick Boulevard ramp. Determination of a cost to avoid the design exception is not feasible given the constraints of the existing geometry.

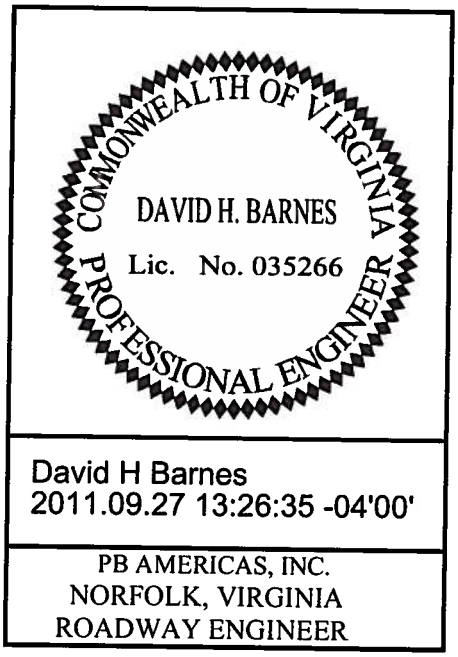
Are there any plans to improve the approach roadway within the next ten (10) years? **No.**

Accident history for the past 3 years:
Not applicable. This is a proposed road segment.

Effect of design exception on safety:
The effect of this exception will be a reduction in ramp terminal spacing from the recommended minimum standard of 2,000 feet (AASHTO) to 1,450 feet. This is a reduction from the IJR which showed the ramp terminal spacing at 1,660 feet. There should be very minimal effect to safety as this is an urban project and a slightly shorter distance between gores than AASHTO recommends should still meet driver expectations for urban conditions.

Any mitigation of the substandard design element (s):
In order to mitigate the substandard design the acceleration and deceleration lanes are connected to provide an auxiliary lane. This continuous acceleration/deceleration lane will improve the traffic operation for the short distance between the successive noses. Signing is another mitigation further discussed in Attachment A.

Has the Regional Traffic Engineer reviewed the substandard design and do they agree with the proposed mitigation measures? If not, please explain.
The Regional Traffic Engineer has reviewed the design and agrees with the proposed mitigation.



Submitted By: David H. Barnes, P.E. (PB) Date: September 27, 2011
Consultant

Remarks:

Recommended for Approval By: R. C. Wooten Date: 10/24/11
Drop-down Selection

and

Recommended for Approval By: _____ Date: _____
State Traffic Engineer (For Crossovers Only)

Remarks:

VDOT Approval By: _____ Date: 10/25/11
~~Drop-down Selection~~
State L&D Engineer

FHWA Approval By: _____ Date: 11-10-11

Remarks:

Cc: Project Manager
Project Designer
QMAC Section Manager

Design Exception Documentation

D 0103041401-5-Rev3
Design Exception 5
(Terminal Spacing between Ramp WN and Ramp N)

Downtown Tunnel - Midtown Tunnel - MLK Expressway

Submitted To:

SKW Constructors
809 S. Military Highway
Virginia Beach, VA 23464

June 24, 2011

Prepared By:

PB Americas, Inc.
6161 Kempsville Circle, Suite 110
Norfolk, VA 23502

TUNNEL VISION
MIDTOWN | MLK | DOWNTOWN

LD-440
(5-17-10)

DEPARTMENT OF TRANSPORTATION
LOCATION AND DESIGN
DESIGN EXCEPTION REQUEST
(Note: Use the Tab key to navigate and complete the Form)

To: Richard Worssam, P.E. Date: June 17, 2011
Drop-down Selection

From: Elizabeth River Crossings
Drop-down Selection

Subject: DESIGN EXCEPTION REQUEST - 5

Prepared by: David H. Barnes, PE (PB)

State Project Number: 0058-965-107 Federal Project Number: Unknown

County/City: Portsmouth District: Hampton Roads Funding Source: PPTA

Project Description
From: London Boulevard UPC: 76642
To: I-264

Design Exception Request For:

☐ Design Speed	☐ Horizontal Clearance* (other than "clear zone")	☐ Vertical Clearance*
☐ Bridge Width*	☐ Horizontal Alignment	☐ Vertical Alignment
☐ Lane Width	☐ Sight Distance	☐ Cross Slope
☐ Shoulder Width	☐ Superelevation	☐ Grade
Structural	☐ Interstate Access Control	☒ Other
☐ Capacity*		

* These are typically requested by the Bridge designer.

Current ADT: n/a Design ADT: 10,600

% Trucks: 6% Design Speed: 50mph Posted Speed: 45mph

Reduced Design Speed (if applicable) _____ Is Project on the NHS? yes

Functional Classification: Urban Principal Arterial (Freeway) Min. VDOT GS Standard: _____

Min. AASHTO Standard: Ramp Spacing=2000'

Existing Dimensions n/a Requested Dimensions Ramp Spacing = 910'

Total estimated construction cost of project: $1,400,000,000
(Based on approval of this exception)

Additional cost to meet minimum AASHTO standard: n/a

Background description of project: (Attach Separate Document) **See Attachment A.**
(Include a description of the general characteristics of the existing highway focusing on the features relevant to the proposed exception. Provide a brief description of the adjacent highway segments, highlighting existing nonstandard features when relevant to the proposed exception as well as the title sheet, typical section sheet, applicable plan sheets, profiles and cross sections.)

Purpose and need for exception; why standards cannot be met (include any future plan to upgrade this exception to standard):
The purpose of this design exception is to request a reduction in the ramp terminal spacing between Ramp WN and Ramp N. A design exception is being requested based on the constraints of existing conditions with the proximity of High Street to I-264. Determination of a cost to avoid the design exception is not feasible given the constraints of existing geometry.

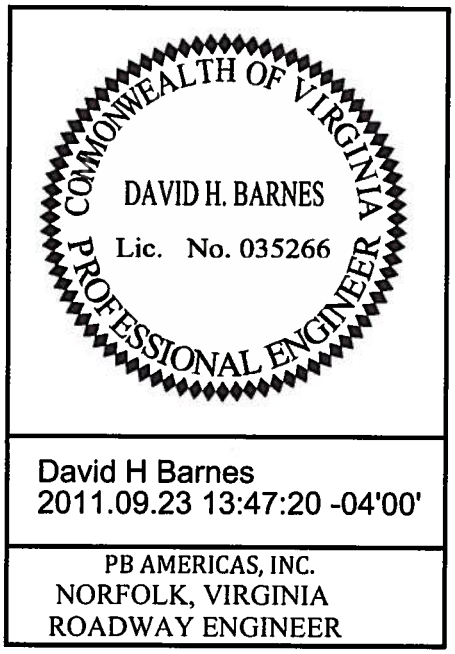
Are there any plans to improve the approach roadway within the next ten (10) years? **No.**

Accident history for the past 3 years:
Not applicable. This is a proposed road segment.

Effect of design exception on safety:
The effect of this exception will be a reduction in ramp terminal spacing from the recommended minimum standard of 2,000 feet (AASHTO Exhibit 10-68) to 910 feet. This is essentially the same as that noted in the Interchange Justification Report, dated 2007, which noted an estimated ramp terminal spacing of 1,000 feet. There should be minimal effect to safety due to relatively low traffic volumes on Ramp N, the use of the auxiliary lane for the entire distance between Ramp WN and Ramp N, and the reduced terminal distance would still meet driver expectations for urban conditions.

Any mitigation of the substandard design element (s):
In order to mitigate the substandard design the acceleration and deceleration lanes are connected to provide an auxiliary lane. This continuous acceleration/deceleration lane will improve the traffic operation for the shorter distance between the successive ramp gores. Signing is another mitigation further discussed in Attachment A.

Has the Regional Traffic Engineer reviewed the substandard design and do they agree with the proposed mitigation measures? If not, please explain.
The Regional Traffic Engineer has reviewed the design and had no comments on the proposed mitigation measures.



Submitted By: David H. Barnes, P.E. (PB) Date: June 17, 2011
Consultant

Remarks:

Recommended for Approval By: R. C. Worsham Date: 10/24/11
Drop-down Selection
and
Recommended for Approval By: _____ Date: _____
State Traffic Engineer (For Crossovers Only)

Remarks:

VDOT Approval By: _____ Date: 10/25/11
~~Drop-down Selection~~
State LED Engineer

FHWA Approval By: _____ Date: 11-10-11

Remarks:

Cc: Project Manager
Project Designer
QMAC Section Manager

Design Exception Documentation

D 0103041401-6-Rev3
Design Exception 6
(MLK Curve No. 10 Stopping Sight Distance)

Downtown Tunnel - Midtown Tunnel - MLK Expressway

Submitted To:

SKW Constructors
809 S. Military Highway
Virginia Beach, VA 23464

June 29, 2011

Prepared By:

PB Americas, Inc.
6161 Kempsville Circle, Suite 110
Norfolk, VA 23502

TUNNEL VISION
MIDTOWN | MLK | DOWNTOWN

LD-440
(5-17-10)
DEPARTMENT OF TRANSPORTATION
LOCATION AND DESIGN
DESIGN EXCEPTION REQUEST
(Note: Use the Tab key to navigate and complete the Form)

To: Richard Worssam, P.E. Date: June 29, 2011
Assistant State Location and Design Engineer
From: Elizabeth River Crossings
Drop-down Selection
Subject: DESIGN EXCEPTION REQUEST - 6

Prepared by: David H. Barnes, PE (PB)

State Project Number: 0058-965-107 Federal Project Number: Unknown

County/City: Portsmouth District: Hampton Roads Funding Source: PPTA

Project Description
From: London Boulevard UPC: 76642
To: I-264

Design Exception Request For:

☐ Design Speed	☐ Horizontal Clearance* (other than "clear zone")	☐ Vertical Clearance*
☐ Bridge Width*	☐ Horizontal Alignment	☐ Vertical Alignment
☐ Lane Width	☒ Sight Distance	☐ Cross Slope
☐ Shoulder Width	☐ Superelevation	☐ Grade
Structural	☐ Interstate Access Control	☐ Other
☐ Capacity*		

* These are typically requested by the Bridge designer.

Current ADT: 8,600 Design ADT: 15,200

% Trucks: 5% Design Speed: 50mph Posted Speed: 45mph

Reduced Design Speed (if applicable) _____ Is Project on the NHS? Yes

Functional Classification: Urban Principal Arterial (Freeway) Min. VDOT GS Standard: _____

Min. AASHTO Standard: HSO=17.3'

Existing Dimensions _____ Requested Dimensions HSO=12.4'

Total estimated construction cost of project: $1,400,000,000
(Based on approval of this exception)

Additional cost to meet minimum AASHTO standard: $54,000,000

Background description of project: (Attach Separate Document) **See Attachment A**
(Include a description of the general characteristics of the existing highway focusing on the features relevant to the proposed exception. Provide a brief description of the adjacent highway segments, highlighting existing nonstandard features when relevant to the proposed exception as well as the title sheet, typical section sheet, applicable plan sheets, profiles and cross sections.)

Purpose and need for exception; why standards cannot be met (include any future plan to upgrade this exception to standard):
The purpose of this design exception is to request a reduction in the stopping sight distance required for Curve 10 of the proposed Martin Luther King Freeway extension. The minimum sight distance standard cannot be met because the mainline alignment crosses under an existing bridge structure. The median barrier, that is required falls within the line of sight for the road, reducing the available sight distance. In order to avoid this design exception, the existing bridge would have to be replaced, which would include significant modifications to the entire London Boulevard interchange.

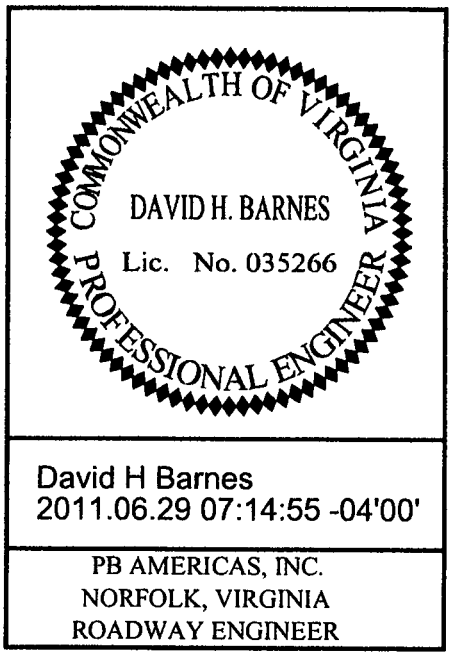
Are there any plans to improve the approach roadway within the next ten (10) years? **No.**

Accident history for the past 3 years:
Not applicable. This is a proposed road segment.

Effect of design exception on safety:
The effect of this exception on safety will be a reduction in stopping sight distance from the recommended minimum standard of 425 feet to 359 feet for the current design speed of 50 mph. In order for the 359 feet of available sight distance to be adequate, the design speed would have to be reduced to 44 mph.

Any mitigation of the substandard design element (s):
The effect of the exception as originally developed has been mitigated to the extent practicable by modifying the geometry of the roadway as described in Attachment A.

Has the Regional Traffic Engineer reviewed the substandard design and do they agree with the proposed mitigation measures? If not, please explain.
The Regional Traffic Engineer has reviewed the substandard design and agrees with the proposed mitigation.



Submitted By: David H. Barnes, P.E. (PB) Date: June 29, 2011
Consultant

Remarks:

Recommended for Approval By: R&P C. Worrum Date: 7/25/11
Drop-down Selection

and

Recommended for Approval By: _____ Date: _____
State Traffic Engineer (For Crossovers Only)

Remarks:

VDOT Approval By: _____ Date: 7/29/11
~~Drop-down Selection~~
State L&D Engineer

FHWA Approval By: _____ Date: 8-22-11

Remarks:

Cc: Project Manager
Project Designer
QMAC Section Manager

ATTACHMENT A

Design Exception for MLK Extension Curve No. 10 Stopping Sight Distance

Background Description of project:

As described in the VDOT prepared Interchange Justification Report for I-264/Martin Luther King Freeway, "The proposed project to extend Route 58 (Martin Luther King Freeway) to I-264, with a new interchange at I-264, will provide a direct freeway-to-freeway connection from I-264 to the Midtown Tunnel between Portsmouth and Norfolk, Virginia. This new connection would improve system linkage with the recently completed Pinners Point Interchange and improve access to existing and proposed regional port facilities. The new facility would also remove over 25,000 daily vehicles, including a significant number of large trucks, from local city streets through Portsmouth, including US 17 (Frederick Boulevard), High Street, London Boulevard, and Effingham Street. Trucks currently constitute as much as 25 percent of peak hour volumes on the US 17/I-264 ramps and local streets, US 17, Turnpike Road, and Harbor Drive."

Curve 10 is located at the interface between the proposed Martin Luther King Extension to existing MLK Freeway. Curve 10 is on Mainline MLK Extension from Station 1039+93.72 to Station 1047+04.19 with a radius of 1,300'. The required horizontal sightline offset (HSO) for a 50 mph design speed with a radius of 1,300' is 17.3 feet; however, the HSO for the proposed roadway is 12.4' for the northbound inside lane, which results in a stopping sight distance of 359', or 44 mph. The radius needed to meet the HSO of 12.4', for 50 mph, is 1,820'.

CURVE 10 ALTERNATIVE DESIGN CONCEPT REVIEWED

1. **Exhibit 6-A depicts the impacts of applying an 1820' radius to the current alignment. Such would involve a significant modification to the Project as approved in the MLK Extension Environmental Assessmsent, including impacts to Bethel Tempel Church and other properties. Further, such would diverge from Project plans to use the existing right-of-way of Harbor Drive as the primary alignment for the MLK Extension.**
2. **We also investigated shifting the location of Curve 10 more to the north in an effort to align with Harbor Drive. Such a shift would impact Curve 11, the existing curve under the London Boulevard Bridge. Thus, the currently proposed alignment of Curve 10 is needed to accommodate the proposed design speed of MLK Extension as it passess under the London Boulevard bridge. Specifically, the PT must be held held for curve 10 because there would be insufficient length between curve 10 and 11 for superelevation transition.**
3. **The vertical alignment is in a crest and at a design speed of 50 mph, thus not allowing for any type of line of sight obstruction horizontally. The lowest height barrier appropriate for the design is a 32" barrier, thus the barrier obstructs the line of sight as shown in Exhibit 6-E. The technical requirements for the project also call for glare screens or extended height barriers to be installed on all concrete median barriers.**

Design Exception Documentation

D 0103041401-7-Rev3
Design Exception 7
(MLK Curve No. 11 Stopping Sight Distance)

Downtown Tunnel - Midtown Tunnel - MLK Expressway

Submitted To:

SKW Constructors
809 S. Military Highway
Virginia Beach, VA 23464

June 29, 2011

Prepared By:

PB Americas, Inc.
6161 Kempsville Circle, Suite 110
Norfolk, VA 23502

TUNNEL VISION
MIDTOWN | MLK | DOWNTOWN

LD-440
(5-17-10)
DEPARTMENT OF TRANSPORTATION
LOCATION AND DESIGN
DESIGN EXCEPTION REQUEST
(Note: Use the Tab key to navigate and complete the Form)

To: Richard Worssam, P.E. Date: June 29, 2011
Assistant State Location and Design Engineer
From: Elizabeth River Crossings
Drop-down Selection
Subject: DESIGN EXCEPTION REQUEST - 7

Prepared by: David H. Barnes, PE (PB)

State Project Number: 0058-965-107 Federal Project Number: Unknown

County/City: Portsmouth District: Hampton Roads Funding Source: PPTA

Project Description
From: London Boulevard UPC: 76642
To: I-264

Design Exception Request For:

☐ Design Speed	☐ Horizontal Clearance* (other than "clear zone")	☐ Vertical Clearance*
☐ Bridge Width*	☐ Horizontal Alignment	☐ Vertical Alignment
☐ Lane Width	☒ Sight Distance	☐ Cross Slope
☐ Shoulder Width	☐ Superelevation	☐ Grade
Structural	☐ Interstate Access Control	☐ Other
☐ Capacity*		

* These are typically requested by the Bridge designer.

Current ADT: 8,600 Design ADT: 15,200

% Trucks: 5% Design Speed: 50mph Posted Speed: 45mph

Reduced Design Speed (if applicable) _____ Is Project on the NHS? Yes

Urban Principal
Functional Classification: Arterial (Freeway) Min. VDOT GS Standard: _____

Min. AASHTO Standard: HSO=21.4'

Existing Dimensions _____ Requested Dimensions HSO=8'

Total estimated construction cost of project: $1,400,000,000
(Based on approval of this exception)

Additional cost to meet minimum AASHTO standard: $54,000,000

Background description of project: (Attach Separate Document) **See Attachment A**
(Include a description of the general characteristics of the existing highway focusing on the features relevant to the proposed exception. Provide a brief description of the adjacent highway segments, highlighting existing nonstandard features when relevant to the proposed exception as well as the title sheet, typical section sheet, applicable plan sheets, profiles and cross sections.)

Purpose and need for exception; why standards cannot be met (include any future plan to upgrade this exception to standard):
The purpose of this design exception is to request a reduction in the stopping sight distance required for Curve 11 of the proposed southbound Martin Luther King Extension. The minimum sight distance standard cannot be met because the mainline alignment crosses under an existing bridge structure. The median barrier, that is required falls within the line of sight for the road, reducing the available sight distance. In order to avoid this exception the existing bridge would have to be demolished and reconstructed, a portion of the existing MLK freeway would need to be reconstructed, and additional properties required.

Are there any plans to improve the approach roadway within the next ten (10) years? **No.**

Accident history for the past 3 years:
The City of Portsmouth was contacted several times for accident data in this area. Such requests were never fulfilled.

Effect of design exception on safety:
The effect of this exception on safety will be a reduction in stopping sight distance from the recommended minimum standard of 425 feet to 260 feet for the current design speed of 50 mph. In order for the 260 feet of available sight distance to be adequate, the design speed would have to be reduced to 35 mph.

Any mitigation of the substandard design element (s):
The effect of the exception as originally developed has been mitigated to the extent practicable by modifying the geometry of the roadway as described in Attachment A.

Has the Regional Traffic Engineer reviewed the substandard design and do they agree with the proposed mitigation measures? If not, please explain.
The Regional Traffic Engineer has reviewed the substandard design and agrees with the proposed mitigation.

COMMONWEALTH OF VIRGINIA
DAVID H. BARNES
Lic. No. 035266
PROFESSIONAL ENGINEER

David H Barnes
2011.06.29 07:24:12 -04'00'

PB AMERICAS, INC.
NORFOLK, VIRGINIA
ROADWAY ENGINEER

Submitted By: David H. Barnes, P.E. (PB) Date: June 29, 2011
Consultant

Remarks:

Recommended for Approval By: R. D. C. Warren Date: 7/25/11
Drop-down Selection

and

Recommended for Approval By: _____ Date: _____
State Traffic Engineer (For Crossovers Only)

Remarks:

VDOT Approval By: _____ Date: 7/29/11
~~Drop-down Selection~~
State L&D Engineer.

FHWA Approval By: Jason Lee Date: 8-22-11

Remarks: It is recommended that a reduced speed limit sign of 35 mph be posted for area within Sta. # 1049+00 to Sta. # 1055+00 on NB and SB.

Cc: Project Manager
Project Designer
QMAC Section Manager

ATTACHMENT A

Design Exception for MLK extension Curve No. 11 Stopping Sight Distance

Background Description of project:

As described in the VDOT prepared Interchange Justification Report for I-264/Martin Luther King Freeway, "The proposed project to extend Route 58 (Martin Luther King Freeway) to I-264, with a new interchange at I-264, will provide a direct freeway-to-freeway connection from I-264 to the Midtown Tunnel between Portsmouth and Norfolk, Virginia. This new connection would improve system linkage with the recently completed Pinners Point Interchange and improve access to existing and proposed regional port facilities. The new facility would also remove over 25,000 daily vehicles, including a significant number of large trucks, from local city streets through Portsmouth, including US 17 (Frederick Boulevard), High Street, London Boulevard, and Effingham Street. Trucks currently constitute as much as 25 percent of peak hour volumes on the US 17/I-264 ramps and local streets, US 17, Turnpike Road, and Harbor Drive."

Curve 11 commences under the existing London Boulevard bridge structure on MLK Mainline and traverses from Station 1051+51.10 to Station 1056+86.81, with a radius of 1,050 feet. The required horizontal sightline offset (HSO) for 50 mph is 21.4', however the HSO for the proposed roadway is 8' for the southbound inside lane, which meets the stopping sight distance of 260', or 35 mph.

CURVE 11 ALTERNATIVE DESIGN CONCEPT REVIEWED

1. **The radius needed to meet the HSO of 21.4' is 2822'. To construct a curve with such a radius would involve the relocation of the London Boulevard Bridge and modifications to the existing interchange. Such would involve a significant modification to the Project as presented in the MLK Extension Environmental Assessment, including additional property impacts and additional wetland impacts.**

DISCUSSION OF DESIGN/OPERATING SPEED

The existing MLK Freeway is currently posted at 35mph, southbound approaching the London Boulevard interchange. This is likely due to the expressway terminating at High Street. Curve 11 is designed with superelevation of e_{max}=8%, which is greater than the e=4% of the existing roadway. In the southbound direction, the MLK Extension will terminate onto ramps of lower design speed within approximately 3,000-feet of the London Boulevard overpass. Thus, a reduction of the posted speed to 35mph for the southbound direction could be considered for the entire length of the MLK Extension. As the proposed facility is being designed as controlled access, it is unlikely that the 85th percentile speed will be under 45mph, regardless of the posted speed. A recommendation to maintain the posted speed of 45mph and add curve warning signage for 35mph for the southbound approach to the London Boulevard interchange was brought to the Regional Traffic

Engineer. The RTE determined that this would not be appropriate signage as the issue is horizontal stopping sight distance, not a deficient curve radius or superelevation.

Design Exception Documentation

D 0103041401-9-Rev3
Design Exception 9
(MTT Ramp B Exit)

Downtown Tunnel - Midtown Tunnel - MLK Expressway

Submitted To:

SKW Constructors
809 S. Military Highway
Virginia Beach, VA 23464

June 21, 2011

Prepared By:

PB Americas, Inc.
6161 Kempsville Circle, Suite 110
Norfolk, VA 23502

TUNNEL VISION
MIDTOWN | MLK | DOWNTOWN

DEPARTMENT OF TRANSPORTATION
LOCATION AND DESIGN
DESIGN EXCEPTION REQUEST

(Note: Use the Tab key to navigate and complete the Form)

To: Richard Worssam — Date: June 21, 2011
Assistant State Location and Design Engineer

From: Elizabeth River Crossings
Drop-down Selection

Subject: DESIGN EXCEPTION REQUEST

Prepared by: David H. Barnes, PE (PB)

State Project Number: 0058-965-107 Federal Project Number: Unknown

County/City: Norfolk District: Hampton Roads Funding Source: PPTA

Project Description
From: Pinner's Point Interchange UPC: 76642
To: Brambleton Avenue Interchange

Design Exception Request For:

☐ Design Speed	☐ Horizontal Clearance* (other than "clear zone")	☐ Vertical Clearance*
☐ Bridge Width*	☐ Horizontal Alignment	☐ Vertical Alignment
☐ Lane Width	☐ Sight Distance	☐ Cross Slope
☐ Shoulder Width	☐ Superelevation	☐ Grade
☐ Structural Capacity*	☐ Interstate Access Control	☒ Other

* These are typically requested by the Bridge designer.

