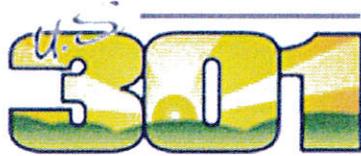


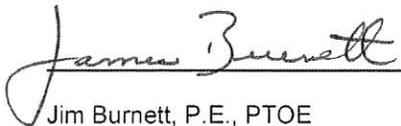
TRANSPORTATION MANAGEMENT PLAN



US ROUTE 301 – WORK ZONE



DELAWARE DEPARTMENT OF TRANSPORTATION
July 2015



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With January 2016 Revisions to Sections 1.1 and 3.2



Table of Contents

1.0 INTRODUCTION..... 1-1

1.1 TMP TEAM 1-1

1.2 TMP MONITORING..... 1-2

1.3 TMP UPDATES 1-2

1.4 RELATED DOCUMENTS 1-2

2.0 PROJECT DESCRIPTION..... 2-1

2.1 PROJECT BACKGROUND 2-1

2.2 PURPOSE AND NEED..... 2-1

2.3 PROJECT COMMITMENTS..... 2-1

2.4 DESIGN SECTIONS..... 2-2

2.5 PROPOSED CONSTRUCTION PHASING 2-2

2.5.1 Corridor wide Construction Phasing Approach..... 2-2

2.6 DESIGN SECTION 1 – CONSTRUCTION PHASING 2-4

2.6.1 Maintenance of Traffic (MOT) Considerations from the FEIS..... 2-4

2.6.2 Construction Phasing Approach 2-4

2.6.3 Construction Phasing Plans..... 2-19

2.7 DESIGN SECTION 2 – CONSTRUCTION PHASING 2-20

2.7.1 Maintenance of Traffic (MOT) Considerations from the FEIS..... 2-20

2.7.2 Construction Phasing Approach 2-20

2.7.3 Construction Phasing Plans..... 2-24

2.8 DESIGN SECTION 3 – CONSTRUCTION PHASING 2-25

2.8.1 Maintenance of Traffic (MOT) Considerations from the FEIS..... 2-25

2.8.2 Construction Phasing Approach 2-25

2.8.3 Construction Phasing Plans..... 2-29

2.9 OTHER AREA PROJECTS 2-29

3.0 EXISTING & CONSTRUCTION PERIOD CONDITIONS 3-1

3.1 CORRIDOR WIDE..... 3-1

3.1.1 Existing Roadway Conditions 3-1

3.1.2 Existing traffic conditions 3-1

3.1.3 Available Crash Data 3-2

3.1.4 Available Traffic Data..... 3-3

3.1.5 Hazard Elimination Program (HEP) and Locations..... 3-4

3.2 DESIGN SECTION 1 3-5

3.2.1 Crash History 3-6

3.2.2 Existing Traffic Conditions 3-7

3.2.3 Construction Period Traffic Conditions 3-9

3.3 DESIGN SECTION 2 3-37

3.3.1 Existing Roadway Characteristics..... 3-37

3.3.2 Crash History 3-38

3.3.3 Existing Traffic Conditions 3-42

3.3.4 Construction Period Traffic Conditions 3-43

3.4 DESIGN SECTION 3 3-53

3.4.1 Existing Roadway Characteristics..... 3-53

3.4.2 Crash History 3-54

3.4.3 Existing Traffic Conditions 3-56

3.4.4 Construction Period Traffic Conditions 3-57

4.0 WORK ZONE IMPACT ASSESSMENT 4-1

4.1 CORRIDORWIDE ASSESSMENTS..... 4-1

4.1.1 Movement of material or equipment along existing roadways..... 4-1

4.1.2 Work Zone Impact on roadways outside of the project area..... 4-1

4.1.3 Coordination between the Design Sections..... 4-1

4.1.4 Intersection Performance Assessment 4-1

4.2 DESIGN SECTION 1 – SR 1 TO EAST OF NORFOLK SOUTHERN RAILROAD 4-2

4.2.1 Introduction 4-2



	4.2.2	Work Zone Impact Assessment –	4-2
4.3		DESIGN SECTION 2 –EAST OF NORFOLK SOUTHERN RAILROAD TO NORTH OF LEVELS ROAD	4-13
	4.3.1	Introduction	4-13
	4.3.2	Work Zone Impact Assessment – Design Section 2	4-13
4.4		DESIGN SECTION 3 – NORTH OF LEVELS ROAD INTERCHANGE TO DELAWARE/MARYLAND STATELINE	4-21
	4.4.1	Introduction	4-21
	4.4.2	Work Zone Impact Assessment	4-21
5.0		WORK ZONE IMPACT MANAGEMENT STRATEGIES	5-3
5.1		CORRIDOR WIDE STRATEGIES	5-3
	5.1.1	Temporary Traffic Control Plan Strategies	5-3
	5.1.2	Transportation Operation Strategies	5-3
	5.1.3	Work Zone Impacts on Roadways Outside of the Project Area	5-4
	5.1.4	Public Information and Outreach Strategies	5-5
5.2		SECTION SPECIFIC STRATEGIES – DESIGN SECTION 1	5-7
	5.2.1	TRAFFIC CONTROL PLAN (TCP) STRATEGIES	5-7
	5.2.2	TRANSPORTATION OPERATIONS (TO) STRATEGIES	5-10
	5.2.3	PUBLIC INFORMATION (PI) AND OUTREACH STRATEGIES	5-11
5.3		SECTION SPECIFIC STRATEGIES – DESIGN SECTION 2	5-11
	5.3.1	TRAFFIC CONTROL PLAN (TCP) STRATEGIES	5-11
	5.3.2	TRANSPORTATION OPERATIONS (TO) STRATEGIES	5-14
	5.3.3	PUBLIC INFORMATION (PI) AND OUTREACH STRATEGIES	5-16
5.4		SECTION SPECIFIC STRATEGIES – DESIGN SECTION 3	5-17
	5.4.1	TRAFFIC CONTROL PLAN (TCP) STRATEGIES	5-17
	5.4.2	TRANSPORTATION OPERATIONS (TO) STRATEGIES	5-18
	5.4.3	PUBLIC INFORMATION (PI) AND OUTREACH STRATEGIES	5-19
6.0		TMP MONITORING REQUIREMENTS	6-1
6.1		INTRODUCTION	6-1
6.2		PROCESS FOR MONITORING TMP PERFORMANCE – CORRIDOR WIDE	6-1
	6.2.1	Work Zone Inspections	6-1
	6.2.2	Work Zone Crashes	6-1
	6.2.3	Signalized Intersections – Method of Verification	6-2
	6.2.4	Monitoring Requirements for SR 1, US 301, Boyds Corner Road, and other active long term detour routes	6-2
6.3		POST CONSTRUCTION REVIEW	6-2
6.4		DESIGN SECTION 1 – MONITORING REQUIREMENTS	6-3
	6.4.1	Monitoring Requirements:	6-3
6.5		DESIGN SECTION 2 – MONITORING REQUIREMENTS	6-5
	6.5.1	Monitoring Requirements:	6-5
6.6		DESIGN SECTION 3 – MONITORING REQUIREMENTS	6-7
	6.6.1	Monitoring Requirements:	6-7
7.0		CONTINGENCY PLAN	7-1
7.1		EMERGENCY RESPONSE PHONE TREE	7-1
7.2		INCIDENT RESPONSE PLAN	7-1



LIST OF TABLES

1.1	TMP Team	1-1
1.2	TMP Coordinators – SDC Members	1-2
2.1	Design Sections	2-2
2.2	Design and Construction Sections	2-3
2.6-1	Structure locations within Section 1	2-5
2.6-2	Section 1 – Construction Period Roadway Closure information	2-17
2.7-1	Section 2 – Construction Period Roadway Closure information	2-21
2.8.2-1	Section 3 – Construction Period Roadway Closure information	2-27
2.10	Construction Projects within US 301 Project Area	2-29
3.1	Summary of Crash Data	3-2
3.2	List of Available 2005 Traffic Counts	3-3
3.3	HEP/ HRRRP Locations	3-4
3.2.2.1	Section 1 – Crash Rate Comparison	3-7
3.2.2.2	Section 1 – Crash History by Manner of Impact	3-7
3.2.3.1	Section 1 – Existing Traffic Volumes	3-9
3.2.4.1	Hyetts Corner Road Closure and Detour (AM Peak)	3-11
3.2.4.2	Hyetts Corner Road Closure and Detour (PM Peak)	3-12
3.2.4.3	Boyds Corner Road Closure and Detour	3-14
3.2.4.4	Boyds Corner Road Flagging Operations and Temporary Closures	3-15
3.2.4.5	SR 1 Lane Closure Summary	3-19
3.2.4.6	US 13 Lane Closure Summary	3-20
3.2.4.7	US 13 at Port Penn Road Construction	3-23
3.2.4.8	SR 1 Closure Summary	3-24
3.2.4.9	Northbound SR 1 Closure and Detour	3-25
3.2.4.10	Southbound SR 1 Closure and Detour	3-26
3.2.4.11	Northbound and Southbound SR 1 Closure and Detour	3-28
3.2.4.12	Boyds Corner Road at SR 1 Ramps – Toll Revenue Analysis	3-30
3.2.4.12A	SR 1 Detour – User Cost Summary	3-32
3.2.4.12B	Anticipated Toll Revenue Losses during SR 1 detours	3-32
3.2.4.13	Northbound US 13 Closure and Detour	3-33
3.2.4.14	Southbound US 13 Closure and Detour	3-35
3.3.2.1	Section 2 – Crash History, Summary	3-39
3.3.2.2	Section 2 – Crash History, Manner of Impact	3-40
3.3.2.3	Section 2 – Accident Rate Comparison	3-41
3.3.4.1	Section 2 – Existing and Construction period traffic conditions (AM Peak)	3-45

3.3.4.2 Section 2 – Existing and Construction period traffic conditions (PM Peak)	3-48
3.3.4.3 Construction Period Queue lengths at Summit Bridge Road/ Marl Pit Road/ Armstrong Corner Road	3-52
3.4.2.1 Section 3 – Crash Data Analysis	3-55
3.4.2.2 Section 3 – Traffic Data Summary	3-57
4.3.2.1 HCM Analysis at Marl Pit Road/ US 13 intersection - Overnight Northbound Summit Bridge Road Detour	4-18
4.3.2.2 Queue Lengths at Marl Pit Road/ US 13 intersection – Overnight Summit Bridge Road Detour	4-19
4.3.2.3 Traffic Analysis – Summit Bridge Road/ Boyds Corner Road Intersection – Overnight Summit Bridge Road Detour	4-20
4.4.2.1 – Section 3 – AADT Capacity Analysis – NB US 301	4-25
4.4.2.2 – Section 3 – 2015 AM Peak Hour LOS Summary	4-27
4.4.2.3 – Section 3 – 2015 PM Peak Hour LOS Summary	4-28
4.4.2.4 – Section 3 – 2015 AM Peak Hour Queue Summary	4-29
4.4.2.5 – Section 3 – 2015 PM Peak Hour Queue Summary	4-30
5.1 Advance Notification	5-4
5.2.1.1 Section 1 – Traffic Control Devices	5-6
5.2.1.2 Section 1 – Project Coordination and Innovative Construction Strategies	5-8
5.3.1.1 Section 2 – Traffic Control Plan Strategies	5-11
5.3.1.2 Section 2 – Traffic Control Devices	5-12
5.3.1.3 Section 2 – Project Coordination Strategies	5-13
5.4.1.1 Section 3 – Traffic Control Plan Strategies	5-17
5.4.1.2 Section 3 – Traffic Control Devices	5-17
7.1 Emergency Response Phone Tree	7-3



LIST OF FIGURES

1.1 Project Area Overview	1-3
3.2.4.1 Boyds Corner Road Flagging Operations – Weekday Hourly Volumes	3-16
3.2.4.2 Boyds Corner Road Flagging Operations – Weekday Maximum Delays	3-16
3.2.4.3 Boyds Corner Road – 2 minute Closure – Weekday Maximum Delays	3-17
3.2.4.4 Boyds Corner Road – Flagging Operation with 30 second Closure	3-17
3.2.4.5 Jamison Corner Road – Weekday Hourly Volumes	3-18
3.2.4.6 SR 1 – Lane Closure Analysis	3-19
3.2.4.7 US 13 Lane Closure Analysis	3-21
3.2.4.8 US 13 at Free Ramp – Single Lane Capacity	3-21
3.2.4.9 NB SR 1 Off-Ramp at Boyds Corner Road Toll Booth (SR 1 NB detour)	3-30
3.2.4.10 SB SR 1 On-Ramp from Boyds Corner Road Toll Booth (SR 1 SB detour)	3-3
3.3.3.1 Seasonal Comparison of Existing US 301 Traffic Volumes	3-43

APPENDICES

- A. TMP Updates
- B. Crash Data (Provided Digitally)
 - I. Section 1
 - II. Section 2
 - III. Section 3
- C. Traffic Data Analyses (Provided Digitally)
 - I. Section 1
 - II. Section 2
 - III. Section 3
- D. Construction Phasing Plans (Provided Digitally)
 - I. Section 1
 - II. Section 2
 - III. Section 3

ACRONYMS

AADT – Average Annual Daily Traffic
DelDOT – Delaware Department of Transportation
MDSHA – Maryland State Highway Administration
GEC – General Engineering Consultant
HSIP – Highway Safety Improvement Program
MP – Milepost
SDC – Section Design Consultant
SR – State Route
TMP – Transportation Management Plan
vpd – vehicles per day





CHAPTER I INTRODUCTION





1.0 INTRODUCTION

The purpose of this Transportation Management Plan (TMP) is to provide for the mobility and safety needs of road users, construction workers, businesses, and the community in the areas impacted by the construction of US 301 and associated local roadway improvements, bridge construction and interchange construction. The Delaware Department of Transportation (DelDOT) *Work Zone Safety and Mobility – Procedures and Guidelines (Guidelines)* require the development of a project specific TMP for all “significant projects” in order to address the impacts associated with such projects. The US Route 301 project has been identified as a “significant project” and requires a “Type B” TMP per DelDOT’s *Guidelines*. While the majority of the construction work will occur on new alignment, the construction of the tie-ins with existing US 301 in Maryland and SR 1 in Delaware, as well as the construction of bridges over or on existing roadways, will require extensive work zone traffic control that may result in mobility and safety impacts for the traveling public.

This TMP lays out a set of strategies and describes how these strategies will be implemented to manage the work zone impacts of the project. The TMP includes a Traffic Control Plan (TCP), as well as Transportation Operations (TO) and Public Information (PI) strategies to address the work zone impacts of the project.

1.1 TMP TEAM

Many members from DelDOT, the US 301 General Engineering Consultant (GEC) team and the Section Design Consultant (SDC) teams have been involved in the development of the construction phasing and temporary traffic control aspects of the TMP. Table 1.1 lists the primary contacts for this TMP Team.

TABLE 1.1 TMP Team – Primary Contact Information				
Agency	Contact Person	Responsibility	Phone	e-mail
DeIDOT	Diane Gunn, P.E.	US 301 Project Manager	(302) 760-2323 (Dover) (320) 326-4487 (Canal District)	Diane.Gunn@state.de.us
DeIDOT	Adam Weiser	TMP Coordinator/ Safety Programs Manager	(302) 659-4073 (Office) (302) 222-5905 (Mobile)	Adam.Weiser@state.de.us
DeIDOT	Javier Torrijos, P.E.	Construction Coordinator	(302) 894-6329	Javier.Torrijos@state.de.us
DeIDOT	Marvin Pedigo	Canal District Traffic Safety Officer	(302) 222-5996	Marvin.Pedigo@state.de.us
DeIDOT	Gerald Nagyiski	Chief Safety Officer	(302)2225977	Gerald.Nagyiski@state.de.us
GEC	Amy Jackson, P.E.	TMP Coordinator	(410) 728-2900	ajackson@rkk.com



In addition, the following individuals with the SDC teams have been involved with the development of this TMP for each individual design section of the US 301 project:

TABLE 1.2 TMP Coordinators - Section Design Consultants				
Section	Design Consultant Team	TMP Coordinator	Phone	e-mail
1	Whitman, Requardt & Assoc. (with McCormick Taylor)	Jeff Cheng/ Bryan Townsend	410-235-3450	jcheng@wrallp.com / btownsend@wrallp.com
2	AECOM (with URS)	Don Blough / John Egger	215-735-0832	don.blough@aecom.com ; john.egger@aecom.com
3	Jacobs (with Pennoni)	Sean Hinze	267.234.9500	sean.hinze@jacobs.com

1.2 TMP MONITORING

As the US 301 project moves into construction, DeIDOT and the GEC will ensure that the TMP and its associated elements are implemented efficiently and appropriately. They will also make sure that all necessary personnel understand the standards and processes detailed in the TMP and related contract documents.

The development and updating of the US 301 Transportation Management Plan will be managed by the US 301 GEC and DeIDOT. As projects move to the construction phase, monitoring of the TMP components will be conducted by the US 301 GEC and DeIDOT’s Construction Managers as well as DeIDOT’s Traffic Safety Officer and the Transportation Management Center. The Contractor selected for the construction of each contract shall provide the contact information of the ATSSA Traffic Control Supervisor that will be responsible for working with the GEC and DeIDOT Construction Managers to implement and monitor the TMP. The monitoring teams will observe and assess the effectiveness of the phasing and staging plans and the TMP strategies. The monitoring teams will develop monitoring requirements to evaluate the successes and failures of the plan. Monitoring requirements that will be the responsibility of the construction contractor will be detailed on plans or in special provisions.

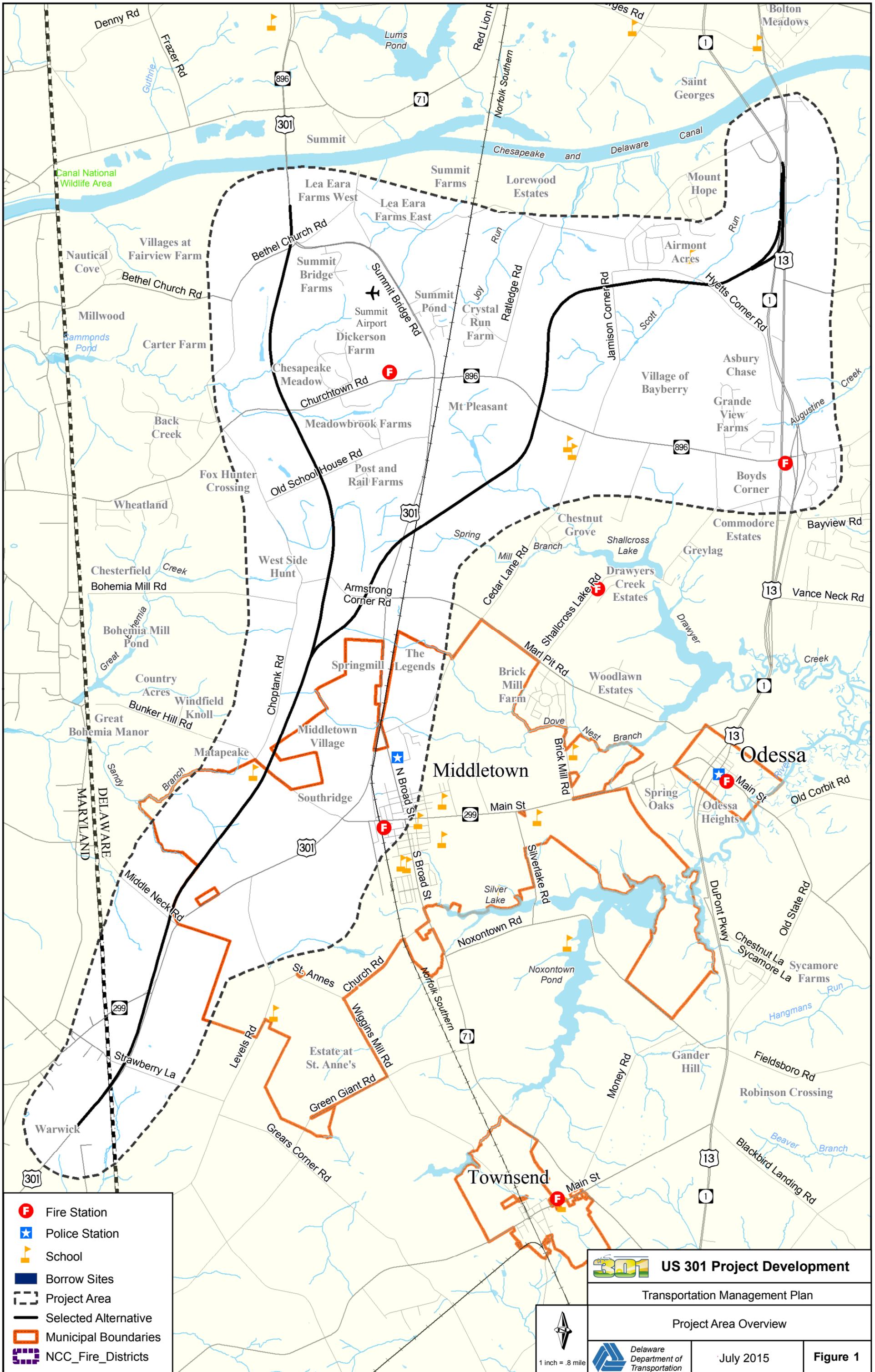
1.3 TMP UPDATES

This TMP is a “living document” that will evolve throughout the design and construction of the US 301 project. The US 301 GEC will maintain the “master” copy of the TMP. As updates to the TMP are made, new pages must be provided to the GEC (by SDCs or others) for insertion into the “master” copy of the TMP. Each new page will contain the current date at the bottom of the page and a memorandum describing the changes that will be implemented as a result of the update. The memorandum shall become part of the TMP and will be contained in Appendix A. Periodically; the GEC will provide the SDCs with updated versions of the entire TMP document.

1.4 RELATED DOCUMENTS

The following list of documents is related to the US 301 project, used in the development of the TMP and incorporated by reference:

- US 301 Final Environmental Impact Statement, November 2007
- US 301 Record of Decision, May, 2008 and all subsequent revisions
- US 301 Draft Travel Analysis Technical Report, December 2006
- US 301 Project Management Manual, May 2008 and all subsequent revisions
- US 301 Design Manual, November 2008 and all subsequent revisions



- F Fire Station
- ★ Police Station
- ▲ School
- Borrow Sites
- Project Area
- Selected Alternative
- Municipal Boundaries
- NCC_Fire_Districts

US 301 Project Development	
Transportation Management Plan	
Project Area Overview	
Delaware Department of Transportation	July 2015
Figure 1	

1 inch = .8 mile



CHAPTER 2 PROJECT DESCRIPTION





2.0 PROJECT DESCRIPTION

The US 301 project consists of the construction of a four-lane, divided, full access controlled, tolled highway between the Delaware/Maryland state line and Delaware State Route 1 (SR 1). In addition, the project includes the construction of a two-lane, divided, full access controlled Spur Road from the US 301 mainline in the Armstrong Corner Road area to the Summit Bridge (SR 896 over the C&D Canal).

Starting at the Delaware/Maryland state line, the new US 301 mainline will travel generally north, bypassing the Town of Middletown, west of existing US 301. In the vicinity of Armstrong Corner Road, the mainline alignment will continue northeast, crossing over existing US 301, the Norfolk Southern Railroad and existing SR 896 (Boyd's Corner Road) before tying into SR 1, north of the Biddles Corner Toll Plaza. The project also includes plans to realign the curve on existing US 301/SR 896 at the base of the Summit Bridge. The total length of the project is 17 miles including the Spur Road. The alignment consists of six interchanges and numerous bridges carrying the proposed roadway over existing features or carrying existing local roadways over the proposed highway. The project area is shown in Figure 1.

According to the current project schedule, construction of mainline US 301 is scheduled to start in 2016 whereas the Spur Road is scheduled to be constructed in 2019-2020. Given the time difference between the construction schedules between mainline US 301 and Spur Road, this TMP will concentrate only on mainline US 301, consisting of Sections 1, 2 and 3. The TMP for Section will be developed as a separate document at a later date.

2.1 PROJECT BACKGROUND

The US 301 Project has been under study for nearly 50 years. In 2004, in response to rapid growth in residential and commercial development in Southern New Castle County, south of the Chesapeake and Delaware Canal, DelDOT made a concerted effort to establish a final corridor for the project. Following three years of intensive research, study, planning, analysis, and public involvement, a Final Environmental Impact Statement (FEIS) and a Record of Decision (ROD) was approved by the Federal Highway Administration (FHWA) in November 2007 and April 2008 respectively, granting the project engineering and environmental approvals to proceed toward construction utilizing Federal Funds. These approvals enabled DelDOT to proceed to the design phase by selecting Section Design Consultants (SDCs) to perform the final design services on the four design segments of the Project, and a General Engineering Consultant (GEC) to coordinate and oversee the design and construction of the project.

2.2 PURPOSE AND NEED

The purpose of this project is to improve and enhance highway safety, manage truck traffic and address existing and projected traffic congestion in the US 301 corridor, while minimizing environmental impacts and accommodating existing and planned development. Substantial residential and commercial growth in the Southern New Castle County area, a steep increase in population in the past two decades, and an increased number of crashes, including a high percentage of fatalities, coupled with increasing regional and truck traffic, has generated the need to improve existing roads as well as a need for additional capacity through the construction of new facilities.

2.3 PROJECT COMMITMENTS

During the project development stage of the US 301 project, numerous public workshops and community meetings were conducted. During those workshops and meetings, several commitments to the public were identified. These commitments were documented in the Record of Decision and **must be adhered to during the construction of the new US 301**. Those commitments are as follows:

- A connection between Strawberry Lane and existing US 301 must be maintained.
- The following crossroads must remain open during construction:
 - Bunker Hill Road (Section 2)
 - Jamison Corner Road (Section 1)



2.4 DESIGN SECTIONS

The US 301 project is being delivered by means of a design-bid-build contracting method and has been divided into four design sections that are being designed by four separate consultant teams. The limits of each design section are included in Table 2.1. Each Section Design Consultant (SDC) developed the construction phasing, work zone impacts assessment, impact management strategies, and traffic control plans for their respective design section. Refer to the following section, Section 2.5.1, Corridor-Wide Construction Phasing, for additional details on how the limits of each section were determined.

Sections	Section Description	Mainline Miles	Road
1	SR 1 to East of Norfolk Southern Railroad	5.8	US 301
2	East of Norfolk Southern Railroad to North of Levels Road	4.2	US 301
3	North of Levels Road to DE/MD state line	3.0	US 301
4	US 301, Armstrong Corner Area to South of Summit Bridge	4.0	Spur Road

2.5 PROPOSED CONSTRUCTION PHASING

2.5.1 Corridor wide Construction Phasing Approach

The design and construction sections were determined primarily by construction contract size and the location of potential soil borrow sources. During the planning process, surveys were sent to local and area contractors asking them to express a construction contract size preference. The responses indicated that larger contracts were preferred.

In addition, several potential borrow sites were identified during the planning process that helped influence where contract limits could be located, with the intention of providing a separate borrow source for each contract.

The potential borrow sites were located at the Levels Road interchange, along Hyetts Corner Road near SR 1, and just east of Summit Airport along the Spur Road. Preliminary borrow quantities were estimated based on soil borings and compared to the amount of borrow material estimated for the overall project.

Design Section 1: The potential borrow site along Hyetts Corner Road was estimated to contain 1.4 million cubic yards of borrow. This borrow quantity allows for a construction contract extending south from SR 1 to the Norfolk Southern Railroad. Locating the section limit at the railroad also eliminated the need for a temporary grade crossing or flaggers to haul dirt across the active railroad during construction.

Design Sections 2 and 3: The largest borrow source was identified at Levels Road, providing in excess of three million cubic yards of borrow. Since a contract requiring such a large amount of borrow would be greater than the contract amount desired, it was determined that the Levels Road location could serve two separate contracts, as long as the contractors were not removing material at the same time. Therefore, the contract limit between Design Sections 2 and 3 was established such that both contractors could access the borrow site, and the construction schedule was developed so that there were no overlaps in activity at the borrow site.

The preliminary construction schedule currently proposes that Section 3 begin construction first, so that borrow material can be removed from the Levels Road site before Section 2 contractors begin construction. Section 1 construction will follow; since the borrow site is located on the northern end of the project, and borrow will be transported south of the proposed roadway corridor. The design for Section 4, the Spur Road, is lagging the other three sections and will likely be the last section constructed.

Detailed construction phasing for each of the design and construction sections will be discussed in Chapter 2.0 of the TMP. Chapter 4.0 will also include an assessment of the work zone impacts associated with the construction phasing schemes for each section of the US 301 project.



US 301 has been divided into the following separate construction contracts, each of which will be awarded through a low-bid process. The 9 contracts, with descriptions, are noted in Table 2.2.

TABLE 2.2 Design and Construction Sections	
Contract No.	Description
1A	US 301 Mainline: South of SR 896 to West of SR 1 + Jamison Corner Road Interchange, Utility Relocations at Hyetts Corner Road (29-113-08 / T200911308) (09-45698)
1B	US 301 Mainline: West of SR 1 to East of SR 1 (Flyover Bridge) + Relocated US 13 Ramp to NB SR 1 (29-113-02 / T200911302) (08-03012)
1C	US 301 Mainline: East of Norfolk Southern RR to South of SR 896 (29-113-01 / T200911301) (08-03011)
1D	US 13 Improvements – North and South of Port Penn Road + Relocated US 13 Ramp to NB SR 1 (30-113-02 / T201011302)
2A	US 301 Mainline: North of Levels Road to East of Norfolk Southern RR (29-113-03 / T200911303) (08-03013)
2B	Existing US 301, North of New US 301 Overpass to South of Armstrong Corner Road (30-113-01 / T201011301)
2D	US 301 Maintenance Facility
2E	Park-and-Ride Facility at Existing/New US 301 Interchange
3	US 301 Mainline, MD/DE Line to North of Levels Road (28-113-01 / T200811301) (08-03015)

2.6 DESIGN SECTION 1 – CONSTRUCTION PHASING

Section 1 consists of proposed US 301 from east of Norfolk Southern Railroad to east of SR 1. Section 1 is divided into 4 construction contracts:

- Contract 1A (T200911308) US 301, SR 896 to SR 1
- Contract 1B (T200911302) US 301 & SR 1 Interchange
- Contract 1C (T200911301) US 301, Norfolk Southern RR to SR 896
- Contract 1D (T201011302) US 13 & Port Penn Road Intersection

The limits of the construction contracts are as noted above in Table 2.2 – Design and Construction Sections. The limits of each construction contract within Section 1 were determined by the size and locations of the potential soil borrow sources, the desire to separate contracts by construction types (Contract 1B is mostly structural work versus mostly roadway work in Contracts 1A/C/D) and to reduce contract sizes so that more contractors, and possibly local contractors, would be able to compete for them.

2.6.1 Maintenance of Traffic (MOT) Considerations from the FEIS

During the project development process leading to the FEIS, the following MOT elements were considered for the construction of Design Section 1.

- SR 1 Flyover:
 - SDCs to determine the feasibility of erecting crane towers on shoulders of SR1. As design has progressed on BR1-3 (US 301 NB Flyover Bridge) the use of crane towers is no longer envisioned for girder erection. It is assumed that girders will be erected during nighttime closures of SR 1. Detour plans have been prepared for this detour.
- Boyds Corner Road:
 - Boyds Corner Road will remain open during construction, and flaggers will operate when necessary to move equipment across the roadway. This assumption remains throughout the development of the maintenance of traffic schemes.
 - Nighttime detours are required for beam erection
- Jamison Corner Road:
 - Jamison Corner Road must remain open during construction. This assumption remains throughout the development of the maintenance of traffic schemes.
 - A temporary runaround road is proposed, located just to the east of the existing roadway
- Hyetts Corner Road:
 - Hyetts Corner Road will be closed during construction once the Jamison Corner Road runaround road is complete and open to traffic. Traffic accessing St. Georges Technical High School will use Jamison Corner Road and Lorewood Grove Road.

2.6.2 Construction Phasing Approach

A narrative of the construction phasing and maintenance of traffic approach for each Section 1 contract has been provided and includes a description of major construction activities and impacts to traffic due to temporary traffic control. Brief descriptions of other construction phasing or maintenance of traffic approaches considered are also provided. References to specific construction phasing, MOT and erosion control plan sheets made throughout Section 2.6.2 refer to the plan set of the contract being discussed as sheet names are repeated in each contract. Traffic analysis supporting all proposed maintenance of traffic and time restrictions for specific maintenance of traffic activities discussed in Section 2.6.2 can be found in Chapter 4. Existing speed limits will be maintained on all roadways through all phases of each contract.

Total and phase by phase durations for each of the contracts are provided below. These durations are subject to revision pending completion of the CPM schedules. Any changes in traffic patterns related to each phase are expected to last for the same duration as the construction phase unless otherwise noted.

- Contract 1A Total Duration – 40 months
 - Phase 1 – 3 months
 - Phase 2 – 12 months
 - Phase 3 – 21 months (US 301 open at end of Phase 3)



- Phase 4 – 4 months
- Contract 1B Total Duration – 29 months
 - Phase 1 – 9 months
 - Phase 2 – 18 months, includes Phase 2A
 - Phase 2A – see above
 - Phase 3 – 2 months
 - Phase 4 – Temporary closure of US 301 until official opening
- Contract 1C Total Duration – 28 months
- Contract 1D Total Duration – 20 months
 - Phase 1 – 8 months, includes Phases 1A & 1B
 - Phase 1A – see above
 - Phase 1B – see above
 - Phase 2 – 12 months, includes Phase 2A & 2B
 - o Phase 2A – see above
 - o Phase 2B – see above
 - o Phase 3 – Temporary closure of Ramp R until opening by Contract 1B

Table 2.2A is a list of all of the structures within Section 1 and their respective contract, location, Section 1 structure designation and DeDOT structure maintenance number. For a graphical figure of all of the Section 1 structures refer to the structure location plans in each plan set.

TABLE 2.6-1 Structure Locations Within US 301 Section 1 Project Area				
Section 1 Structure Designation	DeDOT Structure Maintenance Number	Description	Contract	Location
BR1-1	BR1-903 S	SR 1 SB over Scott Run	1B	SR 1 Baseline Station 1810+00
RW1-1	-	Retaining Wall along SR 1 SB	1B	SR 1 Baseline Station 1809+00
BR1-2	BR1-432	US 301 NB over Scott Run	1B	US 301 Baseline Station 882+00
RW1-3	-	Retaining Wall along US 301 NB	1B	US 301 Baseline Station 862+73 through Station 872+00
RW1-3R	-	Retaining Wall along US 301 NB/ US 13 SB	1B	Ramp R Baseline Station 317+22 through US 301 Baseline Station 874+50
BR1-3	BR1-433	US 301 NB over SR 1	1B	US 301 Baseline Station 859+00
BR1-4	BR1-436	US 301 over tributary to Scott Run	1A	US 301 Baseline Station 830+00
BR1-5	BR1-436A	Hyetts Corner Road over US 301	1A	US 301 Baseline Station 816+25
BR1-6	BR1-458	Hyetts Corner Road over Scott Run	1A	Hyetts Corner Road Baseline Station 910+50



BR1-7 N&S	BR1-460 N&S	US 301 over Scott Run	1A	US 301 Baseline Station 808+00
BR1-8	BR1-460 A	Jamison Corner Road over US 301	1A	US 301 Baseline Station 769+50
WILDLIFE PASSAGE	-	US 301 over Wildlife Passage	1A	US 301 Baseline Station 695+30
BR1-9 N&S	BR1-466 N&S	US 301 over Boyds Corner Road	1A	US 301 Baseline Station 686+00
1-444A	BR1-444A	US 301 over unnamed tributary to Shallcross Lake	1C	US 301 Baseline Station 656+75
BR1-10 N&S	BR1-467 N&S	US 301 over Drawyer Creek	1C	US 301 Baseline Station 637+50
BR2-1	BR1-468	US 301 over Norfolk Southern Railroad	1C	US 301 Baseline Station 494+25

Contract 1A

Introduction

US 301 within the Contract 1A limits is entirely on new alignment located north of Contract 1C and south of Contract 1B. The south limit of the project is at Sta. 682+00 (paving limit), just south of SR 896 (Boyds Corner Road), and the north limit is at Sta. 848+00, south of SR 1. Included in the contract is construction of an interchange at US 301 and Jamison Corner Road and reconstruction of Hyetts Corner Road to cross over proposed US 301 and Scott Run. The contract includes construction of eight bridges and a wildlife passage. Also included is the construction of eight storm water management facilities and construction of two gated emergency access roads linking SR 896 to US 301 northbound and southbound.

The critical path component of construction for Contract 1A is the mass hauling operation. Soil borrow material must be hauled from two sites at the north end of the contract limits to the south, crossing Scott Run. For this operation a temporary haul road will be built using a portion of existing Hyetts Corner Road to avoid building a temporary stream crossing of Scott Run, which would have severe wetland impacts. Using this approach, Hyetts Corner Road will need to be closed to regular traffic and detoured since the existing roadway pavement is not adequate to handle the anticipated larger off-road hauling truck traffic, rendering it impassable by regular motor vehicles. Another advantage to closing Hyetts Corner Road to regular traffic is that it will not need to be maintained simultaneously with hauling traffic, which reduces potential for construction vehicle conflicts with the traveling public. Also, mainline grading will require removal of existing Hyetts Corner Road as the proposed ground surface is 16' lower than the existing roadway surface and the footprints of Bridges 1-5 and 1-6 will impact the existing roadway.

In closing Hyetts Corner Road for hauling, traffic will need to be detoured onto Jamison Corner Road where a temporary runaround road is proposed to the east of the existing alignment. Two main reasons for constructing a temporary run-around road is that existing Jamison Corner Road is not adequate for the bus traffic associated with St. Georges Technical High School and widening or re-constructing Jamison Corner Road on its existing alignment is not feasible due to the construction activities associated with raising Jamison Corner Road and building Bridge 1-8 which carries Jamison Corner Road over proposed US 301. Two projects are also proposed by DeIDOT which will make improvements to Jamison Corner Road north and south of Contract 1A limits: Jamison Corner Road from Boyds Corner Road to Hyetts Corner Road (T200712003), and N412A from Hyetts Corner Road to Lorewood Grove Road (T200912001). These projects, which are scheduled for construction in 2012, must be completed prior to Contract 1A construction to provide access to St. Georges Technical High School and for local access via



Jamison Corner Road on the west side of Hyetts Corner Road. After construction of the adjacent projects and the temporary run-around road, Jamison Corner Road will provide better operations during construction than maintaining traffic on existing Hyetts Corner Road.

Proposed Phasing

Construction Phasing for Contract 1A is divided into four phases. Phase 1 includes construction of the temporary run-around road, the earth berm between the Airmont Neighborhood and proposed US 301, and two of the storm water management facilities. Early construction of the earth berm was a commitment made to the community to alleviate disturbances of the nearby construction. Refer to plan sheets CS-04 - CS-05.

Phase 2 begins when the temporary run-around road is opened to traffic and Hyetts Corner Road is detoured to Jamison Corner Road. This detour will remain in place for the remainder of construction. At this time the temporary haul road which utilizes a portion of existing Hyetts Corner Road can be built and mass hauling and rough grading for embankment can begin. The construction of several structures is started including Bridge No. 1-4 (US 301 over a Scott Run tributary), Bridge No. 1-5 (Hyetts Corner Road over US 301), Bridge Nos. 1-7N and 1-7S (US 301 over Scott Run), Bridge No. 1-8 (Jamison Corner Road over US 301), Bridge Nos. 1-9N and 1-9S (US 301 over SR 896) and the wildlife passage. Other construction activities include construction of ultimate Jamison Corner Road, grading for US 301 between Jamison Corner Road and the northern project limit and construction of the remaining storm water management facilities. Refer to plan sheets CS-06 - CS-07. When construction of Bridge No. 1-8 and ultimate Jamison Corner Road is completed they can be opened to traffic and construction can move into Phase 3.

Hyetts Corner Road will be closed at the beginning of Phase 2 through Phase 4 construction to accommodate soil borrow hauling and reconstruction of the roadway on existing alignment. While closed, access will be maintained for local traffic and to St. Georges Technical High School. Traffic will be detoured to Jamison Corner Road as described above. The roadway closure will cause increased travel times for Hyetts Corner Road traffic but an overall improved route will be provided along the temporary run-around road and future Jamison Corner Road. Refer to the Hyetts Corner Road at Scott Run Detour Plan.

During Phase 3, the hauling operation continues with the focus of moving material and completing grading for the areas south of Jamison Corner Road to the Contract 1A southern limit. Construction also continues for the structures noted in Phase 2, with the exception of Bridge No. 1-8 which is complete. Jamison Corner Road will be opened to traffic and the temporary run-around road will be removed allowing for completion of grading for US 301, Ramp M and Ramp P. Lastly, fine grading, paving and the roadway is completed for all of US 301 and the interchange ramps with Jamison Corner Road. Refer to plan sheets CS-08 - CS-09.

Following completion of paving and all US 301 mainline structures in Phase 3, the contractor can move into Phase 4. Phase 4 construction activities include construction of Bridge No. 1-6 (Hyetts Corner Road over Scott Run), re-aligned Hyetts Corner Road and final grading for the soil borrow sites. US 301 and the Jamison Corner Road interchange could be opened to traffic during this phase pending coordination with other mainline US 301 contracts. Upon completion of Phase 4 Hyetts Corner Road can be opened to traffic and the contract is complete. Refer to plan sheets CS-10.

At the completion of construction the contractor will be required to install temporary traffic control devices to close and prevent access to US 301. These temporary traffic control devices will be removed by the Contract 2C contractor when the US 301 roadway is officially opened.

Maintenance of Traffic Summary

Since US 301 within Contract 1A is entirely on new alignment, maintenance of traffic is only needed where US 301 crosses existing roadways, which includes SR 896, Jamison Corner Road and Hyetts Corner Road.

Maintenance of traffic for Hyetts Corner Road consists of a detour which will begin 3 months after construction is started and last for the remainder of construction. The detour route will utilize US 13, Boyds Corner Road and Jamison Corner Road.

SR 896 is a two-lane two-way roadway with full shoulders on both sides. During construction of Bridge Nos. 1-9N and 1-9S (US 301 bridges over SR 896) temporary concrete barrier will be installed along SR 896. Barrier will be set at the edges of travel lane in both directions, closing the shoulders for approximately 400 feet, to create a work area. The shoulder closures will have minimal impact on traffic passing through the work area. The bridge

substructure (piles, abutments, wing walls and footers) can be constructed under the SR 896 shoulder closures. A detour during night time hours is proposed to erect the girders over SR 896. All construction activities along SR 896 will need to be coordinated with the Contract 2B contractor as SR 896 is used as part of a detour route for construction of the US 301 bridges over existing US 301 in that contract. This coordination must ensure that these closures do not overlap since a SR 896 closure would require US 301 to be open and vice-versa. Section 2 will not be able to have lane closures during times that SR 896 is closed for steel erection. Shoulder closures along SR 896 are expected to last throughout Phases 1, 2 and 3.

While shielding is installed for construction of the rest of the superstructure one half of SR 896 will need to be closed at a time so that vehicles are not traveling under the work area. This will be accomplished with a flagging operation and will allow for the closed portion of the roadway to be switched between the north and south sides of SR 896 as needed for construction. Flagging operations for this work will be completed during weekday off-peak travel times to minimize impact to traffic and may be used periodically by the contractor through Phases 1, 2 and 3. Maintenance of traffic along SR 896 will need to be coordinated between the Contract 1A contractor and the Contract 1C contractor who will be accessing the Contract 1C work site from this location.

Jamison Corner Road is a two-lane, two-way roadway with shoulders in some areas and no shoulders at others. Maintenance of traffic along Jamison Corner Road and the temporary run-around road during Phases 1 through 3 consists of shoulder closures for construction of the various tie-ins to the existing, proposed and temporary roadway. Impacts to traffic should be minimized since only shoulder closures will be implemented and two-lane two-way travel will always be maintained.

Another construction activity which requires maintenance of traffic is the crossing of SR 896 and the Jamison Corner Road temporary run-around by construction vehicles during material hauling. The temporary haul road will intersect these roadways at grade where stabilized construction entrances will be installed on each side of the roadway. Flaggers will be used to control traffic when a construction vehicle is crossing. The flagging operations shall be limited to off-peak travel times to minimize delay to traffic. Hauling across SR 896 is expected to last through Phases 2 and 3. During Phases 3 and 4 there will be no at-grade crossing at Jamison Corner Road; material will be hauled under Bridge No. 1-8, the new Jamison Corner Road over US 301.

Phasing Options Considered

Several other options were considered for maintenance of traffic. One was to alternately close Jamison Corner Road and Hyetts Corner Road by detouring traffic from one roadway to the other during its closure. This was not a viable option since the FEIS (Section II, pg. 6) ruled out any closure of Jamison Corner Road. Not being able to close Jamison Corner Road and the on-alignment construction of proposed Jamison Corner Road were the driving factors in needing to construct the temporary run-around road. Another option considered was to keep Hyetts Corner Road open during construction. This would have required providing a temporary haul road with a wetland crossing and a temporary run-around road bypassing Hyetts Corner Road. It is felt that due to the cost and impacts of this option, a road closure as is proposed is the best option. Although the FEIS (Section II, pg. 6) made a commitment to keep Hyetts Corner Road open, early discussions among the project team resulted in the agreement to close Hyetts Corner Road as an acceptable approach for construction, for the reasons noted above. The only other likely option that could have been considered for construction was a long-term closure of SR 896 at the south end of the project to ease bridge construction and material hauling; however, a long-term closure of this roadway was also precluded by the FEIS.

The phasing option presented is mostly determined by the maintenance of traffic approach. Keeping Jamison Corner Road open and closing Hyetts Corner Road requires certain sequential construction activities such as construction of the temporary run-around road, construction of Bridge 1-8 (Jamison Corner Road over US 301) and construction of proposed Jamison Corner Road. Large scale operations such as hauling borrow and grading have been divided into sections, specifically north and south of Jamison Corner Road, to facilitate earlier construction for a majority of the structures and as a logical progression of work. After completing key sequential and large scale construction activities the contractor will have the ability to work over a large area to complete structural and roadway construction work. Reconstruction of Hyetts Corner Road must occur last since all other contract wide construction is dependent on Hyetts Corner Road being closed for hauling.



Contract 1B

Introduction

Contract 1B is at the northern end of Section 1, and is the proposed northern terminus of US 301. It extends from south of SR 1 to the SR 1 interchange and includes the construction of US 301 ramps from SR 1 southbound and to SR 1 northbound; realignment of US 13 and a portion of the relocation of the US 13 ramp to SR 1 northbound (Ramp R – “Free Ramp”). Structural work included in this contract consists of Bridge No. 1-3 (US 301 northbound over SR 1); widening of Bridge No. 1-1 (SR 1 southbound over Scott Run); construction of Bridge No. 1-2 (US 301 northbound over Scott Run); two retaining walls for the US 301 northbound and Ramp R roadways; and one retaining wall along SR 1 southbound. Major drainage work includes construction of a storm water management facility.

Proposed Phasing & Maintenance of Traffic

There are three major construction phases for Contract 1B with one phase requiring a sub-phase. Maintenance of traffic will require several traffic pattern changes and includes shoulder closures and lane shifts. SR 1 in the project area is a six lane divided freeway with three northbound and three southbound lanes. All six lanes will be maintained throughout construction with the exception of lane closures for miscellaneous items (signing, striping, maintenance of traffic set-up, etc.) and detours needed for various construction activities associated with Bridge 1-3. US 13 is a four lane divided highway with two lanes each in the northbound and southbound directions. Two lanes in each direction of US 13 will be maintained at all times.

US 13 through Contract 1B's limits is a designated bike route. Typically bikes are able to use the shoulders when traveling along US 13. Proposed construction requires that the shoulders be reduced or eliminated during construction. Four foot bike lanes have been provided in place of the open shoulder to maintain bike traffic; however, their use during construction will be considerably more dangerous when adjacent to temporary concrete barrier and high speed traffic. As a safety precaution, a bike detour is proposed throughout all of Contract 1B construction. The bikes lanes will be in place for bicyclists who ignore the detour or are traveling to a location within the work zone. The US 13 bike detour will use Lorewood Grove Road westbound, Jamison Corner Road southbound and Boyds Corner Road eastbound back to US 13. Refer to plan sheet DP-04.

Phase 1

In Phase 1, a shoulder closure with temporary concrete barrier is proposed along the west side of SR 1 southbound beginning south of the SR 1 southbound exit ramp to Lorewood Grove Road and extending into the Biddles Corner Toll Plaza area. The temporary concrete barrier will be placed to allow for a five foot deflection zone from the back face of the barrier to the active construction area. In providing the buffer behind the barrier the existing three SR 1 southbound travel lanes must be shifted east, onto the median shoulder. The travel lanes remain shifted approaching the toll plaza area before tying into the existing travel lanes. Refer to plan sheets CS-103, CS-104, CS-106 – CS-111, and CS-113.

Temporary concrete barrier is generally placed to provide a deflection zone as described for SR 1 southbound throughout Contract 1B where possible. At times the deflection zone must be reduced to a minimum of 3 feet so that adequate roadway remains for vehicle and bicycle traffic use. In rare occurrences a deflection zone cannot be provided; these areas are discussed further below.

A critical early construction item is the relocation of the existing DeIDOT ITMS fiber optic trunk line located along the SR 1 southbound right shoulder. This trunk line carries three fiber optic cables linking the northern part of the state to the TMC to the south. These lines must be relocated early so that service remains uninterrupted during construction of the outside widening of SR 1 southbound for the US 301 exit ramp (Ramp Q).

Items constructed during Phase 1 along SR 1 southbound include widening of SR 1 southbound for ramp Q to US 301 southbound; widening of Bridge No. 1-1 (SR 1 southbound over Scott Run); construction of the US 301 roadway south of SR 1; construction of the south substructure of Bridge No. 1-3 (US 301 northbound over SR 1); and construction of the storm water management facility.

A shoulder closure along the east side (right shoulder) of SR 1 northbound is also established with the placement of temporary concrete barrier. This barrier run begins on the north side of the toll plaza and extends 2000 feet north and allows for construction of the north substructure of Bridge No. 1-3 and preliminary grading for the US

301 northbound and Ramp R roadways. A lane shift for the SR 1 northbound travel lanes is required to provide this work area. In restriping SR 1 northbound for the lane shift it was decided to restripe in the ultimate lane configuration consisting of one receiving lane for the general purpose (Cash) toll plaza and two receiving lanes for the high speed E-ZPass lanes. Traffic analysis supports this configuration in the ultimate conditions and it should help alleviate impacts during construction. Beyond the merging area of the general purpose and high speed E-ZPass lanes, the temporary concrete barrier run ends and the travel lanes are shifted back to the east to tie into the existing three travel lanes. The existing SR 1 northbound on-ramp from US 13 will be maintained on existing alignment during this phase. Refer to plan sheets CS-104, CS-106, CS-112 and CS-113.

A bridge pier and straddle bent pier columns for Bridge 1-3 are proposed in the median of SR 1 which requires the installation of temporary concrete barrier along the left sides of SR 1 northbound and southbound to close the shoulders during Phase 1. These segments of barrier will require shifting SR 1 southbound traffic west and SR 1 northbound traffic east into the gore areas between the high speed E-ZPass lanes and general purpose toll plaza lanes (see plan sheets CS-103, CS-104, CS-106, CS-112 and CS-113). Further north, temporary concrete barrier is also placed along the SR 1 median to provide a work area for construction of temporary widening that is needed during Phase 2. In the southbound direction this run of barrier is set on the far outside of the existing shoulder and does not impact the temporary travel lanes that use the existing shoulder. In the northbound direction the barrier is set 1 foot offset left of the existing edge of travel lanes. Refer to plan sheets CS-107 – CS-110.

Maintenance of traffic is also needed along US 13 during Phase 1. In the ultimate condition, US 13 southbound must be realigned so that US 301 northbound and Ramp R can be accommodated between SR 1 and US 13. This will be achieved by widening into the existing US 13 median and permanently shifting US 13 southbound to the east. Temporary concrete barrier will be placed along the US 13 southbound median to provide a work area for the median construction and both southbound travel lanes will be shifted west, using a portion of the existing shoulder. A shoulder closure with temporary concrete barrier will be used along US 13 northbound for the median construction with both existing travel lanes remaining open. Barrier will also be placed along a portion of the US 13 southbound shoulder at the south end of the project to provide a work area for preliminary grading that needs to occur between SR 1 and US 13. Refer to plan sheets CS-104, CS-106 – CS-108 and CS-112.

The construction of the median widening along US 13 southbound is the critical path step for Phase 1. Once this widening is completed construction can move into Phase 2 where the majority of construction will occur. In Phase 2 work areas are sufficient so that all structure and drainage components of the contract can be worked on and the greater part of the roadway construction can occur.

Phase 2

Moving into Phase 2, US 13 southbound traffic will be shifted east onto the newly constructed median widening allowing for construction of the retaining walls for the US 301 northbound and Ramp R roadway. The temporary concrete barrier that was installed along the median side of US 13 southbound in Phase 1 will be relocated to the west side to provide a work area. The temporary concrete barrier will be positioned to provide a 3 foot deflection zone so that two southbound travel lanes and a bike lane can be maintained. The shoulder closure installed along US 13 northbound in Phase 1 will be removed and traffic returned to existing conditions. Refer to plan sheets CS-203, CS-205 – CS-207 and CS-211.

