



STATE OF DELAWARE  
**DEPARTMENT OF TRANSPORTATION**  
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JENNIFER COHAN  
SECRETARY

**MEMORANDUM**

TO: Jason Hastings, Bridge Design Engineer

FROM: Pamela May, Performance Management Engineer

DATE: May 11, 2017

**SUBJECT: Value Engineering Final Report for I-95 Wilmington Corridor Rehabilitation, Contract No. T201407404, EBHN – N748(01)**

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Attached please find the final analysis report for the above referenced project. The Implementation Committee included the following:

- Rob McCleary, Director, Transportation Solutions and Chief Engineer
- Lanie Thornton, Director, Finance
- Mark Alexander, Director, Maintenance & Operations
- CR McLeod, Director, Community Relations
- John Sisson, Chief Executive Officer, DTC

The Implementation Committee reviewed the recommendations of the Value Engineering Committee and the Project Team and has endorsed several cost and or time savings ideas be pursued for the project (entire list of recommendations included at end of report):

- Retrofitting instead of replacing the fascia girders on Brandywine River Bridge (\$8.7M)
- Partial bearing replacements on Brandywine River Bridge (\$600k)
- Removing bridge painting within Viaduct to future project (\$19M)
- Utilizing deck overhang method under parapets (\$1.7M)
- Not widening Jackson St. ramp – no Amtrak costs (\$11M)
- Use Test Level 4 barrier instead of Test Level 5 (\$14.9M)  
(Includes indirect cost savings of \$13.8M by maintaining some existing barrier)

**Total approximate cost savings: \$55.9M**

It was a pleasure to work with you and your team on this endeavor. The ideas of the Value Engineering Team, Project Team, and Implementation Committee have yielded a substantial benefit to the scope and cost of this project and I thank everyone involved for their time and effort.

PM

cc: Rob McCleary, Director, Transportation Solutions  
Lanie Thornton, Director, Finance  
Mark Alexander, Director, Maintenance & Operations  
CR McLeod, Director, Community Relations  
John Sisson, Chief Executive Officer, DTC  
Shanté Hastings, Deputy Director, Transportation Solutions  
Mary Ridgeway, FHWA, Delaware Division Administrator  
Barry Benton, Assistant Director, Bridge  
Jim Pappas, Assistant Director, Office of Performance Management  
Steve Richter, Project Manager, Bridge Design



# I-95 Wilmington Corridor Rehabilitation Value Engineering Study

Rehabilitation of I-95 from I-495 to North of  
Brandywine River Bridge

**Delaware Department of Transportation**

February 28, 2017 – March 1, 2017

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## EXECUTIVE SUMMARY

The scope of work for the I-95 Wilmington Corridor Rehabilitation project was originally focused on the rehabilitation of structures that comprise the I-95 Wilmington Viaduct through Wilmington, DE. This work included bearing repairs, steel girder painting, crack sealing, approach slab repairs, bridge and roadway barrier replacement, joint repairs, partial deck replacement, and concrete overlay.

In the DelDOT Capital Transportation Program for FY 2017 - FY 2022, the project scope had expanded to include the rehabilitation of I-95 from the I-495 southern interchange to north of the Brandywine River Bridge, a distance of about six miles. The project now included rehabilitation of 19 bridges.

During the Value Engineering review of the Preliminary Plan Submission (30% plan completion), the VE Team addressed the following corridor elements now included in the corridor scope of work. These elements are listed from north to south within the corridor:

- Rehab the Brandywine River Bridge (replace fascia girders and with parapets, deck and joint repairs);
- Increase vertical clearance at the 10<sup>th</sup> Street Overpass (by lowering the profile of I-95);
- Reconstruct mainline pavement between the Brandywine River Bridge and the main viaduct;
- Rehab the Wilmington Viaduct (deck and joint repairs, replace deck LMC overlay, replace and upgrade parapet and median barriers, bearing replacement, substructure repairs, and ramp deck replacement);
- Extend the Jackson Street ramp to southbound I-95 over the Amtrak rail corridor (widen I-95 structure);
- Improve roadway pavement south of the Wilmington Viaduct (upgrade guardrail, and replace median barrier);

- Rehab three structure locations south of the Wilmington Viaduct (deck and joint repairs, replace parapet and median barriers, bearing replacement, and substructure repairs);
- Upgrade overhead signage throughout the corridor;
- Upgrade lighting throughout the corridor, including the installation of highway lighting from south of the Wilmington Viaduct to I-495; and
- Paint structural steel on bridges within the corridor.

The VE Team was informed that all improvements should meet an expected service life of 30 years. Other requirements included: 1) minimize future maintenance costs, 2) address all defects within the corridor, and 3) correct substandard design features. The construction phase budget (for estimated construction costs) was approximately \$165 Million with the possibility of additional funding from a FASTLANE Grant.

The VE Team identified a list of high priority recommendations and best design/construction practices that have been included in this report. The VE Team was unanimous in their support of these recommendations as options to improve the quality of project result, shorten the time for construction, reduce risks that could impact schedule and cost, and extract unique elements of work and create separate construction projects for this work. This approach could potentially reduce overall cost.

The VE Team focused on options that could enhance project quality, mitigate cost or add value to the project, and lessen the overall time of construction and impact to the traveling public.

Of particular concern to the VE Team was the difference between the budget and the construction estimate, the lack of environmental review and approval, and the lack of public input for this project scope. Many of the Team's recommendations could address these concerns and improve the possibility that this project or series of projects could be completed successfully.

In total, rehabilitation of the I-95 Wilmington Corridor would reduce frequency of maintenance, improve traffic operations, and provide another freight corridor alternative for

northern Delaware. The VE Team's recommendations may help DelDOT address the corridor issues more cost effectively to meet these objectives.

The following report describes the VE process that was undertaken for the I-95 Wilmington Corridor. It includes identification, analysis, and development of options with a decision summary that is organized by category of work, shows net benefits for each option, and provides a decision matrix for reference by DelDOT.

## **I. ABSTRACT AND PROJECT LOCATION**

This project, known as the I-95 Wilmington Corridor Rehabilitation Project, is a six-mile stretch of Interstate 95 located in Wilmington, Delaware from the I-495 southern interchange to north of the Brandywine River Bridge.

The project is currently at the 30% design phase. As part of the design process, a Value Engineering Study was performed for this project at the Preliminary Plan Submission. The intention of this study was to perform an independent analysis of the elements of the project and identify improvements that may help optimize the project's value. The VE Engineering Study was performed in accordance with DelDOT and FHWA policy.

The VE Team provided a list of recommended options in this report for DelDOT's consideration that it believes might provide added value for the improvements contemplated for the I-95 Wilmington Corridor Rehabilitation Project.



I-95 Wilmington Corridor Rehabilitation Project



## II. PROJECT DESCRIPTION

The Project is located on Interstate 95 in Wilmington, Delaware, and includes a total of six miles of roadway from the north side of the Brandywine River to the south side of the Christina River. The project goals include a 30-year service life to all rehabilitated and remaining components, the minimization of future maintenance costs, the correction of all defects, and the correction of substandard design features, except for those features with FHWA-approved design exceptions.

The Project includes bridge rehabilitation work on 19 bridges, the Jackson Street ramp extension with the Wilmington Viaduct widening, and highway rehabilitation work. The following list describes the scope of work within the corridor from North to South.

- Rehab the Brandywine River Bridge (replace fascia girders and parapets, make deck and joint repairs);
- Increase vertical clearance at the 10<sup>th</sup> Street Overpass (lower I-95);
- Reconstruct mainline pavement between the Brandywine River Bridge and the main viaduct;
- Rehab the Wilmington Viaduct (deck and joint repairs, replace deck LMC overlay, replace parapet and median barriers, bearing replacement, substructure repairs, and ramp deck replacement);
- Extend the Jackson Street ramp to southbound I-95 over the Amtrak rail corridor (widen I-95 structure);
- Improve roadway pavement south of the Wilmington Viaduct (upgrade guardrail, and replace median barrier);
- Rehab three structure locations south of the Wilmington Viaduct (deck and joint repairs, replace parapet and median barriers, bearing replacement, and substructure repairs);
- Upgrade overhead signage throughout the corridor;
- Upgrade lighting throughout the corridor, including the installation of highway lighting from south of the Wilmington Viaduct to I-495; and
- Paint structural steel on I-95 bridges and overpasses within the corridor.

These project elements pretty much impact all mainline lanes and ramps within the corridor during the construction phase to the extent that the design team currently anticipates seven stages of construction to accommodate traffic on the corridor. In addition, the as-planned Jackson Street ramp extension will require close coordination with Amtrak because viaduct structure widening within the Amtrak right-of-way will be required.

A significant aspect of the scope of work for the I-95 Wilmington Corridor Rehabilitation Project is the seemingly compatible array of work elements, yet the complex interaction and potential risks associated with performing all of these elements under one contract. To this issue, the VE Team addressed options that may minimize these risks and offer DelDOT some flexibility in programming, funding, scheduling, and constructing all of the corridor improvements.

Regarding the current scope of work, it was apparent that scope creep occurred over time. This has caused an apparent disconnect between the dedicated budget for the corridor improvements and current construction estimate. While not a specific part of value engineering, this issue was also addressed by the VE Team. This effort was not dissimilar to a Practical Design program focus on project scope and maintenance of focus on the core purpose and need. To this issue, the VE Team addressed options that may eliminate nonessential project design elements resulting in lower cost and improved value.

The VE Team recommends that the DelDOT team should clarify the project purpose and need, utilize practical design procedures to focus on scope and achieve the desired budget goals, and update the cost estimate to include all additives and contingencies.

Two other issues were noted by the VE Team. First, it did not appear that environmental clearance had been resolved. Although the original scope did not anticipate an increased footprint that would have allowed the use of a Categorical Exclusion, additions to the scope may require a more comprehensive environmental action. This may impact the scope or require mitigations not currently included in the Preliminary Plan Submission.

Second, no public input has been solicited as of the Preliminary Plan Submission. It is quite possible that this process may result in the need for additional mitigations or even provide other options for DelDOT's consideration.

The outcomes from both of these issues are unknown at this time.

III. TEAM MEMBERS AND RESOURCE PERSONS

<b>Value Engineering Team</b>		
<b>Name</b>	<b>Employer</b>	<b>Role</b>
Steve Richter	DelDOT	Project Manager
Darren O’Neill	DelDOT	Program Manager II for North Project Development
LaTonya Gilliam	DelDOT	Program Manager II – Environmental Studies
Scott Neidert	DelDOT	Engineer IV – Traffic
William Pines	MDTA	Director of Project Development
Brian Schilling	DelDOT	Program Manager I – Maintenance and Operations
Jon Ledger	DelDOT	Program Manager II – Construction
Mark Buckalew	DelDOT	Program Manager I – Construction (I-95 experience)
Earl Leach	RK&K	Consultant – Rail
Harold Windisch	PennDOT	Has had experience in viaduct projects
Pamela May	DelDOT	VE Co-Facilitator
John Unbewust	Trauner Consulting	VE Co-Facilitator
Vince Campisi	Trauner Consulting	VE Constructability
Ryan Ebner	Trauner Consulting	VE Scribe
Harry Roecker	AECOM	Consultant – Bridge Design
Dan Montag	Delaware FHWA	Delaware FHWA – specialized in construction
Carlos Castro	Delaware FHWA	Delaware FHWA, Bridge Engineer
<b>Design Team</b>		
<b>Name</b>	<b>Employer</b>	<b>Role</b>
Bill Geschrei	WRA	Project Manager
Bryan Townsend	WRA	Highway Engineer
Jamie Wisner	WRA	CPM Scheduler
Jeff Davis	WRA	Highway Designer
Dave Nizamoff	WRA	Bridge Engineer
Neil Leary	WRA	Traffic Engineer
Phil Horsey	Pennoni Associates	VP and Transportation Division Manager
Doug Finney	TY Lin	PM for Brandywine River Bridge

#### IV. PROJECT VALUE ENGINEERING INITIATIVES TO DATE

The I-95 Wilmington Corridor Rehabilitation Design Team and DelDOT have considered Value Engineering concepts during the planning and preliminary design of this corridor project.

The following are key functional areas and concepts that have been considered/implemented to date or are currently under consideration:

##### Bridge

- Prefabricated Bridge Elements and Systems (PBES) – Precast versus CIP Concrete for the new deck overhangs – Replacement of the deck overhangs and parapets will be constructed using CIP concrete. Precast concrete was evaluated, but due to the length of bridge and unique geometry in the majority of spans, precast deck sections were deemed inefficient due to the need to fabricate numerous unique panels in each of the 60 spans. (The VE Team has recommended that precast or prefabricated deck panels be reevaluated for this project).
- Hydrodemolition vs. Traditional Patching of Deck Repair Locations – Hydrodemolition can accomplish two tasks at once; preparing the deck surface for the subsequent LMC overlay and identifying locations of deteriorated deck requiring patching. Using hydrodemolition will save time over the method of traditional isolated deck patching on long bridges and viaducts.
- Off-Alignment for I-95 SB Widening – Investigated an alternate location for the I-95 SB widening by constructing the ramp completely off alignment to allow the work to be completed separately from the mainline I-95 work. This alternative was never completely studied or vetted.
- Link Slabs – Evaluated the use of link slabs to eliminate transverse roadway joints. Due to the need to replace the bearings at each link slab location, the cost (over \$4,000,000) out-weighed the long-term benefits of the joint removal. (The VE Team has recommended that the use of link slabs to eliminate deck joints be reevaluated).
- I-95 Widening Pier Columns – Steel Girder Extensions versus independent pier columns to support the proposed widening of I-95 SB from S. Jackson Street – Investigated field bolting of steel girder cantilever extensions to the existing transverse girders at each pier to support the new superstructure for the widening. This option was evaluated against the construction of separate independent pier columns to support the widening. The use of pier columns was discarded due to the need to construct the widening with a longitudinal deck joint, considered a maintenance nuisance by DelDOT. The steel girder extensions have been selected for final design.
- Realignment of I-95 SB Widening On-Ramp – This alternative proposes to move the on-ramp further north to eliminate Amtrak impacts. The ramp would begin at

3rd or 4th Street and be built parallel to the current viaduct. The ramp would tie in at or before Maryland Avenue, thus avoiding Amtrak impacts. This option is currently being studied by a multi-discipline team of structural, traffic, and highway engineers. This option is significantly less expensive than the current proposed option. Traffic operations will be the most challenging item to resolve and overcome. (The VE Team has recommended an additional alternative using/restriping the existing shoulder as the lane for the on-ramp, thus eliminating construction on or over Amtrak).

### Highway/Water Resources

- Open Section versus Closed Section – The team is currently evaluating the use of an open section (in lieu of the current closed section) along I-95 south of the viaduct to minimize future maintenance, limit environmental impacts, and improve highway safety.
- Drainage System Modifications – Considering reusing the existing drainage system where alignments and pipe/inlet conditions allow.
- Design Exceptions – Ramp J Profile/Sight Distance – Investigating correcting the profile to improve sight distance and eliminate a design exception. Evaluating the costs vs. the benefits.
- Zero or Minimal Cost Alignment Improvements – Evaluating shoulder width rebalancing and mainline sight distance improvements.
- Left Asphalt Shoulder – Evaluating the retention of the left asphalt shoulder (which is required for MOT) instead of replacing it with concrete.