Current ADT: 19,000 Design ADT: 27,700

% Trucks: 11 Design Speed: 40mph Posted Speed: 35mph

Reduced Design Speed (if applicable) n/a Is Project on the NHS? Yes

Functional Classification: Urban Principal Arterial Min. VDOT GS Standard:

Min. AASHTO Standard: 1000'

Existing Dimensions 561' Requested Dimensions 561'

Total estimated construction cost of project: $1,400,000,000
(Based on approval of this exception)

Additional cost to meet minimum AASHTO standard: n/a

Background description of project: (Attach Separate Document) **See Attachment A**
(Include a description of the general characteristics of the existing highway focusing on the features relevant to the proposed exception. Provide a brief description of the adjacent highway segments, highlighting existing nonstandard features when relevant to the proposed exception as well as the title sheet, typical section sheet, applicable plan sheets, profiles and cross sections.)

Purpose and need for exception; why standards cannot be met (include any future plan to upgrade this exception to standard):
The existing ramp from eastbound Route 58 to southbound Brambleton Avenue is approximately 561' from the Midtown Tunnel portal location. The 2004 AASHTO"Green Book" recommends that exit ramps should be a minimum distance of 1000' from a tunnel portal to permit needed signs between the portal and the point of exit. The horizontal geometry of existing Midtown Tunnel and the Brambleton Avenue interchange will remain in place, so the existing distance will not change. The ramp from Route 58 East to Brambleton Avenue South is being raised vertically for a portion of the alignment to reduce flooding frequency of the Norfolk approach, but it is not feasible to move the ramp to meet the minimum 1000' distance recommended in the 2004 AASHTO "Green Book." Determination of a cost to avoid the design exception is not feasible given the constraints of existing geometry.

Are there any plans to improve the approach roadway within the next ten (10) years? **No.**

Accident history for the past 3 years:
Of the completed accident reports on Route 58 eastbound between the exit of the Midtown Tunnel and the Brambleton Blvd interchange, there was one crash reported in the past 3 years. This was an injury crash that involved loss of control/Hit Fixed Object, and occurred in the rain at night. The driver was also charged with a DUI.

Effect of design exception on safety:
One crash reported in three years indicates that there is not currently a crash problem at this location. The potential for crashes may increase slightly based on the potential for lane-changing vehicles

Any mitigation of the substandard design element (s):
Directional signage prior to the eastbound Midtown Tunnel entrance warning traffic bound for Brambleton Avenue southbound that they should use the right-most lane. A standard single white line is to be carried from the portal to the Ramp B exit to discourage motorists from attempting a lane change in the area between the portal and Ramp B.

Has the Regional Traffic Engineer reviewed the substandard design and do they agree with the proposed mitigation measures? If not, please explain.
Yes, the Regional Traffic Engineer has reviewed and agrees with the proposed mitigation measures.

COMMONWEALTH OF VIRGINIA
DAVID H. BARNES
Lic. No. 035266
PROFESSIONAL ENGINEER

David H Barnes
2011.06.23 10:40:53 -04'00'

PB AMERICAS, INC
NORFOLK, VIRGINIA
ROADWAY ENGINEER

Submitted By: David H. Barnes, P.E. Date: June 21, 2011
Drop-down Selection

Remarks:

Recommended for Approval By: R. C. Worrum Date: 7/25/11
Drop-down Selection
and
Recommended for Approval By: _____ Date: _____
State Traffic Engineer (For Crossovers Only)

Remarks:

VDOT Approval By: _____ Date: 7/29/11
~~Drop-down Selection~~
State L&D Engineer

FHWA Approval By: _____ Date: 8-22-11

Remarks: It is approved with the understanding that proper directional signage shall be placed for Brambleton Avenue prior to the eastbound Midtown Tunnel entrance.

Cc: Project Manager
Project Designer
QMAC Section Manager

ATTACHMENT A

New Midtown Tunnel
Design Exception for reduced distance from tunnel portal to point of exit.

Background Description of project:
The Downtown Tunnel (DT), Midtown Tunnel (MT), Martin Luther King Freeway (MLK) Extension project is located in Norfolk and Portsmouth and is instrumental in addressing the region's transportation needs. A new tunnel, improvements to existing tunnels and the extension of the MLK Freeway to I-264 will increase capacity and reduce congestion - enhancing the economic vitality of the region.

The project includes the following elements:

- **A two-lane tunnel under the Elizabeth River near the existing Midtown Tunnel;**
- **Maintenance and safety improvements to the existing Midtown Tunnel;**
- **Minor modifications to the interchange at Brambleton Avenue and Hampton Boulevard;**
- **Maintenance and safety improvements to the existing Downtown Tunnel;**
- **Extension of the Martin Luther King Freeway from London Boulevard to I-264, with an interchange at High Street and a full directional interchange at I-264; and**

- **Utilities replacement in Norfolk and Portsmouth.**

The project also includes storm water management facilities, intelligent transportation systems such as electronic signs and traffic cameras, electronic tolling systems, and the installation of sound barriers.

The project area for the proposed Midtown Tunnel is located 1,500 feet west of the existing tunnel portal on the Portsmouth side of the river, to Brambleton Avenue in Norfolk. The Downtown Tunnel portion of the project is along I-264, east and west, where it crosses the Southern Branch of the Elizabeth River. The proposed MLK Extension will begin on London Boulevard and extend to I-264, including improvements along the I-264 corridor from Frederick Boulevard to Des Moines Avenue. The project improvement lengths on I-264 are 8,000 feet - from Frederick Boulevard to Des Moines Avenue and the MLK Extension is approximately 4,700 feet - from London Boulevard to I-264.

DOWNTOWN TUNNEL/MIDTOWN TUNNEL/MLK EXTENSION PROJECT

The Technical Requirements

Comprehensive Agreement Exhibit C

Attachment 3A

Project Development Plans

TECHNICAL REQUIREMENTS

Exhibit C

TECHNICAL REQUIREMENTS
Exhibit C

3A.1 Project Development Plans

3A.1.1 General

A. The general requirements for Project Development Plans (PDPs) are noted in Section 1.3 of the Technical Requirements and are not repeated herein.

B. The PDPs shall consider ISO principles, where applicable, (ISO 9001:2000 Quality Management Systems- Requirements; ISO 9004:2000 Quality Management Systems- Guidelines for Performance Improvement; ISO 9000:2000 Quality Management Systems- Fundamentals and Vocabulary; ISO: 19011:2004 Guidelines for Quality and/or Environmental Management Systems Auditing; ISO 14001:2004 Environmental Management Systems-Specifications with Guidance for Use).

C. The PDPs shall comply with the requirements of the Agreement including the Technical Requirements, and shall ensure that when implemented, the Work covered by the PDPs will comply with such requirements.

D. PDP and procedures shall be updated from time to time throughout the Term as agreed to by the parties and in the event the PDP or procedure: 2

1. Does not adequately address the matters it is intended to address as per undisputed finding; 1

2. Does not conform to the Agreement; or

3. Deviates significantly from that previously agreed.

3A.1.2 Concessionaire Management Plan

A. The purpose of the Concessionaire Management Plan is to provide VDOT with a clear perspective of the Project management approach undertaken by the Concessionaire for all aspects and phases of the Project. It shall clearly identify responsibilities and procedures for each Project management activity and demonstrate a thorough understanding of the Agreement and Project requirements.

B. The Concessionaire Management Plan shall provide a cross reference to all other Project Development Plans and identify inter-relationships between Project Development Plans in the context of the Concessionaire's management approach.

C. The Concessionaire Management Plan is an umbrella document that describes the Concessionaire's managerial approach, strategy, and quality procedures to design, construct, operate and maintain the Project and achieve all requirements of the Agreement.

D. The Concessionaire Management Plan shall include an organization chart showing the structure of the Concessionaire's Project organization including:

1. Well defined roles for the design, construction, operations and maintenance; sub-organizations (such as consulting, subcontractors, suppliers) and a description of the roles, responsibilities and professional qualifications of Key Members and each member of the Concessionaire's management team;

2. Relationship with VDOT and third parties and Governmental Authorities; 1

3. Work to be accomplished by each Key Member, including members of the Concessionaire's management team, lead designer, Contractor, major suppliers and subcontractors, Operations and Maintenance Contractor, if applicable; and

4. Elements of the Concessionaire's organization responsible for quality control and quality assurance and their relationships to the management team.

E. The Concessionaire Management Plan shall describe:

1. The management procedures to ensure independence of quality processes and line management from design, construction, operation and maintenance production processes;

2. The approach to preparation, control and update of the Project Schedule to include the approach for integrating subcontract activities into the schedule and the reporting system;

3. The approach to scope control and how requested changes and recommended corrective actions are addressed through an integrated change control process; to include the control of change orders, early identification of scope changes and coordination and communication among team members to address change control; and

4. The approach to identify, assess, manage and mitigate material identified Project risks (regardless of their allocation under the Agreement).

F. The Concessionaire Management Plan shall describe how all PDPs fit within the overall quality management system, responsibilities for developing and maintaining the PDPs and the schedule for implementation. The Concessionaire Management Plan shall be linked to the Quality Management System Plan.

3A.1.3 Document Management Plan

A. The Document Management Plan shall define the document management approach for all Work Product. Document management requirements are set forth in this Section of the Technical Requirements. The Document Management Plan shall address methods by which the Technical Requirements shall be met including:

1. The electronic document management system (EDMS);

2. Document management procedures;

3. Requirements for records retention;

4. Electronic and hardcopy data transmission, storage, sharing and retrieval;

5. A logical, auditable and project-compatible tracking system of all Project correspondence and documents for all phases of the Project.

B. The Document Management Plan shall clearly define document management applicable to all aspects of the project management structure, including: methods for controlling updates, methods for identification of the originator/recipient of all documents, document approvals tracking, methods for enabling a searchable database, methods to establish links among various documents, and protocols for hard-copy and electronic filing.

C. The Document Management Plan shall be appropriately structured to record and track review comments and participation by VDOT, the Concessionaire's internal review processes, and third parties participating and having input regarding the Project. 1

D. The Document Management Plan shall also provide for electronic data management and storage, and electronic access to project documents remotely, with the required safety and security procedures including:

1. Methods by which all documents issued and received by the Concessionaire will be uniquely coded and retrievable in a user-friendly format;

2. The routing, filing, control, and retrieval methods for all documents; and

3. Methods to facilitate sharing of data including procedures for accessing all documents.

E. The Document Management Plans shall include appropriate cross references to specific paragraphs of the Quality Management System Plans, identifying where quality control, quality assurance and audit processes for document management procedures are defined by the Concessionaire to assure that performance of the document management system meets or exceeds the requirements set forth in the Technical Requirements.

3A.1.4 Quality Management System Plan

A. The Quality Management System Plan (QMSP**)** shall:

1. Meet the standards and specifications set for in these Technical Requirements including, where applicable, VDOT's *Minimum Requirements for Quality Assurance & Quality Control on Design-Build & Public-Private Transportation Act Projects – August 2007, (revised July 2008, including tables 105-1, 105-2, 105-4 and 105-4 part 2 as amending on August 2011),* and, where applicable, the requirements for VDOT's *Manual of Instruction – Materials Division, Construction Manual, Maintenance Manual, Inspection Manual*, and the requirements of USC Title 23-Highways Part 635 Subpart D General Materials Requirements, and Part 637 Construction Inspection and Approval. 4

2. Describe the system, policies, and procedures to deliver the Project throughout the Term and provide documented evidence that the work was performed in accordance with the Agreement, and that the materials meet or exceed the specifications.

3. Include a requirement for the Design-Build Contractor and the O&M Contractor to develop, implement and maintain quality management systems for the Work.

4. Include a quality assurance/quality control plan for design and for construction in accordance with *VDOT's Minimum Quality Assurance and Quality Control Requirements for Design-Build and PPTA Projects.*

5. Include a quality assurance/quality control plan for operations and maintenance in accordance with the Technical Requirements which incorporates quality measures to address the Performance Requirements.

6. Include an annual audit of the quality systems of the Concessionaire and the Contractor.

7. The Concessionaire and its contractors and subcontractors shall maintain their quality records and make the same readily available to VDOT upon reasonable request.

8. The Concessionaire shall be responsible for all quality assurance and quality control activities required to manage its own processes as well as those of its contractors, subcontractors and suppliers of any tier. The Quality Management System Plans shall:

   a. Describe the reporting and documentation processes of the quality management system,

   b. Define the quality management system roles and auditing responsibilities and procedures (internal and external);

   c. Establish quality objectives that are specific, quantifiable and time dependent;

   d. Provide an organizational chart with roles, responsibilities and professional qualifications applicable to each phase of the Project including design, construction, operations, and handover and handback and establish appropriate responsibilities of the organization's staff;

   e. Identify the essential processes necessary for the implementation of a quality management system that satisfies the requirements of the Agreement and all other Project Agreements, including its application throughout the Concessionaire's organizational structure;

   f. Address certification, training and experience, to facilitate quality control, assurance and management process;

   g. Define the processes and responsibility for the coding, filing, receiving and distribution of standards, quality records, reports and audits, changes, notices, and other correspsondence for each phase of design, construction and operations and maintenenance, which at a minimum shall include:

      i. Searchable data;

      ii. Summary of inspection and quality control activities;

      iii. Internal and external quality audits performed;

iv. Non-conformances and their status, such as quality item description; date opened; date closed; status (open, closed, pending, follow-up required); disposition (repair, reject, rework); status; corrective actions;

v. How the non-conformity has been accepted by VDOT, if applicable; and

vi. Updates to the Quality Management System;

h. Provide a dispute resolution process in coordinating with that defined in the Concessionaire Management Plan that includes a mechanism for "escalating" quality concerns of VDOT or the Concessionaire. 1

B. The Concessionaire shall submit a Design Quality Management Plan (DQMP). The DQMP shall be a subordinate part of the overall quality management system. The DQMP shall describe the design quality requirements for the Project; explain how the applicable project procedures, practices, and/or plans are to be followed to meet these requirements; and shall identify the organizational structure of the staff responsible for performing quality activities and verifying compliance.

C. The DQMP shall contain the Concessionaire's approach to:

1. Internal and external process of design reviews;

2. Design quality assurance and quality control functions including communicating with multiple design firms and offices in maintaining coordination of design quality;

3. Reporting organizational relationships and responsibilities;

4. Understanding of and compliance with VDOT and Federal oversight procedures;

5. Plan for documentation of quality management;

6. Proposed process to address and obtain approval of design deficiencies or exceptions;

7. Conducting annual audits of design quality control and quality assurance activities to verify conformance to the procedures;

8. Written certification process for all design documentation to ensure that it has been checked and approved prior to construction;

9. Ensuring oversight and constructability reviews by technical and management staff to provide coordination and uniformity among section designs; and to facilitate the timely planning of construction activities.

D. The Concessionaire shall submit its approach to Construction Quality Management Plan to include its:

1. Approach to acceptance testing and inspection and compliance with 23 CFR 637;

2. Approach to scheduling and coordination of inspection and testing, including early establishment of planned tests, frequencies and quantities;

3. Proposed process for identification and correction of construction deficiencies and non-compliances, including provision of a quality auditing and nonconformance recovery plan for resolution of nonconformance issues;

4. Approach to documenting, including the use of checklist certifications forms, the level and degree of conformity of the construction with the approved design plans and verifying that workmanship conforms to the construction documents, specifications and industry standards;

5. Understanding of and compliance with VDOT and Federal design standards and oversight procedures;

6. Description of the quality assurance and quality control functions and how these functions will be managed independent of one another;

7. Integration of construction quality management with design quality management; and

8. Preparation of and maintenance as-built drawings and record documents.

E. The Concessionaire shall submit an Operations and Maintenance Quality Management Plan, which shall be incorporated into the Operations and Maintenance Plan, containing the following:

1. Internal processes for managing and controlling information identified through incident reports, noncompliance reports, and traffic reports to address quality improvement;

2. Methods for documenting and correcting noncompliance issues;

3. Proposed approach to auditing and demonstrating continuous improvement in meeting the operations and maintenance Performance Requirements;

4. Description of operations and maintenance quality assurance and quality control functions; and

5. Integration of quality process into Ordinary Maintenance, Major Maintenance and inspections.

F. The Concessionaire shall have ultimate responsibility for the quality activities throughout the duration of design, construction, operations and maintenance phases of the Project.

3A.1.5 Design Management Plan

A. The Design Management Plan shall provide the organization, relationship and procedures that define clear lines of responsibility and well defined approach for meeting Project requirements and innovation in design approach.

B. The Design Management Plan shall include appropriate cross references to specific paragraphs of the Quality Management System Plans and the Design Quality Management Plan identifying where quality control, quality assurance and audit processes for design management procedures are defined by the Concessionaire.

C. The Design Management Plan shall include appropriate cross references to specific paragraphs in the Construction Quality Management Plan to identify the process for integrating design and construction.

D. The Design Management Plan shall define the design approach, flow charts and activities for the design of the Project and shall address:

1. How design work will be integrated by different firms and/or offices;

2. How the design personnel will interface with construction personnel;

3. A drawing tier indicating organization and hierarchy of the Concessionaire's drawings;

4. The design basis (e.g. design criteria, design standards and specifications);

5. Design validation, ensuring that the intended design meets its intended use;

6. Stages where design reviews are conducted and design work is certified by appropriate design professionals, professional engineers registered in the State;

7. Work zone and worker safety review during design;

8. The breakdown of the Project design into design packages;

9. How each design package will be integrated into the construction plans;

10. The process the engineering consultant and subconsultants will use to design and seal each design package;

11. The system engineering process for the design of the systems components;

12. The proposed strategy for integrating the facilities and systems component into the design process;

13. The proposed strategy to develop and/or accommodate, as applicable, the bicycle and pedestrian requirements as set out in Section 1.13 of the Technical Requirements;

14. Roadway design plan, to include process for ensuring community connectivity and coordination with localities;

15. Drainage design plan to include an Erosion and Sediment Control Plan and a Stormwater Management Plan, to include the Concessionaire's plans to comply with the applicable Laws;

16. Design deliverables;

17. Design control, design input reviews, output reviews and verifications (design checks and professional review and seals) to ensure the Technical Requirements have been met by the Concessionaire;

18. Design changes;

19. The process by which the Concessionaire's team and VDOT will be involved in the design review process; 1

20. Linkage to other PDPs, where appropriate

3A.1.6 Environmental Management Plan

A. The Concessionaire shall maintain and update an Environmental Management Plan that shall include:

1. Procedures and a contingency plan (emergency response plan) for reporting, immediate actions, and remedial actions; to be taken in the event of a potential environmental permit violation, dump, discharge, or spill of hazardous substances or other environmentally deleterious substances, including, as required by regulation, the development and implementation of a Spill Prevention, Control and Countermeasures (SPCC) plan(s);

2. Investigation, handling, monitoring, discharge, release, storage, removal, remediation transportation, tracking, reporting, and other disposition of any Hazardous Substance encountered or used on the Project;

3. Coordination with VDOT and other emergency response-related agencies and organizations; and

4. Submission of "incident" reports for releases of Hazardous Substances or other environmentally deleterious substances.

B. The Environmental Management Plan shall include the procedure and the party responsible for obtaining the required Governmental Approvals, interface with Governmental Authorities, and identifying and controlling the permit conditions to assure environmental compliance.

C. The Environmental Management Plan shall define the environmental activities required during the design and construction of the Project and shall address:

1. Compliance (monitoring, control, follow-up and audits) with the environmental requirements and regulations;

2. Stormwater management plans;

3. Stormwater pollution prevention;

4. Environmental impact avoidance, minimalization, and mitigation measures;

5. Identify environmental monitoring and recording requirements;

6. On-going monitoring and compliance records tracking system;

7. Compatible with ISO 19011:2004 Guidelines for Quality and/or Environmental Management Systems Auditing; and ISO 14001:2004 Environmental Management Systems- Specifications with Guidance for Use; and

8. Linkage to other PDPs, including the Quality Management System Plan.

3A.1.7 Right of Way Acquisition and Relocation Plan

A. The Right of Way (ROW) Acquisition and Relocation Plan shall address the requirements set forth in Section 3.6 of the Technical Requirements.

B. The ROW Acquisition and Relocation Plan shall define the approach to acquisition of the Project Right of Way and shall address:

1. The ROW acquisition and relocation process and procedures, to include Concessionaire/VDOT review and approval procedures and coordination of submittal packages;

2. The process for determining full or partial takes;

3. The process for assessing damages;

4. Appropriate cross-reference to the Design Management Plan to address property access in coordination with the acquisition process;

5. The ROW acquisition services;

6. Coordination with VDOT and property owners;

7. ROW acquisition cost management;

8. The use of RUMS and generation of the appropriate reports with cross-references to the document management system;

9. Environmental concerns;

10. Linkage with other PDPs, including the Quality Management System Plan.

3A.1.8 Utilities Plan

A. The Utilities Plan shall address the requirements set forth in Section 3.7 of the Technical Requirements.

B. The Utilities Plan shall define the utility coordination activities during the design and construction of the Project and shall address:

1. Utility agency coordination plans and process;

2. The utility relocation process;

3. The application of prior rights;

4. Utility agreements including VDOT Master Utility Agreement (MUA) and/or development of Project specific utility relocation agreements;

5. Wet utility relocations;

6. Dry utility relocations;

7. The coordination with VDOT, utilities and other third parties;

8. The resolution of utility conflicts for which the Concessionaire is responsible;

9. Appropriate cross-references to the Design Management Plan and the Construction Quality Management Plan to integrate utility relocation with design and construction of the Project;

10. The development and maintenance of a utility tracking report;

11. On-going monitoring and compliance records tracking system; and

12. Linkage to other PDPs, including the Quality Management System Plan.

C. The Utilities Plan will define third party coordination activities with the railroads impacted by the project. This plan shall address:

1. Coordination with the railroads;

2. The process for obtaining the appropriate permits;

3. Appropriate cross-references to the Design Management Plan to integrate utility relocation with design and construction of the Project; and

4. Appropriate cross-references to other PDPs, including the Quality Management System Plan to assure that the Technical Requirements have been met or exceeded.

3A.1.9 Maintenance of Traffic (MOT) Plan

A. The Concessionaire shall develop a MOT Plan pursuant to Section 3.9 of the Technical Requirements. The MOT Plan shall consider the impact of construction activities on the access and egress of traffic to the London Boulevard Interchange, High Street Interchange, tunnel approach work on Norfolk and Portsmouth sides along Rt 58 and at Brambleton Avenue and Hampton Boulevard, and the new Interchange for MLK Extension and I-264 between Exits 5 and 6 within the immediate construction zone. 2

B. The MOT Plan shall address at a minimum:

1. Construction phasing plans with diagrams and narratives;

2. Procedures for incorporating traffic management in the Project design with specific references to the Design Management Plan;

3. The process for allowing for and scheduling detours;

4. Describe an emergency access plan for emergency vehicles and public/semi-public facilities such as hospitals, fire stations and police stations;

5. Incident management liaison with VDOT;

6. Conform to the *Virginia Work Area Protection Manual*;

7. Plans may include the use of MOT stone for secondary roadways with current traffic volumes of less than 500 vehicles per day;

8. Be proactive in addressing impact of the Project on all road users and general public;

9. Coordinate with the Project Communication Plan for development of Public Information and Communication Plan (as required by the Standard Documents) which clearly demonstrates transportation-related project communication, which also describes the public information approach and activities; and

10. Appropriate cross references to relevant paragraphs of other PDPs, including the Quality Management System Plan, identifying where quality control, quality assurance and audit processes for transportation management procedures are defined by the Concessionaire, to assure that performance of MOT meets or exceeds the Technical Requirements.

3A.1.10 Public Information and Communications Plan

A. The Concessionaire is expected to develop and maintain an effective Public Information and Communications Plan throughout the Project. The Concessionaire shall deliver an integrated Public Information and Communications Plan that at a minimum include the following components:

1. Description of how the Concessionaire proposes to provide an effective framework for communication between the Concessionaire and stakeholders;

2. Description of how the Concessionaire will effectively engage the community in the design, construction and operation of the Project;

3. Description of how the Concessionaire will build a relationship with stakeholders and the community within the Project and its surrounding corridor over the Term;

4. Approach to public information and communications risks, describing or detailing how the Concessionaire will identify and manage risks and including appropriate cross references to the Concessionaire's risk management procedures;

5. Description of how the Concessionaire will develop a brand relationship between the community, road users and the O&M Contractor;

6. Description of how the Concessionaire will maximize public awareness of features and benefits of the Project;

7. A description of communication tools and strategies to be employed during each phase of the Project development, delivery and operation, including:

a. Project branding;

b. Market research and analysis;

c. Media outreach;

d. Stakeholder outreach and information;

e. Interface and liaison with VDOT;

f. Project communication team; and

g. Public information and involvement before Final Completion;

8. Public education and awareness after Final Completion;

9. A crisis communications plan and procedures, addressing coordination with VDOT and responsiveness to the media. The plan shall identify key spokespeople and include protocols, key messages, and procedures to manage communications during a crisis. This plan shall also be shared and coordinated with other local and state emergency service providers;

10. Description of the Concessionaire's reporting and documentation mechanism for public information and communications matters including appropriate cross references to the Document Management Plan;

11. Appropriate cross references to relevant paragraphs of other PDPs, including the Quality Management System Plan, identifying where quality control, quality assurance and audit processes for public information and communication procedures are defined by the Concessionaire, to assure that performance of public information and communication meets or exceeds the Technical Requirements;

12. Methods of monitoring performance of the plan such as formal research surveys and media coverage; and

13. Identification of certain milestones requiring individualized communications activities to be incorporated into the Communications, Public Outreach and Community Engagement Plan, for which targeted communications activities shall be proposed.