The temporary concrete barrier previously installed along SR 1 southbound will remain in place and all Phase 1 construction activities will continue in Phase 2 including SR 1 southbound widening, Bridge No. 1-1 widening and Bridge No. 1-3 construction (see plan sheets CS-202, CS-203, CS-205 – CS-209 and CS-212). Temporary concrete barrier installed in Phase 1 along the right side of SR 1 northbound will also remain in place and Phase 1 construction activities can continue (see plan sheets CS-203, CS-205-CS-209 and CS-211 – CS-212). An extension will be made to this run of barrier to provide additional work area for the construction of the US 301 northbound retaining walls and roadway. This extension of barrier will also provide a work area for Bridge No. 1-2 (US 301 northbound over Scott Run) and the US 301 northbound tie-in with SR 1 northbound. Prior to the construction area of the tie-in the SR 1 northbound travel lanes will be shifted west, utilizing the temporary pavement installed in the median during Phase 1 and the existing northbound left shoulder. Three travel lanes will be maintained in this configuration (see plan sheets CS-205 – CS-209). Shifting of traffic and temporary concrete barrier is also needed along the SR 1 northbound on-ramp from US 13 for construction of the tie-in. Traffic will be shifted east onto the shoulder of the existing ramp. A five foot deflection zone behind the barrier along this ramp has not been provided since traffic is traveling at much lower speeds and doing so would require extensive



temporary widening and grading with a significant cost. Ramp traffic is shifted back to the existing acceleration lane prior to the Roth Bridge and the existing acceleration lane length is maintained. The shift along the ramp is expected to last for several months of Phase 2 (see plan sheets CS-207 – CS-209).

Construction of the bridge piers in the median of SR 1 for Bridge No. 1-3 will continue in Phase 2 and temporary traffic control devices will remain in place in this area (see plan sheets CS-202, CS-203, CS-211 and CS-212). Further north, barrier installed along the SR 1 northbound median for construction of temporary widening will be removed so that traffic can be shifted onto the temporary widening. Temporary concrete barrier installed along SR 1 southbound in this area will remain to provide protection between opposing northbound and southbound SR 1 traffic (see plans sheets CS-206 – CS-209).

A sub-phase, 2A, is proposed during Phase 2 and is needed so that the existing SR 1 northbound on-ramp from US 13 can remain open during construction of the US 301 northbound to SR 1 northbound tie-in. In the main Phase 2, ramp traffic was shifted east onto the existing shoulder. During Sub-Phase 2A ramp traffic is shifted west onto portions of newly built US 301 northbound and existing SR 1 northbound, allowing for construction of the remainder of the tie-in. During this sub-phase, all Phase 2 construction activities occurring elsewhere may continue. Refer to plan sheets CS-2A01 – CS-2A03.

Phase 3

When all of the drainage, structure and roadway construction is completed for US 301 and Ramp R, the contractor can open Ramp R and move into Phase 3. Opening of Ramp will need to be coordinated with Contract 1D which includes constructing a portion of Ramp R as well as reconstruction of the US 13 and Port Penn Road intersection to include a left-turn lane which will feed Ramp R. The projected construction schedule for Contract 1D indicates completion before Contract 1B, so opening of Ramp R should be dependent on the Contract 1B contractor only.

During Phase 3, the existing SR 1 northbound on-ramp from US 13 will be removed and the existing left-turn lane from US 13 northbound feeding the ramp will be shortened to permit u-turns in the ultimate condition. US 13 northbound traffic must be shifted east onto the existing shoulder with temporary concrete barrier installed left of the travel lanes for the northbound left-turn lane shortening. Two northbound travel lanes will be maintained with bikes using the remaining shoulder (see plan sheets CS-303 – CS-305). Along US 13 southbound, traffic will be shifted east towards the median with temporary concrete barrier set along the right shoulder for removal of the existing ramp and some roadway and barrier construction that could not be completed in Phase 2 due to space constraints (see plan sheets CS-301 – CS-307). Two travel lanes and a bike lane will be maintained. Temporary concrete barrier will also be needed along the US 301 northbound shoulder for removal of the existing ramp (see plan sheets CS-305 – CS-306).

In the SR 1 median, temporary pavement installed in Phase 1 and used in Phase 2 will be removed and two sign structures will be installed. Temporary concrete barrier will be installed along both northbound and southbound median shoulders. No lane shift will be needed along SR 1 and traffic will be traveling in the ultimate lane configuration (see plan sheets CS-303 – CS-308). As a last order of work for Phase 3, US 13 will be resurfaced and the final paving surface will be applied using typical applications from the Delaware MUTCD.

Phase 4

At the completion of construction the contractor will be required to install temporary traffic control devices to close and prevent access to US 301. These temporary traffic control devices will be removed by the Contract 2C contractor when the US 301 roadway is officially opened.

Sign Structure Construction

Several sign structures are located outside the roadway construction limits. Plans have been provided for maintenance of traffic during construction of these sign structures which includes shoulder closures and lane shifts. Construction of these sign structures can be completed at any time and are not tied to the other construction activities described above. Refer to plan sheets CS-309 – CS-311. Other sign structures are located within the roadway construction limits and work areas for their construction have been included with the roadway construction. Erection of sign structure trusses over the SR 1 roadway will require 15 minute rolling road block closures. It is unlikely that construction of the sign structures will be timed so that the trusses can be erected during the night time detours of SR 1 for construction of Bridge 1-3 as the bridge construction will occur relatively early in the schedule being a critical path item and sign structures will likely occur later.

Detours

For erection of the bridge girders and straddle bents for Bridge No. 1-3 (US 301 northbound over SR 1) SR 1 northbound and southbound will need to be detoured at various times independently and concurrently. Detours are required so that the roadway can be used to provide a staging area for the beams themselves and for the large truck mounted cranes that will be used to lift them into place. It is anticipated that 2 cranes will be needed for each beam. The outriggers on the truck mounted cranes will extend far beyond the foot print of the truck and will block the travel lanes. Staging the cranes off of the roadway is not possible due to geometrics of the work zone, skew in the bridge and splice locations of the beams. Some beam sections will span over portions of the northbound and southbound roadway. Both directions of SR 1 will need to be closed when setting these beams to accommodate the staging requirements previously noted. Detour routes have been provided on the plans which utilize US 13, Lorewood Grove Road and Boyds Corner Road. Refer to plan sheets DP-01 – DP-04. These detours will be implemented on a nightly basis during Phase 2 as needed for bridge work and the roadway will be re-opened during daytime hours. For other bridge construction activities structural falsework will be used so that travel lanes can remain open during construction. It is anticipated that only large truck mounted cranes will be used for construction of Bridge No. 1-3, eliminating the need for consideration of the use of tower cranes, as identified in the FEIS.

Phasing Options Considered

Several other maintenance of traffic options were considered throughout the various phases of construction. One option was to reduce SR 1 northbound from three to two travel lanes during Phase 2. Under this scenario temporary widening in the SR 1 median would not be needed. However, it was decided that the additional capacity provided by a third travel lane would improve traffic operations during construction as vehicles typically slow down and drivers become disrupted when traveling through work zones.

One other option considered was to close the existing SR 1 northbound on-ramp from US 13. This would eliminate the need for Sub-phase 2A for construction of the US 301 northbound tie-in to SR 1 and would greatly reduce the work that needs to occur in Phase 3. A closure of this ramp would cause more vehicles to access SR 1 south of the project area and pay a toll, forcing them to travel through the work zone or would cause them to continue on US 13 northbound, accessing SR 1 north of the project area where capacity problems would be encountered. With these impacts considered, it was decided to keep the ramp open throughout construction and include a sub-phase.

Options to phase the various steps of construction differently from what is proposed are limited. As described above, the widening of US 13 southbound so that traffic can be permanently shifted is critical for construction of the US 301 northbound roadway between SR 1 and US 13 and associated structures. This widening needs to occur first so that construction of the structures, which constitutes the majority of work, can begin. In Phase 2, construction can essentially occur over all proposed parts of the project and specific phasing is not needed, with the exception of the sub-phase needed for construction of the US 301 northbound tie-in with SR 1. Phase 3 of the project is essentially a “clean-up” phase where existing and temporary roadways that are no longer needed are removed and several minor construction activities occur. Keeping the existing ramp from US 13 to SR 1 northbound open during construction is the main factor requiring this work to occur last once the new Ramp R connection is open traffic.

Maintenance of Traffic Summary

Traffic will be impacted during construction of Contract 1B. Shoulder closures, lane shifts, reduced lane widths and long work zones are necessary for construction. These aspects tend to cause disruption to motorists traveling through a work zone. To minimize these impacts existing travel lanes are maintained throughout the maintenance of traffic phases. Detours needed for SR 1 will be made during night time hours when traffic volumes are lowest to minimize impact.

Contract 1C

Introduction

US 301 within Contract 1C limits is entirely on new alignment and is the southernmost contract in Section 1. The contract begins at the north abutments of Bridges 2-1N and 2-1S (US 301 bridges over Norfolk Southern Railroad) at Sta. 594+50 and extends to just south of SR 896 (Boyds Corner Road) at Sta. 682+00 (paving limit). Included



in this section is the complete construction of Bridge Nos. 1-10N and 1-10S (US 301 over Drawyer Creek) and portions of Bridge Nos. 2-1N and 2-1S (US 301 over Norfolk Southern Railroad). The northern pile foundations, pile caps and MSE wall abutments of Bridge Nos. 2-1N and 2-1S will be built in Contract 1C. Four storm water management facilities are proposed and one stream will be permanently diverted.

Maintenance of Traffic and Phasing Summary

Since Contract 1C is on new alignment major phase changes are not needed during construction and maintenance of traffic is limited to SR 896 (Boyds Corner Road). It is anticipated that construction will progress through the following major construction tasks. First clearing and grubbing will occur with construction of a temporary access road which generally runs along the US 301 alignment. Following construction of the temporary access road, construction of the storm water management facilities and several crossroad pipes spanning all of US 301 will be started. Once completed, grading, excavation and embankment, construction of the bridges and the remaining drainage components will take place. Several areas for stockpiling of materials for these tasks are identified on the plans (see plan sheets CS-07, CS-11, CS-13 and CS-14). Lastly, roadway construction will occur followed by installation of traffic control devices. Construction of Bridge Nos. 2-1N and 2-1S north abutments are the critical path item in this contract and must occur as early as possible so that the Contract 2B contractor can complete construction of the bridges.

The major tasks identified above will most likely be completed in sections by the Contractor. The plans identify four major sections which allow the Contractor to work from north to south. The sections are approximately 2,700 feet (Sta. 659+00 to 686+00), 2,150 feet (Sta. 637+50 to Sta. 659+00), 3,250 feet (Sta. 605+00 to Sta. 637+50) and 1,050 feet (Sta. 594+50 to Sta. 605+00) in length.

Maintenance of Traffic is limited to SR 896 (Boyds Corner Road) where access to the work zone will be made. Flaggers will be utilized as needed to control SR 896 traffic while construction vehicles enter and exit the construction site and impacts to traffic should be minimal. Work zone access and maintenance of traffic will need to be coordinated with the Contract 1A contractor who will be constructing Bridge Nos. 1-9N and 1-9S (US 301 bridges over SR 896) in this area. Construction near the US 301 over Norfolk Southern Railroad Bridge (Bridge Nos. 2-1N and 2-1S) will not require maintenance of railroad traffic or any special considerations by the Contract 1C contractor. Construction of the bridges' superstructures will be completed under Contract 2B and scheduling with the railroad will be the responsibility of that contractor.

Phasing Options Considered

Since Contract 1C is entirely on new alignment the contractor has the ability to work without restrictions and other phasing or maintenance of traffic options were not considered. However, it is anticipated that the contractor will complete the work in sections as described above due to scheduling, work crew availability and as a logical progression of the work.

Contract 1D

Introduction

Contract 1D is a logical break-out project from Contract 1B since the majority of the work occurs along US 13 and all work is roadway related without structures. The SR 1 northbound on-ramp from US 13 (Ramp R – “Free Ramp”) is proposed to be relocated south to become the west leg of the US 13 and Port Penn Road intersection. Contract 1D completes the ramp relocation and major construction components include a mountable curb separated left-turn lane for the heavy US 13 northbound to SR 1 northbound movement, reconstruction of the intersection to include dedicated turning lanes for other intersection movements, relocation of the Biddles Corner Toll Plaza Administration Building entrance, widening for an additional southbound travel lane, construction of a portion of Ramp R, improvements along Port Penn Road and a new traffic signal. The limits of construction along US 13 extend from approximately 5,000 feet south to 1,250 north of the US 13 and Port Penn Road Intersection. The limits along Port Penn Road extend 1,000 feet east of the US 13 intersection.

Bicycle traffic is currently able to use the US 13 shoulders through the limits of Contract 1D. As noted above, a bicycle detour is proposed in Contract 1B for the duration of that contract. The Contract 1B bicycle detour will affectively detour bicycle traffic around the Contract 1D work zone for the duration of Contract 1D as well. Space

has still been provided for bike lanes as noted for Contract 1B and below in the event that a bicyclist ignores the detour or is trying to access an area within the work zone.

Proposed Phasing

There are three major construction phases for Contract 1D with several sub-phases. Maintenance of traffic throughout each construction phase will require several traffic pattern changes and includes shoulder closures and lane shifts. Detours will also be needed for one of the construction phases and for construction of drainage pipes crossing US 13. US 13 is a four lane divided highway with two lanes each in the northbound and southbound directions. Port Penn Road is a two lane two-way roadway with minimal 1-3 foot shoulders.

Pre-Phase 1

Pre-Phase 1 begins with shoulder reconstruction and temporary widening in the median along US 13 southbound. This construction is necessary so that two travel lanes, a bike lane, and a deflection zone for the temporary concrete barrier can be maintained along US 13 southbound throughout construction as the existing shoulder pavement section will not support temporary traffic nor is it wide enough to maintain two travel lanes. This work will be completed under lane closures during off-peak hours following typical applications from the Delaware MUTCD. Refer to plan sheets CS-P101 – CS-P109.

Phase 1

Phase 1 consists of construction along the outside portions of US 13. In the northbound direction, US 13 is maintained in the existing travel lanes. Approaching the Port Penn Road intersection, temporary concrete barrier will be placed on the existing shoulder/right-turn lane to provide a work area for widening/shoulder reconstruction for a right-turn lane and bike lane in the ultimate condition. This barrier will be placed to provide a 3 foot deflection zone and 4 foot bike lane. In this configuration, the right-turn lane from US 13 northbound to Port Penn Road eastbound will be shortened. Refer to plan sheets CS-102 – CS-105.

In the US 13 southbound direction, traffic will be shifted onto the reconstructed shoulder/temporary widening that was completed in Phase 1. Temporary concrete barrier will be placed along the right side of the travel lanes for shoulder re-construction and widening for the additional southbound travel lane, toll plaza entrance driveway, and right turn lane. Two travel lanes and a deflection zone for the temporary concrete barrier will be maintained. The southbound run of barrier begins approximately 1,400 feet north of the Port Penn Road intersection and continues to approximately 2,200 feet south of the intersection. A break in the barrier is made at the Port Penn Road intersection to maintain access to the toll plaza administration building (see plan sheets CS-102 – CS-107). A sub-phase is necessary to complete construction in this area so that the existing driveway can remain open until the new driveway is completed. During this phase, bikes will be required to use the detour that is implemented in Contract 1B and discussed above.

The northernmost widening to the outside of US 13 southbound must be constructed in a sub-phase so that the temporary travel lane shifts between Contract 1D and Contract 1B can be coordinated. This sub-phase, 1B, can be completed by the Contract 1D contractor any time after the Contract 1B contractor completes widening into the US 13 median, which is required as a first order of work in that contract.

Temporary concrete barrier is also placed along the right side of SR 1 southbound to close the shoulder so that Ramp R can be built (see plan sheets CS-105 – CS-107). Roadway widening and re-construction on the south side of Port Penn Road is also proposed in this phase and the work area is protected by temporary concrete barrier closing the shoulder; however, a deflection zone for the barrier is not achievable due to limited pavement width (see plan sheets CS-105 and CS-108).

Once construction of the new toll plaza entrance driveway is complete the contractor can move into Sub-phases 1A & 1B. In this sub-phase, access to the toll plaza administration building is shifted to the new driveway so that the remainder of the construction along the right side of US 13 southbound and Ramp R can occur (see plan sheets CS-1A01 – CS-1A03 and CS-1B01 – CS-1B02). Barrier that was placed along the right side of US 13 northbound is extended so that construction of the new right-turn lane and bike lane can be completed. In this configuration right-turns from US 13 northbound to Port Penn Road eastbound will be made from the right lane which will operate as a shared through/right-turn lane. Further discussion on the impacts of the shared through/right-turn lane is included in Chapter 4.



Phase 2

During Phase 2, temporary concrete barrier is placed along the median of US 13 northbound and southbound to close the median shoulders and create a work area for the northbound left-turn lane construction, removal of several crossovers and removal of the temporary paving installed in Pre-Phase 1. In the southbound direction the barrier run begins at the Port Penn Road intersection and extends approximately 3,200 feet south. In the northbound direction the barrier run begins approximately 5,300 feet south of the Port Penn Road intersection and stops just south of it. A minimum 3 foot deflection zone for the temporary concrete barrier is maintained requiring that the travel lanes either be shifted and/or the lane widths reduced. Two travel lanes in both directions of US 13 are able to be maintained in Phase 2. Bike traffic along both directions of US 13 is maintained on the right shoulders or with four foot striped bike lanes. Refer to plan sheets CS-201 – CS-208.

In Phase 2, all of the US 13 northbound left-turn lane to Ramp R will be constructed with the exception of the 4 feet of pavement between the proposed curb separating the left-turn lane and the existing roadway. South of the proposed curb median, pavement will be constructed as close as 4 feet from the existing left edge of travel lane. This paving work is left out at this time so that a deflection zone behind the temporary concrete barrier can be maintained. Setting the barrier in a location where this pavement could be constructed and a deflection zone maintained would require shifting the travel lanes onto the existing shoulder and would require shoulder reconstruction for approximately 4,000 feet. Alternatively, it is proposed to remove the temporary concrete barrier after the majority of the construction for the left-turn lane is complete and finish the remaining 4 feet of pavement under lane closures using typical applications from the Delaware MUTCD.

Temporary concrete barrier is also placed along the north side of Port Penn Road at the edge of pavement to provide a work area for roadway widening for an additional lane and eight foot shoulder. This barrier starts at the east limit of the project and stops prior to US 13. Refer to plan sheets CS-211 – CS-212.

While the contractor is completing the main Phase 2 construction two sub-phases may also be completed. The first sub-phase, 2A, is needed for construction in the middle of the US 13 and Port Penn Road intersection. This area cannot be built without closing the left lanes on US 13 northbound and southbound and without flagging or restricting the Port Penn Road left-turn movement to US 13 southbound. By completing this work as a sub-phase during off-peak hours the impacts to US 13 can be minimized. A detour will be provided for Port Penn Road left-turns to US 13 southbound in lieu of flagging. Refer to plan sheets CS-2A01 and the Port Penn Road at US 13 Southbound Detour Plan.

The remainder of construction on the north side of Port Penn Road and in the northeast corner of the intersection will be completed under Sub-phase 2B. Providing a work area for this construction in main Phase 2 would require reducing US 13 northbound to one travel lane so that bike traffic and a barrier deflection zone could be maintained. By completing this work in a sub-phase during off-peak hours using a temporary lane closure impacts to traffic can be minimized. Refer to plan sheets CS-2B01 – CS-2B02.

The last order of work for Phase 2 will be to resurface portions of the existing US 13 roadway and place the final paving surface on the new roadway using standard typical applications from the Delaware MUTCD.

Phase 3

At the completion of construction the contractor will be required to install temporary traffic control devices to close Ramp R and the turn lanes from US 13 that feed it. These temporary traffic control devices will be removed by the Contract 1B contractor when the remainder of Ramp R is completed in that contract and it is open to traffic.

Maintenance of Traffic Summary

The maintenance of traffic required will cause impacts to traffic along US 13 throughout construction. Shoulder closures, lane shifts, reduced lane widths and long work zones are necessary for construction. These aspects tend to cause disruption to motorists traveling through a work zone. Two travel lanes are maintained in each direction of US 13 throughout construction with the exception of off-peak lane closures using standard typical applications from the Delaware MUTCD. These lane closures will be needed for various construction activities and construction sub-phases and should not have significant impacts to traffic. Detours are proposed for US 13 northbound and southbound for construction of cross road drainage pipes. These detours will be implemented during night time hours to minimize impact and should last no longer than a few nights.

Maintenance of traffic is also required along Port Penn Road throughout construction. Two-lane two-way travel will be maintained along Port Penn Road with flagging operations being used during off-peak hours for select construction activities. Impacts to traffic should be minimal. In Sub-phase 2A a detour will be implemented for Port Penn Road left-turns to US 13 southbound so the center of the US 13 and Port Penn Road intersection can be built. The detour route uses Port Penn Road eastbound and Pole Bridge Road to US 13 southbound. The detour will only be needed temporarily as the work is completed during off-peak hours. In Sub-phase 2B the existing free-flow right-turn lane from Port Penn Road to US 13 northbound will be closed and all Port Penn Road movements will occur from reduced length turn lanes causing some additional delay. Again, this work will be scheduled for off-peak times to minimize impact.

Contract 1B/1D Coordination

Contract 1D will also require coordination of construction phasing and maintenance of traffic with Contract 1B. Contract 1D must essentially be complete before the Contract 1B contractor can open Ramp R and move into Phase 3 of Contract 1B. Maintenance of traffic must be coordinated where the two contracts limits adjoin. This occurs in two locations; Ramp R and US 13. The SR 1 southbound shoulder closure for construction of Ramp R may need to be field adjusted into one long shoulder closure spanning both contracts. A similar approach will be needed along US 13 southbound where the locations of lane shifts may need to be adjusted depending on the construction phase that each contract is in. It is expected that any adjustments can be worked out in construction and the plans include notes alerting each contractor to the possibility.

Phasing Options Considered

One option considered was to reduce each direction of US 13 to one travel lane during construction. Reducing each direction to one lane would have provided enough room for a full buffer behind the temporary concrete barrier and bike lanes throughout all phases without temporary widening. This would have eliminated the pre-phase needed for temporary widening and median reconstruction and Phase 1B needed to transition two travel lanes between the Contract 1B and Contract 1D work zones. Concerns over capacity along US 13, particularly for SR 1 incident management, factored against this option.

Another phasing option considered was to complete the median construction first and the outside construction second. However, it was thought that it would be better to complete the outside construction first since this is the bulk of the work and this will allow the Contract 1D portion of Ramp R to be constructed earlier. This way the Contract 1D contractor will be out of the way of the Contract 1B contractor for the continued construction of Ramp R. This approach also allows for construction of the new toll plaza entrance driveway which needs to be opened before completing other parts of the contract.

Another option considered was to complete construction of the center of the US 13 and Port Penn Road intersection under flagger control instead of detouring Port Penn Road left-turns to US 13 southbound. Doing so would require several flaggers, including flaggers for the US 13 through movements which is not preferred due to the higher speeds and volumes on the roadway. This construction is intended to be completed straight through and may require an entire weekend for drainage and full-depth pavement construction. Maintaining a flagging operation for a long period of time would be more difficult for the contractor. The proposed detour will have minimal impact for US 13 southbound destined vehicles so it was felt that the detour option is preferable.

Roadway Closure Information

Table 2.2B contains information on all lane closures, flagging operations and roadway closures with detours that will occur in Section 1. The traffic analysis supporting these closures is included in Chapter 3. Several closures on a single roadway may be used in more than one contract, as noted in the table. Temporary lane closures and detours, unless otherwise specified, will not be permitted during major holiday periods and special events as outlined in Section 2.5.2. In addition lane and/or roadway closures are not permitted along SR 1 during NASCAR Race Weekends, specifically, Thursday before the race through the day after the races.



TABLE 2.6-2 Section 1 – Construction Period Roadway Closure Information							
Road Name	Construction Phase	Lane Closure Type	Summer*		Non Summer		Duration
			Days	Hours	Days	Hours	
SR 1	All Phases of Contract 1B	Single Lane Closure (Left or Right Lane)/ NB and SB Directions/Varying Length Lane Closures Over Project Limits	Monday – Thursday	9AM – 3PM and 7PM – 6AM (The Following Morning)	See Summer Days	See Summer Hours	Entire Contract Duration
SR 1	All Phases of Contract 1B	Double Lane Closure (2 Left or 2 Right Lanes)/ NB and SB Directions/Varying Length Lane Closures Over Project Limits	Monday – Thursday	10PM – 5AM (The Following Morning)	See Summer Days	See Summer Hours	Entire Contract Duration
SR 1	Potentially All Phases of Contract 1B	NB Roadway Closure/SB Roadway Closure/Concurrent NB & SB Roadway Closure – All w/ Detours	Monday – Thursday	9PM – 5AM (The Following Morning)	See Summer Days	See Summer Hours	15 Nights (See Table 3.2.4.8)
US 13 NB	All Phases of Contract 1B and Contract 1D	Single NB Lane Closure (Left or Right Lane)/Varying Length Lane Closure Over Project Limits	Monday – Thursday	9AM – 3PM and 6PM – 6AM (The Following Morning)	See Summer Days	See Summer Hours	Entire Contract Duration
US 13 SB	All Phases of Contract 1B	Single SB Lane Closure (Left or Right Lane)/Varying Length Lane Closure Over Project Limits	Monday – Thursday	9AM – 2PM and 8PM – 6AM (The Following Morning)	See Summer Days	See Summer Hours	Entire Contract Duration
US 13 SB	All Phases of Contract 1D	Single SB Lane Closure (Left or Right Lane)/Varying Length Lane Closure Over Project Limits	Monday – Thursday	9AM – 3PM and 7PM – 7AM (The Following Morning)	See Summer Days	See Summer Hours	Entire Contract Duration

Work Zone Transportation Management Plan



US 13 SB	Contract 1D Phase 2	SB Roadway Closure w/ Detour	Monday – Thursday	10PM – 5AM (The Following Morning)	See Summer Days	See Summer Hours	1 Night
US 13 NB	Contract 1D Phase 2	NB Roadway Closure w/ Detour	Monday – Thursday	9PM – 5AM (The Following Morning)	See Summer Days	See Summer Hours	1 Night
SR 896 (Boys Corner Road)	Contract 1A Phases 2 & 3 and All Phases of Contract 1C	Flagging Operation/2 Minute Temporary Roadway Closure for Hauling Operation/ Flagging Operation and Simultaneous 30 Second Temporary Roadway Closure for Hauling Operation	Monday – Friday 9AM – 3PM and Monday – Thursday 7PM – 6AM (The Following Morning)		See Summer Days	See Summer Hours	Entire Duration of Phases Noted
SR 896 (Boys Corner Road)	Contract 1A Phase 2 or 3	Roadway Closure and Detour	Monday - Thursday	9PM – 5AM (The Following Morning)	See Summer Days	See Summer Hours	5 Nights
Jamison Corner Road	Contract 1A Phase 2	2 Minute Temporary Roadway Closure (Hauling Operation)	Monday – Friday 9AM – 3PM and Monday – Thursday 6PM – 7AM (The Following Morning)		See Summer Days	See Summer Hours	Entire Duration of Phase Noted
Jamison Corner Road/Jamison Corner Runaround Road	All Phases of Contract 1A	Flagging Operation	Monday – Friday 9AM – 3PM and Monday – Thursday 6PM – 7AM (The Following Morning)		See Summer Days	See Summer Hours	Entire Duration of Phases Noted
Hyetts Corner Road	Contract 1A Phases 2, 3 & 4	Roadway Closure and Detour	All	All	All	All	Entire Duration of Phases Noted
Port Penn Road	All Phases of Contract 1D	Flagging Operation	Monday – Friday 9AM – 3PM and Monday – Thursday 7P – 6AM (The Following Morning)		See Summer Days	See Summer Hours	Entire Duration of Phases Noted
Port Penn Road Left-turn to US 13 SB	Contract 1D Phase 2A	Detour	Monday – Thursday	9PM – 5AM (The Following Morning)	See Summer Days	See Summer Hours	Several Nights



2.6.3 Construction Phasing Plans

Construction Phasing, M.O.T., and Erosion Control plan sheets and detour plan sheets are provided in Appendix D.1. Detailed construction phasing and maintenance of traffic notes are provided on the plans for each phase of construction.

2.7 DESIGN SECTION 2 – CONSTRUCTION PHASING

Section 2 consists of proposed US 301 from east of Norfolk Southern Railroad to north of Levels Road.

2.7.1 Maintenance of Traffic (MOT) Considerations from the FEIS

During the project development process leading to the FEIS, the following MOT elements were considered for the construction of Design Section 2:

- Maintenance of Traffic Along Armstrong Corner Road:
 - Armstrong Corner Road will remain open during construction, as the construction will ultimately locate the roadway to the south of the existing roadway, for a more direct connection with Bohemia Mill Road.
- Maintenance of Traffic Along Bunker Hill Road:
 - Bunker Hill Road must remain open during construction.
 - A school is located in southwest corner of the intersection with Choptank Road. A historic property is located in the northeast corner of the same intersection.
 - Final location of Bunker Hill Road Overpass was initially undecided; it could have been located to either the north or south of existing road depending on profile. It is being located to the north side as a result of post FEIS evaluation as indicated below.
 - A temporary runaround road was considered to accommodate traffic. Design of a temporary road would minimize impacts to constraints, and is being incorporated into the design.

Given the MOT strategies from the FEIS, Design Section 2 strategies to reduce impacts to existing roadways included maintaining Bunker Hill Road and Armstrong Corner Road during construction phasing. Initially, the MOT strategy to not maintain traffic on Bunker Hill Road was investigated, but quickly dismissed due to the proximity of a local school and surrounding communities. Some additional strategies that were considered involved the location of the temporary road required to maintain Bunker Hill Road (north-side versus south-side of existing Bunker Hill Road). Under initial investigation, it appeared that the south side of Bunker Hill Road looked favorable for a temporary roadway due to the presence of a historical site on the north side; however under further investigation the north side was chosen as preferable due to impacts to the nearby school and communities that have been located post FEIS evaluation.

2.7.2 Construction Phasing Approach

Section 2 is approximately four miles in length, with the south limit located at the midpoint of the proposed Levels Road interchange and the north limit located approximately ½ mile north of the proposed existing US 301 (Summit Bridge Road) interchange, east of Norfolk Southern Railroad. Improvements are planned on existing US 301 within the area of the Summit Bridge Road interchange, with a connector roadway providing access between Summit Bridge Road and the new US 301 highway.

Design Section 2 has been separated into the following design and construction section contracts:

- 2A: US 301 Mainline: North of Levels Road to West of existing US 301, Mainline Bridges (4), West of existing US 301 to East of Norfolk Southern RR
- 2B: Existing US 301, North of New US 301 Overpass to South of Armstrong Corner Road
- 2D: US 301 Maintenance Facility
- 2E: Park-and-Ride Facility at Existing/New US 301 Interchange

The proposed construction sequence for Section 2 has been developed to minimize disruptions to existing US 301 (Summit Bridge Road) traffic, provide a safe working environment during construction, and allow for an efficient construction schedule.



TABLE 2.7 - 1 Section 2 – Construction Period Roadway Closure Information							
Road Name	Construction Phase	Lane Closure Type	Summer*		Non Summer		Duration
			Days	Hours	Days	Hours	
Armstrong Corner Road (N429)	Section 2A Phase 4	Full night-time closure with detour plan	Sunday – Thursday	9PM – 5AM	Sunday – Thursday	9PM – 5AM	Intermittent Over 21 days
Summit Bridge Road US 301 (N39)	Section 2A Phase 4 And Section 2B Phase 1	Full night-time closure with detour plan	Sunday – Thursday	9PM – 5AM	Sunday – Thursday	9PM – 5AM	Intermittent Over 21 days
Armstrong Corner Road (N429)	Section 2B Phase 2A	Full night-time closure with detour plan	Sunday – Thursday	9PM – 5AM	Sunday – Thursday	9PM – 5AM	Intermittent Over 7 days
Marl Pit Road (N429)	Section 2B Phase 2B	Full night-time closure with detour plan	Sunday – Thursday	9PM – 5AM	Sunday – Thursday	9PM – 5AM	Intermittent Over 7 days
Marl Pit Road (N429)	Section 2B Phase 3B	Full night-time closure with detour plan	Sunday – Thursday	9PM – 5AM	Sunday – Thursday	9PM – 5AM	Intermittent Over 7-14 days

Contract 2A (DeIDOT Contract #T200911303) - US 301 Mainline Construction Sequence

The US 301 Mainline Sections 2A and 2B construction sequence has been identified on the Construction Phasing, M.O.T., and Erosion Control Plans as outlined below. Any work on typical US 301 mainline roadway sections during Section 2 is to be completed on new alignment requiring no traffic impacts, if not indicated otherwise below.

Phase 1 Pre-Earth Movement Site Preparation and Construction Sequence (7 month duration, months 1 through 7)

All temporary traffic control devices and permanent warning signs will be placed primarily as per the permanent sign location plans. The haul road from the borrow site to Bunker Hill Road will be installed, including temporary crossings over Sandy Branch and associated perimeter controls.

As the haul road is constructed, Phase 1 Construction of Bunker Hill Rd will begin with clearing and grubbing activities. Erosion and sediment (E&S) controls will be installed as indicated in the E&S Control Plans, including resource protection fence. Earthwork activities associated with earth berms and undercutting will commence following E&S installation. Cross culverts, culverts, and rock outlet protection will be installed subsequently through trench excavation. Clean water will be directed through the culverts as indicated on the phasing plans with proposed ditches or erosion sediment and control devices. Construction of Summit Bridge Road will begin concurrently to earth berm construction according to the Summit Bridge Road construction phasing, MOT, and EC plans.

Phase 2 Mainline Earth Movement Construction Sequence (24 month duration, months 3 through 26)

Phase 2 construction of Bunker Hill Road and US 301 Mainline will begin as Phase 1 E&S control devices are maintained and Phase 2 devices are installed.

Earth moving operations will commence for final grading of US 301, allowing for positive drainage to erosion and sediment control features. The roadway will be stabilized with subbase and all earthen areas with erosion control blanket as indicated on the plans. Roadway drainage pipes, inlets, and rock outlet protection will be constructed in sequence from downstream to upstream, with concurrent installation of erosion and sediment control devices. The US 301 typical roadway section will be constructed to project limits, with roadway construction and tie-ins completed under this Phase.

Phase 3 Bunker Hill Road Over US 301 Mainline Construction Sequence (Phase 3, 20 month duration, months 4 through 23)

Phase 3 construction will begin with establishment of temporary warning signage along Bunker Hill Road in accordance with the MOT plan. The construction of Bunker Hill Road is described below in sub-phases.

During Bunker Hill Road Sub-phase 1 construction, temporary barrier and E&S control devices will be installed and a temporary roadway constructed, bypassing existing Bunker Hill Road.

At the start of Bunker Hill Road Sub-phase 2 construction, traffic will be shifted to the temporary roadway. Temporary barrier will be installed along the edge of the MOT Phase construction area, along with E&S control devices and drainage swales. The proposed Bunker Hill Road and bridge will be constructed. Stabilize all disturbed areas prior to removal of sediment control devices.

Upon completion of Bunker Hill Road construction, traffic will be shifted to Bunker Hill Road as permanent condition. Temporary barrier will be installed along the edge of the MOT Phase construction area along with E&S control devices. The temporary roadway utilized during Bunker Hill construction will be removed after barrier and E&S controls are in place. Drainage swales will be built along the north side of Bunker Hill Road. Overlay is proposed to take place on one side (north/south) of the new roadway while traffic is maintained on the opposing side/direction.

Phase 4, 16 month duration, months 21 through 36.

Phase 4 construction will include the sequences for structures associated with US 301 Mainline Over Armstrong Corner Road and US 301 Mainline Over Summit Bridge Road, and is discussed in the sections below.

US 301 Mainline Over Armstrong Corner Road Construction Sequence (Phase 4)

As work approaches Armstrong Corner Road, all temporary warning signage will be established along Armstrong Corner Road in accordance with the MOT plan. Temporary barrier and E&S control devices will be installed prior to construction of the proposed US 301 mainline bridge pier, median, and pavement.

Armstrong Corner Road will remain open during the majority of overpass construction with short-term (overnight) full roadway closures required for placing bridge beams. Overnight detours are anticipated over a period of 21 days. All detours are to be coordinated with the Middleneck Road detour proposed in Section 3. The short-term detour for Armstrong Corner Road is not anticipated to create significant traffic impacts on Bunker Hill Road, even during a concurrent detour of Middleneck Road (an additional 25 veh/hr from Section 3 traffic analysis is estimated). Detoured eastbound and westbound traffic from Armstrong Corner Road will utilize nearby connector roadways, including Choptank Road, Bunker Hill Road, and Old School House Road during the duration of bridge beam erection activities requiring full roadway closure for Armstrong Corner Road. Refer to Exhibit A (Appendix D) for graphic of proposed detour routes. Temporary shielding should be utilized in order to minimize lane closures during bridge deck installation on Armstrong Corner Rd.

Upon completion of the US 301 mainline structure construction, the associated temporary barrier and MOT features will be removed.

US 301 Mainline Over Summit Bridge Road Construction Sequence (Phase 4)

As work approaches Summit Bridge Road, all temporary warning signage will be established along Summit Bridge Road in accordance with the MOT plan. Summit Bridge Road widening construction is scheduled to begin in Phase 1 of the overall US 301 mainline construction sequence, while earth berm construction is ongoing. For Summit Bridge Road, overlay is proposed to take place in two stages (separate stages for northbound/southbound inner lanes and northbound/southbound outer lanes) in order to maintain traffic on existing Route 301. Temporary barrier and E&S control devices will be installed prior to the construction of the proposed US301 mainline bridge pier, median, and pavement.



Summit Bridge Road will remain open during the majority of overpass construction with short-term (overnight) full roadway closures required for placing bridge beams. Overnight detours are anticipated over a period of 21 days. Detoured northbound and southbound Summit Bridge Road traffic will utilize Marl Pit Rd, Route 13, and Boyds Corner Road (DE 896) during the duration of bridge beam erection activities requiring full roadway closure for Summit Bridge Road. The overnight detours for Summit Bridge Road traffic cannot occur simultaneously with the detour of Marl Pit Road traffic under Section 2B. The overnight detours also cannot occur simultaneously as the detours of Boyds Corner Road (DE 896) traffic and DE 1 traffic in Section 1 and will require coordination of construction schedule with the Section 1 sequence of activities. Refer to Exhibit A (Appendix D) for graphic of proposed detour routes. Temporary shielding should be utilized in order to minimize lane closures during bridge deck installation on Summit Bridge Road. Coordinate scheduling of detour with Section 2B drainage facility work.

Upon completion of the US 301 mainline structure construction, the associated temporary barrier and MOT features will be removed.

Contract 2B (DeIDOT Contract #T201011301) - Summit Bridge Road Construction Sequence (18 month duration, months 10 through 27)

Under Section 2B, Summit Bridge Road improvements are proposed under the construction sequence identified on the construction phasing, M.O.T., and E&S Control plans as outlined below.

The existing northbound and southbound travel lane configuration on Summit Bridge Road will be maintained throughout construction with a narrowed lane with of 11-ft travel lanes allowing for construction work area. All detours and closures required for drainage work will be coordinated with bridge beam erection at the structure for US301 Over Summit Bridge Road. The Summit Bridge Road construction phasing under Section 2B can be summarized as follows:

Phase 1 (2 Month Duration)

Shoulder pavement will be rebuilt on the northbound side of Summit Bridge Road and temporary striping placed. Roadside basins, cross-pipe installations, and sliver widening construction will take place on Armstrong Corner and Marl Pit Road during this phase.

Phase 2 (7 Month, 2 Week Duration)

Traffic will be shifted to the new lanes designated (along northbound side) for phase construction. Temporary barrier will be installed along the edge of the phase construction area. Southbound lanes will be constructed during this phase.

Phase 2A (7 Day Duration, Nights Only)

Nighttime closure(s) of Armstrong Corner Road (and corresponding short-term detour) will be implemented for wedging material on Armstrong Corner Road (closure of Armstrong Corner approach) under this sub-phase.

Phase 2B (7 Day Duration, Nights Only)

Nighttime closure(s) of Marl Pit Road (and corresponding short-term detour) will be implemented for wedging material on Marl Pit Road (closure of Marl Pit Road approach) under this sub-phase. The overnight detour of Marl Pit Road traffic cannot occur simultaneously with the overnight detour(s) of Summit Bridge traffic and will require coordination of construction schedule with Sections 2A and 2B sequence of activities.

Phase 3 (7 Month, 2 Week Duration)

Temporary striping will be placed and traffic shifted to the new constructed lanes (southbound) designated for this phase of construction. Temporary barrier will be installed along the edge of the phase construction area. Northbound lanes will be constructed during this phase.

Phase 3B (1 Month Duration)

The Summit Bridge Road traffic pattern in place will be maintained entering Phase 3B and temporary barrier installed along the edge of the phase construction area for Marl Pit Road approaches. At the intersection of Summit Bridge Road and Marl Pit Road/Armstrong Corner Road, the roadway tie-ins with the minor approaches will be completed. The approved detour for nighttime Marl Pit Road traffic corresponding to the approach construction under this phase is included as Sheet CS04, CD115 in the plans. The overnight detour of Marl Pit Road traffic

cannot occur simultaneously with the overnight detour(s) of Summit Bridge traffic and will require coordination of construction schedule with Sections 2A and 2B sequence of activities.

Summit Bridge Road will remain open during the majority of the widening construction, with short-term (overnight) full roadway closures required for construction of roadway drainage facilities (i.e. placement of drainage cross pipes). Detoured northbound and southbound Summit Bridge Road traffic will utilize Marl Pit Rd, Route 13, and Boyds Corner Road (DE 896) during the short term duration of construction activities requiring full roadway closure for Summit Bridge Road. The detour of Summit Bridge Road traffic (under Sections 2A and 2B) and DE 1 traffic (Section 1) cannot occur simultaneously as both detours utilize the signalized intersection of US 13/ Boyds Corner Road DE 896. Additionally, the detour of Summit Bridge Road traffic will not be permitted to overlap with the detour of Boyds Corner Road DE 896 traffic. Advance coordination of construction schedule with the Section 1 sequence of activities will be required to ensure these overlapping detour routes are not implemented concurrently during construction. Refer to Exhibit A (Appendix A) for graphic of proposed detour routes. Coordinate this work with Section 2A Summit Bridge Road bridge beam erection detours.

A temporary signal will be required to maintain the existing signalized intersection of Summit Bridge Road and Armstrong Corner Road / Marl Pit Road and will be constructed in advance of US301 construction. The existing condition for the temporary signal plan can be found in the contract plans for Contract 2B (DeIDOT Contract #T201011301). The existing right turn lanes on Summit Bridge Road will be eliminated during construction phases 2, 3, and 3B.

Access to all businesses and residences within the project limits will be maintained throughout the duration of Summit Bridge Road construction. Access to the Dani Shade parcel driveway on Summit Bridge Road will not be blocked for any temporary construction purposes during the weekday periods of 6:30am to 8:30am and 3:00pm to 5:30pm, Monday through Friday.

Contract 2D

The Section 2D (US 301 Maintenance Facility) contract is anticipated to be scheduled and constructed after the roadway is open to traffic as a separate contract from the US 301 highway construction. This separate contract would not impact the surrounding road network aside from construction vehicular travel to/from site, as the site would be an extension of the existing roundabout.

Contract 2E

The Section 2E (Park and Ride at Existing 301/301 Mainline interchange) contract is anticipated to be scheduled and constructed after the roadway is open to traffic as a separate contract from the highway construction. This separate contract would not impact the surrounding road network aside from construction vehicular travel to/from site, as the site would be an extension of the existing roundabout.

US 301 Opening Sequence

The Section 2A (DeIDOT Contract #T200911303) contractor will perform work within the Section 1, 2, & 3 design limits and will open the mainline US 301 to traffic according to the construction schedule and bid package specifications.

2.7.3 Construction Phasing Plans

MOT Plan Sheets for the proposed Section 2 US 301 Mainline construction and Section 2B Summit Bridge Road improvements construction have been provided as an Appendix within this TMP document. Detailed sequence of construction notes are provided in the plans for each phase of construction.



2.8 DESIGN SECTION 3 – CONSTRUCTION PHASING

2.8.1 Maintenance of Traffic (MOT) Considerations from the FEIS

Design Section 3 consists of proposed US 301 from approximately one mile south of the Delaware/Maryland border with a northern limit located at the midpoint of the proposed Levels Road interchange. During the project development process leading to the FEIS, the following MOT elements were considered for the construction of Design Section 3.

- Strawberry Lane:
 - Strawberry Lane will be closed during construction for some period of time.
 - The connection from Strawberry Lane to existing US 301 will be completed early in construction to allow access on the east side of the roadway.
 - **Update:** *The connection of Strawberry Lane to existing 301 will not be completed as early as originally anticipated. The intersection configuration at the tie-in of new Middletown Warwick Road and existing US 301 does not allow traffic to be maintained on existing US 301. The new Middletown Warwick Road connection to Strawberry Lane cannot be opened until US 301 traffic is transferred to the newly constructed Southbound Lanes in Phase 5.*
- Warwick Road:
 - The Warwick Road intersection with Existing 301 will remain open as long as possible, leaving a gap in the earthwork at this intersection to be filled in later.
 - New Levels Road will be constructed prior to closing the intersection to existing 301 to allow access to the local roadway at the new Levels Road / existing 301 Intersection.
- Middle Neck Road:
 - The Middle Neck Road intersection with existing US 301 will remain open as long as possible, leaving a gap in the earthwork at this intersection to be filled in later.
 - **Update:** *Middle Neck Road is proposed to be closed earlier in the construction sequence due to the large quantities of material that need to be moved across it. It will remain open as long as possible, but it is anticipated to be closed early in Phase 2.*
 - New Levels Road will be constructed prior to closing the intersection to existing 301 to allow access to the local roadway at the new Levels Road / existing 301 Intersection.
 - **Update:** *Middle Neck Road is proposed to be closed earlier in the construction sequence. The intersection improvements at the new Levels Road will be accomplished during this time and will be completed prior to the re-opening of Middle Neck Road.*
- Bunker Hill Road:
 - Bunker Hill Road must remain open during construction
 - School located in southwest corner of intersection, historic property in northeast corner
 - Final location of Bunker Hill Road Overpass is undecided – could be located to either the north or south of existing road depending on profile.
 - Temporary runaround road can be used, if necessary. Design of a temporary road should minimize impacts to constraints.

2.8.2 Construction Phasing Approach

Section 3 is located at the southern limit of the US 301 project corridor with improvements either on or near existing US 301 for approximately half of the project limits. As such, construction phasing schemes were evaluated to minimize disruptions to existing US 301 traffic, provide a safe working environment during construction, and allow for efficient construction operations.

Phased construction is proposed for Section 3. Several short and long term detours are required. Section 3 construction is anticipated to take two years. Six major phases have been identified as outlined below:

Phase 1

Construct temporary SB US 301 crossover in MD. Phase 1 construction is estimated to last approximately 1 month.

Phase 2



New US 301 alignment will be constructed. Strawberry Lane will be detoured to construct the Strawberry Lane Bridge (BR3-1). Strawberry Lane will be closed at the connection to existing US 301 for construction of Bridge BR3-1. The east side of Strawberry Lane will be detoured to Levels Road back to existing US 301. The west side of Strawberry Lane will be detoured to Warwick Road back to existing US 301. Middle Neck Road will be closed and detoured for the construction of the mainline alignment. The detour will use Old Telegraph Road to Bunker Hill Road to existing US 301. Phase 2 construction is estimated to last approximately 15 months.

Section 2 will be detouring Armstrong Corner Road traffic during overhead beam placement and bridge shielding installation. These activities will be done during week nights and traffic will be detoured to Bunker Hill Road as part of this detour. The potential impact from overlapping detour between sections is being addressed in the Section 2 analyses.

Phase 3

Detour Warwick Road. Complete Warwick Road construction. Warwick Road will be closed for the construction of the tie-in with the new Warwick Road alignment. The detour will use Old Telegraph Road to Middle Neck Road to the new Warwick Road alignment. Phase 3 construction is estimated to last approximately 2 weeks.

Phase 4

Construct temporary NB US 301 crossovers in MD and DE. Phase 4 construction is estimated to last approximately 7 months.

Phase 5

Shift all existing US 301 traffic onto newly constructed SB lanes. Complete US 301 mainline tie-in to existing US 301 and open to traffic. A temporary intersection at the crossover will provide access to/from the new Middletown Warwick Road. Complete mainline construction including northbound lanes and Weigh Station Ramps A and B. The WIM will be closed for the entire duration of Phase 5. Phase 5 construction is estimated to last approximately 6 months.

Phase 6

Shift northbound US 301 traffic onto newly constructed northbound lanes. Remove the temporary northbound crossover in Maryland. The temporary crossover near the Warwick Road intersection (STA 178+00) will still be utilized to transfer traffic onto existing US 301 until Section 2 is completed. Phase 6 will be in place until Section 2 is complete.



TABLE 2.8.2-1 Section 3 – Construction Period Roadway Closure Information							
Road Name	Construction Phase	Lane Closure Type	Summer*		Non Summer		Duration
			Days	Hours	Days	Hours	
Strawberry Lane (N445)	2A & 2B	Full closure with detour	Sunday – Thursday	9PM – 5AM	Sunday – Thursday	9PM – 5AM	October 2015 to June 2016
US 301 (N62)	2A	Temporary 15 minute full closures of NB and SB lanes at Strawberry Lane	Sunday – Thursday	9PM – 5AM	Sunday – Thursday	9PM – 5AM	2 nights in March 2016
US 301 (N62)	2A	Temporary lane closures of NB and SB lanes at Strawberry Lane	Sunday – Thursday	9PM – 5AM	Sunday – Thursday	9PM – 5AM	15 nights in April and May 2016
Middleneck Road (N444)	2 & 3	Full closure with detour	Sunday – Thursday	9PM – 5AM	Sunday – Thursday	9PM – 5AM	December 2015 to September 2016
Warwick Road (N443)	3	Full closure with detour	Sunday – Thursday	9PM – 5AM	Sunday – Thursday	9PM – 5AM	September to October 2016

* Summer – May 15th to September 15th

Alternative MOT Strategies

Temporary Strawberry Lane Intersection

Construct each span of the Strawberry Lane Bridge in different phases. This was considered to maintain access from Strawberry Lane to US 301 and would eliminate the need for a temporary intersection at the Warwick Crossover. Local access could be provided to the properties along existing US 301. By phasing construction of the bridge, work within the travel way would be limited. However this was not feasible due to a significant grade difference between existing US 301 and the new mainline US 301 intersection with Strawberry Lane.

US 301 Tie-In during Phase 2

US 301 could be opened to traffic upon completion of the roadway between Strawberry Lane and existing US 301. Currently local traffic must utilize the Levels Road detour until Phase 5. The intersection of these two roads would require a merging intersection. The configuration of the intersection would not be ideal for the movement of traffic. It was determined that the tie-in work should be included with Phase 5 when mainline traffic is shifted onto the Southbound Lanes of US 301.

Utilizing Levels Interchange

Traffic could utilize the southbound lanes of the newly constructed pavement to a point past the proposed Toll Plaza and then transfer back to existing US 301 via Levels Road interchange. In addition to complications associated with running mainline traffic through the interchange, this traffic pattern could also interfere with Toll Plaza construction.

Detailed Phasing Notes:

Phase 1:

- Northbound and southbound traffic in Maryland will be restricted to one lane on existing US 301. Northbound lanes are tapered to a single lane prior to entering the work zone. The median shoulder will be closed to construct the temporary southbound crossover.
- One culvert installation across existing US 301 will take place during off-peak hours on the northbound side of US 301 where it is still divided.
- At the intersection of Levels Road and existing US 301, a construction entrance will be provided to access the mitigation site for borrow needs.

Phase 2A:

- Southbound traffic in Maryland will be shifted onto the temporary crossover.
- Strawberry Lane will be detoured to begin roadway and bridge construction. The majority of traffic is expected to utilize Levels Road and Warwick Road as shown on the detour plans.
- Middle Neck Road will be detoured to begin mainline earthwork operations. The majority of the traffic is expected to utilize Bunker Hill Road as shown on the detour plans. Section 2 will be detouring Armstrong Corner Road traffic during overhead beam placement and bridge shielding installation. These activities will be done on week nights and traffic will be detoured to Bunker Hill Road as part of this detour. The potential impacts from overlapping detours between sections are being addressed in the Section 2 analyses.
- Haul Road crossings will begin during this phase. Vehicles will cross Warwick Road at the existing intersection with US 301 and travel south to the proposed stockpile site in Maryland. Haul road crossings are labeled on the plans.
- Strawberry Lane bridge construction will begin. Both shoulders will feature temporary concrete safety barrier to provide safe passage of vehicles and workers.
- Three culvert installations across existing US 301 will take place during off-peak hours.

Phase 2B:

- Construction will begin on the US 301 mainline. Vehicles will cross US 301 at the locations shown on the plans.
- Levels Road intersection will be improved as shown on the plans. Southbound existing US 301 will be limited to one through lane. Northbound existing US 301 will be limited to one through lane for the construction of the island on westbound Levels Road. Shoulder closures and right turn lane closures will be implemented on westbound Levels Road.

Phase 3:

- Middle Neck Road detour will be removed. Traffic will utilize the newly constructed Warwick/Levels Road.
- Warwick Road will be detoured to complete the tie-in of existing Warwick Road and the proposed Warwick Road. The majority of the traffic is expected to utilize Middle Neck Road via the newly constructed Warwick/Levels Road.
- Upon completion of the tie-in, re-open Warwick Road.

Phase 4:

- In Maryland the median shoulders will be closed to construct the temporary northbound crossover.
- A temporary crossover will be constructed near Warwick Road to shift traffic from the proposed southbound Lanes to existing US 301. The southbound lanes will carry two-way traffic during Phase 5 construction.
- A temporary intersection will be constructed to provide access to properties to the south along existing US 301.

