

TRANSPORTATION MANAGEMENT PLAN

REHABILITATION OF I-95 FROM I-495 TO NORTH OF BRANDYWINE RIVER BRIDGE (T201407404)

PREPARED FOR:



PREPARED BY:

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February 27, 2018

Recommended

Approved - Safety

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Appendix A. Wilmington Viaduct Traffic Study (May 2015)

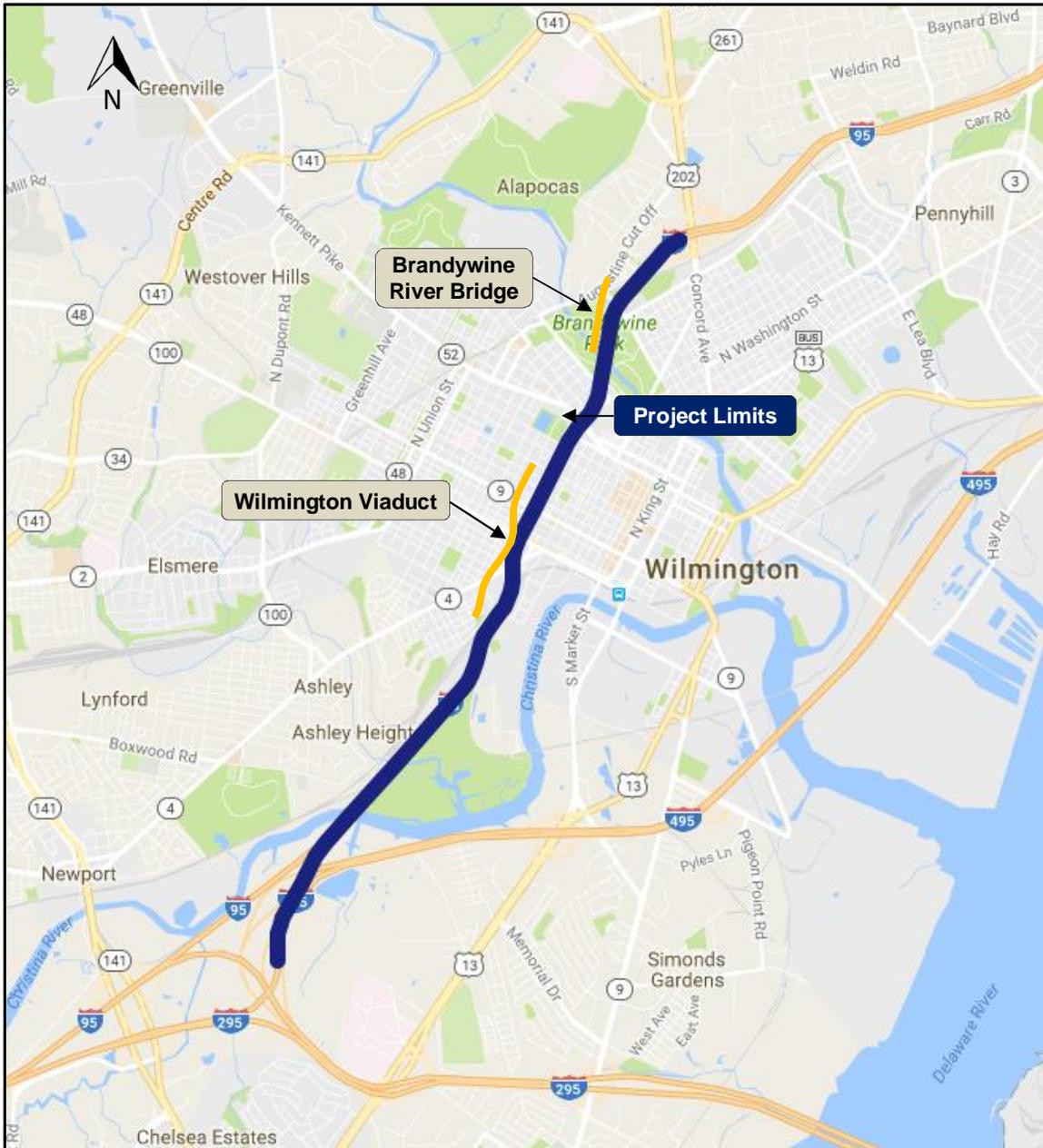
Appendix B. Road User Cost Analysis for Christina River Bridge

I. Project Description

A. Project Background

Originally built in 1964, I-95 runs through downtown Wilmington. The Rehabilitation of I-95 from I-495 to North of Brandywine River Bridge will be performed as part of DeIDOT Contract T201407404 and includes the repair of numerous bridges within the project limits including the mile-long Wilmington Viaduct and the Brandywine River Bridge. Project limits are shown in **Figure 1**.

Figure 1 – Project Limits



The goal of this project is to restore and maintain I-95 through the City of Wilmington in a safe and reliable condition. Planned construction includes the repair of nineteen bridges, I-95 pavement, and ramps within the project limits. The scope of work includes:

- Removing and replacing the top 2” protective layer of concrete on the bridge decks to maintain the integrity of the underlying structural concrete
- Replacing the concrete traffic barriers and roadway expansion joints
- Painting the bridges
- Completing other steel and concrete repairs

In addition, roadway resurfacing and pavement reconstruction on I-95 will also occur within the project limits. I-95 will remain open during this work, but it is anticipated that one lane at a time will be closed to efficiently and safely complete the planned repairs. Closure of all ramps to and from I-95 within the project limits will be required during the planned construction, but the closure will be sequenced to maintain access to/from the City of Wilmington.

In September 2007, the Delaware Department of Transportation (DeIDOT) adopted their *Work Zone Safety and Mobility Procedures and Guidelines* in compliance with Federal Highway Administration regulations. DeIDOT’s guidelines require the development of a Transportation Management Plan (TMP) for all projects that occur along state-maintained roadways. Because the I-95 Wilmington Viaduct project is on an interstate route and will occupy I-95 for more than three consecutive days with lane closures, this project is considered to be “significant” based on DeIDOT’s guidelines and, as a result, this project requires a Type B TMP.

B. Proposed Construction Phasing

A traffic control plan (TCP) has been developed in accordance with the *Delaware Manual on Uniform Traffic Control Devices (DE MUTCD)* to maintain traffic during construction. A summary of the I-95 lane closures and ramp closures by phase is provided in **Table 1**.

The current construction phasing plan predominantly utilizes a contraflow alternative on I-95 through the project limits; however, partial access to opposite-side ramps is maintained via crossovers and collector/distributor roads. This “hybrid” concept was necessary to both allow City of Wilmington access to/from I-95 and provide enough additional capacity so that the phasing plan is feasible.

A prior phasing plan was developed which only included contraflow over the Brandywine River Bridge and single-lane closures on I-95 had been developed in the initial design stage. The current phasing allows for a shorter project duration and a higher-quality product with only moderate delay increases during certain phases, but a lower overall project user cost. The comparison of the two phasing plans is further discussed later in this report.

C. Schedule

According to the project website, design work is tentatively scheduled to end in Spring 2019 and construction will be complete by Spring 2022.

The most recent project schedule estimates a construction period of two years, broken down by phase as follows: Stage 1A – 3 months; Stage 1B – 2 months; Stage 1C – 1 month; Stage 2A – 6 months; Stage 2B – 3 months; Stage 3A – 3 months; Stage 3B – 3 months; Stage 4 – 3 months.

Table 1 – Anticipated Mainline I-95 and I-95 Ramp Construction Phasing

	Project Stage			
	Phase 1A	Phase 1B & 1C	Phase 2A	Phase 2B
I-95	Status	Status	Status	Status
NB South of Viaduct (3-lane section)	Left Lane Closed (3→2)	Left Lane Closed (3→2)	Contraflow (3→2)	Contraflow (3→2)
NB Through City (2-lane section)	Left Lane Closed (2→1)	Left Lane Closed (2→1)	Contraflow with access (2→1)	Contraflow with access (2→1)
NB Brandywine River Bridge (3-lane section)	Left Lane Closed (3→2)	Left Lane Closed (3→2)	Contraflow (3→2)	Contraflow (3→2)
SB Brandywine River Bridge (3-lane section)	Left Lane Closed (3→2)	Left Lane Closed (3→2)	Left Lane Closed (3→2)	Left Lane Closed (3→2)
SB Through City (2-lane section)	Left Lane Closed (2→1)	Right Lane Closed (2→1)	Left Lane Closed (2→1)	Left Lane Closed (2→1)
SB South of Viaduct (3-lane section)	Left Lane Closed (3→2)	Right Lane Closed (3→2)	Left Lane Closed (3→2)	Left Lane Closed (3→2)
I-95 Ramp	Status	Status	Status	Status
NB I-95 off-ramp @ Maryland/MLK (exit 6)	Open, Drop Lane (2→1)	Open, Drop Lane (2→1)	CLOSED	CLOSED
NB I-95 on-ramp @ MLK	Open [acceleration lane]	Open [hard merge]	CLOSED	CLOSED
NB I-95 off-ramp @ Adams ⁹ th (exit 7)	CLOSED	CLOSED	Open, Choice Lane	Open, Choice Lane
NB I-95 on-ramp @ Adams ¹⁰ th	Open, Add Lane (1→2)	Open, Add Lane (1→2)	Open, Add Lane (1→2)	Open, Add Lane (1→2)
NB I-95 on-ramp @ Adams/Delaware	Open [hard merge]	Open [hard merge]	CLOSED	CLOSED
NB I-95 off-ramp @ US 202 (exit 8)	Open	Open	Open	Open
SB I-95 on-ramp @ US 202 SB	Open (ramp 2→1), Add Lane (2→3) [downstream left lane drop]	Open (ramp 2→1), Add Lane (2→3) [downstream right lane drop]	Open (ramp 2→1), Add Lane (2→3) [downstream left lane drop]	Open (ramp 2→1), Add Lane (2→3) [downstream left lane drop]
SB I-95 off-ramp @ Jackson/Gilpin (exit 7B)	Open, Choice Lane	Open, Drop Lane (2→1)	Open, Choice Lane	Open, Choice Lane
SB I-95 off-ramp "flyover" @ 11 th (exit 7A)	Open, Drop Lane (2→1)	CLOSED	CLOSED	Open, Drop Lane (2→1)
SB I-95 on-ramp @ Jackson/Delaware	Open [weave]	CLOSED	Open [hard merge]	Open [acceleration lane]
SB I-95 off-ramp @ Jackson/4 th (exit 6)	Open, Drop Lane (2→1)	Open, Choice Lane	Open, Drop Lane (2→1)	CLOSED
SB I-95 on-ramp "flyunder" @ MLK	Open, Add Lane (1→2)	Open, Add Lane (1→2)	Open to NB, Drop Lane (2→1)	Open to NB, Drop Lane (2→1)
SB I-95 on-ramp @ Jackson/2 nd (Jackson Leg)	Open [hard merge]	Open [hard merge]	Open, Add Lane (1→2)	Open, Add Lane (1→2)
SB I-95 on-ramp @ Jackson/2 nd (2nd St Leg)	CLOSED	CLOSED	CLOSED	CLOSED

	Project Stage		
	Phase 3A	Phase 3B	Phase 4
I-95	Status	Status	Status
NB South of Viaduct (3-lane section)	Left Lane Closed (3→2)	Left Lane Closed (3→2)	3 Lanes Open
NB Through City (2-lane section)	Left Lane Closed (2→1)	Left Lane Closed (2→1)	2 Lanes Open
NB Brandywine River Bridge (3-lane section)	Left Lane Closed (3→2)	Left Lane Closed (3→2)	Left Lane Closed (3→2)
SB Brandywine River Bridge (3-lane section)	Contraflow (3→2)	Contraflow (3→2)	3 Lanes Open
SB Through City (2-lane section)	Contraflow with access (2→1)	Contraflow with access (2→1)	2 Lanes Open
SB South of Viaduct (3-lane section)	Contraflow (3→2)	Contraflow (3→2)	3 Lanes Open
I-95 Ramp	Status	Status	Status
NB I-95 off-ramp @ Maryland/MLK (exit 6)	Open, Drop Lane (2→1)	Open, Drop Lane (2→1)	Open, Drop Lane (3→2)
NB I-95 on-ramp @ MLK	CLOSED	Open [weave]	Open [weave]
NB I-95 off-ramp @ Adams ⁹ th (exit 7)	Open, Choice Lane	Open, Drop Lane (2→1)	Open, Drop Lane (3→2)
NB I-95 on-ramp @ Adams ¹⁰ th	Open, Add Lane (1→2)	CLOSED	Open [acceleration lane]
NB I-95 on-ramp @ Adams/Delaware	Open [hard merge]	Open, Add Lane (1→2)	Open [hard merge]
NB I-95 off-ramp @ US 202 (exit 8)	Open	Open	Open
SB I-95 on-ramp @ US 202 SB	Open (ramp 2→1), Add Lane (2→3) [downstream left lane drop]	Open (ramp 2→1), Add Lane (2→3) [downstream left lane drop]	Open (ramp 2→1), Add Lane (2→3)
SB I-95 off-ramp @ Jackson/Gilpin (exit 7B)	CLOSED	CLOSED	Open, Choice Lane
SB I-95 off-ramp "flyover" @ 11 th (exit 7A)	Open, Drop Lane (2→1+C/D)	Open, Drop Lane (2→1+C/D)	Open, Drop Lane (3→2)
SB I-95 on-ramp @ Jackson/Delaware	Open, [C/D] [weave]	Open, [C/D] [weave]	Open [weave]
SB I-95 off-ramp @ Jackson/4 th (exit 6)	Open, [C/D] Drop Lane	Open, [C/D] Drop Lane	Open, Drop Lane (3→2)
SB I-95 on-ramp "flyunder" @ MLK	CLOSED	Open, [C/D] [merge] C/D+1→2)	Open, Add Lane (2→3)
SB I-95 on-ramp @ Jackson/2 nd (Jackson Leg)	Open, [C/D] [merge] C/D+1→2)	CLOSED	CLOSED
SB I-95 on-ramp @ Jackson/2 nd (2nd St Leg)	CLOSED	CLOSED	CLOSED

II. Existing and Future Conditions

A. Existing Roadway Characteristics

I-95 is a six-lane, limited-access freeway within the project limits, except for a four-lane section that runs through downtown Wilmington, approximately from Maryland Avenue to Delaware Avenue. According to the *2016 Vehicle Volume Summary*, the AADT along I-95 ranges from approximately 116,000 at the north and south project limits down to approximately 75,000 between 9th Street and Delaware Avenue. The posted speed limit is 55 miles per hour.

B. Crash History

The section of I-95 from the northbound Maryland Avenue off-ramp through the northbound Martin Luther King Boulevard on-ramp was included as Site DD of the 2009 Hazard Elimination Program. Remedial signing and striping improvements were recommended, primarily for the ramps within the site limits.

Additionally, crash data at specific locations has been reviewed to guide corresponding design elements within the project. For example, crashes along the southbound on-ramps from Jackson Street and 2nd Street were reviewed as part of the needs analysis to relocate and consolidate the on-ramps and nighttime crash percentages were reviewed to determine continuous lighting needs.

As the design and public involvement efforts progress, additional “spot” crash reviews are anticipated. For example, operations of the 4th Street at Jackson Street/I-95 southbound off-ramp signal were reviewed after safety concerns regarding standing queues on the off-ramp were brought to DeIDOT’s attention. Certain known safety issues have been addressed in the project design; for example, I-95 will be vertically reprofiled in the vicinity of the low-clearance 10th Street bridge due to a history of bridge strikes by overheight vehicles.

C. Traffic Volumes

Substantial analysis of existing I-95 and I-495 traffic volumes was performed for the Wilmington Viaduct Traffic Study, submitted in May 2015 and included at the end of this report as **Appendix A**. The Traffic Study describes traffic characteristics throughout the project area and also describes the technology that will be used to monitor and mitigate traffic issues before and during construction. Available data will include real-time freeway travel times obtained by Bluetooth traffic recorders along I-95, I-495, SR 141, US 13, US 202, SR 2, and SR 4; system loop data along many arterials to assess volume changes; and Wavetronix spot-speed and volume recorders throughout both the interstates and diversion routes. **Figures 2 through 7** provide a sampling of the available data that the Wavetronix devices can provide – I-95 average hourly midweek and weekend traffic volumes by direction at each end of the project limits.