B. The Concessionaire shall develop a Public Information Plan ("PIP") for the Project as part of its overall Public Information and Communications Plan. The

PIP is expected to develop and maintain an effective Communications, Public Outreach and Community Engagement Plan throughout the Project, including during the Term.

C. The PIP will fit within the context of the broader Communication, Consultation, Public Outreach and Community Engagement Plan and shall include the following:

1. Description of how the Concessionaire will identify stakeholders and the outreach tactics that will be used to engage them;

2. Description of how the Concessionaire will train relevant Project personnel in crisis communications, media relations and community outreach techniques;

3. A Community Engagement Program, describing the approach to consulting with the community about design and construction matters, including:

   a. Mechanism to engage the community;

   b. Measures to communicate with and mitigate the impacts of construction on directly impacted properties (dust, noise, access constraints, utility impacts etc);

   c. Hosting community information meetings to provide updated Project information as required; and

   d. Education and awareness related to public safety surrounding the work zone;

4. The Concessionaire's approach to coordinate with VDOT on communication with the public about construction activities, including:

   a. Notification of forthcoming construction activity to surrounding homes and businesses;

   b. Commitment of key Project staff to participate in community outreach activities such as public meetings and media interviews;

   c. Establishment and maintenance of a Project hotline to manage public inquiries and concerns;

   d. Facilitation and maintenance of Project signage, including

information to pedestrians and cyclists, and Project branding and information; and

e. Communicating of Project activities impacting the public, such as changes to traffic patterns with appropriate cross-references to the Transportation Management Plan;

5. Other public information methods/products that the Concessionaire shall consider in preparing the public involvement portion of the Public Information and Communications Plan are: citizen information meetings, which should be planned and carried out similarly to public hearings; an interactive website with forms and/or e-mail addresses for submitting public comments; media campaigns; media background briefing; presentations to community groups; and electronic and/or printed newsletters, brochures and notices;

6. Description of how the Concessionaire will, in coordination with VDOT, provide information to motorists and stakeholders to facilitate the Maintenance of Traffic (MOT) during construction. This shall include:

   a. Packaging of all MOT information, such as anticipated delays and lane closures, for provision to the Project communication team on a regular basis, to facilitate communication to the media, stakeholders and the broader community;

   b. Communication with direct impact area property owners;

   c. Communication with elected officials and other key stakeholders;

   d. Coordination with relevant Government Authorities;

   e. Notification program to inform motorists and the broader community about expected traffic changes/delays (such as on-road signage, SMS and email alerts); and

   f. Information to stakeholders about events in the area that may be affected by construction activities;

7. Description of how the Concessionaire will coordinate with VDOT in the development of construction-related information for inclusion on all Project communication material as developed under the Public Information and Communications Plan (including web, bulletins, etc.)

8. Management of construction site tours, including stakeholder events

9. Recording of Project progress through photography;

10. Packaging and timely delivery to VDOT of information on expected, major traffic changes for inclusion in VDOT public advertising programs. VDOT will manage and execute all advertising related to construction activities, such as significant lane closures and anticipated delays; and

11. Linkage with other PDPs, including the Quality Management System Plan.

3A.1.11 Disadvantaged Business Enterprises/Small, Women and Minority Owned Businesses (DBE/SWaM) Plan

A. The DBE/SWaM Plan shall define the approach to meet the DBE/SWaM participation goal for the Term and shall address:

1. The proposed method to demonstrate a good faith effort to meet the DBE/SWaM participation goal;

2. The proposed methods to comply with EEO, DBE/SWaM, and labor Laws;

3. Appropriate cross references to specific paragraphs of the Design Management Plan, Concessionaire Management Plan and O&M Plan identifying the approach to maximize participation throughout the Term;

4. A proactive DBE outreach program for DBE/SWaM participation;

5. The reporting requirements to VDOT regarding DBE/SWaM participation;

6. Regular updates on the progress in meeting DBE/SWaM requirements;

7. On-going tracking of efforts and corrective actions required and how they have been met; and

8. Appropriate cross references to relevant PDPs, including the Quality Management System Plan, identifying where quality control, quality assurance and audit processes for DBE/SWaM participation are defined by the Concessionaire, to asure that the DBE/SWaM participant meets or exceeds the Project goals.

3A.1.12 Health, Safety and Security Plan

A. The Health, Safety and Security Plan shall define the health, safety and security activities required during the design and construction of the Project and shall address:

1. Construction occupational health and safety;

2. Procedures for worker protection to address such hazards as excavations, flood protection works, concrete placement, mobile equipment, confined space, welding/cutting, electrical and mechancial systems, respiratiory protection, dredging operations;

3. Geological/hydrogeological hazards; temporary and permanent ground support systems for tunnel works;

4. Procedures for hazard communication;

5. Identification of accident prevention programs;

6. The Project health and safety rules and regulations;

7. Site security;

8. Documented procedures on meeting the health and safety requirements for the Concessionaire and its subcontractors and suppliers;

9. Appropriate cross references to specific paragraphs in the Concessionaire Management Plan, O&M Plan, and other PDPs, including the Quality Management System Plan demonstrating the Concessionaire's commitment to safety and security.

3A.1.13 Operations and Maintenance Plan

A. The Operations and Maintenance Plan shall identify the methods, systems and procedures whereby the Concessionaire will perform the O&M Work and comply with the operation and maintenance requirements of the Agreement.

B. The Operations and Maintenance Plan shall address all aspects of Ordinary Maintenance, inspections, operations, maintenance planning and associated activities and shall be cross referenced to the Life Cycle Maintenance Plans. 2

C. The Operations and Maintenance Plan shall be a self contained PDP that includes all necessary components applicable to the O&M Work. The Operations and Maintenance Plan shall follow all the applicable requirement for PDPs to be

developed during the Term, as described in previous sections of this Attachment. These shall be updated and amended as necessary to apply to the O&M Work. The Operation and Maintenance Plan shall contain the following separate but inter-related components:

1. Concessionaire Management Plan;

2. Document Management Plan;

3. Quality Management System Plan;

4. Life Cycle Maintenance Plan;

5. Public Information and Communications Plan (which includes Public Information Plan);

6. Environmental Management Plan;

7. Maintenance of Traffic Plan; 2

8. DBE/SWaM Plan;

9. Health, Safety and Security Plan;

10. Tolling operations and maintenance shall be addressed as a separate component of the Operations and Maintenance Plan;

D. The Operations and Maintenance Plan shall address the following:

1. Organization structure including key operations and maintenance personnel and their responsibilities and level of authority;

2. Key suppliers and subcontractors;

3. Service delivery and operating procedures;

4. Incident management;

5. Inspection methods and inspection schedule;

6. Identification and scheduling of Ordinary Maintenance;

7. Stakeholder communication program;

8. Environmental compliance;

9. Site safety;

10. Emergency response;

11. Tolling operations and maintenance plan;

12. Documentation and reporting procedures;

13. An internal audit program and recording of findings, conformances, non-conformances, corrective actions and preventative actions;

14. Making available documentation for external audits;

15. Submission of annual operations and maintenance report addressing the above components;

16. Reporting and documentation mechanism;

17. Coordination with other projects; and

18. Linkage to other PDPs and the QMSP.

3A.1.14 Life Cycle Maintenance Plan (Operations Period)

A. The Life Cycle Maintenance Plan will be developed in accordance with the Agreement.

B. The Life Cycle Maintenance Plan shall provide the procedures in place for successful management of maintenance, operation and handover of the assets to VDOT.

C. The Life Cycle Maintenance Plan is intended to focus on non-routine maintenance, such as annual or seasonal maintenance, and provide a status of the assets under the control of the Concessionaire.

D. It shall be updated annually and submitted to VDOT for review and approval.

E. It shall clearly identify the life cycle maintenance activities planned, organization, implementation, and quality management measures.

3A.2 Submission Timetable

Project Development Plans are to be developed to implementation status and updated in accordance with the following table, or earlier if required by the Project Agreements.

Project Development Plan	Status of Plan at Agreement Date (Outline or Implementation)	PDP submission date for review by VDOT[1]	Updates [2]	VDOT Review Input 1
Concessionaire Management Plan	Outline	Financial Close Date +90 Days	Quarterly	Review and Approve
Document Management Plan	Outline including interim measures	Financial Close Date +30 Days	Quarterly	Review and Approve
Quality Management System Plan (Work Period)	Outline	Financial Close Date +60 Days	Monthly Reports & Quarterly Updates	Review and Approve
Design Management Plan	Outline including Outline of Design Quality Management Plan 3	Financial Close Date +60 Days	Quarterly	Review and Approve
Environmental Management Plan	Outline	60 days prior to Commencement of Construction Work	Annual – updated as required	Review and Approve
ROW Acquisition and Relocation Plan	Outline	60 Days prior to Commencement of Construction Work related to the Utilities and MOT Notice to Proceed 2	Quarterly	Review and Approve
Utilities Plan	Outline	60 Days prior to Commencement of Construction Work related to the applicable Notice to Proceed	Quarterly	Review and Approve
MOT Plan	Outline	60 Days prior to Commencement of Construction Work related to the applicable Notice to Proceed 2	Quarterly- updated as required	Review and Approve

[1] The PDP submission date is the last date allowable for submittal. Early submittal is acceptable.
[2] Records and logs shall be available for review on an ongoing basis. Major changes as required by project may require more frequent submissions.

Project Development Plan	Status of Plan at Agreement Date (Outline or Implementation)	PDP submission date for review by VDOT[1]	Updates [2]	VDOT Review Input 1
Public Information and Communications Plan	Outline	Financial Close Date +30 Days	Annual- updated as required	Review and Approve
DBE/SWaM Plan	Outline	Financial Close Date +30 Days	Quarterly	Review and Approve
Health, Safety and Security Plan	Outline	60 days prior to Commencement of Construction Work	Quarterly	Review and Approve
Operations and Maintenance Plan	Outline Including Outline of O&M Quality Management Plan	90 Days prior to Tolling and O&M Work Commencement Date.	Quarterly O&M Updates Annual (comprehensive O&M Records and Plans)	Review and Approve
Life Cycle Maintenance Plan (Operating Period)	Outline	Pursuant to Section 9.04 of the Agreement..	Annual	Review and Approve

[1] The PDP submission date is the last date allowable for submittal. Early submittal is acceptable.

[2] Records and logs shall be available for review on an ongoing basis. Major changes as required by project may require more frequent submissions.

DOWNTOWN TUNNEL/MIDTOWN TUNNEL/MLK EXTENSION PROJECT

The Technical Requirements

Comprehensive Agreement Exhibit C

Attachment 3B

Programmatic Agreement for the MLK Freeway Extension Project

TECHNICAL REQUIREMENTS
Exhibit C

PROGRAMMATIC AGREEMENT
AMONG THE FEDERAL HIGHWAY ADMINISTRATION,
THE VIRGINIA STATE HISTORIC PRESERVATION OFFICER, AND
THE VIRGINIA DEPARTMENT OF TRANSPORTATION REGARDING THE
MARTIN LUTHER KING FREEWAY EXTENSION PROJECT,
CITY OF PORTSMOUTH, VIRGINIA

WHEREAS, the Virginia Department of Transportation (VDOT) proposes to extend the Martin Luther King Freeway along and above the alignment of Harbor Drive from London Boulevard (Route 141) to Interstate 264, construct a new full interchange at Interstate 264 between the Frederick Boulevard interchange and the Des Moines Avenue overpass, a new directional interchange at High Street, and new collector/distributor lanes on Interstate 264 (VDOT Project No. 0058-965-107, PE101; UPC 76642; Virginia Department of Historic Resources [DHR] File No. 2007-0602), hereinafter referred to as the Project; and

WHEREAS, Virginia's Commonwealth Transportation Board (CTB) adopted on October 24, 1990 the corridor known as Alternative E for the Project, and a Final Environmental Assessment (EA) was developed in 1992 but the National Environmental Policy Act (NEPA) process was not completed; and

WHEREAS, an Interchange Justification Report (2007) recommended changes to the proposed Interstate 264 interchange, and the revised Alternative E - Option 4, as described in the Environmental Assessment prepared for the Project titled *Route 58 – Martin Luther King Freeway Extension, Environmental Assessment and Section 4(f) Evaluation* and dated April 2008, was adopted by the CTB on September 18, 2008; and

WHEREAS, the VDOT anticipates receiving Federal financial assistance for the Project from the Federal Highway Administration (FHWA); and

WHEREAS, the FHWA has determined that the provision of financial assistance for the Project is an undertaking as defined in 36 CFR Part 800.16(y); and

WHEREAS, pursuant to Section 10 of the Rivers and Harbors Appropriations Act of 1899 (33 U.S.C. 401 and 403) and Section 404 of the Clean Water Act of 1973 (33 U.S.C. 1344), a Department of the Army permit will likely be required from the Corps of Engineers (Corps) for this project, and the Corps has designated the FHWA as the lead federal agency to fulfill federal responsibilities under Section 106 of the National Historic Preservation Act (NHPA), 16 U.S.C. 470f; and

WHEREAS, the VDOT, in consultation with the Virginia State Historic Preservation Officer (SHPO), has defined the Area of Potential Effects (APE) as described in the historic property identification report titled *Cultural Resource Survey: Archaeological and Architectural Surveys, Route 58, Martin Luther King Freeway Extension Project, City of Portsmouth, Virginia* (November 2007) and as depicted in the report as Figures

1A and 1B (attached in Appendix A), and coordinated the report with the SHPO on November 29, 2007; and

WHEREAS, the FHWA, with the assistance of the VDOT, and in consultation with the SHPO, has determined that the following properties are eligible for listing in the National Register of Historic Places (NRHP): archaeological site 44PM0062, the Potter's Field; the Mount Calvary Cemetery Complex [1](DHR Inventory No. 124-5125); Calvary Baptist Church (DHR Inventory No. 124-5129); and the Cottage Place Neighborhood Historic District (formerly known as the High Street/Harbor Drive Neighborhood Historic District; DHR Inventory No. 124-5124); and

WHEREAS, the FHWA, with the assistance of the VDOT, and in consultation with the SHPO, has determined that the Project will have an adverse effect on the Cottage Place Neighborhood Historic District; and

WHEREAS, the FHWA, with the assistance of VDOT, has consulted with the SHPO to resolve the adverse effects of the Project on historic properties in accordance with Section 106 of the NHPA, 16 U.S.C. 470f, and its implementing regulations, 36 CFR Part 800.6(b)(1); and

WHEREAS, the FHWA has notified the Advisory Council on Historic Preservation (ACHP) of its determination of adverse effect pursuant to 36 CFR Part 800.6(a)(1) and the ACHP has chosen not to participate in consultation; and

WHEREAS, the VDOT has participated in this consultation pursuant to 36 CFR Part 800.2(c)(4) and the FHWA has invited the VDOT to join the FHWA and the SHPO as a signatory to this Programmatic Agreement (Agreement) pursuant to 36 CFR Part 800.6(c)(2)(iii); and

WHEREAS, the City of Portsmouth (City) has participated in consultation pursuant to 36 CFR Part 800.2(c)(3) and has been invited by the FHWA to concur in this Agreement; and

WHEREAS, the Calvary Baptist Church (Church), The African-American Historical Society of Portsmouth (Society), Ms. Hajirah Abdus-Salaam, and Ms. Joyce White-Tasby have participated in consultation pursuant to 36 CFR Part 800.2(c)(5) and have been invited by the FHWA to concur in this Agreement;

NOW, THEREFORE, the FHWA and the SHPO agree that this undertaking shall be implemented in accordance with the following stipulations in order to take into account the effects of the undertaking on historic properties.

---

[1] The "Mount Calvary Cemetery Complex", as used in this MOA, includes the Mount Calvary Cemetery, the Fisher's Hill Cemetery, and the Mount Olive Cemetery. The Mount Olive Cemetery is closest to the Project and immediately east of the Potter's Field (44PM0062).

Stipulations

The FHWA shall ensure that the following stipulations are implemented:

I. Treatment of the Cottage Place Neighborhood Historic District (124-5124)

A. The VDOT shall conduct a Reconnaissance-level survey of the Cottage Place Neighborhood Historic District, as depicted in Appendix A, and document every building dating to 1958 or earlier in a DHR Reconnaissance-level Data Sharing System (DSS) record, in accordance with the DHR's *Guidelines for Conducting Cultural Resource Survey in Virginia* (1999, revised 2003) and "Photographic Documentation for National Park Service (NPS) Register Nominations and Virginia Department of Historic Resources (DHR) Basic Survey" (Updated September 13, 2006), or subsequent revisions or replacements of these documents. The VDOT shall perform the survey and submit all DSS records to the SHPO for review and approval within twelve (12) months following execution of this Agreement.

B. The VDOT shall prepare a Preliminary Inventory Form (PIF) for the Cottage Place Neighborhood Historic District and shall submit the PIF to the SHPO for review and approval within eighteen (18) months following execution of this Agreement.

C. The VDOT shall deliver a copy of the final DSS records and the PIF to the City of Portsmouth within thirty (30) days following SHPO approval of those records.

II. Treatment of Calvary Baptist Church (124-5129)

A. The VDOT, using a licensed structural engineer and a licensed historic architect meeting the Secretary of the Interior's *Professional Qualification Standards* in historic architecture (48 FR 44738-44739), shall perform an inspection of the Calvary Baptist Church to document the property's condition prior to the commencement of any construction activity. The VDOT shall provide a copy of the pre-construction inspection report to the Church and the SHPO. The VDOT shall use seismic monitoring devices to document vibration levels before and during construction. The VDOT, using a licensed structural engineer and a licensed historic architect, shall perform an inspection of the Calvary Baptist Church within sixty (60) days after construction has been completed. The VDOT shall provide a copy of the post-construction inspection report to the Church and the SHPO.

B. The VDOT shall refer any claims for damage to the Calvary Baptist Church to its Right-of-Way Division for resolution. If any such claims are approved, the VDOT shall ensure that any resulting repairs to historic materials, design, and/or workmanship are completed in a manner consistent with *The Secretary of the*

Interior's Standards for the Treatment of Historic Properties. The VDOT shall provide the SHPO and the Church with a copy of the proposed scope of work and/or repair plans for review and comment. If no comments are received from the SHPO or the Church within thirty (30) days of receipt of the scope of work and/or repair plans, the VDOT may proceed to implement the proposed scope of work and/or repair plans. The VDOT shall notify the SHPO of the completion of any such repairs within thirty (30) days following completion.

III. Treatment of Potter's Field (Site 44PM0062) and the Mount Calvary Cemetery Complex

A. The VDOT shall design the Project to eliminate all ground-disturbing activities within the boundaries of the Potter's Field site (44PM0062) and the Mount Calvary Cemetery Complex by shifting the southern portion of the Interstate 264 interchange to the west. The VDOT shall provide the SHPO, the City, and the Society the opportunity to review and comment on the preliminary and final plans for those portions of the Project in the vicinity of the Potter's Field site (44PM0062) and the Mount Calvary Cemetery Complex. The VDOT shall take into consideration any comments received from the SHPO, the City, and the Society in ensuring that the Project avoids all disturbance to the Potter's Field site (44PM0062) and the Mount Calvary Cemetery Complex.

B. The VDOT shall erect a temporary chain link fence around the western boundary of the Potter's Field site (44PM0062) and the adjacent portion of the Mount Calvary Cemetery Complex in accordance with the *Virginia Department of Transportation Road and Bridge Specifications* (2007), Section 242.02. The VDOT shall erect a temporary safety fence along the northern boundary of the Mount Calvary Cemetery Complex where it is adjacent to Interstate 264 in accordance with the *Virginia Department of Transportation Road and Bridge Specifications* (2007), Section 242.02(a)(12). The VDOT shall maintain these fences for the duration of Project construction. No construction vehicles, no construction activities, and no storage or staging of construction materials shall be allowed within the perimeter of the fences.

C. In consultation with the City and the Society, the VDOT shall prepare draft text for a Virginia state historical highway marker recognizing the history and significance of the Mount Calvary Cemetery Complex. The VDOT shall submit the draft text for the state historical highway marker to the SHPO within twelve (12) months from the initiation of Project construction. The VDOT and the SHPO shall then perform their respective roles, as prescribed by each agency's established procedures for the Virginia state historical highway marker program, to write, review, and edit the text, select the site, and install the approved state historical highway marker in consultation with the City and the Society. The State Historic Resources Board is under no obligation to approve the state historical highway marker. If the State Historic Resources Board does approve the state historical highway marker, the VDOT shall fund the fabrication and installation of

the marker. If the State Historic Resources Board does not approve the state historical highway marker, the VDOT shall consult with the SHPO, the City, and the Society to identify appropriate substitute mitigation.

IV. Identification, Evaluation, and Treatment of Additional Historic Properties

A. In accordance with 36 CFR Part 800.4(b), the VDOT shall complete efforts, as needed, to identify historic properties within the areas of potential effects for any drainage, stormwater management, and wetland mitigation areas determined necessary during final design of the Project and located outside of the APE for Alternative E - Option 4. The VDOT shall conduct these identification efforts in consultation with the SHPO and the consulting parties and in a manner consistent with the Secretary of the Interior's *Standards for Identification* (48 FR 44720-23), the DHR's *Guidelines for Conducting Cultural Resource Survey in Virginia* (1999, revised 2003), and the *Programmatic Agreement Between the Virginia Departments of Transportation and Historic Resources Concerning Interagency Project Coordination* (1999), or subsequent revisions or replacements to these documents. The VDOT shall submit a report on these investigations to the SHPO for its review and concurrence, and shall provide the consulting parties the opportunity to review and comment on the report.

B. The VDOT shall conduct any further investigations necessary to evaluate the NRHP-eligibility of any resources identified as a result of the investigations described in Stipulation IV.A. These evaluations shall be conducted in accordance with 36 CFR Part 800.4(c), and in a manner consistent with the Secretary of the Interior's *Standards for Identification* (48 FR 44720-23), *Standards for Archaeological Documentation* (48 FR 44734), and *Guidelines for Archaeological Documentation* (48 FR 44734-44737), and the VDHR's *Guidelines for Conducting Cultural Resource Survey in Virginia* (1999, revised 2003), and the *Programmatic Agreement Between the Virginia Departments of Transportation and Historic Resources Concerning Interagency Project Coordination* (1999), or subsequent revisions or replacements to these documents. The VDOT shall submit a report on these evaluations to the SHPO for its review and concurrence, and shall provide the consulting parties an opportunity to review and comment on the report. If the FHWA and the SHPO do not agree on the eligibility of a resource, a determination of eligibility shall be obtained in accordance with 36 CFR Part 800.4(c)(2).

C. If historic properties meeting the criteria for listing on the NRHP are identified as a result of the activities described in Stipulation IV.A and IV.B, the VDOT shall assess the effects of the undertaking on these properties in a manner consistent with 36 CFR Part 800.5. The VDOT shall submit its findings to the SHPO for its review and concurrence, and shall provide the consulting parties to the Section 106 process an opportunity to review and comment on the findings.

D. If it is determined that a property eligible for the NRHP will be affected by any drainage, stormwater management, and wetland mitigation area associated with the Project, the VDOT, in consultation with the SHPO and the consulting parties, shall develop a treatment plan for that property.

Any archaeological data recovery plan shall be consistent with the Secretary of the Interior's *Standards and Guidelines for Archaeological Documentation* (48 FR 44734-37, September 29, 1983) and the SHPO's *Guidelines for Conducting Cultural Resource Survey in Virginia: Additional Guidance for the Implementation of the Federal Standards Entitled Archaeology and Historic Preservation: Secretary of the Interior's Standards and Guidelines* (48 FR 44742, September 29, 1983) 1999, rev. 2003), and the requirements of the Regulations for Permits Governing the Archaeological Removal of Human Remains (17VAC5-20) and shall take into account the ACHP's publications, *Recommended Approach for Consultation on Recovery of Significant Information from Archaeological Sites* (1999; updated July 26, 2002) and *Section 106 Archaeology Guidance* (June 2007), or subsequent revisions or replacements to these documents. The plan shall specify, at a minimum, the following:

(1) information on the portion of the property where data recovery is to be carried out, and the context in which the property is eligible for the NRHP;

(2) the results of previous research relevant to the Project;

(3) research problems or questions to be addressed, with an explanation of their relevance and importance;

(4) the field and laboratory analysis methods to be used, with a justification of the cost-effectiveness and an explanation of their relevance to this particular property and these research needs;

(5) the methods to be used in artifact, data, and other records management;

(6) explicit provisions for disseminating the research findings to professional peers in a timely manner;

(7) arrangements for presenting to the public the research findings, focusing particularly on the community or communities that may have interests in the results;

(8) the curation of recovered materials and records resulting from the data recovery in accordance with 36 CFR Part 79; and

(9) procedures for evaluating and treating discoveries of unexpected remains or newly identified historic properties during the course of the Project, including necessary consultation with other parties.