Phase 5:

- Nighttime mill and overlay will connect existing US 301 to the temporary crossover at Warwick Road.
- Southbound traffic will be shifted onto the newly constructed southbound lanes via the crossover at Warwick Road.
- Northbound traffic will be shifted onto the newly constructed southbound lanes via the crossover in Maryland.
- The final connection between Middletown Warwick Road and existing US 301 will be completed upon shifting mainline traffic. Upon completion, open Middletown Warwick Road.



- Phase 5 construction can begin on the northbound Lanes. The majority of work will be beyond the shoulder of northbound traffic, and outside of the work zone clear zone. However a portion of the northbound shoulder will utilize temporary concrete safety barrier to provide work zone safety.

Phase 6:

- Northbound traffic will be shifted onto the newly constructed northbound lanes in Maryland.
- The temporary northbound crossover in Maryland will be removed and final median work completed.
- During off-peak hours the mill and overlay of northbound and southbound US 301 will be completed at the southern project limit in Maryland.
- Relinquish MOT responsibilities to Section 2 Contractor upon final completion of work.

2.8.3 Construction Phasing Plans

Final MOT Plan Sheets (CS-001 to CS-180, DP-01 to DP-03, SG-01, SG-01A, SG-01B, and SG-04) are provided in Appendix D.3. Detailed sequence of construction notes are provided in the Construction Sequencing plans for each phase of construction. Project schedule

The project schedule, including plan submission dates, beginning of construction and end of construction for each section of the US 301 project, is provided on the next page.

2.9 OTHER AREA PROJECTS

As the US 301 project is constructed, it is anticipated that other roadway improvement projects will be ongoing within the project area. Coordination of work zone activities between the US 301 project and other area projects will be required throughout the design and construction phases to ensure the least practicable inconvenience to the traveling public. The table provided on the following page is a listing of anticipated construction projects within the US 301 project area. This information is based on DelDOT's Capital Transportation Program (CTP) for Fiscal Years 2015-2019.

TABLE 2.10 Construction Projects Within US 301 Project Area			
Project	From	To	Construction Start¹
Boyds Corner Road Improvements	Cedar Lane	Milford Road (approx.)	FY2017
Jamison Corner Road realignment	Jamison Corner Road	Boyds Corner Road	FY2018
Cedar Lane Road	Marl Pit Road	Boyds Corner Road	FY2019
SR 299 improvements	SR 1	Silver Lake Road	FY2019
N412A	Hyetts Corner Road	Lorewood Grove Road	On Hold
Lorewood Grove Road	N412A	DE Route 1	On Hold
Lorewood Grove Road	Breakwater	N412A	On Hold
Wiggins Mill Road	Green Giant Road	St. Anne's Road	FY2018

Notes:

1. Construction year based on DelDOT's CTP for Fiscal Years 2015-2019.





CHAPTER 3 EXISTING AND CONSTRUCTION PERIOD CONDITIONS





3.0 EXISTING & CONSTRUCTION PERIOD CONDITIONS

The US 301 project area includes some of the major roadways in New Castle County such as SR 1, existing US 301 and Boyd's Corner Road. In addition to these roadways, there are a number of rural and urban collector roadways in the project area. This chapter details the existing conditions on these roadways and their geometric and traffic characteristics. It also details the future conditions of these roadways during the construction period.

3.1 CORRIDOR WIDE

3.1.1 Existing Roadway Conditions

US 301 beyond the Project Area

US Route 301 extends approximately 1,100 miles from Sarasota, Florida to New Castle County, Delaware. The Maryland section of US 301 is a four-lane, divided roadway. Throughout its total length of 40 miles in Maryland, the divided highway has a number of at-grade intersections (none are fully signal controlled) and three grade-separated interchanges. Conversion to access control is listed in Maryland's long-term planning document, Highway Needs Inventory.

US 301 within the Project Area

In New Castle County, Delaware, US 301 extends from the Delaware/Maryland state line to Glasgow, Delaware, north of the Chesapeake and Delaware (C&D) Canal. According to the DelDOT Traffic Summary, 2008, US Route 301 in Delaware is classified as a Rural Arterial.

In contrast to the multi-lane, divided roadway in Maryland, US 301 in Delaware, from Ash Boulevard to Mount Pleasant (south of the C&D Canal), a distance of 3.6 miles, is the only portion of the roadway in the region that is two lanes and has several full signal-controlled intersections. At Mount Pleasant, US 301 again becomes a four-lane, divided roadway to its terminus at US 40 in Glasgow, Delaware. Throughout this 15 mile roadway length, there are 27 at-grade intersections with state and county numbered roads and subdivision streets, most of which provide full directional access. Of these 27 intersections, fourteen are signalized. There are also several residential and commercial driveways with direct access to US 301 within this 15 mile segment.

The posted speed limit for the section of roadway within the project limits varies from 35 mph within Middletown's town limits to 55 mph at the Summit Bridge.

3.1.2 Existing traffic conditions

Land Use

The population in the entire study area grew by over 70 percent from 1990 to 2000. This significant growth of population and housing in the project area, coupled with increases in through and seasonal traffic, has resulted in increased traffic congestion and decreased safety on the existing roadway system. Projections for continued, significant growth forebode an ever worsening traffic situation in Delaware's most rapidly developing area. Infrastructure improvements have failed to keep pace with the development in the area.

Regional Distribution

A traffic survey conducted in October 2004 showed that approximately 65 percent of all northbound traffic originating south of the C&D Canal is destined for the northeast to Wilmington, Philadelphia, New Jersey and points beyond. Thirty-five percent of the traffic has destinations to the north towards Newark, Delaware and Pennsylvania. However, the traffic survey, which asked motorists to document their actual travel routes, showed that despite the majority of northbound destinations being to the northeast, approximately 60 percent of the motorists currently continue north on US 301/SR 896 and then travel east on I-95, rather than using a more direct east-west route south of the Canal.



Truck Traffic

US 301 currently functions as a regional truck route with the truck traffic contributing 25 to 30 percent of the overall traffic crossing the Delaware/Maryland state line and traveling north on US 301. Studies also showed that 95 percent of the northbound truck traffic originating south of Middletown is destined to points northeast of the C&D Canal, with nearly 90 percent of them leaving Delaware.

3.1.3 Available Crash Data

To assist the SDCs in performing crash analyses, the GEC obtained crash data for the most recent three year period for the roadways in the project area. Table 3.1 contains a list of roadway segments for which the crash data was requested from DelDOT. A summary of the crash data and analysis of crash trends can be found in each Design Section of this Chapter.

TABLE 3.1 Summary of Crash Data		
Roadway	Start MP	End MP
Strawberry Lane (N445), MD Line to Levels Road	0	1.19
DE 299 / Warwick Road (N443), MD Line to US 301 (N62)	0	0.52
Middle Neck Road (N444), MD Line to US 301 (N443)	0	1.08
Levels Road (N10), St. Annes Church Rd (N447) to US 301 (N443)	2.88	3.97
Bunker Hill Road (N437), Choptank Rd (N435) to US 301(N39)	1.73	2.74
Choptank Road (N435), Bunker Hill Road (N437) to Bethel Church Road (N433)	3.37	4.86
Old Telegraph Road (Maryland), Water Street to Bunker Hill Road (N437)	0	3.1
Armstrong Corner Road (N429), Choptank Rd (N435) to US 301(N39)	3.9	4.79
Old Schoolhouse Road (N431), Choptank Rd (N435) to US 301(N39)	0	1.69
Churchtown Road (N432), Choptank Rd (N435) to US 301 (N39)	1.78	3.82
Bethel Church Road (N433), Choptank Rd (N435) to SR 896 (N16)	1.73	2.55
Bohemia Mill Road (N436), Maryland State Line to US 301 (N39)	0	2.13
SR 896 / Boyds Corner Road (N15), Ratledge Rd (N414) to Cedar Lane Rd (N427)	0.6	1.62
Jamisons Corner Road (N413), SR 896 (N15) to N412A	0	1.76
Hyetts Corner Road (N412), N412A to US 13 (N22)	1.76	3.91
Lorewood Grove Road (N412), Rd 412A to US 13 (N34)	0.0	1.77
US 13 (N34), Port Penn Rd (N2) to Lorewood Grove Road (N412)	0	1.41
SR 1 (N82), Scott Run to Kirkwood St. George's Rd (N409)	0	1.90
SR 1 (N83), US 13 (N22) to Scott Run	6.07	7.75
Existing US 301 (N62, N443, N39, N16), MD Line to C&D Canal	Varies	Varies
N62, MD Line to N443	0	1.01
N443, N62 to N39	0.52	4.35
N39, N443 to N15	0.98	4.31
N16 (NB and Two-Way), N15 to N399	0	3.43
N16 (SB), N15 to N399	0.67	3.83
Choptank Road (N435), Bunker Hill Rd (N437) to Bethel Church Rd (N433)	0	4.86



3.1.4 Available Traffic Data

The US 301 “Travel Analysis Technical Report”, dated December 2006, contains a variety of traffic data and analysis that support the project. As part of the US 301 Study, the project team undertook an extensive data collection effort, obtaining 2005 traffic data at over 30 intersections (peak hour data) and on more than 30 roadway links. Table 3.2 contains a partial list of these count locations, which may be applicable in the development of the TMP. This data was used in the baseline 2003 and projected 2030 capacity analyses conducted to evaluate alignment alternatives.

TABLE 3.2	
List of Available 2005 Traffic Counts	
Intersection Turning Movement Counts (Peak Period)	
US 301 / SR 896 (Summit Bridge Rd) @ SR 15 (Bethel Church Rd)	
US 301 (Summit Bridge Rd) @ SR 896 (Boyds Corner Rd)	
SR 896 (Boyds Corner Rd) @ Cedar Lane Rd	
US 301 / SR 896 (Summit Bridge Rd) @ Old Summit Bridge Rd	
Southbound SR 1 Off-Ramp at Lorewood Grove Rd	
SR 15 (Choptank Rd) @ Churchtown Rd	
US 301 (Summit Bridge Rd) @ Marl Pit Rd / Armstrong Corner Rd	
US 301 (Summit Bridge Rd) @ SR 71 (Broad Street)	
SR 896 (Boyds Corner Rd) @ US 13 (Dupont Highway)	
Marl Pit Rd @ Cedar Lane Rd	
US 13 (Dupont Highway) @ Port Penn Rd	
Tube Counts (minimum of weekday 24-hours)	
Hyetts Corner Rd	
Jamisons Corner Rd	
Lorewood Grove Rd	
Old Summit Bridge Rd	
Ratledge Rd	
SR 15 (Choptank Rd), south of Churchtown Rd	
SR 896 (Boyds Corner Rd), west of Cedar Lane Rd	
US 301 / SR 896 (Summit Bridge Rd) at Summit Bridge	
Cedar Lane Rd	
US 301 / SR 896 (Summit Bridge Rd), south of Victoria Drive	
US 301 (Middletown - Warwick Rd), north of SR 15 (Levels Rd)	
SR 299 (Warwick Rd)	
Strawberry Lane	
US 301 (Middletown - Warwick Rd) at MD / DE state line	

Appendix F of the “Travel Analysis Technical Report” contains results of the capacity analyses, including HCS2000, Synchro 6, and SIDRA Reports. Traffic data, such as signal timings and lane configurations, can be obtained from these reports. The US 301 GEC has also collected traffic data at a variety of locations within the study area in recent years to address specific issues that arose during the planning process.

In addition, traffic data can be obtained from DelDOT’s Traffic Summary Reports, which are available on the DelDOT website:



http://www.deldot.gov/information/pubs_forms/manuals/traffic_counts/index.shtml

These traffic summaries include monthly traffic data at ATR stations, and truck percentages, K factors and D factors by Traffic Pattern Group. To obtain construction year traffic volumes, growth factors will be calculated by looking at ADTs over the past several years to determine a trend.

The high percentage of truck traffic and continued population and development growth in the project area will be considered in traffic data manipulation and analysis.

3.1.5 Hazard Elimination Program (HEP) and Locations

The Hazard Elimination Program is a federally funded program that involves identifying locations having a high frequency of crashes and developing potential short-term and long-term solutions to reduce the severity and frequency of crashes at these locations. In the US 301 project area, three such locations were identified as a part of the program over the past few years (Refer to Table 3.3) in the vicinity of the project area. Detailed information regarding the problems at these locations, potential impact of the project construction on these locations and the potential mitigation measures can be found in each design section.

TABLE 3.3 HEP Locations			
Location	Start MP (Location)	End MP (Location)	Year
SR 299/Main Street	Intersection of US 301	0.11 mile east of Silver Lake Road	2006, 2007, 2009,2010
US 301/SR 896/Summit Bridge Road	1.2 (0.44 N. of Beaston Rd.)	1.59 (0.56 S. of Bethel Church Rd.)	2007
US 13	0.19 mile south of Greylag Road	0.24 mile north of Boyd's Corner Road	2006
SR 299	US 301 (0.0)	0.11 miles east of Silver Lake Road (1.79)	2010
US 301 (N039)	0.21 mile north of Springmill Drive	0.25 mile north of Marl Pit Road	2011
US 13	0.33 miles south of the SR 1 "Free Ramp"	0.26 miles north of the SR 1 "Free Ramp"	2014
Bunker Hill Road	0.04 miles west of Sandhill Drive	US 301	2014

In addition, one High Risk Rural Road Program (HRRRP) location has been identified in the vicinity of the project area.

TABLE 3.3 HRRRP Locations			
Location	Start MP (Location)	End MP (Location)	Year
Churchtown Road	0.11 mile east of Dickerson Lane	0.33 mile west of SR 896/Summit Bridge Road	2009



3.2 DESIGN SECTION 1

This section provides a brief discussion of the existing characteristics of the roadways in the area of Design Section 1.

State Route 1 (SR 1): State Route 1 is one of the major north-south routes in Delaware, spanning all three counties. It is classified as a rural principal arterial in the project area. SR 1 in New Castle County is a 29.5 mile stretch of four-lane, divided, fully controlled access roadway up to the Biddles Corner Toll Plaza, just south of the C&D Canal. North of the toll plaza, SR 1 is a six-lane, divided, fully controlled access roadway until the US 13 split at Tybouts Corner. Approximately one mile north of the Biddles Corner Toll Plaza, there is a slip ramp from US 13 to northbound SR 1 (“Free ramp”) leading towards the SR 1 bridge over the C&D Canal, and a loop ramp from southbound SR 1 to Lorewood Grove Road to US 13.

The posted speed limit on SR 1 in the project area is 65 mph. In addition to the cash lanes, the Biddles Corner Toll Plaza has high-speed EZ Pass lanes in both directions, also with a posted speed limit of 65 mph. The section of SR 1 in the project area serves as the major north-south route leading towards the beaches in Sussex County and hence experiences high traffic volumes during the summer months. It also experiences high traffic volumes during the morning and afternoon peak hours due to drivers commuting to and from areas north of the C&D Canal. According to August 2011 count data at the Biddles Toll Plaza and ATR station 8018, the ADT along SR 1 within this section ranges from approximately 60,200 to 86,800.

US 13 (Dupont Highway): US 13 is a major north-south route in Delaware, spanning all three counties. It is classified as a rural minor arterial within the study area. US 13 within the project area is a four-lane, divided roadway that is reduced to two lanes over the St. Georges bridge.

The posted speed limit on US 13 in the project area is 55 mph. The section of US 13 in the project area serves as one of the major north-south routes leading towards the beaches in Sussex County and hence experiences high traffic volumes during the summer. It also experiences high traffic volumes during the morning and afternoon peak hours due to drivers commuting to and from areas north of the C&D Canal. According to the 2011 DelDOT Traffic Summary, the ADT along US 13 within this section is approximately 26,700.

Boyds Corner Road (SR 896): The 3.75-mile section of Boyds Corner Road in the project area between existing US 301 and SR 1 is classified as a rural principal arterial and is a two lane, undivided roadway with 12-foot lanes and 12-foot shoulders. In the immediate vicinity of the SR 1 northbound and southbound ramps, Boyds Corner Road is a four-lane, divided roadway with varying shoulder widths.

Traveling east from existing US 301, the posted speed limit on Boyds Corner Road is 25 mph from the intersection of existing US 301 to the Norfolk Southern Railroad crossing. East of the railroad crossing to west of Ratledge Road, the speed limit is 35 mph, and the speed limit is 50 mph from Ratledge Road to the intersection of Boyds Corner Road at US 13. Boyds Corner Road provides access to a number of residences and two schools. According to the 2011 DelDOT Traffic Summary, the ADT along Boyds Corner Road within this section is approximately 12,000.

Jamison Corner Road/Hyetts Corner Road: Jamison Corner Road/Hyetts Corner Road (N413) is classified as a rural major/minor collector. Jamison Corner Road is a two-lane, undivided roadway extending 1.6 miles north from its intersection with Boyds Corner Road. It then turns sharply to the east and transitions into Hyetts Corner Road. Hyetts Corner Road is also a two-lane, undivided roadway extending 2.3 miles to intersect US 13. Jamison Corner Road intersects Boyds Corner Road as a three-legged T-intersection, approximately 1.8 miles west of US Route 13. Boyds Corner Road forms the east and west legs while Jamison Corner Road forms the north leg of the intersection. Hyetts Corner Road intersects US 13 as a three-legged T-intersection with US 13 forming the north and south legs and Hyetts Corner Road forming the west leg of the intersection.

There are no speed limit signs posted along Jamison Corner Road within the study area. Southbound traffic on Jamison Corner Road is controlled by a STOP sign at its intersection with Boyds Corner Road. There is a one-lane bridge located on this section of Jamison Corner Road. There is a yield sign on either side of the bridge requiring the northbound and southbound traffic to yield to oncoming traffic on the bridge. The posted speed limit on Hyetts Corner Road is 40 mph. Eastbound traffic on Hyetts Corner Road is controlled by a STOP sign at its intersection with US 13 (installing a traffic signal at US 13 at Hyetts Corner Road is under consideration as of January 2015). According to the 2011 DelDOT Traffic Summary, the ADT along Jamison Corner Road/Hyetts Corner Road is approximately 160.

A project, T200712003 – Jamison Corner Road, From Boyds Corner Road to Hyetts Corner Road, is proposed which will reconstruct Jamison Corner Road with two full width travel lanes, shoulders and a multi-use path. This project should be completed before US 301 construction.

Lorewood Grove Road: Lorewood Grove Road (N412) is classified as a rural major collector. Lorewood Grove Road is a two-lane, undivided roadway extending 4.76 miles between US 13 to the east and Old Summit Bridge Road to the west. Lorewood Grove Road becomes a lane addition on southbound US 13 at its eastern terminus. At its western end, Lorewood Grove Road intersects Old Summit Bridge Road as a three-legged, T-intersection with Old Summit Bridge Road forming the northbound and southbound approaches and Lorewood Grove Road forming the westbound approach. The posted speed limit on Lorewood Grove Road is 50 mph. At its intersection with Old Summit Bridge Road, the westbound Lorewood Grove Road approach is controlled by a STOP sign. According to the 2011 DeIDOT Traffic Summary, the ADT along Lorewood Grove Road is approximately 1,100.

Port Penn Road: Port Penn Road (N2) is classified as a rural minor collector. Port Penn Road is a two-lane, undivided roadway extending 3.93 miles between US 13 to the west and SR 9 (Delaware City Port Penn Road) to the east. Port Penn Road intersects US 13 as a three-legged T-intersection. At its east end, Port Penn Road merges into SR 9/Market Street. The posted speed limit on Port Penn Road is 50 mph. At its intersection with US 13, left-turn movements onto southbound US 13 are controlled by a STOP sign and the right-turn movements are controlled by a YIELD sign. According to the 2011 DeIDOT Traffic Summary, the ADT along Port Penn Road is approximately 1,200.

3.2.1 Crash History

Crash data from January 2009 to December 2011 within the project limits of Section 1 has been evaluated to determine if any existing safety issues are located along the construction corridor and detour routes which may warrant improvements prior to construction. Tables 3.2.2.1 and 3.2.2.2 summarize the Section 1 crash data including a comparison of crash rates along the study roadways to statewide average crash rates (per million vehicle miles traveled).

Based on a review of average crash rates, the following roadway segments exhibit crash rates greater than the statewide average crash rate for similar roadways. Detailed crash data along these roadways is discussed in the safety assessment contained in Chapter 4.

- US 13 (N34/N22), 0.10 south of Hyetts Corner Rd to Lorewood Grove Rd (N412)
- Lorewood Grove Rd (N412), Rd 412A to US 13 (N34)
- Jamison Corner Rd (N413), Boyds Corner Rd to N412A
- Hyetts Corner Rd (N413), N412A to US 13

Additionally, there are no recent HEP/HRRRP locations within the project limits of Section 1.



TABLE 3.2.2.1 Design Section 1 – Crash Rate Comparison					
Roadway	Length (miles)	Crashes (2009-2011)	2011 AADT	Crash Rate	Statewide Average Crash Rate
Boyd's Corner Rd (N15), Rattledge Road to Cedar Lane Rd	1.03	6	11,971	0.52	1.14
US 13 (N34/N22), 0.10 south of Hyetts Corner Rd to Lorewood Grove Rd (N412)	2.64	143	26,646	1.86	1.30
SR 1 (N83/N82), Dupont Pkwy to Kirkwood-St. Georges Rd	3.64	74	66,261	0.28	0.60
Lorewood Grove Rd (N412), Rd 412A to US 13 (N34)	1.96	20	1,092	8.53	1.58
Jamison Corner Rd (N413), Boyd's Corner Rd to N412A	1.77	5	160	16.12	1.58
Hyetts Corner Rd (N413), N412A to US 13	2.15	16	160	42.48	2.06

TABLE 3.2.2.2 Crash History by Manner of Impact						
Manner of Impact (1/1/2009-12/31/2011)	SR 1 (N82/N83)	US 13 (N22/N34)	Boyd's Corner Rd (N15)	Lorewood Grove Rd (N412)	Jamison Corner Rd (N413)	Hyetts Corner Rd (N413)
	Total	Total				
Not collision between two vehicles in transport	14	11	0	3	0	1
Rear end	10	78	2	5	2	4
Head on	1	4	1	0	1	1
Rear-to-rear	0	1	0	0	0	0
Angle	15	19	2	5	1	8
Sideswipe - same direction	19	14	1	2	0	0
Sideswipe - opposite direction	0	1	0	1	0	0
Unknown	15	15	0	4	1	2
Total	74	143	6	20	5	16

3.2.2 Existing Traffic Conditions

Traffic characteristics for the existing impacted roadways are documented in the Existing Roadway Characteristics section above (3.2.1). Table 3.2.3.1 summarizes traffic volumes characteristics of roadways within the study area

including AADT, peak hour volumes and truck percentages (where available). Turning movement count data and ATR data was provided by DeIDOT, the GEC and supplemented with turning movement counts performed by the WR&A section design team.

- Turning movement count locations:
 - US 13 at Marl Pit Road
 - US 13 at SR 896 Boyds Corner Road
 - US 13 at Hyetts Corner Road
 - US 13 at Port Penn Road
 - US 13 at Lorewood Grove Road
 - US 13 at NB SR 1 Ramp/"Free Ramp"
 - US 13 at SR 72/Wrangle Hill Road
 - SR 896/Boyds Corner Road at Jamison Corner Road
 - SR 896/Boyds Corner Road at NB SR 1 ramps
 - SR 896/Boyds Corner Road at SB SR 1 ramps
 - Existing US 301/Summit Bridge Road at Armstrong Corner Road/Marl Pit Road
 - Existing US 301/Summit Bridge Road at Churchtown Road/SR 896/Boyds Corner Road
 - SR 72/Wrangle Hill Road at NB SR 1 Ramps
 - SR 72/Wrangle Hill Road at SB SR 1 Ramps
 - Lorewood Grove Road at Lane Road
- 24-hour count locations:
 - SR 1 at Biddles Toll Plaza
 - SR 1 between Roth Bridge and SR 72 (ATR 8018)
 - US 13 between Marl Pit Road and Boyds Corner Road
 - US 13 at Lorewood Grove Road (ATR 8028)
 - US 13 on St. Georges Bridge
 - SR 896/Boyds Corner Road at proposed US 301 overpass
 - Northbound SR 1 Off-ramp to Boyds Corner Road (Exit 142)
 - Northbound SR 1 On-ramp from Boyds Corner Road
 - Southbound SR 1 Off-ramp to Boyds Corner Road (Exit 142)
 - Southbound SR 1 On-ramp from Boyds Corner Road
 - US 301/Summit Bridge Road between Marl Pit Road and SR 896/Boyds Corner Road
 - Hyetts Corner Road (east of Airmont Drive)
 - Jamison Corner Road (north of Boyds Corner Road)
 - Lorewood Grove Road (west of SR 1)
 - Southbound SR 1 off-ramp to Lorewood Grove Road (Exit 148)
 - Northbound SR 1 Off-ramp to SR 72 (Exit 152)
 - Northbound SR 1 On-ramp from SR 72
 - Southbound SR 1 Off-ramp to SR 72 (Exit 152)
 - Southbound SR 1 On-ramp from SR 72

TABLE 3.2.3.1 Existing Traffic Volumes				
Roadway	Segment	AADT (Year)	Peak Hour Volume	Truck %
SR 1	At Biddles Toll Plaza	60,177 (2011)	4,338	-
	St. Georges Bridge to SR 72	86,722 (2011)	6,417	-
US 13	Marl Pit Road to Boyds Corner Road	27,276 (2008)	2,248	3%
	At Lorewood Grove Rd	10,002 (2011)	995	-
	St. Georges Bridge	12,287 (2008)	1,294	4%
Boyds Corner Road	Existing US 301/Summit Bridge Road to US 13	10,440 (2010)	772	13%
Hyetts Corner Road	Jamison Corner Road to US 13	390 (2006)	72	7%
Jamison Corner Road	Boyds Corner Road to Hyetts Corner Road	916 (2006)	113	3%
Lorewood Grove Road	West of SR 1	3,966 (2010)	387	11%
Port Penn Road	US 13 to SR 9	1,281 (2009)	248	-
US 301 Existing	Armstrong Corner Road/ Marl Pit Road to Boyds Corner Road	22,261 (2010)	1,723	15%
Marl Pit Road	Existing US 301/Summit Bridge Road to US 13	4,171 (2010)	398	7%

3.2.3 Construction Period Traffic Conditions

Construction year (2015) traffic volumes were developed to assess the impacts of maintenance of traffic operations on traffic operations. Based on a review of historic traffic volumes in the study area and based on input from the GEC, a growth rate of 3 percent was assumed for all roadways within the study area. Calculated growth rates along both US 13 and SR 1, the critical roadways within the study area range from 0.2 to 2.4 percent; therefore, based on guidance from the GEC, 3 percent was assumed to be a reasonable and conservative growth rate for the study area.

Traffic forecasts were developed for each phase of construction for relevant detours and lane closures proposed as discussed below. Analyses were performed for 2015 conditions without construction and 2015 conditions during construction. Capacity analysis at signalized intersections were performed using *Synchro Software, Version 7*. Where applicable, existing signal timing data provided by DelDOT was used in the analysis. Signal splits were optimized using Synchro software; however, existing cycle lengths (as provided by DelDOT) were maintained for conditions during construction, **unless otherwise noted**. Capacity analyses at unsignalized intersections were performed using *Highway Capacity Software, 2011 Edition*.

Contract 1A

Hyetts Corner Road Closure and Detour: Construction period traffic volumes were calculated by assigning traffic volumes along Hyetts Corner Road at the proposed roadway closure at Scott Run to the proposed detour route. As shown in Tables 3.2.4.1 and 3.2.4.2, all intersections operate at the same LOS under diverted conditions with the Hyetts Corner Road detour as in the baseline conditions and all approaches meet the established LOS and delay criteria. Although a quantitative analysis was not performed for the proposed Hyetts Corner Road at Jamison Corner Road roundabout, it can be anticipated that the relatively low detoured traffic volumes along Hyetts Corner Road (i.e., less than 35 vph) can be accommodated at the roundabout since the roundabout has been designed to accommodate future design year traffic volumes.

Since the proposed Hyetts Corner Road detour will implemented for the majority of construction of Section 1, the detoured volume conditions were assumed to be the baseline conditions for all further analysis associated with the Section 1 contract.



As of January 2015, DelDOT began considering the need for signaling the US 13 at Hyetts Corner Road intersection. As such, the intersection was analyzed for both unsignalized and signalized conditions. The US 13 at Hyetts Corner Road signal analysis assumed the following:

Existing lane configurations will be maintained

Protected-only left-turn phasing would be installed on the US 13 approaches

Existing cycle lengths at the US 13 at SR 896/Boyds Corner Road intersection were matched at the US 13 at Hyetts Corner Road intersection

As shown below, minimal impacts to traffic operations are anticipated if the US 13 at Hyetts Corner Road intersection is signalized. Due to low turning movements at the intersection, the intersection is not expected to be a constraint for traffic along the US 13 corridor during other phases of construction. Additionally, significant lane closures and or roadway closures required for the US 301 project (i.e., SR 1 Detour, US 13 Lane Closures, Boyds Corner Road Detour, etc.) are planned during off-peak and/or nighttime work hours when turning movements at US 13 at Hyetts Corner Road are less than the AM and PM peak hours shown in the following tables.



TABLE 3.2.4.1 AM Peak Period (7 AM – 8 AM) Hyetts Corner Road Closure and Detour												
			2015 Baseline Conditions					2015 Detour Conditions				
Intersection	Approach	Mvmt	Baseline Volume (Veh/hr)	Mvmt LOS	Delay (s)	95 th % Queue (ft)	Int LOS/ Delay (s)	Diverted Volume (Veh/hr)	Mvmt LOS	Delay (s)	95 th % Queue(ft)	Int LOS/ Delay (s)
SR 896/ Boyds Corner Rd at Jamison Corner Rd (Unsignalized)	SR 896/Boyds Corner Rd	EBL	19	A	8.7	25	N/A	19	A	8.7	25	N/A
		EBT	757	-	-	-		757	-	-	-	
	SR 896/Boyds Corner Rd	WBT	539	-	-	-		539	-	-	-	
		WBR	5	-	-	-		17	-	-	-	
	Jamison Corner Rd	SBL	3	B	14.3	25		19	C	22.3	25	
		SBR	32					32				
US 13 at SR 896/Boyds Corner Rd (Signalized)	SR 896/Boyds Corner Rd	EBL	279	D	52.9	171	48.0	291	D	53.0	178	48.1
		EBT	316	D	53.7	196		316	D	53.3	196	
		EBR	101	D	48.0	51		105	D	47.8	51	
	SR 896/Boyds Corner Rd	WBL	113	E	74.1	165		113	E	74.1	165	
		WBT	154	E	69.1	148		154	E	69.1	148	
		WBR	56	E	60.8	47		56	E	60.8	47	
	US 13	NBL	214	E	70.6	161		222	E	71.1	167	
		NBT	2001	D	49.2	#912		1993	D	49.1	#905	
		NBR	384	C	26.5	65		384	C	26.6	65	
	US 13	SBL	68	E	71.9	#75		68	E	72.1	#75	
		SBT	446	C	30.1	158		442	C	30.4	156	
		SBR	133	C	28.3	49		137	C	28.7	49	
US 13 at Hyetts Corner Rd (Unsignalized)	Hyetts Corner Rd	EBL	102	F	76.6	140	N/A	90	F	59.9	108	N/A
		EBR	35					31				
	US 13	NBL	102	A	9.7	25		94	A	9.6	25	
		NBT	2251	-	-	-		2263	-	-	-	
	US 13	SBT	612	-	-	-		616	-	-	-	
		SBR	44	-	-	-		40	-	-	-	
US 13 at Hyetts Corner Rd (Signalized)	Hyetts Corner Rd	EBL	102	F	124.3	#283	18.4	90	F	99.7	#244	16.8
		EBR	35					31				
	US 13	NBL	102	F	73.7	172		94	E	73.7	162	
		NBT	2251	B	11.9	747		2263	B	12.1	760	
	US 13	SBT	612	B	10.2	166		616	B	9.9	163	
		SBR	44	A	8.3	15		40	A	8.0	14	



TABLE 3.2.4.2
PM Peak Period (5 PM – 6 PM)
Hyetts Corner Road Closure and Detour

			2015 Baseline Conditions					2015 Detour Conditions					
Intersection	Approach	Mvmt	Baseline Volume (Veh/hr)	Mvmt LOS	Delay (s)	95 th % Queue (ft)	Int LOS/ Delay (s)	Diverted Volume (Veh/hr)	Mvmt LOS	Delay (s)	95 th % Queue (ft)	Int LOS/ Delay (s)	
SR 896/ Boyds Corner Rd at Jamison Corner Rd (Unsignalized)	SR 896/Boyds Corner Rd	EBL	17	A	9.6	25	N/A	17	A	9.7	25	N/A	
		EBT	828	-	-	-		828	-	-	-		
	SR 896/Boyds Corner Rd	WBT	777	-	-	-		777	-	-	-		
		WBR	7	-	-	-		24	-	-	-		
	Jamison Corner Rd	SBL	0	C	18.9	30		17	D	32.2	64		
		SBR	100					100					
US 13 at SR 896/Boyds Corner Rd (Signalized)	SR 896/Boyds Corner Rd	EBL	225	E	56.2	140	46.2	234	E	55.9	144	46.7	
		EBT	194	E	55.1	124		194	D	54.6	124		
		EBR	173	E	56.0	123		181	E	56.1	134		
	SR 896/Boyds Corner Rd	WBL	192	F	101.0	#296		192	F	101.0	#296		
		WBT	221	F	85.4	#245		221	F	85.4	#245		
		WBR	92	E	60.8	58		92	E	60.8	58		
	US 13	NBL	NBT	152	E	69.6		#157	158	E	69.4		#165
			NBT	698	C	25.8		231	692	C	26.1		228
		NBR	NBR	97	C	22.5		39	97	C	22.8		39
			SBL	98	E	69.5		87	98	E	69.5		87
	US 13	SBT	SBT	1725	D	40.1		705	1717	D	41.0		700
			SBR	198	C	24.9		52	209	C	25.5		53
		SBR	198	C	24.9	52		209	C	25.5	53		
	US 13 at Hyetts Corner Rd (Unsignalized)	Hyetts Corner Rd	EBL	27	F	71.9		61	N/A	18	F		56.9
EBR			25	17									
US 13		NBL	48	D	25.7	25	42	D		25.0	25		
		NBT	988	-	-	-	997	-		-	-		
US 13		SBT	1996	-	-	-	2007	-		-	-		
		SBR	77	-	-	-	66	-		-	-		
US 13 at Hyetts Corner Rd (Signalized)	Hyetts Corner Rd	EBL	27	E	72.2	76	12.8	18	E	70.8	58	11.7	
		EBR	25					17					
	US 13	NBL	48	F	88.1	98		42	F	90.2	91		
		NBT	988	A	3.0	147		997	A	2.9	145		
	US 13	SBT	1996	B	14.6	880		2007	B	13.6	855		
		SBR	77	A	4.8	16		66	A	4.4	14		

Boyds Corner Road Detour: Construction period traffic volumes were calculated by assigning traffic volumes along Boyds Corner Road at the proposed roadway closure between Ratledge Road and Cedar Lane Road to the proposed detour route. The proposed detour route consists of Summit Bridge Road (existing US 301), US 13, SR 896/Boyds Corner Road, and Marl Pit Road. It should be noted that the proposed detour of Boyds Corner Road is similar to the detour route for the proposed closure of US 301/Summit Bridge Road as part of the Section 2 contract. The analysis assumes that the proposed Boyds Corner Road and proposed US 301/Summit Bridge Road closures do not occur concurrently. Existing signal timings were adjusted, as needed, to accommodate detoured traffic volumes.

In order to assess the impact of nighttime closures, 24-hour count data along US 301/Summit Bridge Road, US 13, SR 896/Boyds Corner Road, and Marl Pit Road was used to calculate off-peak detour volumes. The desired roadway closure period is from 9 PM to 5 AM. During this period, the highest volume of diverted traffic occurs from 9 PM to 10 PM; therefore, this hour was analyzed (see Table 3.2.4.3). During this period, 174 vehicles can be expected to be detoured from eastbound Boyds Corner Road and 213 vehicles can be expected to be detoured from westbound Boyds Corner Road. The analysis assumes all detoured vehicles will follow the signed detour route; however, it is likely that some detoured vehicles will use alternative local routes (e.g., Cedar Lane Road and



Shallcross Lake Road). As previously noted, trucks constitute approximately 19 percent of the traffic volume along Boyds Corner Road. As such, diverted truck volumes were reassigned along the detour route and were included in the analysis. The following four intersections were identified as critical intersections along the proposed detour route:

- US 301/Summit Bridge Road (existing) at Churchtown Road/SR 896/Boyds Corner Road (Signalized)
- US 301/Summit Bridge Road (existing) at Armstrong Corner Road/Marl Pit Road (Signalized)
- US 13 at Marl Pit Road (Unsignalized)
- US 13 at SR 896/Boyds Corner Road (Signalized)

As shown in Table 3.2.4.3, the US 301 (existing) at Churchtown Rd/SR 896/Boyds Corner Road, US 301 at Armstrong Corner Road, US 13 at Marl Pit Road, and US 13 at SR 896/Boyds Corner Road intersections operate at LOS C or better during detoured conditions during the critical hour (i.e., 9 PM to 10 PM) of the proposed detour and delay increases for individual turning movements are within established thresholds.

Under detoured conditions, a significant amount of traffic is added to the minor street approach to the unsignalized US 13 at Marl Pit Road intersection. As shown in Table 3.2.4.3, eastbound left turns at the intersection increase from 18 vehicles in the 2015 Baseline Conditions to 145 vehicles in the 2015 Detoured Conditions. However, due to the relatively low off-peak volumes along US 13, the eastbound left-turn delays are expected to be less than 16 seconds. 95th-percentile queues are 32 feet and can be accommodated within the existing left-turn lane (160 feet existing).



TABLE 3.2.4.3 9 PM – 10 PM Boys Corner Road Closure and Detour												
			2015 Baseline Conditions					2015 Detoured Conditions				
Intersection	Approach	Mvmt	Volume (Veh/hr)	Mvmt LOS	Delay (s)	95 th % Queue (ft)	Int LOS/ Delay (s)	Volume (Veh/hr)	Mvmt LOS	Delay (s)	95 th % Queue (ft)	Int LOS
US 301 Existing at Churchtown Rd/ SR 896/Boys Corner Road (Signalized)	Churchtown Road	EBL	16	E	74.4	43	B 19.2	16	E	74.3	43	B 17.6
		EBT	12	E	73.4	42		0	E	69.7	0	
		EBR	7	-	-	-		19	-	-	-	
	SR 896/ Boys Corner Rd	WBL	57	E	67.4	55		57	E	67.4	55	
		WBT	23	E	67.3	56		23	E	67.2	56	
		WBR	53	E	65.3	47		53	E	65.3	47	
	US 301 Existing	NBL	12	A	7.4	9		50	A	4.7	26	
		NBT	288	A	9.4	89		375	A	5.2	83	
		NBR	64	A	8.6	20		0	-	-	-	
	US 301 Existing	SBL	77	A	4.9	18		0	-	-	-	
		SBT	292	A	7.7	87		369	A	9.3	114	
		SBR	9	A	6.8	8		9	A	7.9	8	
US 301 Existing at Armstrong Corner Rd/Marl Pit Road (Signalized)	Armstrong Corner Rd	EBL	4	E	70.2	65	B 10.1	4	D	46.4	49	C 25.4
		EBT	20					20				
		EBR	16					16				
	Marl Pit Rd	WBL	16	E	72.9	89		95	E	72.0	310	
		WBT	17					17				
		WBR	28					153				
	US 301 Existing	NBL	23	A	1.6	7		23	A	9.4	20	
		NBT	352	A	3.4	132		288	B	14.1	262	
		NBR	18	A	2.2	6		82	B	11.2	37	
	US 301 Existing	SBL	63	A	1.3	14		152	A	7.2	96	
		SBT	408	A	3.2	150		408	B	12.2	344	
		SBR	10	A	1.9	5		10	A	8.2	13	
US 13 at Marl Pit Rd (Unsignalized)	Marl Pit Rd	EBL	18	B	12.6	3	N/A	145	C	15.1	32	N/A
		EBR	7	B	11.9	25		33	A	9.9	25	
	US 13	NBL	7	A	8.4	25		28	A	9.1	25	
		NBT	279	-	-	-		258	-	-	-	
	US 13	SBT	441	-	-	-		391	-	-	-	
		SBR	36	-	-	-		219	-	-	-	
US 13 at SR 896/Boys Corner Rd (Signalized)	SR 896/ Boys Corner Rd	EBL	78	E	75.5	72	C 29.8	12	E	70.4	18	C 20.3
		EBT	67	E	70.8	65		10	E	70.1	16	
		EBR	60	E	68.0	50		9	E	68.9	21	
	SR 896/ Boys Corner Rd	WBL	60	E	66.6	104		157	E	68.3	143	
		WBT	97	E	65.6	91		0	E	60.7	69	
		WBR	31	E	60.6	34		31	E	58.0	33	
	US 13	NBL	21	E	72.1	27		0	-	-	-	
		NBT	260	B	11.1	64		326	B	12.1	86	
		NBR	33	B	10.6	18		94	B	11.9	31	
	US 13	SBL	26	E	72.2	31		26	E	72.3	31	
		SBT	568	B	12.0	135		654	A	8.7	135	
		SBR	86	B	11.0	27		0	-	-	-	

Boys Corner Road Flagging Operation: Figure 3.2.4.1 shows the 2015 hourly traffic volumes along eastbound and westbound Boys Corner Road between Ratledge Road and Jamison Corner Road. A spreadsheet methodology was used to calculate maximum delays associated with a flagging operation for each hour of the day for 2015 traffic volumes to determine appropriate work hour restrictions. Figure 3.2.4.2 shows the maximum anticipated delay under continuous flagging operations (i.e., alternating one-way operations). It was assumed that flagging operations would not be permitted during peak periods (i.e., 7 to 9 AM and 3 to 6 PM) when traffic volumes



are greatest. Additionally, restricting continuous flagging operations from 6 to 7 AM is recommended due to the similar anticipated delays as during the peak hours. As noted below, providing consistent work hour restrictions is preferred. Therefore, continuous flagging operations along Boyds Corner Road should be permitted from 9 AM to 3 PM and from 7 PM to 6 AM.

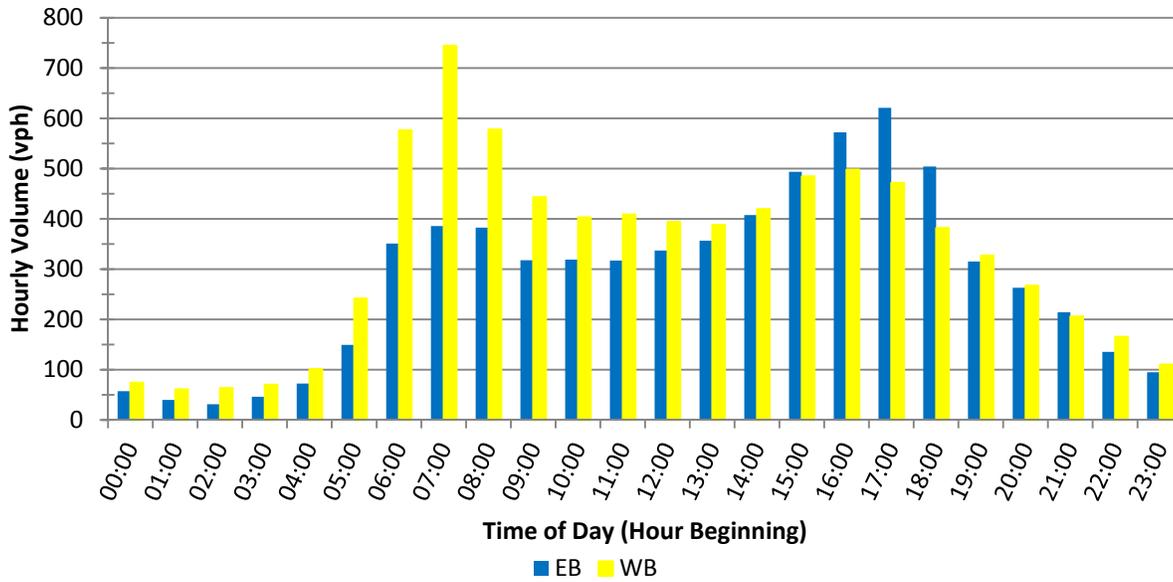
Additionally, hauling operations across Boyds Corner Road may require temporary road closures during both periods when Boyds Corner Road is under normal operations and during flagging operations (i.e., alternating one-way operations). Analyses were performed to determine the impact of both scenarios. Figure 3.2.4.3 shows the maximum anticipated delay assuming a two-minute roadway closure with two-way operations along Boyds Corner Road. Based on this analysis, it is recommended that intermittent two minute closures of Boyds Corner Road be permitted from 9 AM to 3 PM and from 6 PM to 6 AM. Figure 3.2.4.4 shows the maximum anticipated delay assuming 30 second roadway closures in conjunction with the flagging operation to alternate the right-of-way between eastbound and westbound Boyds Corner Road traffic. Based on this analysis, it is recommended that continuous flagging operations with intermittent 30 second roadway closures be permitted from 9 AM to 3 PM and from 7 PM to 6 AM.

Table 3.2.4.4 summarizes the permitted work hours for the three scenarios:

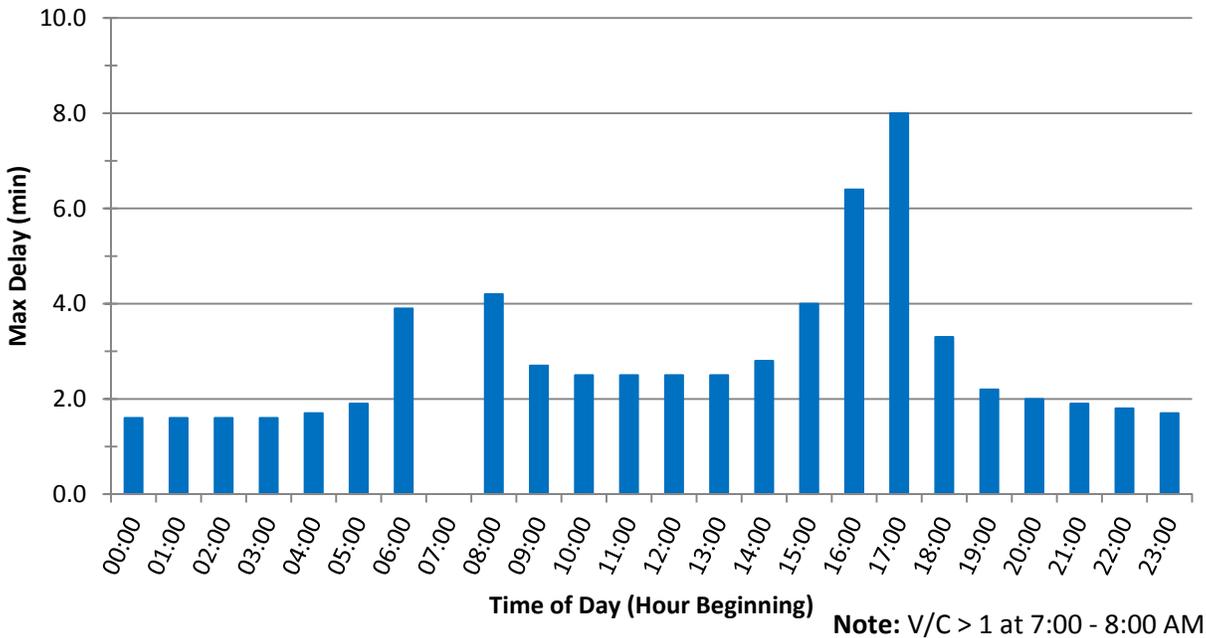
TABLE 3.2.4.4 Boyds Corner Road Flagging Operation and Temporary Closures	
Scenario	Weekday Permissible Work Hours Mon – Thurs (into the following morning)
Flagging Operation	9 AM – 3 PM; 7 PM – 6 AM
2-minute Closure	9 AM – 3 PM; 7 PM – 6 AM
Flagging Operation with 30 second Closures	9 AM – 3 PM; 7 PM – 6 AM

To minimize confusion during construction and provide consistent work hour restrictions, the permitted work hours for stopping traffic along Boyds Corner Road under any scenario are weekdays (Monday through Friday) from 9 AM - 3 PM and weekdays (Monday through Thursday) 7 PM to 6 AM.

**Figure 3.2.4.1: Boyds Corner Road Flagging Operation
Weekday Hourly Volumes**

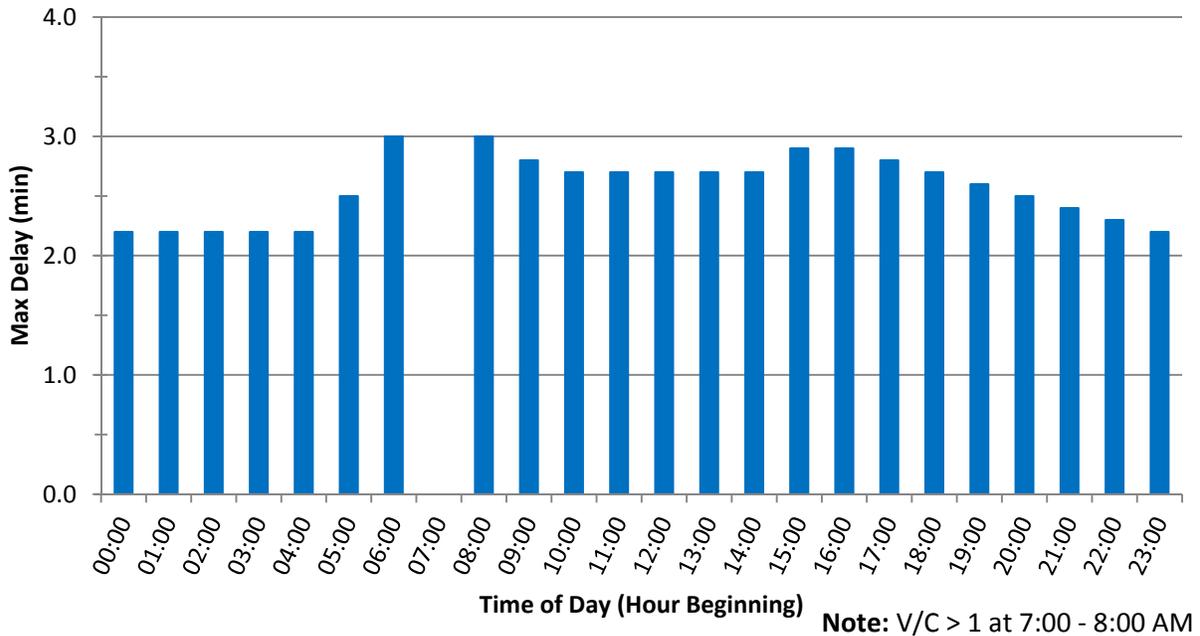


**Figure 3.2.4.2: Boyds Corner Road Flagging Operation
2015 Weekday Maximum Delays**

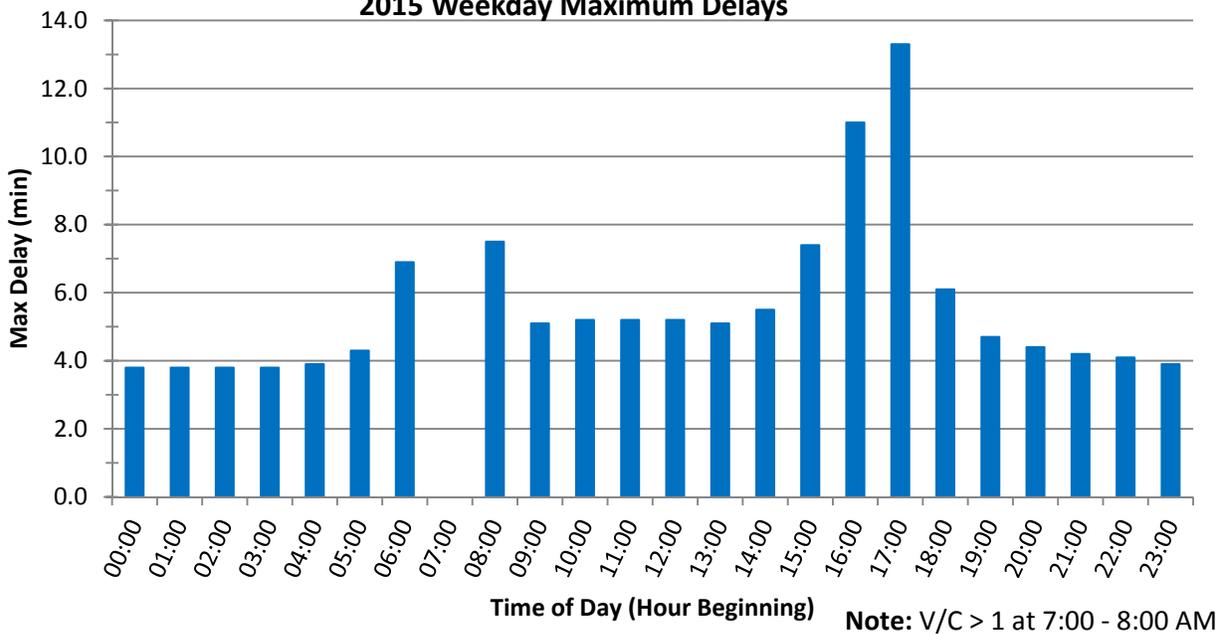




**Figure 3.2.4.3: Boyds Corner Road - 2-minute Closure
2015 Weekday Maximum Delays**



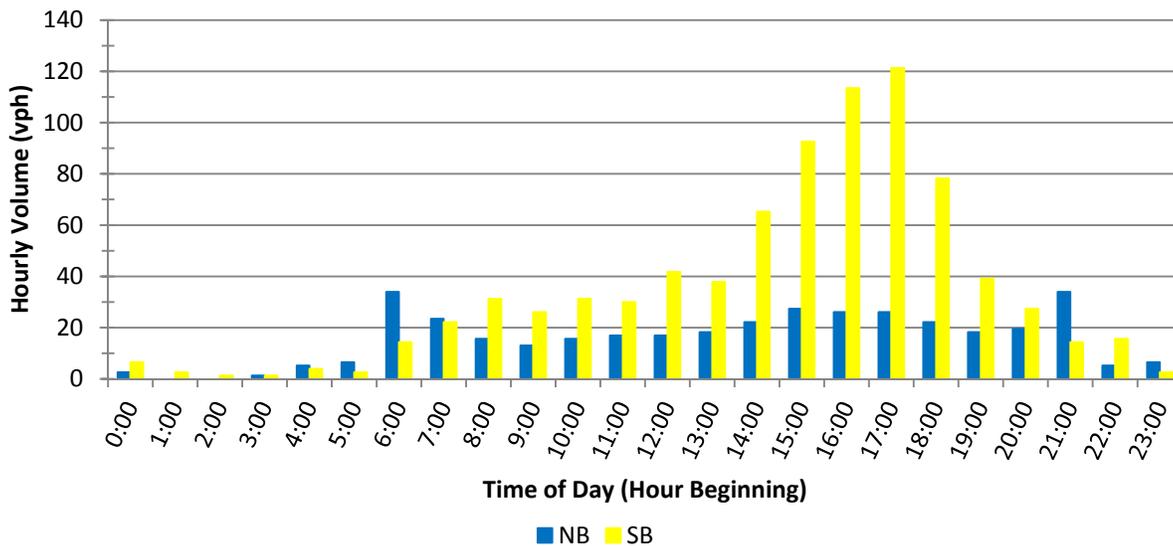
**Figure 3.2.4.4: Boyds Corner Road -
Flagging Operation with 30-second Closure
2015 Weekday Maximum Delays**





Jamison Corner Road Flagging Operation: A spreadsheet methodology was used to calculate delays associated with a flagging operation for each hour of the day for 2015 traffic volumes to determine appropriate work hours. It was also assumed that intermittent road closures would occur for up to two minutes associated with the hauling operation across Jamison Corner Road. As shown in Figure 3.2.4.5, traffic volumes throughout the day are relatively low in the 2015 construction year and delays during flagging operations both with and without closures to accommodate hauling operations are not anticipated to be significant. Therefore, flagging operations and intermittent closures of Jamison Corner Road should be permitted on weekdays from 9 AM to 3 PM and from 6 PM to 7 AM.