### Traffic

- Contraflow vs. Staged Construction – Investigated the use of contraflow for the rehabilitation of the “southern bridges” (i.e., Bridge Nos. 1-744, 1-745, and 1-746). This will improve the quality of the final product and reduce construction time.
- Multiple MOT Staging Alternatives – Evaluated the use of contraflow operation versus half roadway closures vs. single lane closures on the Wilmington Viaduct and the at-grade pavement reconstruction section on I-95 between the Wilmington Viaduct and the Brandywine River Bridge (Bridge No. 1-759).
- Lighting – Evaluated various roadway lighting options.
- Temporary Barriers – Due to the extreme quantity of temporary barriers required for the multiple stages of MOT, various barrier options and purchase mechanisms were investigated including the use of temporary steel barrier. Currently investigating the use of advanced procurement of temporary barrier

## V. VALUE ENGINEERING AGENDA AND MATERIALS PROVIDED

### AGENDA:

#### Tuesday, February 28, 2017

1. Introduction of Value Engineering Process
2. Design Status Presentation (WRA)
  - a. Project Introduction (Bill Geschrei)
  - b. Bridge Design (Dave Nizamoff)
  - c. Highway Design (Bryan Townsend)
  - d. Traffic Design (Neil Leary)
  - e. CPM Scheduling (Jamie Wisner)
3. Function Analysis
  - a. Identify project functions
  - b. Categorize functions
  - c. Analyze functions
  - d. Improve, eliminate, combine
4. Speculation/Creative Phase
  - a. Brainstorming for identified functions and alternatives
  - b. Generate alternative ideas for project functions

#### Wednesday March 1, 2017

5. Design Status Presentation
  - a. Brandywine River Bridge (Doug Finney)
6. Evaluation Phase
  - a. Refine/combine ideas
  - b. Develop functional alternatives
  - c. Evaluate by comparison
  - d. Use Risk Analysis, Adjectival Criteria, Weighted Criteria, Advantage/Disadvantage
7. Development Phase Detail Alternatives
  - a. List alternatives with greatest potential
  - b. Determine costs
  - c. Provide supporting documentation for each alternative

**MATERIALS PROVIDED:**

<b>Information/ Materials Provided</b>		
<b>Item Description</b>	<b>Provided by WRA</b>	<b>Provided by DelDOT</b>
Project Introduction Pamphlet	X	
Bridge Design Pamphlet	X	
CPM Schedule Pamphlet	X	
Traffic Analysis and Design Pamphlet	X	
Highway Design Pamphlet	X	
Wilmington Project Area Map		X
DelDOT VE Policy		X
Amtrak Agreement Information Request		X
Bridge Repair Summary	X	
DelDOT Transportation Mission Objectives		X
I-95 Wilmington Corridor Rehabilitation Design Criteria		X
List of Participants of I-95 Project		X
Wilmington Viaduct Concrete Paving Schedule	X	
Project Cost Estimate	X	
Project Plans Volumes 1-3	X	
Value Engineering Agenda		X
Value Engineering Meeting Agenda Topics		X
DelDOT 2016 Standard Specifications		X
Project Development Manual		X



## VI. INVESTIGATION PHASE

The objective of the Investigation Phase is to obtain an understanding of the design to be studied and to assess its major functions, cost, and value in effectively meeting the goals established for the corridor rehabilitation. For the I-95 Wilmington Corridor Rehabilitation Project, the design team had completed the Preliminary Plan Submission, representing a 30% completion of the project design as of the date of the VE Team review.

DelDOT provided the VE Team with project plans, specifications, design criteria, project data, proposed schedule, cost estimate, and Project Development Manual before the VE meeting dates. As a first agenda item for the VE Team, the design team provided an overview and additional documents describing the design parameters, assumptions made, and work completed to date for the project. In addition, the bridge design team provided an overview for the Brandywine River Bridge. These documents and input by the resource design teams served as the basis for the review performed by the VE Team.

The VE Team considered this information in identifying the needed functions that would address expected community and environmental commitments, safety, reliability, efficiency, and overall life-cycle cost. The VE Team's focus was to determine recommendations that would improve the value and quality of the project and reduce the time to develop and deliver the project.

Value engineering (VE) is a systematic method to improve the value of a project scope by examining function and cost. Value is the ratio of function to cost, so value can be increased by either improving the function or reducing the cost. The VE Team reviewed alternatives with this in mind and compared the potential of alternatives using differences in magnitude between cost and function that indicated the potential value of selected alternatives listed in this report.

The following have been identified by the Value Engineering Team as primary areas of focus and investigation for the Value Engineering Process. Alternatives for eight (8) areas are listed by location within the corridor from north to south and by eight (8) technical categories.

*Alternatives by Corridor Location:*

- Rehab Brandywine River Bridge
- Improve Clearance at 10<sup>th</sup> Street Overpass (Lower I-95)
- Rehab Wilmington Viaduct
- Extend South Jackson Street Ramp
- Rehab Aerial Ramps
- Rehab At-Grade Ramps
- Rehab 3 South Bridges
- Improve At-Grade I-95 Roadway

*Alternatives by Technical Category:*

- Paint Bridges
- Improve Bridge Drainage Systems
- Improve Corridor Safety
- Improve Corridor Lighting
- Install ITS Devices
- Meet Environmental Commitments
- Address Maintenance of Traffic
- Address Constructability

The Functional Analysis Worksheet contains Item Descriptions and Function Verb and Noun for each area of focus listed above. It has been made a part of this Report as Attachment A.

## VII. SPECULATION PHASE

The Value Engineering Team generated ideas, utilizing the brainstorming method, for performing the Value Engineering functional analysis within the previously identified areas of focus by location within the corridor and by technical category, as follows:

### *Corridor Location*

#### **1. Rehab Brandywine River Bridge**

- Perform Painting Before or After Corridor Project (separate project)
- Investigate Retrofit Instead of Replacement for Fascia Girders (concern regarding fracture-critical details for stiffeners)
- For Finger Joint, Consider Alternative Joints
- For Parapets, Consider New Barrier with a Strengthened Existing Deck
- Slip Form Parapets
- Consider Partial Deck Replacement
- Replace Abutment Joints
- Eliminate Joints
- Avoid Bearing Replacement
- For Concrete Repairs, Eliminate Shallow Repairs
- For Deck Overlay, Eliminate or Partial Replacement

#### **2. Improve Clearance at 10<sup>th</sup> Street Overpass (Lower I-95)**

- Remove Rock Excavation – Consider Modifying Roadway Structure Thickness
- Use Precast Concrete Panels for Roadway
- Restripe I-95 (Do Not Lower); Take Advantage of Greater Clearances Nearer the Median
- Discharge Drainage to New Outfall Location

#### **3. Rehab Wilmington Viaduct**

- Consider Partial Deck Replacement
- Strengthen Existing Deck for Parapet Installation
- Slip Form the Parapet Walls

- Use TL-4 Barriers (lesser design criteria)
  - Perform Bridge Painting Before or After Rehab Work
  - Eliminate Abutment Joints
  - Investigate Alternatives for Pier Joints
  - Investigate Alternatives to Substructure Rehab
  - For Deck Overlay, Eliminate or Partial Replacement
- 4. Extend South Jackson Street Ramp**
- Do Not Widen Ramp
  - Restripe the Shoulder
  - Investigate Alternative Barrier over Railroad (to allow better sight distance along entrance ramp over Amtrak)
  - Lengthen Spans in Substructure
  - Use Precast Substructure Elements
  - Use Preconstruction Test Piles for Micro Piles
- 5. Rehab Aerial Ramps**
- Investigate Precast Modular Deck Systems
  - Use Lightweight Concrete for Deck and Median
  - For Parapets, Use New Barrier Strengthened by Existing Deck
  - Slip Form Parapets
  - Install New Parapets without a New Deck Section
  - Use TL-4 Barrier Due to Low Truck Volumes (4% truck traffic)
  - Use Gawk Screen with Temporary Barrier
- 6. Rehab At-Grade Ramps**
- Use Precast Panels for Approach Slabs
  - Use Precast Panels for Roadway Slabs
  - Raise Grade of At-Grade Ramps
- 7. Rehab Three South Bridges**
- Use Precast Modular Deck Systems
  - Eliminate Overlay on Partial Deck Replacements
  - Eliminate Deck Joints
  - Use Optional Joints (i.e. shallow depth strip seals)
  - For Medians, Consider New Barrier Strengthened by Existing Deck

- For Parapets, Use New Barrier Strengthened by Existing Deck
- Slip Form Parapet
- Use TL-4 Barrier Due to Low Truck Volumes (4% truck traffic)

**8. Improve At-Grade I-95 Roadway**

- Convert Concrete Segments of At-Grade Roadway to Asphalt
- Pour Cast-In-Place to Final Grade
- Use Precast Modular Pavement Slabs

*Technical Category*

**1. Paint Bridges**

- Create Separate Project
- Investigate Alternative Work Hours
- Investigate Weekend Closures

**2. Improve Bridge Drainage Systems**

- Consider closed system

**3. Improve Corridor Safety**

- Improve sight distance

**4. Improve Corridor Lighting**

- Eliminate Additional Temporary Lighting
- Eliminate Additional Permanent Lighting
- Move to Advanced Lighting

**5. Install ITS Devices**

- Perform Advanced Work on Wavetronix, Cameras, VMS, and Weather Stations

**6. Meet Environmental Commitments**

- Determine Level of Environmental Clearance for Project
- Mitigate Environmental Impacts
- Address Skate Park under the Brandywine Bridge

**7. Address Maintenance of Traffic**

- Improve Alternative Routes
- Consider SIM Model to Target Improvement Areas
- Avoid Pinning Temporary Barrier to Deck in Non-Critical Areas
- Investigate Reversible Barriers

- Check Performance Specification for Temporary Barrier
- Consider Use of Zone Guard Portable Steel Barrier
- Reroute Truck Traffic
- Investigate Alternative Anchor Systems
- Implement Work Zone Speed Limits
- Investigate Alternative Closure Periods

#### **8. Address Constructability**

- Use Full Work Zone Contraflow
- Adjust Construction Start to Better Sequence with Seasons
- Update Project Cost Estimate to Include Additive Costs
- Review and Modify Maintenance of Traffic (MOT) Assumptions
- Adjust Latex Modified Concrete (LMC) Temperature Standards
- Change Concrete Roadway to Hot Mix Asphalt
- Separate the project into several contracts allowing early start for south bridges

In addition to the above Value Engineering functional analyses, the VE Team determined that the following items were outside of the Value Engineering scope, but should be considered valuable functions based on good practice.

#### ***Good Practice***

##### **1. Brandywine River Bridge**

- Use Gawk Screen with Temporary Barrier
- Address Environmental Commitments (Parks, 4F)
- Provide Enhanced Drainage Improvements

##### **2. Wilmington Viaduct**

- Use Gawk Screen Temporary Barrier
- Provide Enhanced Drainage Improvements

##### **3. South Jackson Street Ramp**

- Review Amtrak Costs
- Determine the Cost for a Catenary Shield
- Identify Force Account Needed for Structure Widening for Ramp
- Determine the Cost of Environmental Testing for Amtrak Corridor

**4. Lower I-95**

- Use Concrete Barriers

**5. Bridge Drainage Systems**

- Provide Downspouts and Scuppers

**6. Corridor Safety Improvements**

- Provide Guard Rail and Other Safety Upgrades

**7. Corridor Lighting**

- Determine the Cost and Time for Permitting

**8. Environmental Commitments**

- Provide Stormwater Management
- Address Environmental Justice
- Address Noise
- Provide Sediment Control
- Secure Permitting

**9. Maintenance of Traffic**

- Review Corridor Signage
- Control and Timing of Traffic Signals at Jackson and Adams Street Ramps

**10. Constructability**

- Evaluate Park and Ride, Employer Outreach, Ride Share Delaware
- Consider Accelerated Bridge Construction (ABC)
- Consider using A+B Bidding as a Delivery Method
- Consider using CMGC as a Delivery Method
- Consider using Incentives-Disincentives in Contract
- Provide Advanced Construction Staging/Parking Areas
- Review Other States' Positions on Early Procurement
- Address Construction Access
- Require Escrowed Bid Documents
- Review Compliance with NFPA 502 and Vulnerabilities
- Eliminate I-95 Widening over Amtrak (restripe shoulder and modify barrier)
- Avoid Construction over Amtrak (difficulty in obtaining track closures and electrical shutdowns that involve limited durations)

## VIII. EVALUATION AND DEVELOPMENT PHASES

The VE Team evaluated all of the items in the Speculation Phase and determined which items were of high priority. These high priority items are discussed in detail below, by location within the corridor and by technical category. For each item, we have included a discussion of the item, followed by Advantages and Disadvantages for that item, and then a recommendation as to the potential effectiveness for that item.

### *Corridor Location*

#### 1. Rehab Brandywine River Bridge

##### Brandywine River Bridge Location



#### a. Perform Painting Before or After Corridor Project (separate project)

##### *Discussion*

If included in the corridor contract, painting work on the Brandywine River Bridge would be performed by a trade subcontractor to the prime contractor. Significant coordination of painting with other work would be necessary over a 2½-year duration. If performed on a



separate contract, work could be completed on a schedule unique to the painting activities.

*Advantages*

- Could paint structure in sections
- Could paint multiple structure sections at same time
- Nighttime work would reduce congestion
- Could paint all substructure without interruption
- Potentially less cost as a separate contract
- Less coordination issues if performed separately
- Potentially reduce multiple mobilizations and associated costs

*Disadvantages*

- Some rehab work may need to be immediately protected with primer
- Potentially difficult for painting contractors to manage corridor scope of work
- Work would take place outside of the corridor work schedule; seen as extending traffic impacts by public

*Recommendation*

Recommend removal of painting items from corridor contract. This would allow possible use of local contractor at potentially lower cost and allow flexibility in scheduling these items. Significant value to project.

b. Investigate Retrofit Instead of Replacement for Fascia Girders

*Discussion*

This option suggests a review of the condition and possibility of rehabilitating the fascia girders by retrofitting improvements or structural deficiencies to the existing girders. This option assumes that the problems with the fascia girders are not extensive and can be repaired and upgraded easily and in less time than total replacement.

*Advantages*

- Cost savings
- Time savings

*Disadvantages*

- Possibility that the retrofit work may take longer than planned

*Recommendation*

Recommend reviewing this option to determine if possible. If possible, it would provide a considerable cost savings to the project, with a solution that would meet the objective on no major work during a 30-year useful life within the corridor. Significant value to project.

c. For Finger Joint, Consider Alternative Joints

*Discussion*

The replacement of finger joints is an expensive proposition. Rehabbing them is also an expensive option. This option suggests alternative joint systems that will provide similar useful lives.

*Advantages*

- Potential cost savings

*Disadvantages*

- Possible problems retrofitting an existing joint

*Recommendation*

Recommend reviewing this option to determine if possible. If possible, it could provide cost savings to the project, with a solution that would meet the objective on no major work during a 30-year useful life within the corridor. Significant value to project.

d. For Parapets, Consider New Barrier with a Strengthened Existing Deck

*Discussion*

Rather than completely replacing the deck where parapets are being replaced, keep the existing deck and strengthen using FRP reinforcement in the parapets. This is similar to the option proposed for the Wilmington Viaduct improvements.