The VDOT shall submit the treatment plan to the SHPO for its review and concurrence, and shall provide the consulting parties an opportunity to review and comment on the plan.

The VDOT shall ensure that any treatment plan developed under the provisions of this stipulation is implemented before construction activities at the affected historic property are initiated.

V. Professional Qualifications

All archaeological and architectural work carried out pursuant to this Agreement shall be conducted by or under the direct supervision of an individual or individuals who meet, at a minimum, the Secretary of the Interior's Professional Qualifications Standards (48 FR 44738-9, September 29, 1983) in the appropriate discipline.

VI. Preparation and Review of Documents

A. The SHPO and other consulting parties agree to provide comments to the VDOT on all technical materials and other documentation arising from this Agreement within thirty (30) calendar days of receipt unless otherwise specified. If no comments are received from the SHPO or other consulting parties, the VDOT may assume that the non-responding party has no comment. The VDOT shall ensure that all comments received within thirty (30) calendar days of receipt shall be addressed in the final documentation.

B. All technical materials prepared pursuant to this Agreement shall be consistent with the federal standards entitled *Archeology and Historic Preservation: Secretary of the Interior's Standards and Guidelines* (48 FR 44716-44742, September 29, 1983) and the SHPO's *Guidelines for Conducting Cultural Resource Survey in Virginia* (rev. 2003), or subsequent revisions or replacements to these documents.

VII. Human Remains

Considering the known proximity of gravesites to the project area, in addition to the requirements of Stipulation III, the VDOT shall make all reasonable efforts to avoid disturbing gravesites, including those containing Native American human remains and associated funerary artifacts. The VDOT shall treat human remains in a manner consistent with the ACHP "Policy Statement Regarding Treatment of Burial Sites, Human Remains and Funerary Objects" (February 23, 2007; http://www.achp.gov/docs/hrpolicy0207.pdf).

Human remains and associated funerary objects encountered during the course of actions taken as a result of this Agreement shall be treated in a manner consistent with the provisions of the Virginia Antiquities Act, Section 10.1-2305 of the *Code of Virginia,* and its implementing regulations, 17 VAC5-20, adopted by the Virginia Board of Historic Resources and published in the Virginia Register on July 15, 1991.

In the event that the human remains encountered are likely to be of Native American origin, whether prehistoric or historic, the FHWA, with the cooperation of the VDOT, shall immediately notify appropriate tribal leaders and the Virginia Council on Indians (VCI). The FHWA and the VDOT shall determine the treatment of Native American human remains and associated funerary objects in consultation with the appropriate tribal leaders and the VCI. The VDOT shall make all reasonable efforts to ensure that the general public is excluded from viewing any Native American gravesites and associated funerary objects. The signatories and the concurring parties to this Agreement shall release no photographs of any Native American gravesites or associated funerary objects to the press or to the general public. The VDOT may obtain a permit from the SHPO for the removal of human remains in accordance with the Commonwealth of Virginia's regulations cited above should removal be necessary.

VIII. Post-Review Discoveries of Archaeological Properties

In the event that a previously unidentified archaeological resource is discovered during ground-disturbing activities associated with construction of the Project, the VDOT, in accordance with Section 107.14(d) of the VDOT's *Road and Bridge Specifications*, shall require the construction contractor to halt all construction work involving subsurface disturbance in the area of the resource and in surrounding areas where additional subsurface remains can reasonably be expected to occur. Work in all other areas of the Project may continue. The VDOT shall notify the FHWA and the SHPO within two (2) working days of the discovery. In the case of prehistoric or historic Native American sites, the VDOT shall also notify appropriate tribal leaders and the VCI within two (2) working days of the discovery.

The VDOT shall ensure that an archaeologist meeting the Secretary of the Interior's Professional Qualifications Standards (48 FR 44739) shall investigate the work site and determine the area and nature of the affected resource, and then the FHWA, in cooperation with the VDOT, shall forward to the SHPO, and tribal leaders and the VCI as appropriate, an assessment of the resource's eligibility for listing on the NRHP. The SHPO, tribal leaders, and the VCI shall respond to the FHWA within two (2) working days of receipt of the FHWA's NRHP assessment.

If the resource is determined eligible for the NRHP, the VDOT shall prepare a plan for its avoidance, protection, or the recovery of important information and shall submit this plan to the FHWA, the SHPO, and tribal leaders and the VCI as

appropriate, for review and approval. The FHWA, the SHPO, tribal leaders, and the VCI shall respond to the VDOT within two (2) working days of receipt of the plans.

Construction of the Project in the affected area shall not proceed until either:
(1) The FHWA and the SHPO have approved and the VDOT has implemented a data recovery plan or other mitigation procedures, or
(2) The FHWA and the SHPO have concurred that the located resource is not eligible for listing on the NRHP.

Disputes between the FHWA and the SHPO over the treatment of historic properties shall be resolved as provided for in Stipulation IX of this Agreement.

IX. Dispute Resolution

A. Should any party to this Agreement object in writing to the FHWA or the VDOT regarding any action carried out or proposed pursuant to this Agreement, the VDOT or the FHWA, as appropriate, shall first consult with the objecting party to resolve the objection. If the FHWA determines that the objection cannot be resolved through such consultation, the FHWA shall forward all documentation relevant to the objection to the ACHP, including the FHWA's proposed response to the objection. Within thirty (30) days of receipt of all pertinent documentation, the ACHP shall exercise one of the following options:

(1) Advise the FHWA that the ACHP concurs with the FHWA's proposed response to the objection, whereupon the FHWA shall respond to the objection accordingly; or
(2) Provide the FHWA with recommendations, which the FHWA shall take into account in reaching a final decision regarding its response to the objection; or
(3) Notify the FHWA that the objection shall be referred for comment pursuant to 36 CFR Part 800.7(a)(4), and proceed to refer the objection and comment. The FHWA shall take the resulting comment into account in accordance with 36 CFR Part 800.7(c)(4).

Should the ACHP not exercise one of the above options within thirty (30) days after receipt of all pertinent documentation, the FHWA may assume the ACHP's concurrence in its proposed response to the objection. The FHWA shall take into account any ACHP recommendation or comment provided in accordance with this stipulation with reference only to the subject of the objection; the FHWA's responsibility to carry out all actions under this Agreement that are not the subject of the objection shall remain unchanged.

B. At any time during implementation of the measures stipulated in this Agreement, should an objection pertaining to this Agreement or the effect of the Project on historic properties be raised by a member of the public, the FHWA shall notify the parties to this Agreement and take the objection into account, consulting with

the objector and, should the objector so request, with any of the parties to this Agreement to resolve the objection.

X. Amendments and Termination

The signatories to this Agreement may amend or terminate it in accordance with the provisions, respectively, of 36 CFR Part 800.6(c)(7) and Part 800.6(c)(8) of the regulations implementing Section 106 of the NHPA (16 U.S.C. 470f). If the FHWA or the VDOT decide not to proceed with the Project, they may so notify the SHPO and the consulting parties and then this Agreement shall become null and void. In the event that this Agreement is terminated, the VDOT shall submit to the SHPO a technical report on the results of any cultural resource investigations conducted prior to and including the date of termination, and shall ensure that any associated records and any collections recovered from VDOT right-of-way are curated in accordance with 36 CFR Part 79.

X. Duration

This Agreement shall continue in full force and effect for ten (10) years after the date of the last signature, unless the FHWA and the VDOT decide not to proceed with the project, at which time they may so notify the signatory parties and this Agreement shall become null and void. At any time, the signatories may agree to extend this Agreement, with or without amendments. No extension, with or without amendments, shall be effective unless all signatories to this Agreement have agreed to the extension in writing.

Execution of this Agreement and implementation of its terms evidence that the FHWA has afforded the ACHP an opportunity to comment on the Project and its effects on historic properties, and that the FHWA has considered the effect of the undertaking on historic properties.

FEDERAL HIGHWAY ADMINISTRATION

By: John Dimkins for Date: 12/8/08
Roberto Fonseca-Martinez, Division Administrator
Virginia Division

VIRGINIA STATE HISTORIC PRESERVATION OFFICER

By: _____ Date: 12/11/08
Kathleen S. Kilpatrick, Director
Virginia Department of Historic Resources

VIRGINIA DEPARTMENT OF TRANSPORTATION

By: _____ Date: 12/8/08
Stephen J. Long, Environmental Division Administrator

FEDERAL HIGHWAY ADMINISTRATION

By: John Dimkins for Date: 12/8/08
Roberto Fonseca-Martinez, Division Administrator
Virginia Division

VIRGINIA STATE HISTORIC PRESERVATION OFFICER

By: _____ Date: 12/11/08
Kathleen S. Kilpatrick, Director
Virginia Department of Historic Resources

VIRGINIA DEPARTMENT OF TRANSPORTATION

By: _____ Date: 12/8/08
Stephen J. Long, Environmental Division Administrator

DOWNTOWN TUNNEL/MIDTOWN TUNNEL/MLK EXTENSION PROJECT

The Technical Requirements

Comprehensive Agreement Exhibit C

Attachment 3C

Moratorium and Removal of Parapet Mounted Sign Structures on Bridges

TECHNICAL REQUIREMENTS

Exhibit C

TECHNICAL REQUIREMENTS
Exhibit C

3E.1 Design Review Process

3E.1.1 Overview

A. The Department's review of the Concessionaire's Design Submittals shall relate only to conformance to and compliance with the requirements of the Agreement for Structure Critical elements. However, the Department reserves the right to request additional information, which shall not be unduly withheld, on related project deliverables. Unless otherwise provided in the Agreement, the Concessionaire will not be eligible for reimbursement from the Department in the execution of delivering requested additional information. Except in special circumstances, or as required by the Agreement, the Department shall not approve Design Submittals. It shall be the responsibility of the Designer to ensure the design is adequate. 4

B. This approach shall require close coordination by all parties involved in the design. An integrated approach is intended to streamline the review process and ensure efficient design progression.

C. This Design Review Process shall be implemented in conjunction with the Concessionaires' Design Management Plan and Design Quality Management Plan. The purpose and intent of this Attachment 3E is to clarify the Department's roles and responsibilities in the design review process and in no way shall limit or increase the Departments rights, obligations and responsibilities as setout here or elsewhere in the Comprehensive Agreement and/or other Project Agreements.

3E.1.2 Work Packages

A. Design Submittals shall be organized by the following work packages: 4

1. New Midtown Tunnel (MTT)
    a. Structural
    b. Mechanical and Electrical
    c. Approaches Civil/Utilities
2. Martin Luther King Extension (MLK) Structural
3. MLK Civil/Utilities
4. ITS Elements Outside MTT/MLK

5. Existing Midtown Tunnel Rehabilitation

6. Downtown Tunnel EB Rehabilitation

7. Downtown Tunnel WB Rehabilitation

8. Harbor Utilities

9. Tolling System

B. Specific Design Submittals may be separated and submitted in advance of their respective work package to support critical construction activities.

3E.1.3 Design Submittals

A. All submittals from the Concessionaire shall be in whole and in their entirety, so as the Department can perform an adequate and appropriate review. Incomplete submittals will be deemed unacceptable and subject to the procedure identified in Section 3E.1.4.B of this Attachment 3E. 4

Any project features or elements subject to the Department's Security Management System (SMS) design review or designated as CII/SSI shall be submitted for the Department's review.

B. The Design Drawings and Special Provisions may vary from the Department's drawings standards usually imposed on a design/bid/build project set of Design Drawings and Special Provisions, as long as the intent of the design is adequately conveyed. For example, drainage quantities and reinforcing steel schedules are not expected to be produced.

C. Staged submissions can be made, but submissions must contain sufficient information for the proposals to be considered. Submission of design information to the Department shall be as follows:

1. <u>Design Reports</u>

a. Design Reports required by the Technical Requirements, including those specified in Section 1.15.15 shall be prepared at the start of Detailed Design, concurrent with the development of Design Drawings and Special Provisions, except for the Tunnel Rehabilitation Drawings, which will be submitted at a 30% design development stage. 4

b. Design Reports shall be submitted to the Department for review and comment only, not approval, per the review procedure in Section 4 herein.

c. Advancement of Design Drawings and Special Provisions shall continue independent but be cognizant of Design Report comments.

2. Design Development Design Submittal (60%)

a. The first submission of the drawings shall be at the approximately 60% design stage, except for the Tunnel Rehabilitation Drawings, which will be submitted at a 30% Design Development stage. Outline Special Provisions shall accompany the 60% Design Drawings. 4

b. For MLK Civil/Utilities and New MTT Approaches Civil/Utilities Design Drawings, Final Right-of-Way Plans shall suffice as 60% Design Drawings.

c. Outline Special Provisions shall define, at a minimum, what Special Provisions shall be submitted to accompany the 90% Design Drawings.

d. 60% Design Drawings and Outline Special Provisions shall be submitted to the Department for review and comment only, not approval, per the review procedure in Section 4.

e. Deleted 4

3. Detailed Design Submittal (90%)

a. The final planned submission of Design Drawings shall be at the 90% design stage for all design work packages. Special Provisions shall accompany the 90% Design Drawings.

b. The 90% Design Drawings and Special Provisions submission shall include responses to any Department comments on the 60% Design Drawings and Outline Special Provisions.

c. 90% Design Drawings and Special Provisions shall be submitted to the Department for review and comment only, not approval, per the review procedure in Section 4.

d. All Structural Critical elements identified in the above work packages during this submittal level shall be accompanied by design calculations showing detail as to how the designer arrived at the selected structural element, for information only, not review and comment. 4

3E.1.4 Review Process for Design Submittals

A. The Department shall have 21 Days to review and comment on all Design Submittals, unless otherwise specified in the Agreement. The Department is responsible for coordination with the following third-party reviewers:

1. Federal Highways Administration (FHWA)

2. Railroads

3. Bureau of Capital Outlay Management (BCOM)

The Concessionaire is responsible for coordinating all other third-party reviews.

B. All Department review comments shall be categorized into one of the following groups:

1. Non-compliance with Comprehensive Agreement

2. Further Information Required in Next Revision

3. Inconsistent with Normal Practice

4. Observation, No response required

Department comments that identify items that are "Observations" need not be responded to or addressed. For comments designated group "1", Department comments shall cite which specific Agreement provision is alleged to be violated. 4

C. To support the integrated review approach, the Designer shall hold monthly design status briefings during the design effort to ensure VDOT and Concessionaire are aware of design progress.

D. To the extent possible, during the comment resolution process for a draft, preliminary, or in-progress Design Documentation and Construction Documentation deliverable, the initial comment resolution sheet should represent all of the comments for that submission. Additional comments to an active comment resolution sheet for a particular submittal are discouraged. Comments

offered after the comment resolution sheet has been issued for disposition to the Designer should be held and processed with the subsequent submittal. Comments should be in-line with the level of completeness of the submittal.

E. Draft, preliminary, or in-progress Design Submittals will not be revised and resubmitted. Comments shall be addressed through the comment resolution process and changes to the work products shall be captured in the subsequently scheduled submittal.

F. At the completion of the Department review period, the Department shall upload formal comments, with category codes set out in Section 4.B herein above, onto the Project SharePoint site and notify the Concessionaire. The Concessionaire shall upload formal comment responses onto the Project SharePoint site and formally release these to the Department containing final disposition and notify the Department accordingly.

G. It shall be the responsibility of the Designer to provide final disposition of comments, professional seals, and release documents for construction.

3E.1.5 Release for Construction (RFC)

A. After the Designer determines that the 90% Design Drawings or Special Provisions are ready to be released for construction, including modifications resulting from the Department's comments as necessary, in accordance with the Design Quality Management Plan the Engineer of Record (EOR) shall seal the document and the document shall be Released for Construction (RFC), at which point, the Concessionaire can begin construction, proceeding at the Concessionaire's own risk, until the Approved for Construction (AFC) Design Drawings or Special Provisions have been received.

B. The RFC Design Drawings and RFC Special Provisions submission shall include responses to any VDOT comments on the 90% Design Drawings and Special Provisions, as appropriate.

C. RFC Design Drawings and RFC Special Provisions shall be submitted to the Department for final approval and signature of the Department's Chief Engineer. With the Chief Engineer's signature, the submitted RFC Design Drawings and RFC Special Provisions will be designated as Approved for Construction (AFC). △4

D. Design Calculations

1. After AFC drawings have been released, design calculations shall be transmitted to the Department for information only.

2. Except as otherwise noted herein this Attachment 3E of the Technical Requirements, design calculations shall not be subject to the Department's review, comment, or approval.

3E.1.6 Shop Drawings

A. Shop Drawings shall be submitted to the EOR for review, comment, and approval.

1. The Designer shall review Shop Drawings to verify that the intent of the design has been met.

2. After review, the Designer shall status the Shop Drawings as one of the following:

   a. Approved,

   b. Approved as Noted, or

   c. Revise and Resubmit.

3. After the Designer has designated a Shop Drawing Approved or Approved as Noted, the Shop Drawing shall be transmitted to the Department for information only.

TECHNICAL REQUIREMENTS
Exhibit C

COMMONWEALTH of VIRGINIA

DEPARTMENT OF TRANSPORTATION
1401 EAST BROAD STREET
RICHMOND, VIRGINIA 23219-2000

David S. Ekern, P.E.
COMMISSIONER

July 24, 2008

MEMORANDUM

TO: District Administrators
District Maintenance Engineers
District Structure and Bridge Engineers
Regional Operations Directors
Regional Traffic Engineers
Regional Traffic Operations Managers
Residency Administrators

FROM: Malcolm T. Kerley, Chief Engineer
Constance S. Sorrell, Chief of System Operations

SUBJECT: Moratorium and Removal of Parapet Mounted Sign Structures on Bridges

This memorandum establishes a moratorium on the placement of parapet mounted sign structures on bridges, addresses how to deal with construction contracts which contain design, fabrication and erection of parapet mounted sign structures and sets a time frame for the removal of such signs currently in place. A follow-up video conference is planned by July 15th with affected Central Office and District personnel to discuss implementation and funding issues.

Required Actions:

The following directives are provided:

1. Bridge parapet/rail mount structures will not be allowed in projects advertised on or after the date of this memorandum.

2. Bridge parapet mount structures included in on-going contracts (advertised but not yet completed) and:

    a. Structure not yet fabricated: Revise the plans to remove the bridge/parapet mounted structure and include an appropriate replacement structure.

b. Structure fabricated but not yet installed: Revise the plans to remove the bridge/parapet mounted structure and include an appropriate replacement structure. Allow the project to reimburse the Contractor for the cost of the engineering, fabrication and transportation (if applicable) but not the costs associated with erection of the structure. Establish work order price for replacement structure.

c. Structure installed: Revise the plans to remove the bridge/parapet mounted structure and include an appropriate replacement structure. Allow the project to reimburse the Contractor for the cost of the engineering, fabrication, transportation and the erection of the structure. Establish work order price for replacement structure.

3. Remove all existing bridge parapet mounts by June 30, 2013. Planning for the funding and the removal of the signs by the C.O. and DME's/ROD's will be developed to accomplish this goal statewide. Further instructions on planning for the removal will be issued after the planned video conference.

Background Information:

There are over 700 bridge parapet mounted sign structures in VDOT's inventory system. A bridge parapet mounted sign structure consists of a structural frame attached to a bridge beam/girder, concrete deck slab, and concrete parapet/rail system. Through the years various methods have been used to attach the structural framing: with expansions anchors, adhesive anchors and or thru-bolting. This memorandum is not applicable to either overhead span sign structures or cantilever sign structures in which the main supporting element consists of one or more poles.

Anchorage Systems:

Prior to the 2001 edition of the VDOT *Road and Bridge Standards,* attachment by means of expansion anchors was noted. With the issuance of the 2001 edition, that option was removed as this installation detail often resulted in cracks to the adjacent concrete when the anchorage is too close to concrete edges or the location lacks sufficient reinforcement in the anchorage area.

The 2001 edition of the VDOT *Road and Bridge Standards,* Volume II, file 1301.78, detailed adhesive anchors as one method of anchoring parapet/rail sign attachments to the bridge structure. In the July 2005 revision, the adhesive anchor option was deleted due to construction issues with insufficient controls on drilling the holes and the tendency of the adhesive material to shrink resulting in a loose connection over a period of time.

Older editions and the current edition of the VDOT *Road and Bridge Standards* indicate thru-bolting as a means of attachment. Through bolting of parapets or rails is labor intensive as the

anchorage system needs to be flush with the parapet/rail to prevent snagging of oncoming vehicles. Some of the bridge parapet mounted structures attached with thru-bolting do not meet the "flush" requirements as plates protrude beyond the parapet/rail face with extending hex headed bolts instead of rounded heads.

Inspection of Bridge Parapet Mounts:

The current VDOT policy is to inspect all traffic control structures (overhead sign structures, cantilever sign structures, bridge parapet mounts, high mast lighting structures and camera poles) every five years.

In the June 15, 2005 memorandum from the Chief Engineer, subject: Traffic Control Device Structures, many areas of concern were noted including the difficulty of being able to adequately inspect some aspects of the traffic control device structures. Bridge parapet mounted sign structures were one type noted as most of the structural elements are inaccessible to inspectors as safety equipment cannot be properly used/deployed to meet OSHA/VOSH requirements.

Recent Prohibitions on the Use of Adhesive Anchors:

The recently released Structure and Bridge Division I&IM (S&B-76.1 dated March 18, 2008, subject: Adhesive Anchors for Structural Applications) does not permit the use of adhesive anchors for parapet/rail sign installations. This memorandum was issued partially in response to a technical advisory issued by the FHWA as well as a response to the National Transportation Safety Board (NTSB).

NTSB recommended that State Departments of Transportation review the use of adhesive anchor systems in highway construction and identify those sites where failure of the adhesive could result in risk to the public. Once the sites are identified an inspection program is required including a repair program to ensure that failures do not occur. In VDOT's response dated November 19, 2007 the Department identified 719 bridge mounted sign structures in which adhesive anchors may have been used.

We have made a random review of the inspection reports of a number of bridge parapet mounts. From the reports and limited pictures we are unable to ascertain which structures could possibly have been erected with adhesive anchors. To adequately inspect this type of anchorage a portion if not all of the structure would have to be removed.

If there are questions regarding the content of this memorandum, please contact Mr. Julius F. J. Volgyi, Jr., P.E., Assistant State Structure and Bridge Engineer, phone: (804) 786-7537, e-mail: Julius.Volgyi@VDOT.Virginia.gov or Mr. Kendal R. Walus, P.E., State Structure and Bridge Engineer Phone: (804)786-4575; Email: Kendal.Walus@VDOT.Virginia.gov.

CC: Mr. David S. Ekern
Mrs. Constance S. Sorrell
Mr. Kendal R. Walus, P.E.
Mr. Raymond J. Khoury, P.E.
Mr. Mohammad Mirshahi, P.E.
Mr. Julius F. J. Volgyi, Jr., P.E.
Mr. Bruce E. McAuliffe, P.E.

DOWNTOWN TUNNEL/MIDTOWN TUNNEL/MLK EXTENSION PROJECT

The Technical Requirements

Comprehensive Agreement Exhibit C

Attachment 3D

Non-Disclosure Forms

TECHNICAL REQUIREMENTS
Exhibit C

Critical Infrastructure Information/Sensitive Security Information (CII/SSI) Multi-Purpose Non-Disclosure Agreement

Retain a copy of both the front and back sides of this form for future reference

VDOT requires CII/SSI be protected and not disclosed to unauthorized persons.

PART A: To Be Completed By Individual VDOT or Company Employee

I agree with the following as a condition of being granted access to CII/SSI:

CII/SSI, which is valuable and sensitive, is protected by law and by strict VDOT policies. The intent of these laws and policies is to assure that CII/SSI will remain confidential - that is, it will be used only as necessary to accomplish VDOT's mission. Disclosure of CII/SSI in any manner that permits interception by unauthorized persons could compromise safety and security and is prohibited. CII/SSI may be released only to persons with a need-to-know.

I might have access to this information in various formats including but not limited to documents and drawings, physical structures, and computer based systems. I have no right or ownership interest in any VDOT CII/SSI. VDOT may at any time revoke my authorization allowing access to CII/SSI.

Willful violation of this agreement may subject me to discipline which might include, but is not limited to, removal from current VDOT projects; exclusion from further VDOT related work; and legal liability. My obligations with respect to the confidentiality and security of all CII/SSI disclosed to me shall survive the termination of any agreement or relationship with VDOT. My execution of this agreement shall not nullify or affect in any manner any other agreement, non-disclosure or otherwise, which I have executed or may execute with VDOT or the Commonwealth of Virginia.