**Figure 3.2.4.5: Jamison Corner Road
2015 Weekday Hourly Volumes**



Contracts 1B and 1D

Contracts 1B and 1D both impact US 13 and are therefore discussed together.

The revised lane configuration proposed along northbound SR 1 at Biddles Toll Plaza during Phase 1 of Contract 1B is similar to conditions proposed as part of the ultimate design and has been documented as part of the memo dated September 2010. Therefore, this operation has not been quantitatively analyzed as part of the TMP since it has been documented that this operation is acceptable under the 2030 ultimate traffic conditions. In addition, during construction, the cash lanes will add to the two left E-ZPass express lanes, with the US 13 northbound on-ramp merging into these three lanes prior to the Roth Bridge, which provides more capacity than the ultimate configuration in which the cash lanes will merge into the two left E-ZPass express lanes prior to Scott Run, with US 301 NB/Ramp R adding onto SR 1 as two lanes with the rightmost lane reducing prior to the Roth Bridge.

SR 1 Lane Closures: Both single and double lane closures are required during off-peak periods at various locations along the six-lane section of SR 1 as follows:

- Northbound SR 1 from the Biddles Toll Plaza to the Roth Bridge
- Southbound SR 1 from the SR 72 interchange to the Biddles Toll Plaza

2015 construction year hourly traffic volumes along northbound and southbound US 13 in the vicinity of the Roth Bridge were reviewed to determine the permissible work hours for single and double lane closures (see Figure 3.2.4.6). Detour conditions traffic analysis was based on August traffic volumes along SR 1 and therefore is assumed to be a conservative estimate of operations along the detour route. Per Table 2 of DelDOT’s Work Zone Safety and Mobility – Procedures and Guidelines, the work zone capacity for a three-lane to two-lane reduction



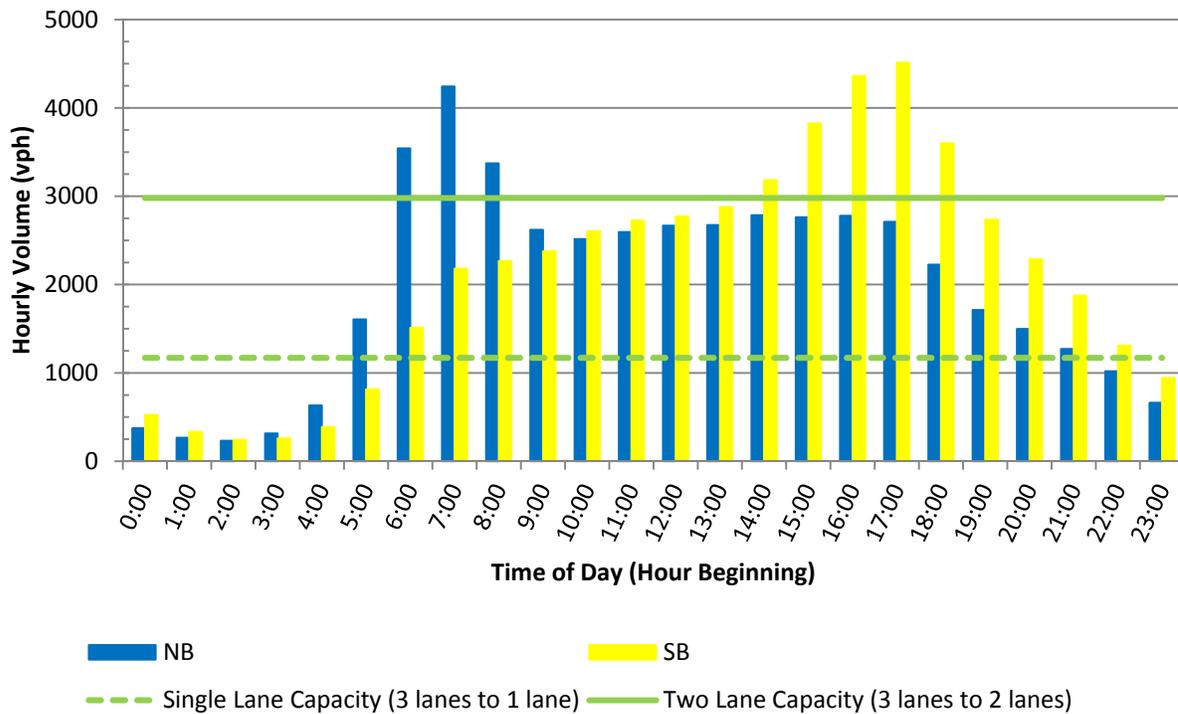
(i.e., single lane closure) is 2,980 vehicles per hour and the work zone capacity for a three-lane to single-lane reduction (i.e., double lane closure) is 1,170 vehicles per hour. As shown, traffic volumes are below the two lane capacity threshold from 9 AM to 6 AM in the northbound direction and from 7 PM to 2 PM in the southbound direction. In addition, lane closures should not be permitted during peak hours in either direction from 7 AM to 9 AM and 3 PM to 6 PM.

Additionally, traffic volumes are below the single lane capacity threshold (i.e., reducing from 3 lanes to 1 lane) from 10 PM to 5 AM in the northbound direction and from 11 PM to 6 AM in the southbound direction.

Both single and double lane closures along SR 1 are permitted Monday through Thursday (into the following morning). To minimize confusion during construction and provide consistent work hours in both directions of SR 1, the permissible work hours are shown in Table 3.2.4.5

TABLE 3.2.4.5 SR 1 Lane Closure Summary	
Scenario	Weekday Permissible Work Hours Mon – Thurs (into the following morning)
Single Lane Closure	9 AM – 3 PM; 7 PM – 6 AM
Double Lane Closure	10 PM – 5 AM

Figure 3.2.4.6: SR 1 - Lane Closure Analysis





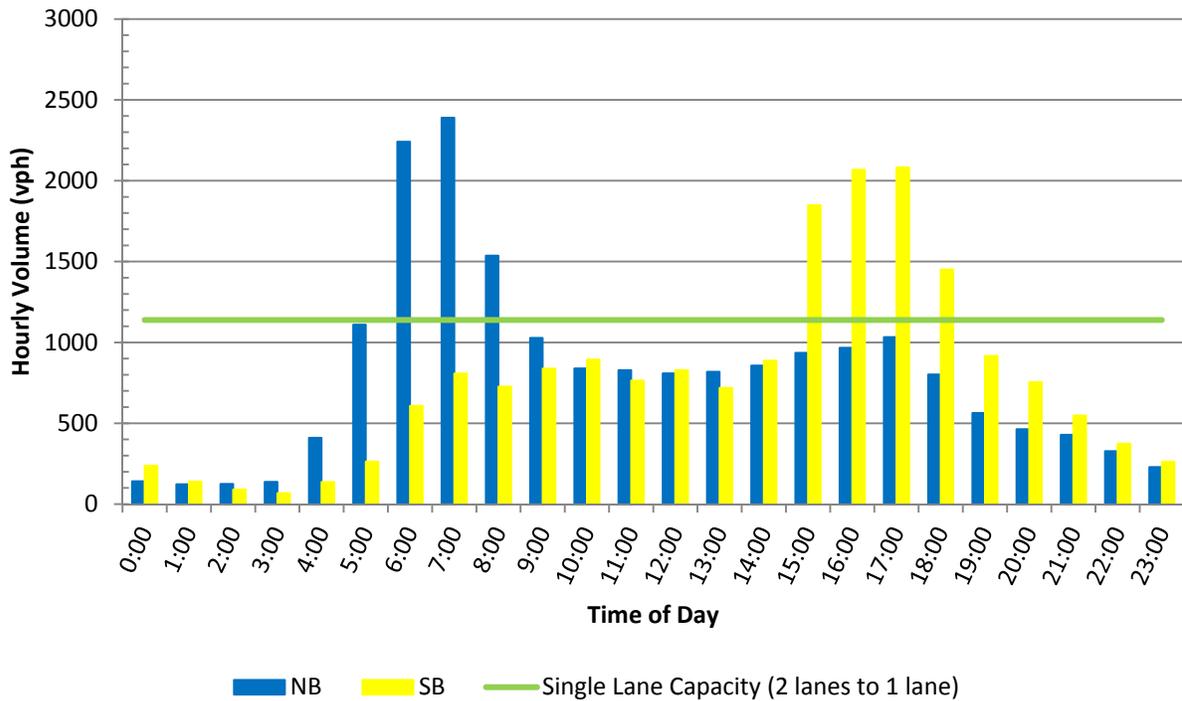
US 13 Lane Closures: Single lane closures are required during off-peak periods at various locations along US 13. 2015 construction year hourly traffic volumes along northbound and southbound US 13 south of the SR 1 “Free Ramp” intersection were reviewed to determine the permissible work hours. Traffic volumes at this location are the highest within the project area and therefore were assumed to reflect a worst-case scenario. Per Table 2 of DelDOT’s Work Zone Safety and Mobility – Procedures and Guidelines, the work zone capacity for a two-lane to single-lane reduction is 1,340 vehicles per hour; however, the capacity threshold was reduced by 15 percent to 1,139 vehicles per hour to account for interference from driveways and unsignalized intersections along US 13. As shown, traffic volumes along US 13 are below this threshold from 9 AM to 6 AM in the northbound directions and from 7 PM to 3 PM in the southbound direction. In addition, lane closures should not be permitted during peak hours in either direction from 7 AM to 9 AM and 3 PM to 6 PM. Therefore, the weekday permissible work hours for single lane closures along US 13 should be as shown in Table 3.2.4.6.

Southbound US 13 single lane closures are anticipated in the vicinity of the US 13 at “Free Ramp” intersection. To determine the allowable work hour for southbound US 13 lane closures through the signal or immediately downstream of the signal, capacity analysis was performed using CMS methodologies. A cycle length of 180 seconds was assumed to determine hours when the US 13 at “Free Ramp” signal will operate below capacity (e.g., the sum of the required splits of the northbound left-turn and the southbound through movements are less than the cycle length) with a single southbound through lane. Based on CMS, the intersection operates below capacity from 9 AM to 2 PM and from 8 PM to 6 AM; therefore, southbound US 13 lane closures at or immediately downstream of the US 13 at “Free Ramp” intersection should only be permitted during these periods.

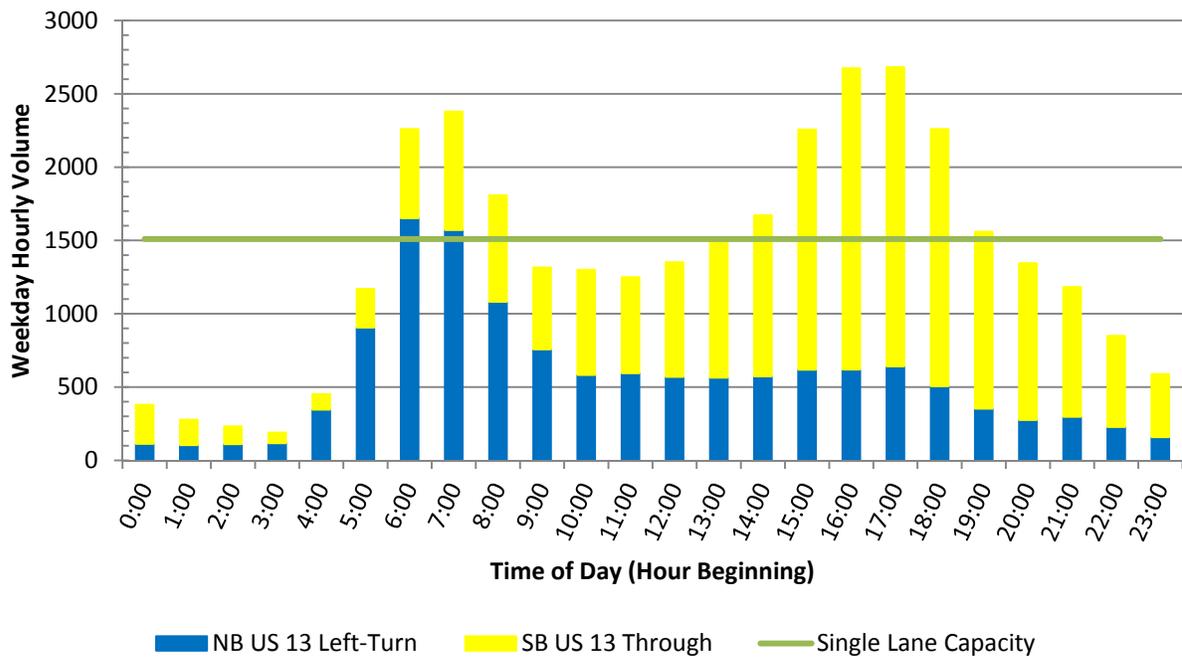
TABLE 3.2.4.6 US 13 Lane Closure Summary	
Scenario	Weekday Permissible Work Hours Mon – Thurs (into the following morning)
Northbound US 13 Single Lane Closure	9 AM – 3 PM; 6 PM – 6 AM
Southbound US 13 Single Lane Closure	9 AM – 3 PM; 7 PM – 7 AM
Southbound US 13 Single Lane Closure at or immediately downstream of US 13 at “Free Ramp” intersection	9 AM – 2 PM; 8 PM – 6 AM



Figure 3.2.4.7: US 13 - Lane Closure Analysis



**Figure 3.2.4.8: US 13 at Free Ramp
Single Lane Capacity**



US 13 at Port Penn Road Intersection Lane Closures and Detour: 2015 traffic volumes and proposed lane configurations during each phase of construction were analyzed to determine the impacts to operations at the US 13 at Port Penn Road intersection. The phases and sub-phases noted below are periods when lane closures are anticipated that will directly impact the Port Penn Road intersection. Table 3.2.4.7 summarizes the unsignalized intersection capacity analysis for both “no-build” conditions and during each phase of construction.

Phase 1:

During this phase, the existing northbound right-turn lane will be shortened to approximately 100 feet. Although northbound right-turning vehicles are more likely to decelerate in the through lane, since the northbound right-turn movement operates as a free-flow movement, this should not significantly impact operations during construction.

Sub-phase 1A:

The northbound approach to the intersection will operate as a through lane and a shared through/right-turn lane. In addition the west leg of the intersection (accessing the Biddle Toll Plaza facility) will be eliminated. See Chapter 4 for a discussion of the safety impacts of the removal of the northbound right-turn lane.

Sub-phase 2A:

During peak conditions, all turn lanes will be accommodated and the west leg will remain closed. As shown in Table 3.2.4.7, this configuration will operate with overall less delay compared to existing conditions due to the removal of the west leg and the reduced number of conflict points within the median opening.

During off-peak periods (9 PM to 5 AM and 9 AM to 3 PM), both northbound and southbound US 13 will be reduced to a single through lane and the westbound left-turn movement will be detoured to alternative routes. Based on a review of traffic volumes, the worst case hours during the proposed lane closures (i.e., 9 AM to 10 AM and 9 PM to 10 PM) were analyzed to determine the impacts of the proposed lane configurations. As shown in Table 3.2.4.7, the proposed off-peak lane configurations during Sub-Phase 2A will not have significant impacts on traffic operations at the intersection and the removal of the westbound left-turn from the intersection will reduce overall delays on the westbound approach to the intersection.

As mentioned above, during Sub-phase 2A, the westbound Port Penn Road at US 13 left-turn movement will be detoured from the intersection. The proposed detour route is comprised of Port Penn Road, Boyds Corner Road/Pole Bridge Road and US 13. Forecasted 2015 peak hour hourly volumes for the movement are a maximum of 33 vehicles per hour (during the PM peak hour). The three critical intersections accommodating additional traffic during the proposed detour are the US 13 at SR 896/Boyds Corner Road, Boyds Corner Road at Southbound SR 1 Ramps, and Boyds Corner Road at Northbound SR 1 Ramps intersections. During the morning peak period, the 33 diverted vehicles currently completing the westbound left-turn movement at the US 13 at Port Penn Road intersection would constitute approximately 1 to 3 percent of the total traffic at the three critical intersections or one to two additional vehicles per cycle. Therefore, the proposed detour of the westbound Port Penn Road left-turn movement at US 13 is assumed to have minimal impacts on the existing traffic operations along the detour route and no additional quantitative analyses have been performed.

Sub-phase 2B:

Although not analyzed specifically, Sub-Phase 2B is similar to Sub-Phase 2A during peak conditions; however, the westbound left-turn storage length will be limited to approximately 80 feet of useable storage. As shown in the Sub-Phase 2A analysis, the 95-percentile queue lengths can be accommodated within the 80 feet of storage.



TABLE 3.2.4.7 US 13 at Port Penn Road Construction										
			2015 AM Peak (7 – 8 AM) Conditions				2015 PM Peak (5 – 6 PM) Conditions			
Phase	Approach	Mvmt	Baseline Volume (Veh/hr)	Mvmt LOS	Delay (s)	95 th % Queue (ft)	Diverted Volume (Veh/hr)	Mvmt LOS	Delay (s)	95 th % Queue (ft)
Existing Conditions	Toll Plaza Driveway	EBL	1	F	ERR	ERR	1	E	44.5	25
		EBT	0				0			
		EBR	3				5			
	Port Penn Road	WBL	30	F	309.8	84	33	F	64.4	37
		WBT	0				0			
		WBR	227				F			
	US 13	NBL	4	A	9.6	25	1	C	18.9	25
		NBT	2163	-	-	-	955	-	-	-
		NBR	16	-	-	-	59	-	-	-
	US 13	SBL	40	D	27.4	25	154	B	12.8	27
		SBT	768	-	-	-	1927	-	-	-
		SBR	0	-	-	-	1	-	-	-
Sub-Phase 1A	Port Penn Road	WBL	30	F	141.8	59	33	E	46.0	28
		WBR	227	F	127.9	270	78	B	13.0	25
	US 13	NBT	2168	-	-	-	956	-	-	-
		NBR	16	-	-	-	59	-	-	-
	US 13	SBL	40	D	27.6	25	154	B	12.8	27
		SBT	768	-	-	-	1928	-	-	-
Sub-Phase 2A Peak	Port Penn Road	WBL	30	F	141.8	59	33	E	45.5	27
		WBR	227	F	122.8	265	78	B	12.7	25
	US 13	NBT	2168	-	-	-	956	-	-	-
		NBR	16	-	-	-	59	-	-	-
	US 13	SBL	40	D	27.6	25	154	B	12.8	27
		SBT	768	-	-	-	1928	-	-	-
			2015 9 – 10 AM Conditions				2015 9 – 10 PM Conditions			
Sub-Phase 2A Off Peak	Port Penn Road	WBL	Detoured	-	-	-	Detoured	-	-	-
		WBR	98	C	24.3	40	33	B	11.1	25
	US 13	NBT	930	-	-	-	396	-	-	-
		NBR	7	-	-	-	24	-	-	-
	US 13	SBL	34	B	10.6	25	50	A	8.4	25
		SBT	804	-	-	-	498	-	-	-

SR 1 Detours: Table 3.2.4.8 summarizes the required closures of SR 1 to accommodate the erection of Bridge No. 1-433 (US 301 Northbound). Section 2.6.2 contains a discussion regarding the need to close and detour SR 1 for select construction activities of this bridge. Hourly traffic volumes along SR 1 and US 13 were reviewed to determine the impacts associated with and feasibility of the required 8-hour (9 PM to 5 AM) northbound and southbound SR 1 detours during off-peak periods. Analyses were performed for each detour individually and then for the full closure of SR 1. Existing signal timings were adjusted, as needed, to accommodate detoured traffic volumes. Based on discussions with the GEC, it is assumed that tolls at the Boyds Corner Road ramps will be lifted during SR 1 detour conditions. The proposed northbound SR 1 detour diverts vehicles to exit SR 1 at the Boyds Corner Road exit (Exit 142), turn left onto westbound Boyds Corner Road, turn right onto northbound US 13 and make a subsequent left turn onto northbound SR 1 at the US 13 at “Free Ramp” intersection. The proposed southbound SR 1 detour diverts vehicles to exit SR 1 at the Lorewood Grove Road exit (Exit 148), turn right onto eastbound Lorewood Grove Road, merge onto southbound US 13, turn left onto eastbound Boyds Corner Road and make a subsequent right turn onto the southbound SR 1 on-ramp at Exit 142. The following critical intersections were identified along the detour routes:

- SR 896/Boyds Corner Road at SR 1 Northbound Ramps
- SR 896/Boyds Corner Road at SR 1 Southbound Ramps



- US 13 at SR 896/Boyds Corner Road
- US 13 at “Free Ramp”

Analyses were performed for 9 PM to 10 PM as these traffic volumes are greater than the 4 AM to 5 AM volumes along both northbound and southbound SR 1.

TABLE 3.2.4.8 SR 1 Closure Summary			
Closure Direction	Days of Week ¹	Time Period	Number of Nights
NB SR 1 (SB SR 1 lanes maintained)	Monday PM through Friday AM	9 PM – 5 AM	9
SB SR 1 (NB SR 1 lanes maintained)	Monday PM through Friday AM	9 PM – 5 AM	2
NB and SB SR 1 (Full Closure)	Monday PM through Friday AM	9 PM – 5 AM	4

¹ SR 1 closures will not be permitted during major holiday periods and special events as outlined in the MOT specifications.

Northbound SR 1 Detour: As shown in Table 3.2.4.9, the Boyds Corner Road at northbound and southbound SR 1 ramps intersections will operate at LOS D or better with all movements also operating at LOS D or better. The US 13 at Boyds Corner Road intersection operates at the same or better LOS for all movements under detoured conditions as compared with baseline conditions. Under northbound SR 1 detoured conditions, it is assumed that the rightmost through lane on the northbound US 13 approach will be closed (i.e., lane reduction) prior to the Boyds Corner Road intersection resulting in two northbound through lanes through the intersection. This will allow for the westbound Boyds Corner Road right-turn lane to be an added (i.e., free right) along northbound US 13. Furthermore, the US 13 at “Free Ramp” intersection will degrade from LOS C to LOS F. The decrease in LOS is due to the increase in northbound left turns. It can be reasonably expected that if queues reach the projected 95th-percentile queue length, northbound left-turn motorists that are familiar with the area will bypass the US 13 at “Free Ramp” signal and continue northbound along US 13 to access SR 1 at the SR 72 interchange. Providing a signed alternate detour along US 13 to SR 72 during the northbound SR 1 Detour is not recommended to avoid motorist confusion. Additionally, it is assumed that if a motorist chooses to avoid the US 13 at “Free Ramp” intersection due to local knowledge, the motorist does not additional signage. Furthermore, the projected 95th-percentile queue lengths for the northbound left-turning movement at US 13 at “Free Ramp” decreases to 1309 feet and 580 feet during the 10 PM to 11 PM and 11 PM to 12 AM hours, respectively. As shown under the full closure scenario, the SR 72 intersections have sufficient capacity to accommodate additional traffic. See the discussion below regarding the northbound SR 1 off-ramp queue approaching Boyds Corner Road which is anticipated to extend to the toll plaza along the ramp.

Providing traffic officers at the Boyds Corner Road at northbound SR 1 Ramps, Boyds Corner Road at southbound SR 1 Ramps, US 13 at Boyds Corner Road (a traffic officer should monitor the northbound right-turn movement), and US 13 at “Free Ramp” intersections is required during the northbound SR 1 detour. Similarly, temporary light plants, shall be used at these locations when the traffic officers are present during detoured conditions.



TABLE 3.2.4.9 9 PM – 10 PM Northbound SR 1 Closure and Detour												
			2015 Baseline Conditions					2015 Detoured Conditions				
Intersection	Approach	Mvmt	Volume (Veh/hr)	Mvmt LOS	Delay (s)	95 th % Queue (ft)	Int LOS/ Delay (s)	Volume (Veh/hr)	Mvmt LOS	Delay (s)	95 th % Queue (ft)	Int LOS/ Delay (s)
Boyd's Corner Rd at NB SR 1 Ramps (Signalized)	Boyd's Corner Rd	EBL	18	A	5.6	6	B 13.5	0	-	-	-	D 37.8
		EBT	76	A	1.7	8		76	B	13.6	30	
	Boyd's Corner Rd	WBT	74	A	4.8	15		77	B	15.6	31	
		WBR	4	A	4.7	4		0	-	-	-	
	NB SR 1 Off-Ramp	NBL	46	D	46.0	32		1038	D	41.3	487	
		NBR	7	D	44.7	14		7	C	22.9	11	
Boyd's Corner Rd at SB SR 1 Ramps (Signalized)	Boyd's Corner Rd	EBT	87	A	4.5	17	B 11.3	69	A	3.9	14	A 5.5
		EBR	80	A	0.1	0		80	A	0.1	0	
	Boyd's Corner Rd	WBL	20	A	5.6	7		20	A	4.6	7	
		WBT	106	A	1.7	12		1098	A	2.6	133	
	SB SR 1 Off-Ramp	SBL	12	D	45.6	26		12	D	53.0	28	
		SBR	66	D	45.0	41		66	D	52.3	45	
US 13 at Boyd's Corner Rd (Signalized)	Boyd's Corner Rd	EBL	78	E	65.3	67	C 30.2	89	E	65.2	74	B 18.1
		EBT	67	E	64.6	61		55	E	63.5	52	
		EBR	60	E	62.7	47		60	E	62.2	47	
	Boyd's Corner Rd	WBL	60	E	68.8	108		60	E	67.5	105	
		WBT	97	E	66.1	93		97	E	65.2	90	
		WBR	31	E	56.0	25		1023	A	2.6	0	
	US 13	NBL	21	E	72.0	27		21	E	72.0	27	
		NBT	260	B	13.7	66		266	B	14.1	107	
		NBR	33	B	13.1	18		28	B	13.0	18	
	US 13	SBL	26	E	70.2	31		26	B	14.6	31	
		SBT	568	B	14.1	140		568	B	14.6	149	
		SBR	86	B	12.8	28		86	B	13.3	30	
US 13 at "Free Ramp" (Signalized)	US 13	NBL	297	E	71.3	433	C 25.2	1289	F	113.7	#2221	F 114.6
		NBT	132	-	-	-		132	-	-	-	
	US 13	SBT	885	B	13.7	365		885	F	134.2	#821	

Southbound SR 1 Detour: As shown in Table 3.2.4.10, all three signalized intersections will operate at LOS C or better from 9 PM to 10 PM. The northbound US 13 through and right-turn movements at Boyd's Corner Road will operate at LOS E and D, respectively, due to the additional green time required for the southbound left-turn movement; however, queues and delays are not anticipated to be excessive during the detour. The eastbound Boyd's Corner Road right-turning movement at the southbound SR 1 Ramps increases from 80 to 1244 vehicles under detoured conditions. It is assumed that tolls on the Boyd's Corner Road on-ramp to southbound SR 1 will be lifted under detoured conditions; therefore, this movement was analyzed as a "free" right turn. Results of a sensitivity analysis indicate the eastbound right-turn movement would operate with 22.9 seconds of delay (LOS 'C') and a 980-foot 95th-percentile queue if analyzed as a "permissive" right turn. Similarly, the impacts of restricting right-turns-on-red for the eastbound right-turn movement were analyzed. The analysis indicates the eastbound Boyd's Corner Road right-turning movement would operate with approximately 84 seconds of delay (LOS 'F') and a 1460-foot 95th-percentile queue. The upper and lower bounds of the sensitivity analysis are shown in the table.

Due to the potentially poor traffic operating conditions anticipated, these two intersections should be closely monitored during the southbound SR 1 detour.

Providing traffic officers at the Boyd's Corner Road at northbound SR 1 Ramps, Boyd's Corner Road at southbound SR 1 Ramps, US 13 at Boyd's Corner Road, and US 13 at "Free Ramp" intersections is recommended during the southbound SR 1 detour. Similarly, temporary light plants, shall be used at these locations when the traffic officers are present during detoured conditions.



TABLE 3.2.4.10
9 PM – 10 PM
Southbound SR 1 Closure and Detour

			2015 Baseline Conditions					2015 Detoured Conditions				
Intersection	Approach	Mvmt	Volume (Veh/hr)	Mvmt LOS	Delay (s)	95 th % Queue (ft)	Int LOS/ Delay (s)	Volume (Veh/hr)	Mvmt LOS	Delay (s)	95 th % Queue (ft)	Int LOS/ Delay (s)
Boyd's Corner Rd at SB SR 1 Ramps (Signalized) ¹	Boyd's Corner Rd	EBT	87	A	4.5	17	B 11.3	87	A	4.5	17	A 7.7
		EBR	80	A	0.1	0		1244	A	6.0	0	
	Boyd's Corner Rd	WBL	20	A	5.6	7		20	A	5.6	7	
		WBT	106	A	1.7	12		106	A	1.7	12	
	SB SR 1 Off-Ramp	SBL	12	D	45.6	26		12	D	45.6	26	
		SBR	66	D	45.0	41		66	D	45.0	41	
Boyd's Corner Rd at SB SR 1 Ramps (Signalized) ²	Boyd's Corner Rd	EBT	Same as above					87	A	3.7	15	E 71.4
		EBR						1244	F	84.2	#1459	
	Boyd's Corner Rd	WBL						20	A	7.9	8	
		WBT						106	A	1.4	11	
	SB SR 1 Off-Ramp	SBL						12	E	55.0	30	
		SBR						66	D	54.0	27	
US 13 at Boyd's Corner Rd (Signalized)	Boyd's Corner Rd	EBL	78	E	65.3	67	C 30.2	78	E	65.3	67	C 27.4
		EBT	67	E	64.6	61		67	E	64.6	61	
		EBR	60	E	62.7	47		60	E	62.7	47	
	Boyd's Corner Rd	WBL	60	E	68.8	108		60	E	68.8	108	
		WBT	97	E	66.1	93		97	E	66.1	93	
		WBR	31	E	56.0	25		31	E	61.8	36	
	US 13	NBL	21	E	72.0	27		21	E	72.0	27	
		NBT	260	B	13.7	66		260	E	58.2	125	
		NBR	33	B	13.1	18		33	D	54.1	35	
	US 13	SBL	26	E	70.2	31		1190	B	16.9	593	
		SBT	568	B	14.1	140		568	A	7.7	116	
		SBR	86	B	12.8	28		86	B	14.8	15	
US 13 at "Free Ramp" (Signalized)	US 13	NBL	297	E	71.3	433	C 25.2	297	D	53.6	#477	C 26.6
		NBT	132	-	-	-		132	-	-	-	
	US 13	SBT	885	B	13.7	365		2050	C	24.5	1020	

¹ Eastbound right turn modeled as "free" under Detoured Conditions

² Eastbound right turn modeled as permissive (with right-turn-on-red movements restricted) for Detoured Conditions

Northbound and Southbound SR 1 Detours (Full Closure): In addition to the individual detours of northbound SR 1 and southbound SR 1, a complete closure of SR 1 is required for four nights. Section 2.6.2 contains discussion on the need to close and detour both directions of SR 1. Whether or not the roadway is closed on four consecutive days will depend on the contractor's approach to the work, the ability to produce and deliver materials to the site, the availability of equipment and other contractor controlled means and methods. Based on a review of traffic volumes and CMS analysis at the US 13 at "Free Ramp" intersection, diverting all northbound and southbound SR 1 traffic through this intersection will result in severely over-capacity conditions from 9 PM to 11 PM. CMS analysis indicates a required total split (i.e., sum of all critical movements) of 275 seconds and 210 seconds from 9 – 10 PM and from 10 – 11 PM, respectively, when assuming a 180 second cycle length. Furthermore, Synchro analysis was performed at the intersection to determine the magnitude of delays. Intersection delays are anticipated to be 293 seconds (LOS F) from 9 – 10 PM and 127 seconds (LOS F) from 10 – 11 PM. As such, prohibiting the northbound left-turn movement at the US 13 at "Free Ramp" intersection is proposed when closing SR 1 in both directions. Under this scenario, the proposed southbound SR 1 detour is as previously discussed; however, the northbound SR 1 detour diverts vehicles to exit SR 1 at the Boyd's Corner Road exit (Exit 142), turn left onto westbound Boyd's Corner Road, turn right onto northbound US 13, continue through the US 13 at "Free Ramp" intersection, turn left onto SR 72 and make a subsequent right turn onto the northbound SR 1 on-ramp at the SR



72 at SR 1 Northbound Ramps intersection. Coordinating with the US Army Corps of Engineers to temporarily lift (and cover corresponding signs) the truck restrictions on the US 13 St. Georges Bridge is required during the SR 1 full closure scenario.

Due to the potentially poor traffic operating conditions anticipated, the three intersections along Boyds Corner Road in this area should be closely monitored during the SR 1 closure. **Additionally, the US 13 at SR 72 intersection and northbound US 13 merge point south of St. Georges Bridge should be monitored closely.**

As shown in Table 3.2.4.11, the Boyds Corner Road at NB SR 1 ramps intersection will operate similar to when the northbound SR 1 detour is in effect (see discussion above). As with the northbound and southbound SR 1 detours, the Boyds Corner Road at SB SR 1 ramps intersection will operate at LOS A. The US 13 at Boyds Corner Road intersection will operate at LOS C, similar to baseline conditions. Similar to the northbound Route 1 detour, the northbound US 13 approach to Boyds Corner Road will be reduced from three to two lanes to allow for a free right-turn movement from westbound Boyds Corner Road. As noted above, the northbound US 13 through and right-turn movements at Boyds Corner Road will operate at LOS E and D, respectively; however, queues and delays are not anticipated to be excessive during the detour. The US 13 at SR 72 intersection will operate at LOS F. With the exception of the eastbound **and southbound left-turn movements** which **are** low volume movements, **the westbound left-turn movement** and the northbound left-turn movement, all movements are anticipated to operate at LOS D or better. **Modifying the signal cycle length at the US 13 at SR 72 intersection to 150 seconds (as shown below) would increase capacity at the intersection, improve overall LOS to 'E', and improve operations during detoured conditions.** The analysis assumes a 75%/25% split of traffic between the two northbound US 13 left-turn lanes at SR 72 as it is assumed that some traffic will utilize the second (inside) left-turn lane and merge after turning onto westbound SR 72. The analysis assumes signal timing adjustments will be made to accommodate diverted traffic during detoured conditions. Signal timing adjustments for critical movements are noted below.

- The northbound left-turn phase at Boyds Corner Road at Northbound SR 1 Ramps was increased by decreasing the Boyds Corner Road mainline phases.
- The westbound through phase at Boyds Corner Road at Southbound SR 1 Ramps was increased by decreasing the southbound off-ramp phase.
- The southbound US 13 left-turn phase at Boyds Corner Road was increased by decreasing the northbound US 13 through and left-turn phases.
- The northbound US 13 left-turn phase at SR 72 was increased by decreasing the SR 72 through and left-turn phases. **Additionally, consideration should be given to temporarily increasing the cycle length at this intersection.**

Providing traffic officers at the Boyds Corner Road at northbound SR 1 Ramps, Boyds Corner Road at southbound SR 1 Ramps, US 13 at Boyds Corner Road (a traffic officer should monitor the northbound right-turn movement), US 13 at "Free Ramp", US 13 at SR 72 (**a traffic officer should monitor the northbound left-turn movement**), and SR 72 at northbound SR 1 Ramps intersections is recommended during the northbound and southbound SR 1 detours (Full Closure). Similarly, temporary light plants, shall be used at these locations when the traffic officers are present during detoured conditions.

Under the SR 1 Full Closure scenario, diverted northbound SR 1 vehicles will re-enter SR 1 from the SR 72 on-ramp. Under detoured conditions, northbound SR 1 will be close upstream of this location; therefore, minimal to no traffic will be present on northbound SR 1 where vehicles will merge from the SR 72 On-Ramp (the only traffic permitted on northbound SR 1 will originate as a southbound US 13 right-turn at the US 13 at Free Ramp intersection). The need for a right-turn lane closure along northbound SR 1 was considered; however, due to the minimal volume anticipated along SR 1, minimal to impacts are anticipated as a result of the high volume merge onto northbound SR 1 at the SR 72 On-Ramp.



TABLE 3.2.4.11
9 PM – 10 PM
Both Northbound and Southbound SR 1 Closure and Detour

			2015 Baseline Conditions					2015 Detoured Conditions				
Intersection	Approach	Mvmt	Volume (Veh/hr)	Mvmt LOS	Delay (s)	95 th % Queue (ft)	Int LOS/ Delay (s)	Volume (Veh/hr)	Mvmt LOS	Delay (s)	95 th % Queue (ft)	Int LOS/ Delay (s)
Boyd's Corner Rd at NB SR 1 Ramps (Signalized)	Boyd's Corner Rd	EBL	18	A	5.6	6	B 13.5	0	B	13.6	-	D 37.8
		EBS	76	A	1.7	8		76	-	-	30	
	Boyd's Corner Rd	WBT	74	A	4.8	15		77	B	15.6	31	
		WBR	4	A	4.7	4		0	-	-	-	
	NB SR 1 Off-Ramp	NBL	46	D	46.0	32		1038	D	41.3	487	
		NBR	7	D	44.7	14		7	C	22.9	11	
Boyd's Corner Rd at SB SR 1 Ramps (Signalized) ¹	Boyd's Corner Rd	EBT	87	A	4.5	17	B 11.3	87	A	4.0	17	A 5.9
		EBS	80	A	0.1	0		1244	A	6.1	0	
	Boyd's Corner Rd	WBL	20	A	5.6	7		20	A	5.0	7	
		WBT	106	A	1.7	12		1098	A	2.6	133	
	SB SR 1 Off-Ramp	SBL	12	D	45.6	26		12	D	52.7	28	
		SBR	66	D	45.0	41		66	D	51.9	45	
Boyd's Corner Rd at SB SR 1 Ramps (Signalized) ²	Boyd's Corner Rd	EBT	Same as above					87	A	3.7	15	D 44.4
		EBS						1244	F	84.2	#1459	
	Boyd's Corner Rd	WBL						20	A	7.9	8	
		WBT						1098	A	2.5	119	
	SB SR 1 Off-Ramp	SBL						12	E	55.0	30	
		SBR						66	D	54.0	27	
US 13 at Boyd's Corner Rd (Signalized)	Boyd's Corner Rd	EBL	78	E	75.5	72	C 29.8	89	E	65.2	74	C 27.8
		EBS	67	E	70.8	65		55	E	63.5	52	
		EBS	60	E	68.0	50		60	E	62.2	47	
	Boyd's Corner Rd	WBL	60	E	66.6	104		60	E	68.8	108	
		WBT	97	E	65.6	91		97	E	66.1	93	
		WBR	31	E	60.6	34		1023	A	2.6	0	
	US 13	NBL	21	E	72.1	27		21	E	72.0	27	
		NBT	260	B	11.1	64		266	E	62.2	190	
		NBR	33	B	10.6	18		28	D	54.1	32	
	US 13	SBL	26	E	72.2	31		1190	D	36.7	688	
		SBT	568	B	12.0	135		568	B	14.3	141	
		SBR	86	B	11.0	27		86	B	13.0	29	
US 13 at "Free Ramp" (Signalized)	US 13	NBL	297	E	71.3	433	C 25.2	NB Left-Turn Movement Prohibited				
		NBT	132	-	-	-						
	US 13	SBT	885	B	13.7	365						
US 13 at SR 72 (Signalized)	SR 72	EBL	11	E	57.6	24	C 26.4	11	F	102.3	24	F 197.8
		EBS	58	B	18.9	28		58	D	35.2	37	
		EBS	152	B	19.6	45		152	D	35.5	59	
	SR 72	WBL	85	D	40.7	92		85	E	69.8	#148	
		WBT	252	B	15.1	82		252	C	34.2	114	
		WBR	11	B	13.7	11		11	C	29.9	16	
	US 13	NBL	112	D	38.0	59		1400	F	284.7	#1112	
		NBT	57	C	28.7	34		57	B	12.4	23	
		NBR	16	C	28.2	18		16	B	12.2	12	
	US 13	SBL	11	E	57.6	24		11	F	102.3	23	
		SBT	96	D	36.5	54		96	D	40.3	57	
		SBR	19	D	35.1	22		19	D	38.2	23	



TABLE 3.2.4.11 (Continued) 9 PM – 10 PM Both Northbound and Southbound SR 1 Closure and Detour												
			2015 Baseline Conditions					2015 Detoured Conditions				
Intersection	Approach	Mvmt	Volume (Veh/hr)	Mvmt LOS	Delay (s)	95 th % Queue (ft)	Int LOS/ Delay (s)	Volume (Veh/hr)	Mvmt LOS	Delay (s)	95 th % Queue (ft)	Int LOS/ Delay (s)
US 13 at SR 72 (Signalized)	SR 72	EBL	<i>Detoured Conditions with 150 sec cycle length (modified from existing 90 sec cycle length):</i>					11	F	98.6	36	E 63.6
		EBT						58	E	67.2	55	
		EBR						152	E	66.3	71	
	SR 72	WBL						85	F	156.1	#213	
		WBT						252	E	71.9	187	
		WBR						11	E	58.7	0	
	US 13	NBL						1400	E	57.9	#1376	
		NBT						57	A	8.3	21	
		NBR						16	A	8.2	0	
	US 13	SBL						11	F	98.6	36	
		SBT						96	E	71.6	#115	
		SBR						19	E	66.8	0	



were identified as critical capacity constraints along the proposed northbound and southbound SR 1 detours, respectively. Both toll booths consist of one EZ-Pass Only lane and one unmanned shared EZ-Pass/Exact Change lane. Based on an August 2009 study performed at the North Dover Toll Plaza, the hourly processing rate for an Exact Change lane is approximately 235 vehicles per hour. However, since it can be assumed that a larger portion of motorists that are detoured from Route 1 may not anticipate the need to have exact change, and at the direction of the GEC, the shared EZ-Pass/Exact Change lanes along the Boyds Corner Road ramps are assumed to have a capacity of 100 to 150 vph. Based on studies performed for the I-95 Toll Plaza, it was assumed that the EZ-Pass Only lanes can accommodate approximately 1,000 vph.

Based on data at the nearby Biddles Toll Plaza, a 65 percent EZ-Pass usage rate was assumed for the analysis of the Boyds Corner Road toll booths. Therefore, the unmanned shared EZ-Pass/Exact Change lanes are anticipated to accommodate 35 percent of the traffic volume entering the toll plaza. These assumptions were used for both detoured SR 1 traffic and existing traffic using the Boyds Corner Road ramps.

Figures 3.2.4.9 and 3.2.4.10 show the capacity of the two lanes approaching the toll plaza and the assumed traffic volumes anticipated to be in each lane (e.g., the EZ-Pass Only lane and the unmanned shared EZ-Pass/Exact Change lane) for the proposed detour period (i.e., 9 PM to 5 AM). The assumed capacity of the unmanned shared EZ-Pass/Exact Change lane is 100 to 150 vph; therefore, both thresholds are shown for comparison purposes. As shown, the capacity of the EZ-Pass Only lane exceeds the anticipated volume within the lane for the entire proposed detour period.

Anticipated traffic volumes along the northbound SR 1 off-ramp to Boyds Corner Road toll booth will be above capacity when assuming an EZ-Pass/Exact Change lane capacity of 100 vph from 9 PM to 1 AM and from 4 AM to 5 AM. When assuming a capacity of 150 vph, the EZ-Pass/Exact Change lane will be above capacity from 9 PM to 12 AM.

The southbound SR 1 on-ramp from Boyds Corner Road toll booth will be above capacity when assuming an EZ-Pass/Exact Change lane capacity of 100 vph from 9 PM to 12 AM and from 4 to 5 AM. When assuming a capacity of 150 vph, the EZ-Pass/Exact Change lane will be above capacity from 9 PM to 12 AM.

Figure 3.2.4.9: NB SR 1 Off-Ramp at Boyds Corner Road Toll Booth (SR 1 NB Detoured)

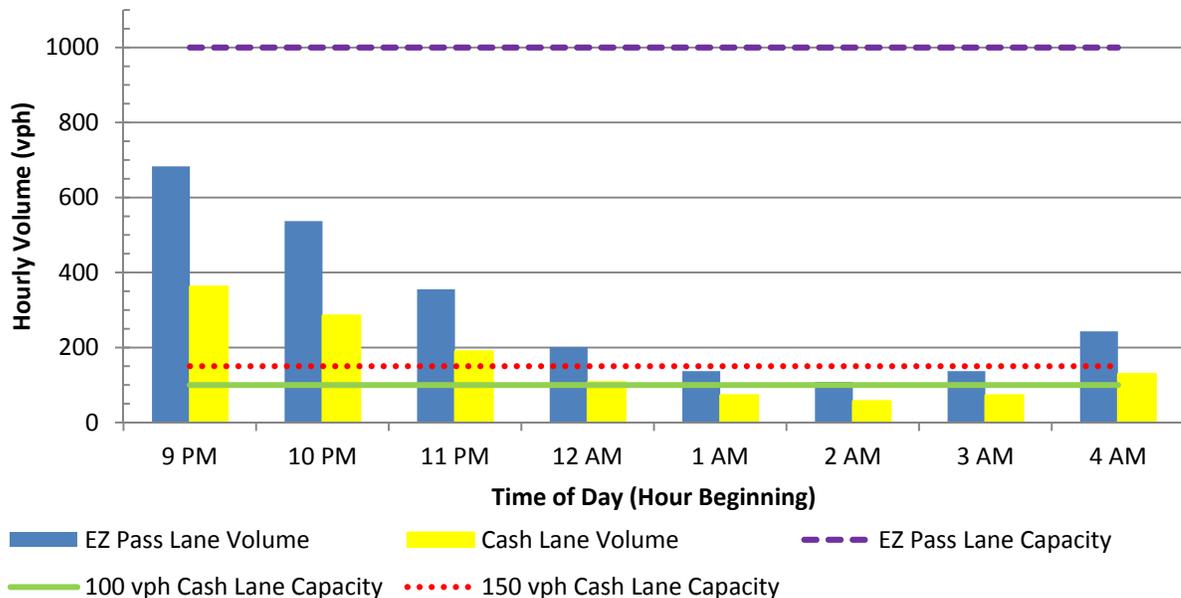
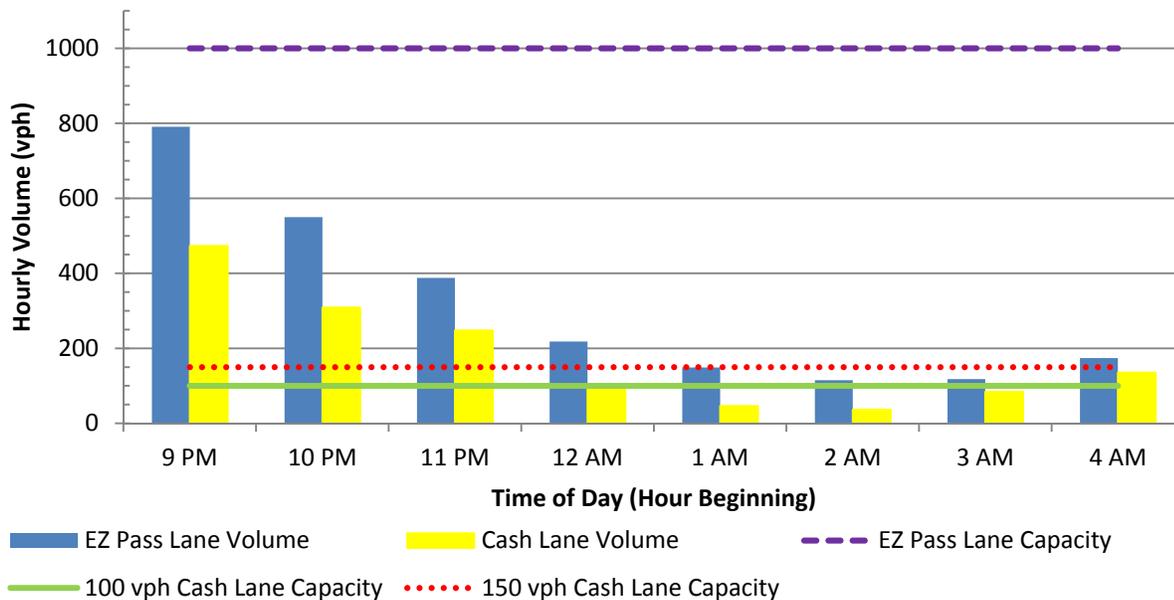




Figure 3.2.4.10: SB SR 1 On-Ramp from Boyds Corner Road Toll Booth (SR 1 SB Detoured)



Due to the short storage area along the southbound SR 1 on-ramp from Boyds Corner Road between the toll plaza and the painted gore along the ramp south of Boyds Corner Road (i.e., approximately 275 feet), any significant queues generated by the EZ-Pass/Exact Change lane will extend to Boyds Corner Road intersection and restrict capacity to the EZ-Pass Only lane, further reducing the capacity of the toll plaza.

The two-lane portion of the ramp along the northbound SR 1 off-ramp approaching the Boyds Corner Road toll plaza is approximately 500 feet before tapering to a single lane from northbound SR 1. Any significant queuing from the toll plaza is likely to extend into the single lane portion of the ramp and potentially block access to the EZ-Pass Only lane.

Additionally, based on the analysis of the northbound SR 1 detour, the northbound queue (487 feet) from the Boyds Corner Road at SR 1 northbound ramps signal is likely to extend to the toll plaza from 9 PM to 10 PM. The toll plaza is located approximately 450 feet from the stop line for the signal.

Therefore, lifting the tolls during the entire duration of the SR 1 detours (9 PM to 5 AM) is recommended. Table 3.2.4.12 summarizes the anticipated revenue losses for lifting the toll for the entire duration of the detour. Historical 2012 toll revenues from the Biddles Tolls Plaza and Boyds Corner Road Ramps provided by DeIDOT were used to calculate the revenue losses for each scenario.

TABLE 3.2.4.12 Boyds Corner Road at SR 1 Ramps – Toll Revenue Analysis				
Location	Time Period	Daily Cost (\$)	# Days Anticipated	Total Cost
NB SR 1 off-ramp to Boyds Corner Road (NB SR 1 Detour)	9 PM – 5 AM	\$3,302	13	\$42,932
SB SR 1 on-ramp from Boyds Corner Road (SB SR 1 Detour)	9 PM – 5 AM	\$3,320	6	\$19,921



SR 1 Detour User Cost Analysis: User delay costs for the proposed SR 1 detours were calculated following the procedures outlined in *DeIDOT's DGM 1-24 (Road User Cost Analysis)* to estimate work zone impacts to the traveling public if SR 1 is not reopened to the public following the proposed nighttime closure. Road user costs include both delay costs (i.e., value of time associated with time lost) and operating costs (i.e., operating and ownership costs). SR 1 road closures are permitted Monday through Thursday from 9 PM to 5 AM (the following morning). User costs were calculated for each hour between 5 AM and 9 AM. The study network considered in the analysis includes US 13, SR 1, Boyds Corner Road, Lorewood Grove Road, and SR 72 (i.e., the roads included in the planned detour). Values of time and operating costs included in *DeIDOT's DGM 1-24 Attachment* for 2013 were used in the analysis.

Travel times and travel distances along US 13, Boyds Corner Road, Lorewood Grove Road, and SR 72 were generated using the overall network measures of effectiveness (i.e., total network delay and total network travel distance) generated from SimTraffic simulations. Travel times and travel distances along SR 1 and at the Biddles Toll Plaza and Boyds Corner Road toll booths were calculated manually using spreadsheet methodologies. User costs (i.e., delay costs and operating costs) for each scenario and each hour (i.e., 5 AM – 9 AM) were compared to 2015 traffic volume conditions without the detour to determine the net change in user costs resulting from the detours.