*Advantages*

- Less time to construct
- Less cost
- One less longitudinal joint in the deck

*Disadvantages*

- Dependent on the condition of the deck at the tie in location for the parapet wall

*Recommendation*

Recommend consideration of this option as it is a potential cost reducer. Significant value to the project.

e. Slip Form Parapets

*Discussion*

Slip forming the parapet walls is a continuous installation method that is tried and true. It requires close adherence to quality guidelines to ensure that the finished product remains in the desired alignment. With compliance to set guidelines, this option will provide benefits to

the project. This is similar to the option proposed for the Wilmington Viaduct improvements.

*Advantages*

- Time savings
- Cost savings

*Disadvantages*

- Quality issue with cracking
- Slip forming on a bridge with traffic may cause problems

*Recommendation*

Recommend that this option be considered for placing large quantities of parapet walls. Recommend review of parapet design elements and materials to better accommodate use of slip forming. Significant value to the project.

f. Consider Partial Deck Replacement

*Discussion*

Rather than rehab of the existing deck to various depths, the partial deck replacement would include alternatives such as a precast modular deck system, or the replacement of standard strength concrete with lightweight concrete. For spans that show many deck sections with significant deterioration, it may be more cost effective to identify complete sections or spans for total removal and full depth replacement.

*Advantages*

- Fabricate sections off site
- Less time to complete
- Less costly removal pay items
- Less uncertainty of rehab cost that is dependent on the deck condition found during removal of overlay and partial deck removal

*Disadvantages*

- Cost of total deck segments may be higher

*Recommendation*

Recommend consideration of partial full depth deck replacement in locations/spans that have significant deterioration. Potentially high value to the project.

g. Replace Abutment Joints

*Discussion*

Bridge joints can cause maintenance problems on structures over time. Where possible, no joints or joints not over substructure support can minimize maintenance problems. This option may provide relief from maintenance costs in the corridor.

*Advantages*

- Reduced maintenance costs

*Disadvantages*

- Additional up front cost

*Recommendation*

Recommend this option because of the 30-year goal of minimal impact to traffic in the corridor after rehabilitation. High value to the project.

h. Eliminate Joints

*Discussion*

This is another option for reducing on-going maintenance and substructure degradation over time. Consider options to the existing joint systems or other approaches to minimizing the active joints on the Brandywine River Bridge.

*Advantages*

- Reduced maintenance costs

*Disadvantages*

- Additional up front cost

*Recommendation*

Recommend considering this option because of the 30-year goal of minimal impact to traffic in the corridor after rehabilitation. High value to the project.

i. Avoid Bearing Replacement

*Discussion*

The condition of bearings on the Brandywine River Bridge varies a lot. Consider an option of total replacement of all of the bearings with a repair, rehabilitation, or replacement approach based on a condition inventory of the bearings and an action plan that would provide a cost effective response to their condition.

*Advantages*

- Time savings
- Cost savings

*Disadvantages*

- Seismic vulnerability

*Recommendation*

Recommend considering this option over a complete replacement of bearings. This option may be more cost effective. High value to the project.

j. For Concrete Repairs, Eliminate Shallow Repairs

*Discussion*

For small spalled areas of deck, consider eliminating one step by including the volume of the cleaned area in the replacement deck pour.

*Advantages*

- Time savings
- Short term cost savings

*Disadvantages*

- Increase future maintenance costs

*Recommendation*

Recommend considering this option as a cost and time savings for the project. High value to the project.

k. For Deck Overlay, Eliminate on Partial Replacement

*Discussion*

This option proposes eliminating the deck overlay on segments of the deck where the deck is partially replaced. Place deck concrete to the surface of the travel lane, thus eliminating one step for these areas.

*Advantages*

- Cost savings due to high cost of Latex Modified Concrete
- One pour phase, not two
- Time savings on pours and forming

*Disadvantages*

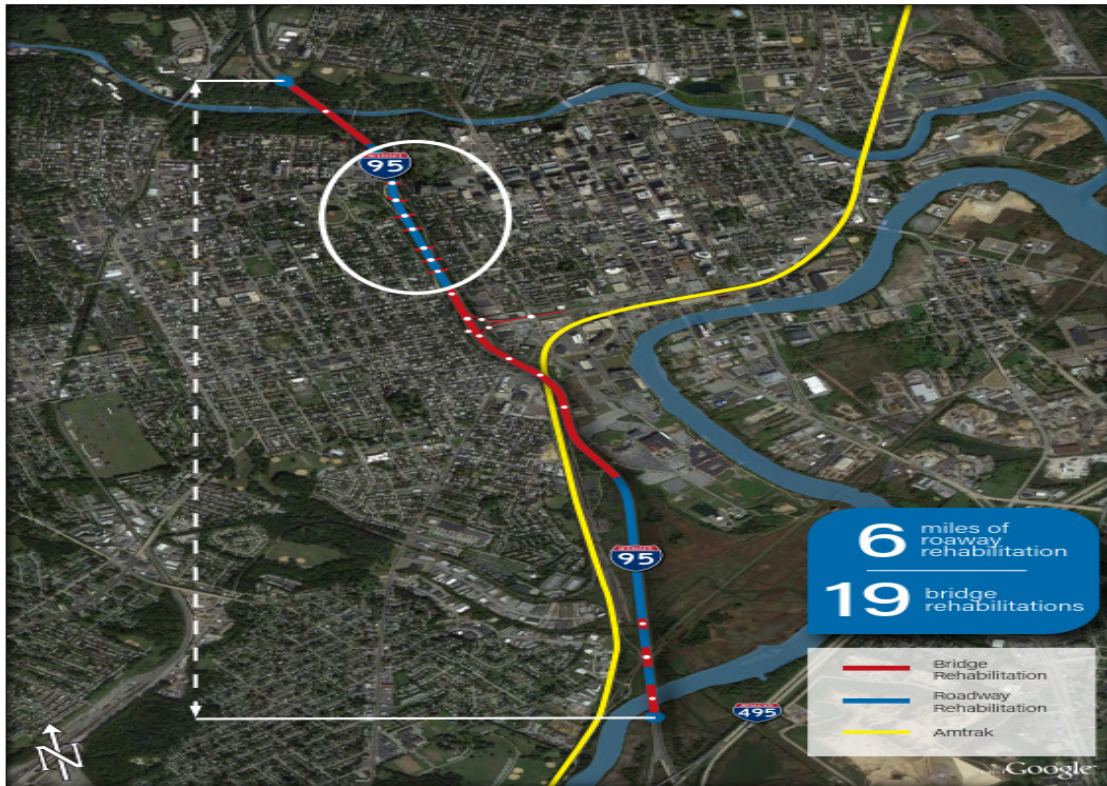
- Two stages of finishing
- Joints between concrete-only sections and LMC sections

*Recommendation*

Recommend this option as a possible cost savings to the project. Medium value to the project.

2. Improve Clearance at 10<sup>th</sup> Street Overpass (Lower I-95)

Overpass Bridges



a. Remove Rock Excavation – Consider Modifying Roadway Structure Thickness

*Discussion*

This area of the viaduct includes rock cuts with high bedrock beneath I-95. Lowering I-95 to comply with current clearance would necessitate rock blasting to lower the profile grade of I-95. Removing the existing pavement, subbase, and subgrade to bedrock, and using a modified roadway structure design would eliminate blasting of bedrock to lower the grade.

*Advantages*

- Reduced cost
- Reduced noise (blasting)
- Less material to remove from site
- Minimize soil testing

*Disadvantages*

- Less overhead clearance possible than full compliance
- Drainage may become problematic

*Recommendation*

Recommend lowering the I-95 profile grade without blasting bedrock and using a modified roadway design section. This would provide an improvement in clearance, but may not allow compliance with the maximum requirement. Significant value to project.

**b. Use Precast Concrete Panels for Roadway***Discussion*

This area of the viaduct includes rock cuts with high bedrock beneath I-95. Lowering I-95 to comply with current clearance would necessitate rock blasting to lower the profile grade of I-95. Removing the existing pavement, subbase, and subgrade to bedrock and using a modified roadway structure design would eliminate blasting of bedrock to lower the grade.

*Advantages*

- Shorter construction duration
- Possible lower roadway profile than for cast-in-place design
- Decreased maintenance costs

*Disadvantages*

- Delivery costs may be higher than cast-in-place concrete

*Recommendation*

Recommend using precast concrete panels to replace the lowered I-95 roadway section. This would provide a quicker replacement of the roadway pavement primarily because of the elimination of the cure time needed for cast-in-place concrete pavement. With a modified design, this option could potentially reduce the pavement thickness, meaning more clearance for the 10<sup>th</sup> Street Overpass. Significant value to the project.

**c. Restripe I-95, Taking Advantage of Greater Clearances Nearer the Median***Discussion*

This area of the viaduct includes rock cuts with high bedrock beneath I-95. Lowering I-95 to comply with current clearance would necessitate rock blasting to lower the profile grade of I-95. Another option would simply use the roadway grade nearer the median where clearance is greater than on the outside shoulder of I-95.

*Advantages*

- Much shorter construction duration
- Decreased cost of construction
- Minor alignment shift

*Disadvantages*

- Provides the least clearance improvement of the options

*Recommendation*

Recommend considering the minor realignment of I-95 to gain clearance at the 10<sup>th</sup> Street Overpass. This option would provide a quick solution to this problem, although it would not meet the optimal clearance requirement. This is a quick and least cost fix for the problem. High value to the project.

d. Discharge Drainage to New Outfall Location

*Discussion*

With the lowering of I-95 at the 10<sup>th</sup> Street Overpass, drainage will need to be addressed. The existing system empties into the City of Wilmington storm sewer system. This has caused maintenance problems in the past. One option is to divert roadway drainage to the north and provide containment and release in a park setting.

*Advantages*

- Disconnect from CSO
- Environmentally friendly alternative
- DelDOT would control maintenance of entire system

*Disadvantages*

- Potential higher cost to construct

*Recommendation*

Recommend considering this option for the improvement of drainage and control of the ongoing maintenance of the system. High value to the project.

**3. Rehab Wilmington Viaduct**

The Wilmington Viaduct includes three bridges: 1-748, 1-748N, and 1-748S. The major challenges to this work include the Amtrak catenary and transmission lines, the Norfolk Southern rail line, the local streets, the future skate park, and the DART parking and bus lots.



### Bridge Work Along Amtrak Line



a. Consider Partial Deck Replacement (Full Depth)

*Discussion*

Rather than rehab of the existing deck to various depths, the partial deck replacement would include alternatives such as a precast modular deck system, or the replacement of standard strength concrete with lightweight concrete. For spans that show many deck sections with significant deterioration, it may be more cost effective to identify complete sections or spans for total removal and full depth replacement.

*Advantages*

- Fabricate sections off site
- Less time to complete
- Less costly removal pay items
- Less uncertainty of rehab cost that is dependent on the deck condition found during removal of overlay and partial deck removal

*Disadvantages*

- Curves and variable overhangs make precasting segments more difficult
- Cost of total deck segments may be higher

*Recommendation*

Recommend consideration of partial full depth deck replacement in locations/spans that have significant deterioration. Potentially high value to the project.

b. Strengthen Existing Deck for Parapet Installation

*Discussion*

Rather than completely replacing the deck where parapets are being replaced, keep the existing deck and strengthen using FRP reinforcement in the parapets.

*Advantages*

- Less time to construct
- Less cost
- One less longitudinal joint in the deck

*Disadvantages*

- Dependent on the condition of the deck at the tie in location for the parapet wall

*Recommendation*

Recommend consideration of this option as it is a potential cost reducer. Significant value to the project.

c. Slip Form The Parapet Walls

*Discussion*

Slip forming the parapet walls is a continuous installation method that is tried and true. It requires close adherence to quality guidelines to ensure that the finished product remains in the desired alignment. With compliance to set guidelines, this option will provide benefits to the project.

*Advantages*

- Time savings
- Cost savings

*Disadvantages*

- Quality issue with cracking
- Slip forming on a bridge with traffic may cause problems

*Recommendation*

Recommend that this option be considered for placing large quantities of parapet walls. Recommend review of parapet design elements and materials to better accommodate use of slip forming. Significant value to the project.

d. Use TL-4 Barriers (lesser design criteria)

*Discussion*

The purpose of the TL-5 barrier is to ensure that trucks and large vehicles will not leave the elevated roadway, and cause damage. However, the truck volume for the I-95 Wilmington Corridor is about 4%. In addition, the corridor has wide shoulders that may allow for the use of TL-4 barrier.

*Advantages*

- Cost savings
- Time savings

*Disadvantages*

- Not consistent with I-95 as a dedicated truck route

*Recommendation*

Recommend consideration of this option as a cost saving measure. If it is desired that this corridor should provide an alternative for trucks, the increased truck traffic may negate this option. High value for the project.

e. Perform Bridge Painting Before or After Rehab Work

*Discussion*

If included in the corridor contract, painting work should be performed by a trade subcontractor to the prime contractor. Significant coordination of painting with other work would be necessary over a 2 ½-year duration. If performed on a separate contract, work could be completed on a schedule unique to the painting activities.

*Advantages*

- Could paint structure in sections
- Could paint multiple structure sections at same time
- Nighttime work would reduce congestion
- Could paint all substructure without interruption
- Potentially less cost as a separate contract
- Less coordination issues if performed separately
- Potentially reduce multiple mobilizations and associated costs

*Disadvantages*

- Some rehabilitation work may need to be immediately protected with primer
- Potentially difficult for painting contractors to manage corridor scope of work
- Work would take place outside of the corridor work schedule; seen as extending traffic impacts by public

*Recommendation*

Recommend removal of painting items from corridor contract. This would allow possible use of local contractor at potentially lower cost and allow flexibility in scheduling these items. Significant value to project.

f. Eliminate Abutment Joints

*Discussion*

Bridge joints can cause maintenance problems on structures over time. Where possible, no joints or joints not over substructure support can minimize maintenance problems. This option may provide relief from maintenance costs in the corridor.

*Advantages*

- Reduced maintenance costs

*Disadvantages*

- Additional up front cost

*Recommendation*

Recommend this option because of the 30-year goal of minimal impact to traffic in the corridor after rehabilitation. High value to the project.

g. Investigate Alternatives for Pier Joints

*Discussion*

This is another option for reducing on-going maintenance and substructure degradation over time.

*Advantages*

- Reduced maintenance costs

*Disadvantages*

- Additional up front cost

*Recommendation*

Recommend this option because of the 30-year goal of minimal impact to traffic in the corridor after rehabilitation. High value to the project.

h. Investigate Alternatives to Substructure Rehab

*Discussion*

This option suggests the possibility that substructure rehabilitation could be minimized and that some of the rehabilitation could be replaced with cleaning and coating. This would reduce the overall effort and allow for the more focus on those more deteriorated sections of substructure.

*Advantages*

- Reduced cost
- More rapid substructure rehabilitation

*Disadvantages*

- Increase future maintenance costs

*Recommendation*

Recommend that this option be evaluated to determine if it is possible to reduce the level of substructure rehabilitation to what is required for each element. High value to the project.

i. For Deck Overlay, Eliminate on Partial Replacement

*Discussion*

This option proposes eliminating the deck overlay on segments of the deck where the deck is partially replaced. Place deck concrete to the surface of the travel lane, thus eliminating one step for these areas.

*Advantages*

- Cost savings due to high cost of Latex Modified Concrete
- One pour phase, not two
- Time savings on pours and forming

*Disadvantages*

- Two stages of finishing
- Joints between concrete-only sections and LMC sections

*Recommendation*

Recommend this option as a possible cost savings to the project. Medium value to the project.