I am obligated to protect this information from unauthorized disclosure in accordance with the terms of this agreement. I will only use CII/SSI that I obtain to perform my legitimate VDOT related duties. I will conduct myself in a strict conformance to applicable laws and VDOT policies governing CII/SSI. I will safeguard the confidentiality of all CII/SSI at all times. I will be responsible for my misuse or my wrongful disclosure of CII/SSI.

Each provision of this agreement is severable. If any administrative or judicial tribunal should find any provision of this agreement to be unenforceable, all other provisions shall remain in full force and effect.

I make this agreement in good faith, without mental reservation or purpose of evasion.

Printed Name	Date
VDOT District/Division OR Company Name	Phone Number
Company Address	
Signature	Signature of Authorized Agent (Not required for VDOT employees)

PART B: To Be Completed By Company Agent Only:

In addition to the provisions above, I certify:

All employees of this company involved with this VDOT project, regardless of location, who will have access to CII/SSI, myself included, will complete Part A of the Critical Infrastructure Information/Sensitive Security Information Multi-Purpose Non-Disclosure Agreement. The Agreement will be signed by me and accepted by VDOT prior to being granted access to CII/SSI. We will only access CII/SSI for which we have a need-to-know.

We will safeguard the confidentiality of all CII/SSI at all times. We will conduct ourselves in strict conformance to applicable laws and VDOT policies governing CII/SSI. Obligations with respect to the confidentiality and security of all CII/SSI disclosed to us shall survive the termination of any agreement or relationship with VDOT.

Authorized Company Agent:

Signature of Authorized Agent	Date
Printed Name	Title
Company Name	Phone Number
Company Address	
VDOT Contract Name and Number	

This form is valid for the identified project for a period of two years, while employed by the same company.

Critical Infrastructure Information/Sensitive Security Information (CII/SSI)
Multi-Purpose Non-Disclosure Agreement
Back Page

Retain a copy of both the front and back sides of this form for future reference.

Handling CII/SSI

In accordance with applicable law and the Virginia Department Transportation CII/SSI Guide as in effect from time to time.

You are responsible for safeguarding Critical Infrastructure Information/Sensitive Security Information (CII/SSI) in your custody or under your control.

The extent of protection afforded CII/SSI shall be sufficient to reasonably foreclose the possibility of its loss or compromise.

The terms of this clause (*Handling CII/SSI*), including this paragraph, must be included in any dissemination of any document, in whole or in part, that contains CII/SSI.

Protection - CII/SSI shall be protected at all times, either by appropriate storage or having it under the personal observation and control of a person authorized to receive it. Each person who works with protected CII/SSI is personally responsible for taking proper precautions to ensure that unauthorized persons do not gain access to it.

Use and Storage - During working hours, reasonable steps shall be taken to minimize the risks of access to CII/SSI by unauthorized personnel. After working hours, CII/SSI shall be secured in a secure container, such as a locked desk, file cabinet or facility where contract security is provided.

Reproduction - Documents or material containing CII/SSI may be reproduced to the minimum extent necessary consistent with the need to carry out official duties provided that the reproduced material is marked and protected in the same manner as the original material.

Disposal - Material containing CII/SSI shall be disposed of by any method that prevents unauthorized retrieval (e.g. shredding, burning, returning to original source, etc.).

Transmission - CII/SSI shall be transmitted only by VDOT courier, US first class, express, certified or registered mail, or through secure electronic means.

Downtown Tunnel/Midtown Tunnel/MLK Extension Project

SPECIAL TERMS AND CONDITIONS

(Revised 12/09)

Security Requirements

1. All Vendors, Contractors or other Persons accessing VDOT's CII/SSI material in any form shall be required to comply with VDOT's *CII/SSI Policy Guide for Employees, Vendors, Contractors or other Persons Accessing VDOT's CII/SSI*. This guide can be located at; http://www.virginiadot.org/business/const/CII-CriticalStructureInformation.asp

2. A Criminal History Record Check (CHRC), through the Virginia Capitol Police, shall be required of all employees of the Contractor and all subcontractors of the contractor for work conducted at, or in support of the VDOT Central Office.

3. A Criminal History Record Check (CHRC), through VDOT Personnel Security Section (PSS), shall be required of all employees of the Contractor and all subcontractors of the contractor for work conducted at all other VDOT locations, where VDOT is directly responsible for the day-to-day management of staff, or the individual has unrestricted access to Critical Infrastructure (CI), Critical Infrastructure Information (CII), Sensitive Security Information (SSI), or Personally Identifiable Information (PII).

4. All costs for the CHRC will be the responsibility of the Contractor.

5. All individuals undergoing the CHRC shall be required to complete and sign any VDOT required forms necessary to release personal information or to agree to non-disclosure of VDOT critical, sensitive or personal information.

6. CHRC records search timelines vary depending on records found on file (if any). In the event non-favorable records exist, VDOT reserves the right to approve and deny issuance of any Security Clearance. Upon denial, there are no available appeals.

7. Upon CHRC clearance and approval, Contractor and subcontractor (if any) personnel shall be required to obtain a VDOT issued access identification badge prior to working on VDOT's premises, unless a written waiver is approved by the PSS.

8. Contractor and sub contractor personnel shall wear VDOT-issued access identification badge at or above waist level on the outermost garment at all times while on VDOT's premises.

9. For safety concerns regarding the badge display requirement, the VDOT Personnel Security Section, Contact Administrator, Project Manager or designee may waive the above requirement. The Contractor's employees shall possess the VDOT access identification badge at all times to be available for display.

10. The Contractor shall return all VDOT access identification badges on the day any employee is no longer assigned to VDOT's premises and upon contract expiration. The Contractor shall notify Contract Administrator within eight business hours upon discovery of any lost, stolen or damaged access identification badge. Failure to return access identification badges or notify the Contract Administrator that access identification badge has been lost, stolen or damaged may be cause for debarment. See: Commonwealth of Virginia, Vendor's Manual Section 7.20.

11. The Contractor shall be responsible for notifying the PSS whenever an employee or subcontractor employee is charged with any criminal violation. Notification shall be made no later then the next regular business day of finding.

12. In the event of loss, suspected loss or compromise of any VDOT CII/SSI material, the Contractor having possession of the said CII/SSI material will immediately upon having knowledge of the loss, suspected loss or compromise of any VDOT CII/SSI material, notify the VDOT project manager. If the loss is a result of a theft or suspected theft, of either the actual CII/SSI material or any device containing or storing CII/SSI material, the Contractor will immediately file a report with a law enforcement agency having jurisdiction and forward a copy of the report to the VDOT project manager.

Confidentiality Agreement

This Confidentiality Agreement ("Agreement") is made and entered into as of _____, 200__ (Effective Date) by and between the Virginia Department of Transportation, an Agency of the Commonwealth of Virginia (VDOT), whose address is 1401 East Broad Street, Richmond, Virginia 23219, and **[RECIPIENT]**, a _____ ("Recipient"), with its principal place of business at_____.

WHEREAS, VDOT is the owner of confidential and proprietary records and other information relative to the Downtown Tunnel/Midtown Tunnel/MLK Extension Project that is exempt from public disclosure (hereinafter "Records");

WHEREAS, such Records have been determined by VDOT to be exempt from disclosure under the Freedom of Information Act (FOIA - §2.2-3700 et seq.) and are being disclosed to Recipient only under the terms and conditions of this Agreement;

WHEREAS, both parties to this Agreement consider the disclosure of Records by VDOT to Recipient to be necessary and desirable for the purpose of facilitating discussion, the development and evaluation of proposals, and the negotiation of contracts to be awarded, pursuant to the Public-Private Transportation Act of 1995, as amended (the Act, or PPTA) and/or other related activities; and

WHEREAS, this Agreement is being entered into by and between the parties in order to protect the confidentiality and non-disclosure of Records by Recipient.

NOW, THEREFORE, the parties agree as follows:

1. **Records**.

A. VDOT may elect to disclose certain of its Records to Recipient. Nothing herein shall require VDOT to disclose Records or any of its information...

B. Records shall include (i) memoranda, staff evaluations, or other records prepared by or for VDOT for the evaluation and negotiation of proposals filed under PPTA; and (ii) any other documents or records otherwise exempt from public disclosure by VDOT procurement and applicable law. Records shall include such information whether disclosed or submitted orally, in writing, or by any other media, to Recipient by VDOT and/or its consultants.

2. **Recipient's Obligations**.

A. Recipient agrees that the Records are to be considered confidential and proprietary to VDOT and Recipient shall hold the same in confidence, shall not use the Records other than for the purposes of its business with VDOT, and shall disclose it to no one, except officers, employees or consultants of Recipient who have agreed to observe the terms of this Agreement and for whom Recipient shall ensure compliance with the Agreement. Recipient will not disclose, publish or otherwise reveal any of the Records to any other party whatsoever except with the specific prior written authorization of VDOT.

B. **Ownership of the Records.** All Records are and remain the property of VDOT. Records furnished in tangible form shall not be duplicated by Recipient. Upon the earlier of VDOT's written request or the termination or expiration of this Agreement, Recipient shall return all Records received in written or

tangible form, including copies, or reproductions and any notes or memoranda of conversations relating thereto, including any copies thereof or other media containing such Records, within ten (10) calendar days of such request. At Recipient's option and VDOT's approval, any documents or other media developed by Recipient containing Records may be destroyed by Recipient. Recipient shall provide VDOT's authorized Point of Contact (POC) a notarized affidavit certifying destruction of such Records within ten (10) calendar days thereafter.

3. **Term of Agreement and Termination Requirements**.

The obligations of Recipient under this Agreement shall begin on the Effective Date of this Agreement and shall remain in effect until terminated by a written instrument executed by both parties. Recipient's obligations shall not be affected by bankruptcy, receivership, assignment, attachment or seizure procedures, whether initiated by or against Recipient, nor by the rejection of any agreement between VDOT and Recipient, by a trustee of Recipient in bankruptcy, or by the Recipient as a debtor-in-possession or the equivalent of any of the foregoing under the Code of Virginia.

4. **Governing Law and Equitable Relief.**

This Agreement shall be governed and construed in accordance with the laws of the Commonwealth of Virginia. All litigation between the parties arising out of or pertaining to this Agreement or its breach shall be filed, heard and decided in the Circuit Court of the City of Richmond, Virginia, which shall be the exclusive jurisdiction and venue for any such civil actions brought by either party against the other. Recipient consents to the exclusive jurisdiction of the Circuit Court of the City of Richmond and agrees that, in the event of any breach or threatened breach by Recipient, VDOT may obtain, in addition to any other legal remedies which may be available, such equitable relief as may be necessary to protect VDOT against any such breach or threatened breach.

5. **Limitations on Confidentiality**.

A. Nothing in this Agreement shall be interpreted as placing any obligation of confidentiality and nonuse by Recipient with respect to any information that:

1. is or becomes publicly available to Recipient, without breach of this Agreement or is rightfully received by Recipient without an obligation or breach of confidentiality;

2. can be demonstrated to have been in the public domain as of the Effective Date of this Agreement, or legitimately comes into the public domain thereafter through no fault of the Recipient;

3. can be demonstrated to have been known to the Recipient prior to execution of this Agreement and was not acquired, directly or indirectly, from VDOT or from a third party under a continuing obligation of confidentiality;

4. is required to be disclosed pursuant to law or court order; provided that Recipient provides prior notice to VDOT and provides sufficient time to VDOT to assert any exclusions or privileges that may be available by law; or

5. is developed by Recipient without breach of this Agreement;

provided, however, such Records shall not be disclosed until thirty (30) days after written notice of intent to disclose is given to VDOT's POC along with the asserted grounds for disclosure.

B. The Recipient will forward all written or oral requests for disclosure of Records to VDOT immediately upon receiving said request. .

6. **Entire Agreement.**

This Agreement sets forth the parties' entire understanding as to its subject matter and terminates and supersedes all prior understandings or agreements, oral or written, between VDOT and Recipient, relating to the subject matter of this Agreement, but shall neither nullify nor otherwise affect any other existing or future confidentiality or nondisclosure agreements between the Recipient and either the Commonwealth of Virginia or VDOT.

7. **Amendments.**

This Agreement may not be changed, modified, or discharged, released, abandoned, or otherwise terminated in whole or in part, except by an instrument in writing signed by duly authorized representatives of VDOT and Recipient.

8. **Assignment**

Recipient may not sell, assign, or transfer, either voluntarily or by operation of law this Agreement or any interest herein without VDOT's express prior written consent. This Agreement shall inure to the benefit of and shall be binding upon VDOT and Recipient and VDOT's and Recipient's respective successors and permitted assigns.

9. **Severability**.

If any term of this Agreement is held by a court of competent jurisdiction to be invalid or unenforceable, then this Agreement, including all of the remaining terms, will remain in full force and effect as if such invalid or unenforceable term had never been included.

10. **Notices**.

Any notice required by this Agreement, or given in connection with it, shall be in writing and shall be given to VDOT by delivery to the designated VDOT POC named below and to Recipient to its designated representative named below, by personal delivery or by certified mail, postage prepaid, or recognized overnight delivery services.

VDOT's Representative (POC)

Mr. Raymond Partridge
Innovative Project Delivery Division
Virginia Department of Transportation
1401 East Broad Street
Richmond, Virginia 23219

Recipient's Representative:

_____

_____

_____

_____

11. **No Implied Waiver.**

Either party's failure to insist in any one or more instances upon strict performance by the other party of any of the terms of this Agreement shall not be construed as a waiver of any continuing or subsequent failure to perform or delay in performance of any term hereof.

IN WITNESS WHEREOF, the parties have executed this Agreement as of the Effective Date above written.

_____	_____
VDOT's Designated Representative	Date
_____	_____
Recipient's Designated Representative	Date

DOWNTOWN TUNNEL/MIDTOWN TUNNEL/MLK EXTENSION PROJECT

The Technical Requirements

Comprehensive Agreement Exhibit C

Attachment 3E

Design Review Process

TECHNICAL REQUIREMENTS

Exhibit C

TECHNICAL REQUIREMENTS
Exhibit C

3E.1 Design Review Process

3E.1.1 Overview

A. The Department's review of the Concessionaire's Design Submittals shall relate only to conformance to and compliance with the requirements of the Agreement for Structure Critical elements. However, the Department reserves the right to request additional information, which shall not be unduly withheld, on related project deliverables. Unless otherwise provided in the Agreement, the Concessionaire will not be eligible for reimbursement from the Department in the execution of delivering requested additional information. Except in special circumstances, or as required by the Agreement, the Department shall not approve Design Submittals. It shall be the responsibility of the Concessionaire to ensure the design is adequate. 4

B. This approach shall require close coordination by all parties involved in the design. An integrated approach is intended to streamline the review process and ensure efficient design progression.

C. This Design Review Process shall be implemented in conjunction with the Concessionaires' Design Management Plan and Design Quality Management Plan. The purpose and intent of this Attachment 3E is to clarify the Department's roles and responsibilities in the design review process and in no way shall limit or increase the Departments rights, obligations and responsibilities as setout here or elsewhere in the Comprehensive Agreement and/or other Project Agreements.

3E.1.2 Work Packages

A. Design Submittals shall be organized by the following work packages: 4

1. New Midtown Tunnel (MTT)
    a. Structural
    b. Mechanical and Electrical
    c. Approaches Civil/Utilities
2. New Martin Luther King Extension (MLK) Structural
3. MLK Civil/Utilities
4. ITS Elements Outside MTT/MLK

5. Existing Midtown Tunnel Rehabilitation

6. Existing Downtown Tunnel EB Rehabilitation

7. Existing Downtown Tunnel WB Rehabilitation

8. Harbor Utilities

9. Tolling System

B. Specific Design Submittals may be separated and submitted in advance of their respective work package to support critical construction activities.

3E.1.3 Design Submittals

A. All submittals from the Concessionaire shall be in whole and in their entirety, so as the Department can perform an adequate and appropriate review. Incomplete submittals will be deemed unacceptable and subject to the procedure identified in Section 3E.1.4.B of this Attachment 3E. 4

Any project features or elements subject to the Department's Security Management System (SMS) design review or designated as CII/SSI shall be submitted for the Department's review.

B. The Design Drawings and Special Provisions may vary from the Department's drawings standards usually imposed on a design/bid/build project set of Design Drawings and Special Provisions, as long as the intent of the design is adequately conveyed. For example, drainage quantities and reinforcing steel schedules are not expected to be produced.

C. Staged submissions can be made, but submissions must contain sufficient information for the proposals to be considered. Submission of design information to the Department shall be as follows:

1. <u>Design Reports</u>

a. Design Reports required by the Technical Requirements, including those specified in Section 1.15.15 shall be prepared at the start of Detailed Design, concurrent with the development of Design Drawings and Special Provisions, except for the Tunnel Rehabilitation Drawings, which will be submitted at a 30% design development stage. 4

b. Design Reports shall be submitted to the Department for review and comment only, not approval, per the review procedure in Section 4 herein.

c. Advancement of Design Drawings and Special Provisions shall continue independent but be cognizant of Design Report comments.

2. Design Development Design Submittal (60%)

a. The first submission of the drawings shall be at the approximately 60% design stage, except for the Tunnel Rehabilitation Drawings, which will be submitted at a 30% Design Development stage. Outline Special Provisions shall accompany the 60% Design Drawings. 4

b. For MLK Civil/Utilities and New MTT Approaches Civil/Utilities Design Drawings, Final Right-of-Way Plans shall suffice as 60% Design Drawings.

c. Outline Special Provisions shall define, at a minimum, what Special Provisions shall be submitted to accompany the 90% Design Drawings.

d. 60% Design Drawings and Outline Special Provisions shall be submitted to the Department for review and comment only, not approval, per the review procedure in Section 4.

e. Deleted 4

3. Detailed Design Submittal (90%)

a. The final planned submission of Design Drawings shall be at the 90% design stage for all design work packages. Special Provisions shall accompany the 90% Design Drawings.

b. The 90% Design Drawings and Special Provisions submission shall include responses to any Department comments on the 60% Design Drawings and Outline Special Provisions.

c. 90% Design Drawings and Special Provisions shall be submitted to the Department for review and comment only, not approval, per the review procedure in Section 4.

d. All Structural Critical elements identified in the above work packages during this submittal level shall be accompanied by design calculations showing detail as to how the designer arrived at the selected structural element, for information only, not review and comment. 4

3E.1.4 Review Process for Design Submittals

A. The Department shall have 21 Days to review and comment on all Design Submittals, unless otherwise specified in the Agreement. The Department is responsible for coordination with the following third-party reviewers:

1. Federal Highways Administration (FHWA)

2. Railroads

3. Bureau of Capital Outlay Management (BCOM)

The Concessionaire is responsible for coordinating all other third-party reviews.

B. All Department review comments shall be categorized into one of the following groups:

1. Non-compliance with Comprehensive Agreement

2. Further Information Required in Next Revision

3. Inconsistent with Normal Practice

4. Observation, No response required

Department comments that identify items that are "Observations" need not be responded to or addressed. For comments designated group "1", Department comments shall cite which specific Agreement provision is alleged to be violated. 4

C. To support the integrated review approach, the Designer shall hold monthly design status briefings during the design effort to ensure VDOT and Concessionaire are aware of design progress.

D. To the extent possible, during the comment resolution process for a draft, preliminary, or in-progress Design Documentation and Construction Documentation deliverable, the initial comment resolution sheet should represent all of the comments for that submission. Additional comments to an active comment resolution sheet for a particular submittal are discouraged. Comments

offered after the comment resolution sheet has been issued for disposition to the Designer should be held and processed with the subsequent submittal. Comments should be in-line with the level of completeness of the submittal.

E. Draft, preliminary, or in-progress Design Submittals will not be revised and resubmitted. Comments shall be addressed through the comment resolution process and changes to the work products shall be captured in the subsequently scheduled submittal.

F. At the completion of the Department review period, the Department shall upload formal comments, with category codes set out in Section 4.B herein above, onto the Project SharePoint site and notify the Concessionaire. The Concessionaire shall upload formal comment responses onto the Project SharePoint site and formally release these to the Department containing final disposition and notify the Department accordingly.

G. It shall be the responsibility of the Designer to provide final disposition of comments, professional seals, and release documents for construction.

3E.1.5 Release for Construction (RFC)

A. After the Designer determines that the 90% Design Drawings or Special Provisions are ready to be released for construction, including modifications resulting from the Department's comments as necessary, in accordance with the Design Quality Management Plan the Engineer of Record (EOR) shall seal the document and the document shall be Released for Construction (RFC), at which point, the Concessionaire can begin construction, proceeding at the Concessionaire's own risk, until the Approved for Construction (AFC) Design Drawings or Special Provisions have been received.

B. The RFC Design Drawings and RFC Special Provisions submission shall include responses to any VDOT comments on the 90% Design Drawings and Special Provisions, as appropriate.

C. RFC Design Drawings and RFC Special Provisions shall be submitted to the Department for final approval and signature of the Department's Chief Engineer. With the Chief Engineer's signature, the submitted RFC Design Drawings and RFC Special Provisions will be designated as Approved for Construction (AFC). △4

D. Design Calculations

1. After AFC drawings have been released, design calculations shall be transmitted to the Department for information only.

2. Except as otherwise noted herein this Attachment 3E of the Technical Requirements, design calculations shall not be subject to the Department's review, comment, or approval.

3E.1.6 Shop Drawings

A. Shop Drawings shall be submitted to the EOR for review, comment, and approval.

1. The Designer shall review Shop Drawings to verify that the intent of the design has been met.

2. After review, the Designer shall status the Shop Drawings as one of the following:

   a. Approved,

   b. Approved as Noted, or

   c. Revise and Resubmit.

3. After the Designer has designated a Shop Drawing Approved or Approved as Noted, the Shop Drawing shall be transmitted to the Department for information only.

DOWNTOWN TUNNEL/MIDTOWN TUNNEL/MLK EXTENSION PROJECT

The Technical Requirements

Comprehensive Agreement Exhibit C

Attachment 4A

Performance Requirements Baseline Tables

TECHNICAL REQUIREMENTS
Exhibit C

TECHNICAL REQUIREMENTS
Exhibit C

ATTACHMENT 4A: Performance Requirements Baseline Tables

The Performance Requirements are stated in the Performance Requirements Baseline Tables.

An Asset meets a Performance Requirement provided that, where applicable:

a) the requirement(s) stated in Table 4A.1a under Performance Requirement are fulfilled;

b) the Asset fulfils the "Asset Condition Criteria" set forth in the third column of Table 4A.1a to the extent required in the fourth column of Table 4A.2b (entitled "Minimum") as a percentage of the total measurements performed with respect to each criterion; and

c) the requirements(s) stated in Table 4A.2b under Outcome (second column) are fulfilled;

d) the Asset fulfils the "Routine Maintenance Criteria" set forth in the fourth column of Table 4A.2b to the extent required in the third column of Table 4A.2b (entitled "Minimum") as a percentage of the total measurements performed with respect to each criterion; and

e) the Concessionaire meets the "Timeliness Requirements" set forth in the fourth column of Table 4A.2b of the Technical Requirements.

The Performance Requirements Baseline Tables shall be reviewed and updated annually following Substantial Completion as described in Section 4.4 of the Technical Requirements.