The following is a summary other key assumptions of the analysis:

- Southbound SR 1 tolls at Biddles Toll Plaza and the Boyds Corner Road on-ramp to southbound SR 1 will be maintained during the northbound SR 1 detour. Similarly, northbound SR 1 tolls at Biddles Toll Plaza and the Boyds Corner Road off-ramp from northbound SR 1 will be maintained during the southbound SR 1 detour. All tolls at the Biddles Toll Plaza and Boyds Corner Road ramps will be lifted during the combination SR 1 detour.
- To calculate delays under “no detour” conditions, a 65% EZ-Pass usage rate was assumed. Additionally, it was assumed that all EZ-Pass users use the dedicated EZ-Pass lanes.
- The prevailing speed along SR 1 is 70 mph (i.e., 5 mph greater than the 65-mph posted speed limit). The 65 mph operating costs from *DeIDOT's DGM 1-24 Attachment* were assumed along SR 1. Calculated average network travel speeds from SimTraffic were used to establish the operating costs for the arterial roadway network (i.e., US 13, Boyds Corner Road, Lorewood Grove Road, and SR 72).
- Truck percentages at the Biddles Toll Plaza were assumed for the entire network to establish the value of time and operating costs from *DeIDOT's DGM 1-24 Attachment*.



Table 3.2.4.12A shows the hourly delay costs, operating costs, and net increase in road user costs for the three detour scenarios compared to “no detour” conditions from 5 AM to 9 AM.

TABLE 3.2.4.12A SR 1 Detour - User Cost Summary					
Detour Scenario	Time	Hourly Costs			Net User Costs (Detour Scenario – No Detour Scenario)
		Delay Costs	Operating Costs	Total	
No Detour	5 – 6 AM	\$8,741	\$13,459	\$22,200	-
	6 – 7 AM	\$23,224	\$19,647	\$42,871	-
	7 – 8 AM	\$31,290	\$25,458	\$56,747	-
	8 – 9 AM	\$16,011	\$22,127	\$38,138	-
NB Detour	5 – 6 AM	\$16,422	\$14,007	\$30,428	\$8,229
	6 – 7 AM	\$71,674	\$15,511	\$87,185	\$44,314
	7 – 8 AM	\$85,938	\$20,447	\$106,384	\$49,637
	8 – 9 AM	\$55,358	\$20,009	\$75,367	\$37,228
SB Detour	5 – 6 AM	\$12,096	\$13,539	\$25,635	\$3,436
	6 – 7 AM	\$48,267	\$17,980	\$66,247	\$23,376
	7 – 8 AM	\$71,323	\$22,724	\$94,046	\$37,299
	8 – 9 AM	\$54,535	\$21,421	\$75,956	\$37,818
Combo Detour	5 – 6 AM	\$26,227	\$8,877	\$35,104	\$12,904
	6 – 7 AM	\$107,599	\$8,676	\$116,275	\$73,404
	7 – 8 AM	\$136,717	\$9,770	\$146,487	\$89,740
	8 – 9 AM	\$104,343	\$10,120	\$114,463	\$76,325

As noted above, the Biddles Toll Plaza and Boyds Corner Road ramp tolls are assumed to be lifted during detoured conditions and would remain lifted if the contractor’s closure of SR 1 extends past 5 AM. 2012 actual revenues at the toll booths were increased to the 2015 construction year assuming a 3 percent annual growth rate. Table 3.2.4.12B summarizes the anticipated toll revenue losses on an hourly basis from 5 AM to 9 AM at the Biddles Toll Plaza and Boyds Corner Road toll booths for each of the detour scenarios.

TABLE 3.2.4.12B Anticipated Toll Revenue Losses during SR 1 Detours						
Detour Scenario	Time	Biddles Toll Plaza		Boyds Corner Road Ramps		Total
		NB	SB	NB	SB	
NB Detour	5 – 6 AM	\$1,052	-	\$17	-	\$1,069
	6 – 7 AM	\$2,475	-	\$40	-	\$2,514
	7 – 8 AM	\$2,885	-	\$57	-	\$2,942
	8 – 9 AM	\$2,198	-	\$44	-	\$2,242
SB Detour	5 – 6 AM	-	\$710	-	\$22	\$732
	6 – 7 AM	-	\$1,327	-	\$52	\$1,379
	7 – 8 AM	-	\$1,814	-	\$93	\$1,907
	8 – 9 AM	-	\$1,840	-	\$66	\$1,906
Combo Detour	5 – 6 AM	\$1,052	\$710	\$17	\$22	\$1,800
	6 – 7 AM	\$2,475	\$1,327	\$40	\$52	\$3,893
	7 – 8 AM	\$2,885	\$1,814	\$57	\$93	\$4,849
	8 – 9 AM	\$2,198	\$1,840	\$44	\$66	\$4,148

US 13 Closure: Single night road closures (i.e., 9 PM to 5 AM) are required along northbound and southbound US 13 between Hyetts Corner Road and Port Penn Road for the installation of a drainage pipe. The pipe will be



installed in half-sections to ensure that northbound and southbound US 13 will not be closed at the same time. The contractor is required to coordinate with the Contract 1B contractor to ensure that these closures will not occur when SR 1 is being closed. US 13 traffic will be diverted to SR 1 utilizing the interchanges at Boyds Corner Road and SR 72; therefore, traffic volumes along US 13, Boyds Corner Road, and SR 72 were evaluated to determine the impacts associated with the proposed detours. It is assumed that tolls along SR 1 at Biddles Toll Plaza will be lifted during US 13 road closures. Although some minor traffic generators are located along US 13 between Boyds Corner Road and SR 72, they were not specifically included in the analysis with the exception of the entrance ramp along southbound US 13 from Lorewood Grove Road. Existing signal timings were adjusted, as needed, to accommodate detoured traffic volumes.

NB US 13 Closure: A total of 369 vehicles from the US 13 at SR 896/Boyds Corner Road intersection are anticipated to be detoured from US 13 to SR 1 from 9 PM to 10 PM during the proposed northbound US 13 closure.

As shown in Table 3.2.4.13, all intersections will operate at LOS C or better under detoured conditions. Additionally, all movements will operate within the establish LOS and delay thresholds.

Additionally, it is assumed that tolls at the Biddle Toll Plaza will be lifted along northbound SR 1 during the northbound US 13 detour as detoured motorists will be forced to travel along SR 1 through the toll plaza. The expected toll revenue lost during a single night closure of northbound US 13 from 9 PM to 5 AM is \$3,521.

Providing traffic officers at the US 13 at Boyds Corner Road, Boyds Corner Road at southbound SR 1 Ramps, Boyds Corner Road at northbound SR 1 Ramps, SR 72 at northbound SR 1 Ramps, and US 13 at SR 72 intersections is recommended during the northbound US 13 detour. Similarly, temporary light plants, as needed, should be used at these locations during detoured conditions.

TABLE 3.2.4.13 9 PM – 10 PM Northbound US 13 Closure and Detour												
			2015 Baseline Conditions					2015 Detoured Conditions				
Intersection	Approach	Mvmt	Volume (Veh/hr)	Mvmt LOS	Delay (s)	95 th % Queue (ft)	Int LOS/ Delay (s)	Volume (Veh/hr)	Mvmt LOS	Delay (s)	95 th % Queue (ft)	Int LOS/ Delay (s)
Boyds Corner Rd at NB SR 1 Ramps (Signalized)	Boyds Corner Rd	EBL	18	A	5.6	6	B 13.5	356	A	7.5	79	B 10.2
		EBT	76	A	1.7	8		76	A	1.8	8	
	Boyds Corner Rd	WBT	74	A	4.8	15		43	A	7.9	14	
		WBR	4	A	4.7	4		35	A	7.9	13	
	NB SR 1 Off-Ramp	NBL	46	D	46.0	32		46	D	43.9	33	
		NBR	7	D	44.7	14		7	D	42.6	14	
Boyds Corner Rd at SB SR 1 Ramps (Signalized)	Boyds Corner Rd	EBT	87	A	4.5	17	B 11.3	425	A	4.7	72	A 9.0
		EBR	80	A	0.1	0		80	A	0.1	0	
	Boyds Corner Rd	WBL	20	A	5.6	7		20	A	6.2	7	
		WBT	106	A	1.7	12		75	A	1.6	9	
	SB SR 1 Off-Ramp	SBL	12	D	45.6	26		12	D	50.1	28	
		SBR	66	D	45.0	41		66	D	49.4	43	
US 13 at Boyds Corner Rd (Signalized)	Boyds Corner Rd	EBL	78	E	75.5	72	C 29.8	0	-	-	-	C 30.7
		EBT	67	E	70.8	65		145	E	64.6	112	
		EBR	60	E	68.0	50		60	E	60.0	46	
	Boyds Corner Rd	WBL	60	E	66.6	104		60	E	67.5	105	
		WBT	97	E	65.6	91		97	E	65.2	90	
		WBR	31	E	60.6	34		0	-	-	-	
	US 13	NBL	21	E	72.1	27		21	E	72.0	27	
		NBT	260	B	11.1	64		0	-	-	-	
		NBR	33	B	10.6	18		293	B	16.1	0	
		SBL	26	E	72.2	31		26	E	72.2	31	
	US 13	SBT	568	B	12.0	135		568	B	15.8	155	
		SBR	86	B	11.0	27		86	B	14.3	31	
		EBL	47	A	1.6	6		47	A	4.7	20	
	SR 72	EBL	47	A	1.6	6		A	47	A	4.7	



TABLE 3.2.4.13
9 PM – 10 PM
Northbound US 13 Closure and Detour

			2015 Baseline Conditions					2015 Detoured Conditions				
Intersection	Approach	Mvmt	Volume (Veh/hr)	Mvmt LOS	Delay (s)	95 th % Queue (ft)	Int LOS/ Delay (s)	Volume (Veh/hr)	Mvmt LOS	Delay (s)	95 th % Queue (ft)	Int LOS/ Delay (s)
SR 72 at NB SR 1 Ramps (Signalized)	SR 72	EBT	211	A	1.7	11	9.7	211	A	4.7	36	20.3
		WBT	227	A	6.7	68		227	B	17.8	116	
		WBR	86	B	13.1	40		86	D	44.4	79	
	NB SR 1 Off-Ramp	NBL	85	D	39.9	47		308	D	36.4	127	
		NBR	12	A	2.3	4		158	A	4.9	20	
US 13 at SR 72 (Signalized)	SR 72	EBL	11	E	57.6	24	C 26.4	125	D	35.3	122	C 29.5
		EBT	58	B	18.9	28		90	B	15.8	39	
		EBR	152	B	19.6	45		152	C	24.5	59	
	SR 72	WBL	85	D	40.7	92		85	D	40.9	93	
		WBT	252	B	15.1	82		252	C	23.1	100	
		WBR	11	B	13.7	11		11	C	21.0	13	
	US 13	NBL	112	D	38.0	59		111	D	38.0	59	
		NBT	57	C	28.7	34		57	C	28.7	34	
		NBR	16	C	28.2	18		16	C	28.2	18	
	US 13	SBL	11	E	57.6	24		11	E	57.6	24	
		SBT	96	D	36.5	54		96	D	36.5	54	
		SBR	19	D	35.1	22		19	D	35.1	22	

SB US 13 Closure: Preliminary analysis of the westbound left-turn queue length at the US 13 at Boyds Corner Road intersection indicated that the 95th-percentile queues would extend beyond the intersection at the SB SR 1 ramps. Southbound SR 1 ramp motorists exiting onto westbound Boyds Corner Road will be required to weave across two lanes before entering the left-turn lane for southbound US 13 in a distance of approximately 450 feet from the ramp gore to the stop line. As such, the proposed southbound US 13 road closure was assumed to begin at 10 PM when traffic volumes are lower. The 10 PM to 11 PM hour was analyzed to determine the effects of and feasibility of the proposed southbound US 13 road closure. A total of 131 southbound US 13 vehicles will be detoured from SR 72 from 10 PM to 11 PM. Additionally, an additional 504 vehicles currently traveling along southbound SR 1 and exiting onto southbound US 13 at Exit 148 will be forced to continue along southbound SR 1 to the Boyds Corner Road interchange (Exit 142) to access southbound US 13. The analysis conservatively assumes that all 504 vehicles currently completing this movement will exit southbound SR 1 at the Boyds Corner Road ramps (Exit 142); however, it should be noted that some portion of these motorists are expected to continue traveling along SR 1 to destinations south of Boyds Corner Road.

As shown in Table 3.2.4.14, all intersections operate at LOS C or better under detoured conditions except for the US 13 at Boyds Corner Road intersection which operates at LOS D (delay less than 45 seconds). Additionally, all movements will operate within the establish LOS and delay thresholds.

Similar to the northbound US 13 closure and detour, it is assumed that tolls at the Biddle Toll Plaza will be lifted along southbound SR 1 during the southbound US 13 detour as detoured motorists will be forced to travel along SR 1 through the toll plaza. The expected toll revenue lost during a single night closure of southbound US 13 from 10 PM to 5 AM is \$3,084.

Providing traffic officers at the US 13 at SR 72, SR 72 at northbound SR 1 Ramps, SR 72 at southbound SR 1 Ramps, Boyds Corner Road at southbound SR 1 Ramps, and US 13 at Boyds Corner Road intersections is recommended during the northbound US 13 detour. Similarly, temporary light plants, as needed, should be used at these locations during detoured conditions.



TABLE 3.2.4.14 10 PM – 11 PM Southbound US 13 Closure and Detour												
			2015 Baseline Conditions					2015 Detoured Conditions				
Intersection	Approach	Mvmt	Volume (Veh/hr)	Mvmt LOS	Delay (s)	95 th % Queue (ft)	Int LOS/ Delay (s)	Volume (Veh/hr)	Mvmt LOS	Delay (s)	95 th % Queue (ft)	Int LOS/ Delay (s)
Boyd's Corner Rd at SB SR 1 Ramps (Signalized)	Boyd's Corner Rd	EBT	60	A	3.9	13	B 12.4	60	A	6.8	22	C 30.4
		EBR	42	A	0.0	0		42	A	0.0	0	
	Boyd's Corner Rd	WBL	11	A	4.9	4		11	A	8.4	10	
		WBT	79	A	1.6	9		79	A	3.6	21	
	SB SR 1 Off-Ramp	SBL	9	D	46.8	22		33	C	34.6	42	
		SBR	49	D	46.3	36		660	D	37.7	105	
US 13 at Boyd's Corner Rd (Signalized)	Boyd's Corner Rd	EBL	49	E	68.3	48	C 27.8	49	E	68.3	48	D 44.3
		EBT	42	E	67.7	44		42	E	67.7	44	
		EBR	38	E	65.9	40		38	E	65.9	40	
	Boyd's Corner Rd	WBL	39	E	67.3	81		554	D	53.0	378	
		WBT	78	E	65.9	75		174	D	46.4	263	
		WBR	24	E	57.1	22		24	D	35.5	14	
	US 13	NBL	7	E	78.5	13		7	E	78.5	13	
		NBT	194	B	11.4	48		194	C	25.2	74	
		NBR	25	B	11.1	15		25	C	24.3	23	
	US 13	SBL	17	E	70.1	23		4	E	71.3	8	
		SBT	369	B	10.1	86		92	C	23.1	40	
		SBR	69	A	9.6	24		17	C	22.8	19	
SR 72 at SB SR 1 Ramps (Signalized)	SR 72	EBT	172	A	5.1	36	B 14.7	112	A	6.2	26	B 13.7
		EBR	58	A	5.0	15		118	A	6.4	22	
	SR 72	WBL	17	A	3.4	3		88	A	2.4	31	
		WBT	223	A	3.7	15		223	A	3.0	33	
	SB SR 1 Off-Ramp	SBL	80	D	37.9	44		80	D	37.9	44	
		SBR	134	D	37.1	53		134	D	37.1	53	
SR 72 at NB SR 1 Ramps (Signalized)	SR 72	EBL	43	A	2.3	5	A 6.7	43	A	2.0	4	A 7.4
		EBT	176	A	2.3	15		116	A	1.8	5	
	SR 72	WBT	189	A	3.6	26		260	A	4.5	43	
		WBR	80	A	2.3	8		80	A	4.9	15	
	NB SR 1 Off-Ramp	NBL	58	D	39.8	36		58	D	39.8	36	
		NBR	8	A	2.2	3		8	A	2.2	3	
US 13 at SR 72 (Signalized)	SR 72	EBL	9	E	55.8	24	C 28.9	9	D	47.5	24	C 25.3
		EBT	49	B	14.4	22		49	B	12.2	21	
		EBR	127	D	36.9	74		67	C	22.6	1	
	SR 72	WBL	71	D	40.6	81		38	D	43.0	52	
		WBT	210	B	13.6	68		243	B	13.6	82	
		WBR	10	B	12.6	10		10	B	12.5	11	
	US 13	NBL	92	D	40.1	51		92	D	39.8	51	
		NBT	48	C	30.4	30		48	C	30.9	30	
		NBR	13	C	29.9	17		13	C	30.4	17	
	US 13	SBL	9	D	54.2	21		9	D	51.7	21	
		SBT	80	D	36.1	47		42	D	36.1	29	
		SBR	16	D	35.0	20		54	D	35.7	35	



Contract 1C

Maintenance of traffic is limited to SR 896/Boyds Corner Road where access to the work zone will be made. Flaggers will be utilized as needed to control SR 896 traffic while construction vehicles enter and exit the construction site and impacts to traffic should be minimal. Work zone access and maintenance of traffic will need to be coordinated with the Contract 1A contractor who will be constructing Bridge Nos. 1-9N and 1-9S (US 301 bridges over SR 896) in this area. Construction near the US 301 over Norfolk Southern Railroad bridge (Bridge Nos. 2-1N and 2-1S) will not require maintenance of railroad traffic or any special considerations by the Contract 1C contractor. Construction of the bridges' superstructures will be completed under Contract 2B and scheduling with the railroad will be the responsibility of that contractor.



3.3 DESIGN SECTION 2

3.3.1 Existing Roadway Characteristics

This section provides a brief discussion of the existing characteristics of the roadways in the area of Design Section 2. The functional classification information and the Annual Average Daily Traffic (AADT) values mentioned in the following section reflect the information obtained from DelDOT's Traffic Summary, 2008.

Existing US 301: The section of existing US 301 (N39) between Armstrong Corner Road and Boyds Corner Road is classified a Principal Arterial with an AADT of 22,225 vpd. It is a two lane, undivided roadway, serving residential and commercial development on either side. The speed limit through the section is 45 mph. The intersections of existing US 301 with Armstrong Corner and Boyds Corner Road are controlled by traffic signals.

Armstrong Corner Road: Armstrong Corner Road (N429) is classified as a Minor Collector with an AADT of 656 vpd. It is a two-lane, undivided roadway stretching 0.9 miles between Summit Bridge Road (existing US 301) and Choptank Road. Armstrong Corner Road intersects US 301 as a four-legged intersection with US 301 comprising the northbound and southbound approaches and Marl Pit Road and Armstrong Corner Road comprising the eastbound and westbound approaches, respectively. Armstrong Corner Road intersects Choptank Road as a three-legged intersection with Choptank Road comprising the northbound and southbound approaches and Armstrong Corner Road comprising the eastbound approach.

The posted speed limit on Armstrong Corner Road is 35 mph. The roadway consists of two 11' lanes and no shoulders. All the approaches at the intersection of Armstrong Corner Road and US 301 are controlled by a traffic signal. The eastbound approach at the intersection of Armstrong Corner Road and Choptank Road is controlled by a STOP sign. There are no other traffic control devices at this location.

In the past few years, there has been a steep increase in residential and commercial development along the SR 299 (Main Street) corridor in Middletown. Due to the increase in congestion on SR 299, the stretch of N 429 comprising Armstrong Corner Road and Marl Pit Road from US 13 to Choptank road has been experiencing a considerable increase in traffic as one of the major east-west routes bypassing the town of Middletown.

Bunker Hill Road: Bunker Hill Road is classified as a Major Collector with an AADT of 1,769 vpd. It is a two-lane, undivided roadway extending 2.7 miles between existing US 301 and the Delaware/Maryland state line. Approximately 1 mile west of its intersection with existing US 301, Bunker Hill Road is intersected by Choptank Road. Bunker Hill Road intersects US 301 as a four-legged intersection with US 301 comprising the northbound and southbound legs of the intersection, and Bunker Hill Road and Main Street (State Route 299) comprising the eastbound and westbound legs of the intersection, respectively. Bunker Hill Road is intersected by Choptank Road as a T-intersection with Bunker Hill Road comprising the eastbound and westbound approaches to the intersection and Choptank Road comprising the southbound approach.

The posted speed limit on the section of Bunker Hill Road immediately west of existing US 301 is 35 mph. The posted speed limit transitions to 45 mph just east of the Delaware/Maryland Stateline. Bunker Hill Road has bike lanes on either side of the roadway in the project area. All approaches to the intersection of Bunker Hill Road and US 301 are controlled by a traffic signal. The intersection of Bunker Hill Road and Choptank Road is controlled by a roundabout.

Choptank Road: Choptank Road is classified as a Major Collector with an AADT of 1,184 vpd. It is a two-lane, undivided roadway extending 4.86 miles between Bethel Church Road and Bunker Hill Road. The roadway has recently been upgraded to two 11' lanes and 5' shoulders. Choptank Road intersects Armstrong Corner road as a T-intersection with Choptank Road comprising the southbound and northbound approaches to the intersection and Armstrong Corner Road comprising the eastbound approach. The intersection of Choptank Road and Bunker Hill Road is controlled by a roundabout.

Marl Pit Road: Marl Pit Road (N429) is classified as a Minor Collector with an AADT of 3636 vpd. It is a two-lane, undivided roadway stretching 3.9 miles between Summit Bridge Road (existing US 301) and S Dupont Pkwy (US 13). Marl Pit Road intersects US 301 as a four-legged intersection with US 301 comprising the northbound and southbound approaches and Marl Pit Road and Armstrong Corner Road comprising the eastbound and westbound approaches, respectively. Marl Pit Road intersects US 13 as a three-legged intersection with US 13 comprising the northbound and southbound approaches and Marl Pit Road comprising the eastbound approach. The

existing cross section of Marl Pit Rd consists of 11 ft travel lanes and there are currently no truck restrictions or rationale to eliminate as a state detour route alternative.

The posted speed limit on Marl Pit Road is 35 mph. The roadway consists of two 11' lanes and no shoulders. All the approaches at the intersection of Marl Pit Road and US 301 are controlled by a traffic signal. The westbound approach at the intersection of Marl Pit Road and US 13 is controlled by a STOP sign. There are no other traffic control devices at this location.

In the past few years, there has been a steep increase in residential and commercial development along the SR 299 (Main Street) corridor in Middletown. Due to the increase in congestion on SR 299, the stretch of N 429 comprising Armstrong Corner Road and Marl Pit Road from US 13 to Choptank road has been experiencing a considerable increase in traffic as one of the major east-west routes bypassing the town of Middletown.

US 13: The section of US 13 (N1) between Boyds Corner Road and Marl Pitt Road is classified a Principal Arterial with an AADT of 12,370 vpd. It is a four lane, divided roadway, serving residential and commercial development on either side.

The roadway consists of four 11' lanes and 10' shoulders. The speed limit through the section is 45 mph. All the approaches at the intersection of Boyds Corner Road and US 13 are controlled by a traffic signal. The westbound approach at the intersection of Marl Pitt Road and US 13 is controlled by a STOP sign. There are no other traffic control devices at this location.

Old School House Road: Old School House Road (N431) is classified as a Minor Collector with an AADT of 402 vpd. It is a two-lane, undivided roadway stretching 1.7 miles between Summit Bridge Road (existing US 301) and Choptank Road. Old School House Road intersects US 301 as a three-legged intersection with US 301 comprising the northbound and southbound approaches and Old School House Road comprising the eastbound approach. Old School House Road intersects Choptank Road as a three-legged intersection with Choptank Road comprising the northbound and southbound approaches and Old School House Road comprising the westbound approach.

Old School House Road consists of two 11' lanes and no shoulders. The westbound approach at the intersection of Old Shool House Road and US 301 is controlled by a STOP sign. There are no other traffic control devices at this location. The eastbound approach at the intersection of Old School House Road and Choptank Road is controlled by a STOP sign. There are no other traffic control devices at this location.

3.3.2 Crash History

Available crash data within the anticipated project limits of Section 2 has been evaluated to determine if any pre-existing safety issues are located along the construction corridor and detour routes which may warrant improvements prior to construction letting. Data from the most recent three (3) year time period was considered and will be updated throughout design. This data will be used to create a baseline to help assess work zone incidents during construction. The table below summarizes the Section 2 crash data. Detailed crash data tables are included in Appendix B.



TABLE 3.3.2.1 Design Section 2 Crash History, Summary									
SUMMARY: 1-01-2009 to 12-31-2011	Existing 301			N429: Armstrong Corner Rd	N435: Choptank Rd	N437: Bunker Hill Rd	US13 from Marl Pit Rd to Boyds Corner Rd	US 301 at Marl Pit Rd Intersection	US 301 at Boyds Corner Rd Intersection
	N443	N39	Sum						
Total Accidents	124	91	215	10	13	18	74	17	47
Fatal Accidents	1	1	2	0	1	0	1	0	0
Total Alcohol-Related Accidents	9	8	17	1	1	0	1	1	1
Total Non-Alcohol-Related Accidents	116	83	199	9	12	18	73	16	46
Total Fatalities	1	1	2	0	01	0	1	0	0
Total Pedestrian Fatalities	1	0	1	0	0	0	0	0	0
Total Pedestrian Injuries	0	0	0	0	0	0	0	0	0
Total Pedestrian Accidents	0	0	0	0	0	0	0	0	0
Total Motorcycle Accidents	4	0	4	0	1	0	3	0	0
Total Pedalcyclist Accidents	0	0	0	0	0	0	0	0	0



TABLE 3.3.2.2 Design Section 2 Crash History, Manner of Impact									
SUMMARY: 1-01-2009 to 12-31-2011	Existing 301			N429: Armstrong Corner Rd	N435: Choptank Rd	N437: Bunker Hill Rd	US13 from Marl Pit Rd to Boyds Corner Rd	US 301 at Marl Pit Rd Intersection	US 301 at Boyds Corner Rd Intersection
	N443	N39	Sum						
Front to Rear	61	54	115	1	2	5	42	7	24
Front to Front	9	3	12	0	0	2	1	1	1
Angle	28	9	37	4	5	7	15	4	14
Sideswipe, same direction	8	8	16	0	0	1	3	3	8
Sideswipe, opposite direction	4	3	7	1	0	1	1	1	0
Rear to side	0	0	0	0	0	0	0	0	0
Rear to rear	0	0	0	0	0	1	0	0	0
Other	11	8	19	0	5	1	5	1	0
Unknown	2	0	2	0	0	0	0	0	0
Not a collision between two vehicles	2	6	8	4	1	0	7	0	0
Total	125	91	216	10	13	18	74	17	47



TABLE 3.3.2.3 Design Section 2 Accident Rate Comparison								
HEP Code	Roadway	Limits	Total Crashes (2009-2011)	Length of Road Type (mi)	AADT	AART	New Castle County - AART	Statewide - AART
2	N443, N39: Existing 301 (Summit Bridge Rd)	Warwick Rd to Churchtown Rd	124	7.16	22,225	0.71	1.17	1.14
13	N429: Armstrong Corner Road	Choptank Rd to Existing 301 (Summit Bridge Rd)	10	1.01	656	13.78	2.37	1.58
14	N435: Choptank Road	Bunker Hill Rd to Bethel Church Rd	13	4.98	1,184	2.01	1.68	2.06
14	N437: Bunker Hill Road	Choptank Rd to Existing 301 (Summit Bridge Rd)	18	0.89	1,769	10.44	1.68	2.06
2	N1:US13	Marl Pit Rd to Boyds Corner Rd	74	2.42	12,370	2.26	1.17	1.14

The Hazard Elimination Program (HEP) is a federally funded program that involves identifying locations having a high frequency of crashes and developing potential short-term and long-term solutions to reduce the severity and frequency of crashes at these locations. Based on Table 3.3, there does not appear to be any HEP (formerly HSIP) locations within the anticipated project limits Section 2.

The average accident rate (AART) is a measure of number of crashes per million vehicle miles traveled along a particular roadway. The AART developed for Armstrong Corner Road stands out as particularly high in comparison to the New Castle County Average Rate for HEP Code 13. Four of the ten crashes between 2008-2011 on Armstrong Corner Road are identifiable as 'not collision between two vehicles in transport'.

The AART rates developed for Bunker Hill Road and Choptank Road in the study areas appear to be approximately 3-4 times the average rate developed for New Castle County HEP 14.

Although the AART rates mentioned above are relatively high compared to the state averages, the state average AARTs by comparison use large lengths of roadway, with reported lengths mostly in excess of 30+ miles.

The following intersections are seen as critical detour intersections for construction activities associated with the US 301 bridge structures at Armstrong Corner Road and Summit Bridge Road, as well as widening construction associated with Summit Bridge Road:

- Summit Bridge Rd (Existing 301) and Old School House Rd
- Old School House Rd and Choptank Rd
- Armstrong Corner Rd and Choptank Rd
- Bunker Hill Rd and Choptank Rd (Roundabout)
- Summit Bridge Rd (Existing 301) and Bunker Hill Rd (Signalized)
- Armstrong Corner / Marl Pit Road and Summit Bridge Rd (Existing 301) (Signalized)
- Marl Pit Road and US Route 13
- Boyds Corner Rd and US Route 13 (Signalized)
- Boyds Corner Rd and Summit Bridge Rd (Signalized)



3.3.3 Existing Traffic Conditions

Traffic characteristics for the existing impacted roadways are documented in the Existing Roadway Characteristics section above (3.3.1). Existing traffic conditions were studied along the proposed traffic control (detour) routes to evaluate potential work zone restrictions or other traffic-related existing issues.

2008 AADT information was initially obtained from the 2008 Traffic Summary for Delaware roadways. In addition to 7-Day Class Count data locations, existing peak hour turning movement count data for the following intersections was provided by the GEC:

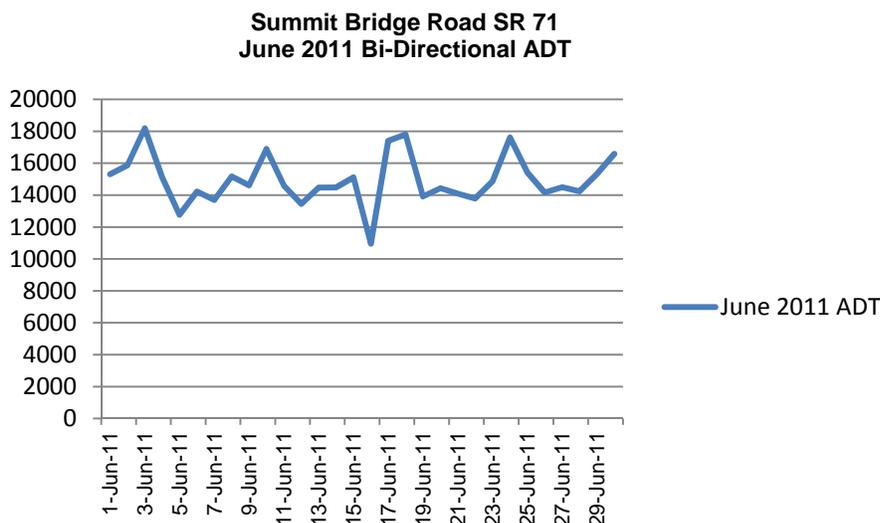
1. Summit Bridge Rd (Existing 301) and Old School House Rd
2. Old School House Rd and Choptank Rd
3. Armstrong Corner Rd and Choptank Rd
4. Summit Bridge Rd (Existing 301) and Marl Pit Road / Armstrong Corner Rd (Signalized)
5. Summit Bridge Rd (Existing 301) and Bunker Hill Rd (Signalized)
6. Boyds Corner Rd (SR 896) and US Route 13 (Signalized)
7. Boyds Corner Rd (SR 896) and Summit Bridge Rd (Signalized)

Additional traffic count data for the following intersections was obtained January 2011 for analysis of Design Section 2 detour routes:

1. Marl Pit Road and US Route 13
2. Summit Bridge Road / Peterson Rd / Doc Levinson Dr. (Signalized)
3. Bunker Hill Rd between Choptank and Summit Bridge Road (ATR Tube Count)
4. Armstrong Corner Rd between Choptank and Summit Bridge Road (ATR Tube Count)
5. US Route 13 between Marl Pit Rd and Boyds Corner Rd (ATR Tube Count)

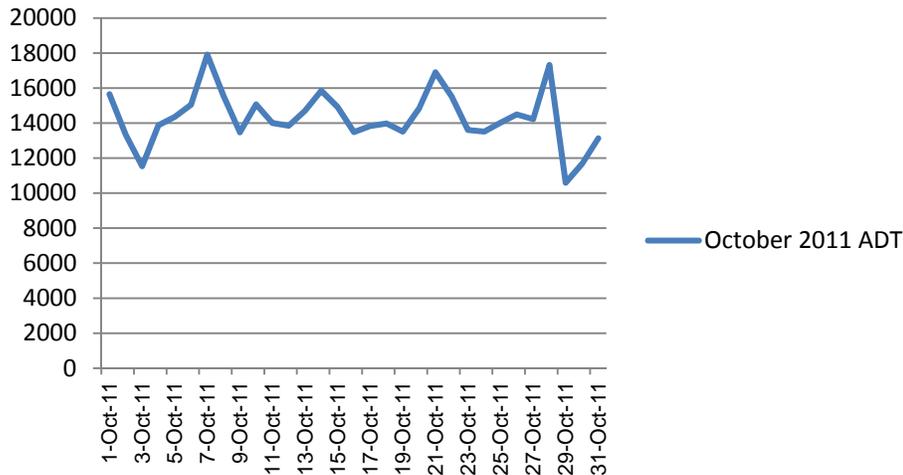
Existing Summit Bridge Road traffic volume data was queried from the existing ACTRA signal monitoring location at Summit Bridge Road/Peterson Drive and compared to identify any seasonal trends (summer vs fall) in the area of the planned construction detour (see Figure 3.3.3.1 below). Although weekday volumes remain fairly constant, weekend daily volumes could be expected to increase by as much as 10% due to summer seasonal traffic in the area. Full-closure detours are to be considered for weeknight overnight work hours to avoid any weekend traffic increases.

Figure 3.3.3.1 Seasonal Comparison of Existing 301 (Summit Bridge Road) Traffic Volumes, 2011





Summit Bridge Road SR 71
October 2011 Bi-Directional ADT



Existing signal timing information at signalized intersections was provided by the GEC for analysis purposes. It is noted that the intersections of Bunker Hill Rd and Summit Bridge Rd, Doc Levinson Drive and Summit Bridge Rd, and Boyds Corner Rd and US Route 13 have recently undergone geometric upgrades and safety improvements. Existing and construction traffic analysis for Bunker Hill Rd and Summit Bridge Rd can be found in TMP Section 3.4, Design Section 3 traffic conditions. The traffic impacts for Section 2 are discussed in the following section; detour-related activities affecting the intersection of Bunker Hill Rd and Summit Bridge Road are anticipated to be overnight and anticipated to have no impact to off-peak level-of-service at the intersection (Armstrong Rd detour volumes are expected to be less than 20 vehicles for the EB and WB directions during overnight roadway closures – see Exhibit C in Appendix C for detour volume estimates).

Capacity analysis was conducted using HCM based software (Synchro, Version 7) for existing (baseline) conditions to evaluate any existing traffic-related issues in the area. Proposed measures of effectiveness of the intersections included level-of-service (LOS), delay, and queue lengths.

The results of the existing conditions capacity analysis can be seen in comparison to construction period traffic conditions in the next section, Section 3.3.4 Construction Period Traffic Conditions. The existing intersections identified for analysis within Design Section 2 operate at LOS 'C' or better under existing conditions, with the exception of the intersection of Boyds Corner Road (SR896) and Summit Bridge Road (SR71), which operates at LOS D(D) during the AM(PM) peaks, respectively. It is noted that a cycle length of 150 seconds was used to evaluate the peak operation of the signalized intersections on Boyds Corner Rd at Summit Bridge Road and US Route 13 as per the maximum cycle length of recent coordination timing plan data. These two signals are currently on-system at DelDOT TMC for timing evaluation and modifications.

The unsignalized intersections of Old School House Road at Summit Bridge Road and Marl Pit Road at US Route 13 currently have movements on the minor stop approach that experience delay due to heavy arterial volumes on the major approaches. These intersection movements have been assessed for traffic impacts due to construction-related traffic during detours and the corresponding level-of-service has been documented for the detour plans provided in this contract.

3.3.4 Construction Period Traffic Conditions

Based on the proposed construction phasing approach, key roads and intersections to be analyzed in greater detail have been identified in the TMP. Capacity analysis was conducted for the construction period condition (background growth) and any relevant detour conditions to identify anticipated area traffic impacts due to construction.

Construction Period Conditions

Development of construction year volumes was performed using existing peak hour traffic data collected as outlined in the previous section. A conservative growth factor of 2% has been applied to the network to obtain future construction year volumes. A construction year of 2015 was used for analysis purposes.

Capacity analysis was conducted using HCM based software (Synchro, Version 7) for construction year conditions to evaluate any future traffic-related issues in the area. Proposed measures of effectiveness of the intersections included LOS, delay, and queues.

The results of the 2% background growth analysis (construction period) in comparison to existing traffic conditions can be found in the following Tables 3.3.4.1 and 3.3.4.2.

It is noted that under peak hour conditions during construction, day-to-day construction work zone capacity impacts are anticipated along Bunker Hill Road, Armstrong Corner Road, and Summit Bridge Road (between the extents of the widening construction contract). These capacity reductions are anticipated due to typical work zone impacts (i.e. work zone signage, construction vehicles, etc) and Summit Bridge Road construction phasing (lane width reductions, 11' lane widths proposed).

For a several month period during the Summit Bridge Road widening contract, the current traffic control plan eliminates the right-turn lanes traveling northbound and southbound on Summit Bridge Road at the intersection of Marl Pit Road/Armstrong Corner Rd/Summit Bridge Road, restricting the approach northbound and southbound approach movements to a shared through and right-turn lane for a several month period. For the construction peak period analysis, this condition has been implemented as the worst-case scenario at the intersection to verify construction conditions. Additionally, a SimTraffic simulation has been analyzed for the intersection to verify queue lengths and other impacts under construction conditions.

In coordination with Design Sections 1 and 3, it is anticipated that two detours related to adjacent contracts will impact Section 2.

In Design Section 1, Boyds Corner Road and a section of US13 north of Boyds Corner Road are being utilized for the Hyetts Corner Road detour for a period over three years. The detour traffic obtained from Section 1 indicates an estimated AADT of 188 vpd being detoured, which indicates a design hourly bi-directional volume for peak period of 19 vehicles, with the existing direction distribution yielding a maximum of 12 vehicles diverted southbound on Jamison Road and 7 vehicles diverted northbound in the peak hour. The effects of the Hyetts Corner Road detour are expected to be minimal (maximum 12 additional vehicles during peak period per direction) and these impacts have been added into the construction peak period analysis. Refer to Section 2.7-2 of this TMP document for allowable detour overlapping and construction phasing.

In Design Section 3, the temporary roadway over Bunker Hill Road and a section of existing US 301 immediately south of Bunker Hill Road are being utilized for the Middleneck Road detour for a period of approximately 10 months. The detour traffic obtained from Section 3 indicates an estimated AADT of 487 vpd being detoured, which indicates a design hourly bi-directional volume for peak period of 48 vehicles, with the existing direction distribution yielding a maximum of 24 vehicles diverted in both directions across Bunker Hill Road. The effects of the Middleneck Road detour are expected to be minimal (maximum 24 additional vehicles during peak period per direction) and these impacts have been added into the construction peak period analysis. Refer to Section 2.7-2 of this TMP document for allowable detour overlapping and construction phasing.

Construction impacts due to off-peak detours associated with proposed US 301 overpass and Summit Bridge Road widening construction are discussed in the sections following the construction peak period analysis.



TABLE 3.3.4 .1 Existing and Construction Traffic Conditions AM Peak Period (7:00AM - 8:00AM) US 301 Design Section 2 - Levels Rd to Summit Bridge Rd												
			Existing Baseline Conditions					Construction Year Conditions				
Intersection	Approach	Mvmt	Existing Volume (Veh/hr)	Mvmt LOS	Delay (s)	95th % Queue (ft)	Int LOS	Constr Volume (Veh/hr)	Mvmt LOS	Delay (s)	95th % Queue (ft)	Int LOS
N702 Summit Bridge Rd (SR71) and Armstrong Corner Rd/ Marl Pit Rd (Signalized)	Armstrong Corner Rd	EBL	15	D	36.3	117	B	16	D	36.2	127	C
		EBT	69					75				
		EBR	33					36				
	Marl Pit Rd	WBL	46	D	44.9	173		50	D	47.0	193	
		WBT	39					42				
		WBR	108					117				
	Summit Bridge Road (SR71)	NBL	16	A	5.7	11		17	A	6.3	12	
		NBT	630	B	19.7	513		712	C	25.4	#730	
		NBR	28	A	7.4	19		*Temporary closure for work zone				
	Summit Bridge Road (SR71)	SBL	58	A	6.2	28		63	A	7.3	32	
		SBT	379	B	10.8	236		429	B	12.2	291	
		SBR	18	A	6.6	14		*Temporary closure for work zone				
N330 Boyds Corner Rd (SR896) and US Rte 13 (Signalized)	Boyds Corner Rd (SR 896)	EBL	241	D	42.9	103	C	273	D	43.7	115	C
		EBT	273	D	44.7	118		296	D	44.7	127	
		EBR	87	A	0.1	0		94	A	0.1	0	
	Pole Bridge Rd	WBL	77	E	80.1	135		83	F	80.2	143	
		WBT	133	E	72.6	119		144	E	72.3	126	
		WBR	48	A	0.0	0		52	A	0.0	0	
	US Rte 13 (S Dupont Hwy)	NBL	185	E	74.3	139		200	E	74.3	148	
		NBT	904	B	20.1	272		979	C	21.9	311	
		NBR	331	A	0.4	0		358	A	0.4	0	
	US Rte 13 (S Dupont Hwy)	SBL	44	E	72.6	46		48	E	72.8	48	
		SBT	385	C	22.2	124		417	C	24.0	140	
		SBR	115	A	0.1	0		136	A	0.1	0	



TABLE 3.3.4 .1 Existing and Construction Traffic Conditions AM Peak Period (7:00AM - 8:00AM) US 301 Design Section 2 - Levels Rd to Summit Bridge Rd												
			Existing Baseline Conditions					Construction Year Conditions				
Intersection	Approach	Mvmt	Existing Volume (Veh/hr)	Mvmt LOS	Delay (s)	95th % Queue (ft)	Int LOS	Constr Volume (Veh/hr)	Mvmt LOS	Delay (s)	95th % Queue (ft)	Int LOS
N371 Boys Corner Rd / SR 896 and Summit Bridge Rd (Signalized)	Churchtown Rd	EBL	69	E		116	D	75	E		125	D
		EBT	116	E		192		126	E		207	
		EBR	12					13				
	Boys Corner Rd (SR 896)	WBL	163	C		127		176	C		120	
		WBT	41	C		m69		44	C		m63	
		WBR	283	B		254		306	B		276	
	Summit Bridge Road	NBL	13	E		35		14	E		36	
		NBT	713	D		422		772	D		470	
		NBR	181	A		0		196	A		0	
	Summit Bridge Road	SBL	237	E		170		257	E		182	
		SBT	495	D		284		536	D		309	
		SBR	17	B		20		18	B		21	
Marl Pit Rd and US Rte 13 (Unsignalized)	Marl Pit Rd	EBL	71	F	60.3	84	N/A	77	F	95.6	121	N/A
		EBR	17					18				
	US Rte 13 (S Dupont Hwy)	NBL	16	A		1		17	A	8.8	1	
		NBT	1607	-	-	-		1739	-	-	-	
	US Rte 13 (S Dupont Hwy)	SBT	463	-	-	-		501	-	-	-	
		SBR	19	-	-	-		21	-	-	-	
Armstrong Corner Rd and Choptank Dr (Unsignalized)	Armstrong Corner Rd	WBL	25	B		9	N/A	27	B		10	N/A
		WBR	43					47				
	Choptank Drive	NBT	112	-	-	-		121	-	-	-	
		NBR	48	-	-	-		52	-	-	-	
	Choptank Drive	SBL	75	A		5		81	A		5	
		SBT	226	-	-	-		245	-	-	-	



TABLE 3.3.4 .1 Existing and Construction Traffic Conditions AM Peak Period (7:00AM - 8:00AM) US 301 Design Section 2 - Levels Rd to Summit Bridge Rd												
			Existing Baseline Conditions					Construction Year Conditions				
Intersection	Approach	Mvmt	Existing Volume (Veh/hr)	Mvmt LOS	Delay (s)	95th % Queue (ft)	Int LOS	Constr Volume (Veh/hr)	Mvmt LOS	Delay (s)	95th % Queue (ft)	Int LOS
Old School House Rd and Choptank Dr (Unsignalized)	Old School-house Rd	WBL	39	B	12.4	7	N/A	42	B	12.9	8	N/A
		WBR	5					5				
	Choptank Drive	NBT	168	-	-	-		182	-	-	-	
		NBR	9	-	-	-		10	-	-	-	
	Choptank Drive	SBL	11	A	0.4	1		12	A	0.4	1	
		SBT	288	-	-	-		312	-	-	-	
Old School House Rd and Summit Bridge Rd (Unsignalized)	Old School-house Rd	EBL	36	E	43.3	40	N/A	39	F	58.9	55	N/A
		EBR	15					16				
	Summit Bridge Road	NBL	5	A	9.2	0		5	A	9.5	0	
		NBT	845	-	-	-		915	-	-	-	
	Summit Bridge Road	SBT	613	-	-	-		664	-	-	-	
		SBR	30	-	-	-		32	-	-	-	
N727 Doc Levinson Dr and Summit Bridge Road (SR71) (Signalized)	Doc Levinson Drive	EBL	5	D	49.6	27	A	5	D	49.6	27	A
		EBT	6					6				
		EBR	48	A	0.0	0		52	A	0.0	0	
	Peterson Road	WBL	1	D	54.2	31		1	D	54.3	33	
		WBT	12					13				
		WBR	18	A	0.0	0		19	A	0.0	0	
	Summit Bridge Road	NBL	19	A	3.5	13		21	A	3.5	14	
		NBT	333	A	5.3	94		360	A	5.3	102	
		NBR	1	A	7.0	3		1	A	7.0	3	
	Summit Bridge Road	SBL	30	A	3.3	18		32	A	3.3	18	
		SBT	407	A	5.0	114		441	A	5.4	124	
		SBR	15	A	4.1	10		16	A	4.1	11	
Bunker Hill Road	EBL	61	E	56.9	48		66	E	57.0	51		



TABLE 3.3.4 .1 Existing and Construction Traffic Conditions AM Peak Period (7:00AM - 8:00AM) US 301 Design Section 2 - Levels Rd to Summit Bridge Rd												
			Existing Baseline Conditions					Construction Year Conditions				
Intersection	Approach	Mvmt	Existing Volume (Veh/hr)	Mvmt LOS	Delay (s)	95th % Queue (ft)	Int LOS	Constr Volume (Veh/hr)	Mvmt LOS	Delay (s)	95th % Queue (ft)	Int LOS
Bunker Hill Rd and Summit Bridge Rd (SR71) Signalized		EBT	182	E	57.6	115	C	197	E	57.5	122	C
		EBR	28	A	0.0	0		55	A	0.1	0	
	Bunker Hill Rd	WBL	142	E	58.0	92		153	E	58.4	98	
		WBT	167	D	48.4	102		180	D	48.1	108	
		WBR	72	A	0.1	0		78	A	0.1	0	
	Summit Bridge Rd	NBL	21	A	9.2	18		48	A	9.6	33	
		NBT	298	B	15.8	108		322	B	16.6	119	
		NBR	97	A	0.1	0		105	A	0.1	0	
	Summit Bridge Rd	SBL	82	A	9.2	51		89	A	9.7	55	
		SBT	219	B	13.0	76		237	B	14.8	85	
		SBR	53	A	0.1	0		57	A	0.1	0	

TABLE 3.3.4 .2 Existing and Construction Traffic Conditions PM Peak Period (5:00PM - 6:00PM) US 301 Design Section 2 - Levels Rd to Summit Bridge Rd												
			Existing Baseline Conditions					Construction Year Conditions				
Intersection	Approach	Mvmt	Existing Volume (Veh/hr)	Mvmt LOS	Delay (s)	95th % Queue (ft)	Int LOS	Constr Volume (Veh/hr)	Mvmt LOS	Delay (s)	95th % Queue (ft)	Int LOS
N702 Summit Bridge Rd (SR71) and Armstrong Corner Rd/ Marl Pit Rd (Signalized)	Armstrong Corner Rd	EBL	8	C	30.3	96	C	9	C	31.6	110	C
		EBT	49					53				
		EBR	44					48				
	Marl Pit Rd	WBL	46	D	47.5	173		50	D	51.2	200	
		WBT	50					54				
		WBR	81					88				
	Summit Bridge Road (SR71)	NBL	38	A	6.7	20		41	A	9.1	23	
		NBT	548	B	19.5	435		642	C	27.3	#708	
		NBR	45	A	7.2	27		*Temporary closure for work zone				



TABLE 3.3.4 .2 Existing and Construction Traffic Conditions PM Peak Period (5:00PM - 6:00PM) US 301 Design Section 2 - Levels Rd to Summit Bridge Rd															
			Existing Baseline Conditions					Construction Year Conditions							
Intersection	Approach	Mvmt	Existing Volume (Veh/hr)	Mvmt LOS	Delay (s)	95th % Queue (ft)	Int LOS	Constr Volume (Veh/hr)	Mvmt LOS	Delay (s)	95th % Queue (ft)	Int LOS			
	Summit Bridge Road (SR71)	SBL	140	A	7.2	58		152	A	9.0	69				
		SBT	820	C	25.0	#854		910	C	35.0	#1074				
		SBR	20	A	8.3	17		*Temporary closure for work zone							
N330 Boyds Corner Rd (SR896) and US Rte 13 (Signalized)	Boyds Corner Rd (SR 896)	EBL	194	E	56.0	83	C	222	D	53	91	C			
		EBT	167	D	52.7	75		181	D	49.0	79				
		EBR	149	A	0.1	0		161	A	0.1	0				
	Pole Bridge Rd	WBL	160	E	78.9	200		173	E	77.8	209				
		WBT	191	E	70.7	177		207	E	70.2	190				
		WBR	79	A	0.1	0		86	A	0.1	0				
	US Rte 13 (S Dupont Hwy)	NBL	131	E	74.4	105		142	E	74.4	112				
		NBT	602	C	20.4	182		652	C	22.4	206				
		NBR	84	A	0.1	0		91	A	0.1	0				
	US Rte 13 (S Dupont Hwy)	SBL	66	E	73.0	62		71	E	73.0	65				
		SBT	1154	C	26.4	406		1249	C	29.8	469				
		SBR	171	A	0.2	0		197	A	0.2	0				
	N371 Boyds Corner Rd / SR 896 and Summit Bridge Rd (Signalized)	Church-town Rd	EBL	49	D	54.6		88	D	53	D		54.9	93	D
			EBT	66	D	52.0		129		71	D		52.6	136	
			EBR	18						19					
Boyds Corner Rd (SR 896)		WBL	209	D	39.8	158	226	D		39.2	170				
		WBT	117	D	41.1	195	127	D		40.7	210				
		WBR	168	B	17.7	92	182	B		17.0	39				
Summit Bridge Road		NBL	17	E	56.2	41	18	E		56.3	44				
		NBT	562	D	42.5	330	608	D		44.4	362				
		NBR	151	A	0.1	0	163	A		0.1	0				
Summit Bridge Road		SBL	284	E	72.8	198	307	E		73.0	212				
		SBT	755	D	50.9	459	817	D		53.7	504				



TABLE 3.3.4 .2 Existing and Construction Traffic Conditions PM Peak Period (5:00PM - 6:00PM) US 301 Design Section 2 - Levels Rd to Summit Bridge Rd												
			Existing Baseline Conditions					Construction Year Conditions				
Intersection	Approach	Mvmt	Existing Volume (Veh/hr)	Mvmt LOS	Delay (s)	95th % Queue (ft)	Int LOS	Constr Volume (Veh/hr)	Mvmt LOS	Delay (s)	95th % Queue (ft)	Int LOS
		SBR	47	B	15.4	43		51	B	16.4	47	
Marl Pit Rd and US Rte 13 (Unsignalized)	Marl Pit Rd	EBL	51	F	113.0	106	N/A	55	F	193.6	150	N/A
		EBR	20					22				
	US Rte 13 (S Dupont Hwy)	NBL	14	B	13.8	3		15	B	14.9	3	
		NBT	712	-	-	-		771	-	-	-	
	US Rte 13 (S Dupont Hwy)	SBT	1244	-	-	-		1347	-	-	-	
		SBR	103	-	-	-		111	-	-	-	
Armstrong Corner Rd and Choptank Dr (Unsignalized)	Armstrong Corner Rd	WBL	48	B	11.9	15	N/A	52	B	12.4	17	N/A
		WBR	49					53				
	Choptank Drive	NBT	178	-	-	-		193	-	-	-	
		NBR	26	-	-	-		28	-	-	-	
	Choptank Drive	SBL	55	A	2.1	3		60	A	2.2	4	
		SBT	184	-	-	-		199	-	-	-	
Old School House Rd and Choptank Dr (Unsignalized)	Old School-house Rd	WBL	18	B	11.8	3	N/A	19	B	12.3	4	N/A
		WBR	3					3				
	Choptank Drive	NBT	263	-	-	-		285	-	-	-	
		NBR	9	-	-	-		10	-	-	-	
	Choptank Drive	SBL	7	A	0.3	0		8	A	0.4	1	
		SBT	185	-	-	-		200	-	-	-	
Old School House Rd and Summit Bridge Rd (Unsignalized)	Old School-house Rd	EBL	6	E	39.6	14	N/A	6	E	48.5	18	N/A
		EBR	12					13				
	Summit Bridge Road	NBL	20	B	12.2	3		22	B	12.9	4	
		NBT	656	-	-	-		710	-	-	-	
	Summit Bridge Road	SBT	1112	-	-	-		1204	-	-	-	
		SBR	39	-	-	-		42	-	-	-	
		EBL	25	E	68.4	53		27	E	70.5	56	



TABLE 3.3.4 .2 Existing and Construction Traffic Conditions PM Peak Period (5:00PM - 6:00PM) US 301 Design Section 2 - Levels Rd to Summit Bridge Rd												
			Existing Baseline Conditions					Construction Year Conditions				
Intersection	Approach	Mvmt	Existing Volume (Veh/hr)	Mvmt LOS	Delay (s)	95th % Queue (ft)	Int LOS	Constr Volume (Veh/hr)	Mvmt LOS	Delay (s)	95th % Queue (ft)	Int LOS
N727 Doc Levinson Dr and Summit Bridge Road (SR71) (Signalized)	Doc Levinson Drive	EBT	3				B	3				B
		EBR	50	B	16.0	38		54	B	15.5	40	
	Peterson Road	WBL	1	D	54.7	37		1	D	54.8	38	
		WBT	16					17				
		WBR	44	A	0.0	0		48	A	0.0	0	
	Summit Bridge Road	NBL	49	A	5.8	27		53	A	5.9	29	
		NBT	469	A	9.5	141		508	A	9.8	154	
		NBR	0	A	0.0	0		0	A	0.0	0	
	Summit Bridge Road	SBL	33	A	5.9	20		36	A	5.9	21	
		SBT	499	A	10.3	153		540	B	10.7	168	
		SBR	21	A	5.0	13		23	A	5.0	14	
	Bunker Hill Rd and Summit Bridge Rd (SR71) Signalized	Bunker Hill Road	EBL	103	E	57.4		72	C	111	E	
EBT			261	E	56.9	153	282	E		56.9	163	
EBR			48	A	0.0	0	77	A		0.1	0	
Bunker Hill Rd		WBL	212	E	60.4	130	229	E		63.3	141	
		WBT	210	D	48.2	123	227	D		47.9	131	
		WBR	86	A	0.1	0	93	A		0.1	0	
Summit Bridge Rd		NBL	31	B	10.9	26	58	B		11.9	43	
		NBT	370	B	19.4	137	400	C		20.4	148	
		NBR	158	A	0.2	0	171	A		0.2	0	
Summit Bridge Rd		SBL	166	B	12.7	102	179	B		14.7	114	
		SBT	379	B	16.0	138	409	B		18.4	152	
		SBR	51	A	0.1	0	55	A		0.1	0	

indicates 95% volume exceeds capacity, queue length undetermined

The intersections identified for analysis within Design Section 2 operate at similar conditions to the existing analysis, with some intersection movements experiencing a slight shift in LOS due to increased delay associated with the additional background traffic volumes.