#### 4. Extend South Jackson Street Ramp

##### Location of Lane Widening



##### a. Do Not Widen Ramp

###### *Discussion*

The extension of the South Jackson Street ramp is problematic on many levels. Primarily it requires work over and on the Amtrak right-of-way. It was not part of the original purpose and need. It modifies the rehabilitation scope of work to the extent that an environmental clearance via a Category Exclusion may not be possible. It is a cost addition to the project. This option is the no-build option.

###### *Advantages*

- Better fits purpose and need
- Time savings
- Cost savings
- No risk of delay to the project by Amtrak
- No risk of environmental issues being encountered on Amtrak ROW

###### *Disadvantages*

- Does not address issue with ramp

###### *Recommendation*

Recommend that this option be considered because it would eliminate cost and the risk of indeterminate impacts to the project. Significant value to the project.

b. Restripe the Shoulder

*Discussion*

The extension of the South Jackson Street ramp is problematic on many levels. Primarily it requires work over and on the Amtrak right-of-way. It was not part of the original purpose and need. It modifies the rehabilitation scope of work to the extent that an environmental clearance via a Category Exclusion may not be possible. It is a cost addition to the project. This option suggests use of the striped shoulder and restriping it and the through lanes to extend the ramp acceleration lane.

*Advantages*

- Better traffic flow
- Minimal cost
- No need for work on Amtrak right-of-way
- No potential delay issues by AMTRAK

*Disadvantages*

- Potential sight distance issue (mitigation possible by using alternative barrier design)
- Traffic analysis needed to address potential safety issues

*Recommendation*

Recommend that this option be considered because it would eliminate cost and the risk of other impacts to the project. Significant value to the project.

c. Investigate Alternative Barrier

*Discussion*

The extension of the South Jackson Street ramp is problematic on many levels. Primarily it requires work over and on the Amtrak ROW. It is not part of the original purpose and need. It modifies the rehabilitation scope of work to the extent that an environmental clearance via a Category Exclusion may not be possible. It is a cost addition to the project. This option suggests modifying the barrier above the parapet over the Amtrak rails to improve sight distance for vehicles using the ramp's acceleration lane.

*Advantages*

- Improves sight distance
- Low cost to implement

*Disadvantages*

- Requires Amtrak approval
- Requires unique design of the barrier and its support system

*Recommendation*

Recommend that this option be considered because it would eliminate cost and the risk of other impacts to the project. It would also address the sight distance issue that now exists. It could also be included with the restriping option to extend the acceleration lane. Significant value to the project.

d. Lengthen Spans in Substructure*Discussion*

The extension of the South Jackson Street ramp is problematic on many levels. Primarily it requires work over and on the Amtrak right-of-way. It is not part of the original purpose and need. It modifies the rehabilitation scope of work to the extent that an environmental clearance via a Category Exclusion may not be possible. It is a cost addition to the project. This option suggests the possibility of extending the substructure to accommodate a widened and extended ramp. If possible, it would eliminate the need to work on Amtrak right-of-way.

*Advantages*

- Avoid issues with Amtrak
- Time savings

*Disadvantages*

- Additional substructure span cost in exchange for time and convenience

*Recommendation*

Recommend that this option be considered because it would eliminate cost and the risk of other impacts to the project. It would address the sight distance issue and allow the planned extension of the ramp. Significant value to the project.

e. Use Precast Substructure Elements*Discussion*

The extension of the South Jackson Street ramp is problematic on many levels. Primarily it requires work over and on the Amtrak ROW. It is not part of the original purpose and need. It modifies the rehabilitation scope of work to the extent that an environmental clearance via a Category Exclusion may not be possible. It is a cost addition to the project. This option just employs the use of precast structure sections that should save installation time and curing time.

*Advantages*

- Installation time savings
- Avoid issues with Amtrak



*Disadvantages*

- Additional substructure span cost in exchange for time and convenience

*Recommendation*

Recommend that this option be considered because it would eliminate cost and the risk of other impacts to the project. It would address the sight distance issue and allow the planned extension of the ramp. Significant value to the project.

f. Preconstruction Test Piles for Micro Piles

*Discussion*

The extension of the South Jackson Street ramp is problematic on many levels. Primarily it requires work over and on the Amtrak right-of-way. It is not part of the original purpose and need. This option suggests a review of design options that may eliminate the need to strengthen foundations, thus eliminating or reducing micropiles. It also suggests consideration of an alternate analysis method that could justify keeping the existing foundation for the proposed loads without modifications.

*Advantages*

- Cost savings for the construction phase
- Time savings for the construction phase

*Disadvantages*

- None

*Recommendation*

Recommend that this option be considered because it would eliminate cost and the risk associated with work on Amtrak right-of-way during the construction phase. It would allow the planned extension of the ramp without potential impacts from Amtrak during the construction phase. Significant value to the project.

**5. Rehab Aerial Ramps**

a. Investigate Precast Modular Deck Systems

*Discussion*

This option considers the time required to remove portions of deteriorated deck and replace with varying thicknesses of new concrete deck and topping. If total removal is feasible, the ease of demolition and replacement with precast deck sections is a reasonable alternative to consider. In addition, the operation will be faster (no concrete cure time) and the result should yield a higher quality fix.

For ramps especially, this option will provide a significant value to the project.

*Advantages*

- Installation time savings
- Higher quality result
- Removal more efficient

*Disadvantages*

- May cost more if total deck replacement is not needed

*Recommendation*

Recommend that this option be considered because it would provide a higher quality result for ramp rehabilitation. High value to the project.

b. Use Lightweight Concrete for Deck and Median

*Discussion*

This option offers a legitimate solution for rehabilitation projects. Especially for the precast option, this solution would yield a high quality result with benefits to the longevity of the viaduct substructure. It also would better accommodate the added dead weight required by the areas of widenings and median infill.

*Advantages*

- Easier transport
- Cost savings

*Disadvantages*

- Possible reduction in deck service life

*Recommendation*

Recommend that this option be considered because of potential cost savings to the project. High value to the project.

c. For Parapets, Use New Barrier Strengthened by Existing Deck

*Discussion*

Rather than completely replacing the deck where parapets are being replaced, keep the existing deck and strengthen using FRP reinforcement in the parapets.

*Advantages*

- Less time to construct
- Less cost
- One less longitudinal joint in the deck

*Disadvantages*

- Dependent on the condition of the deck at the tie in location for the parapet wall

*Recommendation*

Recommend consideration of this option as it is a potential cost reducer. Significant value to the project.

d. Slip Form The Parapet Walls

*Discussion*

Slip forming the parapet walls is a continuous installation method that is tried and true. It requires close adherence to quality guidelines to ensure that the finished product remains in the desired alignment. With compliance to set guidelines, this option will provide benefits to the project.

*Advantages*

- Time savings
- Cost savings

*Disadvantages*

- Quality issue with cracking
- Slip forming on a bridge with traffic may cause problems

*Recommendation*

Recommend that this option be considered for placing large quantities of parapet walls. Recommend review of parapet design elements and materials to better accommodate use of slip forming. Significant value to the project.

e. Install New Parapets Without a New Deck Section

*Discussion*

Rather than completely replacing the deck where parapets are being replaced, keep the existing deck and strengthen using FRP reinforcement in the parapets.

*Advantages*

- Less time to construct
- Less cost
- One less longitudinal joint in the deck

*Disadvantages*

- Dependent on the condition of the deck at the tie in location for the parapet wall

*Recommendation*

Recommend consideration of this option as it is a potential cost reducer. Significant value to the project.

f. Use TL-4 Barrier Due to Low Truck Volumes (4% truck traffic)

*Discussion*

The purpose of the TL-5 barrier is to ensure that trucks and large vehicles will not leave the elevated roadway, and cause damage. However, the truck volume for the I-95 Wilmington Corridor is about 4%. In addition, the corridor has wide shoulders that may allow for the use of TL-4 barrier.

*Advantages*

- Cost savings
- Time savings

*Disadvantages*

- Decreased safety measures

*Recommendation*

Recommend consideration of this option as a cost saving measure. If it is desired that this corridor should provide an alternative for trucks, the increased truck traffic may negate this option. High value for the project.

g. Use Gawk Screen with Temporary Barrier

*Discussion*

This option considers the safety implications of opposing traffic in close proximity during construction phases. It also addresses the implications for use of contraflow options during construction.

*Advantages*

- Improved safety
- Improved traffic flow

*Disadvantages*

- Added cost

*Recommendation*

Recommend this option for the improvements identified for a minimal cost of installation and maintenance. High value to the project.

## 6. Rehab At-Grade Ramps

### At- Grade Ramp



#### a. Use Precast Panels for Approach Slabs

##### *Discussion*

This option considers the time saved by replacing old roadway approach slabs with new precast panels. The ease of placement and the time savings make this option reasonable to consider.

##### *Advantages*

- Installation time savings (no cure time)
- Higher quality result

##### *Disadvantages*

- Coordinated delivery of precast panels vs. concrete delivery

##### *Recommendation*

Recommend that this option be considered because it would provide a higher quality result in less time. High value to the project.

#### b. Use Precast Panels for Roadway Slabs

##### *Discussion*

This option considers the time saved by replacing old roadway approach slabs with new precast panels. The ease of placement and the time savings make this option reasonable to consider.

*Advantages*

- Installation time savings (no cure time)
- Higher quality result

*Disadvantages*

- Coordinated delivery of precast panels vs. concrete delivery

*Recommendation*

Recommend that this option be considered because it would provide a higher quality result in less time. High value to the project.

c. Raise Grade of At-Grade Ramps

*Discussion*

This option considers the improvements that can be made by raising the profile grade of roadway ramps. If possible, this option also can benefit the project.

*Advantages*

- Reduced cost
- Reduced removals
- Improved drainage
- Improved base support of roadway structure

*Disadvantages*

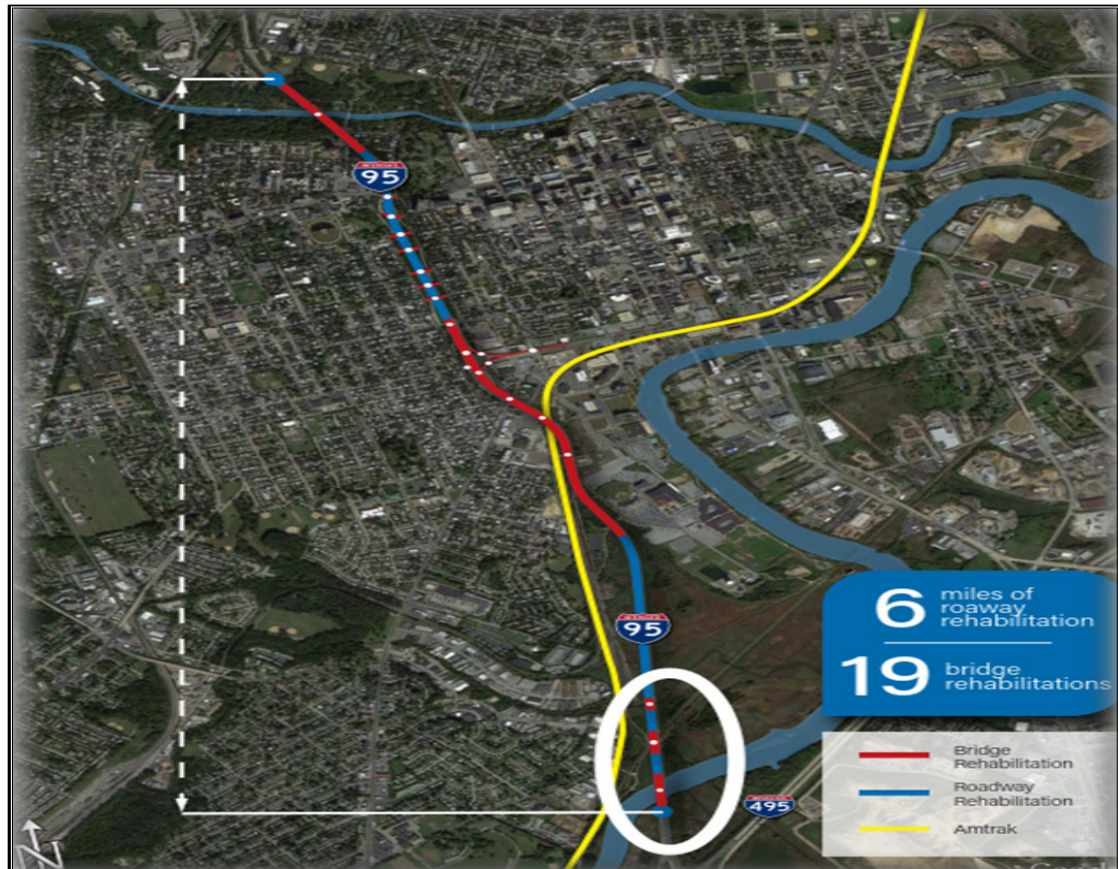
- Grade limitations at main line tie-in locations
- Extended noise propagation

*Recommendation*

Recommend this option where possible. The benefits to the project are many. High value to the project.

## 7. Rehab Three Southern Bridges

### Location of Three Southern Bridges



#### a. Use Precast Modular Deck Systems

##### *Discussion*

This option considers the time required to remove portions of deteriorated deck and replace with varying thicknesses of new concrete deck and topping. If total removal is feasible, the ease of demolition and replacement with precast deck sections is a reasonable alternative to consider. In addition, the operation will be faster (no concrete cure time) and the result should yield a higher quality fix. For ramps especially, this option will provide a significant value to the project.

##### *Advantages*

- Installation time savings
- Higher quality result
- Removal more efficient

*Disadvantages*

- May cost more if total deck replacement is not needed

*Recommendation*

Recommend that this option be considered because it would provide a higher quality result for ramp rehabilitation. High value to the project.

b. Eliminate Overlay on Partial Deck Replacements

*Discussion*

This option proposes eliminating the deck overlay on segments of the deck where the deck is partially replaced. Place deck concrete to the surface of the travel lane, thus eliminating one step for these areas.

*Advantages*

- Cost savings due to high cost of Latex Modified Concrete
- One pour phase, not two
- Time savings on pours and forming

*Disadvantages*

- Two stages of finishing
- Joints between concrete-only sections and LMC sections

*Recommendation*

Recommend this option as a possible cost savings to the project. Medium value to the project.

c. Eliminate Deck Joints

*Discussion*

Bridge joints can cause maintenance problems on structures over time. Where possible, no joints or joints not over substructure support can minimize maintenance problems. This option may provide relief from maintenance costs in the corridor.

*Advantages*

- Reduced maintenance costs

*Disadvantages*

- Additional up front cost

*Recommendation*

Recommend this option because of the 30-year goal of minimal impact to traffic in the corridor after rehabilitation. High value to the project.

d. Use Optional joints (i.e. shallow depth strip seals)

*Discussion*



This option suggests the evaluation of alternative joints for structures to more quickly make repairs and reduce costs of rehab.

*Advantages*

- Lower cost
- Faster installation

*Disadvantages*

- More frequent repairs and replacement schedule
- Will not meet 30-year useful life directive

*Recommendation*

Recommend the evaluation of alternative deck joints and materials to ensure cost effective solutions for the corridor structures. High value to the project.

e. Consider New Barrier Strengthened by Existing Deck

*Discussion*

Rather than completely replacing the deck where median barriers are being replaced, keep the existing deck and strengthen using FRP reinforcement in the barriers. This is a similar approach to that suggested for parapets.