Figure 2 – I-95 at Stadium Drive Midweek Traffic Volumes (North End of Project)

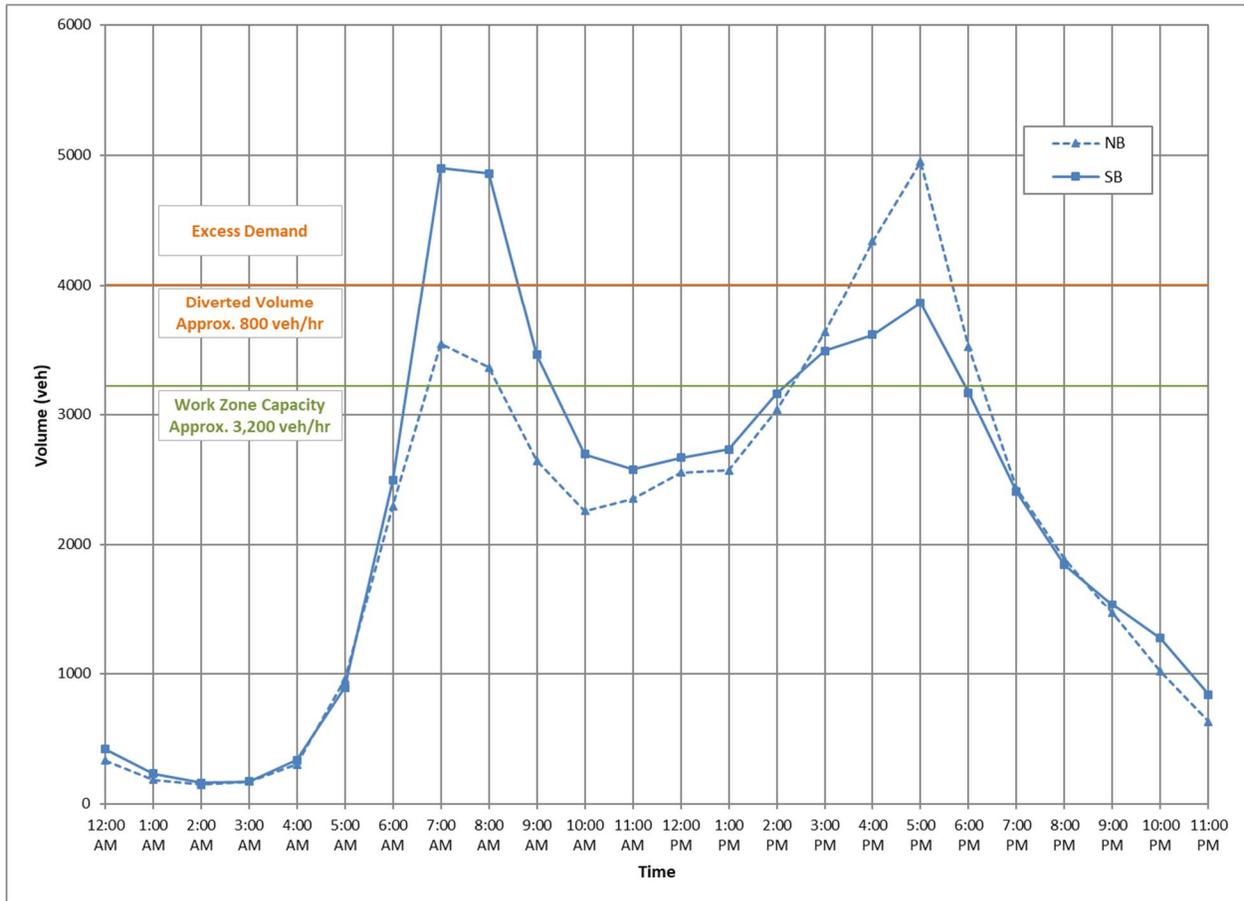


Figure 3 – I-95 at Stadium Drive Weekend Traffic Volumes (North End of Project)

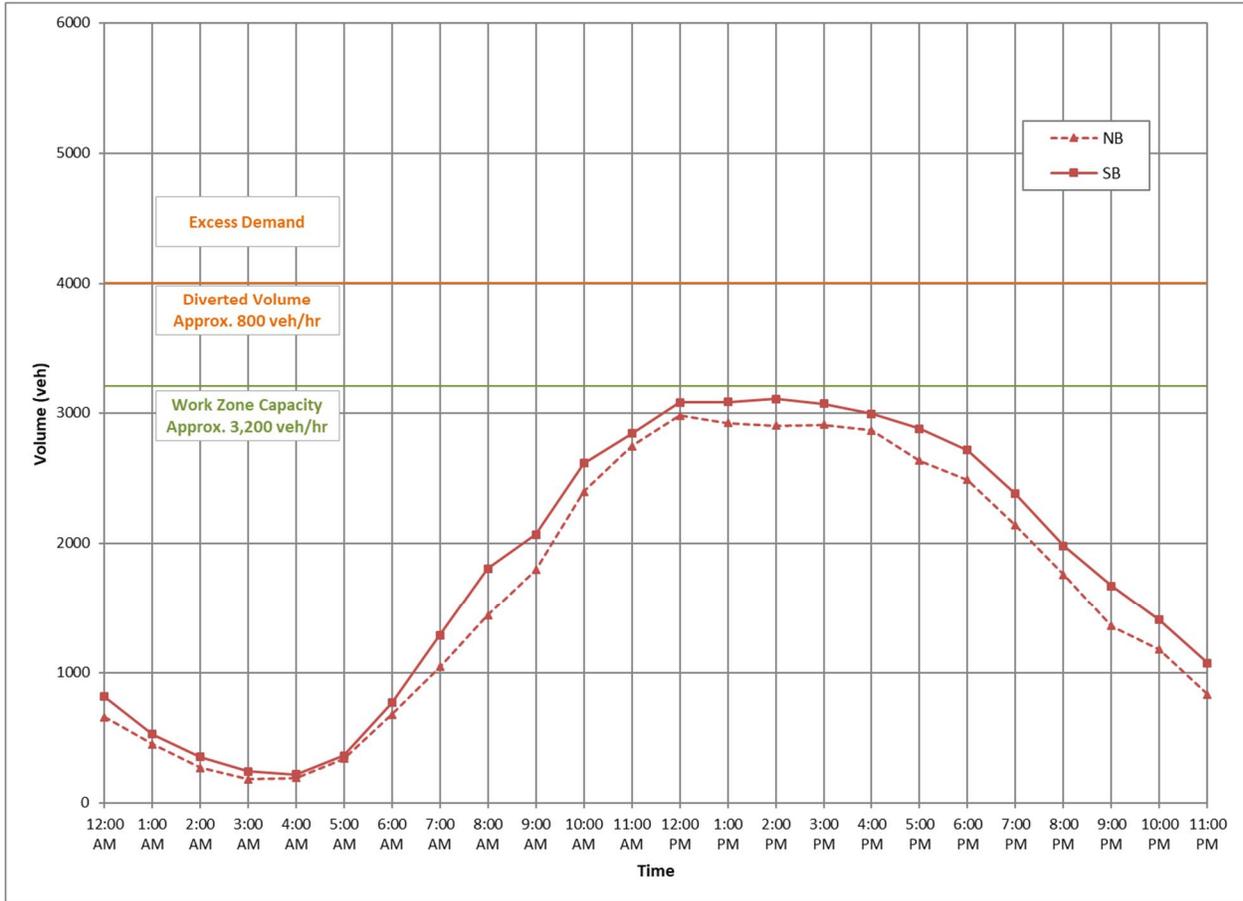


Figure 4 – I-95 at Delaware Avenue Midweek Traffic Volumes (Middle of Project)

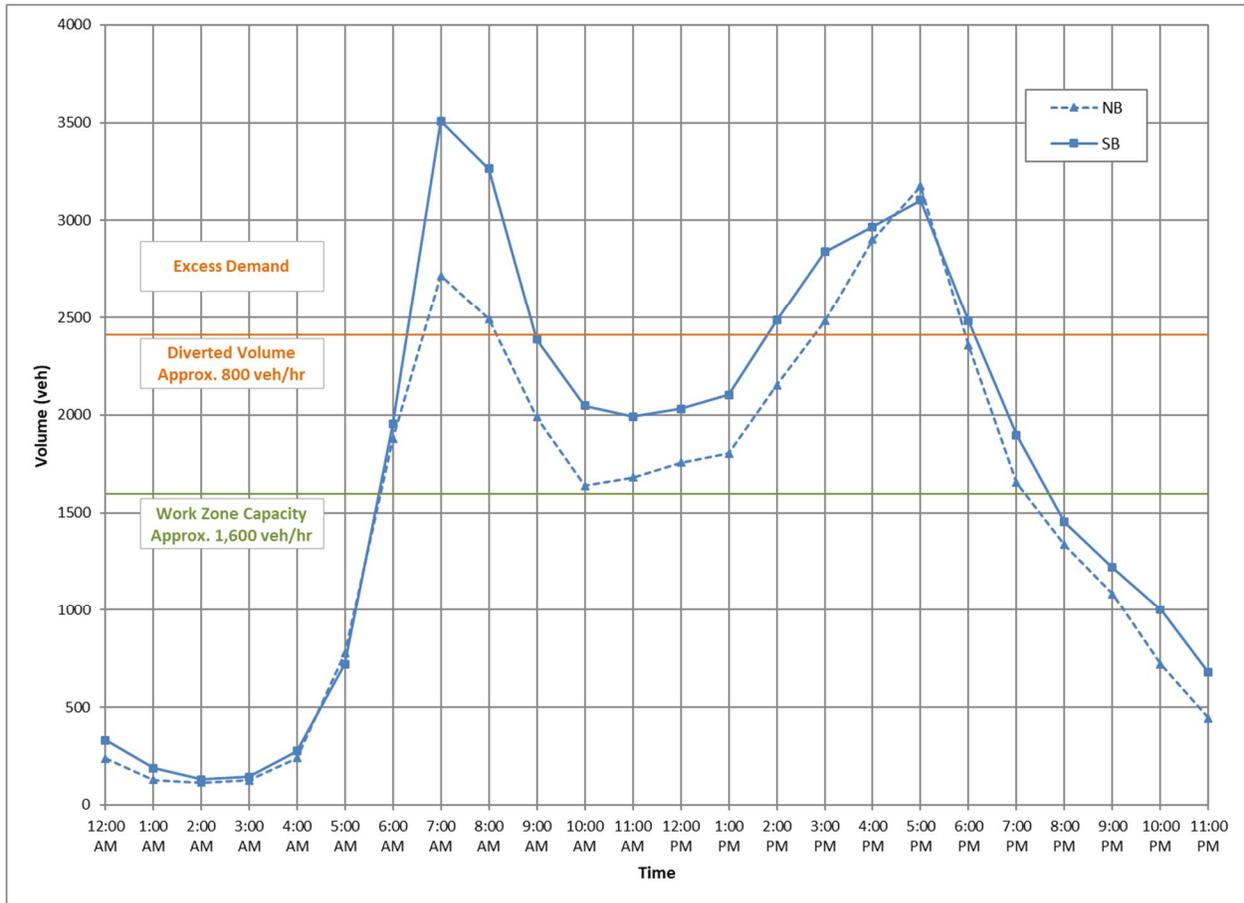


Figure 5 – I-95 at Delaware Avenue Weekend Traffic Volumes (Middle of Project)

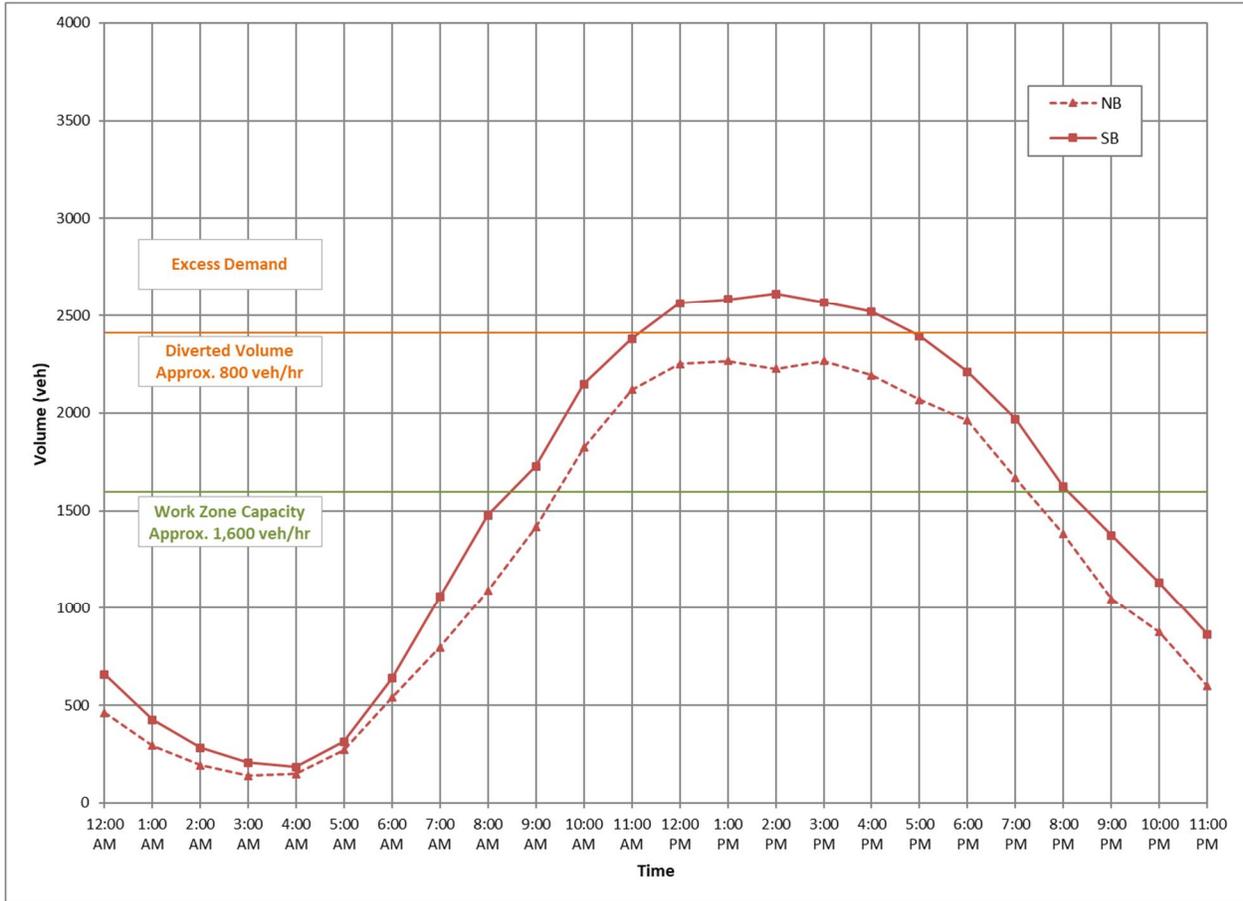


Figure 6 – I-95 at Frawley Stadium Midweek Traffic Volumes (South End of Project)