Based on the analysis results without construction detours, the intersections shown are expected to accommodate area traffic during the construction year at a similar LOS as existing conditions.

Westbound queue lengths at the intersection of existing US 301 (Summit Bridge Road) and SR 896 (Boys Corner Rd) are not anticipated to interfere with the existing Norfolk Southern railroad crossing located 300' east of the intersection.

Due to the work zone impacts of the Summit Bridge Road widening, the intersection of Marl Pit Road/Armstrong Corner Road/Summit Bridge Road is expected to experience increased queue lengths during peak periods due to work zone impacts and the temporary reduction of the approach (elimination of right turn lanes for work zone). A SimTraffic analysis was performed for the intersection under peak conditions to verify queue lengths and can be found in Appendix C, with results depicted in Table 3.3.4.3.

SimTraffic analysis was also performed for the unsignalized intersection of Marl Pit Road and US 13 in order to verify existing queue lengths for comparison to detour conditions and can be found in Appendix C, as well as Table 4.3.2.2.

TABLE 3.3.4 .3 Construction Traffic Conditions - Queue Lengths at Summit Bridge Rd/Marl Pit Rd/Armstrong Corner Rd US 301 Design Section 2 - Levels Rd to Summit Bridge Rd								
			Construction Year AM Conditions			Construction Year PM Conditions		
Intersection	Approach	Mvmt	Constr Volume (Veh/hr)	Synchro 95th % Queue (ft)	SimTraffic 95th % Queue (ft) (All Intervals)	Constr Volume (Veh/hr)	Synchro 95th % Queue (ft)	SimTraffic 95th % Queue (ft) (All Intervals)
N702 Summit Bridge Rd (SR71) and Armstrong Corner Rd/ Marl Pit Rd (Signalized)	Armstrong Corner Rd	EBL	16	127	135	9	110	91
		EBT	75			53		
		EBR	36			48		
	Marl Pit Rd	WBL	50	193	213	50	200	182
		WBT	42			54		
		WBR	117			88		
	Summit Bridge Road (SR71)	NBL	17	12	73	41	23	92
		NBT	712	#730	548	642	#708	604
		NBR	*Temporary closure for work zone			*Temporary closure for work zone		
	Summit Bridge Road (SR71)	SBL	63	32	83	152	69	281
		SBT	429	291	286	910	#1074	712
		SBR	*Temporary closure for work zone			*Temporary closure for work zone		

indicates 95% volume exceeds capacity, queue length undetermined



3.4 DESIGN SECTION 3

3.4.1 Existing Roadway Characteristics

This section provides a brief discussion of the existing characteristics of the roadways in the area of Design Section 3. The functional classification information and the Annual Average Daily Traffic (AADT) values mentioned in the following section reflect the information obtained from DelDOT's 2010 Traffic Summary and traffic count data provided by the GEC.

Existing US 301: The section of existing US 301 (N62) between the Maryland line and Warwick Road is classified as a Rural Arterial with an AADT of 11,002 vpd. The section of existing US 301 (N443) between Warwick Road and Levels Road is classified a Rural Arterial with an AADT of 15,470 vpd. Existing US 301 is a two lane, undivided roadway, serving residential and commercial development on either side. The speed limit through the section is 50 mph. At its intersection with Warwick Road, all movements from Warwick Road onto existing US 301 are controlled by a STOP sign. There are no traffic control devices on existing US 301 at this location. The intersection of existing US 301 and Levels Road is a three leg signalized intersection. At the intersection with Strawberry Lane, all movements from Strawberry Lane onto existing US 301 are controlled by a STOP sign. There are no traffic control devices on existing US 301 at Strawberry Lane.

Strawberry Lane: Strawberry Lane (N445) is classified as a Rural Minor Collector with an AADT of 565 vpd. It is a two-lane, undivided roadway extending approximately 1.2 miles from the Delaware/Maryland state line to its terminus at Levels Road (SR 15). Strawberry Lane intersects existing US 301 approximately 1,200 feet north of the Delaware/Maryland state line. There are no speed limit signs posted in the study section of Strawberry Lane in Delaware. Delaware Code states that speed limits on two-lane two-way roadways shall be 50 mph unless otherwise posted lower therefore, the speed limit on Strawberry Lane is 50 mph. Strawberry Lane intersects existing US 301 as a four-legged intersection. The traffic on Strawberry Lane is controlled by a STOP sign on either side of US 301. There are no other traffic control devices at this location.

Warwick Road: The section of Warwick Road (N443) in the project area is classified as a Rural Arterial with an AADT of 3,140 vpd. It is a two-lane, undivided roadway extending approximately 0.5 miles from the Delaware/Maryland state line and intersecting existing US 301 approximately 0.7 miles north of the intersection of Strawberry Lane and existing US 301. It consists of two 11' lanes and 7' shoulders on either side. The posted speed limit of the roadway within the project limits is 40 mph. Eastbound Warwick Road intersects existing US 301 as a four-legged intersection. The eastbound traffic on Warwick Road is controlled by a STOP sign. Westbound traffic from the opposing Hooper Equipment driveway is also STOP controlled. There are no other traffic control devices at this location.

Middle Neck Road: Middle Neck Road (N444) is classified as a Rural Minor Collector with an AADT of 458 vpd. It is a two-lane, undivided roadway extending approximately 1.1 miles southeast from the Delaware/Maryland state line to intersect existing US 301 as a T-intersection approximately half a mile north of the intersection of Warwick Road and US 301. There are currently no pavement markings on Middle Neck Road. The pavement width is approximately 26 feet. There are no speed limit signs posted in the study section of Middle Neck Road therefore a speed limit of 50 mph is assumed. Eastbound traffic on Middle Neck Road is controlled by a STOP sign at the intersection with Existing US 301. There are no other traffic control devices at this location.

Old Telegraph Road: Old Telegraph Road is located within Maryland. It is a two-lane, undivided rural roadway which extends approximately 3.1 miles from Bunker Hill Road to Strawberry Lane (Wilson Street and Water Street in Maryland). The AADT is 826 vpd and there is a posted speed limit of 35 mph.

State Route 15 (SR 15): Four different segments of SR 15 lie within the US 301 project area – Levels Road (N10), Bunker Hill Road (N437), Choptank Road (N435) and Bethel Church Road (N433). SR 15 stretches 57 miles starting just north and west of Milford in Kent County and terminating just south of the Summit Bridge in New Castle County. The sections of Bunker Hill Road, Choptank Road and Bethel Church Road on SR 15 are also a part of Delaware Bicycle Route 1. The following paragraph discusses the existing roadway characteristics of the above mentioned sections of SR 15 that fall under Design Section 3. The rest of the sections are covered under Section 4.

Levels Road: Levels Road in the project area is classified as a Rural Minor Collector with an AADT of 2,680 vpd. Levels Road is a two-lane undivided roadway extending approximately 3.15 miles from Dogtown Road to existing



US 301. Levels Road intersects existing US 301 approximately 0.85 miles north of the intersection of Middle Neck Road and US 301. The posted speed limit on Levels Road varies from 40 mph to 50 mph between existing US 301 and Dogtown Road. Levels Road intersects US 301 as a T-intersection with US 301 comprising the northbound and southbound approaches and Levels Road comprising the westbound approach. The intersection of Levels Road and existing US 301 is currently signalized.

3.4.2 Crash History

The following roadways are expected to experience an increase in volumes or change in traffic patterns due to detours which will be in place during construction:

- US 301
- Levels Road (SR 15, N10)
- Warwick Road (SR 299, N443)
- Bunker Hill Road (N437)
- Middle Neck Road (N444)
- Strawberry Lane (N445)
- Old Telegraph Road (Maryland)

Available three year crash data within the anticipated project limits of Section 3 has been evaluated to determine if any pre-existing safety issues are located along the proposed detour routes which may warrant improvements prior to construction letting. Data from the most recent three 3 year time period was considered and has been updated throughout design. This data will be used to create a baseline to help assess work zone incidents during construction. The table below summarizes the Section 3 crash data. Crash data rate calculation worksheets are included in Appendix B.3.



Table 3.4.2.1 - Crash Data Analysis

Roadway	Start MP	End MP	Crashes (Jan '09 - Dec '11)	2011 AADT	ACRT ¹	Statewide ACRT ²
Strawberry Lane (N445), MD Line to Levels Road	0	1.19	5	565	6.79	3.22
Middle Neck Road (N444), MD Line to US 301 (N443)	0	1.08	1	458	1.85	3.22
Levels Road (N10), MD Line to N447	0	2.88	8	2,680	0.95	3.22
Levels Road (N10), St. Annes Church Rd (N447) to US 301 (N443)	2.88	3.97	0	2,680	0.00	3.22
Existing US 301, N62, MD Line to N443	0	1.01	16	11,222	1.29	1.40
DE 299/Warwick Road(N443), MD Line to US 301(N62)	0	0.52	4	3,140	2.24	2.08
Existing US 301, N443, N62 to N10	0.52	2.02	38	15,470	1.50	1.40
Existing US 301, N443, N10 to N437	2.02	3.13	71	16,456	3.55	1.40
Bunker Hill Road (N437), MD Line to US 301 (N39)	0	2.74	25	2,667	3.12	3.22
Old Telegraph Road (Maryland), Water Street to Bunker Hill Road *	0	3.1	6	826	2.14	3.93

1. ACRT – Average Crash Rate.
2. 2011 ACRT data was provided by DelDOT.
- * Old Telegraph Road data was provided by Cecil County, MD.

Based on Table 3.3, there are no HSIP locations within the project limits of Section 3.

DelDOT provided 2011 statewide average crash rate data for use in comparing roadway crash data to statewide averages. The average crash rates for several roads in the study area exceed the statewide averages as identified in the table above and therefore, detailed crash report data was reviewed to assess any existing safety issues.

Based on a review of average crash rates, the following roadway segments exhibit crash rates greater than the statewide average crash rate for similar roadways. Detailed crash data along these roadways is discussed in the safety assessment contained in Chapter 4.

- Strawberry Lane (N445), MD Line to Levels Road
- DE 299/Warwick Road (N443), MD Line to US 301 (N62)
- Existing US 301 , N443, N62 to N10
- Existing US 301, N443, N10 to N 437

The following intersections are seen as critical intersections considering the current construction phasing and detour plans.

- Levels Road and 301 (Signalized)



- Bunker Hill and 301 (Signalized)
- Warwick Road and 301
- Bunker Hill and Old Telegraph Road
- Middle Neck Road and Old Telegraph Road
- Strawberry Lane and Old Telegraph Road
- Strawberry Lane and Warwick Road
- Strawberry Lane and Levels Road
- 301 and Temporary Intersection

3.4.3 Existing Traffic Conditions

Information related to a majority of the roadways within Section 3 is documented in the Existing Roadway Characteristics section above (3.4.1). The table below summarizes the traffic data collection efforts for Section 3. **Figure 1** in Appendix C.3 illustrates existing AADT's along study roadways and turning movement counts at critical intersections which will be evaluated further in the work zone assessment section of the TMP.



Table 3.4.2.2 - Traffic Data Summary

Roadway/Intersection	Traffic Count Type	Source	Date
Levels Road	AADT	DeIDOT Traffic Summary	2011
Strawberry Lane	AADT	DeIDOT Traffic Summary	2011
Warwick Road	AADT	DeIDOT Traffic Summary	2011
Bunker Hill Road	AADT	DeIDOT Traffic Summary	2011
US 301, N62, MD Line to N443	AADT	GEC provided data from count station # 8025 at MD Line	2010
US 301, N443, N62 to N10	AADT	DeIDOT Traffic Summary	2011
US 301, N443, N10 to N437	AADT	DeIDOT Traffic Summary	2011
Old Telegraph Road	AADT	GEC provided 2011 data	2011
Middleneck Road	AADT	DeIDOT Traffic Summary	2011
Bunker Hill Road / US 301	PH TMC	Pennoni	2010
Levels Road / US 301	PH TMC	Pennoni	2010
Warwick Road / US 301	PH TMC	Pennoni	2010
Strawberry Lane / US 301	PH TMC	Pennoni	2009

AADT – Average Annual Daily Traffic
 PH TMC - Peak Hour Turning Movement Counts

3.4.4 Construction Period Traffic Conditions

Development of construction year volumes was completed using existing peak hour traffic data which was collected as outlined in the previous section. Growth factors which were applied to existing traffic counts to obtain future construction year volumes were provided by the GEC. A near-term growth rate of 2% was applied to all existing traffic volumes to develop construction year traffic forecasts. Existing and collected data was used to develop a traffic model based on the traffic control plan and construction year volumes. The results of the level of service and queue analysis are summarized on the tables in the Work Zone Impact Assessment (section 4.4) and Appendix C.3.

The No Build 2015 (Baseline) traffic volumes and construction year traffic volumes for each phase of construction impacted by a detour are illustrated on the figures in Appendix C.3.





CHAPTER 4 WORK ZONE IMPACTS ASSESSMENTS





4.0 WORK ZONE IMPACT ASSESSMENT

The construction of the US 301 project will occur on new alignment, which will minimize the impact to motorists on existing routes. However, construction of bridges carrying existing roadways over the new US 301, construction of new US 301 bridges over existing roadways, construction of US 301 tie-in points, and relocation or construction of adjacent roadways have a potential to cause significant impacts to motorists and the surrounding community.

4.1 CORRIDORWIDE ASSESSMENTS

4.1.1 Movement of material or equipment along existing roadways

All construction will be planned in such a way as to minimize any need for crossing or traveling along existing roadways with construction equipment or for moving large quantities of earthen material along them. If there is a need to move material or equipment across existing roadways, a plan will be developed scheduling the movement of material and earthwork in such a manner as would cause minimal impact to the roadway and the traffic using the roadway.

4.1.2 Work Zone Impact on roadways outside of the project area

During the construction phase, probable temporary lane closures on major roadways in the project area such as SR 1, existing US 301 and Boyds Corner Road may result in an increase in traffic on alternative routes such as US 13, Choptank Road, Summit Bridge Road and Marl Pit Road, as motorists look for alternate routes to avoid delays. If such traffic diversions are observed by DelDOT during the construction phase, additional measures would be needed to mitigate the impacts caused by this increase in traffic.

4.1.3 Coordination between the Design Sections

During the construction phase, if a particular roadway is impacted by work zones of more than one design section, the phasing of these sections will be adjusted so that the roadway is not impacted by both the sections at any given point of time. The work zone impact assessment and management strategies for the roadway will be developed by the SDCs in conjunction with each other.

4.1.4 Intersection Performance Assessment

Signalized Intersections

If the existing level of service on each approach is between 'A' and 'C', then the level of service during the construction period on each approach will not be reduced below a 'D' with control delay of 45 seconds. If delays of more than 45 seconds are projected on an approach, mitigation strategies will be reviewed and proposed.

If the existing level of service on each approach is 'D' or worse, then the control delay during the construction period on each approach will not increase more than 30%. If the 30% threshold is exceeded, mitigation strategies will be reviewed and proposed.

Unsignalized Intersections

If the existing level of service on controlled approaches is between 'A' and 'C', then the level of service during the construction period on each approach will not be reduced below a 'D' with control delay of 30 seconds. If delays of more than 30 seconds are projected on a controlled approach, mitigation strategies will be reviewed and proposed.

If the existing level of service on each approach is 'D' or worse, then the control delay during the construction period on each approach will not increase more than 30%. If the 30% threshold is exceeded, mitigation strategies will be reviewed and proposed.

4.2 DESIGN SECTION 1 – SR 1 TO EAST OF NORFOLK SOUTHERN RAILROAD

4.2.1 Introduction

Design Section 1 includes the construction of the US 301 mainline from east of the Norfolk Southern Railroad to SR 1, approximately 3.6 miles; as well as, reconstruction/widening of portions of US 13 from north of Hyetts Corner Road to south of Lorewood Grove Road. This section includes nine (9) bridges over environmental features, three (3) bridges over existing roads, two (2) bridges carrying existing roads over the new US 301 and the construction of one diamond interchange at Jamison Corner Road. This section also includes the relocation of the northbound SR 1 “Free Ramp” from northbound US 13. The following is a list of locations where work zone impacts are expected to occur:

Contract 1A

- Construction of Jamison Corner Road overpass – requires temporary run-around road, flagging for haul road and tie-in construction
- Construction of Hyetts Corner Road overpass, adjacent structures, and temporary haul road access – requires long-term detour for entire duration of Contract
- Construction of US 301 over SR 896 – requires temporary lane closures, shifts, and detour

Contract 1B

- Widening and re-construction along SR 1 – requires temporary lane closures and shifts
- Construction of Bridge 1-3 - requires shoulder closures and temporary night time closures of SR 1 northbound/southbound for girder erection
- Re-construction of US 13 and construction of retaining walls for northbound US 301 – requires temporary lane closures on US 13
- Construction along northbound SR 1 – requires revised lane configuration for northbound SR 1 departing the Biddles Corner Toll Plaza
- US 301 northbound tie-in to northbound SR 1 and re-construction of US 13 northbound on-ramp to SR 1 northbound “Free Ramp” – requires lane shifts and shoulder closures

Contract 1C

- Construction access from SR 896 and coordination with 1A Contractor

Contract 1D

- Widening and re-construction of US 13 - requires temporary lane closures along US 13 northbound/southbound and temporary night time closure of US 13 northbound/southbound for cross pipe installation
- Port Penn Road intersection re-construction, requires:
 - Shared thru/right lane configuration during select phases
 - Westbound Port Penn Road left turn prohibition
 - Removal of westbound Port Penn Road right-turn lane
- Construction of Ramp R – requires closure of northbound US 13 access to Biddles Corner Toll Plaza facility

4.2.2 Work Zone Impact Assessment –

Construction of Jamison Corner Road overpass/Contract 1A

Impacts of Construction Phasing Approaches

Construction of the Jamison Corner Road overpass and closure of Hyetts Corner Road requires the construction of a temporary run-around road. In closing Hyetts Corner Road for hauling, traffic will need to be detoured onto



Jamison Corner Road where a temporary runaround road is proposed to the east of the existing alignment. Two main reasons for constructing a temporary run-around road is that existing Jamison Corner Road is not adequate for the bus traffic associated with St. Georges Technical High School and widening or re-constructing Jamison Corner Road on its existing alignment is not feasible due to the construction activities associated with raising Jamison Corner Road and building Bridge 1-8 over proposed US 301. Intermittent closures and flagging will be required to construct the tie-ins of the temporary run-around road with existing/proposed Jamison Corner Road. In addition, flagging will be required along temporary run-around road to allow construction vehicles to cross along the haul road. Since shoulders are provided along the temporary run-around road, no impacts to pedestrians or bicyclists are anticipated.

Safety Issues

- Crash History Assessment – although Jamison Corner Road has a higher crash rate when compared to the statewide average crash rate based on data from January 2009 – December 2011. Five crashes were reported during the study period.
- Jamison Corner Road will be upgraded to provide 12-foot travel lanes, 8-foot shoulders and a 10-foot shared use path, so it is anticipated that there will be no safety-related issues along this section of roadway.
- Geometric Conditions – since Jamison Corner Road will be upgraded to provide 12-foot travel lanes, 8-foot shoulders, and a 10-foot shared use path, no geometric condition issues are envisioned.
- Construction Related Safety – since the majority of construction will be off alignment, and Jamison Corner Road to the north and south of US 301 would have been recently upgraded, no construction safety-related issues are envisioned, except for the stopping of vehicles on the temporary run-around road for crossings along the haul road. Since these crossings will be controlled by flaggers, safety issues should be minimized.
- Maintenance of Traffic related Safety – construction of the run-around road will provide the highest level of safety for the construction of the Jamison Corner Road overpass off alignment. The only maintenance of traffic required will be flagging and intermittent closures at the tie-ins of the run-around road to the existing roadway, and flagging for the haul road crossing of the run-around road.

Qualitative Analysis

Since all construction will be off alignment, and the roads to the north and south of US 301 would have been recently upgraded no major work zone impacts are envisioned for this construction element in Contract 1A.

Quantitative Analysis

Construction year traffic volumes were reviewed to determine the impact of flagging operations and intermittent closures of Jamison Corner Road to accommodate the hauling operation (see Chapter 3). Based on the relatively low traffic volumes, flagging operations and intermittent closures of Jamison Corner Road should be permitted on weekdays from 9 AM to 3 PM and from 6 PM to 7 AM.

Community Issues

The construction of the Jamison Corner Road overpass itself should have no major community issues besides general construction related impacts; however, the Hyetts Corner Road closure and detour will have much greater impact on the community (see discussion below related to Hyetts Corner Road).

Construction of Hyetts Corner Road overpass, adjacent structures, and temporary haul road access/Contract 1A

Impacts of Construction Phasing Approaches

Construction of the Hyetts Corner Road overpass, adjacent structures and the temporary haul road access require the long term closure and detour of Hyetts Corner Road. In closing Hyetts Corner Road, traffic will need to be detoured onto Jamison Corner Road, SR 896/Boyd's Corner Road, and US 13. The Jamison Corner Road temporary run-around road must be constructed prior to closing Hyetts Corner Road because existing Jamison Corner Road is not adequate for the bus traffic associated with St. Georges Technical High School. The main entrance for the high school will be open at all times with bus access only provided to the bus entrance to the east during school hours. This access will be controlled by flaggers during school hours. Except for the increased travel time associated with the detour, no major impacts to pedestrians, bicyclist or transit (if present) are anticipated.

Safety Issues

- Crash History Assessment - The following three roadways form the proposed Hyetts Corner Road detour route:
 - Jamison Corner Road has a higher crash rate when compared to the statewide average crash rate based on January 2009 – December 2011 data. Jamison Corner Road will be upgraded to provide 12-foot travel lanes, 8-foot shoulders and a 10-foot shared use path, so it is anticipated that there will be no safety-related issues along this section of roadway.
 - Boyds Corner Road has a lower crash rate when compared to the statewide average crash rate based on January 2009 – December 2011 data. Based on a review of crash data at the intersection of Boyds Corner Road at Jamison Corner Road, only one crash was reported. No additional crash related issues are anticipated with the additional detoured volume.
 - US 13 has a higher than average crash rate when compared to the statewide average crash rate. Based on a review of crash data (January 2009 – December 2011) at the US 13 at Hyetts Corner Road intersection, ten total crashes were reported including six angle crashes involving southbound and eastbound vehicles, primarily associated with eastbound vehicles failing to yield the right-of-way. Side Road warning signs are provided on the northbound and southbound US 13 approaches to Hyetts Corner Road and WATCH FOR ENTERING TRAFFIC signs are posted on both sides of the roadway on the northbound approach to the intersection. Turning movements at the US 13 at Hyetts Corner Road intersection will decrease as a result of the proposed detour, decreasing the potential for angle crashes while the detour is in effect.
 - No additional crash-related issues are anticipated with the diversion of traffic associated with the Hyetts Corner Road detour.
- Geometric Conditions
 - Jamison Corner Road – since Jamison Corner Road will be upgraded to provide 12-foot travel lanes, 8-foot shoulders, and a 10-foot shared use path, no geometric condition issues are envisioned.
 - Boyds Corner Road – there are no known geometric deficiencies that would advise against the use of this segment of Boyds Corner Road for a detour.
 - US 13 – there are no known geometric deficiencies that would advise against the use of this segment of US 13 for a detour.
- Construction Related Safety
 - Since all construction will be off alignment, and the work areas will be protected by P.C.C. safety barrier with buffer provided, no construction safety-related issues are envisioned.
 - Maintenance of Traffic related Safety
 - No maintenance of traffic related safety issues are envisioned.

Qualitative Analysis

Although the detour will cause increased travel time for motorists, the detour route roadways will provide a higher degree of safety compared to Hyetts Corner Road today. SR 896/Boyd's Corner Road is higher functional classified roadway and Jamison Corner Road will be recently reconstructed for a major portion of the detour route.

Quantitative Analysis

Critical intersections along the proposed detour route associated with the closure of Hyetts Corner Road were analyzed (see Chapter 3). Based on the capacity analysis, all intersections meet the LOS and delay thresholds.

Community Issues

The increased travel time and additional volume on the detour route would be the two most likely community issues. This was discussed at a community meeting in February 2011. At the meeting, the community appeared to have accepted the Hyetts Corner Road detour; however, the community is concerned about existing traffic diverting through Airmont Drive from Lorewood Grove Road to Hyetts Corner Road, that should be using Road 412A but cuts through the community to get to St. Georges Technical High School. They are concerned that this traffic will increase, and that construction traffic will also cut through Airmont Drive. The community has voted to close Airmont Drive at Hyetts Corner Road during construction. Temporary concrete barrier, Type III barricades and signs will be placed at the intersection so that it is impassable. See discussion above regarding high school access at the main entrance and at the bus entrance.



Construction of US 301 over SR 896 (temporary lane closures, shifts, and detour for SR 896 (Boyd's Corner Road))/Contract 1A

Impacts of Construction Phasing Approaches

In Contract 1A, during construction of Bridge 1-9 N/S, US 301 over SR 896, travel lanes will need to be shifted and closed with flaggers during various times for bridge construction, girder erection, etc. In addition, during bridge girder erection SR 896 will be temporarily closed and detoured to US 13, Marl Pit Road, and US 301. It should be noted that the proposed detour of Boyd's Corner Road is similar to the detour route for the proposed closure of US 301/Summit Bridge Road as part of the Section 2 contract.

Safety Issues

- Crash History Assessment - This segment of SR 896/Boyd's Corner Road has a lower crash rate compared to the statewide average crash rate. Based on a review of crash data (January 2008 – December 2010) along Boyd's Corner Road between Ratledge Road and Cedar Lane Road (excluding crashes associated with the intersections), three crashes were reported including two roadway departure crashes and one rear end crash. No safety-related issues are anticipated.
- Geometric Conditions - During these phases, traffic may be shifted, or lanes closed with flaggers. All work will be in accordance with the Delaware MUTCD.
- Construction Related Safety - All construction will be performed behind P.C.C safety barrier with buffer provided or with proper offsets and buffers; therefore no construction related safety issues are envisioned. All work will be in accordance with the pertinent standards.
- Maintenance of Traffic related Safety - There are existing horizontal curves on SR 896 which may create a potential safety issue during flagging operations at the haul road crossing.

Qualitative Analysis

No major issues are envisioned with temporary lane closures or shifts, and since traffic will only be flagged during off-peak hours, no major issues are envisioned for this work zone except for the additional travel time associated with the detour.

Quantitative Analysis

Construction year traffic volumes were reviewed to determine the impact of flagging operations and intermittent closures of Boyd's Corner Road to accommodate the hauling operation (see Chapter 3). Based on the results of the analysis, the flagging operation and closures should be permitted during weekday off-peak hours (see Table 3.2.4.4).

In addition, critical intersections along the proposed detour route associated with the closure of Boyd's Corner Road were analyzed (see Chapter 3). The detour will occur during off-peak periods (i.e., 9 PM – 5 AM). As shown in Table 3.2.4.3, the US 301 (existing) at Churchtown Rd/SR 896/Boyd's Corner Road, US 301 at Armstrong Corner Road, US 13 at Marl Pit Road, and US 13 at SR 896/Boyd's Corner Road intersections operate at LOS C or better during detoured conditions during the critical hour (i.e., 9 PM – 10 PM) of the proposed detour and delay increases for individual turning movements are within established thresholds.

Under detoured conditions, a significant amount of traffic is added to the minor street approach to the unsignalized US 13 at Marl Pit Road intersection. Eastbound left turns at the intersection increase from 18 vehicles in the 2015 Baseline Conditions to 145 vehicles in the 2015 Detoured Conditions. However, due to the relatively low off-peak volumes along US 13, the eastbound left-turn delays are expected to be less than 16 seconds. 95th-percentile queues are 32 feet and can be accommodated within the existing left-turn lane (160 feet existing). Additionally, detoured volumes do not meet warrants for the installation of signalization.

Community Issues

No community issues are envisioned with this proposed work zone.

Widening and re-construction along SR 1 – (shoulder closures, temporary lane closures and shifts)/Contract 1B

Impacts of Construction Phasing Approaches

In Contract 1B, during all phases of construction shoulders will be closed with and without P.C.C. barriers; lanes will be temporarily closed; and traffic will be shifted as required to provide work zones during various times for maintenance of traffic set-ups, roadway widening, striping, signing installation, etc.

Safety Issues

- Crash History Assessment – SR 1 has a lower crash rate when compared to the statewide average crash rate. No safety-related issues are anticipated.
- Geometric Conditions – during these phases, shoulders will be closed, lanes may be temporarily closed and/or traffic may be shifted. All work will be in accordance with the pertinent standards.
- Construction Related Safety – shoulder closures will typically be protected by P.C.C. safety barrier with buffer provided, no construction safety-related issues are envisioned for this work. All other shoulder closures, temporary lane closures, and shifts will be in accordance with the pertinent standards, therefore no construction related safety issues are envisioned.
- Maintenance of Traffic related Safety – no maintenance of traffic related safety issues are envisioned.

Qualitative Analysis

No major issues are envisioned with shoulder closures, temporary lane closures or shifts.

Quantitative Analysis

Single and double lane closures along northbound and southbound SR 1 were analyzed by comparing available capacity with either a single lane or two lanes to traffic volumes (see Figure 3.2.4.6). Permissible lane closure hours were recommended when the capacity exceeded the anticipated volume (see Table 3.2.4.5).

Community Issues

No community issues are envisioned with this proposed work zone

Construction of Bridge 1-3 (closure of SR 1 northbound/southbound for girder erection) /Contract 1B

Impacts of Construction Phasing Approaches

Erection of the girders for this complex horizontally curved structure will require nighttime closures in excess of the typical 15 minute blockages associated with smaller less complex overpass construction. In order to give the contractor sufficient time to set-up and erect a girder line, it is anticipated that an 8 hour window will be needed with one or both directions of SR 1 completely closed to traffic. This window can only be provided at night to minimize impacts to traffic as much as possible. Traffic on southbound SR 1 would be detoured to exit at Lorewood Grove Road to southbound US 13 to Boyds Corner Road to southbound SR 1. Traffic on northbound SR 1 would be detoured to exit at Boyds Corner Road to northbound US 13 to northbound SR 1 at the “Free Ramp”. When both northbound and southbound SR 1 are closed at the same time, northbound SR 1 traffic will be detoured north along US 13 to SR 72 to northbound SR 1 to avoid capacity constraints at the “Free Ramp” intersection. These detours will impact toll revenues, which have been evaluated in Chapter 3.

Safety Issues

- Crash History Assessment - The following roadways are included in the SR 1 detour:
 - Lorewood Grove Road has a higher than average crash rate when compared to the statewide average crash rate. Based on a review of data (January 2009 – December 2011) along the portion of Lorewood Grove Road included in the detour route, there were thirteen total crashes including eight crashes associated with the curve and merge approaching southbound US 13 and 3 crashes at the Lorewood Grove Road at SR 1 southbound ramp intersection. However, due to the recent signing and striping improvements along Lorewood Grove Road approaching US 13 and along southbound US 13



approaching Lorewood Grove Road associated with the restriping of St. Georges bridge to provide bike lanes, it can be assumed that the potential for these crashes will be reduced.

- US 13 has a higher than average crash rate when compared to the statewide average crash rate. Based on a review of crash data (January 2009 – December 2011), 60 total crashes were reported at the US 13 at Boyds Corner Road/Pole Bridge Road intersection and 69 total crashes were reported at the US 13 at “Free Ramp” intersection. Of the crashes at the Boyds Corner Road/Pole Bridge Road intersection, there were 16 northbound rear end crashes and 13 southbound rear end crashes and no other clusters greater than 5 crashes. At the US 13 at “Free Ramp” intersection, there were 46 rear end crashes related to the northbound left-turn lane to SR 1 and 18 southbound rear end crashes. Based on a review of the 46 rear end crashes related to the northbound left-turn lane approaching the “Free Ramp,” crashes decreased following the installation of Qwick Kurb between the northbound through and left-turn lanes in September/October 2009 from 16 crashes in 2008 and 23 crashes in 2009 to 7 crashes in 2010.
- Along Boyds Corner Road/Pole Bridge Road, four crashes were reported at the northbound SR 1 ramps intersection and no crashes were reported at the southbound SR 1 ramps intersection. See above for a discussion of crashes at the US 13 at Boyds Corner Road/Pole Bridge Road intersection. No safety-related issues are anticipated.
- Geometric Conditions
 - Lorewood Grove Road – there are no known geometric deficiencies that would advise against the use of this segment for a detour
 - US 13 – there are no known geometric deficiencies that would advise against the use of this segment for a detour.
 - Boyds Corner Road – there are no known geometric deficiencies that would advise against the use of this segment for a detour.
- Construction Related Safety – since all construction will be performed when the road is closed, no construction safety-related issues are envisioned.
- Maintenance of Traffic related Safety – the detour route is very straightforward with existing guide signs for SR 1 along the routes, therefore no additional safety issues envisioned.

Qualitative Analysis

The detour will cause increased travel time for motorists, and although the detour will occur at night, some capacity issues are anticipated in the beginning and ending hours of the detour (see Chapter 3) and the quantitative discussion below.

Quantitative Analysis

As discussed in Chapter 3, the intersections along the northbound and southbound detours are anticipated to operate at an acceptable LOS during detour conditions with the exception of the US 13 at “Free Ramp” intersection which is anticipated to operate at LOS F from 9 PM to 10 PM with the northbound SR 1 detour; however, it is anticipated that some motorists will bypass the long northbound US 13 left-turn queue to return to SR 1 and will continue to the SR 72 interchange, minimizing delays. Additionally, the US 13 at SR 72 intersection is anticipated to operate at LOS F from 9 PM to 10 PM with the combination northbound and southbound SR 1 detour due to the heavy northbound left-turn volume.

In addition, it is anticipated that the toll booths along the northbound and southbound SR 1 ramps serving Boyds Corner Road will be critical capacity constraints along the proposed detour route. As such, lifting the tolls along the ramps during the entire detour period is recommended. Table 3.2.4.12 summarizes the anticipated toll revenue losses associated with lifting the tolls.

Community Issues

No community issues are envisioned with this proposed detour. Advance notification during construction prior to planned closures should help to keep the public informed.

Re-construction along US 13 and construction of retaining walls for US 301 Northbound (temporary lane closures on US 13)/Contract 1B

Impacts of Construction Phasing Approaches

The proposed construction sequence in the area where US 301 northbound ties into SR 1 requires the reconstruction and permanent shifting of US 13 into the median to accommodate the proposed retaining walls for northbound US 301. In order to provide work area, buffer behind the P.C.C. safety barrier, and bicycle lane, US 13 will be shifted and lane widths will be reduced. Two lanes will be maintained during peak hours with temporary lane closure permitted during off-peak hours.

Safety Issues

- Crash History Assessment – this segment of US 13 has a high than average crash rate when compared to the statewide average crash rate. See discussion above regarding crash clusters along US 13.
- Geometric Conditions – although narrow lanes will exist in the work area, two lanes will be provided during peak hours with a bike lane. In addition, a bike detour will be provided for bicyclists to avoid the construction. No issues are envisioned with the proposed temporary lane geometrics.
- Construction Related Safety – all construction will be performed behind P.C.C safety barrier with a buffer provided, therefore no construction related safety issues are envisioned.
- Maintenance of Traffic related Safety – no maintenance of traffic related safety issues are envisioned.

Qualitative Analysis

The off-peak lane closures are not anticipated to result in any significant delays or queues for motorists traveling through the work zone.

Quantitative Analysis

Single lane closures of northbound and southbound US 13 were analyzed by comparing available capacity with a single lane to traffic volumes (see Figures 3.2.4.7 and 3.2.4.8). In addition, since lane closures will be required through the US 13 at “Free Ramp” signal at times during construction, permissible work hours were also calculated for lane closures in the vicinity of this intersection. Permissible lane closure hours were recommended when the capacity exceeded the anticipated volume (see Table 3.2.4.6).

Community Issues

No community issues are envisioned with this proposed lane closure. Advance notification during construction prior to planned closures should help to keep the public informed, including notice of the planned bike detour.

Construction along SR 1 northbound (revised lane configuration for northbound SR 1 departing the Biddles Corner Toll Plaza)/Contract 1B

Impacts of Construction Phasing Approaches

During construction in order to provide a work area and to reduce the amount of lane shift, the lane configuration leaving the toll plaza will be revised. The temporary lane configuration will be similar to the ultimate lane configuration upon completion of the project. Therefore, this operation has not been quantitatively analyzed as part of the TMP since it has been documented that this operation is acceptable under the 2030 ultimate traffic conditions. In addition during construction the cash lanes will add to the two left E-ZPass express lanes, with the US 13 northbound on-ramp (“Free Ramp”) merging into these three lanes prior to the SR 1 over C&D Canal Bridge, which provides more capacity than the ultimate configuration in which the cash lanes will merge into the two left E-ZPass express lanes prior to Scott Run, with US 301 northbound/Ramp R adding onto SR 1 as two lanes with the right most lane reducing prior to the SR 1 over C&D Canal Bridge. Since this scenario has been previously analyzed, only a qualitative review of the detour has been evaluated. No other evaluation of safety, quantitative analysis, or community impact review is proposed for this work zone impact.



Construction of US 301 northbound tie-in to SR 1 northbound and reconstruction of “Free Ramp” /Contract 1B

Impacts of Construction Phasing Approaches

During Phases 2 and 3, the tie-in of northbound US 301 and the existing US 13 northbound “Free Ramp” will be constructed/reconstructed. In order to provide a work area during Phase 2, northbound SR 1 traffic will be shifted into the median, with the “Free Ramp” traffic maintained on alignment. In Phase 2A, northbound SR 1 traffic will be shifted into the median, with the “Free Ramp” traffic maintained on a temporary alignment. In Phase 3, it is assumed Contract 1D is complete and Ramp R is open to traffic allowing for the removal of the existing “Free Ramp”.

Safety Issues

- Crash History Assessment – US 13 has a higher than average crash rate when compared to the statewide average crash rate; however, no additional crash related issues are envisioned.
- Geometric Conditions – during these various phases, temporary configurations have been designed to the pertinent standards, and all turning movements have been evaluated using AutoTURN.
- Construction Related Safety – all construction will be performed behind P.C.C safety barrier with a buffer provided; therefore no construction related safety issues are envisioned.
- Maintenance of Traffic related Safety – no maintenance of traffic related safety issues are envisioned.

Qualitative and Quantitative Analysis

Since traffic will be maintained with all lanes open, no work zone impacts are envisioned, and therefore no additional analysis has been performed.

Community Issues

No community issues are envisioned with this proposed work zone.

Construction access from SR 896 and coordination with 1A Contractor/Contract 1C

Impacts of Construction Phasing Approaches

Maintenance of traffic is limited to SR 896/Boyd's Corner Road where access to the work zone will be made. Flaggers will be utilized as needed to control SR 896 traffic while construction vehicles enter and exit the construction site and impacts to traffic should be minimal. Work zone access and maintenance of traffic will need to be coordinated with the Contract 1A contractor who will be constructing Bridge Nos. 1-9N and 1-9S (US 301 bridges over SR 896) in this area. Construction near the US 301 over Norfolk Southern Railroad Bridge (Bridge Nos. 2-1N and 2-1S) will not require maintenance of railroad traffic or any special considerations by the Contract 1C contractor. Construction of the bridges' superstructures will be completed under Contract 2B and scheduling with the railroad will be the responsibility of that contractor. Since this scenario has been previously analyzed for the construction of US 301 over SR 896(Boyd's Corner Road)/Contract 1A, no other evaluation of safety, quantitative analysis, or community impact review is proposed for Contract 1C.

Widening and re-construction of US 13 - requires temporary lane closures along US 13 northbound/southbound/Contract 1D

Impacts of Construction Phasing Approaches

Through discussions with DeIDOT and the GEC, the proposed construction phasing approach has been revised to provide two lanes during the peak periods at all times on US 13. In order to provide two lanes during the peak periods temporary widening is required to provide work area and buffer behind the P.C.C. safety barrier. This temporary widening is constructed in Pre-Phase 1 under temporary lane closures during off-peak periods. Temporary lane closures will also be required for the P.C.C. safety barrier installation for Phases 1 and 2; Phase 2A; and other miscellaneous items such as signing and striping.

Safety Issues

- Crash History Assessment – this segment of US 13 has a higher than average crash rate when compared to the statewide average crash rate. See above discussions for Contracts 1A and 1C for a summary of recent crash data along US 13.
- Geometric Conditions – although narrow lanes will exist in the work area, two lanes will be provided during peak hours for all Phases. Bicycles will be detoured throughout Phase 1. No issues are envisioned with the proposed temporary lane geometrics.
- Construction Related Safety – During Pre-Phase 1 construction of the temporary widening will be performed without P.C.C. barrier to allow phased construction to occur during off-peak periods. The adjacent lane will be closed to provide a buffer and the work area will be safety graded at the completion of each work day.
- During Phases 1 and 2 the majority of construction will be performed behind P.C.C safety barrier with a buffer provided, therefore no construction related safety issues are envisioned.
- Maintenance of Traffic related Safety – no maintenance of traffic related safety issues are envisioned.

Qualitative Analysis

This proposed construction phasing has been through detailed review with DelDOT and the GEC with all options weighed in order to provide as much capacity as possible during the peak periods. The selected construction phasing balanced impacts to sub-standard shoulders, capacity, bicycles, and construction sequence.

Quantitative Analysis

Single lane closures of northbound and southbound US 13 were analyzed by comparing available capacity with a single lane to traffic volumes (see Figures 3.2.4.7 and 3.2.4.8). Permissible lane closure hours were recommended when the capacity exceeded the anticipated volume (see Table 3.2.4.6.).

Community Issues

Except for the impacts to access to the Biddles Corner Toll Plaza facility and the Ches-Del Restaurant, no community issues are envisioned with this proposed lane closure. Advance notification during construction prior to planned closures should help to keep the public informed. In addition, signing for alternate access to both the Biddles Corner Toll Plaza facility and the Ches-Del Restaurant are provided in the construction phasing plans. At least two weeks' advance notice will be provided for construction impacting the Ches-Del restaurant so that they can make any necessary plans in order to accommodate the closure/modifications of their access points.

Temporary night time closure of US 13 northbound/southbound for cross pipe installation/Contract 1D

Impacts of Construction Phasing Approaches

Installation of cross pipes across US 13 northbound and southbound will require nighttime closures in excess of the typical 15 minute blockages associated with less complex overpass construction. In order to give the contractor sufficient time to set-up and construct the pipes, it is anticipated that an 8 hour window will be needed for each direction of US 13 completely closed to traffic on separate nights. This window can only be provided at night to minimize the impacts to traffic as much as possible. The pipe will be installed in half-sections to ensure that northbound and southbound US 13 will not be closed at the same time. US 13 traffic will be diverted to SR 1 utilizing the interchanges at Boyds Corner Road and SR 72; therefore, traffic volumes along US 13, Boyds Corner Road, and SR 72 were evaluated to determine the impacts associated with the proposed detours.

Safety Issues

- Crash History Assessment – See previous discussion regarding Boyds Corner Road and SR 1 regarding crash trends along the proposed detour route.
- Geometric Conditions –
 - SR 72 – there are no known geometric deficiencies that would advise against the use of this segment for a detour
 - SR 1 – there are no known geometric deficiencies that would advise against the use of this segment for a detour.



- Boyds Corner Road – there are no known geometric deficiencies that would advise against the use of this segment for a detour.
- Construction Related Safety – since all construction will be performed when the road is closed, no construction safety-related issues are envisioned.
- Maintenance of Traffic related Safety – the detour route is very straightforward with existing guide signs for SR 1 and US 13 along the routes, therefore no additional safety issues are envisioned.

Qualitative Analysis

The detour will cause increased travel time for motorists currently traveling along US 13.

Quantitative Analysis

With the northbound detour, as shown in Table 3.2.4.13, all critical intersections along the detour route will operate at LOS C or better under detoured conditions. Additionally, all movements will operate within the established LOS and delay thresholds. With the southbound US 13 detour, as shown in Table 3.2.4.14, all critical intersections along the detour route will operate at LOS C or better under detoured conditions except for the US 13 at Boyds Corner Road intersection which operates at LOS D (delay less than 45 seconds). Additionally, all movements will operate within the establish LOS and delay thresholds.

Community Issues

Since the detour route is along a toll road, the tolls are proposed to be lifted along SR 1 to allay community concerns. Advance notification during construction prior to planned closures should help to keep the public informed.

Port Penn Road intersection re-construction/Contract 1D

Impacts of Construction Phasing Approaches

In order to reconstruct the US 13 and Port Penn Road intersection various turn lanes will need to be closed and movements prohibited during various phases to provide work areas. These include removing the right turn lane in off-peak hours along US 13 northbound in Phase 1A causing the right lane to become a shared through/right-turn lane since; prohibit westbound Port Penn Road left turns to southbound US 13 and detour that movement and close the left lanes along US 13 northbound/southbound in Phase 2A; removal of westbound Port Penn Road right turn lane causing the right lane to become a shared right-through lane in Phase 2B.

Safety Issues

- Crash History Assessment – Based on a review of more recent data (January 2009 – December 2011) at the intersection of US 13 at Port Penn Road, 9 total crashes were reported including 4 westbound right-turn rear end crashes and 4 northbound/westbound angle crashes.
- Geometric Conditions – during these various phases temporary configurations have been designed to the pertinent standards, and all turning movements will be evaluated using AutoTURN.
- Construction Related Safety – all construction will be performed behind P.C.C safety barrier with buffer provided, or behind adjacent closed lanes to provide a buffer during off-peak hours. No construction related safety issues are envisioned.
- Maintenance of Traffic related Safety – the shared through/right-turn lane in Phase 1 along northbound US 13 in Phase 1A is the only maintenance of traffic related safety item of significance. There is a potential for an increase in rear end crashes due to the loss of the right-turn lane. Narrow lanes along Port Penn Road, changing lane configurations at the intersection, and tight work areas at the intersection during construction are all expected issues; however, since this will only occur during off peak hours, the effect should be minimized.

Qualitative Analysis

During Sub-phase 2A, the westbound Port Penn Road left-turn movement will be detoured from the intersection. The proposed detoured volumes will increase intersection volumes at the critical intersections along the detour route by approximately 1 to 3 percent or one to two additional vehicles per cycle. Therefore, the proposed detour



of the westbound Port Penn Road left-turn movement at US 13 is assumed to have minimal impacts on the existing traffic operations along the detour route.

Quantitative Analysis

Capacity analyses were performed for the phases and sub-phases when lane closures are proposed at the US 13 at Port Penn Road intersection. As discussed in Chapter 3, anticipated LOS and delays are within the established thresholds for all proposed lane closures at the intersection.

Community Issues

The increased travel time, additional volume on the detour route, and constrained access during construction would be the most likely community issues that would need to be addressed. Advance notification during construction prior to planned closures should help to keep the public informed.



4.3 DESIGN SECTION 2 –EAST OF NORFOLK SOUTHERN RAILROAD TO NORTH OF LEVELS ROAD

4.3.1 Introduction

Section 2 is approximately four miles in length, with the south limit located at the midpoint of the proposed Levels Road interchange and the north limit located approximately ½ mile north of the proposed existing 301 (Summit Bridge Road) interchange, east of Norfolk Southern Railroad. Two bridges will be constructed over Norfolk Southern Railroad for proposed mainline US 301 traffic. Rail traffic is estimated at one train per day. During all work activities within the clearance envelope of the NSRR tracks, an NSRR flagger will monitor rail traffic and notify the Contractor of oncoming trains at which time the track clearance envelope must be cleared.

In addition to new US 301 alignment and interchange with Summit Bridge Road, Section 2 includes improvements along Summit Bridge Road within the vicinity of the interchange to accommodate the proposed connection.

In conjunction with new and realigned roadways, the following bridges are proposed in Section 2; one (1) bridge over environmental features, two (2) bridges over existing roadway, and one (1) bridge carrying existing roads over the new US 301. Multiple drainage culverts are also proposed. Additional design elements located within Section 2 include proposed ITMS devices.

The following is a list of locations where work zone impacts are expected to occur:

- Construction of Bunker Hill Road Overpass
- Construction of US 301 over Armstrong Corner Road
- The proposed Connector Roadway tie-in point at existing 301 (Summit Bridge Road)
- Construction of US 301 over existing 301 (Summit Bridge Road)
- Widening of Summit Bridge Road (includes intersection of existing 301 (Summit Bridge Road) and Armstrong Corner Road/Marl Pit Road)

DART transit routes in the immediate area include the US 301 route, which provides service at the Boyds Corner Park-n-Ride along Route 1 between Wilmington and Smyrna, DE. No work zone impacts are expected for transit service in the project area.

Due to the list of overpass locations above and the widening of Summit Bridge Road (existing 301) in Section 2 in the area of the proposed US 301 interchange, some minor work zone traffic, bicycle, and pedestrian impacts can be expected along Summit Bridge Road and the immediate surrounding area. While the existing travel lane configuration is proposed to be maintained along existing 301 (Summit Bridge Road) during the widening reconstruction, work zone capacity impacts can be expected due to lane width reductions (11' lane widths proposed). There are no existing dedicated bicycle or pedestrian facilities within Section 2 that have been identified to be impacted by the work zone.

4.3.2 Work Zone Impact Assessment – Design Section 2

Impacts of Construction Phasing Approaches

The proposed construction sequence for Section 2 has been developed to minimize disruptions to existing US 301 (Summit Bridge Road) traffic, provide a safe working environment during construction, and allow for an efficient construction schedule.

Roadway capacity impacts to existing facilities and expected detours have been discussed in Chapter 3: Existing and Construction Period conditions.

Safety Issues

- Crash History Assessment - Available crash data summaries within the anticipated project limits of Section 2 have been evaluated to determine if any pre-existing safety issues are located along the proposed detour routes which may warrant improvements prior to construction letting. It was determined that crash reports exceeding county and statewide averages were short collector roadway sections in length compared to the

county and statewide roadway code lengths used. The longer sections contained rates comparable to the statewide averages.