*Advantages*

- Less time to construct
- Less cost
- One less longitudinal joint in the deck

*Disadvantages*

- Dependent on the condition of the deck at the tie in location for the parapet wall

*Recommendation*

Recommend consideration of this option as it is a potential cost reducer. Significant value to the project.

f. For Parapets, Use New Barrier Strengthened by Existing Deck

*Discussion*

Rather than completely replacing the deck where parapets are being replaced, keep the existing deck and strengthen using FRP reinforcement in the parapets.

*Advantages*

- Less time to construct
- Less cost
- One less longitudinal joint in the deck

*Disadvantages*

- Dependent on the condition of the deck at the tie in location for the parapet wall

*Recommendation*

Recommend consideration of this option as it is a potential cost reducer. Significant value to the project.

g. Slip Form Parapet

*Discussion*

Slip forming the parapet walls is a continuous installation method that is tried and true. It requires close adherence to quality guidelines to ensure that the finished product remains in the desired alignment. With compliance to set guidelines, this option will provide benefits to the project.

*Advantages*

- Time savings
- Cost savings

*Disadvantages*

- Quality issue with cracking
- Slip forming on a bridge with traffic may cause problems

*Recommendation*

Recommend that this option be considered for placing large quantities of parapet walls. Recommend review of parapet design elements and materials to better accommodate use of slip forming. Significant value to the project.

h. Use TL-4 Barrier Due to Low Truck Volumes (4% truck traffic)

*Discussion*

The purpose of the TL-5 barrier is to ensure that trucks and large vehicles will not leave the elevated roadway, and cause damage. However, the truck volume for the I-95 Wilmington Corridor is about 4%. In addition, the corridor has wide shoulders that may allow for the use of TL-4 barrier.

*Advantages*

- Cost savings
- Time savings

*Disadvantages*

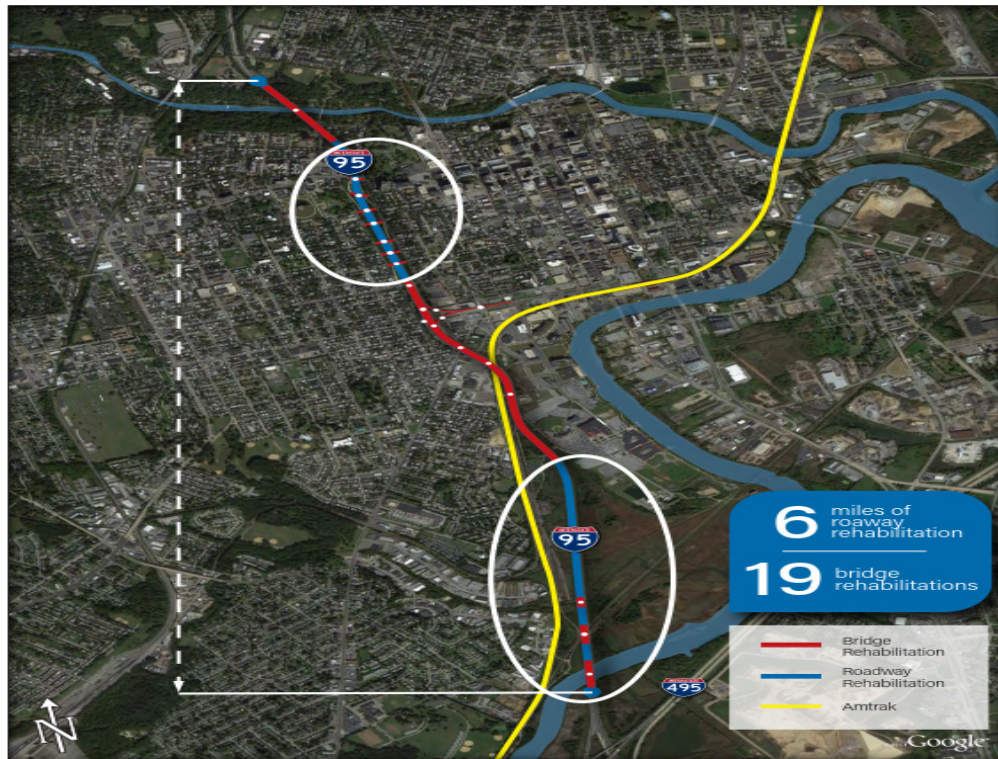
- Not consistent with I-95 as a dedicated truck route

*Recommendation*

Recommend consideration of this option as a cost saving measure. If it is desired that this corridor should provide an alternative for trucks, the increased truck traffic may negate this option. High value for the project.

**8. Improve At-Grade Roadway**

**Location of Pavement Rehabilitation**



a. Convert Concrete Sections to Asphalt

*Discussion*

This option is offered to allow a faster completion of on-grade roadway portions of the corridor project. In addition, it would allow more flexibility to the contractor to incrementally modify phasing activities.

*Advantages*

- Time savings
- Cost savings

*Disadvantages*

- May not meet goal of 30-year life without intermediate overlays.

*Recommendation*

Recommend that this option be evaluated and considered in order to provide flexibility in completing construction phases. Recommend that at-grade pavement sections be rehabbed under a separate project. High value to the project.

b. Pour Cast-In-Place to Final Grade

*Discussion*

This option suggests the traditional concrete pavement solution for all roadway sections within the corridor. The concrete solution would meet the 30-year useful life directive.

*Advantages*

- Longer useful life
- Minimal interim maintenance
- More consistent surface with all structure deck systems

*Disadvantages*

- Higher cost
- Longer time because of concrete cure times

*Recommendation*

Recommend that this option be evaluated with others to determine the best solution for roadway surfacing within the corridor project. High value to the project.

c. Use Precast Modular Pavement Systems

*Discussion*

This option considers the time saved by replacing old roadway pavement precast panels. The ease of placement and the time savings make this option reasonable to consider.

*Advantages*

- Installation time savings (no cure time)
- Higher quality result

*Disadvantages*

- Coordinated delivery of precast panels vs. concrete delivery

*Recommendation*

Recommend that this option be considered because it would provide a higher quality result in less time. High value to the project.

## Technical Category

### 1. Paint Bridges

#### Underside of Wilmington Viaduct



#### a. Create Separate Project

##### *Discussion*

Painting substructures and overpasses can benefit from an analysis of the possible options for performing structural painting on all structures within the corridor. This option suggests considering the creation of a separate project for the painting activities. This option may allow flexibility and efficiency in performing this work.

##### *Advantages*

- Reduce work zone congestion
- Potential for increased efficiency
- Smaller contract specifically for structure painting
- Possible lower costs

##### *Disadvantages*

- None

*Recommendation*

Recommend a review of alternatives for painting all substructures. This option using a separate project may provide flexibility and cost saving to the project. High value to the project.

b. Investigate Alternative Work Hours

*Discussion*

Painting substructures and overpasses can benefit from an analysis of the possible options to the standard work hours for the rehabilitation and decking work within the corridor. This option suggests considering other approaches for painting that would allow flexibility in performing this work.

*Advantages*

- Reduce work zone congestion
- Potential for increased efficiency
- Possible lower costs

*Disadvantages*

- None

*Recommendation*

Recommend a review of alternatives for painting all substructures. This option may provide flexibility and cost saving to the project. High value to the project.

c. Investigate Weekend Closures

*Discussion*

Painting substructures and overpasses can benefit from an analysis of the possible options to the standard work hours for the rehabilitation and decking work within the corridor. This option suggests considering other approaches for painting that would allow flexibility in performing this work.

*Advantages*

- Reduce work zone congestion
- Potential for increased efficiency
- Possible lower costs

*Disadvantages*

- None

### *Recommendation*

Recommend a review of alternatives for painting all substructures. This option may provide flexibility and cost saving to the project. High value to the project.

## **2. Improve Bridge Drainage Systems**

### **Downspout Under Wilmington Viaduct**



#### a. Consider Closed System

##### *Discussion*

This general category of structure drainage has been problematic regarding long-term maintenance. It suggests that a review of the current drainage systems be made to determine if options exist to continue the connection to the city storm sewer system. One option may be the treatment of drainage on site.

##### *Advantages*

- Reduce reliance on old city system
- Treat drainage on ROW below structures
- Control runoff and treatment

##### *Disadvantages*

- Higher initial cost
- Maintenance costs over time

*Recommendation*

Recommend that this option be reviewed for the possibility to address drainage more proactively. ROW beneath all structures exists to create and maintain treatment areas. Medium value to the project.

**3. Improve Corridor Safety**

**Photo of Wilmington Corridor**



a. Improve Sight Distance

*Discussion*

This general category of addresses corridor safety. In addition to what has been recommended elsewhere in this report, improving safety where curb and gutter, guardrail end treatments, and sign structures now exist will enhance the overall corridor safety.

*Advantages*

- Improve the driving experience
- Reduce accident history regarding substandard installations
- Minimize problems at documented incident locations

*Disadvantages*

- Cost of upgrades

*Recommendation*

Recommend safety be reviewed within the corridor to ensure it is addressed uniformly. Significant value to the project.



## 4. Improve Corridor Lighting

### Existing Corridor Lighting



#### a. Eliminate Additional Temporary Lighting

##### *Discussion*

The addition of temporary lighting is not cost effective because it is not known exactly what the contractor's means and methods will be. Anticipating that and placing temporary lighting based on those assumptions may lead to unnecessary and ineffective expenditure of project funds. In addition, the contractor is responsible to light the work zones. This option suggests that no additional temporary lighting be included in the contract.

##### *Advantages*

- Cost savings
- Time savings
- Same traveler experience (lighting) as currently exists

##### *Disadvantages*

- Potential safety concerns

*Recommendation*

Recommend that this option be considered because it is not needed.  
High value to the project.

b. Eliminate Additional Permanent Lighting*Discussion*

The addition of permanent lighting within the corridor was not contemplated in the original scope of work. It would require additional work to wire the parts of the corridor not now provided with lights. This option suggests that a review of the corridor lighting be made to establish the need for modifying or upgrading the current condition. In addition, it is suggested that unless there is a safety concern based on corridor information, additional permanent lighting should be eliminated from the contract.

*Advantages*

- Cost savings
- Time savings

*Disadvantages*

- Potential safety concerns

*Recommendation*

Recommend that this option be considered because it is not needed.  
High value to the project.

c. Move to Advanced Lighting*Discussion*

This option considers the use of high mast lighting for key areas within the corridor. It allows for fewer light standards and fewer safety impact areas during maintenance.

*Advantages*

- Fewer light standards
- Lower maintenance costs

*Disadvantages*

- Higher first cost per unit, lower overall cost

*Recommendation*

Recommend this option where location can cover multiple lanes and ramps. Safety of workers can be increased and maintenance costs can be reduced. Medium value to the project.

## 5. Install ITS Devices

### Wavetronix Device



#### a. Perform Advanced Work on Wavetronix, Cameras, VMS and Weather Stations

##### *Discussion*

This option suggests that all ITS portions of the corridor project should be installed before the construction phase starts. It is important that these systems and the real-time data that they provide will assist in managing traffic and incidents within the corridor. In addition, it will provide information to the media regarding the current condition of the corridor in real time.

##### *Advantages*

- Improves the agency's ability to manage the corridor
- Improves coordination with the media
- Improves image of the agency

##### *Disadvantages*

- Increased cost to the project

*Recommendation*

Recommend this option be considered because of the need to efficiently manage traffic and incidents within the corridor. Significant value to the project.

**6. Meet Environmental Commitments**

a. Determine Level of Environmental Clearance for Project

*Discussion*

Because the scope of this corridor project has expanded beyond the original scope, the assumption that a Categorical Exclusion could be approved may not now be valid. In addition, public input on the potential impacts and possible mitigation measures has not yet started. This process could identify obligations that will need to be addressed by the project and even identify opportunities to use alternative construction approaches like full corridor contraflow.

*Advantages*

- Unknown at this time

*Disadvantages*

- Unknown at this time

*Recommendation*

Recommend starting the environmental and stakeholder processes as soon as possible. The potential impacts, costs, and opportunities need to be identified before the final design is completed. Significant value to this project.

b. Mitigate Environmental Impacts

*Discussion*

Because the scope of this corridor project has expanded beyond the original scope, the assumption that a Categorical Exclusion could be approved may not now be valid. In addition, public input on the potential impacts and possible mitigation measures has not yet started. This process could identify obligations that will need to be addressed by the project and even identify opportunities to use alternative construction approaches like full corridor contraflow.

*Advantages*

- Unknown at this time

*Disadvantages*

- Unknown at this time

*Recommendation*

Recommend starting the environmental and stakeholder processes as soon as possible. The potential impacts, costs, and opportunities need to be identified before the final design is completed. Significant value to this project.

c. Address Skate Park under the Brandywine Bridge

*Discussion*

Beneath a portion of the Brandywine Bridge is open space that includes an area that has been set aside for a skate park. The skate park is scheduled to be built separate from the rehab of the Brandywine Bridge. However, to ensure that the rehab work does not interfere with the new skate park, one option would be to delay the skate park construction. This process may need input from the local community regarding the sequence of work and agency commitment to the skate park.

*Advantages*

- Removes any impact to the skate park
- Allows unrestricted access to rehab contractor

*Disadvantages*

- Possible poor timing for fulfilling agency commitment

*Recommendation*

Recommend starting the environmental and stakeholder processes as soon as possible. The potential impacts, costs, and opportunities need to be identified before the rehab project final design is completed. Significant value to this project.

## 7. Address Maintenance of Traffic

### Traffic Along Wilmington Corridor



#### a. Improve Alternative Routes

##### *Discussion*

This is a matter of considering what alternate routes may help take demand off the corridor during the construction phase. It requires discussions with the public and stakeholders to identify options and opportunities for making improvements to and using alternative routes. The City of Wilmington is a primary stakeholder in this discussion.

##### *Advantages*

- Improved traffic flow
- Improved public relations

##### *Disadvantages*

- Additional up front work to prepare for the corridor project
- Additional cost for work on alternative routes

##### *Recommendation*

Recommend starting the environmental and stakeholder processes as soon as possible. These will provide identification of potential

alternative route opportunities and will gauge the public support for them. These need to be identified before the final design is completed. Significant value to this project.

b. Consider SIM Model to Target Improvement Areas

*Discussion*

This option should be employed to identify potential alternative route improvements that would benefit the corridor project. Ideally, this information should be available before the public discussion process so that improvements and mitigation measures can be well thought out before the discussion.

*Advantages*

- Better definition of improvements available
- Basis for cost/benefit determination of alternative route improvements

*Disadvantages*

- Increased cost

*Recommendation*

Recommend generating information from this methodology as soon as possible. This information will provide what improvements on what alternative routes will be most beneficial to the diversion of traffic from the corridor project. Significant value to this project.

c. Avoid Pinning Temporary Barrier to Deck in Non-Critical Areas

*Discussion*

This option offers a less costly alternative to temporary barrier placement than is currently contemplated for the corridor project. Where the corridor provides wide shoulders or for low speed ramps, there may be an opportunity to eliminate the physical attachment of the barrier to the deck. A traffic safety analysis of these areas should be performed to determine if this option is possible.

*Advantages*

- Cost savings
- Time savings

*Disadvantages*

- Possible decreased safety

*Recommendation*

Recommend that a traffic safety analysis be performed to determine if there are locations that this option is viable. High value to the project.

d. Investigate Reversible Barriers

*Discussion*

This option suggests the use of temporary reversible barriers for certain lane closure circumstances. This system is very effective in allowing directional use of the same lanes for opposite peak traffic flows.