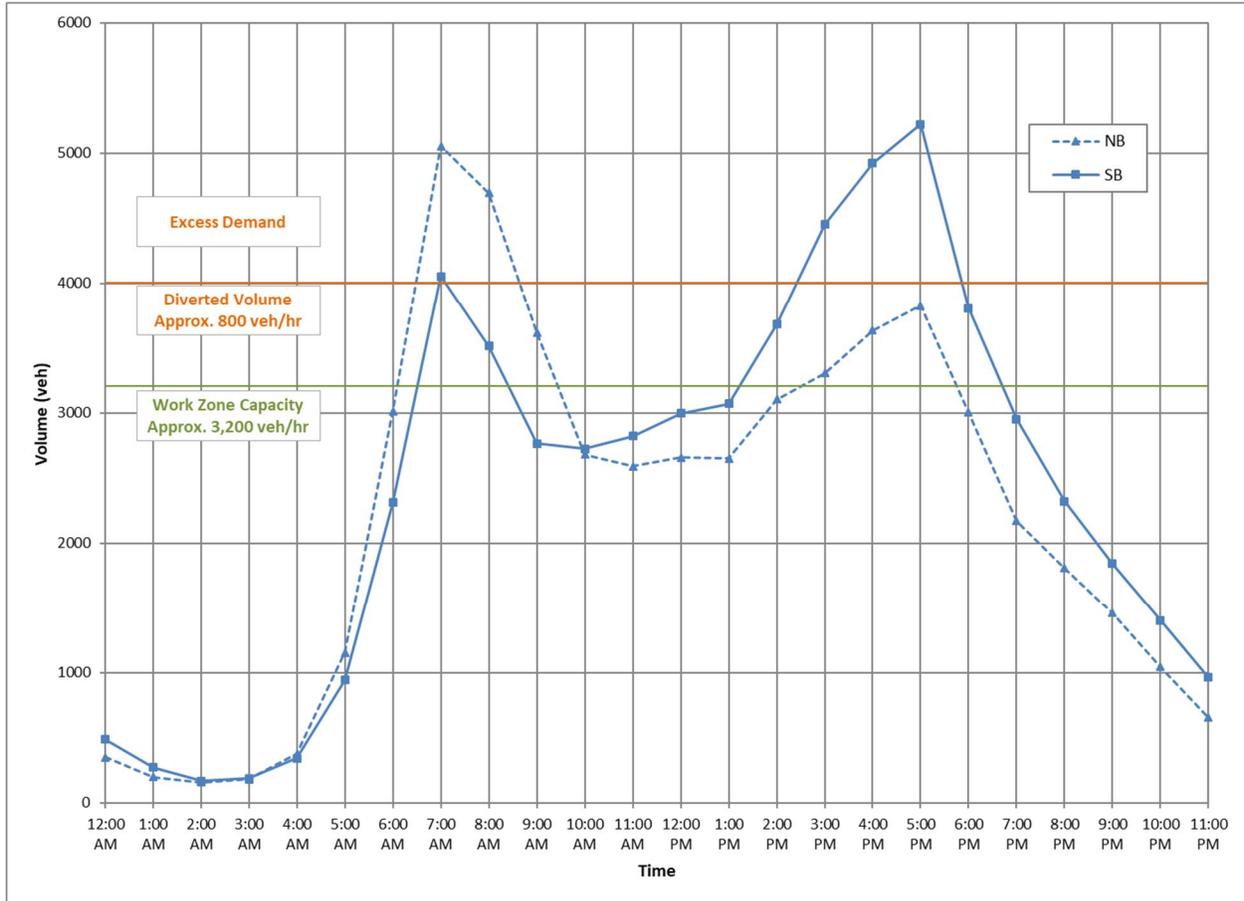
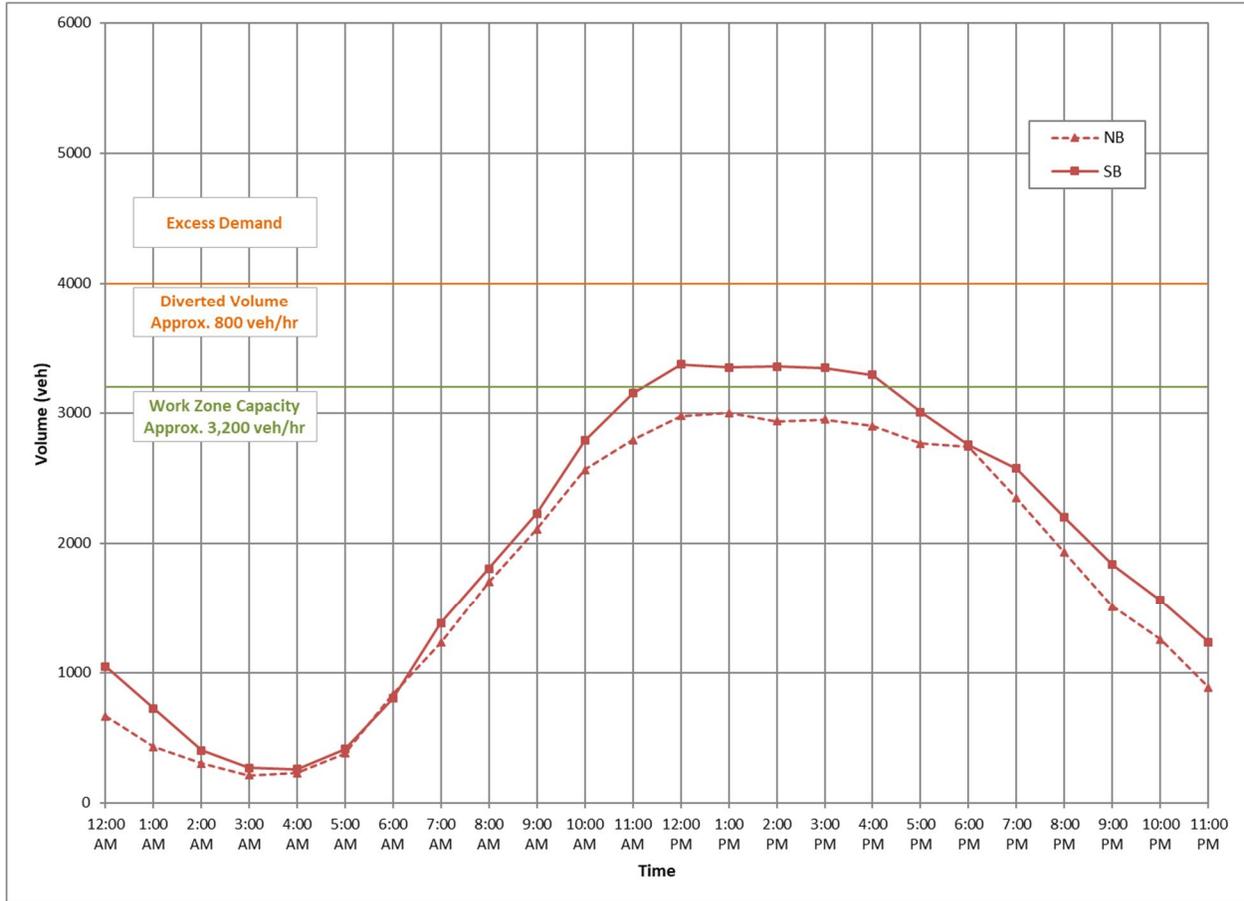


Figure 7 – I-95 at Frawley Stadium Weekend Traffic Volumes (South End of Project)



Typically, a growth factor would be applied to existing traffic volumes when analyzing impacts during a future project; however, as discussed in the Traffic Study, the 2011 Wilmington Downtown Circulation Study indicated that expected growth rates in the city were actually negative. For this reason, no growth rate was applied to the volumes analyzed in 2014.

III. Work Zone Impacts Assessment

A. Selected Alternative

Wilmington Viaduct Traffic Study (2015) and Initial Construction Phasing/TMP Draft (2016)

The Wilmington Viaduct Traffic Study analyzed several MOT alternatives for mainline I-95 including a half roadway closure, contraflow, and sustained single- and double-lane closures (see **Appendix A**). The study concluded that the extent of the roadway user costs associated with the half roadway closure and contraflow alternatives, including the overwhelming and frequent burden on primary and secondary alternate routes and the City of Wilmington's intramobility, are significantly more severe than those using conventional, single lane closures and most likely intolerable to motorists for any extended period of time. Utilizing sustained, single lane closures would permit a construction sequence inclusive of both the Wilmington Viaduct and Brandywine River Bridge rehabilitation, while still providing much-needed capacity on I-95, especially with respect to traffic destined to/from US 202. Although there will be peak periods with I-95 over capacity by relatively low amounts, reasonable demand reductions are anticipated through aggressive, transparent, and real-time public information campaigns and the recommended off-site traffic mitigation projects will help provide additional capacity on several logical diversion routes.

The final design recommendation uses the single lane closure MOT alternative in combination with a "scaled-back" Brandywine River Bridge contraflow during certain construction phases.

As discussed in the Wilmington Viaduct Traffic Study and depicted in **Figure 8**, sensitivity analyses indicate that with a 10 to 15-percent reduction in peak demand (e.g., local arterial diversions, increased transit usage, peak spreading, etc.) capacity problems at the most critical bottlenecks on I-95 would be very manageable, with over-capacity conditions similar to the present levels and minimal backups of about 1 mile during commuting hours. Reasonable demand reductions are anticipated based on the US 202 Bluetooth O/D results, and the I-495 Bridge over the Christina River emergency closure "after" studies indicated 10 to 30 percent of motorists significantly altered, diverted, or eliminated their trips.

Updated Construction Phasing (2017)

Because the estimated project schedule was longer than two years with reduced capacity along I-95, DelDOT requested that a phasing sequence be considered that would allow for a more condensed schedule. Additionally, an opportunity had been identified to utilize the on-ramp from Martin Luther King, Jr. Boulevard to southbound I-95 ("flyunder" ramp) as a contraflow northbound off-ramp during the phases in which northbound traffic was on the southbound side of I-95. The contraflow ramp would require additional construction on Martin Luther King, Jr. Boulevard; however, it would effectively replace the capacity lost due to the loss of access to the northbound I-95 off-ramp to Maryland Avenue. The phasing plans also provide for limited access to certain on- and off-ramps on the closure side of I-95. Although the "full contraflow" alternative analyzed in the 2015 traffic study was deemed infeasible, this "contraflow with access" alternative provides comparable capacity to the single-lane closure alternative with some benefits to schedule duration and construction quality.

A road-user-cost-style impact comparison was prepared to analyze the projected savings of the updated construction phasing with contraflow. Expected diversions had been calculated by phase and by peak hour for each phasing alternative and scheduled phase durations were provided based on the most recent schedule. Thus, an impact measure of "diversion-days" was calculated for each peak hour of each phase. The results are depicted in **Table 2** (estimated durations and phase IDs have changed slightly since the creation of this table). When accounting for duration, the contraflow construction phasing was found to be approximately 14% less impactful than the single-lane closure alternative.

Figure 8 – Sensitivity Analysis of Capacity at Critical Bottlenecks on I-95 during Single Lane Closure

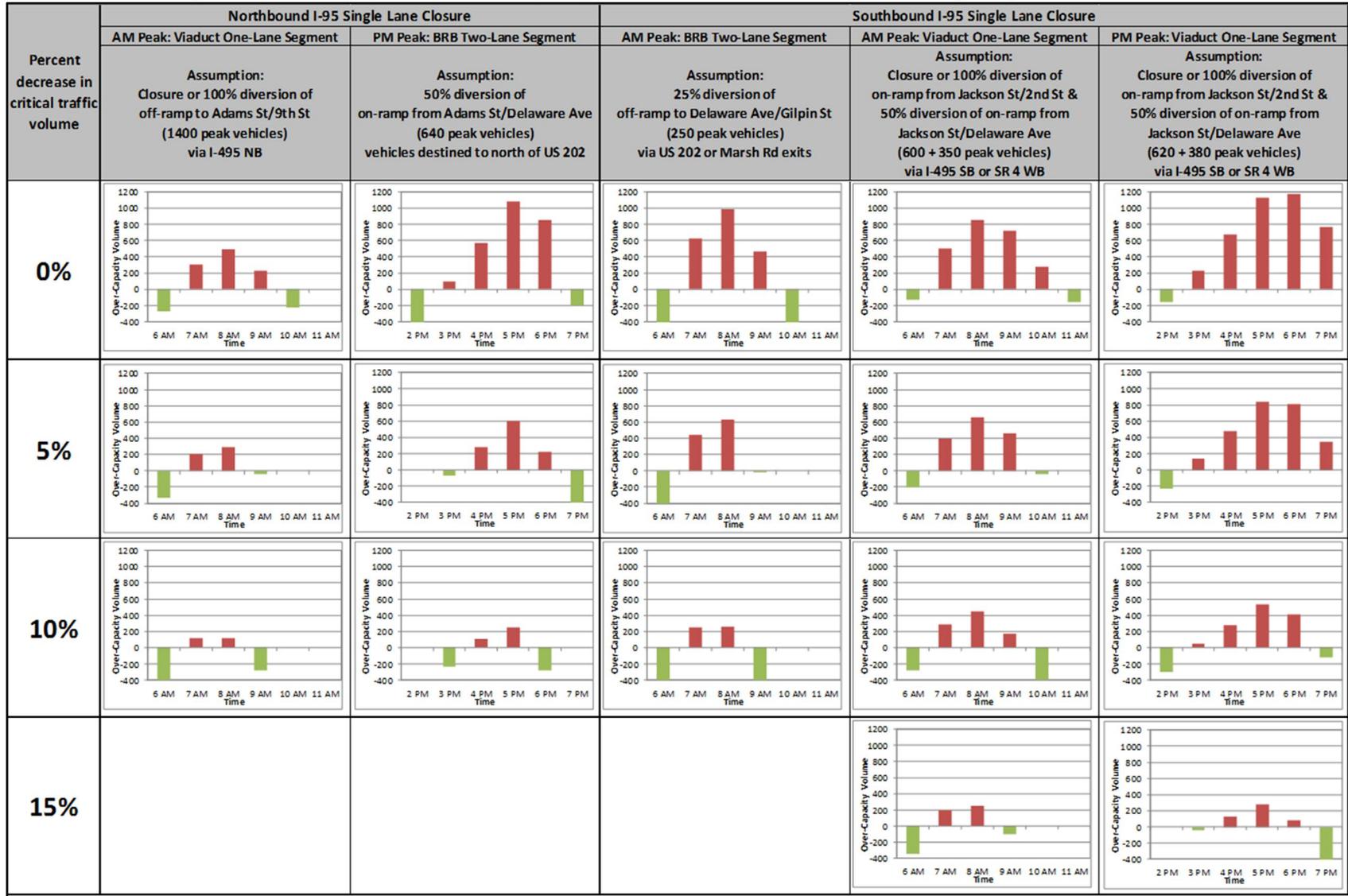


Table 2 – “User Cost” Comparison of Contraflow Phasing vs. Single Lane Closure Phasing

Phasing Alternative	Stage	Peak Hour	Peak Hourly Volume						Total Diversions	Duration (days)	AM & PM Peak Hour Diversion * Days
			Mainline Over Capacity Volume - Likely to Divert		Wilmington Ramp Traffic - Downtown & Local Roadway Diversions						
			NB I-95 ¹	SB I-95 ¹	NB - Downtown Ramp Changes ²	SB - Downtown Ramp Changes ²	NB - Downtown O/D Diverted Outside City ³	SB - Downtown O/D Diverted Outside City ³			
2017 Contraflow with partial ramp access	1B	AM	700	900	310	1,300	1,170	620	5,000	57	285,000
		PM	800	0	800	1,050	200	1,160	4,010		228,570
	2A	AM	500	900	2,190	600	1,150	40	5,380	234	1,258,920
		PM	0	800	1,920	1,110	1,980	360	6,170		1,443,780
	2B	AM	500	200	2,190	1,850	1,150	40	5,930	73	432,890
		PM	0	800	1,920	1,640	1,980	360	6,700		489,100
	3A	AM	400	400	650	840	1,060	400	3,750	163	611,250
		PM	1,200	500	1,700	1,250	0	710	5,360		873,680
	3B	AM	700	400	680	830	1,060	770	4,440	135	599,400
		PM	800	700	720	680	580	560	4,040		545,400
Total (*17 Staging)									662	6,767,990	
2016 Single lane closures with BRB contraflow	2	AM	200	900	290	730	1,420	470	4,010	278	1,114,780
		PM	500	900	750	900	1,380	490	4,920		1,367,760
	3	AM	700	400	480	2,050	1,340	0	4,970	169	839,930
		PM	800	1,200	1,450	1,460	830	0	5,740		970,060
	4	AM	700	900	760	1,330	1,230	770	5,690	192	1,092,480
		PM	800	900	1,120	980	580	560	4,940		948,480
	5	AM	400	600	650	1,560	1,060	400	4,670	150	700,500
		PM	1,200	600	1,700	1,530	0	710	5,740		861,000
	Total (*16 Staging)									789	7,894,990

within two-lane section

¹I-95 peak-hour volume remaining (over 1600 vehicles per lane) at most-critical "pinch point" of each construction stage. Vehicles on I-95 traveling from south of the I-95/I-495 split to north of US 202 (and the reverse) have previously been diverted to I-495 and are not included. The volumes primarily represent origins/destinations within the City of Wilmington or on US 202.