- This data will be used to create a baseline to help assess safety within the work zone and detour routes during construction. The TMP should be evaluated and modified as necessary if crash history during construction appears to have the potential to exceed baseline values or new locations of incidents are identified to be the result of the work zone traffic control.
- The monitoring plan during construction activities will include provisions for reviewing updated crash data available during construction to identify any issues and assess safety within the work zone during construction.
- Geometric Conditions - Detour routes will be required for two overpass locations (US 301 over Armstrong Corner Road and US 301 over existing 301 (Summit Bridge Road)) and work required for the reconstruction of Summit Bridge Road under the proposed Section 2 Construction Phasing.
- No geometric deficiencies have been identified along existing routes that are proposed for improvements as a result of the new highway construction.
- Based on construction year volumes, a traffic signal is warranted at the proposed intersection of the connector roadway access to US 301 and existing 301 (Summit Bridge Road). This signal is being installed in conjunction with ultimate improvements and is not required for work zone traffic management. The signal is to be activated when US 301 is open to traffic.
- Construction Related Safety - It is anticipated that construction activities will either be outside of the clear zone or adequately shielded with concrete safety barrier.
- The location of all staging areas needs to be reviewed with the Engineer and DeIDOT Safety prior to approval.
- The contractor will be responsible to provide access to construction staging and field office locations that meet standard design criteria for driveway access.
- Maintenance of Traffic related Safety - The goal of proposed MOT phasing is to minimize disruption to daily traffic while providing a safe and efficient work zone. The MOT plan for the Delaware work zone is being developed in accordance with Part 6 – Temporary Traffic Control of the Delaware MUTCD, DeIDOT's Road Design Guide, and Chapter 9 – Traffic Barrier, Traffic Control Devices, and Other Safety Features for Work Zones of the AASHTO Roadside Design Guide.
- Other issues (if any) - No additional issues have been identified at the semi-final design stage.

Qualitative Analysis

- Construction of Bunker Hill Road Overpass
 - Minimal work zone impacts are anticipated along Bunker Hill Road due to the construction of a temporary roadway bypassing existing Bunker Hill Road for accommodating existing traffic during construction of the overpass. No detour is anticipated for existing traffic.
 - After traffic is shifted to the Bunker Hill Road overpass (permanent condition), overlay will take place on one side (north/south) of new roadway while maintaining traffic on the opposing side.
 - Temporary warning signage will be established along Bunker Hill Road in accordance with the Maintenance of Traffic Plan.
- Construction of US 301 over Armstrong Corner Road
 - It is anticipated that Armstrong Corner Road will remain open during the majority of construction with short term full roadway closures (weekday night-time closures) required for placing bridge beams. Refer to Section 2.7-2 of this TMP document for allowable detour overlapping between adjacent Sections and construction phasing.
 - Eastbound and westbound detours will be implemented for the short-term full roadway closures (weekday night-time closures to utilize Old School House Road and Bunker Hill Road for collector roadway access between Summit Bridge Road and Choptank Road. Refer to Exhibit A (Appendix A) for graphic of proposed detour routes. Refer to Section 2.7-2 of this TMP document for allowable detour overlapping and construction phasing.
 - Detour and temporary warning signage will be established along Armstrong Corner Road in accordance with the Maintenance of Traffic Plan.
- The proposed Connector Roadway (US 301 Interchange Access) tie-in point at existing 301 (Summit Bridge Road)



- Lane and shoulder closures are anticipated on existing US 301 to construct the new leg of the intersection as well as additional turning lane improvements. Maintenance of Traffic during lane closures and lane shifts to conform to Case TA-10 of the Delaware MUTCD. If the work being completed requires that a lane on existing US 301 be closed, then flaggers will be required. Two lanes are to be maintained at all times possible during this stage of construction (i.e. lane shifts utilized in lieu of lane closures). All work requiring lane closures will be scheduled to accommodate off-peak short-term night-time weekday closures. Refer to Section 2.7-2 of this TMP document for allowable detour overlapping between adjacent Sections and construction phasing.
- Concrete safety barrier will be utilized to shield the work zone and eliminate impacts to traffic along existing US 301.
- Temporary warning signage will be established along existing 301 (Summit Bridge Road) in accordance with the Maintenance of Traffic Plan.
- Construction of US 301 over existing 301 (Summit Bridge Road)
 - 11-ft travel lanes (northbound and southbound) will be maintained during bridge construction. The bridge pier, median, and pavement will be constructed with lanes shifted to the outside of the median work area. Overlay is anticipated to be completed in two stages: inner lanes (northbound and southbound) and outer lanes (northbound and southbound).
 - Summit Bridge Road to remain open during the majority of overpass construction with short term closures required for placing bridge beams. Detoured northbound and southbound Summit Bridge Road traffic will utilize Marl Pit Rd, Route 13, and Boyds Corner Road (DE 896) during the duration of bridge erection activities requiring full roadway closure for Summit Bridge Road. Refer to Appendix A for graphic of proposed detour routes. Refer to Section 2.7-2 of this TMP document for allowable detour overlapping between adjacent Sections and construction phasing.
 - A temporary signal will be utilized to maintain the existing signalized intersection of Summit Bridge Road and Marl Pit Road / Armstrong Corner Road. The Summit Bridge Road/Marl Pit Road traffic signal will be realigned to adjust with proposed lane shifts during the Summit Bridge Road widening construction sequence in phases 1 through 3B.
 - A single temporary signal plan is provided in advance of the contract, with signal head shifts for each phase of construction. The signalized intersection will be maintained through construction, with anticipated impacts including phase shifts during construction, and the elimination of right turning lanes on Summit Bridge Rd during stages where the work area will be required.
 - Temporary warning signage will be established along existing 301 (Summit Bridge Road) in accordance with the Maintenance of Traffic Plan.
- Widening of Existing US 301 (Summit Bridge Road)
 - Work zone impacts are anticipated along Summit Bridge Road during construction of the proposed improvements near the interchange with the new US 301 highway. This is due to the phased approach of new lane construction that will allow for the permanent southbound and northbound lanes to be constructed separately, while maintaining the existing travel lanes along Existing 301 and at the Marl Pit Road/Armstrong Corner Road/Existing 301 intersection.
 - The existing signal at the intersection of Marl Pit Road/Armstrong Corner Road/Existing 301 will need to be re-aligned with the temporary alignment shift during construction phasing.
 - Summit Bridge Road to remain open during the majority of the widening construction with short term closures required for construction of roadway drainage facilities (i.e. placement of drainage cross pipes) that will be coordinated with US 301 over existing US 301 (Summit Bridge Road) overpass construction. Detoured northbound and southbound Summit Bridge Road traffic will utilize Marl Pit Rd, Route 13, and Boyds Corner Road (DE 896) during the short term duration of construction activities requiring full roadway closure for Summit Bridge Road. Refer to Exhibit A (Appendix A) for graphic of proposed detour routes. Refer to Section 2.7-2 of this TMP document for allowable detour overlapping between adjacent Sections and construction phasing.
 - Accesses to all businesses and residences within the project limits to be maintained throughout the duration of construction. Refer to Section 2.7-2 of this TMP document for further access requirements.

Quantitative Analysis

Construction Detour(s) Analysis

Refer to Section 2.7-2 of this TMP document for allowable detour overlapping between adjacent Sections, coordination required between Sections, and overall construction phasing. During construction, the following work areas are anticipated to involve detours associated with construction activities:

- Section 2A: US 301 over Armstrong Corner Road – Full Closure of Armstrong Corner Road and corresponding EB/WB detours for residential collector traffic. Closure work activities include bridge beam placement and assembly of construction shielding over Armstrong Corner Road. Short term, nighttime closures (estimated 21 night duration) are proposed for this work.
- Section 2A: US 301 Over Summit Bridge Road – Full Closure of Summit Bridge Road (Existing 301) and corresponding NB/SB detours for principal arterial traffic. Closure work activities include bridge beam placement and assembly of bridge construction shielding over Summit Bridge Road. Short term, nighttime closures (estimated 21 night duration) are proposed for this work. Refer to Section 2.7-2 of this TMP document for allowable detour overlapping between adjacent Sections and construction phasing.
- Section 2B: Summit Bridge Road Reconstruction – Full Closure of Summit Bridge Road (Existing 301) and corresponding NB/SB detours for principal arterial traffic. Closure work activities include activities associated with the construction area of US 301 over Summit Bridge Road within the widening contract. Short term, nighttime closures are proposed for this work. Pipe and drainage construction work related to the Section 2B widening contract will be coordinated with Section 2A US 301 over Summit Bridge Road closures/detours. The work within 2B widening contract is estimated to 16 nights' duration with use of single lane closures with flagger control (or corresponding 8 night duration with use of full roadway closures). Refer to Section 2.7-2 of this TMP document for allowable detour overlapping between adjacent Sections and construction phasing.

As described in the Construction Phasing Approach (Section 2.7.2), a temporary roadway is planned for maintaining Bunker Hill Road travel lanes during the Bunker Hill Road over 301 overpass construction. Minor capacity impacts on Bunker Hill Road are anticipated due to typical work zone impacts (i.e. work zone signage, construction vehicles, etc.).

In addition to the overpass construction, the existing cross section of Summit Bridge Road is proposed to be widened in the vicinity of the proposed US 301 interchange. The existing travel lane configuration is proposed to be maintained along existing US 301 (Summit Bridge Road) during the widening reconstruction, with minor work zone capacity impacts expected due to lane width reductions (11' lane widths proposed).

In the construction period analysis, approach lanes at the Summit Bridge Rd / Marl Pit Rd/ Armstrong Corner Rd intersection have been assigned according to MOT pattern (shared through, right-turn lanes on northbound and southbound approaches during several months of Contract 2B construction).

Proposed US 301 Over Armstrong Corner Road Detour(s)

In order to assess the impact of a full roadway (eastbound/westbound) closure to Armstrong Corner Road for the US 301 bridge deck placement activities, ATR tube count data was collected to initially assess both peak and non-peak roadway usage.

Average two-way weekday peak hour trips were recorded in the range of 140-160 vehicles (entering/exiting this section of Armstrong Corner during peak periods from either approach). See Appendix C (Armstrong Corner Road ATR Count, 4 miles east of Choptank Road) for Section 2 Traffic Data. The roadway is classified as a minor collector and connects residential areas immediately west of Summit Bridge Road.

The full closures required for Armstrong Corner Road are proposed to be scheduled as overnight work to minimize impacts to existing traffic in the area. Overnight traffic volumes are also shown in the ATR tube count data in Appendix C.

A traffic control plan involving eastbound and westbound detour signage is proposed to accommodate traffic approaching the overnight roadway closure from its connections on Choptank Rd and Summit Bridge Rd. See Appendix A, TMP Updates, for Section 2 detour plans (*note: to be provided at final plan stage*).



It is anticipated that the existing traffic utilizing Armstrong Corner Road during the overnight closure will disperse to the other east-west connector roadways in the immediate vicinity (Old School House Road to the north and Bunker Hill Road to the south). Bunker Hill Road is proposed to be maintained throughout construction, offering a non-disrupted east-west alternative route to Armstrong Corner Road at any time during construction.

The detoured volumes anticipated for overnight work are expected to be lower than peak period analysis conditions, which indicated that the adjacent east-west connector roadways/intersections currently operate at acceptable LOS. The detour route(s) will not be significantly impacted by additional traffic from the off-peak closure of Armstrong Corner Road, with overall detour hourly volumes anticipated in the range of 20 eastbound and 20 westbound vehicles. The overnight detour would overlap with Middleneck Road detour from Design Section 3, which has been included in the construction period traffic analysis. Given the overnight detour volumes for Armstrong Corner, no significant traffic impacts are anticipated to the area.

The following intersections were identified as accommodating turning movements in the proposed detour route:

1. Summit Bridge Rd (Existing 301) and Old School House Road (Unsignalized)
2. Choptank Road and Old School House Road (Unsignalized)
3. Choptank Road and Armstrong Corner Road (Unsignalized)
4. Choptank Road and Bunker Hill Road (Roundabout)
5. Summit Bridge Rd (Existing 301) and Bunker Hill Road (Signalized) – *note: existing LOS analyzed in Design Section 3*

SR 71 Summit Bridge Road (Existing US 301) Detour(s)

The impact of a full roadway (northbound/southbound) closure to Summit Bridge Road (existing 301) for the proposed US 301 bridge deck placement activities and Summit Bridge Road widening activities was evaluated using count data collected as detailed in Section 3.3.3. The data collected as part of the spur road monitoring program (Site 00006 Existing US 301 between Armstrong Corner Road and Mt. Pleasant) shows weekday and weekend trends in the area of the planned full roadway closure. Graphs depicting weekend versus weekday hourly volumes on Summit Bridge Road can be found in Appendix C.

All full closures required for Summit Bridge Road are proposed to be scheduled as overnight work to minimize impacts to existing traffic in the area. The planned full roadway closures to place structural beams and assemble shielding for the bridge construction are expected to occur during short-term night-time closures in the construction schedule. Drainage pipe construction during the widening of Summit Bridge Road is expected to be coordinated concurrently with the US 301 over existing US 301 (Summit Bridge Road) overpass construction.

In order to assess the impact of overnight closures, ATR tube count data from Summit Bridge Road, Marl Pit Road, and US Route 13 in the immediate area was used to develop off-peak detour volume estimates. At the start of the proposed full Summit Bridge Road roadway closure (estimated 10:00PM-6:00AM), based on the spur road monitoring station data an estimated 300-350 vehicles per hour can be expected to be redirected from northbound Summit Bridge Road and an estimated 300-400 vehicles per hour redirected from southbound Summit Bridge Road. All vehicles encountering the road closure may not specifically follow the signed detour route to US Route 13; local vehicular traffic may alternatively use closer north-south routes (i.e. Choptank Road or Cedar Lane Road).

Given the existing heavy vehicle percentages for Summit Bridge Road (10-15% according to existing turning movement count data), the overnight truck detoured volumes can be considered to be in the range of 30-50 trucks per hour per direction.

During the planned detour hours (overnight work) volumes are notably lower than the peak hour volumes evaluated in the existing and construction period conditions, particularly on the two arterial routes in the study area. Given the signalized intersections currently operate at acceptable LOS under peak conditions, the intersections will operate at acceptable LOS under lower-volume night-time detour conditions.

The following intersections were identified as accommodating turning movements in the proposed detour route:

1. Summit Bridge Rd (Existing 301) and Marl Pit Road / Armstrong Corner Rd (Signalized)
2. Marl Pit Road and US Route 13 (Unsignalized)
3. Boyd's Corner Road (SR 896) and US Route 13 (Signalized)
4. Boyd's Corner Road (SR 896) and Summit Bridge Road (Signalized)



An unsignalized intersection containing a major turning movement for the proposed detour exists at Marl Pit Road and US Route 13. Under existing and construction period traffic conditions, this stop-controlled movement is operating at a LOS 'F' during peak hour conditions due to the main through movement volumes on US Route 13 during daytime hours. The existing storage at the eastbound stop controlled movement consists of a left turn lane (eastbound travel lane opens into left turn lane) and 150' right turn slip lane. It is anticipated that the queued traffic will be for the left-turn movement involved with the detour, as right-turn volumes at the time of the detour (10PM-5AM hours) are anticipated to be minimal. Sight lines in the area of the intersection and anticipated queues are unobstructed.

Table 4.3.2.1 below shows an HCM analysis performed for the proposed northbound detour volume during detour hours in comparison to construction period peak hour conditions. This analysis conservatively assumes that the entire volume encountering the northbound Summit Bridge Road closure will utilize the signed detour route. The level-of-service for the stop controlled approach is anticipated to remain at LOS 'F'. Based on the analysis, it is anticipated that control delay will decrease during the detour time due to less cross traffic along US Route 13, while queue lengths will increase due to diverted Summit Bridge Road traffic volumes being three times the peak hour volume on Marl Pit Rd. The storage on Marl Pit Rd is available to accommodate the queues obtained from analysis. It is recommended that advance CMS signs be utilized to warn vehicles of anticipated delay at the intersection. With the proposed overnight detours, a temporary signal at this location is not warranted or required on the detour route. Refer to Section 2.7-2 of this TMP document for allowable detour overlapping between adjacent Sections and construction phasing.

**TABLE 4.3.2.1
HCM Analysis – Marl Pit Road and US Route 13
Overnight Northbound Summit Bridge Rd Detour Condition
US 301 Design Section 2 - Levels Rd to Summit Bridge Rd**

			Construction PM Peak Hour Conditions					Overnight Detour Hr Start Conditions (estimated 10:00PM start)				
Intersection	Approach	Mvmt	Existing Volume (Veh/hr)	Mvmt LOS	Delay (s)	95th % Queue (ft)	Int LOS	Constr Volume (Veh/hr)	Mvmt LOS	Delay (s)	95th % Queue (ft)	Int LOS
Marl Pit Rd and US Rte 13 (Unsignalized)	Marl Pit Rd	EBL	55	F	184.2	146	N/A	(357)	F	88.3	330	N/A
		EBR	22					14				
	US Rte 13 (S Dupont Hwy)	NBL	15	B	14.1	3		5	A	8.6	0	
		NBT	771	-	-	-		252	-	-	-	
	US Rte 13 (S Dupont Hwy)	SBT	1347	-	-	-		410	-	-	-	
		SBR	111	-	-	-		40	-	-	-	

* () indicates estimated Summit Bridge Road detour volumes for closure scenario based upon Spur Monitoring Count Station 0006 Existing US 301 between Armstrong Corner Rd and Mt Pleasant. Assumes all NB Summit Bridge Road traffic will utilize detour route.



TABLE 4.3.2 .2 Detour Traffic Conditions - Queue Lengths at Marl Pit Rd/US 13 US 301 Design Section 2 - Levels Rd to Summit Bridge Rd								
			Construction PM Peak Hour Conditions			Overnight Detour Hr Start Conditions (estimated 10:00PM start)		
Intersection	Approach	Mvmt	Constr Volume (Veh/hr)	Synchro 95th % Queue (ft)	SimTraffic 95th % Queue (ft) (All Intervals)	Constr Volume (Veh/hr)	Synchro 95th % Queue (ft)	SimTraffic 95th % Queue (ft) (All Intervals)
Marl Pit Rd and US Rte 13 (Unsignalized)	Marl Pit Rd	EBL	55	146	108	(357)	330	1004
		EBR	22			14		
	US Rte 13 (S Dupont Hwy)	NBL	15	N/A	34	5	N/A	182
		NBT	771	-	-	252	-	-
		SBT	1347	-	-	410	-	-
		SBR	111	-	-	40	-	-

* () indicates estimated Summit Bridge Road detour volumes for closure scenario based upon Spur Monitoring Count Station 0006 Existing US 301 between Armstrong Corner Rd and Mt Pleasant. Assumes all NB Summit Bridge Road traffic will utilize detour route.

Additional analysis has been undertaken to evaluate the detour impacts at the intersection of Existing US 301 Summit Bridge Road and SR896 Boyd's Corner Road. The intersection is expected to operate at an overall level-of-service comparable to peak conditions (LOS D) when the timing is optimized to accommodate the detour movements as indicated in Table 4.3.2.3 shown below. The estimated detour volumes were developed using tube counts from the spur monitoring location of Existing US 301 and SR 896. Weekday overnight volumes (10pm estimated highest volumes) were averaged to develop a typical weekday overnight detour hour volumes on Summit Bridge Road. The volumes showed a 56% reduction from peak hour volumes at the intersection; this percentage reduction was applied to obtain turning movement volumes to redistribute according to detour pattern. The analysis was undertaken to provide an estimated impact of the detour on the intersection (seen in Table 4.3.2.3); during construction the detour route shall be monitored to real-time evaluate changes required to the signal timing (in particular the southbound left-turn movement at the intersection).



TABLE 4.3.2 .3 Signalized Analysis – Summit Bridge Road and Boyd’s Corner Road Overnight Summit Bridge Rd Detour Condition US 301 Design Section 2 - Levels Rd to Summit Bridge Rd												
		Construction PM Peak Hour Conditions						Overnight Detour Hr Start Conditions (estimated 10:00PM start)				
Intersection	Approach	Mvmt	Existing Volume (Veh/hr)	Mvmt LOS	Delay (s)	95th % Queue (ft)	Int LOS	Est Detour Volume (Veh/hr)	Mvmt LOS	Delay (s)	95th % Queue (ft)	Int LOS
N371 Boyd's Corner Rd / SR 896 and Summit Bridge Rd (Signalized)	Church- town Rd	EBL	53	D	54.9	93	D	28	E	61.1	61	D
		EBT	71	D	52.6	136		48	E	62.9	92	
		EBR	19					0				
	Boyd's Corner Rd (SR 896)	WBL	226	D	39.2	170		0	-	-		
		WBT	127	D	40.7	210		190	E	79.0	284	
		WBR	182	B	17.0	39		448	C	29.4	188	
	Summit Bridge Road	NBL	18	E	56.3	44		0	-	-		
		NBT	608	D	44.4	362		0	-	-		
		NBR	163	A	0.1	0		0	-	-		
	Summit Bridge Road	SBL	307	E	73.0	212		1035	E	55.8	600	
		SBT	817	D	53.7	504		0	-	-		

The detour route will not be significantly impacted by additional traffic from the off-peak closure of Summit Bridge Road, however it is recommended that the intersections identified on the Summit Bridge Road corridor and construction detours within Design Section 2 be evaluated for communications and traffic-responsive upgrades to provide DeIDOT TMC the capability of monitoring the signals during construction conditions and reevaluating signal timings as necessary throughout construction phasing.

Existing camera locations at Boyd's Corner Road (SR 896) and US 13 Summit Bridge Road, as well as existing US 301 and Boyd's Corner Rd (SR 896), Mt. Pleasant will be used to monitor the detour intersections closely during construction by both the TMP monitoring effort as well as from the TMC.

A truck restriction will be posted for Cedar Lane Road during construction to prevent truck traffic from using the road when the short term overnight detour is in place.

Community Issues

- Section 2 work zone phasing is being developed to minimize disruptions to local traffic and construction durations. The current plan is to maintain access to driveways and businesses on existing US 301 at all times during construction.

Other Construction Issues

No additional issues have been identified at the Semi-final design stage.



4.4 DESIGN SECTION 3 – NORTH OF LEVELS ROAD INTERCHANGE TO DELAWARE/MARYLAND STATELINE

4.4.1 Introduction

Design Section 3 consists of proposed US 301 from the southern limit of the US 301 project corridor at approximately 2,000 feet south of the Maryland/Delaware state line in Cecil County, Maryland, extending to a proposed diamond interchange with Levels Road in Delaware. Section 3 ties into the existing four-lane limited access roadway in Maryland. In addition to US 301 mainline construction and the interchange with Levels Road, Section 3 includes realignment of Strawberry Lane (Wilson Street in MD) to accommodate the proposed crossing over existing US 301, a new local road (Middletown Warwick Road) connecting existing US 301 with Strawberry Lane, revised access to the newly constructed truck weigh station north of Strawberry Lane, realignment of Warwick Road from near the existing intersection with existing US 301 to the proposed interchange at Levels Road, and an extension of Levels Road from the existing intersection with US 301 bypass west to the proposed diamond interchange.

In conjunction with new and realigned roadways, two bridges are proposed in Section 3 that will carry Strawberry Lane over US 301 just north of the DE/MD line and Levels Road over US 301 as part of the US 301 Interchange with Levels Road. Multiple drainage culverts are also proposed. Additional design elements located within Section 3 include a proposed mainline toll plaza, utility relocations, and proposed ITMS devices.

The following is a list of locations where work zone impacts are expected to occur.

1. The US 301 tie-in point at existing US 301 in Maryland
2. The US 301 interim tie-in point at existing US 301 in Delaware
3. Construction of the Strawberry Lane overpass
4. Warwick Road west of existing 301 (Haul road crossing)
5. Construction of Levels Road intersection with existing 301
6. Culvert installations under existing 301

4.4.2 Work Zone Impact Assessment

Impacts of Construction Phasing Approaches

It is not anticipated that Section 3 construction will have a severe impact on daily traffic within the work zone or surrounding area. Construction phasing has been evaluated to minimize disruption to daily traffic while providing a safe and efficient work zone.

The following intersections are seen as critical intersections considering the current construction phasing and detour plans.

- Levels Road and 301 (Signalized)
- Bunker Hill and 301 (Signalized)
- Warwick Road and 301
- Bunker Hill and Old Telegraph Road
- Middle Neck Road and Old Telegraph Road
- Strawberry Lane and Old Telegraph Road
- Strawberry Lane and Warwick Road
- Strawberry Lane and Levels Road
- 301 and Temporary Intersection (Constructed in Phase 4)

Impacts on Bicycles, Pedestrians and Transit

There are limited pedestrian and bicycle facilities along roadways and at critical intersections in the study area. The signalized intersection of Bunker Hill Road and existing US 301 provides crosswalks on all four legs of the intersection and there are designated bike lanes on the eastbound and westbound approaches of Bunker Hill Road. The remaining critical intersections have no existing crosswalks, sidewalks or bike lanes. There is not expected to be any impact to bicycles or pedestrians related to the construction of section 3.

The Delaware Transit Corporation (DTC) currently provides weekday bus service to Middletown. Route 43 has a stop at the intersection of existing US 301 / Merrimac Avenue. There will be no impact on the transit service or schedule because of the proposed construction.

Safety Issues

- Crash History Assessment
 - Available crash data within the anticipated project limits of Section 3 has been evaluated to determine if any pre-existing safety issues are located along the proposed detour routes which may warrant improvements prior to construction letting. Data from the most recent three (3) year time period was considered and will be updated throughout design. This data will be used to create a baseline to help assess safety within the work zone and detour routes during construction. The TMP should be evaluated and modified as necessary if crash history during construction appears to have the potential to exceed baseline values or new locations of incidents are identified to be the result of the work zone traffic control.
 - Strawberry Lane has a calculated average crash rate of 6.79 for the period of January 2009 through December 2011. There were total 5 crashes, out of which one was fatality crash. The fatality was also a DUI. A further review of crash types, locations, and causes does not reveal any crash patterns which indicate the need for safety improvements along this roadway. Furthermore, with the closure of Strawberry Lane at existing US 301 during construction, vehicle conflicts at the intersection will be eliminated.
 - Warwick Road has a calculated average crash rate of 2.24 for the period of January 2009 through December 2011. Three of the four crashes were personal injury crashes. A further review of crash types, locations, and causes does not reveal any crash patterns which indicate the need for safety improvements along this roadway.
 - Existing US 301, between Warwick Road and Levels Road, has a calculated average crash rate 1.50 for the period of January 2009 through December 2011. There were total 38 crashes along this segment of US 301 out of which 17 were personal injury crashes. A review of crash types, locations, and causes does not reveal any crash pattern which indicates the need for safety improvements along this roadway.
 - Existing US 301, between Levels Road and Bunker Hill Road, has a calculated average crash rate 3.55 for the period of January 2009 through December 2011. There were total 71 crashes along this segment of US 301 out of which 21 were personal injury crashes and one was fatality crash. A review of crash types, locations, and causes does not reveal any crash pattern which indicates the need for safety improvements along this roadway. Additional traffic during detour conditions is not expected to increase crashes along this roadway.
- Geometric Conditions
 - No geometric deficiencies have been identified along the proposed detour routes.
 - Interim mainline median crossovers have been designed to satisfy traffic in accordance with the 2004 AASHTO Greenbook. The Maryland Crossovers satisfy a 50 MPH design speed with normal crown and will be posted at 50 MPH. The northern crossover in Delaware satisfies a 43 MPH design speed with normal crown. Per DelDOT direction the Delaware workzone will remain posted at 50 MPH with 45 MPH advisory signage placed for the crossover. Additional crossover design details are included in the MOT plans.
 - The temporary intersection between mainline US 301 and existing 301 south of Warwick Road has been designed to accommodate WB-67 vehicles to minimize impacts to the adjacent farm equipment business. In addition, based on construction year volumes, a temporary signal is not warranted at this location.
- Construction Related Safety
 - It is anticipated that construction activities will either be outside of the clear zone or adequately shielded with concrete safety barrier.
 - The contractor will be responsible to provide access to construction staging and field office locations that meet standard design criteria for driveway access.
 - Temporary short term mainline closures will be implemented during beam and deck pan placement at the Strawberry Lane Bridge.



- Flagging operations are anticipated to be utilized at the proposed haul road crossings of Warwick Road and mainline US 301 at Strawberry Lane and the northbound stockpile location in Maryland. Further details are incorporated in the MOT plans.
- Maintenance of Traffic related Safety
 - The goal of proposed MOT phasing is to minimize disruption to daily traffic while providing a safe and efficient work zone. The MOT plan for the Delaware workzone has been developed in accordance with Part 6 – Temporary Traffic Control of the Delaware MUTCD, DeIDOT's Road Design Guide, and Chapter 9 – Traffic Barrier, Traffic Control Devices, and Other Safety Features for Work Zones of the AASHTO Roadside Design Guide. Likewise, the MOT plan for Maryland workzone has been prepared in accordance with Maryland MUTCD specific standards.
- Other issues (if any)
 - No additional issues have been identified.

Qualitative Analysis

- The US 301 tie-in point at existing US 301 in Maryland
 - The northbound and southbound mainline median crossovers in Maryland have been designed with horizontal alignments utilizing 8,000' radii that satisfy a 50 MPH design speed with normal crown in accordance with AASHTO standards. The proposed posted speed limit in Maryland during construction is 50 MPH. This reduced work zone speed limit is within 10 MPH of the current regulatory limit.
 - No adverse impacts are expected as a result of implementing these crossovers. (See quantitative analysis below)
 - Northbound traffic will be tapered to a single lane prior to entering the work zone. Southbound traffic will maintain a single lane configuration as they travel through the existing crossover. Work will be located in the median area. Both directions of traffic will have the left shoulder closures delineated by drums and/or temporary striping.
 - Traffic officers will be utilized at night to provide added safety for the workers as they implement the temporary traffic control schemes.
- The US 301 tie-in point at existing 301 in Delaware
 - The interim mainline 301 connection between newly constructed southbound roadway and existing 301 in Delaware has a horizontal alignment utilizing a 6,000' radius that satisfies a 43 MPH design speed with normal crown in accordance with AASHTO standards. The proposed posted speed limit in Delaware during construction will remain 50 MPH and the crossover will be signed with 45 MPH advisory signage.
 - No adverse impacts are expected as a result of implementing this interim connection and therefore quantitative analysis is not warranted. It is anticipated that the interim connection will remain in place until Section 2 construction is complete.
 - The temporary crossover will utilize 12' travel lanes, with 12' turn lanes at the temporary intersection with existing US 301. Full 10' shoulders are provided for the through lanes.
 - Mill and overlay operations will be required to complete the crossover tie-in with US 301. This work is anticipated to be performed under nighttime flagging operations.
 - Traffic officers will be utilized at night to provide added safety for the workers as they implement the temporary traffic control schemes.
- Construction of the Strawberry Lane overpass
 - Temporary short term mainline US 301 closures will be implemented for bridge beam erection utilizing 15 minute complete closures during week nights. Single lane closures with flagging operations will be implemented for mainline US 301 during installation and removal of temporary deck overhang formwork and installation of permanent deck formwork. The temporary short term closures and single lane closures are only required on the eastern bridge span located over existing US 301. Flagging will be necessary to control northbound mainline traffic to allow earthmoving vehicles to access the eastern bridge approach.
 - Strawberry Lane will be detoured during construction of the overpass. Traffic will be diverted to Levels Road and Warwick Road during the closure. The closure is estimated to be in place for 10 months. No adverse impacts are expected as a result of the detour at surrounding intersections or roadways.

- Temporary traffic barriers will be utilized to protect the traveling public and the workers. The typical section through this area will consist of two 12' travel lanes with 2' offsets from the barrier. These barriers are expected to remain in place up to Phase 5.
- Traffic officers will be utilized at night to provide added safety for the workers as they implement the temporary traffic control scheme and for the temporary short term mainline 301 closures.
- Warwick Road west of existing 301 (Haul road crossing)
 - Flagging operations will be necessary to control Warwick Road traffic to allow earthmoving vehicles to cross Warwick Road as part of earthwork hauling operations during construction Phase 2A and 2B.
 - Delaware MUTCD Typical Application 14 (TA-14) has been followed for haul road crossings along with a truck crossing sign at each haul road crossing to notify drivers.
 - Flagging operations are expected to occur during daytime, off-peak hours, and last through Phase 2A and 2B. It has been noted on the project plans that the contractor shall not have multiple haul road crossings occurring simultaneously.
- Construction of Levels Road intersection with existing US 301
 - Lane and shoulder closures are anticipated to construct the new leg of the intersection as well as additional turning lane improvements. Existing southbound US 301 traffic will be reduced to one through lane at times to complete the intersection improvements. Northbound traffic will have a right shoulder closure for the duration of the intersection improvements to allow pavement tie-in and concrete island construction. Levels Road Westbound will have the right turn lane closed for the duration of the intersection improvements. Safety drums are utilized to shield the work zone and eliminate impacts to traffic along existing 301 and eastern leg of Levels Road.
 - Traffic officers will be utilized at night to provide added safety for the workers as they implement the temporary traffic control scheme.
- Culvert installations under existing 301
 - Nighttime lane closures with flagging operations are anticipated to install four culverts under existing 301. Each of these closures shall conform to TA-10 of the Delaware MUTCD and are not permitted to occur simultaneously. Each culvert installation is estimated to be completed within a week's duration.
 - Traffic officers will be utilized at night to provide added safety for the workers as they install the proposed culverts.

Quantitative Analysis

- The US 301 Tie-In point at Existing 301 in Maryland
 - The hourly volumes for northbound US 301 traffic at the crossover point were developed using the AADT established with 2010 traffic count data from count station 8025, located along existing US 301 near the Maryland line, and diurnal distribution factors as published in the 2010 DelDOT Traffic Summary. A yearly growth factor of 2% was applied to the 2010 AADT to obtain 2015 construction condition volumes. The hourly volumes were then compared to the available capacity of this work zone. According to guidance published in DelDOT's *Work Zone Safety and Mobility Procedures and Guidelines*, the average work zone capacity for a work zone which is being reduced from two travel lanes to one is 1340 vehicles per hour (vph). As can be seen in the table below, the hourly volumes expected on Northbound US 301 at the crossover are well below capacity. Therefore, no queuing or vehicle delay is expected with a lane reduction in this area.



Table 4.2.2.1 - AADT Capacity Analysis – Northbound US 301

Hour	Hourly Distribution	Hourly Volume NB US 301	NB US 301 Capacity Volume/Capacity (%)
0	1.04%	64	4.81%
1	0.73%	45	3.37%
2	0.61%	38	2.82%
3	0.60%	37	2.77%
4	0.86%	53	3.98%
5	1.78%	110	8.23%
6	3.52%	218	16.27%
7	5.15%	319	23.81%
8	5.14%	318	23.76%
9	5.36%	332	24.78%
10	5.85%	362	27.05%
11	6.27%	388	28.99%
12	6.55%	406	30.28%
13	6.61%	409	30.56%
14	6.89%	427	31.85%
15	7.39%	458	34.17%
16	7.73%	479	35.74%
17	7.16%	444	33.10%
18	5.65%	350	26.12%
19	4.47%	277	20.67%
20	3.73%	231	17.24%
21	3.07%	190	14.19%
22	2.26%	140	10.45%
23	1.56%	97	7.21%

* Based on a 2015 AADT of 12,147 (2010 AADT of 11,002 with applied growth rate of 2% per year)

* Directional split of 51% (from 2011 traffic data collected at count station #8025 @ MD Line)

- Critical Intersections
 - Peak hour traffic volumes at critical intersections were collected during weekday peak hours and these volumes were used to develop construction year (2015) traffic forecasts. Baseline (no build) and construction condition traffic volume networks were developed and capacity analysis was conducted using HCM based software (Synchro, Version 7). Figures illustrating the modeled traffic volumes can be found in **Appendix C.3**. The following tables summarize the baseline and construction phase level of service, vehicle delay and queues at the critical intersections which will experience change in traffic volumes due to detours implemented during construction or will experience lane closures due to construction activities. The scenarios analyzed at critical study intersections and reflected in the tables are as follows:
 - Baseline (no build) 2015 conditions
 - Phase 1 Construction – Haul Road at Levels Road opened, temporary signal configuration in place.
 - Phase 2A Construction - Strawberry Lane and Middle Neck Road under Detour – Lane closures at Levels Rd / existing 301 consist of single through lane closures NB and SB on existing 301. Temporary signal configuration in place.
 - Phase 2B Construction – Strawberry Lane and Middle Neck Road under Detour – Lane closures at Levels Rd / Existing 301 consist of single through lane closure on NB existing 301, and right turn lane closure on WB Levels Road. Temporary signal configuration in place.
 - Phase 3 Construction – Warwick Road under Detour – Traffic diverted to Middle Neck Road and Old Telegraph Road. Levels Rd / existing 301 opened to final configuration. Temporary signal is removed.
 - Phase 4 Construction – Temporary intersection in place to provide local access along existing US 301 south of the crossover.
 - Results of the capacity analysis indicate that all critical study intersections will continue to operate at an overall acceptable level of service in the AM peak hour. During the PM peak hour under baseline conditions, the Warwick Road STOP controlled approach to existing 301 operates at a failing level of service with approximately 130 seconds of vehicle delay. This approach will experience an increase in approach volumes with the implementation of the Strawberry Lane detour in Phase 2 construction. Under detour conditions this approach will continue to operate at a failing level of service with vehicle delay of over 300 seconds on the STOP controlled approach. Due to the significant increase in vehicle delay during Phase 2 of construction at the intersection of 301 and Warwick Road the need for a temporary traffic signal was evaluated. This location will meet Delaware MUTCD Signal Warrant 2, Four-Hour Vehicular Volume, under Phase 2 construction conditions. The signal warrant analysis is included in Appendix C.3. All other intersections will operate at an overall acceptable level of service in the PM peak hour under detour conditions.
 - There are limited pedestrian and bicycle facilities along roadways and at critical intersections in the study area. The signalized intersection of Bunker Hill Road and existing US 301 provides crosswalks on all four legs of the intersection and there are designated bike lanes on the eastbound and westbound approaches of Bunker Hill Road. The remaining critical intersections have no existing crosswalks, sidewalks or bike lanes. There is not expected to be any impact to bicycles or pedestrians related to the construction of section 3.
 - The Delaware Transit Corporation (DTC) currently provides weekday bus service to Middletown. Route 43 has a stop at the intersection of existing US 301 / Merrimac Avenue. There will be no impact on the transit service or schedule because of the proposed construction.



Table 4.2.2.2 - 2015 AM Peak Hour Level of Service Summary

Intersections	Approach		Movement	AM Peak Hour									
				Baseline Conditions		Phase 1 Conditions		Phase 2A Conditions		Phase 2B Conditions		Phase 3 Conditions	
				LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Existing US 301 and Bunker Hill Road	Bunker Hill Road	EB	LL	E	68.8	E	68.8	E	68.8	E	68.9	E	68.9
			TT	E	68.9	E	68.9	E	68.9	E	68.8	E	68.8
			R	E	57.9	E	57.9	E	57.9	E	57.1	E	57.1
	W. Main Street	WB	LL	E	69.4	E	69.4	E	69.4	E	69.3	E	69.3
			TT	E	58.5	E	58.5	E	58.5	E	59.6	E	59.6
			R	D	54.3	D	54.3	D	54.3	E	55.1	E	55.1
	Existing US 301	NB	L	E	71.4	E	70.4	E	57.5	E	59.8	E	59.3
			TT	B	18.8	B	18.2	C	28.0	C	29.0	C	20.9
			R	A	9.9	A	8.8	D	51.3	D	52.8	B	18.2
	Existing US 301	SB	L	E	74.2	E	74.2	E	74.2	E	74.2	E	74.2
			TT	C	21.5	C	21.5	C	22.6	C	22.9	C	22.9
			R	B	19.2	B	19.2	C	20.2	C	20.6	C	20.6
Overall				D	44.3	D	44.1	D	48.7	D	49.9	D	46.6
Existing US 301 and Levels Road	Levels Road	EB	LL	-	-	-	-	-	-	-	-	E	68.9
			LTR	-	-	E	76.6	E	76.6	E	76.6	-	-
			T	-	-	-	-	-	-	-	-	E	58.8
			R	-	-	-	-	-	-	-	-	E	57.5
	Levels Road	WB	L	E	67.4	-	-	-	-	-	-	F	80.7
			LTR	-	-	-	-	-	-	E	70.5	-	-
			LT	-	-	E	67.7	E	67.8	-	-	-	-
			T	-	-	-	-	-	-	-	-	E	64.2
	Existing US 301	NB	R	E	68.0	E	67.9	E	67.2	-	-	E	65.5
			L	-	-	F	89.0	F	132.5	F	132.5	E	76.9
			T	-	-	-	-	B	17.5	B	18.3	-	-
			TT	A	8.8	B	12.6	-	-	-	-	B	16.3
	Existing US 301	SB	R	A	7.3	B	10.4	B	11.7	B	12.7	B	14.3
			L	E	62.1	E	68.0	F	81.5	E	77.8	E	75.4
			TT	A	0.3	-	-	-	-	-	-	B	12.9
			TTR	-	-	A	1.9	-	-	A	9.2	-	-
			T	-	-	-	-	-	-	-	-	-	-
Existing US 301	SB	TR	-	-	-	-	B	12.9	-	-	-	-	
		R	-	-	-	-	-	-	-	-	C	24.0	
Overall				C	21.3	C	24.8	C	33.1	C	32.8	D	38.0
Existing US 301 and Warwick Road	Warkwick Road	EB	LTR	D	33.2	D	33.2	E	41.6	E	41.6	-	-
	Hooper Inc. Driveway	WB	LTR	C	18.9	C	18.9	C	19.7	C	19.7	C	15.8
	Existing US 301	NB	LT	A	0.3	A	0.3	A	0.3	A	0.3	-	-
			T	-	-	-	-	-	-	-	-	A	0.0
	Existing US 301	SB	R	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0
			LT	A	0.9	A	0.9	-	-	-	-	A	1.1
	Existing US 301		SB	LTR					A	0.8	A	0.8	-
Overall				A	5.4	A	5.4	A	7.4	A	7.4	A	0.8



Table 4.4.2.3 - 2015 PM Peak Hour Level of Service Summary

Intersections	Approach		Movement	PM Peak Hour									
				Baseline Conditions		Phase 1 Conditions		Phase 2A Conditions		Phase 2B Conditions		Phase 3 Conditions	
				LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Existing US 301 and Bunker Hill Road	Bunker Hill Road	EB	LL	E	69.6	E	69.6	E	69.6	E	70.0	E	70.0
			TT	E	68.4	E	68.4	E	68.4	E	68.2	E	68.2
			R	E	56.4	E	56.4	E	56.4	E	56.1	E	56.1
	W. Main Street	WB	LL	E	68.9	E	68.9	E	69.3	E	69.2	E	69.2
			TT	D	53.2	D	53.2	D	53.3	D	54.5	D	54.5
			R	D	49.2	D	49.2	D	49.2	D	49.9	D	49.9
	Existing US 301	NB	L	E	71.0	E	66.9	E	57.4	D	58.7	E	65.2
			TT	C	25.0	C	29.5	D	39.5	C	29.6	C	27.2
			R	B	10.1	D	37.9	F	84.6	D	41.6	C	20.9
	Existing US 301	SB	L	E	73.8	E	73.8	E	73.8	E	73.8	E	73.8
			TT	C	26.6	C	26.6	C	27.2	C	26.6	C	26.6
			R	C	21.9	C	21.9	C	22.4	C	22.3	C	22.3
Overall				D	45.6	D	48.2	D	53.2	D	48.6	D	47.0
Existing US 301 and Levels Road	Levels Road	EB	LL	-	-	-	-	-	-	-	-	E	69.2
			LTR	-	-	E	76.6	E	76.6	E	76.6	-	-
			T	-	-	-	-	-	-	-	-	E	65.6
			R	-	-	-	-	-	-	-	-	E	63.6
	Levels Road	WB	L	E	67.2	-	-	-	-	-	-	E	63.5
			LTR	-	-	-	-	-	-	F	115.1	-	-
			LT	-	-	E	67.3	E	70.3	-	-	-	-
			T	-	-	-	-	-	-	-	-	E	63.6
	Existing US 301	NB	R	E	67.9	E	67.8	E	65.7	-	-	E	63.4
			L	-	-	F	132.5	F	132.5	F	132.5	E	77.5
			T	-	-	-	-	C	27.4	D	39.3	-	-
			TT	B	14.0	B	17.6	-	-	-	-	B	15.6
	Existing US 301	SB	R	B	11.0	B	13.9	B	15.9	C	21.8	B	13.1
			L	E	61.4	E	64.1	E	78.3	F	89.7	E	59.8
			TT	A	0.5	-	-	-	-	-	-	A	0.9
			TTR	-	-	A	2.7	-	-	A	3.6	-	-
			T	-	-	-	-	-	-	-	-	-	-
			TR	-	-	-	-	B	14.4	-	-	-	-
R	-	-	-	-	-	-	-	-	A	0.1			
Overall				C	22.2	C	25.3	D	36.9	D	47.0	C	29.7
Existing US 301 and Warwick Road	Warkwick Road	EB	LTR	F	133.3	F	133.3	F	303.7	F	303.7	-	-
	Hooper Inc. Driveway	WB	LTR	C	23.5	C	23.5	D	27.7	D	27.7	C	17.8
	Existing US 301	NB	LT	A	0.2	A	0.2	A	0.6	A	0.6	-	-
			T	-	-	-	-	-	-	-	-	A	0
	Existing US 301	SB	R	A	0.0	A	0.0	A	0.0	A	0.0	A	0
			LT	A	0.6	A	0.6	-	-	-	-	A	0.8
LTR	-	-	-	-	A	0.6	A	0.6					
Overall				C	19.5	C	19.5	E	49.7	E	49.7	A	0.9



Table 4.4.2.4 - 2015 AM Peak Hour Queue Summary

Intersections	Approach		Movement	Available Storage (feet)	AM Peak Hour				
					Baseline Conditions	Phase 1 Conditions	Phase 2A Conditions	Phase 2B Conditions	Phase 3 Conditions
					95th percentile Queue Length (feet)				
Existing US 301 and Bunker Hill Road	Bunker Hill Road	EB	LL	300	56	56	56	66	66
			TT	-	150	150	150	160	160
			R	250	28	28	28	31	31
	W. Main Street	WB	LL	350	122	122	122	118	118
			TT	-	136	136	136	141	141
			R	300	52	52	52	52	52
	Existing US 301	NB	L	400	62	62	m58	m63	60
			TT	-	132	126	243	248	159
			R	400	9	8	63	61	17
	Existing US 301	SB	L	450	169	169	169	169	169
			TT	-	137	132	141	138	138
			R	350	23	23	24	25	25
Existing US 301 and Levels Road	Levels Road	EB	LL	350	-	-	-	-	82
			LTR	-	-	35	35	35	-
			T	-	-	-	-	-	63
			R	550	-	-	-	-	20
	Levels Road	WB	L	500	14	-	-	-	21
			LTR	-	-	-	-	147	-
			LT	-	-	35	62	-	-
			T	-	-	-	-	-	22
	Existing US 301	NB	R	450	48	48	47	-	47
			L	400	-	20	21	21	31
			T	-	-	-	470	457	-
			TT	-	157	198	-	-	150
	Existing US 301	SB	R	300	1	1	0	0	2
			L	500	144	193	221	200	237
			TT	-	4	-	-	-	126
			TTR	-	-	121	-	143	-
Existing US 301	SB	T	-	-	-	-	-	-	
		TR	-	-	-	466	-	-	
		R	550	-	-	-	-	42	
Existing US 301 and Warwick Road	Warkwick Road	EB	LTR	-	74	74	109	109	-
	Hoover Inc. Driveway	WB	LTR	-	6	6	6	6	4
	Existing US 301	NB	LT	-	1	1	1	1	-
			T	-	-	-	-	-	0
	Existing US 301	SB	R	150	0	0	0	0	0
			LT	-	2	2	-	-	3
			LTR	-	-	-	2	2	-

Table 4.4.2.5 - 2015 PM Peak Hour Queue Summary

Intersections	Approach		Movement	Available Storage (feet)	PM Peak Hour				
					Baseline Conditions	Phase 1	Phase 2A Conditions	Phase 2B Conditions	Phase 3 Conditions
					95th percentile Queue Length (feet)				
Existing US 301 and Bunker Hill Road	Bunker Hill Road	EB	LL	300	95	95	95	100	100
			TT	-	202	202	202	206	206
			R	250	33	33	33	34	34
	W. Main Street	WB	LL	350	160	160	161	151	151
			TT	-	148	148	148	160	160
			R	300	50	50	51	51	51
	Existing US 301	NB	L	400	76	69	m64	m61	88
			TT	-	167	232	304	m210	194
			R	400	18	72	116	m48	50
	Existing US 301	SB	L	450	285	285	285	285	285
			TT	-	260	260	261	250	250
			R	350	25	25	25	26	26
Existing US 301 and Levels Road	Levels Road	EB	LL	350	-	-	-	-	89
			LTR	-	-	35	35	35	-
			T	-	-	-	-	-	71
			R	550	-	-	-	-	24
	Levels Road	WB	L	500	23	-	-	-	44
			LTR	-	-	-	-	#483	-
			LT	-	-	36	122	-	-
			T	-	-	-	-	-	73
	Existing US 301	NB	R	450	11	11	7	-	7
			L	400	-	21	21	21	35
			T	-	-	-	636	680	-
			TT	-	241	283	-	-	184
	Existing US 301	SB	R	300	7	8	14	16	9
			L	500	170	228	314	263	196
			TT	-	14	-	-	-	16
			TTR	-	-	207	-	68	-
T			-	-	-	-	-	-	
TR			-	-	-	516	-	-	
R	550	-	-	-	-	-	0		
Existing US 301 and Warwick Road	Warwick Road	EB	LTR	-	225	225	405	405	-
	Hooper Inc. Driveway	WB	LTR	-	11	11	14	14	7
	Existing US 301	NB	LT	-	1	1	2	2	-
			T	-	-	-	-	-	0
			R	150	0	0	0	0	0
	Existing US 301	SB	LT	-	2	2	-	-	2
LTR			-	-	-	2	2	-	

Community Issues

Section 3 work zone phasing is being developed to minimize disruptions to traffic, detour lengths and durations. The current plan is to maintain access to businesses on existing 301 south of Levels Road, and Middletown Veterinary Hospital on Warwick Road at all times during construction utilizing either a temporary intersection, flagging operations, or detours.



Other Construction Issues

Section 3 earthwork borrow operations at the Levels Road Mitigation Site must be complete within the first 9 months of construction based on current borrow site phasing with Section 2. Based on the magnitude of material to be moved, hauling routes and operations have been evaluated with respect to efficiency and impacts to traffic.

A detour of Middle Neck Road is proposed in Phase 2A to increase hauling operation efficiency and avoid conflicts with traffic. Flagging operations will be required for the haul road crossing at Warwick Road and northbound 301 to place embankment on the eastern approach of Strawberry Lane Bridge, as well as to provide access to the northbound 301 stockpile site in Maryland. This detour will be in place beginning in Phase 2A and will remain in place until Phase 3, approximately 13 months.





CHAPTER 5

WORKZONE IMPACTS MANAGEMENT STRATEGIES





5.0 WORK ZONE IMPACT MANAGEMENT STRATEGIES

Work zone impact management strategies are used to minimize impacts to existing traffic operations; maintain or improve worker and motorist safety in the work zone; and, communicate with the impacted residents, communities and businesses along the project corridor. The following sections detail the corridor wide strategies as well as section-specific strategies to be implemented during construction. The strategies are categorized as Temporary Traffic Control Plan (TTCP) strategies, Traffic Operation (TO) strategies and Public Involvement (PI) strategies.

Where appropriate, the selected impact management strategies have been detailed on the plan sheets or in the specifications.

5.1 CORRIDOR WIDE STRATEGIES

5.1.1 Temporary Traffic Control Plan Strategies

Project Coordination: During construction, DeIDOT and the GEC will be responsible for coordinating the construction efforts of the various US 301 construction contracts. This will involve coordinating, sequencing and scheduling construction activities to minimize impacts to the traveling public. DeIDOT and the GEC are also responsible for coordinating with Maryland SHA to minimize traffic impacts on Maryland roadways as a result of the US 301 construction in Delaware.

Temporary Traffic Control Devices: Design of the US 301 Project follows the standards provided in the Delaware MUTCD, Part 6 – Temporary Traffic Control; DeIDOT’s Road Design Manual; and, the AASHTO Roadside Design Guide, Chapter 9 – Traffic Barriers, Traffic Control Devices, and Other Safety Features. Details of specific traffic control devices to be used in each contract, such as temporary signs, channelizing devices, temporary barrier and temporary pavement markings, are shown on the plans.

Temporary traffic control devices used on all highways open to the public shall be crashworthy in accordance with the National Cooperative Highway Research Program (NCHRP) Report 350 and/or the Manual for Assessing Safety Hardware (MASH).

Portable Changeable Message Signs (PCMS): PCMS must be used throughout the project corridor to provide key information to motorists. PCMS may be used to display a decrease in work zone speed limit, to act as advanced warning signs on roadways leading towards the work zones, or to display other necessary information regarding the work zone conditions to drivers using the roadway. All PCMS must be installed only after DeIDOT’s approval through their “Portable Changeable Message Sign Approval Form”. This form will be submitted by the Contractor to DeIDOT’s District Safety Officer at least 48 hours prior to placement of any device.

Temporary Concrete Barriers: Slotted temporary barriers must be considered for use during temporary lane/shoulder closures on existing roadways that might impact the existing drainage conditions on the roadways. This would ensure that the water does not pool on the roadway during inclement weather conditions, thus posing a safety concern to the drivers.

5.1.2 Transportation Operation Strategies

Work Zone Speed Limit: Reducing the work zone speed limit will be considered on a case by case basis. Where work zone speed limits are reduced, Work Zone Speed Limit (Work Zone Speed Limit XX Fines Doubled) signs will be considered on a case by case basis. Reduced work zone speed limits shall be approved by DeIDOT Traffic Safety prior to implementation

Use of State Police for Lane Closures: The use of State Police should be considered for certain operations, such as enforcement of reduced work zone speed limits, traffic incident management and traffic control. Use of Uniformed Law Enforcement will be in accordance with the document entitled "Guidelines for the Use of Law Enforcement Officers in Work Zones".