*Advantages*

- Time savings
- Flexible lane closure schedule
- Allows optimal use of limited lanes and structure widths

*Disadvantages*

- Additional costs

*Recommendation*

Recommend that this option be evaluated for certain construction phases as a way to enhance improved traffic throughout. High value to the project.

e. Check Performance Specification for Temporary Barrier

*Discussion*

This option suggests that the agency review what performance requirements are specified for temporary barrier in the types of applications that will be needed for the corridor project. The intent is to ensure that the project require only what is needed for each application of temporary barrier.

*Advantages*

- Reduced cost
- Optimal use of temporary barrier

*Disadvantages*

- Safety issues must be addressed

*Recommendation*

Recommend that this option be evaluated so that appropriate specifications for temporary barrier are included in the contract. High value to the project.

f. Consider Use of Zone Guard Portable Steel Barrier

*Discussion*

This option suggests the use of one type of temporary barrier for certain lane closure circumstances. This system may provide



advantages over traditional barrier systems and should be evaluated to determine if it should be considered.

*Advantages*

- Possible cost savings
- Easier installation
- Faster installation

*Disadvantages*

- Possible system costs

*Recommendation*

Recommend that this option be evaluated for certain construction phases as a way to improve production and enhance traffic safety. High value to the project.

g. Reroute Truck Traffic

*Discussion*

The I-95 Wilmington Corridor handles about 4% truck traffic. If that traffic can be removed during the construction phase, the temporary traffic alignment phases may operate more efficiently and certain physical options for the alignment may be possible.

*Advantages*

- Less congestion
- More efficient traffic flow
- Safer work zone
- Less stringent safety regulations
- Modified pinning requirements for temporary barrier

*Disadvantages*

- Potential business impacts

*Recommendation*

Recommend that this option be discussed during the public outreach function. The advantages are important to facilitating a safe work zone for traffic and workers. Significant value to the project.

h. Investigate Alternative Anchor Systems

*Discussion*

This option suggests a review of alternative anchoring systems for temporary barrier. This would ensure that the best solutions are considered for inclusion in the project. A traffic safety analysis of areas within the corridor could identify what options should be used for each area.

*Advantages*

- Cost savings
- Time savings

*Disadvantages*

- Possible decreased safety

*Recommendation*

Recommend that a traffic safety analysis be performed to determine if there are appropriate alternative anchor systems available for the corridor. High value to the project.

i. Implement Work Zone Speed Limits

*Discussion*

For the construction phase of this corridor project with multiple traffic alignments and reconfigured lanes, it is important that speed limits set the tone for a safe work zone. A traffic speed analysis will identify safe speeds for the traffic alignment conditions. These speeds will need to be posted and enforced.

*Advantages*

- Increased safety
- Optimize traffic flow
- Minimize enforcement/incident management

*Disadvantages*

- Increased congestion from non-construction phase condition

*Recommendation*

Recommend that a speed limit analysis be performed for each construction phase traffic alignment to determine the most optimal posted speed limit. Significant value to the project.

j. Investigate Alternative Closure Periods

*Discussion*

The 30% preliminary plans anticipate that multiple construction phases will be required to accommodate traffic into and out of the City of Wilmington. Ramp closures and lane closures will be phased to address this need. Options to this approach should be considered and discussed with the public and stakeholders. Nighttime or weekend closures may be acceptable if tied to a shorter construction time line. Contraflow with total lane closures may be possible if alternative accesses into the city are improved. This would enhance the construction productivity and reduce the closure/impact duration.

*Advantages*

- Reduced construction duration

- Enhanced work zone safety
- Possible reduced construction cost

*Disadvantages*

- Cost of mitigation measures
- Public push-back

*Recommendation*

Recommend that the public outreach activity explore alternative closure options with stakeholders and the city. If tied to reduced construction duration and mitigation measures, opportunities may be found that could be supported by stakeholders. Significant value to the project.

**8. Address Constructability**

**Example of Contraflow**



a. Use Full Work Zone Contraflow

*Discussion*

The option of full work zone contraflow offers an opportunity for the contractor to perform work more expeditiously. This may allow for a shorter construction phase duration. However, this option must be analyzed to determine if the corridor can physically accommodate it. Public outreach should be performed to address concerns about impacts to other corridors if this approach is used.

*Advantages*

- Increased traffic flow
- Increased lane closure flexibility
- Greater productivity
- Possible shorter construction duration
- Possible lower construction costs

*Disadvantages*

- Heavy impact to traditional traffic flow
- Potential safety concerns
- Off-site traffic impacts

*Recommendation*

Recommend that this option be considered because of the potential benefits to the project and the public. If tied to reduced construction duration and mitigation measures, stakeholders may support. Significant value to the project.

b. Adjust Construction Start to Better Sequence with Seasons

*Discussion*

The construction phase duration is estimated for about 2 ½ years. The projected start of this phase is November 2019. This means that construction and traffic impacts will occur through three winters. If the construction phase were to start in late winter or early spring, the project duration would extend only through two winters.

*Advantages*

- Decreased lost work days due to winter work restrictions
- Lower construction costs
- Decreased traffic impacts due to winter weather
- Safer construction zone

*Disadvantages*

- Ensure that no lane closures occur before end of snow season

*Recommendation*

Recommend that this option be considered because of the potential benefits to the project and the public. A project of this magnitude should take advantage of an optimal start date in the spring just to avoid as much impact to traffic as possible. Significant value to the project.

c. Update Project Cost Estimate to Include Additive Costs

*Discussion*

The scope for this corridor project has increased from what was originally planned. In addition, costs for environmental mitigation measures, utilities, construction engineering costs, and contingency

funding for unforeseen conditions need to be included in the cost estimate for the project. A project estimate update should be calculated. It is understood that the final design cost will be or has already been funded.

*Advantages*

- More accurately reflects project costs
- Addresses all identified costs to be included in this project
- Provides management to make good decisions going forward

*Disadvantages*

- Inaccurate estimate may cause project to be delayed

*Recommendation*

Recommend that the project estimate be updated to ensure that funding is in place for the construction phase. Significant value to the project.

d. Review and Modify Maintenance of Traffic (MOT) Assumptions

*Discussion*

The MOT is an important aspect of the scope of work for this corridor project. As soon as public discussions have been facilitated regarding the traffic options (closures, contraflow, remove truck traffic, etc.), and information about the reasonableness of phasing options becomes available, the MOT should be updated to reflect the current options and revised assumptions that will be included in the project.

*Advantages*

- Reflect decisions for traffic operations for the construction phase
- Establish costs for options chosen
- Convey to stakeholders the options chosen

*Disadvantages*

- None

*Recommendation*

Recommend that the MOT be updated as soon as public input is available to ensure that MOT reflects the assumptions and decisions supporting agreements with stakeholders for the construction phase. Significant value to the project.

e. Adjust Latex Modified Concrete (LMC) Temperature Standards

*Discussion*

The DelDOT specifications require 50°F for placement of LMC. Other technical information suggests that this limit could be set at 45°F. This would allow placement of LMC during calendar days that

would not be available to the contractor under the current specification requirement.

*Advantages*

- Time savings
- Meets manufacturer’s recommendations
- Possibly lower unit costs for LMC

*Disadvantages*

- None

*Recommendation*

Recommend that the temperature specification for application of LMC be reduced to 45°F. This meets manufacturer’s recommendation for placement of LMC. Medium value to the project.

f. Change Concrete Roadway to Hot Mix Asphalt

*Discussion*

This option is offered to allow a faster completion of on-grade roadway portions of the corridor project. In addition, it would allow more flexibility to the contractor to incrementally modify phasing activities.

*Advantages*

- Time savings
- Cost savings

*Disadvantages*

- May not meet goal of 30-year life without intermediate overlays.

*Recommendation*

Recommend that this option be evaluated and considered in order to provide flexibility in completing construction phases. High value to the project.

g. Separate the Project into Several Contracts Allowing Early Start for South Bridges

*Discussion*

This option is offered to allow a faster completion of on-grade roadway portions of the corridor project. In addition, it would allow more flexibility to the contractor to incrementally modify phasing activities.

*Advantages*

- Time savings
- Cost savings

*Disadvantages*

- May not meet goal of 30-year life without intermediate overlays.

*Recommendation*

Recommend that this option be evaluated and considered in order to provide flexibility in completing construction phases. High value to the project.

**IX. SUMMARY OF VE RECOMMENDATIONS AND IMPLEMENTATION PANEL DECISIONS**

Summary of VE Recommendations and Implementation Panel Decisions						
VE Recommendation Item	VE Priority	Justification	Economic Benefit	Time Savings	Panel Decision	
<b>Corridor Location</b>						
<b>1</b>	<b>Rehab Brandywine River Bridge</b>					
1a	Perform Painting Before or After Corridor Project (separate project)	Significant	Reduced Cost and Improved Flexibility	\$	0	N
1b	Investigate Retrofit Instead of Replacement for Fascia Girders	Significant	Reduced Cost and Time	\$\$\$	3	Y
1c	For Finger Joint, Consider Alternative Joints	Significant	Reduced Cost	\$	0	N
1d	For Parapets, utilize deck overhang method	Significant	Reduced Cost	\$\$	3	N/A
1e	Slip Form Parapets	Significant	Reduced Time and Cost	\$	2	N/A
1f	Consider Partial Deck Replacement	Potentially High	Reduced Time and Cost	\$	1	N/A
1g	Replace Abutment Joints	High	Maintenance Cost	\$	0	Included
1h	Eliminate Joints	High	Maintenance Cost	\$	0	N
1i	Avoid Bearing Replacement	High	Reduced Time and Cost	\$	2	Partial
1j	For Concrete Repairs, Eliminate Shallow Repairs	High	Reduced Time and Cost	\$	0	Y
1k	For Deck Overlay, Eliminate on Partial Replacement	Medium	Reduced Time and Cost	\$	2	N
<b>2</b>	<b>Improve Clearance at 10th Street Overpass (Lower I-95)</b>					
2a	Remove Rock Excavation – Consider Modifying Roadway Structure Thickness	Significant	Reduced Cost and Material Removal	\$\$	3	Y, Investigate
2b	Use Precast Concrete Panels for Roadway	Significant	Reduced Time	—	3	N
2c	Restripe I-95, Taking Advantage of Greater Clearances Nearer the Median	High	Reduced Time and Cost	\$\$	3	Y
2d	Discharge Drainage to New Outfall Location	High	Drainage and Maintenance	—	0	Y
<b>3</b>	<b>Rehab Wilmington Viaduct</b>					
3a	Consider Partial Deck Replacement	Potentially High	Reduced Time and Cost	\$	1	N/A
3b	For Parapets, utilize deck overhang method	Significant	Reduced Cost	\$\$	3	Y
3c	Slip Form the Parapet Walls	Significant	Reduced Time and Cost	\$	2	N
3d	Use TL-4 Barriers (lesser design criteria)	High	Reduced Time and Cost	\$	1	Y



<b>Summary of VE Recommendations and Implementation Panel Decisions</b>						
	<b>VE Recommendation Item</b>	<b>VE Priority</b>	<b>Justification</b>	<b>Economic Benefit</b>	<b>Time Savings</b>	<b>Panel Decision</b>
3e	Perform Bridge Painting Before or After Rehab Work	Significant	Reduced Cost and Flexibility	\$	0	Y
3f	Eliminate Abutment Joints	High	Maintenance Costs	\$	1	Included
3g	Investigate Alternatives for Pier Joints	High	Maintenance Costs	\$	0	Y
3h	Investigate Alternatives to Substructure Rehab	High	Reduced Time and Cost	\$	2	Included
3i	For Deck Overlay, Eliminate on Partial Replacement	Medium	Reduced Time and Cost	\$	1	N/A
<b>4</b>	<b>Extend South Jackson Street Ramp</b>					
4a	Do Not Widen Ramp	Significant	Reduced Time and Cost	\$\$	6	Y
4b	Restripe the Shoulder	Significant	Reduced Time and Cost	\$\$	3	N
4c	Investigate Alternative Barrier	Significant	Safety and Time	—	3	N/A
4d	Lengthen Spans in Substructure	Significant	Reduced Time and Risk	\$\$	3	N/A
4e	Use Precast Substructure Elements	Significant	Reduced Time and Risk	\$	3	N/A
4f	Use Preconstruction Test Piles for Micro Piles	Significant	Reduced Time and Cost	\$	1	N/A
<b>5</b>	<b>Rehab Aerial Ramps</b>					
5a	Investigate Precast Modular Deck Systems	High	Improved Quality	\$	1	N
5b	Use Lightweight Concrete for Deck and Median	High	Reduced Cost	\$	0	N
5c	For Parapets, utilize deck overhang method	Significant	Reduced Time and Cost	\$	1	Y
5d	Slip Form Parapets	Significant	Reduced Time and Cost	\$	1	N
5e	Install New Parapets without a New Deck Section	Significant	Reduced Time and Cost	\$	1	Partial
5f	Use TL-4 Barrier Due to Low Truck Volumes (4% truck traffic)	High	Reduced Time and Cost	\$	1	Y
5g	Use Gawk Screen as Temporary Barrier	High	Improved Safety	—	0	Y
<b>6</b>	<b>Rehab At-Grade Ramps</b>					
6a	Use Precast Panels for Approach Slabs	High	Reduced Time and Improved Quality	—	1	N
6b	Use Precast Panels for Roadway Slabs	High	Reduced Time and Improved Quality	—	1	N
6c	Raise Grade of At-Grade Ramps	High	Reduced Time	—	2	Partial
<b>7</b>	<b>Rehab Three South Bridges</b>					

<b>Summary of VE Recommendations and Implementation Panel Decisions</b>						
<b>VE Recommendation Item</b>		<b>VE Priority</b>	<b>Justification</b>	<b>Economic Benefit</b>	<b>Time Savings</b>	<b>Panel Decision</b>
7a	Use Precast Modular Deck Systems	High	Reduced Time and Improved Quality	—	3	N/A
7b	Eliminate Overlay on Partial Deck Replacements	Medium	Reduced Time and Cost	\$	1	N
7c	Eliminate Deck Joints	High	Maintenance Cost	\$	0	Included
7d	Use Optional Joints (i.e. shallow depth strip seals)	High	Reduced Cost	\$	0	N
7e	Consider New Barrier Strengthened by Existing Deck	Significant	Reduced Time and Cost	\$	1	N/A
7f	For Parapets, utilize deck overhang method	Significant	Reduced Time and Cost	\$	1	N/A
7g	Slip Form Parapet	Significant	Reduced Time and Cost	\$	2	N/A
7h	Use TL-4 Barrier Due to Low Truck Volumes (4% truck traffic)	High	Reduced Time and Cost	\$	1	Y
<b>8</b>	<b>Improve At-Grade I-95 Roadway</b>					
8a	Convert to Asphalt	High	Reduced Time and Cost	\$	2	N
8b	Pour Cast-In-Place to Final Grade	High	Maintenance	—	0	N
8c	Use Precast Modular Deck Systems	High	Reduced Time and Improved Quality	—	3	N/A
<b>Technical Category</b>						
<b>1</b>	<b>Paint Bridges</b>					
1a	Create Separate Project	High	Reduced Cost and Improved Flexibility	\$	0	Partial
1b	Investigate Alternative Work Hours	High	Reduced Cost and Improved Flexibility	\$	1	N/A
1c	Investigate Weekend Closures	High	Reduced Cost and Improved Flexibility	\$	1	Y
<b>2</b>	<b>Improve Bridge Drainage Systems</b>					
2a	Consider closed system	Medium	System Control	—	0	Y
<b>3</b>	<b>Improve Corridor Safety</b>					
3a	Improve sight distance	Significant	Improved Safety	—	0	N
<b>4</b>	<b>Improve Corridor Lighting</b>					
4a	Eliminate Additional Temporary Lighting	High	Reduced Time and Cost	\$	1	N, min req'd
4b	Eliminate Additional Permanent Lighting	High	Reduced Time and Cost	\$	1	N, min req'd
4c	Move to Advanced Lighting	Medium	Maintenance Costs	—	0	Y