4A.1 Asset Condition Performance Requirements

Table 4A.1a: Asset Condition Performance Requirements Baseline Table

Table 4A.1a

Asset	NCP Table Reference*	Performance Requirement	Asset Condition Criteria and Timeliness Requirements	Minimum
Pavement (Asphalt Surface)	O7.3	Roadways have a smooth, durable and quiet surface course with adequate skid resistance and free from defects	Pavement condition rating shall be performed following VDOT's document entitled, "A Guide to Evaluate Pavement Distress Through the Use of Digital Image" dated May 2007.	**NA**
	O7.3		**<u>Asset Condition Criteria</u>** Pavement with rut depth measured using a straight edge at any point • 3/4" **Timeliness Requirement**	**100%**

Table 4A.1a

Asset	NCP Table Reference*	Performance Requirement	Asset Condition Criteria and Timeliness Requirements	Minimum
			Pavement rut depth shall be brought below maximum within 3 months of the measurement of failure to meet the minimum.	
	O7.3		**Asset Condition Criteria** Mean rut depth (measured following the VDOT's Maintenance Division protocol) per 0.1-mile segment length • 1/2". **Timeliness Requirement** Pavement rut depth shall be brought below maximum within 3 months of the measurement of failure to meet the minimum.	**85%**
	O7.3		Within 30 days after the pavement construction or any resurfacing work, the average International Roughness Index ("IRI") • 70 per 0.1- mile segment length with no 0.01-mile long section have an IRI • 100. **Asset Condition Criteria** Overall Ride Quality: International Roughness Index (IRI) • 110 in/mi (per 0.1-mile segment length). Localized Roughness: Continuous IRI • 300 in/mi (per 0.01-mile segment length). Note: continuous IRI defined in AASHTO MP-11. **Timeliness Requirement** Ride quality and local roughness shall be brought below maximum within 6 months of the measurement of failure to meet the minimum.	**100%**
	O7.3		**Asset Condition Criteria** Pavement with Critical Condition Index (CCI) [(1)] better than 'Good' (>70) for each consecutive 1 mile section.	**100%**

Table 4A.1a

Asset	NCP Table Reference*	Performance Requirement	Asset Condition Criteria and Timeliness Requirements	Minimum
	O7.3		**Timeliness Requirement** Critical Condition Index shall be brought above minimum within 6 months of measurement of failure to meet minimum.	
			Asset Condition Criteria Skid resistance, measured using standard test method (ASTM E-274) at any point • 20. **Timeliness Requirement** Skid resistance shall be brought above minimum within 3 months of measurement of failure to meet minimum.	**100%**
	O7.3		**Asset Condition Criteria** For pavement sections at the approach slabs, bridge decks, and at tie-ins to the Project, grade tolerance shall be measured with a 10-ft straightedge. The variations of the surface from the testing edge of the straightedge between any two contacts with the surface shall not be more than (+/-)¼ inch. **Timeliness Requirement** Variations in the pavement surface shall be brought below maximum within 3 months of the measurement of failure to meet the minimum	**100%**
Pavement (Hydraulic Cement Concrete Surface)	O7.3	Roadways have a smooth, durable and quiet surface course with adequate skid resistance and free from defects	Pavement condition rating shall be performed following VDOT's document entitled, "A Guide to Evaluate Pavement Distress Through the Use of Digital Image" dated May 2007.	
	O7.3		**Asset Condition Criteria** Faulting shall be • 1" at any crack and/or joint at any point along the pavement surface. **Timeliness Requirement**	

Table 4A.1a

Asset	NCP Table Reference*	Performance Requirement	Asset Condition Criteria and Timeliness Requirements	Minimum
			Pavement faulting shall be brought below maximum within 3 months of the measurement of failure to meet the minimum.	
	O7.3		Within 30 days after the pavement construction or any resurfacing work, the average International Roughness Index ("IRI") • 70 per 0.1- mile segment length with no 0.01-mile long section have an IRI • 100. **Asset Condition Criteria** Overall Ride Quality: International Roughness Index (IRI) • 110 in/mi (per 0.1-mile segment length). Localized Roughness: Continuous IRI • 300 in/mi (per 0.01-mile segment length). Note: continuous IRI defined in AASHTO MP-11. **Timeliness Requirement** Ride quality and local roughness shall be brought below maximum within 6 months of the measurement of failure to meet the minimum.	
	O7.3		**Asset Condition Criteria** Pavement with Critical Condition Index (CCI) [(1)] better than 'Good' (>70) for each consecutive 1 mile section. **Timeliness Requirement** Critical Condition Index shall be brought above minimum within 6 months of measurement of failure to meet minimum.	
	O7.3		**Asset Condition Criteria** Skid resistance, measured using standard test method (ASTM E-274) at any point • 20. **Timeliness Requirement**	

Table 4A.1a

Asset	NCP Table Reference*	Performance Requirement	Asset Condition Criteria and Timeliness Requirements	Minimum
			Skid resistance shall be brought above minimum within 3 months of measurement of failure to meet minimum.	
	O7.3		**Asset Condition Criteria** For pavement sections at the approach slabs, bridge decks, and at tie-ins to the Project, grade tolerance shall be measured with a 10-ft straightedge. The variations of the surface from the testing edge of the straightedge between any two contacts with the surface shall not be more than (+/-)¼ inch. **Timeliness Requirement** Variations in the pavement surface shall be brought below maximum within 3 months of the measurement of failure to meet the minimum	
Bridges and Bridge-Class Culverts	O7.3	Bridges and bridge-class culverts are safe, fully functional, and structurally sound.	**Asset Condition Criteria** All new structures maintain a general condition rating for Decks (Item 58), Superstructures (Item 59), Substructures (Item 60), Channels and Channel Protections (Item 61), and Bridge Classed Culverts (Item 62) at a level of 6 "Satisfactory Condition" or better, as defined in the *FHWA Recording and Coding Guide for Structure Inventory and Appraisal of the Nation's Bridges*. All existing structures maintain a general condition rating for Decks (Item 58), Superstructures (Item 59), Substructures (Item 60), Channels and Channel Protections (Item 61), and Bridge Classed Culverts (Item 62) at a level of 5 "Fair Condition" or better, as defined in the *FHWA Recording and Coding Guide for Structure Inventory and Appraisal of the Nation's Bridges*.	**100%**

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Table 4A.1a

Asset	NCP Table Reference*	Performance Requirement	Asset Condition Criteria and Timeliness Requirements	Minimum
			Perform inspections and assessment in accordance with the requirements of federal National Bridge Inspection Standards (NBIS) of the Code of Federal Regulations, 23 Highways – Part 650 and S&B I&IM 27.6. All inspection reports and load ratings shall be submitted to VDOT. Bridge deck ride quality shall conform to "Localized Roughness" criteria for pavement (i.e., Continuous IRI • 300 in/mi per 0.01-mile segment length). There are no Structurally Deficient Bridges(2) or Bridge-Class Culverts. There are no weight restricted bridges(3) or Bridge-Class Culverts. **Timeliness Requirements** Structure condition ratings shall be brought above minimum performance levels within 6 months of measurement of failure to meet minimum. Localized roughness shall be brought below maximum within 18 months of measurement of failure to meet minimum.	
Drainage	O7.3	Drainage system is effective at ensuring travel way is free from water such that the water does not present a hazard by virtue of its location, size and depth	**Asset Condition Criteria** Length of roadway with visual inspection confirming no evidence of hazardous free standing water. **Timeliness Requirements** Conditions giving rise to standing water shall be rectified within 3 months of discovery. If condition is threatening to public safety, condition shall be rectified immediately.	**100%**
Electrical Supply	O7.3	[Electrical supply, feeder pillars, cabinets,	**Asset Condition Criteria**	**90%**

Table 4A.1a

Asset	NCP Table Reference*	Performance Requirement	Asset Condition Criteria and Timeliness Requirements	Minimum
		switches and fittings are electronically, mechanically and structurally sound and functioning]	Percentage of pillars, cabinets and fittings confirmed sound and functioning by visual inspection **Timeliness Requirements** Instances of unsound and non-functioning equipment shall be rectified within 3 months of discovery.	
Hazardous materials / spillage	O7.3	Control of hazardous materials shall be in accordance with Chapter 13, NFPA 502	**Asset Condition Criteria** Incident reports showing compliance **Timeliness Requirements** Failures to comply with Chapter 13, NFPA 502 shall be investigated and revised procedures shall be put in place within 1 month.	**100%**
Structural assessment	O7.3	Evaluate structural damage to structures and liaise with emergency services to ensure safe working in clearing incidents	**Asset Condition Criteria** Inspections and surveys as required by incident that are correctly reported. **Timeliness Requirement** Failures to evaluate damage to structures and to assist emergency services with clearing of incidents shall be investigated and revised procedures shall be put in place within 1 month.	**100%**

(*) – NCP = cross reference to Non-Compliance Points Table in Exhibit Z of the Comprehensive Agreement.

(1) CCI is to be computed based on the distress data collected in accordance with Maintenance Division's publication "A Guide to Evaluating Pavement Distresses Through the Use of Digital Images (May 2007)". Calculation of CCI from distress data shall be consistent with the following Maintenance Division's publications: Development and Implementation of Pavement Condition Indices for Virginia Department of Transportation Phase I Flexible Pavements (September 2002); and Development of Pavement Condition Indices for Virginia Department of Transportation Phase II Rigid Pavement (September 2002).

(2) Structurally Deficient: A bridge or a bridge class culvert is deemed structurally deficient if any of its NBI general condition rating (deck, superstructure, substructure, or culvert) is 4 or less, or one of two appraisal ratings (structural condition or waterway adequacy) is 2 or less.

(3) Weight Restricted: When the load carrying capacity of a structure as a result of a structural evaluation is determined to be less than the State's legal loads, the bridge is then posted in accordance with VDOT's policies. All structures are to be analyzed and load rated in accordance with the National Bridge Inspection Standards, AASHTO Bridge Evaluation Manual, and the latest VDOT Structure and Bridge Division's IIM 27.6 and memorandum dealing with load ratings.

4A.2 Ordinary Maintenance Performance Requirements

The Project shall be subject to VDOT's Maintenance Rating Program (MRP), or subsequent update or replacement program. The Concessionaire shall use the MRP to verify performance of each Asset against the criteria set out in the Performance Requierments Baseline Tables. The Concessionaire shall include in the end of year report outlined in Section 1.10 of the Technical Requirements, a summary of the results of annual assessments in a format to be agreed between the Concessionaire and VDOT.

The Concessionaire shall achieve and maintain a MRP rating of 90% or above for all Assets unless otherwise noted in Table 4A.2b below. The Concessionaire shall achieve the criteria in Table 4A.2b and shall cause the level of maintenance attained to be uniform and consistent at all times. All Asset Groups shall achieve a minimum rating of 90% unless otherwise noted herein.

Table 4A.2b – Ordinary Maintenance Performance Requirements Baseline Table

Note: Unless stated otherwise all minimums relate to individual 0.1 mile measurement sections.

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
ROADSIDE ASSET GROUP					
Mowing/Vegetation Control		Healthy Growing Neat appearance Acceptable coverage Proper sight distance	90	**Ordinary Maintenance Criteria** • <10% of mowable area per 1/10th mile section to exceed 12" in height (unless otherwise noted). • All sight distances are clear. • Neat/trimmed around guardrail, headwalls, paved ditches, concrete barriers, curb and gutters, rock or median areas, signs, and other fixed objects. • <10% bare ground per 1/10th mile section. • No cut less than 4" in height. • No invasive species in mowable areas (Canadian Thistle, Kudzu Vine, Johnson Grass, Japanese Knotweed). • Litter pickup shall occur in advance of each mowing cycle.	**Acre**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
				• Prevent the growth of unwanted weeds, grass, brush and trees. **Timeliness Requirement:** • Vegetation-affecting sight distance or otherwise presenting a safety hazard shall be removed within 24 hours of notification or discovery. • All other vegetation deficient areas shall be corrected within 4 days of notification or discovery.	
Brush & Trees		No hazardous trees Unobstructed sight distance Vertical clearance Structure inspection & repairs unobstructed Proper notification shall be provided to local owners before trimming trees	90	**Ordinary Maintenance Criteria** • No trees or brush affecting sight distance. • Vertical clearance of 20’ over roadway (includes shoulders). • Vertical clearance of 7’ over sidewalks. • No leaning or dead trees that present a hazard. • No brush or trees that affect the inspection or repair of bridges or other structures. • No brush or trees that affect utility company reading or inspection. • No trees within the clear zone or mowing areas. **Timeliness Requirement:** • Trees/brush affecting sight distance to regulatory signs and/or creating a safety hazard shall be removed within 48 hours of notification. • All other tree issues shall be removed within 2 weeks. • Safety issues shall be mitigated immediately.	**Acre**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
Debris & Road Kill	O7.1b	Roadway free of debris & Road Kill No dump sites	100	**Ordinary Maintenance Criteria** • No dump sites on right-of-way. • Debris and Road kill promptly removed from the right-of-way and properly disposed. • Owner of household pets to be notified if identification is available. **Timeliness Requirement:** • If Road Kill is in roadway, Concessionaire shall respond immediately upon notification or discovery, 60 minute response time during normal work hours and 120 minute response time outside normal work hours. If not in roadway, Concessionaire shall respond within 24 hours.	**Each**
Litter		Right-of-way neat & attractive	90	**Ordinary Maintenance Criteria** • <20 items per 1/10th mile section. **Timeliness Requirement:** • Concessionaire shall respond to locations of excessive litter with 24 hours of notification or discovery.	**Acre**
Landscaping, Wildflowers Beds, Bulb Beds, Ornamental Shrub Beds		Neat Attractive Growing	90	**Ordinary Maintenance Criteria** • <10% of bed contains weeds. • Beds will be mulched. • <10% of bed not growing. • Neat appearance and pruned. **Timeliness Requirement:** • Concessionaire shall ensure compliance within 14 days of notification or discovery.	**Acre**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
Illegal signs/ structures		Right-of-way free of illegal signs or structures	100	**Ordinary Maintenance Criteria** • No illegal signs on the right-of-way. • No illegal structures on the right-of-way. **Timeliness Requirement:** • Concessionaire shall remove illegal signs/structures within 3 days of notification or discovery. • Safety issues shall be mitigated immediately.	**Each**
Concrete Barriers		Safe Structurally sound	90	**Ordinary Maintenance Criteria** • Free of vegetation. • <10% joint material damaged or missing. • Weep Holes > 90% free of obstruction. **Timeliness Requirement:** • Mitigation of damaged or misaligned barriers due to accidents/ incidents shall commence immediately upon notification or discovery, 60 minute response time during normal work hours and 120 minute response time outside normal work hours, or before accident scene is cleared. • Repairs to barriers shall be completed within 10 days of notification or discovery. • Safety issues shall be mitigated immediately.	**Each**
Sound Walls & Barriers		Structurally sound Functional	90	**Ordinary Maintenance Criteria** • Free of damaging vegetation. • <10% damage to surface materials. **Timeliness Requirement:** • Mitigation damaged or misaligned barriers or walls due to accidents/incidents shall commence immediately upon notification or discovery, 60 minute response time during normal work hours and 120 minute response time outside normal work hours, or before accident scene is cleared. • A plan for repairs to barriers or walls shall be completed within 10	**LFT**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
				days of notification or discovery. • Safety issues shall be mitigated immediately.	
Slopes	O7.1e	Stable No erosion	90	**Ordinary Maintenance Criteria** • <8" deep erosion. • No pattern of erosion, crack and/or sloughing that endangers the stability of the slope. • <105 feet greater than 2" lower than paved shoulder within 0.1-mile sample unit. • <105 feet greater than 2" higher than paved shoulder within 0.1-mile sample unit. **Timeliness Requirement:** • Any safety hazard that results from a sink hole, slide, high slope or low slope areas shall commence mitigation immediately upon notification or discovery, 60 minute response time during normal working hours and 120 minute response time outside normal working hours. • Repairs to sink holes and slides shall be completed within in 7 days of notification or discovery. • High and or low slope areas shall be repaired within 30 days.	**LFT**
Fence		Functional Structurally sound	90	**Ordinary Maintenance Criteria** • <10% fence in need of repair. • No damage that allows access. • Free of damaging vegetation. **Timeliness Requirement:** • Any damaged or fallen fencing that allows access shall be mitigated immediately, 60 minute response time during normal working hours and 120 minutes outside normal working hours, and replaced/repaired within 7 days after notification or discovery. • Safety issues shall be mitigated immediately.	**LFT**

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Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
Crossovers/Police Parking Locations		Safe Functional	95	**Ordinary Maintenance Criteria** • Properly signed if open. • Properly signed / blocked if restricted access. • Free of potholes/pavement failures. • Properly maintained driving surface (as constructed). **Timeliness Requirement:** • Damage crossovers/police parking locations shall be repaired within 30 days of notification or discovery. • Safety issues shall be mitigated immediately.	**Each**
Retaining Walls		Structurally sound Safe Clean Stable	90	**Ordinary Maintenance Criteria** • Free of damaging vegetation. • Weep holes open. • No damaged or missing parts. • Metal components free of rust. • Joints and joint material intact. **Timeliness Requirement:** • Damage to retaining walls shall be repaired within 30 days of notification or discovery. • Safety issues shall be mitigated immediately.	**Each**
DRAINAGE ASSET GROUP					
Pipes & Box Culverts (• 36 sq. ft.)				**See "Bridge Class Culverts" under the "Bridge" Asset Group**	
Pipes & Box Culverts (>36 sq. ft.)		Structurally Sound Open & Drains	90	**Ordinary Maintenance Criteria** • <10% diameter closed.	**Each**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
		Joints intact Functional Free of damage		• No separated joints. • No missing joints material. • No loss of soil along the outside perimeter of pipes or culvert due to excessive erosion (piping failure) • <1' deep erosion at ends. • Free of damaging vegetation. • End walls & end sections intact and free of damage (includes load carrying grates). **Timeliness Requirement:** • Culverts or structures beyond 25% diameter closed shall have a planned action for permanent resolution submitted for approval within 14 days of discovery with completion of repairs 30 days from notification or discovery. • Culverts/structures structurally near collapse shall be mitigated immediately. • Formation of large voids along the perimeter of the culverts or structures shall be mitigated immediately. • Safety issues shall be mitigated immediately.	
Ditches, Paved		Structurally sound Joints intact Open & Drains	90	**Ordinary Maintenance Criteria** • <2 inches settlement & joints intact. • No undermining or undercutting. • No obstructions impeding the flow of water. • <25% spalling of surface area. • <10% surface area cracking > ¼" wide. • No damaged or missing sections (includes energy dissipaters). **Timeliness Requirement:** • Open complete blockages and abate significant erosion immediately upon discovery or notification. • Clean debris or remove vegetation impeding flow to clear flow lines within 30 days from notification or discovery. • Damage to paved ditch should be repaired within 90 days of	**LFT**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
				notification or discovery, unless flow is impaired. Refer to the above for timeframes. • Safety issues shall be mitigated immediately.	
Ditches, Unpaved		Open & Drains Minimal Erosion	90	**Ordinary Maintenance Criteria** • No water ponding. • No erosion > 6" deep. • No obstruction impeding the flow of water. **Timeliness Requirement:** • Open complete blockages and abate significant erosion immediately upon discovery or notification. • Clean debris or remove vegetation to clear flow lines within 30 days from notification or discovery. • Safety issues shall be mitigated immediately.	**LFT**
Under drains & Edge drains		Structurally Sound Functional	90	**Ordinary Maintenance Criteria** • <10% damage or deterioration to outlet pipe. • <10% blockage of pipe or end protection. • No damaged or missing end protection (includes rodent screen). **Timeliness Requirement:** • Conduct repairs within 90 days from notification or discovery. • Safety issues shall be mitigated immediately.	**Each**
Storm Drains & Drop Inlets		Structurally sound Functional	90	**Ordinary Maintenance Criteria** • No damage or missing parts (includes steps, grate, cover & throat). • No obstructions (<10% of opening) (includes top, throat & drop inlet). **Timeliness Requirement:** • Storm Drains and Drop Inlets beyond 25% closed shall be cleaned within 14 days. • Storm Drains and drop Inlets beyond 50% diameter closed shall be cleaned and opened within 7 days. • Safety issues shall be mitigated immediately.	**Each**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
Curb & Gutter, Curbing Raised, Concrete Median		In line Draining Structurally sound	90	**Ordinary Maintenance Criteria** • No obstruction which impedes the flow of water. • <25% of surface area spalling. • No damaged or missing section. • No separation > ½" from asphalt surface. • Joints and joint material intact. **Timeliness Requirement:** • Open complete blockages and abate significant erosion immediately upon discovery or notification. • Clean debris or remove vegetation impeding flow to clear flow lines within 30 days from notification or discovery. • Damages should be repaired within 90 days of notification or discovery unless flow is impaired (refer to the above for timeframes). • Safety issues shall be mitigated immediately.	**LFT**
Storm Water Management Basins		Safe Structurally sound Functional	90	**Ordinary Maintenance Criteria** • No damage to stem pipes, weirs, grates, drainage tubing or debris racks. • Free of debris (stem pipes, weirs, grates, drainage tubing & debris racks). • No vegetation that affects the function (mowed, sprayed). • No fence missing or damaged. • No grass or vegetation greater than 12 inches. • Conduct inspections in compliance with regulations. **Timeliness Requirement:** • Inspection once every six months and after every significant storm event (documentation shall be maintained according to applicable State regulations). • All deficiencies reported or discovered shall be corrected within 45 days. • Safety issues shall be mitigated immediately.	**Each**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
TRAFFIC ASSET GROUP					
Signs (static) – **Post Mounted**		Meets Reflectivity Standards Clean & Clear Free of Damage	95	**Ordinary Maintenance Criteria** • Meets current reflectivity standards (Type VIII sheeting or better), as updated (replacements). • Reflective at 120' day or night. • Surface clean & legible. • <10% Damage to surface of sign (scratches, dents, graffiti, bullet holes, etc.). • No down or missing signs. • Mile markers are 60" in height to achieve uniform appearance. **Timeliness Requirement:** • Damaged Regulatory/Warning signs shall be mitigated immediately upon notification or discovery. • Damaged Regulatory/Warning signs shall be repaired or replaced within 2 days of notification or discovery. • Damaged lane use informational signs shall be repaired or replaced within 10 days of notification or discovery. • All other signs repaired or replaced within 30 days of notification or discovery.	**Each**
Cable Locating: Electric, Fiber, Communications		Maintain Cable Facilities	100	**Ordinary Maintenance Criteria** • No errors per cable markings. • <2 linear ft. tolerance from actual cable plant. • Must maintain any and all cable infrastructure as as-built drawings. • Excavators shall not begin work until all underground utilities have been marked including those that might be maintained by Miss Utility. • Concessionaire shall mark all VDOT cables, concessionaire responsible for Miss Utility for work done under the contract	

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
				Timeliness Requirement: • All cable marking requests must be logged and accomplished within 72 hrs of request. • All emergency cable marking requests must be accomplished within 4 hrs. Emergency situations are defined as "a sudden or unexpected occurrence involving a clear and immediate danger, demanding immediate action to prevent or mitigate loss of, or damage to life, health, property or essential public services." • Damaged facilities due to mis-marked cables must be repaired or replaced within 8 hrs.	
Junction Boxes		Maintain Junction Boxes	100	**Ordinary Maintenance Criteria** • All junction or pull boxes shall be free from damage or missing parts. • Boxes, frames, and covers shall be watertight except for approved weep holes. • Must maintain any and all junction boxes infrastructure as as-built drawings. • Covers shall be fitted with gaskets and secured with VDOT approved fastening hardware. **Timeliness Requirement:** • All cable junction boxes and or pull boxes must be repaired within 7 days discovery or notification.	
Signs (static) - Overhead and Bridge Mounted		Structurally Sound Meets Reflectivity standards Free of Damage	90	**Ordinary Maintenance Criteria** • Meets current reflectivity standards (Type VIII sheeting or better), as updated (replacements). • Reflective at 120' day or night. • Surface clean & legible. • <10% Damage to surface of sign (scratches, dents, bullet holes, graffiti, etc). • No damage or missing parts. • Structure & support areas kept free of dirt & debris.	**Each**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
				Timeliness Requirement: • Damaged sign structures shall be mitigated immediately upon notification or discovery. • Damaged sign structures shall be repaired within 60 days of notification or discovery. • Damaged Regulatory/Warning signs shall be mitigated immediately upon notification or discovery. • Damaged Regulatory/Warning signs shall be repaired or replaced within 2 days of notification or discovery. • Damaged lane use informational signs shall be repaired or replaced within 10 days or notification or discovery. • All other signs shall be repaired or replaced within 30 days of notification or discovery.	
Pavement Markings		Present Reflective	90	**Ordinary Maintenance Criteria** • <10% damaged or missing due to incidents, patching operations or snow removal operations. • <10% covered by debris. • All markings to be VDOT approved durable, high quality materials per specifications. **Timeliness Requirement:** • Damage to pavement markings shall be corrected within 5 business days unless adverse weather conditions exist.	**LFT**
Pavement Markers (Raised & Recessed)		Present Reflective	90	**Ordinary Maintenance Criteria** • <30% missing or damaged within a 1/10th mile section. • Meets reflectivity standards. • Missing pavement marker lenses shall be repaired or replaced. **Timeliness Requirement:** • Pavement markers that present a hazard shall be removed immediately upon notification, discovery or inspection. • Inspections shall be conducted every 30 days and within 48 hours	**Each**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
				after every weather event that requires the use of snow plows. • Units shall be repaired or replaced within 10 days.	
Pavement Messages		Present Reflective	90	**Ordinary Maintenance Criteria** • <10% damaged. • <10% covered by debris. • Meets reflectivity standards. • All markings to be VDOT approved, and must be durable and high quality materials.	**Each**
Lighting – Roadway		Operational Structurally sound	90	**Ordinary Maintenance Criteria** • Conventional Lighting (single bulb structure): Functional at all times. • High Mast Lighting: >75% of bulbs per structure functional at all times. • No damaged or missing parts. **Timeliness Requirement:** • Damaged or non-functional lamps shall be repaired or replaced within 7 days of notification or discovery. • Damaged or non-functional structures shall be repaired or replaced within 7 days of notification or discovery. • Daytime burning lamps and circuits shall be repaired within 24 hours of notification or discovery.	**Each**
Lighting – Sign		Operational Structurally sound	90	**Ordinary Maintenance Criteria** • No damaged or missing parts. • 90% of lamps shall be working properly at all times, per structure, during functional conditions. **Timeliness Requirement:** • Damaged or non-functional lamps shall be repaired or replaced within 7 days of notification or discovery. • Damaged or non-functional structures shall be repaired or replaced within 7 days of notification or discovery.	**Each**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
				• Daytime burning lamps and circuits shall be repaired within 8 hours of notification or discovery.	
Lighting – Under Deck or Tunnel		Operational Safe	90	**Ordinary Maintenance Criteria** • No damaged or missing parts. • 90% of lamps shall be working properly at all times, per structure, during functional conditions. **Timeliness Requirement:** • Damaged or non-functional lamps shall be repaired or replaced within 7 days of notification or discovery. • Damaged or non-functional structures shall be repaired or replaced within 7 days of notification or discovery. • Daytime burning lamps and circuits shall be repaired within 8 hours of notification or discovery.	**Each**
Guardrail	O7.1f	Functional Undamaged	100	**Ordinary Maintenance Criteria** • No damage or rust that affects the structural integrity, no missing or damaged post. • No loose or missing parts. • No cables loose or improperly secured. • No graffiti. • Meets applicable standards. • If W-Beam Guardrail (GR-2. GR-8) runs are more than 60% damaged, the Concessionaire shall upgrade the entire run to current standards. All fixed objects attachments when damaged shall be repaired with current standards. **Timeliness Requirement:** • Mitigation of non-functional guardrail shall commence immediately upon notification or discovery, 60 minute response time during normal working hours and 120 minutes outside normal working hours. • Non-functional guardrail shall be repaired or replaced permanently within 3 days of notification or discovery.	**LFT**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
				• Damaged but functional guardrail shall be repaired or replaced within 7 days of notification or discovery.	
Impact Attenuators		Functional Undamaged	100	**Ordinary Maintenance Criteria** • No damaged or missing parts. • Properly maintained to manufacturer's standards. **Timeliness Requirement:** • Mitigation of damaged attenuators shall commence and area protected immediately upon notification or discovery, 60 minute response time during normal working hours and 120 minutes outside normal working hours. • Damaged attenuators shall be repaired within 7 days of notification or discovery.	**Each**
Object Markers & Delineators		Present Reflective Functional	90	**Ordinary Maintenance Criteria** • <10% missing or damaged parts. • Post mounted delineator height shall be 4 feet (+/-) 6 inches to achieve uniform appearance; mileage markers shall be at least 60" high to achieve uniform appearance. • Meets reflectivity standards. **Timeliness Requirement:** • Damaged object markers & delineators shall be repaired or replaced within 7 days of notification or discovery.	**Each**
Glare Foils		Present Functional	90	**Ordinary Maintenance Criteria** • <10% missing or damaged. • Properly mounted in accordance with the manufacturer's standards. • Uniform in appearance. **Timeliness Requirement:** • Damaged glare foils shall be repaired or replaced within 14 days of notification or discovery.	**Each**