²Diversions of I-95 traffic volume due to on- and off-ramp closures from one downtown ramp to a different downtown ramp. Impacts of diversions will be mostly limited to City streets in the vicinity of I-95. Volumes included in these totals include diversions to/from: Jackson Street, Adams Street, MLK Boulevard, and Maryland Avenue

³Diversions of I-95 traffic volume due to on- and off-ramp closures to or from ramps outside the downtown area. Impacts of diversions will be felt more regionally as most diverted vehicles must cross either the Brandywine River or Christina River on "local" roadways, many of which are already capacity-constrained. Volumes included in these totals include diversions to/from: US 13, SR 141, 12th Street, Terminal Avenue, and US 202.

Analyses were performed on the most impactful construction phases to help approximate delay and queuing estimates on mainline I-95 for future public relations efforts. To provide these estimates, diurnal traffic (daily hourly volume on an average weekday) along I-95 and impacted ramps was distributed throughout the I-95 and I-495 network with assumed diversions and required ramp detours based on ramp closures for each specific phase. The remaining hourly traffic on I-95 was compared to an assumed construction zone capacity of 1,600 vehicles per hour per lane. Volume in excess of this capacity was assumed to cause delay and queuing in proportion to the magnitude of the over-capacity volume. Additionally, a 10-percent overall volume reduction scenario was considered, a reasonable assumption based on the discussion above, which typically reduces the estimated delays and queues to much more manageable values. The proceeding pages and figures depict and discuss the results of this analysis for each construction phase.

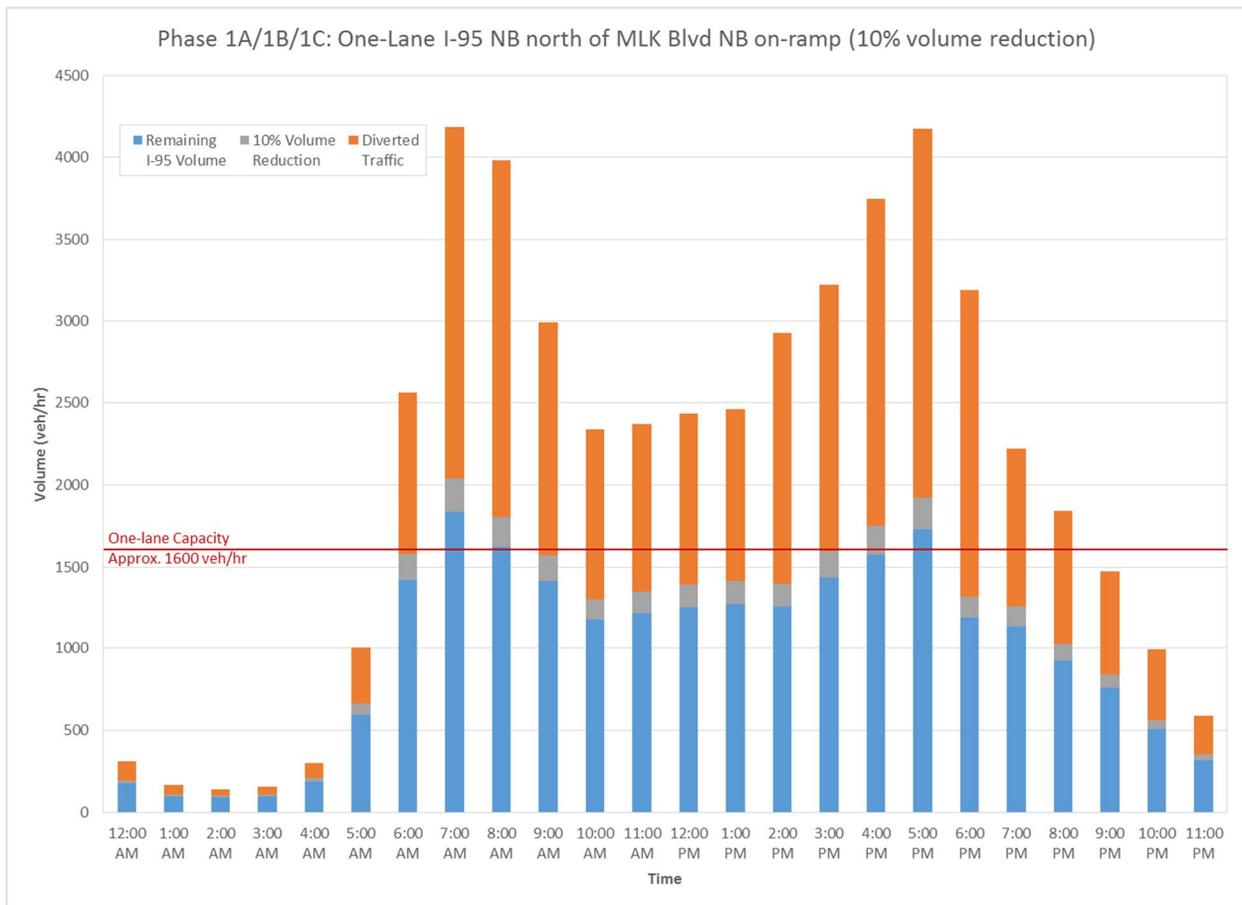
Traffic projections for some phases provide initial delay and queuing estimates that are very high and unlikely to occur during the project. Further analysis and discussion of these values is provided at the end of this section.

Phase 1A, 1B, and 1C Northbound I-95 Impacts

During all of construction Phase 1, the northbound I-95 off-ramp to Adams Street/9th Street will be closed. The detour route will be the Maryland Avenue off-ramp or I-495 to US 13 if the Maryland Avenue off-ramp is over capacity. Additionally, the northbound on-ramp from Martin Luther King, Jr. Boulevard will merge with the northbound I-95 section already reduced to one lane on the Viaduct. This location represents the critical point for northbound traffic during this phase. Some traffic from this on-ramp is expected to divert to use the Adams Street/10th Street on-ramp during peak periods. **Figure 9** depicts the remaining volume expected on I-95 at the critical point and how the 10-percent traffic reduction would affect the over-capacity conditions. The following I-95 mainline summary compares the projected 10-percent diversion scenario to the “worst-case” zero-diversion scenario:

- Anticipated duration: 6 months
- Expected AM peak delay: 10 to 24 minutes
- Expected AM peak queue: 0.9 to 1.8 miles
- Expected PM peak delay: 4 to 11 minutes
- Expected PM peak queue: 0.6 to 1.4 miles

Figure 9 – I-95 Northbound Diurnal Curve, Phase 1A, 1B, and 1C



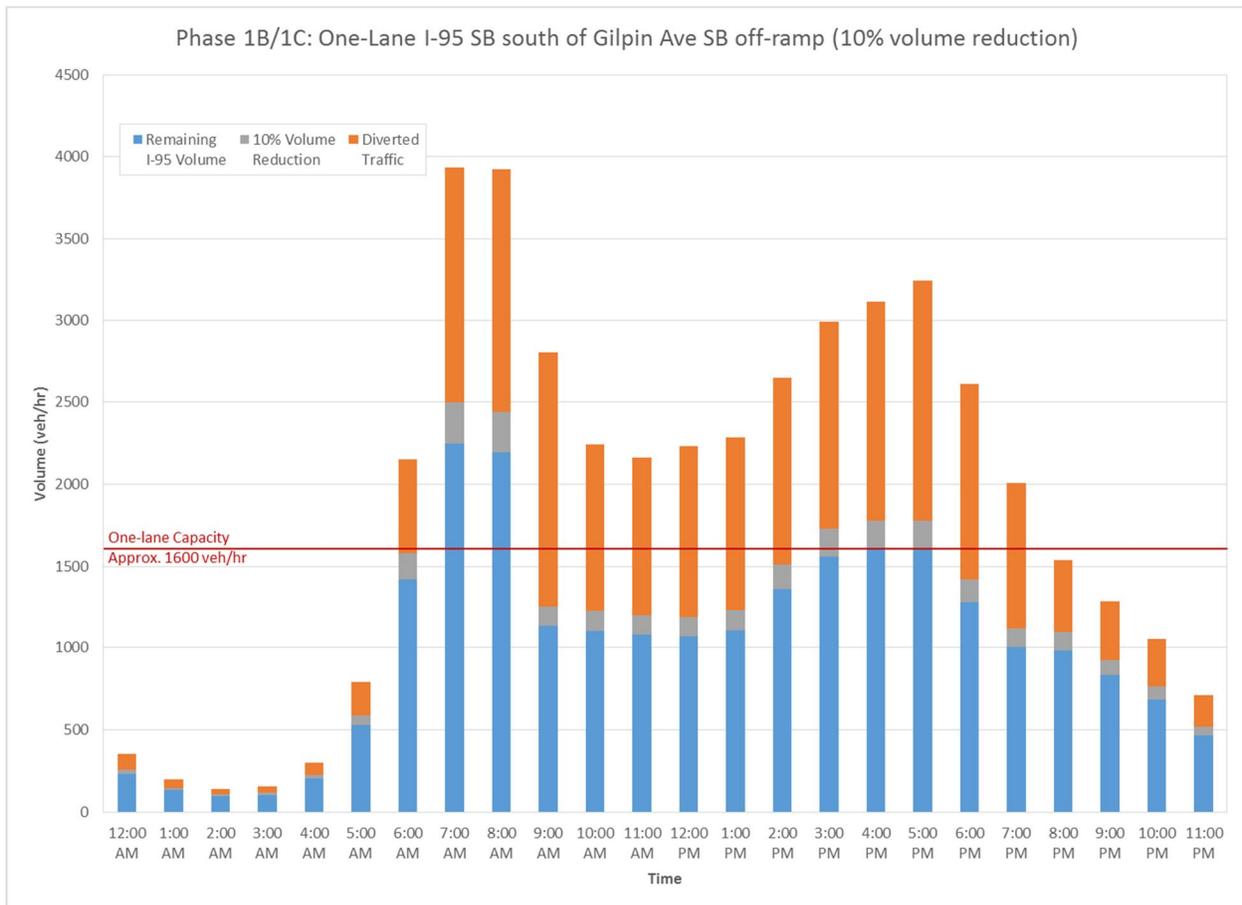
Phase 1B and 1C Southbound I-95 Impacts

During construction Phase 1A, no significant southbound ramp closures are projected to impact I-95.

During construction phase 1B and 1C, the southbound I-95 off-ramp to Adams Street/11th Street will be closed. The detour route will be the Jackson Street/Gilpin Avenue off-ramp. Additionally, some traffic from the Jackson Street/4th Street southbound off-ramp will divert to the Jackson Street/Gilpin Avenue off-ramp due to over-capacity conditions on I-95. The one-lane section of I-95 south of the Jackson Street/Gilpin Avenue off-ramp represents the critical point for southbound traffic during this phase. The southbound on-ramp from Jackson Street/Delaware Avenue is also closed during these phases; however, no impacts from this closure are expected to alter the volume at the critical point on southbound I-95. **Figure 10** depicts the remaining volume expected on I-95 at the critical point and how the 10-percent traffic reduction would affect the over-capacity conditions. The following I-95 mainline summary compares the projected 10-percent diversion scenario to the “worst-case” zero-diversion scenario:

- Anticipated duration: 3 months
- Expected AM peak delay: 47 to 65 minutes
- Expected AM peak queue: 2.9 to 4.1 miles
- Expected PM peak delay: 0 to 18 minutes
- Expected PM peak queue: 0.0 to 1.2 miles

Figure 10 – I-95 Southbound Diurnal Curve, Phase 1B and 1C

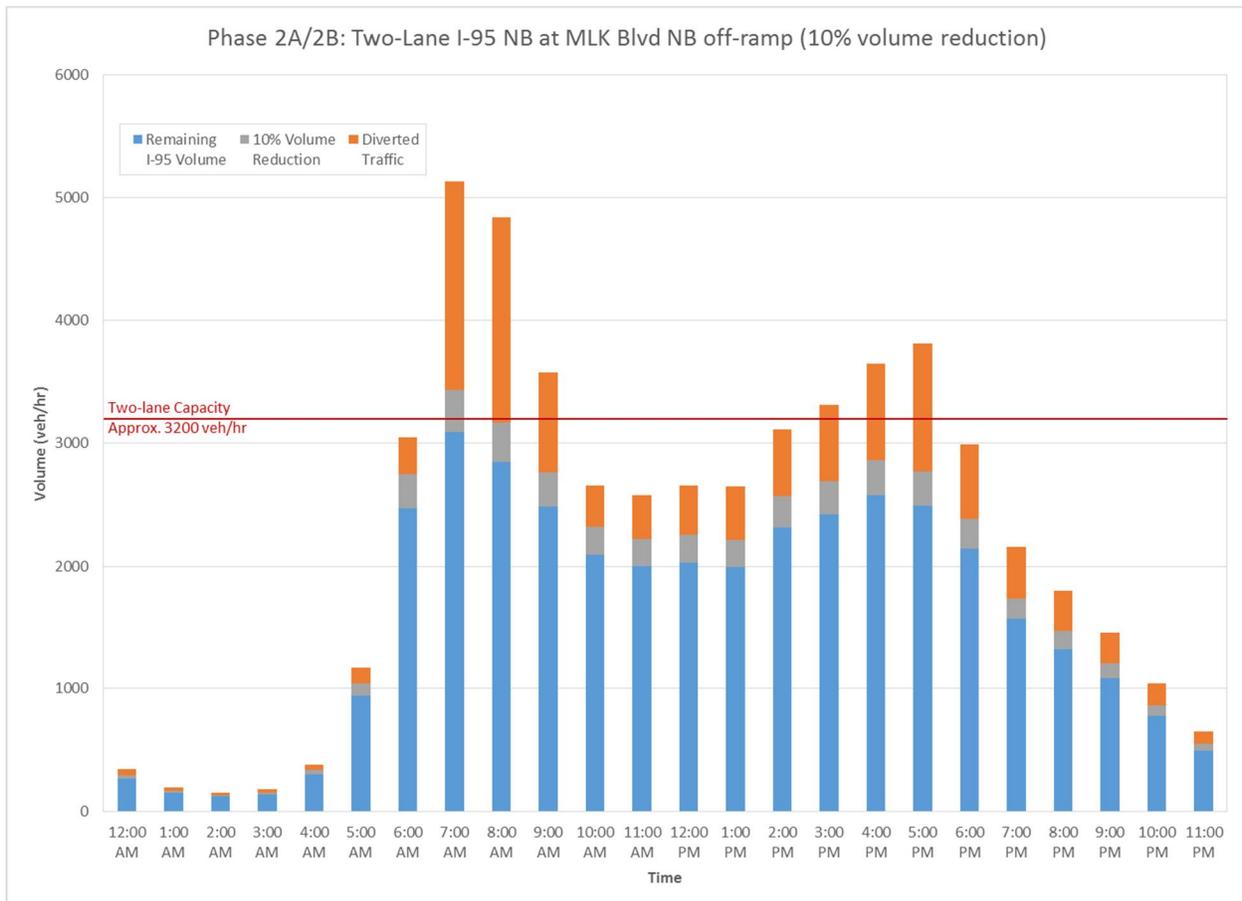


Phase 2A and 2B Northbound I-95 Impacts

During all of construction Phase 2, three I-95 northbound ramps will be closed: the off-ramp to Maryland Avenue, the on-ramp from Martin Luther King, Jr. Boulevard, and the on-ramp from Adams Street/Delaware Avenue. However; as part of the contraflow operation, northbound traffic will have access to the “flyunder” ramp typically serving as an on-ramp to southbound I-95 from Martin Luther King, Jr. Boulevard. Contraflow on this ramp will effectively serve as the primary detour route for the closure of the off-ramp to Maryland Avenue. Additionally, during over-capacity conditions on I-95, it is projected that much of the northbound off-ramp traffic to Adams Street/9th Street will divert to I-495 and US 13 to access Wilmington with significantly less delay. The critical point for northbound traffic during this phase is the two-lane section approaching the contraflow off-ramp. Because the Maryland Avenue off-ramp closure has a direct, full-capacity replacement, and the other closures are to on-ramps (preventing access to I-95), mainline northbound I-95 impacts during this stage are expected to be minimal. **Figure 11** depicts the remaining volume expected on I-95 at the critical point and how the 10-percent traffic reduction would affect the over-capacity conditions. The following I-95 mainline summary compares the projected 10-percent diversion scenario to the “worst-case” zero-diversion scenario:

- Anticipated duration: 9 months
- Expected AM peak delay: 0 to 4 minutes
- Expected AM peak queue: 0.0 to 0.6 miles
- Expected PM peak: no significant delays and queuing are projected