Summary of VE Recommendations and Implementation Panel Decisions						
VE Recommendation Item	VE Priority	Justification	Economic Benefit	Time Savings	Panel Decision	
<b>5</b>	<b>Install ITS Devices</b>					
5a	Perform Advanced Work on Wavetronics, Cameras, VMS, and Weather Stations	Significant	Traffic Management	—	0	Included
<b>6</b>	<b>Meet Environmental Commitments</b>					
6a	Determine Level of Environmental Clearance for Project	Significant	Unknown	?	?	Investigate
6b	Mitigate Environmental Impacts	Significant	Unknown	?	?	Investigate
6c	Address Skate Park on Liberty Street	Significant	Unknown	?	?	Included
<b>7</b>	<b>Address Maintenance of Traffic</b>					
7a	Improve Alternative Routes	Significant	Improved Traffic Flow	\$	3	Included
7b	Consider SIM Model to Target Improvement Areas	Significant	Improved Traffic Flow	?	?	N
7c	Avoid Pinning Temporary Barrier to Deck in Non-Critical Areas	High	Reduced Time and Cost	\$	1	Y
7d	Investigate Reversible Barriers	High	Reduced Time	—	3	N
7e	Check Performance Specification for Temporary Barrier	High	Reduced Cost	—	?	N
7f	Consider Use of Zone Guard Portable Steel Barrier	High	Reduced Time and Cost	\$	2	Investigate
7g	Reroute Truck Traffic	Significant	Improved Traffic Flow	\$	3	N
7h	Investigate Alternative Anchor Systems	High	Reduced Time and Cost	\$	1	Investigate
7i	Implement Work Zone Speed Limits	Significant	Improved Safety and Traffic Flow	?	?	Investigate
7j	Investigate Alternative Closure Periods	Significant	Improved Safety and Reduced Cost	\$	0	Investigate
<b>8</b>	<b>Address Constructability</b>					
8a	Use Full Work Zone Contraflow	Significant	Reduced Cost and Improved Traffic Flow	\$\$	6	N
8b	Adjust Construction Start to Better Sequence with Seasons	Significant	Reduced Cost and Improved Safety	\$\$	6	Y
8c	Update Project Cost Estimate to Include Additive Costs	Significant	Reduced Cost	?	0	Included
8d	Review and Modify Maintenance of Traffic (MOT) Assumptions	Significant	Reduced Cost	\$	0	Included
8e	Adjust Latex Modified Concrete (LMC) Temperature Standards	Medium	Reduced Time and Cost	?	1	N
8f	Change Concrete Roadway to Hot Mix Asphalt	High	Reduced Time and Cost	\$	3	N

Summary of VE Recommendations and Implementation Panel Decisions						
VE Recommendation Item		VE Priority	Justification	Economic Benefit	Time Savings	Panel Decision
8g	Separate the Project into Several Contracts Allowing Early Start for South Bridges	High	Reduced Time and Cost	\$\$	?	Partial

KEY		
Economic Benefit	\$0 < \$100,000	\$
	≥ \$100,000 ≤ \$1,000,000	\$\$
	> \$1,000,000	\$\$\$
Time Savings	Number of Months	X

In addition to the Value Engineering recommendations provided above, the Value Engineering team recommends the following Good Practices be considered.

Summary of VE Recommended Good Practices and Implementation Panel Decisions		
VE Recommendation Item		Panel Decision
<b>1</b>	<b>Brandywine River Bridge</b>	
1a	Use Gawk Screen with Temporary Barrier	Y
1b	Address Environmental Commitments (Parks, 4F)	Y
1c	Provide Enhanced Drainage Improvements	Investigate
<b>2</b>	<b>Wilmington Viaduct</b>	
2a	Use Gawk Screen with Temporary Barrier	Y
2b	Provide Enhanced Drainage Improvements	Investigate
<b>3</b>	<b>South Jackson Street Ramp</b>	
3a	Review Amtrak Costs	N/A
3b	Determine the Cost for a Catenary Shield	N/A
3c	Identify Force Account Needed for Structure Widening for Ramp	N/A
3d	Determine the Cost of Environmental Testing for Amtrak Corridor	N/A
<b>4</b>	<b>Lower I-95</b>	
4a	Use Concrete Barriers	Investigate
<b>5</b>	<b>Bridge Drainage Systems</b>	
5a	Provide Downspouts and Scuppers	Investigate
<b>6</b>	<b>Corridor Safety Improvements</b>	
6a	Provide Guard Rail and Other Safety Upgrades	Y
<b>7</b>	<b>Corridor Lighting</b>	

Summary of VE Recommended Good Practices and Implementation Panel Decisions		
VE Recommendation Item		Panel Decision
7a	Determine the Cost and Time for Permitting	Y
<b>8</b>	<b>Environmental Commitments</b>	
8a	Provide Stormwater Management	Y
8b	Address Environmental Justice	Y
8c	Address Noise	Y
8d	Provide Sediment Control	Y
8e	Secure Permitting	Y
<b>9</b>	<b>Maintenance of Traffic</b>	
9a	Review Corridor Signage	Y
9b	Control Traffic Signals at Ramps	Investigate
<b>10</b>	<b>Constructability</b>	
10a	Evaluate Park and Ride, Employer Outreach, Ride Share Delaware	Y
10b	Consider Accelerated Bridge Construction (ABC)	Investigate
10c	Consider using A+B Bidding as a Delivery Method	Investigate
10d	Consider using CMGC as a Delivery Method	Investigate
10e	Consider using Incentives-Disincentives in Contract	Investigate
10f	Provide Advanced Construction Staging/Parking Areas	Investigate
10g	Review Other States' Positions on Early Procurement	Investigate
10h	Address Construction Access	Y
10i	Require Escrowed Bid Documents	Investigate
10j	Review Compliance with NFPA 502 and Vulnerabilities	Y
10k	Eliminate I-95 Widening over Amtrak (restripe shoulder and modify barrier)	Y, partial
10l	Avoid Construction over Amtrak (difficulty in obtaining track closures and electrical shutdowns that involve limited durations)	Y

**Corridor Location**

**1. Brandywine River Bridge**

See responses by TYLin

**2. Improve Clearance at 10th Street Overpass (Lower I-95)**

VE Study Item	Option	Pros	Cons	Comments
a. Remove Rock Excavation - Consider Modifying Roadway Structure Thickness	1 - leave rock excavation in contract	Rock will be encountered for barrier construction; rock profiles are unknown.		
	2 - remove rock excavation			Roadway thickness requires input from M&R.
b. Use Precast Concrete Panels for Roadway				Requires input from M&R.
c. Restripe I-95, Taking Advantage of Greater Clearances Nearer the Median		Potential for less rock excavation.	Wide shoulder may encourage traffic use, and will require design exceptions for shoulder width and vertical clearance, difficult to justify. Clearance is not measured from travel lanes but entire road including shoulders.	Potential cost benefit negligible and doesn't justify design exception. Shallow rock appears to be a different formation than that observed at I-95/US 202 rock; hardness unknown.
d. Discharge Drainage to New Outfall Location				Will review.

**3. Rehab Wilmington Viaduct**

VE Study Item	Option	Pros	Cons	Comments
a. Consider Partial Deck Replacement (Full Depth)	1 - overlay deck			This option is not relevant to the partial replacement of the deck in the first bay.
	2 - precast modular deck system	a. Saves construction time. b. Provides for a potentially superior product	a. Incurs additional cost to the project. b. Piecemeal fabrication of the panels will be required due to the inconsistent bridge geometry which could lead to a lower quality finished product if panels do not fit-up properly.	
	3 - lightweight concrete	a. May provide an improvement to the load ratings.		
b. Strengthen Existing Deck for Parapet Installation	1 - strengthen deck by fully removing overhang and part of first interior bay	a. May provide a superior final product with minimal construction joints.	a. Labor intensive for large amounts of concrete removal increases cost and time to construct.	Several options have been developed to provide a good balance between cost, time to construct, and final product quality.
	2 - strengthen deck using FRP		a. Large application for a unique use of this material may increase project cost.	
	3 - strenghten deck by not fully cutting through deck	a. Less concrete removal and less labor costs  b. Utilizes hydrodemolition to aid in concrete removal thus saving time and providing good bond for overlay.	a. Placement of overaly material must be detailed properly to avoid future maintenance issues and related costs from joints.	
c. Slip Form the Parapet Walls	1 - slip form	a. Potential cost and time savings	a. Potential cracking in parapet due to live load on bridge during construction  b. Must form around light poles c. Must start and stop at each roadway joint	



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VE Study Item	Option	Pros	Cons	Comments
d. Use TL-4 Barriers (lesser design criteria)	1 - TL-5	a. Added safety and rollover protection, specifically for large trucks.	a. Higher cost b. limits stopping sight distance around some of the curves on the viaduct	
	2 - TL-4	a. "Generally acceptable for the majority of applications on high speed highways, freeways, expressways, and Interstate highways with a mixture of trucks and heavy vehicles". b. Saves project cost.	a. Provides less rollover protection.	This portion of I-95 carries a relatively lower percentage of trucks (4%). Reference AASHTO 13.7.2; note, this recommendation has already been implemented. See graphic distributed with 3/9/17 meeting minutes for additional information.
e. Perform Bridge Painting Before or After Rehab Work	1 - leave painting in contract	a. Avoids potential for localized paint failure and resulting corrosion to adversely affect load ratings.	a. schedule sensitivity	
	2 - painting in separate contract	a. painting contractor is the prime contractor b. schedule flexibility c. potential cost savings d. most of the painting operations will not have a significant impact on I-95 mainline	a. may be viewed by public as separate traffic interruption	If painting removed from contract, should consider leaving the painting of the overpass bridges in the main contract to avoid I-95 traffic disruptions at a later date.
f. Eliminate Abutment Joints				In the Preliminary Plans, WRA proposed moving the abutment joint off the bridge to the approach end of the approach slab.
g. Investigate Alternatives for Pier Joints	1 - install link slabs where possible	a. elimination of roadway joint b. cost for the link slab work is less than cost to install new strip seal c. reduced future maintenance costs	a. Need to replace steel sliding plate bearings with elastomeric bearings increasing construction time and cost for link slabs (~\$3.2M additional for bearings)	Because of the need to replace additional bearings the overall net cost increase for the link slab work is approximately \$2.5M.





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VE Study Item	Option	Pros	Cons	Comments
h. Investigate Alternatives to Substructure Rehab				This recommendation has already been implemented by the removal of the shallow spall repair and by reducing the removal limits into sound concrete at deep spall repairs.
i. For Deck Overlay, Eliminate on Partial Replacement	1 - Overlay new overhang	a. Added protection for the construction joint in between the existing and proposed deck	a. Additional time/prep work to prepare the new concrete to receive the LMC overlay	
	2 - Do not overlay new overhang	a. Only need to prep surface and pour concrete once in this area b. Potential cost and time savings	a. The exposed construction joint in the bridge deck creates a potential spot for roadway salts to penetrate into the deck	Assuming the deck will be replaced in 25 years, this may be a maintenance item the Department can withstand.

4. Extend South Jackson Street Ramp

VE Study Item	Option	Pros	Cons	Comments
a. Do Not Widen Ramp				Widening over Amtrak has been removed from the project. Alternate new on-ramp alignments are being investigated.
b. Restripe the Shoulder		Lower cost and increased acceleration length.	Insufficient stopping sight distance on inside of vertical curve (which has an insufficient radius). Would require different striping configuration, with 12' lanes and 2' offsets to barrier - different deck joint layout. Would require design exceptions.	
c. Investigate Alternative Barrier				Widening over Amtrak has been removed from the project. Alternate new on-ramp alignments are being investigated.
d. Lengthen Spans in Substructure				Widening over Amtrak has been removed from the project. Alternate new on-ramp alignments are being investigated.
e. Use Precast Substructure Elements				Widening over Amtrak has been removed from the project. Alternate new on-ramp alignments are being investigated.



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VE Study Item	Option	Pros	Cons	Comments
f. Preconstruction Test Piles for Micro Piles		Operation can take place before traffic is disrupted	Additional Mobilization of Micro Pile Crews	Shown in Preliminary CPM as starting before traffic disrupted; note, widening over Amtrak has been removed from the project. Alternate new on-ramp alignments are being investigated.

5. Rehab Aerial Ramps

VE Study Item	Option	Pros	Cons	Comments
a. Investigate Precast Modular Deck Systems	1 - traditional CIP deck	a. ramp structures are not critical path on the schedule so no need to pay a premium for precast elements		Due to TL-4 parapet changes this comment only applies to BRs 1-749, 1-758, and 1-750.
	2 - precast modular deck systems	a. limits time over Amtrak for BR 1-749	a. still need demo shields to demo existing spans, therefore savings is minimal b. higher cost due to precast premium	
b. Use Lightweight Concrete for Deck and Median			a. higher cost for LWC b. no need for LWC because existing ratings are >> 1.0	None of the ramps have a median.
c. For Parapets, Use New Barrier Strengthened by Existing Deck				This comment no longer applies to any of the ramp bridges due to the changes in the barrier work
d. Slip Form the Parapet Walls	1 - slip form	a. potential cost and time savings b. ramps are closed to traffic allowing for the potential to slip form pending approval by The Department	a. must form around light poles b. must start and stop at each roadway joint	Applies to BRs 1-749, 750, and 758
e. Install New Parapets Without a New Deck Section				This comment no longer applies to any of the ramp bridges due to the changes in the barrier work
f. Use TL-4 Barrier Due to Low Truck Volumes (4% truck traffic)				This recommendation has already been implemented. See graphic distributed with 3/9/17 meeting minutes for additional information.



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VE Study Item	Option	Pros	Cons	Comments
g. Use Gawk Screen with Temporary Barrier				Will comply. For a minimal cost it prevents motorists from watching the work being completed in lieu of watching the roadway. Proven safety success on other similar projects.

**6. Rehab At-Grade Ramps**

VE Study Item	Option	Pros	Cons	Comments
a. Use Precast Panels for Approach Slabs	1 - use CIP	a. since approach slabs are not critical path CIP is an acceptable alternative		
	2 - use precast	a. potential time savings	a. increased cost	
b. Use Precast Panels for Roadway Slabs	1 - use CIP	a. since pavement is not critical path CIP is an acceptable alternative		
	2 - use precast	a. potential time savings	a. increased cost	
c. Raise Grade of At-Grade Ramps		May reduce rock excavation	NB bridge clearances will likely not allow this option.	Investigation of raising SB I-95 south of Ramp L and raising Ramp J may be warranted.

**7. Rehab Three Southern Bridges**

VE Study Item	Option	Pros	Cons	Comments
a. Use Precast Modular Deck Systems				Since the existing barriers and overhangs are to remain based on 3/9/17 conference call discussion, this comment is no longer applicable.
b. Eliminate Overlay on Partial Deck Replacements				Since the existing barriers and overhangs are to remain based on 3/9/17 conference call discussion, this comment is no longer applicable.
c. Eliminate Deck Joints	1 - install link slabs where possible	a. elimination of roadway joint  b. reduced future maintenance costs	a. need to replace steel sliding plate bearings with elastomeric bearings increasing construction time and cost for link slabs (~\$200k increase to replace bearings)	This comment only applies to BR 1-746 - total increased cost is approximately \$150k; the skew is too high at 744 for link slabs and 745 has box girder and double joints.