Crash Data in the Work Zone: Crash data will be reviewed by the SDC on a regular basis, as part of the TMP Monitoring Program, to identify crash trends. Changes to work zone temporary traffic control setup will be made, as needed, based on increases in crash trends.



Transportation Management Center (TMC): DelDOT’s TMC will coordinate and manage traffic and incident management activities in and around the project corridor. Prior to beginning construction, each Contractor should provide the DelDOT TMC with a current list of contact information for key field and office personnel, including 24-hour emergency phone numbers and the emergency phone tree. Each contractor shall also provide the TMC an updated construction schedule.

Coordination with the Media: DelDOT’s Public Relations section and the TMC will work with the local media to publicize information regarding work zone temporary traffic control operations and potential traffic delays.

Proposed Advance Notification Requirements (For Review by DelDOT): At least **seven (7)** Calendar Days before a road closure or major change in the roadway configuration or travel pattern, the Contractor shall use an advance warning sign or portable changeable message sign to warn motorists of the pending changes. This sign shall remain in place at least **five (5)** but no more than **seven (7)** calendar days after a major change in the roadway configuration or travel pattern.

The Contractor is required to submit requests for traffic restrictions to the GEC and DelDOT in accordance with Table 5.1.

TABLE 5.1 Advance Notification		
Type of Restriction	Minimum Advance Notice	Maximum Advance Notice
1	30 Days	45 Days
2	10 Days	21 Days
3	7 Days	14 Days
4	5 Days	14 Days
<p>Type 1: Planned and acceptable closures of an arterial or local street, traffic switches, new ramp openings, or changed traffic patterns.</p> <p>Type 2: A lane(s) closure that would have significant impact on traffic, such as temporarily stopping traffic completely (traffic drags), closing 2 or more lanes, closing an exit or entrance ramp at freeway interchanges, or flagging operations.</p> <p>Type 3: A lane closure that would have minor or no impact on the flow of traffic, such as closing one lane on a three-lane freeway during off-peak hours.</p> <p>Type 4: A lane closure that would close a shoulder (right or left)</p>		

For Type 1 closures, the Contractor shall make provisions in the Temporary Traffic Control Plan for local traffic to access properties and businesses at all times on the closed arterial or local street.

Type 1 and 2 closures will require extensive media and stakeholder notification effort and coordination among various local and State agencies. The Contractor shall assist with all notification and coordination efforts.

All advanced notification time periods exclude weekend and holidays.

5.1.3 Work Zone Impacts on Roadways Outside of the Project Area

All major roadways in the immediate vicinity of the project area will be continuously monitored by the GEC and DelDOT to determine if they experience an increase in traffic volumes due to construction activities on existing US 301 and Boyds Corner Road. Roadways to be monitored include US Route 13, Choptank Road, SR 299 and Marl Pit Road from US 13 to existing US 301. Additional measures may be needed to mitigate any impacts caused by an increase in traffic along these additional routes due to potential diversions from existing US 301 and Boyds Corner Road.



5.1.4 Public Information and Outreach Strategies

Coordination with Stakeholders:

Project Commitments from the US 301 Record of Decision:

Several commitments were made during the US 301 project development phase regarding traffic operations during construction. These commitments were a result of input from stakeholders and aim to address specific concerns raised by communities during the public involvement process. The commitments were recorded in the Record of Decision and **must be adhered to during the construction of the new US 301**. Those commitments are as follows:

- *A connection between Strawberry Lane and existing US 301 must be maintained.*
- *The following crossroads must remain open during construction:*
 - *Bunker Hill Road (Section 2)*
 - *Jamison Corner Road (Section 1)*

Current and future Public workshops and meetings:

- Public workshops will be conducted for the design and construction phases where work zone impacts, mitigation strategies and other Transportation Management Plan (TMP) elements for that section of the roadway are presented to the public. These meetings will be scheduled by the GEC with input from the SDCs and DeIDOT.
- A public workshop will be scheduled prior to construction to provide an update to the public and stakeholders on the project and construction schedules.
- Input from the public will be taken into consideration when modifying the TMP to minimize impacts on residences and businesses.
- Construction Information meetings will be conducted, when necessary, throughout the construction phase to provide information on changes in traffic and travel patterns due to the work zone.

DeIDOT Travelers Advisory Radio Station (WTMC-1380AM): The Transportation Management Center (TMC) staff will prepare and broadcast the necessary radio messages associated with traffic restrictions (shoulder, lane and road closures) on this project.

DeIDOT Real-Time Travelers Advisory Website:

- The TMC staff will update the traveler's advisory information on the DeIDOT website based on shoulder, lane or road closures for this project.
- The Contractor is required to provide DeIDOT with the necessary information on traffic restrictions at least 7 days prior to setting up the work zone for construction.
- The Contractor is also required to contact the TMC immediately prior to implementing any shoulder, lane or road closures. The contractor is then required to contact the TMC after the restrictions have been lifted.

School Districts, DART and Police/Emergency Services Coordination: The Public Information and Outreach Strategies undertaken as part of this project will include coordination with all the affected School Districts, Police, Fire and other emergency services in the project area. Currently, there is only one DART bus route within the project area, running on SR 1. If and when new bus routes or park and ride facilities are planned in the project area through the construction period, the GEC in coordination with DeIDOT and the SDCs will set up meetings with DART to develop alternatives to minimize impact to the traveling public.

Updates from these meetings will be provided to the public and stakeholders at the Construction Information meetings.



Communications Plan: The Project Team will develop a communication plan to implement during construction. Input from the SDCs may be required in the development of this plan. Typical communication strategies may include:

- Construction Information Meetings
- Project website
- Email alerts
- Press Releases
- Transportation Management Team (TMT) Meetings

Section Specific Strategies

Public outreach strategies will be used to inform the public throughout the construction phase of the project to ensure the public is aware of construction activities and potential impacts to travel. The following public outreach strategies will be used to inform the public of activities associated with each of the sections:

- Construction Information Meetings
- DelDOT Press Releases
- Portable changeable message signs (PCMS)
- DelDOT variable message signs (VMS)
- DelDOT travelers advisory radio station (WTMC - 1380 AM)
- DelDOT website
 - Interactive Traffic map
 - Streaming audio of WTMC
 - Live traffic cameras
- MyDelDOT e-mail alerts
- Press Briefings
- Transportation Management Team (TMT) Meetings

In an effort to alert trucks of the construction work as far in advance as possible, the following notifications will be made:

- DelDOT Public Relations to contact the Pennsylvania Motor Trucking Association, Delaware Motor Transport Association, Maryland Motor Truck Association, and New Jersey Motor Truck Association to notify them of any closure(s) so that they may use their internal communication protocols to alert members.
- DelDOT will contact Maryland and Pennsylvania DOTs to notify them of roadway closures and detours so that they may use their public information tools to alert truckers in those states.



5.2 SECTION SPECIFIC STRATEGIES – DESIGN SECTION 1

5.2.1 TRAFFIC CONTROL PLAN (TCP) STRATEGIES

Control Strategies

Control strategies include various traffic control strategies to accommodate motorists, pedestrians, and bicyclists in a safe and efficient manner within the work zone, and providing access to the roadway for the proposed construction. The table below lists the traffic control strategies from DelDOT’s Work Zone Safety and Mobility Procedures and Guidelines, Appendix B, with pros and cons for each strategy with a location where they were employed in the Section 1 traffic control plans.

TABLE 5.2.1.1 Design Section 1 - Traffic Control Devices			
Traffic Control Plan Strategy	Pro	Con	Location
Construction Phasing	Provides the ability to allow traffic to be maintained, in lieu of full closure	May increase contract duration versus full closure	Throughout all contracts phasing is set-up to provide logical construction sequence while minimizing impacts to traffic.
Construction Staging	Provides clear area for contractor to lay down material and access the site	Potentially requires additional right-of-way to provide staging areas	Throughout all contracts staging areas have been provided.
Full Roadway Closures			
- Intermittent (<i>typically less than 15 minutes</i>)	Provides safest work area for both workers and motorists. Allows for longer term completion of work tasks	Inconvenience to motorists, additional travel time and delay.	May be required throughout all contracts for tie-ins to existing roadways and sign structure erection
- Off-peak (<i>typically less than 15 minutes</i>)			May be required throughout all contracts for tie-ins, girder erection, etc.
- Short-term at Night (<i>more than 15 minutes and less than 8 hours</i>)			1A/1B/1D/bridge girder erection, sign structure erection, tie-ins, cross pipe installation, etc.
- Long-term (<i>more than 8 hours</i>)			1B/Phases 1-2/SR 1/Bridge girder erection, sign structure erection, tie-ins, etc. 1A/Phases 2-6/Hyetts Corner Road
Lane Shifts or Closures	See detailed discussion below		
Reduced Lane Widths to Maintain Number of Lanes			
Lane Closures to Provide Worker Safety	See detailed discussion below		
- Intermittent	Provides work area, while maintaining reduced traffic, without the effects of full closures	Inconvenience to motorists, reduction in capacity	May be required throughout all contracts for various work activities, including MOT set-up, striping, signing, etc.
- Off-peak			May be required throughout all contracts for tie-ins, girder erection, etc. 1D for various phases
- Short-term at Night			1A/1B for bridge girder erection, sign structure erection, tie-ins, etc.
- Long-term			None currently proposed
Reduced Shoulder Width to Maintain Number of Lanes	Provides work area while maintaining traffic	Reduces opportunity for emergency pull-off	Throughout all contracts for various work activities
Shoulder Closures to Provide Worker Safety			
Lane Shift to Shoulder/Median to Maintain Number of Lanes			



One-Lane, Two Way Operation	Provides work area while maintaining traffic	Requires flagging	1A/Various/SR 896 & Run-around road/Haul road crossing, utilities, tie-ins, etc.
Two-Way Traffic on One Side of Divided Facility (Crossover)	Strategy not utilized		
Reversible Lanes	Strategy not utilized		
Ramp Closures/Relocation	Provides work area while maintaining traffic	May involve temporary signing and striping changes	1B/US 13 NB on-ramp to SR 1 NB phased to relocate and reroute to provide work area
Night Work	Provides work area during lower volume night time hours therefore minimizing impacts to motorists	Requires lighting	Throughout all contracts night work is anticipated.
Weekend Work	Provides work area for longer time periods than possible in off-peak times only	Inconvenience to motorists, additional travel time and delay.	May be required, no specific locations detailed in the design.
Work Hour Restrictions for Peak Travel	Provides capacity during higher volume peak hours	Reduces contractor's available work time	Throughout all contracts peak hour restrictions are provided.
Pedestrian/Bicycle Access Improvements	Ensures all road users have access through work zone	Requires additional lane/shoulder width through work zones, and other additional accommodations	Throughout all contracts pedestrians and bicyclists will be accommodated and/or detoured.
Business Access Improvements	Ensures customers have access to businesses during construction	May require additional construction effort, time and/or temporary construction elements	Signing for Ches-Del restaurant provided in Contract 1D
Off-site Detours/Use of Alternate Routes	Provides work area for workers and travel route for motorists. Allows for longer term completion of work tasks	Inconvenience to motorists, additional travel time and delay.	Detours of Hyetts Corner Road, SR 1, and US 13 proposed in Contracts 1A, 1B, and 1D respectively



Traffic Control Devices

The following traffic control devices will be utilized during various phases of construction for all contracts within Section 1:

- Temporary Signs
- Changeable Message Signs (CMS)
- Arrow Panels
- Channelizing Devices and Impact Attenuators
- Temporary Pavement Markings
- Flaggers
- Uniformed Law Enforcement Officers
- Temporary Barricades
- Truck Mounted Attenuators
- Lighting Devices

Project Coordination and Innovative Construction Strategies

TABLE 5.2.1.2 Design Section 1 - Project Coordination and Innovative Construction Strategies		
Task	Contract	Action
Coordination with Other Projects	1A	Jamison Corner Road from Boyds Corner Road to Hyetts Corner Road (T200712003)
		1B and Section 2
		1A and 1D
	1B	1A and Section 2
	1C	1B
	1D	Original sewer relocation contract 1E has been merged into 1A
Utilities Coordination	1A	ITMS fiber optic cable relocation and other
	1B	Other utility coordination
	Section 1	ITMS/Traffic power feed coordination Key project element to ensure sufficient right-of-way is acquired for the project, both permanent and temporary needs. Temporary needs also include evaluation of staging areas and concrete batch plant location
Right-of-Way Coordination	Section 1	Signal timing changes and lifting of tolls during SR 1 and US 13 detours
Cooperation with Other Transportation Infrastructure	1B/1D	Adjustments to existing traffic operations based on traffic monitoring during construction

5.2.2 TRANSPORTATION OPERATIONS (TO) STRATEGIES

Demand Management Strategies

There are currently no transit routes in the project area with the exception of Route 1.

Corridor/Network Management Strategies

- Signal Timing/Coordination Improvements: Various signals will be impacted during the detour routes proposed during Section 1 construction. Signal timings should be adjusted at the following intersections during each of the contracts as summarized below:
- Contract 1A – Boyds Corner Road Detour
 - US 301/Summit Bridge Road at Churchtown Road/SR 896/Boyds Corner Road
 - US 301/Summit Bridge Road at Armstrong Corner Road/Marl Pit Road
 - US 13 at SR 896/Boyds Corner Road
- Contract 1B – Southbound US 13 Lane Closures that impact the “Free Ramp” Signal
 - US 13 at “Free Ramp”
- Contract 1B – SR 1 Northbound Detour
 - SR 896/Boyds Corner Road at SR 1 Northbound Ramps
 - SR 896/Boyds Corner Road at SR 1 Southbound Ramps
 - US 13 at SR 896/Boyds Corner Road
 - US 13 at “Free Ramp”
- Contract 1B – SR 1 Southbound Detour
 - SR 896/Boyds Corner Road at SR 1 Southbound Ramps
 - US 13 at SR 896/Boyds Corner Road
 - US 13 at “Free Ramp”
- Contract 1B – SR 1 Northbound and Southbound Detour
 - SR 896/Boyds Corner Road at SR 1 Northbound Ramps
 - SR 896/Boyds Corner Road at SR 1 Southbound Ramps
 - US 13 at SR 896/Boyds Corner Road
 - US 13 at “Free Ramp”
 - US 13 at SR 72
- Contract 1D – US 13 Northbound Detour
 - SR 896/Boyds Corner Road at SR 1 Northbound Ramps
 - SR 896/Boyds Corner Road at SR 1 Southbound Ramps
 - US 13 at SR 896/Boyds Corner Road
 - SR 72 at Northbound SR 1 Ramps
 - US 13 at SR 72
- Contract 1D – US 13 Southbound Detour
 - SR 896/Boyds Corner Road at SR 1 Southbound Ramps
 - US 13 at SR 896/Boyds Corner Road
 - SR 72 at Northbound SR 1 Ramps
 - SR 72 at Southbound SR 1 Ramps
 - US 13 at SR 72

Work Zone Safety Management Strategies

- Temporary Traffic Barrier: Temporary traffic barrier will be provided (where feasible and practical) to provide a physical separation between travel lanes and the adjacent work space.
- Safety Officers – A DeIDOT Safety Officer will conduct periodic work zone inspections. Frequency of inspections will depend upon the type and complexity of work occurring at the time. It is expected that due to the size of the project, the GEC will assign personnel to act as a daily liaison between Traffic Safety and the Project Team to address any issues that arise related to work zone safety and mobility issues and potential changes to the TMP.



- ATSSA-certified field personnel – The contractor’s American Traffic Safety Services Association (ATSSA) certified supervisor should monitor safety and operations in the work zone and coordinate with DeIDOT Construction and DeIDOT’s Safety Officer.
- Portable Changeable Message Signs – PCMSs will be displayed on all approaches to a work zone for 10 days prior to and 14 after the start of construction and for all phase changes. The PCMSs will display the message “New Traffic Pattern” (Screen 1) “Use Caution” (Screen 2).

Traffic/Incident Management and Enforcement Strategies

- Intelligent Transportation System Monitoring: Traffic cameras at the following locations will be used to monitor traffic throughout construction:
 - SR 1 at SR 72 (Wrangle Hill Road)
 - SR 1 and South St. Georges
 - US 13 at SR 896/Boyds Corner Road
 - US 301/Summit Bridge Road at Churchtown Road/SR 896/Boyds Corner Road
- Transportation Management Center (TMC) – DeIDOT’s TMC will coordinate and manage traffic and incident management activities in and around the work zone. Prior to beginning construction, the Contractor should provide the DeIDOT TMC with a current list of contact information for key field and office personnel, including 24-hour emergency phone numbers and an updated construction schedule.
- Coordination with Media – Throughout construction, DeIDOT will coordinate with the media regarding changes to traffic patterns, proposed detour routes, and anticipated delays.
- Uniformed Law Enforcement Officers – Law enforcement officers will be required for all intermittent road closures (less than 15 minutes) throughout all contracts for tie-ins to existing roadways and sign structure erection. In addition, it is anticipated that law enforcement officers will be required during the full roadway closures associated with the SR 1 and US 13 detours. Law enforcement officers may also be needed to provide point control at select intersections that experience poor operations during temporary traffic control operations as directed by DeIDOT.

5.2.3 PUBLIC INFORMATION (PI) AND OUTREACH STRATEGIES

Please refer to Section 5.1.4 for all corridor-wide and section specific Public Information and Outreach Strategies.

5.3 SECTION SPECIFIC STRATEGIES – DESIGN SECTION 2

5.3.1 TRAFFIC CONTROL PLAN (TCP) STRATEGIES

Control Strategies

Control strategies listed in Appendix B of the Work zone Safety Guidelines were considered. The following list includes the control strategies that will be utilized in Section 2:

TABLE 5.3.1.1 Design Section 2 Traffic Control Plan Strategies				
Traffic Control Plan Strategies		Pros	Cons	Location
✓	Construction Phasing/Staging	Identifies overlapping work zone areas and impacts	Construction duration may be lengthened by sequencing to reduce impacts	US 301 mainline, crossings, existing roadways
✓	Temporary Roadway Closures	Duration of construction may be shortened if full roadway closures permitted	Interruption to existing traffic for the duration of closure work (i.e. bridge deck placements)	Proposed US 301 crossings over existing roadways
✓	Lane Shifts or Closures	Maintains existing lane configurations	Reduced roadway capacity due to shifts and closures	Summit Bridge Road

Work Zone Transportation Management Plan



✓	Reduced Lane Widths to Maintain Number of Lanes	Maximize work area and shorten construction duration	Reduced roadway capacity; OS/OW vehicle coordination with Maryland SHA	Summit Bridge Road
✓	Lane Closures to Provide Worker Safety	Provide safer work areas during MOT setup; Standard lane closure to be utilized during specified work hours	Reduced roadway capacity; may need to monitor to keep during specified work hours	Existing roadways
✓	Shoulder Closures to Provide Worker Safety	Provide safer work areas during MOT setup	Reduced roadway capacity; may need to monitor to keep during specified work hours	Summit Bridge Road
✓	Lane Shift to Shoulder/Median to Maintain Number of Lanes	Maintains existing lane configurations	Reduced roadway capacity due to shifts and closures	Summit Bridge Road
✓	Night Work	Maintains roadway capacity during daytime operations; prevent full daytime closures	Increased speeds due to reduced number of vehicles at night; decreased visibility	Proposed US 301 crossings over existing roadways
✓	Work Hour Restrictions for Peak Travel	Maintains roadway capacity during peak operations	Increased construction duration due to limited working hours	Proposed US 301 crossings over existing roadways
✓	Business Access Improvements	Accesses to all businesses and residences within the project limits maintained	Maintains business traffic within reduced capacity work zone area	Summit Bridge Road, existing roadways
✓	Off-Site Detours/Use of Alternate Routes	Reduces construction duration in specific work areas	Increased travel times and delay, potential congestion on proposed detour routes	Armstrong Corner Rd, Summit Bridge Road



Traffic Control Devices

TABLE 5.3.1.2 Design Section 2 Traffic Control Devices		
Temporary Traffic Control Devices	Purpose	Location
✓ Temporary Signals	Maintains existing signal operations during construction; Manages detour volumes if required	Summit Bridge Road and Marl Pit Rd;
✓ Temporary Signs	Routes traffic along detour routes; Warns drivers in advance of construction zone	Existing roadways, proposed detours
✓ Changeable Message Signs (CMS)	Warns drivers in advance of construction zone or lane shifts/closures	Existing roadways, proposed detours
✓ Arrow Panels	Warns drivers in advance of construction zone or lane shifts/closures	Summit Bridge Road
✓ Channelizing Devices	Work zone safety for construction workers	Summit Bridge Road, Bunker Hill Rd
✓ Temporary Pavement Markings	Warns drivers in advance of construction zone or lane shifts/closures	Summit Bridge Road, Bunker Hill Rd
✓ Centerline Rumble Strips	Work zone safety for construction workers	Summit Bridge Road
✓ Flaggers and Uniformed Traffic Control Officers	Work zone safety; Speed Enforcement	Summit Bridge Road, Bunker Hill Rd
✓ Lighting Devices	Work zone safety, visibility	Work zone area



Project Coordination and Innovative Construction Strategies

TABLE 5.3.1.3 Design Section 2 Project Coordination Strategies			
Project Coordination		Purpose	Identified Conflicts
✓	Construction Phasing Coordination with Other Projects	Identify construction projects that may overlap impacts to existing roadways (see Table 2.3)	<p><u>Boyds Corner Road Improvements (FY2016)</u> Description:</p> <ul style="list-style-type: none"> Proposed roadway improvements extend east along Boyds Corner Road (DE 896) from Cedar Lane Road to approximately 500-feet west of US13 (Boyds Corner). Planned improvements include conversion of the existing two-lane roadway to a four-lane divided roadway with 11-foot travel lanes; a 26-foot raised median; 8-foot shoulders; and a ten foot wide bicycle/pedestrian path. Additional signalization for future commercial and residential intersections will also be included. <p>Possible Conflicts:</p> <ul style="list-style-type: none"> DeIDOT currently has completed preliminary plans for the improvements and will engineer final plans once funding becomes available. <p><u>Cedar Lane Road Improvements (FY2017)</u> Description:</p> <ul style="list-style-type: none"> The project is located in southern New Castle County on Cedar Lane Road, just north of Middletown. The southern end point is Bridge 403, which is south of Marl Pit Road, and the northern end point is Boyds Corner Road. Cedar Lane Road will be widened to provide 12-foot travel lanes, 8-foot shoulders, an open ditch drainage system and a 10-foot multi-use path. Intersection Improvements will be made to the intersection of Cedar Lane Road and Marl Pit Road. In addition, bridges 401 and 402 will be replaced. <p>Possible Conflicts:</p> <ul style="list-style-type: none"> Construction is anticipated to begin in FY2015. Cedar Lane Road is a north-south collector running parallel to Summit Bridge Road, and may experience increased volumes under Section 2 construction. Additional signage may be necessary to warn drivers in advance of work zone.
✓	Utilities Coordination	Identify utility conflicts and areas of coordination with adjacent design sections	Ongoing
✓	Right-of-Way Coordination	Identify right-of-way coordination required with adjacent design sections	Ongoing
✓	Cooperation with Other Transportation Infrastructure	Identify conflicts with public transportation routes, nearby airports, etc.	No impacts identified in Semi-Final plan stage

5.3.2 TRANSPORTATION OPERATIONS (TO) STRATEGIES

Demand Management Strategies

The following Demand Management Strategies shall be used during Section 2 construction:

- Transit. There are currently no transit routes in the project area with the exception of DE Route 1.



- Pedestrian Impacts and Detours. There are no existing designated pedestrian routes that have been identified in Section 2 as being impacted by construction.

Corridor/Network Management Strategies

The following Corridor/Network Management Strategies shall be used during Section 2 construction:

Signal Timing/Coordination Improvements.

- In order to facilitate transportation operations along the detour routes for this project, the traffic signals at the following intersections will be verified to have the following modifications:
 - Signal upgrades to DeIDOT TMC (ACTRA connective)
 - Traffic Responsive Systems (i.e. system loops, detection)
 - Signalized Intersections Along Section 2 Detour Routes:
 - o N371 Boyds Corner Road / SR 896 @ Churchtown Road (ACTRA)
 - o N673 Boyds Corner Road / SR 896 @ Cedar Lane Road
 - o N330 Boyds Corner Road / SR 896 @ SR 13 (ACTRA)
 - o N597 SR 13 @ Greylag Road (ACTRA)
 - Signalized Intersections within Section 2 project area:
 - o N215 Summit Bridge Road (Existing 301) @ SR 71 Frogtown Crossing
 - o N680 Summit Bridge Road (Existing 301) @ N. Broad Street
 - o N727 Summit Bridge Road (Existing 301) @ Peterson Road / Doc Levinson Drive (ACTRA)
 - o N556 Summit Bridge Road (Existing 301) @ Bunker Hill Rd (ACTRA)
 - o N702 Summit Bridge Road (Existing 301) @ Marl Pit Rd / Armstrong Corner Rd
 - All signalized intersections within construction area and detours are to be monitored during construction for timing adjustments and capacity concerns.
 - Existing Traffic Monitoring Cameras.
 - Traffic cameras at the following locations will be utilized to monitor traffic conditions in/adjacent to the project area and along the detour route:
 - o Boyds Corner Road / SR 896 @ US Route 13
 - o Summit Bridge Road (Existing 301) @ SR 896, Mt. Pleasant
 - o Summit Bridge Road (Existing 301) @ SR 299
 - o Summit Bridge Road (Existing 301)/SR 71 @ Bethel Church Road, Middletown

DeIDOT Radio Station WTMC, 1380 AM.

- Traveler information will be updated upon information from work zone strategies that will be implemented as part of the transportation operations plan (i.e. existing camera locations, etc).
- Temporary project-specific conditions during construction phasing are to be announced rather than long-term issues. (i.e., broadcast any lane closures/shifts instead of only mentioning the fact that road work is occurring and to expect delays).

Work Zone Safety Management Strategies

The following Work Zone Safety Management Strategies shall be used during Section 2 construction:

Roadway Weather Information System.

- Weather updates for construction work zone and the DeIDOT Radio Station WTMC, 1380 AM.

Speed Management.

- Speed management is identified as a work zone strategy in areas approaching work zone. Speed management will include police enforcement and signage. "Speed Limit/Your Speed" radar trailer signs will be used periodically on a temporary basis in order to retain effectiveness.

Changeable Message Signs.



- Portable changeable message signs (PCMS) will be used as a work zone strategy in the project corridor to provide key information to motorists. PCMS will also be used at decision points on major travel routes in the area to potentially divert traffic to alternate routes.
- PCMS will be used to act as advanced warning signs on roadways leading towards the work zones, or to display other necessary information regarding the work zone conditions to drivers using the roadway. All PCMS must be installed only after DeIDOT's approval through their "Portable Changeable Message Sign Approval Form". This form will be submitted by the Contractor to DeIDOT's Safety Programs Engineer at least 48 hours prior to placement of any device.

Temporary Barrier.

- Temporary traffic barriers will be used to minimize conflicts and provide a physical barrier between the work areas and travel lanes.

Traffic Control Inspection.

- Daily inspection of safety and traffic control devices and operations should be provided to ensure work zone safety. The GEC and DeIDOT construction inspectors are required to complete daily work zone inspections. Traffic Safety will complete periodic work zone inspections. Frequency will depend upon the type of work zone in place.

TMP Monitoring.

- TMP monitoring team should provide onsite monitoring of the transportation operations to ensure compliance with the TMP and provide adjustments if necessary.

Traffic/Incident Management and Enforcement Strategies

The following Traffic Incident Management and Enforcement Strategies shall be used during Section 2 construction:

Transportation Management Center (TMC).

- The TMC will be used to monitor traffic conditions and coordinate response to traffic incidents.

Coordination with the Media.

- DeIDOT will coordinate updates and changes in diversion routes or closures with the media in order to disseminate information as quickly and as widely as possible.

Safety Officer.

- Both DeIDOT and the Contractor will provide a Safety Officer to operate as a contact person for any emergency needs. The Safety Officers will be available 24/7.

5.3.3 PUBLIC INFORMATION (PI) AND OUTREACH STRATEGIES

Please refer to Section 5.1.4 for all corridor-wide and section specific Public Information and Outreach Strategies.



5.4 SECTION SPECIFIC STRATEGIES – DESIGN SECTION 3

5.4.1 TRAFFIC CONTROL PLAN (TCP) STRATEGIES

Temporary Traffic Control Strategies

Control strategies A-N listed in Appendix B of the Work Zone Safety and Mobility Guidelines were considered. The following list includes the control strategies that will be utilized in Section 3:

TABLE 5.4.1.1 Design Section 3 Temporary Traffic Control Plan Strategies		
Traffic Control Plan Strategies		Location/Notes
1	Construction Phasing/Staging	6 major Phases with Staging as shown on MOT Plans.
2	Full Roadway Closures	> Existing US 301 at Strawberry Lane during beam placement > Strawberry Lane (Detour) > Middleneck Road (Detour) > Warwick Road (Detour)
3	Lane Shifts or Closures	Mainline US 301
4	Reduced Shoulder Widths to Maintain Number of Lanes	Mainline US 301
5	Shoulder Closures to Provide Worker Safety	Mainline US 301
6	Lane Shift to Shoulder/Median to Maintain Number of Lanes	Mainline US 301
7	One-Lane, Two-way Operation	Existing mainline US 301 at Strawberry Lane
8	Two-Way Traffic on One Side of Divided Facility (Crossover)	> Temporary southbound crossover in MD > Temporary northbound crossover in MD > Temporary NB & SB near existing Warwick Road in DE
9	Ramp Closures/Relocation	Existing Truck Weigh Station, Levels Road interchange
10	Night Work	Strawberry Lane bridge and mainline US 301 culverts
11	Work Hour Restrictions for Peak Travel	Mainline US 301
12	Business Access Improvements	Existing mainline US 301, Warwick Road
13	Off-Site Detours/Use of Alternate Routes	Strawberry Lane, Middleneck Road, Warwick Road
14	Temporary Traffic Signal	Existing US 301 at Warwick Road and Levels Road
15	Temporary Speed Reduction	Mainline US 301 at crossovers in MD.

Temporary Traffic Control Devices

TABLE 5.4.1.2 Design Section 3 Temporary Traffic Control Devices		
Traffic Control Devices		Location
1	Temporary Signs	US 301 mainline, crossings, existing roadways
2	Changeable Message Signs (CMS)	US 301 mainline, crossings, existing roadways
3	Arrow Panels	US 301 mainline
4	Channelizing Devices	US 301 mainline, crossings, existing roadways
5	Temporary Pavement Markings	US 301 mainline, crossings, existing roadways
6	Flaggers and Uniformed Traffic Control Officers	US 301 mainline, crossings, existing roadways
7	Temporary Traffic Signals	Existing US 301 at Warwick Road and Levels Road
8	Lighting Devices	Strawberry Lane bridge and mainline US 301 culverts

Project Coordination and Innovative Construction Strategies

Contract 28-128-04, US 301 from N444, Middle Neck Road to N58 Peterson Road was completed in 2011. The improvements completed under this contract have been incorporated as existing features in Section 3 plans.

Coordination is required with Section 2 during borrow site operations, Levels Road interchange construction, and transfer of responsibilities at the end of Section 3, Phase 6 construction.

5.4.2 TRANSPORTATION OPERATIONS (TO) STRATEGIES

Demand Management Strategies

There are currently no transit routes in the project area with the exception of SR 1.

Corridor/Network Management Strategies

Signal timings at signalized intersections on the existing 301 corridor throughout the work zone should be monitored and adjusted as needed to optimize traffic flow and minimize delay.

A temporary traffic signal will be installed at the intersection of 301 and Warwick Road during Phase 2 construction to mitigate the increase in delay expected with the implementation of detours. The traffic signal warrant analysis for this location can be found in Appendix C.3.

The existing traffic signal at the intersection of Levels Road and 301 will be modified in Phase 1 to accommodate construction traffic entering/exiting the project. This signal will be modified as noted on the signal plans during Phase 1, Phase 2A, and Phase 2B. The signal will be in a final configuration at the end of Phase 2B.

Work Zone Safety Management Strategies

The following safety management strategies should be implemented during construction:

- A work zone speed limit will be implemented to encourage reduced speeds throughout the work zone in Maryland in association with the temporary crossover geometry. The existing posted speed will remain in place within Delaware work zone with advisory signage for the temporary crossover.
- Temporary traffic barriers will be used to minimize conflicts and provide a physical barrier between the work areas and travel lanes.
- Daily inspection of safety and traffic control devices and operations should be provided to ensure work zone safety.
- A TMP monitoring team should provide onsite monitoring of the transportation operations to ensure compliance with the TMP and provide adjustments if necessary.

Traffic/Incident Management and Enforcement Strategies

The following incident management and enforcement strategies should be implemented during construction:

- Use of police presence in the work zone to provide immediate response to work zone incidents and provide enforcement of work zone speed limits.
- Use of the DeIDOT TMC to coordinate and manage traffic and incident management activities around the work zone.
- Coordination with the local media to alert public of delays and/or incidents in the work zone.
- Haul road crossings
 - The major earthmoving operations are to occur off of existing 301, out of the work zone clear zone. Material will be transported on the proposed Warwick Road alignment, cross at the Warwick Intersection, and down the proposed southbound lanes. Haul road crossings are identified on the Construction Phasing Plans.
 - Haul road crossings are planned to occur at off-peak daytime hours under control of flagging operations.
 - Haul road crossings along existing 301 shall not occur simultaneously which should limit traffic impacts.



5.4.3 PUBLIC INFORMATION (PI) AND OUTREACH STRATEGIES

Please refer to Section 5.1.4 for all corridor-wide and section specific Public Information and Outreach Strategies.





CHAPTER 6

TMP MONITORING REQUIREMENTS





6.0 TMP MONITORING REQUIREMENTS

6.1 INTRODUCTION

This chapter contains DeIDOT's policies, standards, requirements and procedures for TMP implementation and monitoring on the US 301 project. It also details the methods for monitoring the TMP performance, approaches for corrective action, when the TMP requirements are not met, and the process for submission and approval of alternate TMPs.

6.2 PROCESS FOR MONITORING TMP PERFORMANCE – CORRIDOR WIDE

Safety and mobility in the work zone will be continuously monitored during the construction phase. Construction activities will be monitored to ensure that individual TMP strategies are operating as anticipated. In addition, overall performance of the work zones and work zone impacted areas will be monitored.

6.2.1 Work Zone Inspections

Work zone inspections will be conducted daily by DeIDOT's Construction Inspector to ensure that the work zone traffic control devices are installed and maintained according to this TMP and the Construction Phasing Plans. DeIDOT Safety Section will conduct periodic inspections depending upon the scale of the Temporary Traffic Control (TTC) in place. A copy of the completed inspection report will be sent to the DeIDOT Project Supervisor. Deficiencies will be corrected by the contractor within the time frames approved by the District Safety Officer and the Project Supervisor. The TMP and the Construction Phasing Plans will be revised as needed based on the results of the inspections.

Each Contractor is responsible for conducting routine inspections of the temporary traffic control set-ups. Each contractor is required to have an American Traffic Safety Services Association (ATSSA) certified traffic control supervisor on the project. The ATSSA certified traffic control supervisor's responsibilities include the installation, operation, maintenance and service of traffic control devices. The supervisor will fill out a daily maintenance of traffic log to record MOT activities. The daily MOT log will be submitted to DeIDOT's Project Supervisor and the District Safety Officer on a daily basis. The supervisor will notify the TMC on a daily basis of any lane closures/restriction before they are implemented and after they are complete.

The ATSSA certified traffic control supervisor will also coordinate with the TMC to provide updated information regarding the closures and detours.

The GEC will conduct travel time runs along all detour routes at the beginning of every major road closure. All major roadway closures and detour routes will be monitored by the TMC using traffic cameras.

Based on the results of the inspection, the contractor needs to determine if any repairs, restriction modifications, additions or removal of equipment are required to the existing work zone setup. These issues need to be addressed as soon as possible and modifications completed in a timely fashion to minimize impacts to the motorists.

6.2.2 Work Zone Crashes

Upon notification from the Contractor of a crash in a work zone, DeIDOT's District Safety Officer will respond to the location to review the crash and investigate if any of the temporary traffic control setup in the work zone was a contributing factor to the crash. Revisions to the work zone setup may be made based on the findings of this analysis.

Additionally, the SDC/Contractor will review crash data every quarter for the project area to identify if there are any trends that indicate that a work zone may be a primary factor contributing to the crashes. If trends are noted, the GEC will work with DeIDOT and the Contractor to identify potential improvements to the work zone setup to reduce future crash potential.



6.2.3 Signalized Intersections – Method of Verification

Queue lengths at intersections will be qualitatively inspected on an as needed basis (typically, weekly) by the designated GEC's on-site traffic manager (certified by ATSSA); and measures will be taken accordingly, if necessary, based on the findings.

6.2.4 Monitoring Requirements for SR 1, US 301, Boyds Corner Road, and other active long term detour routes

A detailed monitoring program will be developed by DeIDOT, FHWA and the US 301 GEC team as needed before the beginning on construction along these roadways.

6.3 POST CONSTRUCTION REVIEW

The "Post Construction Review Form" from Figure 4 in DeIDOT's "Work Zone Safety and Mobility Procedures" will be completed by DeIDOT/GEC as part of the post construction review for each construction contract.



6.4 DESIGN SECTION 1 – MONITORING REQUIREMENTS

6.4.1 Monitoring Requirements:

During detours, lane closures, and other work zone activities that impact the traveling public, the following will be monitored to ensure that the TMP strategies are operating as anticipated:

Intersections/Toll Plazas

- Contract 1A – Boyds Corner Road Detour
 - US 301/Summit Bridge Road at Armstrong Corner Road/Marl Pit Road – If southbound left-turn queues extend beyond the left-turn lane and block through traffic, signal timings should be adjusted to provide more green time for the left-turn phase.
 - US 13 at Marl Pit Road – If eastbound Marl Pit Road motorists turning onto US 13 experience average delays exceeding 50 seconds (LOS F threshold), the use of law enforcement officers should be considered.
- Contract 1B – Southbound US 13 Lane Closures that impact the “Free Ramp” Signal
 - US 13 at “Free Ramp” – If southbound through queues extend to the ramp from Lorewood Grove Road, revising the allowable off-peak work hours should be considered.
- Contract 1B – SR 1 Northbound Detour
 - SR 896/Boyds Corner Road at SR 1 Northbound and Southbound Ramps and US 13 at SR 896/Boyds Corner Road – If westbound Boyds Corner Road queues between the three intersections extend through upstream intersections, blocking motorists’ ability to turn during their phase (i.e., when green), consideration should be given to adjusting signal timings, manually controlling the signals, and/or the use of uniformed law enforcement officers.
 - US 13 at “Free Ramp” – If northbound left-turn queues extend to the Port Penn Road intersection, consideration should be given to detouring northbound left-turning motorists to the US 13 at SR 72 intersection to access northbound SR 1 and/or the use of uniformed law enforcement officers.
- Contract 1B – SR 1 Southbound Detour
 - SR 896/Boyds Corner Road at SR 1 Southbound Ramps and US 13 at SR 896/Boyds Corner Road - If eastbound Boyds Corner Road queues between the US 13 and the SR 1 Southbound Ramps intersection extend through upstream intersections (i.e., US 13 at SR 896), blocking motorists’ ability to turn during their phase (i.e., when green), consideration should be given to adjusting signal timings, manually controlling the signals, and/or the use of uniformed law enforcement officers.
 - US 13 at “Free Ramp” – If southbound through queues extend to the ramp from Lorewood Grove Road, signal timing adjustments and/or the use of uniformed law enforcement officers to control the intersection should be considered.
- Contract 1B – SR 1 Northbound and Southbound Detour
 - SR 896/Boyds Corner Road at SR 1 Northbound and Southbound Ramps and US 13 at SR 896/Boyds Corner Road – If eastbound and westbound Boyds Corner Road queues between the three intersections extend through upstream intersections, blocking motorists’ ability to turn during their phase (i.e., when green), consideration should be given to adjusting signal timings, manually controlling the signals, and/or the use of uniformed law enforcement officers.
 - US 13 at SR 72 – If northbound left-turn queues extend out of the left- turn lane and block the through lanes, consideration should be given to providing more green time for the left-turn phase, manually controlling the signal, and/or the use of uniformed law enforcement officers.
- Contract 1D – US 13 at Port Penn Road Lane Closures
 - US 13 at Port Penn Road – If average delays on the Port Penn Road approach exceed two minutes, consideration should be given to implementing the detour planned during Sub-phase 3A.

Major Roadways

- Contract 1A – Boyd Corner Road Flagging Operation and Temporary Closures
- If the flagging operation and temporary closures cause westbound queues to extend beyond Cedar Lane Road or eastbound queues to extend beyond Ratledge Road, consideration should be given to modifying the allowable off-peak work hours.
- Contract 1B/D – US 13 Lane Closures



- Allowable work hours are proposed when it is anticipated that queues will not develop on the approaches to the lane closures; however, if queues exceed ½ miles, consideration should be given to modifying the allowable off-peak work hours.
- Contract 1B – SR 1 Lane Closures
- Allowable work hours are proposed when it is anticipated that queues will not develop on the approaches to the lane closures; however, if queues exceed ½ miles, consideration should be given to modifying the allowable off-peak work hours.

Local Roadways

- **Contract 1A - Jamison Corner Road Flagging Operation** – Due to low volumes it is not anticipated that queues will be significant; however, if queues exceed ½ miles, consideration should be given to modifying the allowable off-peak work hours.

Crash Data

- **All Contracts** – The GEC will conduct periodic reviews of crash data during construction within the limits of each contract.



6.5 DESIGN SECTION 2 – MONITORING REQUIREMENTS

6.5.1 Monitoring Requirements:

The following monitoring requirements are to be implemented for Design Section 2:

Process for monitoring TMP performance

At a minimum, ensure the following:

- Messages on VMS and portable changeable message boards are easy to understand and follow
- Detour signs are properly positioned, clear and easy to follow
- Traffic delay levels are not excessive, based upon the following:
 - Delays at traffic signals are no longer than two cycles
 - No “spillback” of traffic in which queues block intersections or turning lanes
- Monitor crash data on a quarterly basis throughout the project.
- Keep a field log of observations as part of the process for monitoring TMP performance.

Approach for corrective action when TMP performance requirements are not met

When TMP performance requirements mentioned above are not met, the following corrective actions will be implemented:

- Notify DelDOT’s Project Supervisor, with a copy to the District Safety Officer, to reprogram the messages on VMS and portable changeable message boards to make them easy to understand and follow
- Notify DelDOT’s Project Supervisor, with a copy to the District Safety Officer, to reposition the detour signs so that they are properly positioned, clear and easy to follow.
- Notifications related to signal timing adjustments should be sent to the TMC for consideration via the tmc1@state.de.us with a copy to the District Safety Officer and the GEC. If traffic delays are excessive, send notification to adjust the timings at traffic signals.

Complete Figure 4: Post-Construction TMP Review Form from the Work Zone and Safety Mobility Guidelines as part of the TMP performance and corrective action evaluation.

Intersections

Signalized Intersections along Section 2 Detour Routes to be monitored:

- N371 Boyds Corner Road / DE 896 @ Churchtown Road
- N673 Boyds Corner Road / DE 896 @ Cedar Lane Road
- N330 Boyds Corner Road / DE 896 @ DE 13
- N597 US 13 @ Greylag Road

Signalized Intersections within Section 2 project area to be monitored:

- N215 Summit Bridge Road (Existing 301) @ DE 71 Frogtown Crossing
- N680 Summit Bridge Road (Existing 301) @ N. Broad Street
- N727 Summit Bridge Road (Existing 301) @ Peterson Road / Doc Levinson Drive
- N556 Summit Bridge Road (Existing 301) @ Bunker Hill Rd
- N702 Summit Bridge Road (Existing 301) @ Marl Pit Rd / Armstrong Corner Rd

All signalized intersections noted above within construction area and detours are to be monitored for excessive queue lengths during construction for timing adjustments and capacity concerns.

Major Roadways

- Summit Bridge Road (Existing 301 from Bunker Hill Road to Boyds Corner Road)
- US Route 13 (from Marl Pit Road to Boyds Corner Road)



- Boyds Corner Road (From US Route 13 to Summit Bridge Road)

All major roadways noted above within construction area and detours are to be monitored for excessive queue lengths and delay during construction for timing adjustments and capacity concerns.

Local Roadways

- Bunker Hill Road
- Armstrong Corner Road
- Marl Pit Road
- Old School House Road
- Choptank Road
- Cedar Lane Road

All local roadways noted above within construction area and detours are to be monitored for excessive queue lengths and delay during construction for timing adjustments and capacity concerns.



6.6 DESIGN SECTION 3 – MONITORING REQUIREMENTS

6.6.1 Monitoring Requirements:

The US 301 work zone including key roadways and intersections along proposed detour routes should be closely monitored during construction and detour conditions. The process for monitoring TMP performance should follow the procedures outlined in Section 6.2. If operational or safety concerns develop during construction, the MOT plan should be modified as appropriate.

Intersections

Signalized intersections within the work zone in particular should be monitored and signal timing changes implemented if monitoring indicates excessive delays or queues. Any change to the MOT plan should be coordinated with the Project Supervisor and District Safety Officer. Any changes to traffic signal timings should be coordinated with the District Safety Officer and the DelDOT TMC. The following intersections will experience changes in traffic volumes or traffic flow during detour conditions and should be closely monitored for excessive queuing and delay:

- Existing US 301 and Bunker Hill Road (Signalized)
- Existing US 301 and Levels Road (Signalized)
- Existing US 301 and Warwick Road (Temporary Signal during detours)

Excessive queue lengths can include queues which reach adjacent intersections and interfere with the operation of those intersections. Excessive queues should also include those in which queued vehicles consistently do not clear the signal in two signal cycles. If these conditions are observed then the on-site traffic manager should coordinate remediation measures or contingency plan implementation. Some possible remediation measures that the DelDOT TMC may pursue would be to temporarily modify signal splits to provide additional green time to the approaches on which excessive queuing is observed.

Roadways

In addition to the monitoring of the critical intersections identified above, the detour routes should be driven during peak hours to monitor travel times, inspect signage and document any operational or safety issues which develop during the detours on the local roadways. Crash data should also be monitored to make sure crash rates do not increase due to detoured traffic.

Work Zone Speeds

A reduced speed limit will be posted within the work zone in Maryland. The existing posted speed will remain in place within Delaware work zone with advisory signage for the temporary crossover. Speeds should be monitored and documented during construction. Adjustments to the posted speed limits beyond those approved in the plans may be required based on the prevailing data which is observed during construction.





CHAPTER 7 CONTINGENCY PLAN





7.0 CONTINGENCY PLAN

7.1 EMERGENCY RESPONSE PHONE TREE

The contractor will be required to establish and provide an emergency response telephone tree.

Note: *DelDOT to provide emergency contact information of the Project Supervisor, Project Resident, Area Engineer, Project Engineer, Construction Engineer and Safety Officer at TMC for insertion into the "Emergency Contact Information" table.*

7.2 INCIDENT RESPONSE PLAN

This sections contains a draft Incident Response Plan for all major roadways within the US 301 Study area that may be affected during construction. This plan is currently in a draft stage and will be updated by DelDOT/ GEC as required throughout the construction process

Strawberry Lane Detour

- Duration – 12 months
- Existing Detour: Levels Road - Existing US 301 - Wilson Street (Maryland).
- Incident Location: Levels Road
 - Levels Road between Strawberry Lane and St. Annes Church Road
 - Proposed alternative detour:
 - Green Giant Road – St Annes Church Road – Levels Road – US 301
 - Levels Road between St. Annes Church Road and US 301 - Proposed alternative detour:
 - Levels Road – St. Annes Church Road – Broad Street (SR 71) – Main Street (SR 299) – US 301

Middle Neck Road Detour

- Duration – 12 months
- Possible overlap with Strawberry Road detour for 9 months along US 301
- Existing Detour: Existing US 301 - Bunker Hill Road - Old Telegraph Road
- Incident: Bunker Hill Road between Choptank Road and Old Telegraph Road
 - Proposed alternative detour: Old Telegraph Road - Bohemia Mill Road - Choptank Road

Hyetts Corner Road Detour

- Duration – 37 months
- Existing Detour: Jamison Corner Road - Boyds Corner Road - US 13.
- Incident: Closure/ incident on Jamison Corner Road
 - Proposed alternative detour: Lorewood Grove Road – Ratledge Road – Boyds Corner Road.
- Incident: Closure/incident on Boyds Corner Road between Jamison Corner Road and US 13
 - Proposed alternative detour: Jamison Corner Road – Boyds Corner Road - Summit Bridge Road – Marl Pit Road – US 13.

Summit Bridge Road Detour

- Short term, night time closures
- Conflict/ Overlap with Hyetts Corner Road detour
- Existing Detour: Marl Pit Road – US 13 – Boyds Corner Road
- Incident location: Marl Pit Road
 - Marl Pit Road between US 301 and Cedar Lane
 - Proposed alternative detour:
 - Summit Br. Road – SR 71 – Cedar Lane Road (?) – Marl Pit Road – US 13 – Boyds Corner Road – Summit Bridge Road (OR)

- Existing US 301 – SR 71 – Main Street – US 13 – Boyds Corner Road – Summit Br. Road
- Marl Pit Road between Cedar Lane and US 13
Proposed alternative detour:
 - Marl Pit Road – Cedar Lane Road (?) – SR 71 - Main Street – US 13 – Boyds Corner Road – Summit Br. Road (OR)
 - Summit Br. Road – SR 71 – Main Street – US 13 – Boyds Corner Road – Summit Br. Road
- Incident location: Boyds Corner Road
 - Boyds Corner Road between US 301 and Jamison Corner Road
Proposed alternative detour:
 - Local Traffic Only - Summit Br. Road – Lorewood Grove. Rd – Jamison Cr. Rd – Boyds Corner Road
 - Boyds Corner Road between Jamison Corner Road and US 13
 - Local Traffic Only – Summit Br. Road – Boyds Corner Road – Jamison Corner Road – Lorewood Grove Road – US 13 – Marl Pit Road

Armstrong Corner Road Detour

- Short term, night time closures
- Existing Detour: Bunker Hill Road – Choptank Road – Old School House Road
- Incident location: Choptank Road
 - Choptank Rd between Bunker Hill Rd and Bohemia Mill Rd
Proposed alternative detour
 - Bunker Hill Road – Old Telegraph Road – Bohemia Mill Road – Choptank Road – Old School House Road
 - Choptank Rd between Bohemia Hill Rd and Old School House Road
Proposed alternative detour
 - Bunker Hill Road – Choptank Road – Bohemia Mill Road – Old Telegraph Road – Churchtown Road
- Incident location: Old School House Road
Proposed Alternative Detour
 - Bunker Hill Road – Choptank Road – Churchtown Road – Summit Bridge Road

Marl Pit Road Detour

- Short term, night time closures
- Detour Route TBD (waiting on signed plans for Section 2B)

SR 1 Northbound & Southbound Detours

- Short term, night time closures: ~ 15 nights between 12th and 24th months of construction.
- Existing Detour: US 13 NB & SB
- Incident Location: US 13 NB/ SB
Proposed Alternative Detour
 - Boyds Corner Road – Summit Bridge Road – US 40 to SR 1? (OR)
 - Boyds Corner Road – Summit Bridge Road – I-95 – SR 1?
 - Boyds Corner Road – Summit Bridge Road – Porter Road – SR 72 – SR 1?
- Refer to existing US 13 detour plans??

SR 896 (Boyds Corner Rd) Detour

- Short term, night time closures – 6 nights between 12th and 18th months of construction.
- Existing Detour: Summit Bridge Road – Marl Pit Road - US 13 – Boyds Corner Road
- Incident Location: Summit Bridge Road
 - Summit Br. Rd between Marl Pit Road and Old School House Road



Proposed alternative detour

- Summit Br. Rd – Old School House Road – Choptank Road – Armstrong Corner Road – Marl Pit Road – US 13 – Boyds Corner Road (OR)
- Boyds Corner Road – Churchtown Road – Choptank Road – Armstrong Corner Road – Marl Pit Road – US 13 – Boyds Corner Road
- Summit Br. Rd between Boyds Corner Rd and Old School House Road

Proposed alternative detour

- Churchtown Road – Choptank Road – Armstrong Corner Road – Marl Pit Road – US 13 – Boyds Corner Road (OR)
 - Churchtown Road – Choptank Road – Old School House Road – Summit Br. Road – Marl Pit Road – US 13 – Boyds Corner Road
- Cannot occur simultaneously with Summit Bridge Road detour.

US 13 south of Port Penn Road detour

- a. To be updated when Section 1 D PS&E plans are submitted.

Warwick Road Detour

- Duration: 2 weeks
- Existing Detour: Old Telegraph Road – Middle Neck Road – New Warwick Road
 - Incident Location: Middle Neck Road

Proposed alternative detour

- Old Telegraph Road – Bunker Hill Road – Summit Br. Road – New Warwick Road??

US 13 at Port Penn Road Detour

- A few off-peak hour closures during 15-18 months of construction
- To be updated when Section 1 D TMP is submitted in March 2015.

All US 301 Traffic is shifted to new SB Lanes

- *Incident:* Lane closures due to an incident
- Contingency Plan: Shift traffic back to existing US 301 lanes

DRAFT





**Appendix A
TMP UPDATES**



Section 1



Section 2



Section 3



Appendix B CRASH DATA



Section 1



Section 2



Section 3



Appendix C

TRAFFIC DATA ANALYSES



Section 1



Section 2



Section 3



Appendix D
CONSTRUCTION PHASING PLANS



Section 1



Section 2



Section 3