Figure 11 – I-95 Northbound Diurnal Curve, Phase 2A and 2B

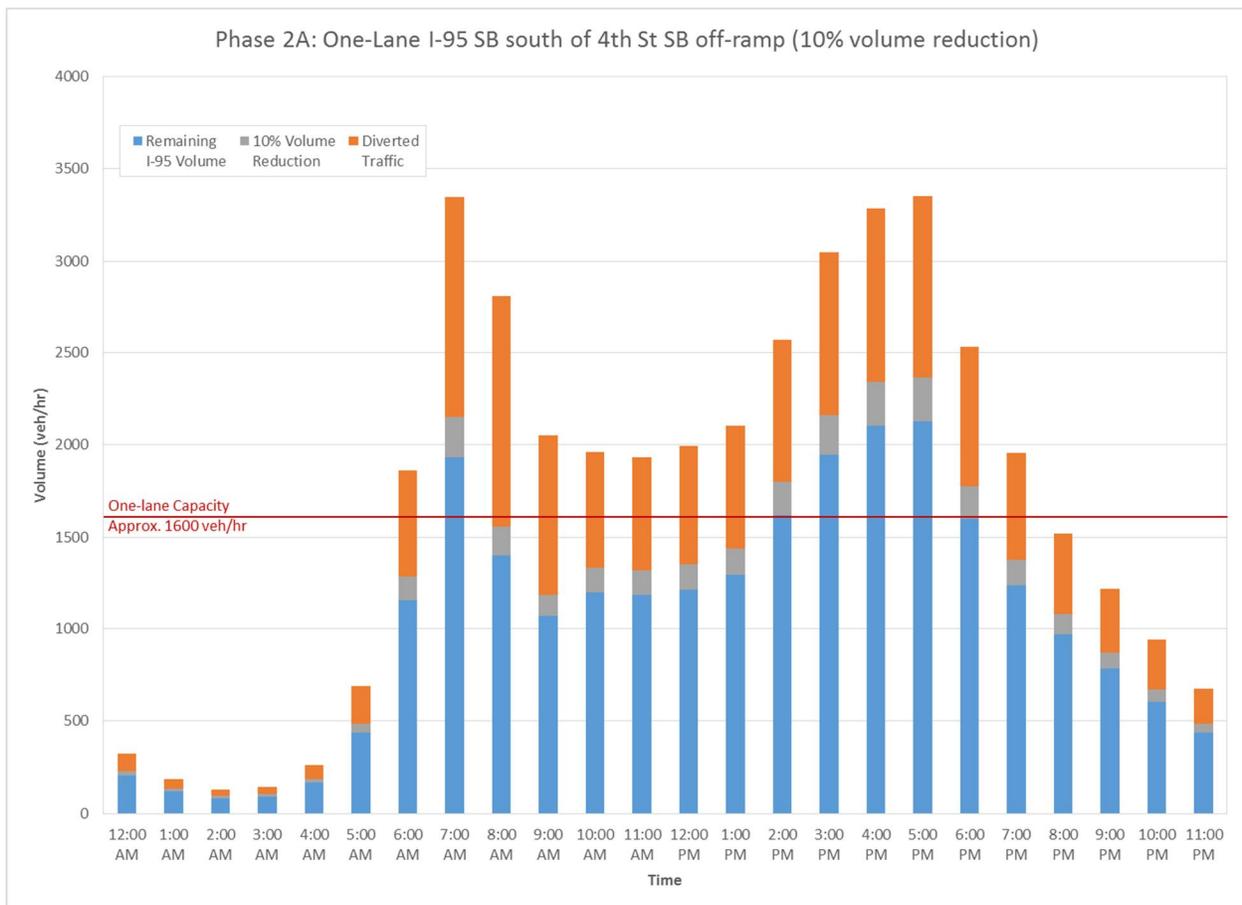


Phase 2A Southbound I-95 Impacts

During construction phase 2A, the southbound I-95 off-ramp to Adams Street/11th Street will remain closed from phase 1C. The detour route will be the Jackson Street/Gilpin Avenue off-ramp. Two southbound lanes are maintained until the Jackson Street/4th Street southbound off-ramp. This location represents the critical point for southbound traffic during this phase. The southbound on-ramp from Martin Luther King, Jr. Boulevard is also closed during these phases (serving as northbound contraflow off-ramp); however, no impacts from this closure are expected to alter the volume at the critical point on southbound I-95. **Figure 12** depicts the remaining volume expected on I-95 at the critical point and how the 10-percent traffic reduction would affect the over-capacity conditions. The following I-95 mainline summary compares the projected 10-percent diversion scenario to the “worst-case” zero-diversion scenario:

- Anticipated duration: 6 months
- Expected AM peak delay: 13 to 21 minutes
- Expected AM peak queue: 0.8 to 1.3 miles
- Expected PM peak delay: 52 to 92 minutes
- Expected PM peak queue: 3.3 to 5.8 miles

Figure 12 – I-95 Southbound Diurnal Curve, Phase 2A

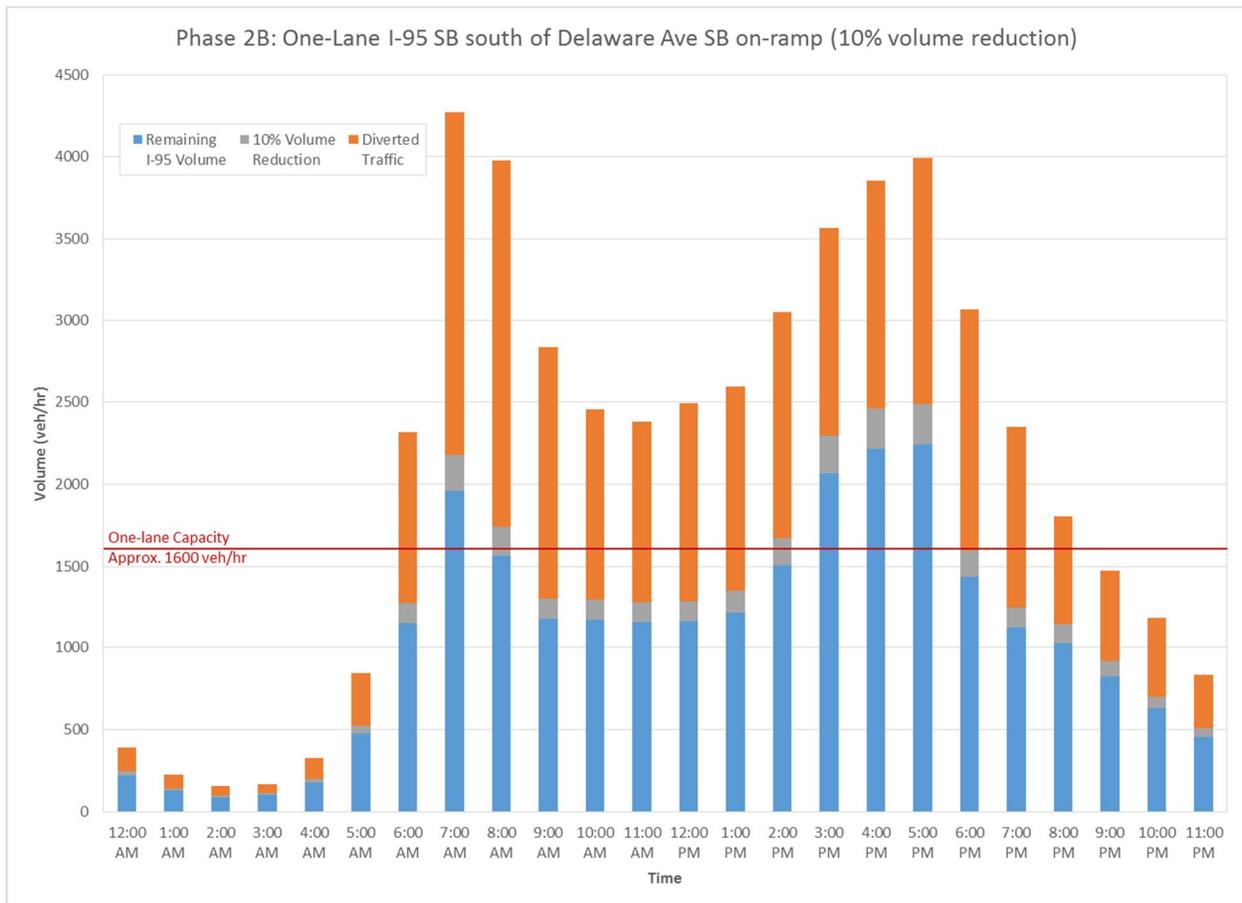


Phase 2B Southbound I-95 Impacts

During construction phase 2B, the southbound I-95 off-ramp to Jackson Street/4th Street be closed. The detour route will be the Jackson Street/Gilpin Avenue off-ramp. Because only one southbound lane is provided south of the until the Adams Street/11th Street off-ramp, a portion of the Jackson Street/Delaware Avenue southbound on-ramp is expected to divert to the Jackson Street/2nd Street southbound on-ramp. As the Jackson Street/Delaware Avenue ramp remains open, some traffic will still utilize the ramp, and the merge with southbound I-95 represents the critical point for southbound traffic during this phase. The southbound on-ramp from Martin Luther King, Jr. Boulevard is also closed during these phases (serving as northbound contraflow off-ramp); however, no impacts from this closure are expected to alter the volume at the critical point on southbound I-95. **Figure 13** depicts the remaining volume expected on I-95 at the critical point and how the 10-percent traffic reduction would affect the over-capacity conditions. The following I-95 mainline summary compares the projected 10-percent diversion scenario to the “worst-case” zero-diversion scenario:

- Anticipated duration: 3 months
- Expected AM peak delay: 14 to 27 minutes
- Expected AM peak queue: 1.0 to 1.8 miles
- Expected PM peak delay: 65 to 95 minutes
- Expected PM peak queue: 4.2 to 6.1 miles

Figure 13 – I-95 Southbound Diurnal Curve, Phase 2B



Phase 3A Northbound I-95 Impacts

During construction Phase 3A, the on-ramp from Martin Luther King, Jr. Boulevard will remain closed from Phase 2B. All other ramps will be open; however, I-95 will continue to operate with only one lane between the Maryland Avenue off-ramp and the Adams Street/10th Street on-ramp and two lanes throughout the rest of the project limits. Additionally, during over-capacity conditions on I-95, it is projected that much of the northbound off-ramp traffic to Adams Street/9th Street will divert to either Maryland Avenue off-ramp or I-495/US 13 to access Wilmington. There are two critical points for northbound traffic during this phase – the one-lane section north of the Maryland Avenue off-ramp in the morning as motorists enter the City, and the two-lane section over the Brandywine River Bridge in the evening as motorists leave the City. **Figures 14 and 15** depict the remaining volume expected on I-95 at the critical points and how the 10-percent traffic reduction would affect the over-capacity conditions. The following I-95 mainline summary compares the projected 10-percent diversion scenario to the “worst-case” zero-diversion scenario:

- Anticipated duration: 3 months
- Expected AM peak delay: 15 to 30 minutes
- Expected AM peak queue: 1.0 to 1.9 miles
- Expected PM peak delay: 18 to 34 minutes
- Expected PM peak queue: 2.3 to 4.2 miles

Figure 14 – I-95 Northbound Diurnal Curve, Phase 3A (AM critical point)

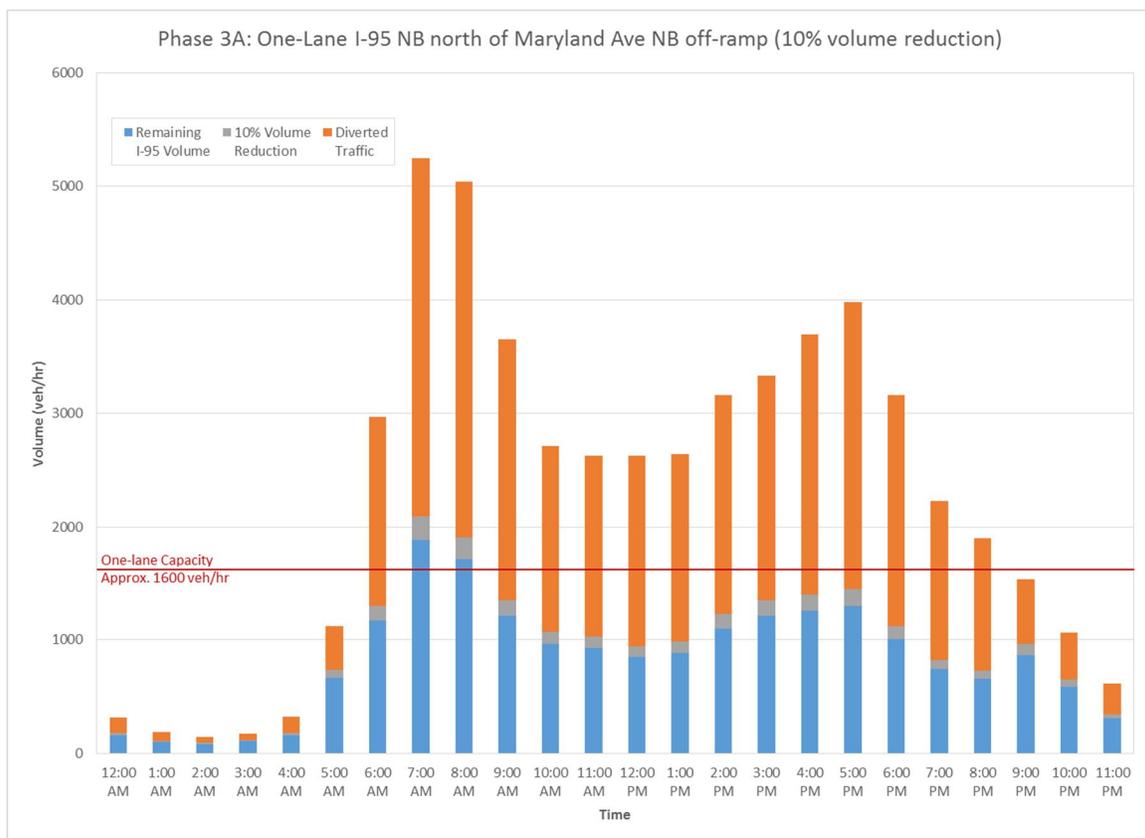
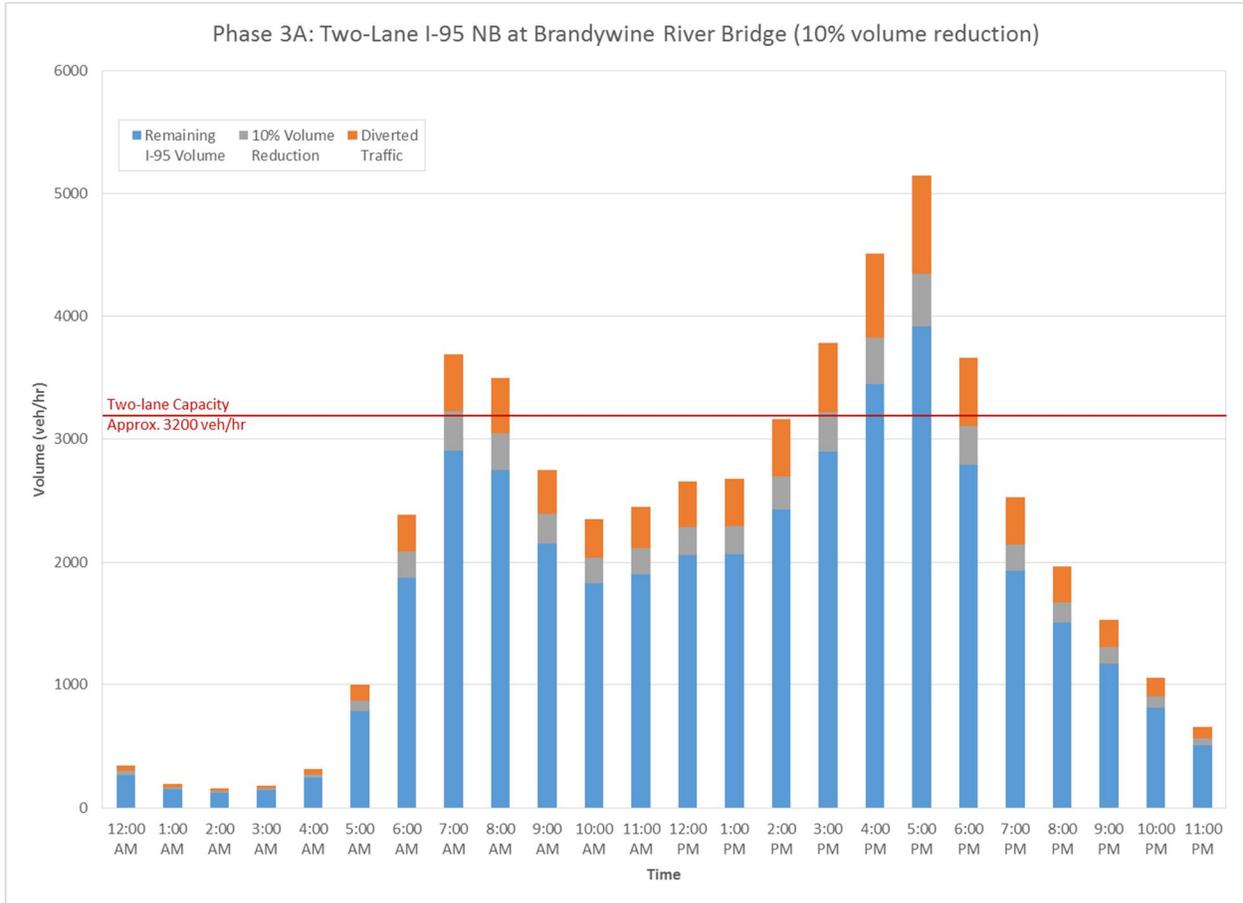