3

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
ROADWAY & SHOULDER ASSET GROUP					
Asphalt Surface	O7.1c	Safe Durable Smooth	95	**Ordinary Maintenance Criteria** • No potholes or pavement failures. • Patches <¼" higher or lower than surrounding pavement. • No pavement obstructions that present a safety hazard. **Timeliness Requirement:** • Temporary repairs to potholes 6" x 6" x 1 ½" or equivalent deep or larger shall commence immediately upon notification or discovery, 60 minute response time during normal work hours and 120 minute response time outside normal work hours and such repairs shall be complete within 2 hours of commencing repair, for each area as designated by notice or discovery. All others shall be repaired within 2 days of notification or discovery. • Permanent repairs to potholes/ pavement failures shall be completed within 30 days of notification or discovery during seasons when asphalt plants are operating or within 30 days of asphalt plants opening for the season with a product listed on the VDOT approved patching material list. • Pavement obstructions that present a safety hazard shall be mitigated immediately.	**Sq. Ft**
Paved Shoulders and Rumble Strips (Asphalt)		Safe Smooth Functional	90	**Ordinary Maintenance Criteria** • No potholes or pavement failures. • <105 linear feet edge drop-off high or low >1 ½". • <105 linear feet separation >½" wide. • No false ditch or build up on shoulder that causes water to stand on shoulder or drain onto the travel lanes. • <10% of rumble strips needs to be sealed. • No accumulated shoulder debris that will pose a safety hazard. **Timeliness Requirement:**	**Sq. Ft.**

△3

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
				• Temporary repairs to potholes >6" X 6" X 1½" or equivalent deep shall be completed within 2 days of notification or discovery. • Permanent repairs to potholes shall be completed within 30 days of notification or discovery during seasons when asphalt plants are operating or within 30 days of asphalt plants opening for the season with a product listed on the VDOT approved patching material list.	
Unpaved Shoulders		Safe Smooth	90	**Ordinary Maintenance Criteria** • No potholes and/or rutting • <105 linear feet edge drop off high or low >1 ½". • No false ditch or build up on shoulder that causes water to stand on shoulder or drain onto the travel lanes. • No erosion >2" deep. **Timeliness Requirement:** • All potholes shall be repaired within 7 days of notification or discovery with a product listed on the VDOT approved patching material list. • Erosion or drop offs >2" deep shall be repaired within 7 days of notification or discovery.	**Sq. Ft**
Concrete Surface		Safe Durable Smooth	95	**Ordinary Maintenance Criteria** • No potholes or pavement failure. • • 1" faulting at any crack and/or joint • <25% of joint material missing; no silt, debris, or grass growing in joint. • No pavement obstructions that present a safety hazard. **Timeliness Requirement:** • Temporary repairs to potholes 6" x 6" x 1 ½" or equivalent deep or larger shall commence immediately upon notification or discovery, 60 minute response time during normal work hours and 120 minute response time outside normal work hours and	**Sq. Ft**

△3

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
				such repairs shall be complete within 2 hours of commencing repair, for each area as designated by notice or discovery. All others shall be repaired within 2 days. • Permanent repairs to potholes/ pavement failures shall be completed within 30 days of notification with a product listed on the VDOT approved concrete patching material list. • Pavement obstructions that present a safety hazard shall be mitigated immediately.	
BRIDGE ASSET GROUP					
Deck		Safe Structurally Sound Free of Dirt/ Debris	90	**Ordinary Maintenance Criteria** • Perform all routine/ordinary maintenance including sweeping, washing and cleaning. • No potholes. • ≤10% surface area spalling <1" deep. • Temporary patches ≤ ¼" higher or lower than surrounding concrete deck surface. • No damaged or missing bridge railings. Railings are intact and connections are tight. • Drains and scuppers open and functional. • The deck is free of foreign material (grass, stones, limbs, trash, etc.). • Joints are clean, intact, and joint material is present and functioning as designed and not leaking. • Drainage system (drains, scuppers, trough, etc) is clean and functioning as designed. **Timeliness Requirement:** • Temporary repairs to potholes 6" x 6" x 1 ½" or equivalent deep or larger shall commence immediately upon notification or discovery, 60 minute response time during normal work hours and 120 minute response time outside normal work hours and	**Sq. Ft**

3
4

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
				such repairs shall be complete within 2 hours of commencing repair, for each area as designated by notice or discovery. All others shall be repaired within 2 days of notification or discovery. • Permanent repairs to potholes shall be completed within 30 days of notification or discovery and flush with surrounding surface. • Mitigation of damaged or missing bridge railing shall commence immediately upon notification or discovery, 60 minute response time during normal work hours and 120 minute response time outside normal work hours. • Damaged or missing railing shall be repaired or replaced within 30 days.	
Superstructure (Includes Parapet Walls)		Structurally Sound Free of Debris	90	**Ordinary Maintenance Criteria** • Perform all routine/ordinary maintenance including sweeping, washing, and clearing of all obstructions at a minimum annually. • No spalling >1" deep. • All structural steel and bearing assemblies will be clean and free of debris. • No damaged or missing parts. • Bridge components are free of damaging vegetation. **Timeliness Requirement:** • Clean at a minimum, once every 12 months.	**Sq. Ft**
Substructure		Structurally Sound Free of debris	90	**Ordinary Maintenance Criteria** • Seats & Pier Caps clean and free of debris. **Timeliness Requirement:** • Clean every 24 months.	**Sq. Ft**
Bridge Class Culverts (Pipes & Box Culverts • 36 sq. ft.)		Structurally Sound Open & Drains Joints intact Functional	90	**Ordinary Maintenance Criteria** • <10% diameter blockage to the hydraulic opening. • No separated joints. • No missing joints material. • <1' deep erosion at ends.	**Each**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
		Free of damage		• Free of damaging vegetation. • End walls & end sections intact and free of damage (includes load carrying grates). **Timeliness Requirement:** • Culverts or structures beyond 50% diameter closed shall have a planned action for permanent resolution submitted for approval within 14 days of discovery with completion of repairs 30 days from notification or discovery. • Culverts/structures structurally near collapse shall be mitigated immediately. Safety issues shall be mitigated immediately.	
Slope Protection		Structurally Sound Minimal Erosion	90	**Ordinary Maintenance Criteria** • No trend or pattern of erosion > 2" deep. • No settlement >2". • No damaging vegetation. **Timeliness Requirement:** • Repair within 30 days of notification or discovery.	**Sq. Ft**
Weep Holes		Functional	90	**Ordinary Maintenance Criteria** • ≥90% of diameter opens. **Timeliness Requirement:** • Repair within 30 days of notification or discovery.	**Each**
TUNNEL MECHANICAL SYSTEMS GROUP					
Tunnel Ventilation System	O15.1	Ventilation fans/jet fans are operational	100	**Ordinary Maintenance Criteria** • The ventilation fans/jet fans shall be regularly inspected and maintained in accordance with the manufacturer's requirements **Timeliness Requirements:** • Any failure to the ventilation fans/jet fans shall be repaired within	**Each**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
				2 days of notification or discovery. • Deficiencies to the ventilation system shall have a planned action for permanent resolution submitted for approval within 14 days of discovery with completion of repairs 30 days from notification or discovery	
	O15.2	CO monitoring systems are operational	100	**Ordinary Maintenance Criteria** • The CO monitoring system shall be regularly inspected and maintained in accordance with the manufacturer's requirements • Continuous monitoring to ensure that the following exposure times are not exceeded o 120 ppm for 15 minutes; o 65 ppm for 30 minutes; o 45 ppm for 45 minutes; and o 35 ppm for 60 minutes. **Timeliness Requirements:** • CO readings in excess of the maximum described previously shall be mitigated immediately. • Any failure to the CO monitoring systems shall be repaired within 2 days of notification or discovery.	**Each**
Tunnel Drainage System	O15.3	Drainage pumps functioning Wet well level control systems functioning Wet well hydrocarbon systems functioning	100	**Ordinary Maintenance Criteria** • Pumps and sensors shall be regularly inspected and maintained in accordance with the manufacturer's requirements. • All pipes shall be routinely inspected for any leaks or deficiencies. **Timeliness Requirements** • Any failure to the pumps and sensors shall be repaired within 5 days of notification of discovery • Deficiencies to the drainage pump and sensors system shall have a planned action for permanent resolution submitted for approval within 14 days of discovery with completion of repairs 30 days from notification or discovery	**Each**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
				• Safety issues shall be mitigated immediately	
		Drainage pump piping systems functioning	100	**Ordinary Maintenance Criteria** • All pipes shall be routinely inspected for any leaks or deficiencies **Timeliness Requirements** • Pipes with identified deficiencies shall have a planned action for permanent resolution submitted for approval within 14 days of discovery with completion of repairs 30 days from notification or discovery • Safety issues shall be mitigated immediately	**Each**
Tunnel Tidal Flood Gate System	O15.4	Tidal flood gate lifting/lowering systems functioning Gate sealing systems functioning Open cut roadway drainage system shut- off valve functioning	100	**Ordinary Maintenance Criteria** • Tidal flood gates and shut-off valves shall be routinely tested • Gate and gasket seals shall be kept free of leakage **Timeliness Requirements** • Any failure to the tidal flood gate systems shall be repaired within 5 days of notification or discovery. • Deficiencies to the flood gate system shall have a planned action for permanent resolution submitted for approval within 14 days of discovery with completion of repairs 30 days from notification or discovery • Safety issues shall be mitigated immediately	**Each**
Tunnel Fire Protection System	O15.5	Fire pumps fully functioning Fire mains functioning Fire main riser pipe – fire hose valves	100	**Ordinary Maintenance Criteria** • Fire protection systems shall be routinely inspected and tested. • Fire protection system shall be maintained in accordance with the manufacturer's requirements • Current NFPA maintenance criteria shall be met **Timeliness Requirements:** • Any failure to the fire protection systems shall be repaired within 2 days of notification or discovery.	**Each**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
		functioning Sprinkler system sectionalizing valve (deluge valve) functioning Fire alarm system functioning		• Deficiencies to the fire protection system shall have a planned action for permanent resolution submitted for approval within 14 days of discovery with completion of repairs 30 days from notification or discovery • Safety issues shall be mitigated immediately	
Tunnel Emergency Egress Passageway System	O15.6	Pressurization fans functioning Roadway to egress passageway doors functioning	100	**Ordinary Maintenance Criteria** • Emergency passageways shall be regularly inspected • Mechanical systems shall be maintained in accordance with the manufacturer's requirements • All emergency signing and lighting shall be fully functional **Timeliness Requirements:** • Any failure to the emergency egress passageway systems shall be repaired within 2 days of notification or discovery. • Deficiencies to the emergency egress passageway system shall have a planned action for permanent resolution submitted for approval within 14 days of discovery with completion of repairs 30 days from notification or discovery • Safety issues shall be mitigated immediately	**Each**
Tunnel Generators	O15.7	Generators functioning	99	**Ordinary Maintenance Criteria** • The generators shall be regularly inspected and maintained in accordance with the manufacturer's requirements **Timeliness Requirements:** • Any failure to the generators shall be repaired within 5 days of notification or discovery. • Deficiencies to the generators shall have a planned action for	**ISA**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
				permanent resolution submitted for approval within 14 days of discovery with completion of repairs 30 days from notification or discovery	
Tunnel Closed Circuit Television System	O15.8	CCTV cameras and monitors functioning	95	**Ordinary Maintenance Criteria** • The CCTV cameras and monitors shall be regularly inspected and maintained in accordance with the manufacturer's requirements **Timeliness Requirements:** • Any failure to the CCTV and monitors shall be repaired within 2 days of notification or discovery. • Deficiencies to the CCTV and monitors shall have a planned action for permanent resolution submitted for approval within 14 days of discovery with completion of repairs 30 days from notification or discovery	**ISA**
TUNNEL ELECTRICAL/INSTRUMENTATION SYSTEMS GROUP					
Tunnel Power Distribution System	O16.1	Tunnel feeder cables functioning Substation transformers functioning Medium/low voltage breakers functioning Power metering devices functioning	100	**Ordinary Maintenance Criteria** • Power distribution system shall be regularly tested and inspected • Electrical systems shall be maintained in accordance with the manufacturer's requirements **Timeliness Requirements:** • Any failure to the power distribution systems shall be repaired within 2 days of notification or discovery. • Deficiencies to the power distribution system shall have a planned action for permanent resolution submitted for approval within 14 days of discovery with completion of repairs 30 days from notification or discovery • Safety issues shall be mitigated immediately	**Each**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
		Emergency power (generator) power transfer devices functioning Switchgear DC control batteries functioning Electrical/mechanical alarm panel functioning			
Tunnel Electrical/Mechanical Equipment Control System	O16.2	Main and backup PLC functioning Operator's console (monitoring and control) functioning	100	**Ordinary Maintenance Criteria** • Equipment control systems shall be regularly tested and inspected • Equipment control systems shall be maintained in accordance with the manufacturer's requirements **Timeliness Requirements:** • Any failure to the equipment control systems shall be repaired within 2 days of notification or discovery. • Deficiencies to the electrical/mechanical equipment control system shall have a planned action for permanent resolution submitted for approval within 14 days of discovery with completion of repairs 30 days from notification or discovery • Safety issues shall be mitigated immediately	**Each**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
Tunnel Lighting System		Operational Safe	90	**Ordinary Maintenance Criteria** • No damaged or missing parts to tunnel lighting fixtures. • 90% of lamps shall be working at all times, per structure, during functional conditions **Timeliness Requirements:** • Damaged or non-functional lamps shall be repaired or replaced within 7 days of notification or discovery. • Damaged or non-functional structures shall be repaired or replaced within 7 days of notification or discovery. • Damaged or non-functional daytime burning lamps and circuits shall be repaired within 8 hours of notification or discovery	**Each**
	O16.3	Lighting power distribution system functioning Tunnel emergency lighting UPS functional	100	**Ordinary Maintenance Criteria** • Lighting power distribution system shall be regularly tested and inspected • Electrical systems shall be maintained in accordance with the manufacturer's requirements **Timeliness Requirements:** • Any failure to the lighting power systems shall be repaired within 2 days of notification or discovery. • Deficiencies to the lighting power system shall have a planned action for permanent resolution submitted for approval within 14 days of discovery with completion of repairs 30 days from notification or discovery • Safety issues shall be mitigated immediately	**Each**
Tunnel Communications Systems	O16.4	UHF and VHF radio systems functional AM/FM rebroadcast and override systems	100	**Ordinary Maintenance Criteria** • Communications system shall be regularly tested and inspected • Communications systems shall be maintained in accordance with the manufacturer's requirements **Timeliness Requirements:** • Any failure to the communications systems shall be repaired	**Each**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
		functional Facility telephone system functional		within 2 days of notification or discovery. • Deficiencies to the communications systems shall have a planned action for permanent resolution submitted for approval within 14 days of discovery with completion of repairs 30 days from notification or discovery • Safety issues shall be mitigated immediately	
Tunnel Traffic Control System	O16.5	Primary and backup computer system functioning Operator's console is fully functioning Field communications functioning Traffic control system UPS functioning	100	**Ordinary Maintenance Criteria** • Traffic control system shall be regularly tested and inspected • Traffic control systems shall be maintained in accordance with the manufacturer's requirements **Timeliness Requirements:** • Any failure to the traffic control systems shall be repaired within 2 days of notification or discovery. • Deficiencies to the traffic control systems shall have a planned action for permanent resolution submitted for approval within 14 days of discovery with completion of repairs 30 days from notification or discovery • Safety issues shall be mitigated immediately	**Each**
		Field VMS and VSS functioning Field overheight functioning Filed lane use signals functioning	100	**Ordinary Maintenance Criteria** • Traffic control displays and detection shall be regularly tested and inspected to ensure that they are functioning properly **Timeliness Requirements:** • Any failure to the traffic control displays and detection systems shall be repaired immediately upon notification or discovery. • Deficiencies to the traffic control systems shall have a planned action for permanent resolution submitted for approval within 14 days of discovery with completion of repairs 30 days from notification or discovery	**Each**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
		Field loop detectors functioning			
Tunnel Closed Circuit Televisions System	O16.6	Tunnel and tower cameras functioning Control room monitors functioning Field communications (video/controls) functioning Main video switchers functioning	100	**Ordinary Maintenance Criteria** • CCTV and camera systems shall be regularly tested and inspected • CCTV and camera systems shall be maintained in accordance with the manufacturer's requirements **Timeliness Requirements:** • Any failure to the CCTV and camera systems shall be repaired within 2 days upon notification or discovery. • Deficiencies to the CCTV and camera systems shall have a planned action for permanent resolution submitted for approval within 14 days of discovery with completion of repairs 30 days from notification or discovery • Safety issues shall be mitigated immediately	**Each**
SERVICES GROUP					
Incident/Emergency Response	O9.1	Timely Efficient Safe Effective	100	**Ordinary Maintenance Criteria** • The Concessionaire shall provide equipment and labor resources necessary for Incident Management Operations for 24 hours a day, seven days a week. The Concessionaire shall provide equipment/personnel as necessary to support emergency medical services and other emergency response operations 24 hours a day, seven days a week. • The Concessionaire shall coordinate activities with VDOT as applicable.	**Each**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
				• The Concessionaire shall document all aspects of incidents to include type, response time, actions taken, and other necessary information. • The Concessionaire shall coordinate activities in accordance with the terms outlined in the VDOT, VDEQ, VDEM interim agreement for emergency response (executed by VDOT May 12, 2005) and any subsequent agreements that substantially reflect the terms outlined in the interim agreement. **Timeliness Requirement:** • On site response during normal business hours of 0500 to 1900 hours (considered normal business hours) shall be no greater than 60 minutes, once notification or discovery of the incident. • On site response during the hours of 1900 to 0500 hours (after normal business hours) shall be no greater than 120 minutes once notification or discovery of the incident. • Temporary lane closures shall be installed immediately. • Traffic detours and diversions, if needed, shall be installed within 120 minutes after notification. Permanent lane closures if needed shall be installed within 120 minutes after notification.	
Customer Response	O11.1	Timely Efficient Effective Productive	100	**Ordinary Maintenance Criteria** • All customer concerns and or requests relating to maintenance shall be resolved to the Concessionaire's and VDOT's satisfaction. **Timeliness Requirement:** • Contact the Call Center within 12 hrs following the initial customer inquiry, if the request has been provided by the Call Center • Work resulting from request shall be scheduled within 2 days of the initial customer contact or advice from VDOT. • Follow-up contact with Call Center and customer within 3 days of the completion of work.	**Each**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
Severe Weather, Snow/Freezing Rain & Ice Control, Tree & Debris Removal	O7.1d	Safe Effective Efficient	100	**Ordinary Maintenance Criteria** • During Snow/Ice/Freezing Rain events, all travel lanes, turn lanes, intersections and interchanges shall be kept free of snow, freezing rain and ice so that traffic can proceed in a safe and orderly manner without service delay except in periods of extreme heavy falling or drifting snow. • Remove Tree and Debris so that traffic can proceed in a safe and orderly manner without service delay except in periods of falling or drifting snow. **Timeliness Requirements :** • All travel surfaces, including shoulders, gore areas, and crossovers, shall be treated within ½ hour of precipitation commencing and be free of snow, ice or frozen precipitation within 2 hours after the precipitation stops. • The following timeframes are for removal of precipitation from non-travel surface areas after the cessation of the weather event: (included but not limited to shoulders, gore areas, crossovers): o 0”-4” accumulation (including ice and freezing rain)- within 8 hours. o >4”-12” accumulation- Within 12 hours ** o >12”-18” accumulation- Within 24 hours** o >18” accumulation- Within 48 hours ** ** The Concessionaire shall remove piles, mounds, windrows of snow and ice from all toll plazas within 24 hours after the winter event and after all other contract criteria has been met. • During times of severe weather events, the Concessionaire shall make a constant and diligent effort to remove trees and debris from the roadway, from the beginning of such events to the end of such events, and shall achieve complete removal of the tress and debris from all travel surfaces including shoulders, gore areas and crossovers within two hours after the cessation of such an	**Each**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
				event.	
Roadway Sweeping		Neat, Clean appearance Free of Debris	90	**Ordinary Maintenance Criteria** • No debris (sand, gravel, dirt) at barrier walls, retaining walls, sidewalks, or curb and gutter. • Concessionaire to provide schedule of planned sweeping operations. **Timeliness Requirements:** • Sweeping shall be performed every 4 months and spot sweeping shall be performed as necessary.	**Each**
Bay Saver Separation System		Neat, Clean, and Less than 40% Full		**Timeliness Requirements:** • Quarterly inspection • Annual cleaning or as needed by inspection	**Each**
Barrier Gates		Clean and Fully Operational	100	**Timeliness Requirements:** • Weekly Operations Check and Inspection • Quarterly cleaning or as needed on a more frequent basis.	**Each**
Graffiti Removal		None present	90	**Ordinary Maintenance Criteria** • Concessionaire is to remove all graffiti. **Timeliness Requirements:** • Graffiti to be removed within 48 hours from notification or discovery. • Graffiti hit photographs shall be taken for each site and shared with law enforcement as requested.	**Each**
TRAFFIC MANAGEMENT SERVICE					
Roadside equipment		Fully functioning and available	99.9%	**Ordinary Maintenance Criteria** • Cables and roadside ITS equipment maintained clean and	**ISA**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
				functional. Cabinets are easily accessible. • In service availability; percentage of time = hours available / hours in service x 100 (in service time excludes scheduled down time and loss of power outside Concessionaire control). **Timeliness Requirements:** • Damage response and repair times to cable shall not exceed 24 hours.	
Traffic Management System		Incident information transfer time to VDOT	95%	**Timeliness Requirements:** • Incident information shall be passed to VDOT within 5 minutes of incident detection.	**Each**
Traffic Management System		Timely relevant messages on Dynamic Message Signs (DMS)	95%	**Ordinary Maintenance Criteria** • Messages displayed on DMS must be appropriate, relevant and up-to-date at all times. (% Time per month). **Timeliness Requirements:** • Traffic Management Messages that contribute to the safety of motorists and road workers shall be applied within 5 minutes of the detection and classification of an incident or the identification of deteriorated road conditions.	**Time** **Each**
MISCELLANEOUS INFRASTRUCTURE ASSET GROUP					
Janitorial services		All state owned facilities shall be clean, pleasant smelling and free of all dirt, trash or insects at all times	90	**Ordinary Maintenance Criteria** • Urinals and commodes clean and functional. • Floors clean and dry (wet floor notices deployed when cleaning). • Trash bins emptied before overflowing. • No graffiti or other markings. • No cracked, broken, non-functioning items (rusted lights, liquid soap dispensers, trash receptacles, hand dryers, sinks, mirrors, stall doors, partitions, urinals or commodes.	**Daily Report**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
				• Lobby or entry area clean. • Restroom closures for janitorial work scheduled for off peak times. **Timeliness Requirement:** • Unsafe conditions mitigated or rectified immediately upon discovery. • Inspect each restroom a minimum of once each hour during scheduled duty hours. • Offensive or blasphemous graffiti shall be removed or covered immediately upon discovery.	
Grounds within O&M Boundaries		Grounds and grassed areas are clean and neat in appearance	90	**Ordinary Maintenance Criteria** • Site free of any visible litter. • Litter removed from the grounds and barrels before being allowed to accumulate outside of the barrels. • Dead, dying or damaged vegetation is replaced. • All curbs and sidewalks are edged and repaired • Drinking fountains are operational, clean and sanitary. . • Tables, benches, arbors, trash receptacles, barbecue pits, fireboxes and other outdoor appurtenances are clean and functional. • Slabs, walks and driveways are free of chewing gum, sand, gravel, grease, leaves, spills, animal droppings and all other types of debris. • Grounds are maintained free of litter. • Trash receptacles and dumpsters are emptied before overflowing and are kept free of offensive odors. **Timeliness Requirements** • General maintenance issues shall be addressed within 7 days of notification or discovery. • Issues affecting public safety shall be addressed immediately	**Weekly Report**