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VE Study Item	Option	Pros	Cons	Comments
d. Use Optional Joints (i.e. shallow depth strip seals)	1 - use strip seals	a. lower overall maintenance as long as seals are properly cleaned and maintained	a. higher initial cost	
	2 - use alternative joints	a. lower initial cost and faster installation	a. higher maintenance cost to replace seals more frequently b. will not meet 30 year service life	
e. Consider New Barrier Strengthened by Existing Deck				Since the existing barriers and overhangs are to remain based on 3/9/17 conference call discussion, this comment is no longer applicable.
f. For Parapets, Use New Barrier Strengthened by Existing Deck				Since the existing barriers and overhangs are to remain based on 3/9/17 conference call discussion, this comment is no longer applicable.
g. Slip Form Parapet				Since the existing barriers and overhangs are to remain based on 3/9/17 conference call discussion, this comment is no longer applicable.
h. Use TL-4 Barrier Due to Low Truck Volumes (4% truck traffic)				This recommendation has already been implemented. See graphic distributed with 3/9/17 meeting minutes for additional information.

**8. Improve At-Grade Roadway**

VE Study Item	Option	Pros	Cons	Comments
a. Convert Concrete Sections to Asphalt		More flexibility for MOT; may save time (but not critical path.)		Requires input from M&R.
b. Pour Cast-In-Place to Final Grade			May not be feasible for MOT.	
c. Use Precast Modular Pavement Systems		May save time (but not critical path.)	Likely more expensive.	Requires input from M&R.

**Technical Category**

**1. Paint Bridges**

VE Study Item	Option	Pros	Cons	Comments
a. Create Separate Project				See discussion above.
b. Investigate Alternative Work Hours				If painting bridges is left in contract the painting can be completed in the work areas established for the work on the decks and at-grade sections. If painting is removed and performed in a separate contract the work will be completed with off-peak lane closures with minimal traffic impacts.
c. Investigate Weekend Closures				

**2. Improve Bridge Drainage Systems**

VE Study Item	Option	Pros	Cons	Comments
a. Consider Closed System				The current system on the Viaduct is a closed system that ties into the City's combined system.

**3. Improve Corridor Safety**

VE Study Item	Option	Pros	Cons	Comments
a. Improve Sight Distance				Sight distance is being maximized throughout corridor, given fixed constraints.

**4. Improve Corridor Lighting**

VE Study Item	Option	Pros	Cons	Comments
a. Eliminate Additional Temporary Lighting	1. Maintain proposed temporary lighting	a. Maintains existing lighting levels with reduced lane widths and lateral offsets b. Complies with DelDOT Lighting Guidelines c. Added safety	a. Increased cost	The only temporary lighting that is being installed is to maintain existing lighting. Regardless of contractors means and methods existing lighting will be impacted when the outside parapets are removed.
	2. Eliminate proposed temporary lighting	a. Cost savings	a. Violates DelDOT Lighting Guidelines which indicates that lighting SHALL be provided along interstates at junctions with mainline routes, ramp terminals with mainline route and crossing roadways  b. Potential safety concern	
b. Eliminate Additional Permanent Lighting	1. Install additional permanent lighting	a. Provides continuous lighting in section of roadway that experiences significant amount of weaving traffic due to left entry and exit ramps	a. Increase in project cost b. Future maintenance costs will be higher	
	2. Eliminate additional permanent lighting	a. Cost savings	a. potential safety concern due to weaving traffic	
c. Move to Advanced Lighting	1. Install high mast light poles where applicable (between Exits 5C and 6)	a. Cost savings b. Consistent with lighting at I-295 interchange	a. Not practical to install high mast poles in most portions of project due to light trespass concerns	Option should be explored.
	2. Install all low level light poles	a. Eliminate light trespass concerns b. More common type of lighting provided	a. Increase in project cost b. Future maintenance costs will be higher	

**5. Install ITS Devices**

VE Study Item	Option	Pros	Cons	Comments
a. Perform Advanced Work on Wavetronix, Cameras, VMS and Weather Stations				Already being completed.

**6. Meet Environmental Commitments**

VE Study Item	Option	Pros	Cons	Comments
a. Determine Level of Environmental Clearance for Project				Will investigate
b. Mitigate Environmental Impacts				Will investigate
c. Address Skate Park under the Brandywine Bridge				Further coordination with City is on-going.

**7. Address Maintenance of Traffic**

VE Study Item	Option	Pros	Cons	Comments
a. Improve Alternative Routes				Already being completed. Traffic mitigation projects already in design.
b. Consider SIM Model to Target Improvement Areas	1. Create traffic simulation model to analyze alternative routes	a. Traffic simulation is useful tool to show public traffic operations b. Can test multiple diversion scenarios and sensitivity analyses c. Can be used for other future modeling needs within the City	a. Significant cost (Benefits don't outweigh costs) b. Significant time to develop model c. Difficult to project future travel patterns	
	2. Conduct traffic analyses of alternative routes by establishing available capacity levels	a. Less time to obtain results b. lower cost to obtain results c. Accurate results	a. No traffic simulations to show public	



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VE Study Item	Option	Pros	Cons	Comments
c. Avoid Pinning Temporary Barrier to Deck in Non-Critical Areas	1. Pin temporary barrier in non-critical areas	a. Improved safety for traveling public and workers b. Cannot provide 5 foot deflection zone to work area	a. Significant cost b. Significant construction time	DeIDOT Traffic preference is that if required lateral deflection to work area can not be provided temporary barrier needs to be pinned.
	2. Don't pin temporary barrier in non-critical areas	a. Cost savings b. Reduced construction time	a. Potential safety concern	
d. Investigate Reversible Barriers				Already evaluated in Wilmington Viaduct Traffic Study and not recommended due to amount of traffic diversion required.
e. Check Performance Specification for Temporary Barrier				DeIDOT already has specifications on the use of temporary concrete barrier. Covered in Design Guidance Memorandum Number 1-21 and DEMUTCD.
f. Consider Use of Zone Guard Portable Steel Barrier	1. Use tempoary concrete barrier	a. More readily available b. Potential initial cost savings	a. Significant construction time to install b. More expensive to transport (limited to 8 pieces per load)	This is an option that should be allowed and ultimately made by the contractor. There is a potential to use both types of barrier on the project.
	2. Use zone guard portable steel barrier	a. Potential construction time savings b. Much cheaper to transport (can move upto 750LF per truck load)	a. mateiral availability in bulk amounts b . Potential initial cost increase	This is an option that should be allowed and ultimately the decision made by the Contractor. There is a potential to use both types of barrier on the project.





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VE Study Item	Option	Pros	Cons	Comments
g. Reroute Truck Traffic	1. Maintain truck traffic on I-95	a. Minimizes impacts to local deliveries into and out of the City of Wilmington  b. Relatively low percentage of trucks along I-95 and with congestion percentage of truck traffic is likely to decrease which minimizes benefit of restricting trucks	a. Potentially more congestion and less efficiency of traffic flow with truck traffic permitted	The potential benefits don't outweigh the potentially significant impacts that restricting trucks on I-95 will have to the local business community.
	2. Prohibit trucks on I-95	a. Potentially less congestion and more efficient traffic flow with trucks removed	a. Significant impacts to local deliveries into and out of the City of Wilmington  b. Likely to receive public opposition due to impacts to City businesses  c. Difficult to enforce since truck traffic will still be required for the actual construction activities	
h. Investigate Alternative Anchor Systems				Several systems have been found that will work with limited embedment depth of the anchor, however they do require additional anchors compared to other systems; Contractor shall submit chosen system for approval during shop drawing phase.
i. Implement Work Zone Speed Limits	1. Maintain posted speed limit			This decision should be determined as design progresses. If the MOT can be designed at the roadway design speed in terms of lane shifts, sight distances, etc. it may be safer to maintain the current posted 55 mph speed limit since reducing it will only increase speed differential amongst motorists. Another option that will be explored will be the installation of advisory speed plaques to mitigate a specific area with a design element lower than the posted speed limit (i.e. curve warning sign with advisory plaque).
	2. Create reduced work zone speed limit			
j. Investigate Alternative Closure Periods				Will comply.

**8. Address Constructability**

VE Study Item	Option	Pros	Cons	Comments
a. Use Full Work Zone Contraflow				Has been implemented for the three southern bridges and Brandywine River bridge. Due to traffic impacts presented in Wilmington Viaduct Traffic Study, full work zone contraflow operation is not practical and has significant traffic impacts.
b. Adjust Construction Start to Better Sequence with Seasons				Adjustment can be made after VE study and scope changes
c. Update Project Cost Estimate to Include Additive Costs				Will require input and direction from the Department to incorporate the proper additives.
d. Review and Modify Maintenance of Traffic (MOT) Assumptions				Multiple MOT alternatives were already evaluated and a preferred alternative (sustained single lane closures) was recommended by DelDOT Upper Management and City of Wilmington representatives. If during the Public Outreach process a suggested modified MOT alternative is presented it will be evaluated at that time. This is similar to the process that is occurring for Ramps B/C based on City of Wilmington input.
e. Adjust Latex Modified Concrete (LMC) Temperature Standards				Will require input and direction from the Department to adjust these standards.
f. Change Concrete Roadway to Hot Mix Asphalt		HMA - easier to adjust grades between phases	HMA has temperature restrictions, concrete does not.	
g. Separate the Project into Several Contracts Allowing Early Start for Southern Bridges				Break-out of the southern bridges into their own contract has already been implemented.

VE Study Item	Option	Pros	Cons	Comments and Recommendations (in bold)
a. Perform Painting Before or After Corridor Project (separate project)	1 - Leave painting in contract	<ul style="list-style-type: none"> <li>a. Painting is done immediately after repairs are made leaving little time for new corrosion to initiate</li> <li>b. Have full access to the bridge while either NB or SB is shutdown</li> </ul>	<ul style="list-style-type: none"> <li>a. Schedule sensitivity</li> </ul>	<b>Keep painting for BR 1-759 in the contract.</b>
	2 - Painting in separate contract	<ul style="list-style-type: none"> <li>a. Painting contractor is the prime contractor</li> <li>b. Schedule flexibility</li> <li>c. Potential cost savings</li> </ul>	<ul style="list-style-type: none"> <li>a. Viewed by public as separate traffic interruption</li> </ul>	
b. Investigate Retrofit Instead of Replacement for Fascia Girders	1 - Fascia girder replacement	<ul style="list-style-type: none"> <li>a. Eliminates the risk of future fatigue cracks</li> <li>b. Can move the fascia girder inward from the end of the pier cap</li> <li>c. No areas of section loss</li> </ul>	<ul style="list-style-type: none"> <li>a. Significant cost</li> <li>b. Significant construction time</li> <li>c. Requires deck, barrier and lighting replacement over fascia girder</li> </ul>	The fascia girders (S1 and S12) do not control the bridge load rating.
	2- Fascia girder repair/retrofit	<ul style="list-style-type: none"> <li>a. Approximate cost savings vs Option 1 is \$8,700,000.</li> <li>b. Approximate construction time savings vs Option 1 is 135 working days.</li> <li>c. Eliminates the need for deck, barrier and lighting replacement over fascia girder</li> <li>d. Reduces construction impact to park, residents and streets beneath the bridge</li> </ul>	<ul style="list-style-type: none"> <li>a. Risk that all potential fatigue prone locations have not been identified and mitigated</li> <li>b. Future maintenance costs will be higher</li> </ul>	<b>Fascia girders are no longer being replaced. Repair/retrofit fascia girders and diaphragms as necessary. Investigate the extent of the retrofits done in 2004.</b>
c. Consider Alternatives to Finger Joint	1 - Use Finger Joint	<ul style="list-style-type: none"> <li>a. Longer service life</li> </ul>	<ul style="list-style-type: none"> <li>a. Trough maintenance and potential replacement</li> </ul>	<b>Replace joints as currently proposed with finger joints.</b>
	2 - Use Modular Joint		<ul style="list-style-type: none"> <li>a. Complex design (more moving parts that could potentially fail)</li> <li>b. Includes fatigue prone details</li> <li>c. Difficulty in replacing multiple glands per joint</li> <li>d. No cost history in Delaware</li> </ul>	Strip seal is not an option due to bridge skew and superstructure movements. No anticipated cost savings vs finger joint.
d. For Parapets, Consider New Barrier with a Strengthened Existing Deck				Does not apply to BR 1-759. If we replace the fascia girder, we need to remove enough of the deck for demo and erection. If we do not replace the fascia girder, then we do not need to replace the parapet.
e. Slip Form Parapets				Does not apply to BR 1-759 because the parapet requires formliners to reproduce the architectural treatment
f. Consider Partial Deck Replacement				There are no areas of the deck that have significant deterioration. TYLI engaged Siva Corrosion Services to evaluate the condition of the deck and they concluded that the defects are limited to the overlay and do not extend into the original deck.

VE Study Item	Option	Pros	Cons	Comments and Recommendations (in bold)
g. Replace Abutment Joint				<b>Abutment joints will be pushed off the deck and approach slabs will be replaced, consistent with recommendation in the preliminary plans.</b>
h. Eliminate Joints				Eliminating joints is not an option due to bridge skew and superstructure movements.
i. Avoid Bearing Replacement	1 - Replace all bearings with elastomeric bearings	<ul style="list-style-type: none"> <li>a. Reduce seismic vulnerability</li> <li>b. Replaces bearings that exhibit significant corrosion</li> <li>c. If the fascia girders are replaced, we can maintain bearing type consistency at each bearing line.</li> </ul>	<ul style="list-style-type: none"> <li>a. Highest cost</li> <li>b. Increased construction time. Need to rebuild all pedestals to make up height difference between steel bearings and elastomeric bearings</li> </ul>	Approximate cost to replace all bearings and pedestals is \$2,500,000.
	2 - Replace all expansion bearings	<ul style="list-style-type: none"> <li>a. The fixed bearings are generally in good condition and can be cleaned, painted and greased</li> <li>b. Replaces bearings that exhibit significant corrosion</li> <li>c. Approximate cost savings vs Option 1 is \$600,000.</li> <li>d. Approximate construction time savings vs Option 1 is 20 working days.</li> </ul>	<ul style="list-style-type: none"> <li>a. If we replace the fascia girders, we may need to detail a new steel fixed bearing to be consistent with the rest of the bearings in the line.</li> </ul>	<b>Replace all expansion bearings. Clean, paint, and grease existing fixed bearings.</b>
	3 - Reset rocker bearings	<ul style="list-style-type: none"> <li>a. Approximate cost savings vs Option 1 is \$1,000,000.</li> <li>b. Approximate construction time savings vs Option 1 is 50 working days.</li> <li>b. Pedestals will not need to be reconstructed. They only need to be repaired.</li> </ul>	<ul style="list-style-type: none"> <li>a. The rocker bearings exhibit significant corrosion</li> <li>b. Need to retrofit restraint system to prevent future walking of bearings</li> <li>c. Does not address seismic vulnerability</li> </ul>	
j. For Concrete Repairs, Eliminate Shallow Repairs				Will comply for substructure repairs. For the deck, the spec already addresses these shallow spall repair areas.