Figure 15 – I-95 Northbound Diurnal Curve, Phase 3A (PM critical point)



Phase 3A Southbound I-95 Impacts

During construction phase 3A, southbound I-95 will operate with one through lane (contraflow on the northbound side of the road) and a collector/distributor road to serve ramp traffic in Wilmington. The southbound I-95 off-ramp to Jackson Street/Gilpin Avenue will be closed. The detour route will be the Adams Street/11th Street off-ramp, however, some traffic is expected to divert to use US 202 or I-495 during peak periods. Similar to northbound traffic during this phase, there are two critical points for southbound traffic during this phase – the two-lane section over the Brandywine River Bridge in the morning as motorists enter the City, and the one-lane collector/distributor road south of the on-ramps in the evening as motorists leave the City. The southbound on-ramp from Martin Luther King, Jr. Boulevard is also closed during this phase; however, no impacts from this closure are expected to alter the volume at the critical points on southbound I-95. **Figures 16 and 17** depict the remaining volume expected on I-95 at the critical points and how the 10-percent traffic reduction would affect the over-capacity conditions. The following I-95 mainline summary compares the projected 10-percent diversion scenario to the “worst-case” zero-diversion scenario:

- Anticipated duration: 3 months
- Expected AM peak delay: 8 to 22 minutes
- Expected AM peak queue: 1.0 to 2.8 miles
- Expected PM peak delay: 22 to 44 minutes
- Expected PM peak queue: 2.0 to 3.4 miles

Figure 16 – I-95 Southbound Diurnal Curve, Phase 3A (AM critical point)

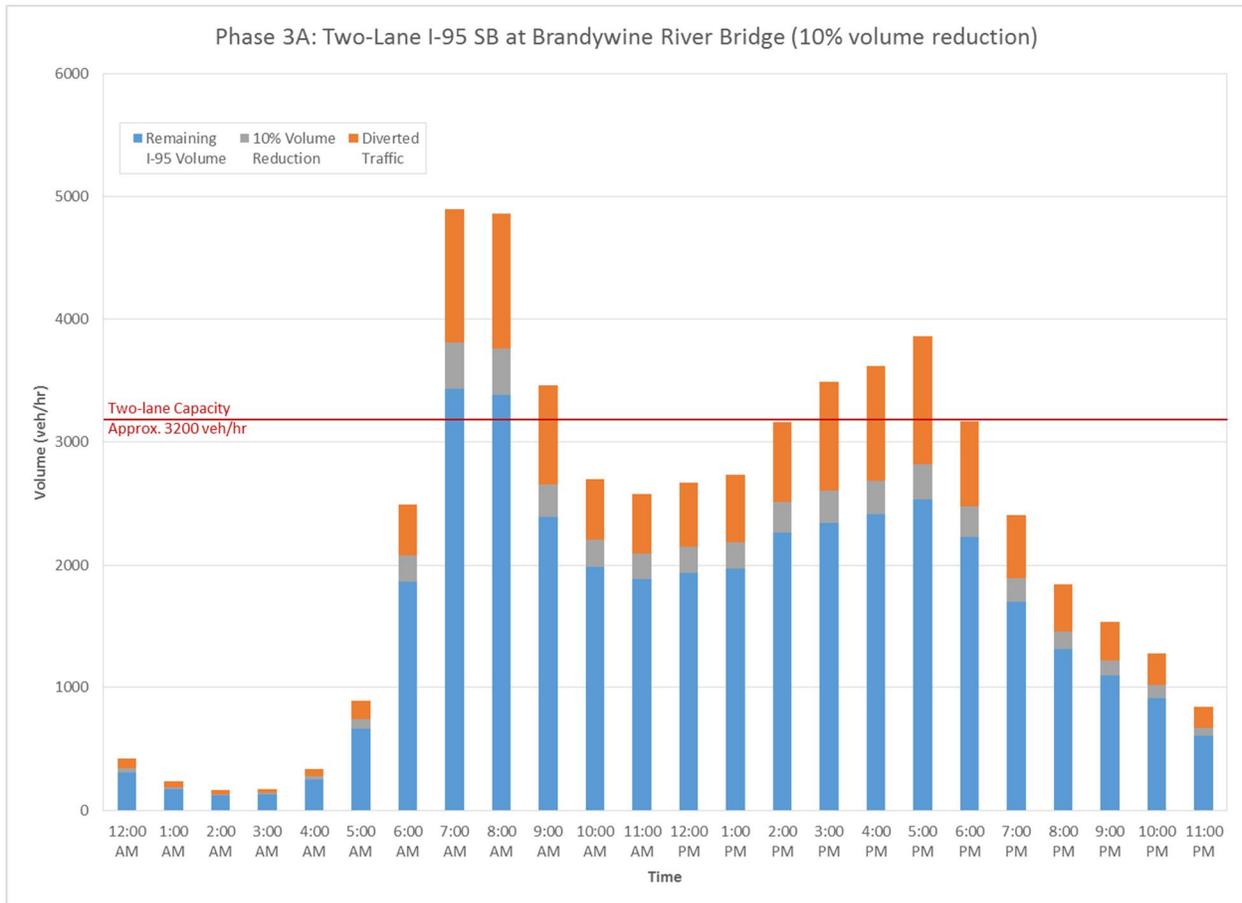
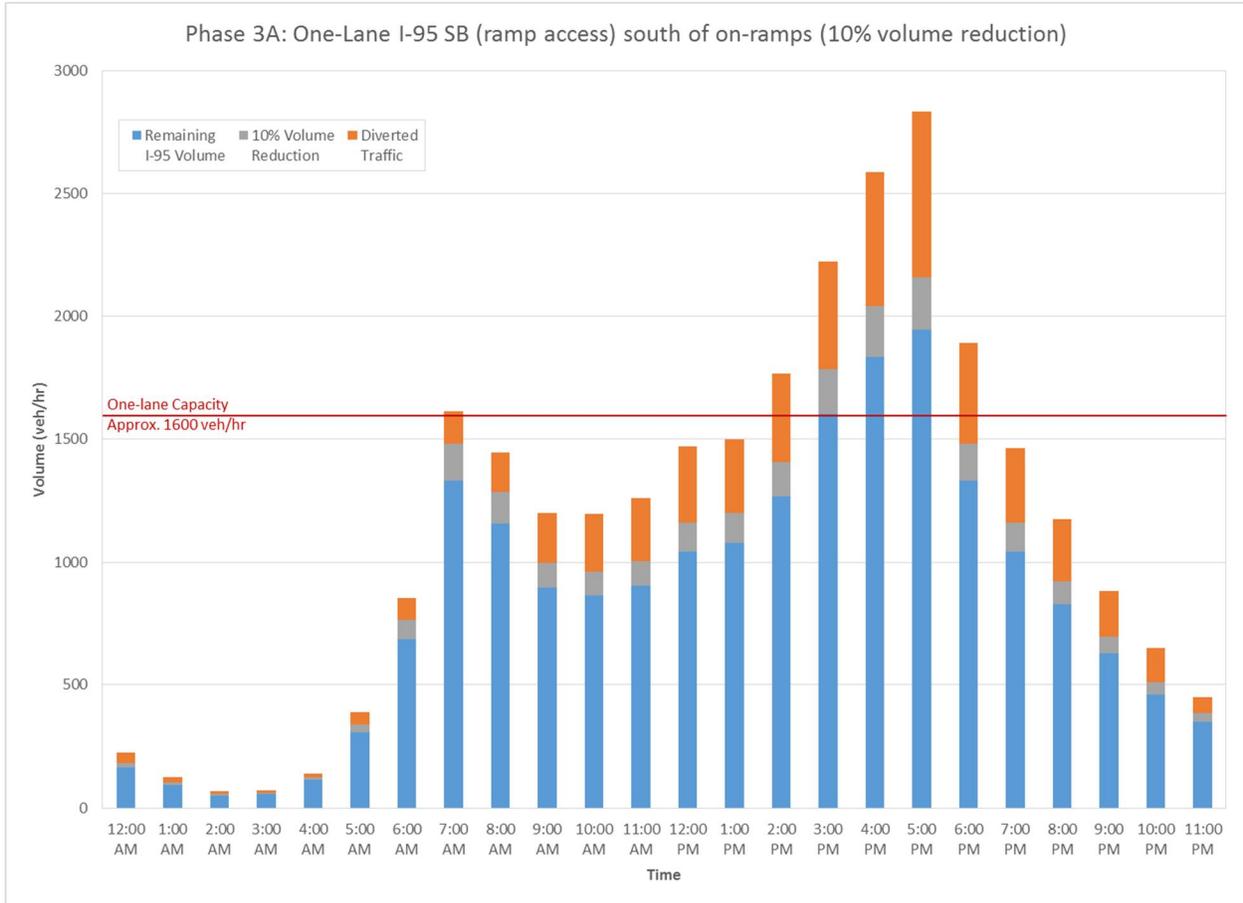


Figure 17 – I-95 Southbound Diurnal Curve, Phase 3A (PM critical point)

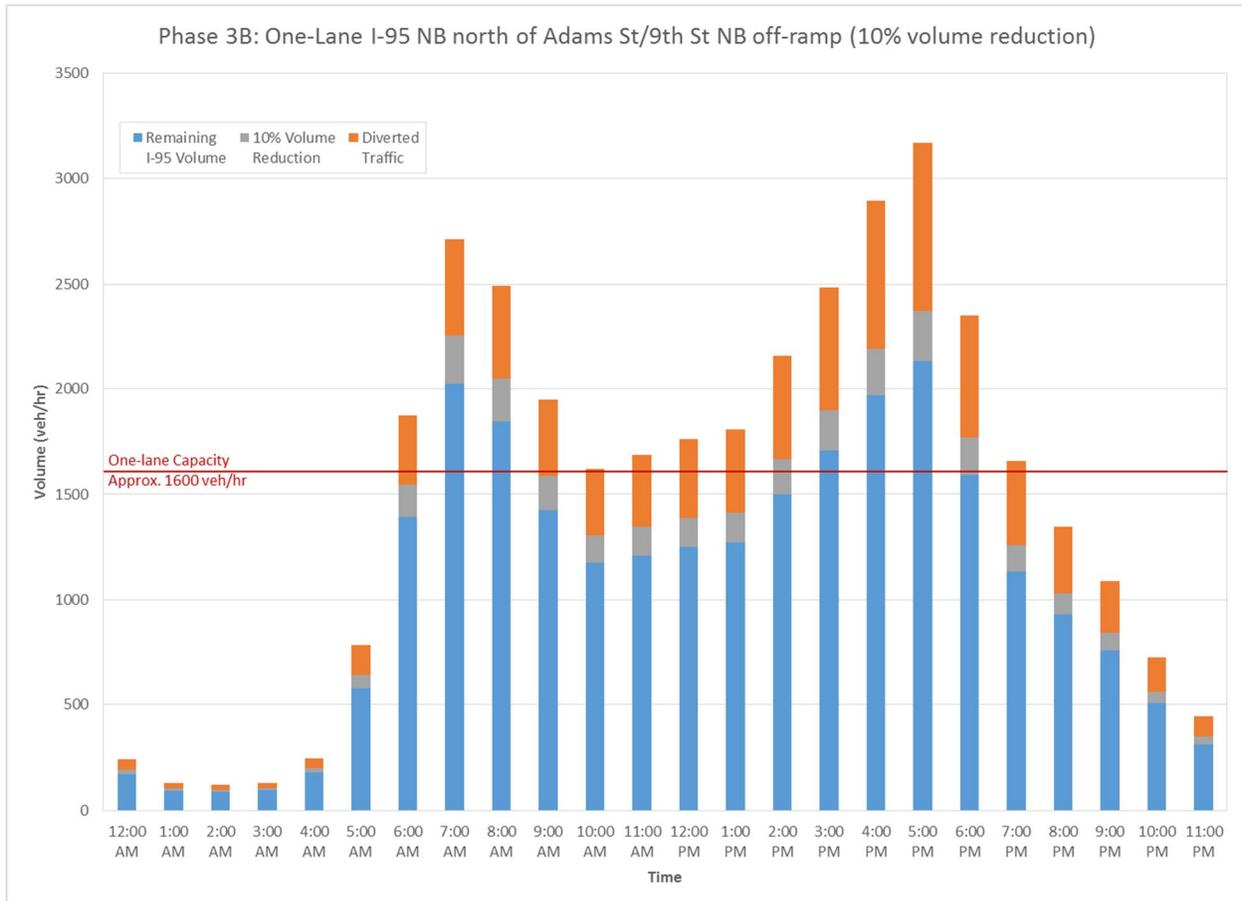


Phase 3B Northbound I-95 Impacts

During construction Phase 3B, the on-ramp from Adams Street/10th Street will be closed. The detour route will be to use the on-ramp from Adams Street/Delaware Avenue. All other ramps will be open; however, two sections of I-95 will continue to operate with only one lane. The one-lane section north of the off-ramp to Adams Street/9th Street represents the critical point for northbound traffic during this phase. **Figure 18** depicts the remaining volume expected on I-95 at the critical point and how the 10-percent traffic reduction would affect the over-capacity conditions. The following I-95 mainline summary compares the projected 10-percent diversion scenario to the “worst-case” zero-diversion scenario:

- Anticipated duration: 3 months
- Expected AM peak delay: 25 to 41 minutes
- Expected AM peak queue: 2.0 to 3.0 miles
- Expected PM peak delay: 38 to 76 minutes
- Expected PM peak queue: 2.8 to 5.2 miles