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Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
Vegetation Maintenance		Grassed and landscape areas are maintained neat, beds mulched, with healthy plants and no weeds at all times.	90	**Ordinary Maintenance Criteria** • Trees and shrubs are trimmed neatly. • No insect infestations, damaging fungi, and damaging parasites. • Bare ground is re-vegetated as needed; no bare ground areas larger than 5 square feet. • Mowing area plans are developed. • Grass height maintained between 2 to 5 inches. Maintain remote areas from 4 to 8 inches. • Wildflowers left to grow in remote areas. • Ornamental bedding areas are planted and maintained with blooming flowers or perennials from March through November, annually. • Vegetation trimmed around all buildings, trees, shrubs, light poles, guard posts, signs, delineator posts, culvert headwalls and any other appurtenances. • No weeds and other undesirable growth in lawns or landscape areas. • No trees or shrubs to encroach upon walkways or structures more than two (2) inches at any time. • No prohibited, invasive or noxious weeds present. • No occurrences of deviation of soil or mulch above or below the top of the curb. • Grounds, buildings and arbors free of tree clippings, limbs, leaves and pine straw. **Timeliness Requirements** • General maintenance issues shall be addressed within 7 days of notification or discovery. • Issues affecting public safety shall be addressed immediately	**Weekly Report**
Paved Areas		Parking lots, Sidewalks, Curbs and Pavements		**Ordinary Maintenance Criteria** • Pavements and sidewalks maintained free of unsealed cracks,	**Weekly Report**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
		maintained free of defects with clear markings		potholes. • No discontinuities greater than ½" on sidewalks. • Roadways, parking lots and sidewalks are kept free of ice and snow. • Striping and specialty markings clearly visible and maintained to Manual on Uniform Traffic Control Devices (MUTCD). • No missing or broken raised pavement markers. • All signing clear and visible, and lighting functional in accordance with MUTCD. • No standing water, drainage maintained in functional condition **Timeliness Requirements** • General maintenance issues shall be addressed within 7 days of notification or discovery. • Issues affecting public safety shall be addressed immediately	
Building Maintenance and Repair		Buildings structurally sound and serviceable	90	**Ordinary Maintenance Criteria** • Structural integrity of all buildings is maintained at all times • Electrical system, plumbing system, utility lines, water and waste water system, hand dryers, light fixtures, lavatory fixtures, fully functioning • No paint blistering or peeling, mildew, or mold, rusted metal fittings. **Timeliness Requirements** • General maintenance issues shall be addressed within 7 days. of notification or discovery. • Issues affecting public safety shall be addressed immediately.	**Weekly Report**

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
ELECTRONIC TOLL AND TRAFFIC MANAGEMENT (ETTM) SYSTEM AND TRAFFIC MANAGEMENT ASSET GROUP					
ETTM System		ETTM System is reliable	99.90% accuracy	In Service Availability (ISA) of the entire ETTM System excluding scheduled down time and loss of power outside the Concessionaire's control.	Quarterly records
ETTM System Requirements		ETTM System roadside equipment is reliable	99.00% accuracy	In Service Availability (ISA) of ETTM System roadside equipment excluding scheduled down time and loss of power outside the Concessionaire's control.	Quarterly records
		ETTM system is reliable	100% accuracy	• A backup power supply system must be available when needed. • All ETTM System equipment, cables, duct markers, and cabinets are correctly identified and visible. • Equipment drainage is in operational condition. • Communication hubs, ground boxes, cabinets and sites are accessible for maintenance and inspection. • External fixtures and fittings are in an operational condition.	Each
Transponder and Payment Records (Note 1)	O14.1	Transponder data are accurate	99.95%	Accuracy of transponder records (the data supplied to VDOT is complete and relates correctly to the transponder detected for properly fitted and operating transponders, excluding abnormal operation due to signal attenuation from a metallic windscreen or similar).	Quarterly records
		Transponder status files are available quickly and reliably	99.0%	Proportion of transponder status files availability for use by roadside equipment within 1 hour of receipt from VDOT (subject to receipt of a confirmed accurate transponder status file from VDOT).	Quarterly records
		Transponder status files are available quickly and reliably	99.95% (error rate no more than one	Proportion of transponder numbers captured from transponder and recorded without error. (No more than one such error in two thousand shall result in the wrong tag number becoming associated with the capture).	Quarterly records

Table 4A.2b

Asset	NCP Table Reference*	Outcome	Minimum (%)	Ordinary Maintenance Criteria and Timeliness Requirements	UOM
			in 2000)		
	O14.2	Payment claim records are accurate	99.99%	Accuracy of payment claim records (the data supplied to VDOT is complete and relates correctly to the payment due for the trip, the displayed prices and the transponder to which it relates).	Quarterly records
Violation Enforcement System (VES)		VES is accurate	99.90%	In Service Availability (ISA) of VES roadside equipment.	Quarterly records
Traffic Management System (TMS)	O11.3	TMS is accurate	99.90%	In Service Availability of TMS roadside equipment and all other TMS functions (including CCTV, Dynamic Message Signs, traffic monitoring sensors).	Quarterly records
Central Control Computer System (CCCS)		CCS is accurate	99.995%	In Service Availability of CCCS other than Redundant Components.	Quarterly records
			99.90%	In Service Availability of CCCS Redundant Components.	Quarterly records

(*) – NCP = cross reference to Non-Compliance Points Table in Exhibit Z of the Comprehensive Agreement.

Note 1 – Performance Requirements relating to Transponder and Payment Records in which data is received or transmitted to VDOT shall apply only where VDOT and the Concessionaire enter into an Electronic Toll Collection A

DOWNTOWN TUNNEL/MIDTOWN TUNNEL/MLK EXTENSION PROJECT

The Technical Requirements

Comprehensive Agreement Exhibit C

Attachment 4B

Residual Life Table

TECHNICAL REQUIREMENTS

Exhibit C

TECHNICAL REQUIREMENTS
Exhibit C

4B.1 Residual Life Requirements at Handback

4B.1.1 New Midtown Tunnel – Structural Elements

A. The Residual Life of structural elements shall not be less than the values specified in Table 1 below.

B. All structures shall be free from any material defect of a nature that would have required to have been rectified within a period of one (1) year to comply with O&M requirements had it been identified during the Term.

Table 1: Residual Life for New Midtown Tunnel Structures (including Approach Ramp and Service Buildings)

Structural Element	**Residual Life from end of Term (years)** **Assuming 58 year Concession period**
Tunnel Structures including approach ramp and service buildings:	62
Reinforced Concrete	62
Mass Concrete	62
Prestressed Concrete	62
Structural Steelwork	62
Weathering Steel	62
Corrugated steel buried structures	62
Reinforced Earth/Anchored Earth Structures	62
Flood gate structures	62
Fire Insulation	5
Wall panels/cladding/steel cover plates	5
Concrete/steel coatings in accessible areas where maintenance can be undertaken	5

3

Concrete/steel coating in inaccessible areas	2
Internal joint seals – i.e. elastomeric, gun applied, fire protection seals/fire stops, caulking	5
Bearings	5

4B.1.2 Existing Midtown Tunnel and Existing Downtown Tunnels – Structures

A. The Residual Life of structural elements shall not be less than the values specified in Table 2 below. In addition the structures shall not be structurally deficient.

B. All structures shall be free from any defect of a nature that would have required to have been rectified within a period of one (1) year to comply with O&M requirements.

Table 2: Residual Life for Existing Tunnel Structures (including Approach Ramp and Service Buildings)

Structural Element	**Residual Life from end of Term (years)**
Tunnel structures including approach ramp and service buildings:	
Reinforced Concrete	2
Structural Steelwork	2
Fire insulation	5
Wall panels/cladding/steel coverplates	5
Concrete/steel coatings in accessible areas where maintenance can be undertaken	5
Concrete/steel coating in inaccessible areas	2
Flood gate structures	2

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4B.1.3 New Midtown Tunnel – Mechanical & Electrical Works

A. The Residual Life of the tunnel systems elements shall not be less than the values specified in Table 3 below.

B. The residual life of individual items shall be determined as appropriate for the equipment under consideration. Possible determining factors may include:

1. Statistical evidence of failure rates;

2. Deterioration in performance;

3. Uneconomic running or repair costs; and

4. Obsolescence or non-availability of spares.

Table 3: Residual Life for New Midtown Tunnel – Mechanical & Electrical Works

Mechanical & Electrical Elements	Residual Life from end of Term (years)
Stainless Steel:	
Fixings and Supports	10
Conduits	10
Cable Tray	10
Pipe Work	10
Mechanical Components associated with flood gate	10
Electrical power cables and communications and data wiring	10
Stainless steel enclosures for equipment	10
Fire suppression water mist/deluge systems	5
Emergency doors including mechanisms	10
Electrical transformers, switchgear, distribution boards and control panels	5

Standby generators, including systems for fuel, exhaust and cooling	5
Uninterruptible power supplies (excluding lead-acid batteries)	5
Tunnel luminaries (excluding lamps)	5
Fans and pumps, valve and actuators.	5
Fire hydrants and hose outlets, including enclosures	5
Ductile iron pipe work	5
Galvanized steel fixings and support systems	5
Variable message signs, lane control signs and barriers	5
Other Mechanical and Electrical Systems and Equipment: Electronic equipment (including computers, instrumentation, CCTV, incident detection systems, telephone, public address and radio systems) LED-based lighting Signs and Signals Vehicle detector loops Air quality detectors Cabling Raceways Pipe Work Fixings and Supports	 2 2 2 2 2 2 2 2 2
All lamps in: Tunnel luminaries Traffic signs and signals Emergency signage (except for those employing LED light sources)	Functioning at handover

4B.1.4 Tunnels – Other Elements

A. Other elements associated with the New Midtown Tunnel and Existing Midtown Tunnel and Existing Downtown Tunnels not specified above shall have a Residual Life not less than the value specified for that element in Tables 4 and 5 below and in Appendix A at the end of this document.

B. If no Residual Life is specified within these requirements, that element shall be functioning at handover.

C. Where the Initial or Second Inspection of other elements identifies:

1. Any maintenance works or replacement which should proceed as soon as possible.

2. Any special investigation required to determine the nature of scope of works required.

3. Any maintenance work or replacement that would normally be carried out concurrently with other works to avoid traffic disruption.

4. And if these works and any works arising from any special investigation are carried out as part of the Major Maintenance, the Residual Life of each other element required by Tables 4 and 5 will be deemed to be achieved provided the Concessionaire carries out all necessary inspections, testing, repairs and maintenance until the expiration date.

D. All elements of the Project listed in Tables 4 and 5 shall be free from any material defect of a nature that would, had it been identified during the Operational Period, have required to have been rectified within a period of one (1) year to comply with the Performance Requirements.

E. All Pavement Markers in the roadway shall be functioning at handover.

Table 4: Residual Life for the New Midtown Tunnel – Other Elements

Elements	Residual Life from end of the Term (years)
Buildings	2
Miscellaneous paved surfaces such as parking areas	5
Pavement	5
Toll Gantry	5
Toll Collection System	2
Earthwork Slopes	10
Pedestrian and Bicycle Facilities	5
Covers, Gratings, Frames and Boxes	5
Curbs, Edgings and Pre-formed Channels	5
Piped Drainage Systems	5
Ditches, Catch Basins and Drainage Structures	5
Filter Drains	5
Fin Drains	5
Headwalls, Aprons and Sluices	10
Tidal Flaps, Penstocks and Valves	5
Housings, Cabinets, Mountings and Posts for Communications Equipment	5
Boundary Fences	3
Walls	5
Environmental Barriers	5
Pedestrian Guard Rails	5
Safety Fences	5
Safety Barriers	5
Road Markings	2
Traffic Signs	2

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Traffic Signals Housings, Mountings and Posts	3
Lighting Columns	5
Corrosion protection for non-structural steelwork including lighting columns	2
Availability Monitoring Equipment	5

Table 5: Residual Life of Other Elements for the Existing Downtown Tunnels & Existing Midtown Tunnel

Other Elements	**Residual Life Requirement (Years)**
Tunnel Ventilation:	
Jet Fans	5
Motors	5
Fire Pumps	5
Fire Detection	5
Drainage Pumps	5
Midtown Only:	
Tide Gate	10
Building Electrical Systems:	
Electrical Systems	10
Power Cable Plant	10
Switchgear	10
Generators	5
Control Room:	
UPS/Lighting & CR	5
Tunnel:	
Lighting System	5
Control Room:	
UPS/Lighting & CR	5

2

Drainage:	
Pipes	5
Culverts – Plastic	5
Culverts – Steel	5
Culverts – Concrete	5
Culverts – Cast Iron	5
Paved Ditches	5
Unpaved Ditches	5
Inlets	5
Edge and Under drains	5
Channels	5
Outfalls	5
Curbs and Gutters	5
Storm Water Management	5
Storm Drain	5
Sanitary Sewer	5
Earthwork:	
Roadway Earthwork and Sub-base	10
Earthwork Slopes	10
Ancillary Items:	
Concrete Barriers	5
Guardrail	5
Impact Attenuators	5
Fences	3
Sound Walls	5
Landscaping	2
Traffic Signals	2
Luminaries	3
Lighting Columns	5
Glare Foils	5

Object Markers and Delineators	2
Manhole covers, gratings, frames and boxes	10
Cabinet and Cabling	5
Video Detectors	2
Loop Detectors	3
LED's	3
UPS (Uninterrupted Power Supply) Unit	3
UPS (Uninterrupted Power Supple) Batteries	3
Telecommunications Hardware (New, Chassis/Hub, Subcomponents, Common Systems)	2
Dynamic Message Signs	5
Traffic Cameras – Cabinet	2
Traffic Cameras – Pole	2
Traffic Cameras – Electronics	2

4B.1.5 MLK Freeway and Midtown Approaches – Bridges and Bridge-Class Culverts

2

A. At Handback, all bridges and bridge-class culverts located within the O&M Boundaries shall meet, at a minimum, the ratings and criteria stated in this section.

B. The determination as to whether a structure requires rehabilitation or replacement shall be in accordance with the Highway Bridge Replacement and Rehabilitation Program (23 CFR 650.409).

C. Bridge structures and bridge-class culverts are to be maintained as safe, fully functional and structurally sound facilities. As defined in the FHWA Recording and Coding Guide for Structure Inventory and Appraisal of the Nation's Bridges:

3

1. For all new structures and bridge-class culverts a general condition rating of 6 "Satisfactory Condition" or better shall be maintained for the following elements:

a. Decks (Item 58)

b. Superstructures (Item 59)

c. Substructures (Item 60)

d. Channels and Channel Protections (Item 61)

e. Bridge Classed Culverts (Item 62)

2. For all existing structures and bridge-class culverts a general condition rating of 5 "Fair Condition" or better shall be maintained for the following elements: 3

a. Decks (Item 58)

b. Superstructures (Item 59)

c. Substructures (Item 60)

d. Channels and Channel Protections (Item 61)

e. Bridge Classed Culverts (Item 62)

D. Inspections and assessments shall be performed in accordance with the requirements of federal National Bridge Inspection Standards (NBIS) of the Code of Federal Regulations, 23 Highways – Part 650 and VDOT Structure and Bridge Division I&IM 27.6. All inspection reports and load ratings shall be submitted to VDOT.

E. Bridge deck ride quality shall conform to "Localized Roughness" criteria for pavement (i.e. Continuous IRI • 300 in/mi per 0.01-mile segment length).

F. There are no Structurally Deficient Bridges or Bridge-Class Culverts. A bridge or a bridge-class culvert is deemed structurally deficient if any of its NBI general condition rating (deck, superstructure, substructure or culver) is 4 or less, or one of two appraisal ratings (structural condition or waterway adequacy) is 2 or less.

G. There are no weight restricted bridges or Bridge-Class Culverts. When the load carrying capacity of a structure as a result of a structural evaluation is

determined to be less than the State's legal loads, the bridge is then posted in accordance with VDOT's policies. All structures are to be analyzed and load rated in accordance with the requirements stated in 4B.1.5.C above.

4B.1.6 New MLK Freeway Extension – Other Elements

A. Other Elements associated with the New MLK Freeway Extension shall have a Residual Life not less than the value specified for that element in Table 6 below and in Appendix A at the end of this document.

B. If no Residual Life is specified within these requirements, that element shall be functioning at handover.

C. Where the Initial or Second Inspection of other elements identifies:

1. Any maintenance works or replacement which should proceed as soon as possible.

2. Any special investigation required to determine the nature of scope of works required.

3. Any maintenance work or replacement that would normally be carried out concurrently with other works to avoid traffic disruption.

4. And if these works and any works arising from any special investigation are carried out as part of the Renewal Works, the Residual Life of each other element required by Table 6 will be deemed to be achieved provided the Concessionaire carries out all necessary inspections, testing, repairs and maintenance until the expiration date.

D. All Pavement Markers in the roadway shall be functioning at handover.

Table 6: Residual Life of Other Elements for New MLK Extension 2

Other Structural Elements	**Residual Life from end of the Term (years)**
Corrugated steel buried Structures	30
Corrosion protection for structural steelwork	5
Deck waterproofing	5

Sign/Signal Gantries	15
Reinforced Earth/Anchored Earth Structures	30
Gabions	15
Crib walls	30
Soil nails	30
Ground Anchors	30
Catenary lighting systems	8
High mast lighting	8
CCTV poles	8
Traffic signal poles	8
Other Elements	
Road Pavements:	
I-264, MLK Extension and Tunnel Approaches	5
Ramps/direct connectors	5
Structures:	
Reinforced Concrete	2
Pre-stressed Concrete	2
Structure – Steelwork	2
Railing	5
Sign/Signal Gantries (Structural Elements)	5
Retaining Walls	10
Poles, mast arms or spanwire	3
High Mast Lighting	5
Buildings and Enclosed Facilities:	
Structural Elements	10
Installation and Finishes	3
Roofing	5
Building Mechanical Equipment:	
Plumbing	5
HVAC	5

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Fire Systems	3

4B.2 Handback Requirements

2

Performance and

Measurement Table Baseline

		HANDBACK REQUIREMENTS		
Asset Description	**Asset Sub System Description**	**Handback Evaluation Tasks**	**Handback Evaluation Criteria**	**Life Remaining at Handback (Years)**
Asphalt Pavement	Pavement section within the O&M Limits (Operating Period)	The Concessionaire shall provide a Pavement Coring Plan for VDOT approval and the Concessionaire shall provide Pavement Cores with VDOT oversight. Mill and resurface pavement; shall be open to traffic a maximum of ten years (120 months) and a minimum of three years (36 months) prior to the end of the Operating Period. Asphalt Pavement Condition Survey no later than 180	Pavement shall be milled and resurfaced with a pavement design which is the greater of the following: 1. Pavement design per the VDOT Asphalt Pavement Design Manual (20 yr design life) based on pavement cores, Asphalt Pavement Condition Report, and projected traffic loadings as provided by VDOT. 2. Pavement: mill and resurface 2	N/A

		calendar days before the end of the Operating Period. Completion of all remedial work.	inches minimum of existing HMA.	
Rigid Pavement	Pavement section within the O&M Limits (Operating Period)	Inspection in accordance with VDOT Performance Based Specification 355 (Value Added Portland Cement Concrete Pavement & VDOT's Rigid Pavement Design Manual, Rigid Pavement Condition Survey Handbook.	Perform rehabilitation of the pavement to obtain a Rigid Distress Rating of greater than 8.5; Rigid Ride Rating of greater than 7.5.	N/A
Guardrail	Guardrail systems within the O&M Limits (Operating Period)	Complete the inspection in accordance with applicable VDOT Instructional and Informational Memoranda (IIM).	Completion of all deficiencies identified in the final inspection.	5
Attenuators	Attenuator systems within the O&M Limits (Operating Period)	Complete the inspection in accordance with applicable VDOT Instructional and Informational Memoranda (IIM).	Completion of all deficiencies identified in the final inspection.	5
Signs	Single-post, multi-post & overhead within the O&M Limits (Operating	Complete the inspection in accordance with IIM – S&B – 82 and other applicable VDOT Instructional	Completion of all deficiencies identified in the final inspection	2

	Period)	and Informational Memoranda (IIM). Conduct a Reflectivity test in accordance with MUTCD.	Replace sign panels as required by MUTCD	2
Drainage Systems	Drainage systems elements (side/cross drains, roadside ditches, inlets, and miscellaneous drainage structures)	Conduct a video inspection of all drainage pipes and provide clean out and repairs. Conduct inspection of all drainage systems elements (side/cross drains, roadside ditches, inlets, and miscellaneous drainage structures) in accordance with applicable VDOT Instructional and Informational Memoranda (IIM).	Completion of all deficiencies identified in the final video inspection.	N/A
Highway Lighting	Includes Roadway, under-deck, signing and high mast within the O&M Limits (Operating Period)	Replacement of all luminaries and Ballasts.	100% of lights are operational.	2
High Mast Light Poles	Structural within the O&M Limits (Operating Period)	Pending the results of the testing and inspection criteria, all High Mast Light Poles under the responsibility of the Concessionaire	If any High Mast Light Poles under the responsibility of the Concessionaire are found to have an overall	5

		shall have an overall condition rating of six (6) or better. This condition rating is in accordance with IIM – S&B – 73 and other applicable VDOT Instructional and Informational Memoranda (IIM).	condition rating less than six (6), the Concessionaire shall be responsible for making any and all repairs necessary to improve the condition rating of the High Mast Light Pole(s) to a six (6) or better. All repairs shall be of a substantial and permanent nature.	
Over-lane Sign Structures/ Toll Gantry System	Structural within the O&M Limits (Operating Period)	Pending the results of the testing and inspection criteria, all Over-lane Sign Structures and Toll Gantry System under the responsibility of the Concessionaire shall have an overall condition rating of four (4) or higher in accordance with IIM – S&B – 82 and other applicable VDOT Instructional and Informational Memoranda (IIM).	If any Overlane Sign Structures and Toll Gantry Systems under the responsibility of the Concessionaire are found to have an overall condition rating less than four (4) the Concessionaire shall be responsible for making any and all repairs necessary to improve the condition rating of the Overlane Sign Structure(s) and Toll Gantry System (s) to a four (4) or better.	5

			All repairs shall be of a substantial and permanent nature.	
Bridges	Within the O&M Limits (Operating Period)	Pending the results of the testing and inspection criteria, each new Bridge under the responsibility of the Concessionaire shall have an overall condition rating of six (6) or better. This condition rating is in accordance with the National Bridge Inspection Standards and IIM – S&B – 82 and other applicable VDOT Instructional and Informational Memoranda (IIM). Pending the results of the testing and inspection criteria, each existing Bridge under the responsibility of the Concessionaire shall have an overall condition rating of five (5) or better. This condition rating is in accordance with the National Bridge Inspection Standards and IIM – S&B – 82 and other applicable VDOT	If any new Bridge Structure under the responsibility of the Concessionaire is found to have an overall condition rating less than six (6), the Concessionaire shall be responsible for making any and all repairs necessary to improve the condition rating of the Bridge(s) to a six (6) or better. All repairs shall be of a substantial and permanent nature. If any existing Bridge Structure under the responsibility of the Concessionaire is found to have an overall condition rating less than five (5), the Concessionaire shall be responsible for making any and all repairs	N/A

		Instructional and Informational Memoranda (IIM).	necessary to improve the condition rating of the Bridge(s) to a five (5) or better. All repairs shall be of a substantial and permanent nature.	
Sound Barriers	Within the O&M Limits (Operating Period)	Inspect the paint/coatings of the Sound Barriers under the responsibility of the Concessionaire, and meet the criteria established in applicable VDOT Instructional and Informational Memoranda (IIM).	If Sound Barriers paint/coating are found to have a condition rating less those specified in applicable VDOT Instructional and Informational Memoranda (IIM), the Concessionaire shall pressure wash and paint/recoat Sound Barriers.	N/A
ITS	Includes all ITS subsystems, communication and ancillary components of O&M.	The Concessionaire shall purchase new hardware in the final year of the program and configure, test, deploy and deliver for handback. The Department will retain manufacturer warranties (minimum of 4-year warranty) on the hardware.	99.99% of all ITS devices are Operational.	N/A

	Software programs	The Concessionaire shall deliver the software programs utilized.	Software is licensed and available for Department use	N/A