Figure 18 – I-95 Northbound Diurnal Curve, Phase 3B

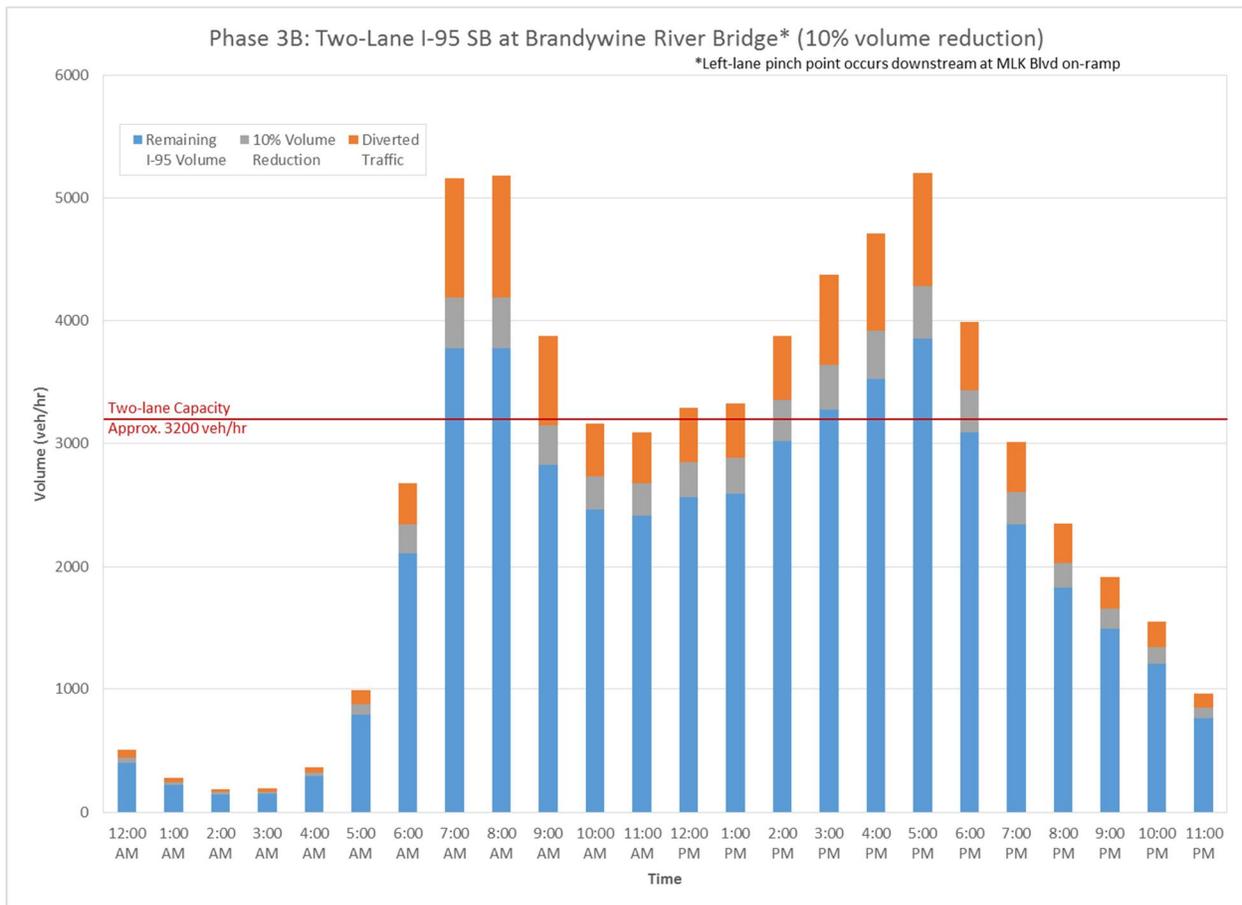


Phase 3B Southbound I-95 Impacts

During construction phase 3B, southbound I-95 will operate with one through lane (contraflow on the northbound side of the road) and a collector/distributor road to serve ramp traffic in Wilmington. The southbound I-95 off-ramp to Jackson Street/Gilpin Avenue will be closed. The detour route will be the Adams Street/11th Street off-ramp, however, some traffic is expected to divert to use US 202 or I-495 during peak periods. Additionally, the southbound I-95 on-ramp from Jackson Street/2nd Street will be closed. The primary detour route will be US 13 to I-495 southbound. Because southbound I-95 capacity approaching the City is not significantly impacted, the critical point is expected to be the two-lane section over the Brandywine River Bridge. **Figure 19** depicts the remaining volume expected on I-95 at the critical point and how the 10-percent traffic reduction would affect the over-capacity conditions. The following I-95 mainline summary compares the projected 10-percent diversion scenario to the “worst-case” zero-diversion scenario:

- Anticipated duration: 3 months
- Expected AM peak delay: 22 to 37 minutes
- Expected AM peak queue: 2.7 to 4.7 miles
- Expected PM peak delay: 20 to 55 minutes
- Expected PM peak queue: 2.5 to 6.9 miles

Figure 19 – I-95 Southbound Diurnal Curve, Phase 3B



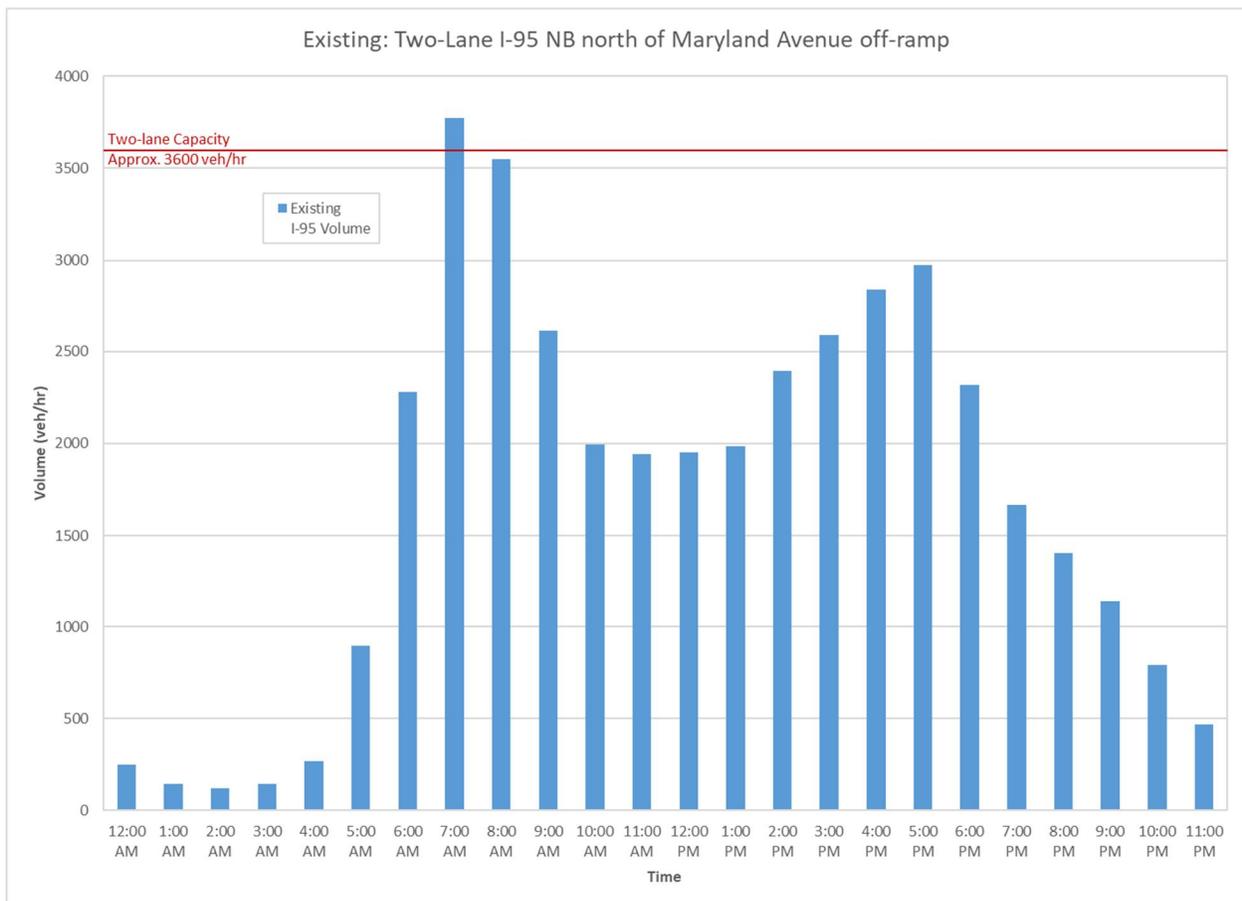
Comparison to Existing Conditions

Currently, I-95 regularly experiences moderate peak-hour queuing and delays. To compare the construction phasing queue and delay estimates with existing conditions, the existing traffic volumes were analyzed in a similar fashion to the projected traffic in each construction phase. However, lane capacity is expected to be greater in the existing condition with no construction than in the construction conditions analyzed above – instead of 1,600 vehicles per lane per hour, a capacity of 1,800 vehicles per lane per hour was used. The critical points used in the analysis were northbound in the two-lane section north of the Maryland Avenue off-ramp and southbound in the two-lane section south of the Jackson Street/2nd Street on-ramp. **Figures 20** and **21** depict the average midweek volumes recorded at these points for northbound and southbound I-95, respectively. There is no diversion traffic in these scenarios, but to calculate an upper limit in a range of expected queues and delays, an “average plus 5 percent” traffic scenario was calculated as well, representing I-95 volumes on a busier than average weekday. Expected AM and PM peak delays and queues were calculated for each direction:

Northbound I-95

- AM peak delay: 3 to 8 minutes
- AM peak queue: 0.3 to 0.8 miles
- PM peak: no significant delays and queuing

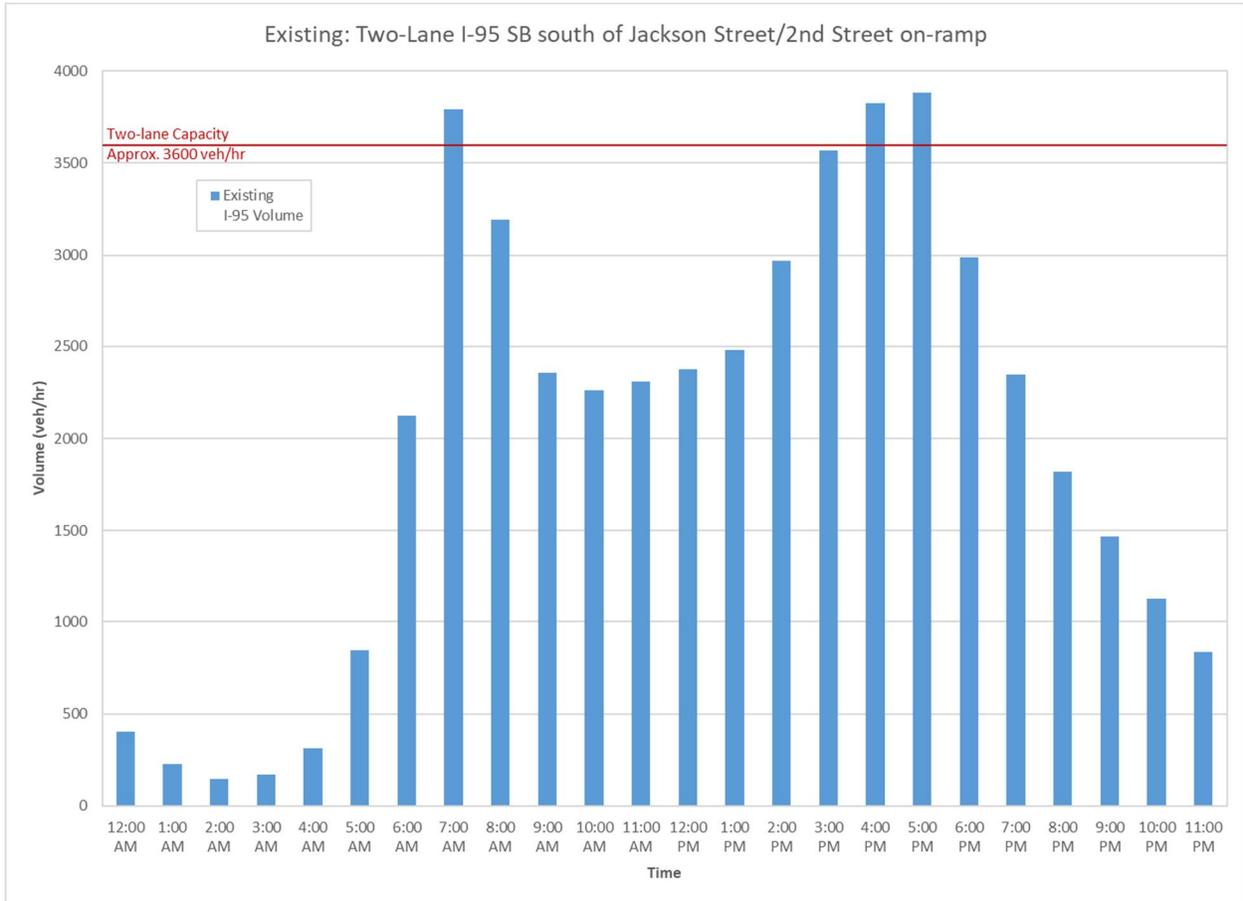
Figure 20 – I-95 Northbound Diurnal Curve, Existing Traffic



Southbound I-95

- AM peak delay: 3 to 6 minutes
- AM peak queue: 0.5 to 0.9 miles
- PM peak delay: 8 to 17 minutes
- PM peak queue: 1.1 to 2.0 miles

Figure 21 – I-95 Southbound Diurnal Curve, Existing Traffic



A summary of the delay and queuing estimates presented above is provided in **Table 3**.

Table 3 – Initial Delay and Queuing Estimates by Construction Phase

Phase	Duration (months)	Northbound I-95				Southbound I-95			
		AM Peak		PM Peak		AM Peak		PM Peak	
		Delay (min)	Queue (mi)	Delay (min)	Queue (mi)	Delay (min)	Queue (mi)	Delay (min)	Queue (mi)
Existing	-	3 - 8	0.3 - 0.8			3 - 6	0.5 - 0.9	8 - 17	1.1 - 2.0
1A	3	10 - 24	0.9 - 1.8	4 - 11	0.6 - 1.4				
1B	2	10 - 24	0.9 - 1.8	4 - 11	0.6 - 1.4	47 - 65	2.9 - 4.1	0 - 18	0.0 - 1.2
1C	1	10 - 24	0.9 - 1.8	4 - 11	0.6 - 1.4	47 - 65	2.9 - 4.1	0 - 18	0.0 - 1.2
2A	6	0 - 4	0.0 - 0.6			13 - 21	0.8 - 1.3	52 - 92	3.3 - 5.8
2B	3	0 - 4	0.0 - 0.6			14 - 27	1.0 - 1.8	65 - 95	4.2 - 6.1
3A	3	15 - 30	1.0 - 1.9	18 - 34	2.3 - 4.2	18 - 22	1.0 - 2.8	22 - 44	2.0 - 3.4
3B	3	25 - 41	2.0 - 3.0	38 - 76	2.8 - 5.2	22 - 37	2.7 - 4.7	20 - 55	2.5 - 6.9
4	3								

To address the feasibility of the higher queuing and delay estimates, Bluetooth travel time data along I-95 was reviewed to determine how much delay motorists regularly encounter and what maximum delay might motorists would be willing to tolerate. Midweek travel time data for February 2018 was reviewed and analyzed – **Figures 22 and 23** depict the typical average and minimum travel times throughout the day on northbound and southbound I-95, respectively.

Figure 22 – I-95 Northbound Midweek Travel Times through City of Wilmington

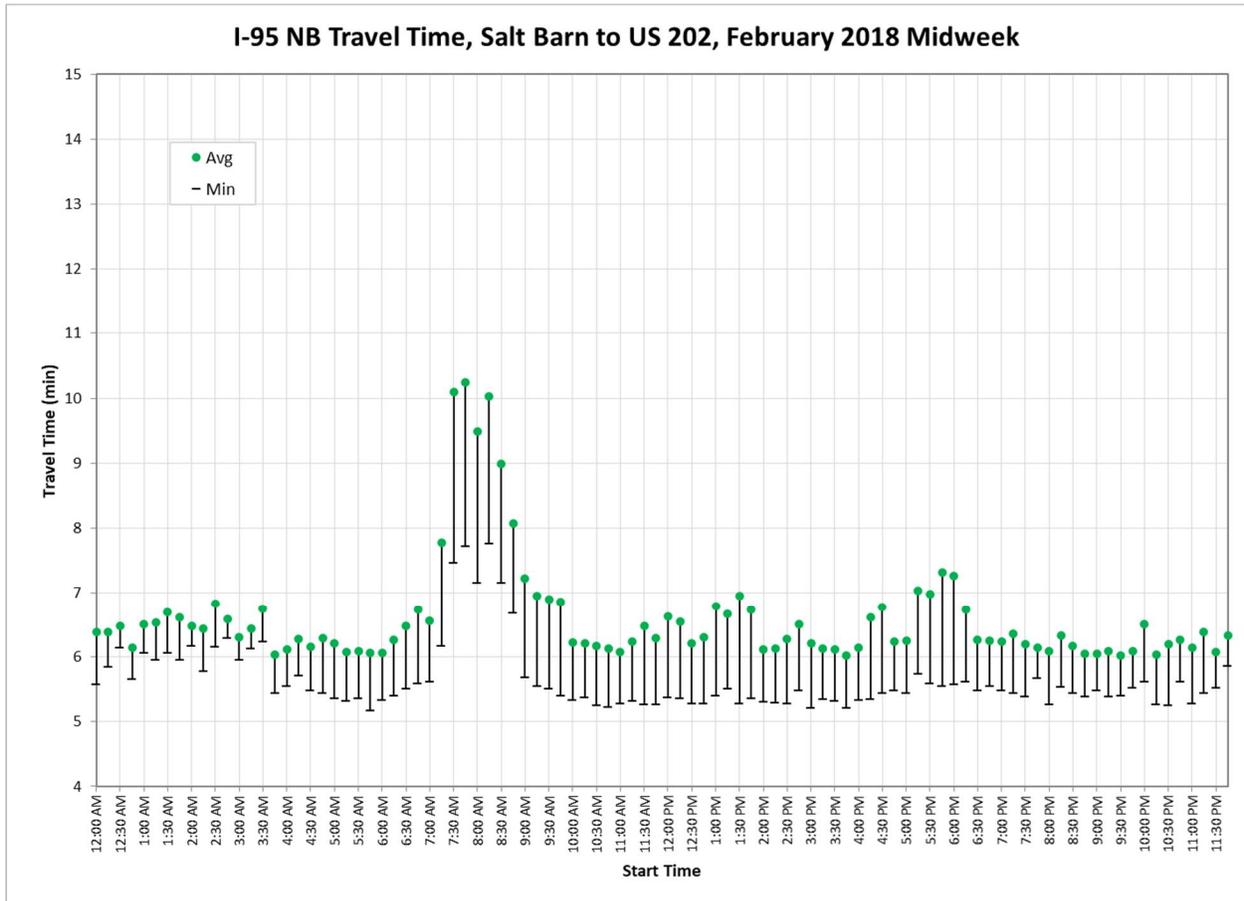
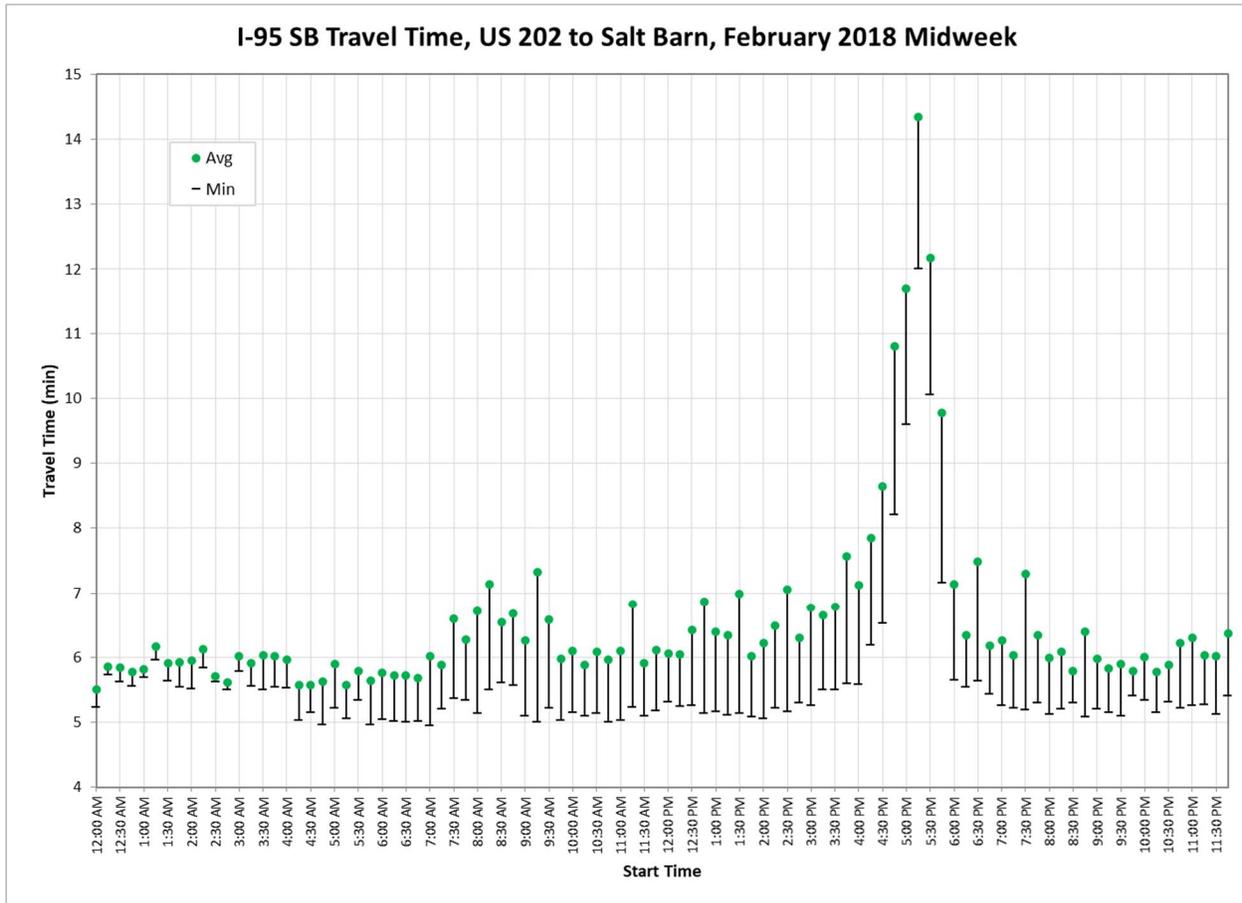


Figure 23 – I-95 Southbound Midweek Travel Times through City of Wilmington



As depicted in the figures, minimum travel times northbound and southbound through the City are approximately 5.5 minutes. During the northbound morning peak, typical delays range from about 3-5 minutes, and during the southbound evening peak, typical delays range from about 4-9 minutes. To determine how much delay motorists are used to occasionally tolerating, the maximum delay for each interval was found and then averaged over the analysis period. **Figures 24** and **25** show this data for the two peak periods – northbound AM and southbound PM, respectively.

The figures show that 15-minute delays are relatively common during both peak periods. Furthermore, the day-to-day data records some delays up to 20 to 25 minutes. Based on this analysis, and the assumption that motorists may be more tolerant of slightly increased delay during ongoing construction, a threshold of 20 minutes was assumed as the upper limit of feasible expected delay. This threshold was assumed to apply to both directions in each peak hour, despite only moderate existing delays in the southbound morning peak and northbound evening peak.

Finally, to determine how much additional peak-hour volume must be removed (by additional diversions, peak spreading, mode choice, etc.) the diurnal volume analysis was run again in 5 percent increments for diversions greater than 10 percent to reduce the projected delay to below 20 minutes. **Table 4** summarizes this sensitivity analysis. These identified phases and travel directions may require additional community outreach and public awareness to achieve the desired traffic reduction percentages.

Figure 24 – I-95 Northbound Peak-Period Midweek Travel Times through City of Wilmington

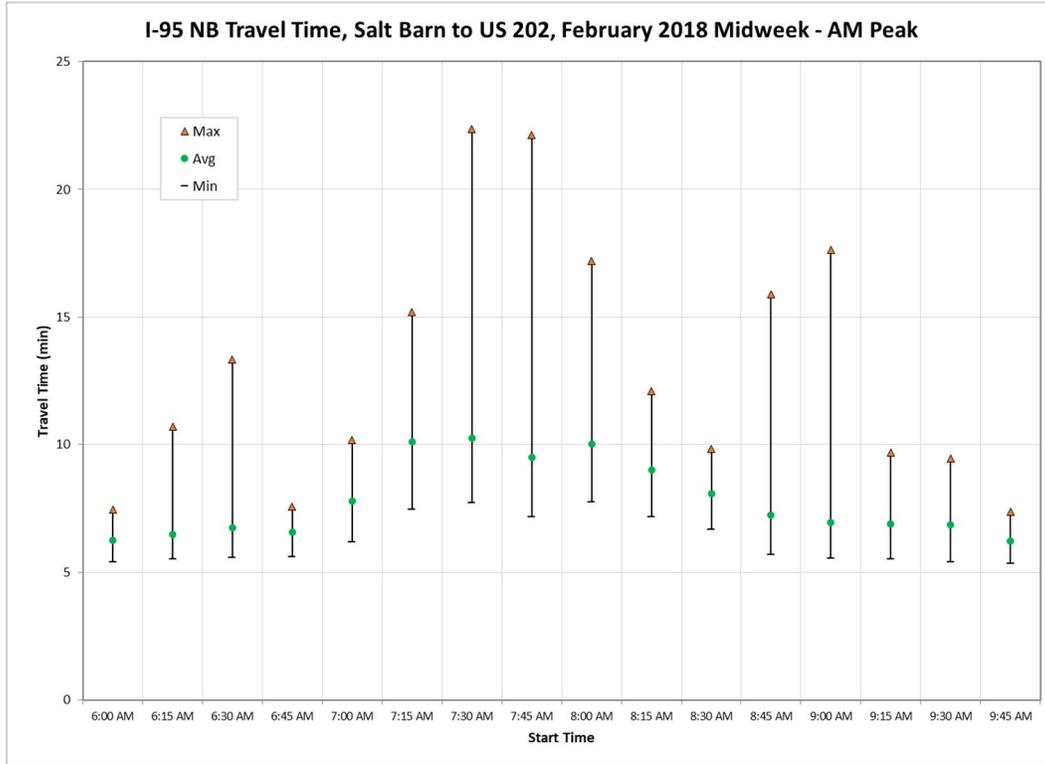


Figure 25 – I-95 Southbound Peak-Period Midweek Travel Times through City of Wilmington

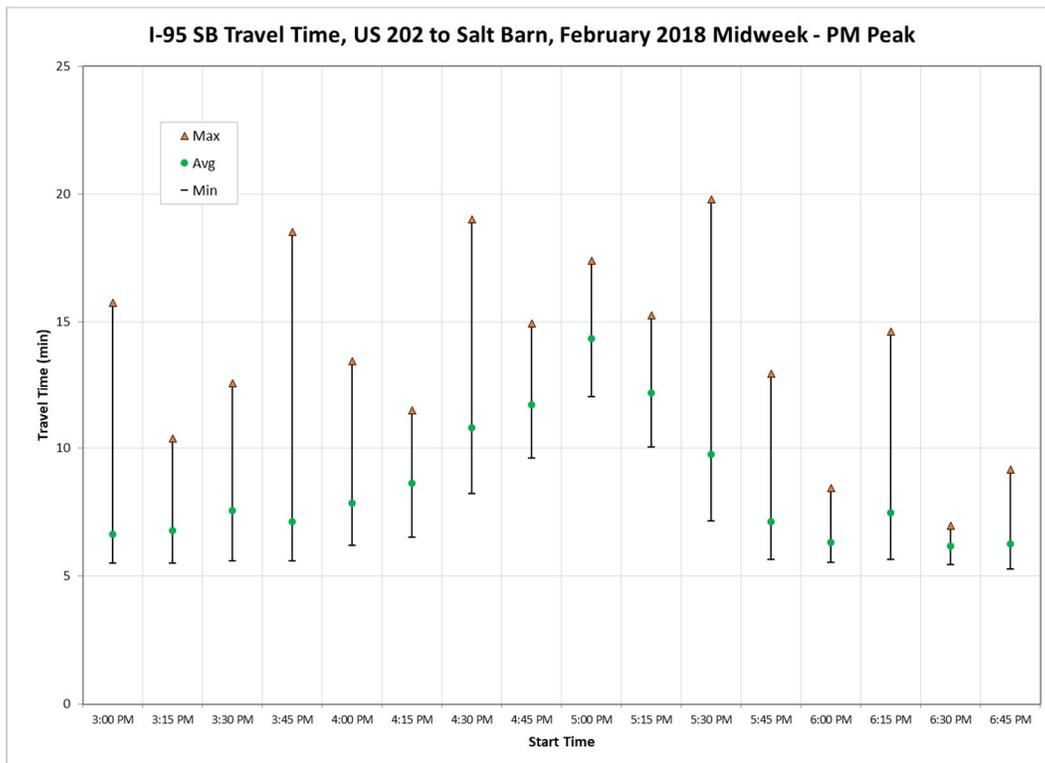


Table 4 – Required Diversions by Construction Phase to Achieve less than 20-min Mainline Delays

Phase	Duration (months)	Northbound I-95		Southbound I-95	
		AM Peak	PM Peak	AM Peak	PM Peak
		Diversion (%)	Diversion (%)	Diversion (%)	Diversion (%)
1A	3	5%	0%	0%	0%
1B	2	5%	0%	25%	0%
1C	1	5%	0%	25%	0%
2A	6	0%	0%	5%	25%
2B	3	0%	0%	10%	30%
3A	3	10%	10%	10%	15%
3B	3	15%	20%	15%	15%
4	3	0%	0%	0%	0%

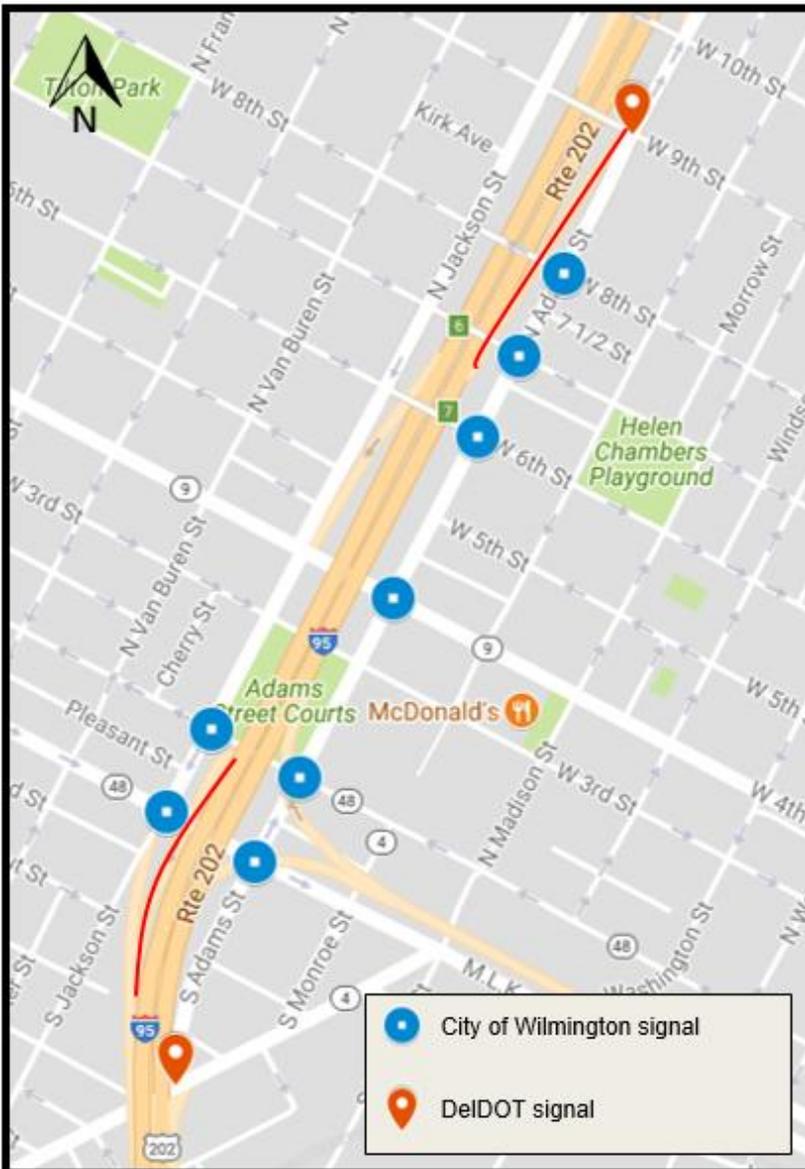
The data helps to show which peak and travel direction to focus outreach and awareness efforts to maintain traffic at tolerable delays. Higher reduction percentages are likely to place higher stress the secondary network, so preparation efforts should also focus on optimizing those corridors as well. It is believed that up to 30 percent overall traffic diversions were achieved during the Bridge 1-813 on I-495 over Christina River Emergency Repairs project in 2014, as noted in the Wilmington Viaduct Traffic Study in **Appendix A**.

B. Ramp Detours

Each I-95 on- and off-ramp within the project limits will be closed during at least one construction phase. During these closures, ramp detours will be posted. Detour plans have been prepared for each ramp closure and are included in the semifinal design submission.

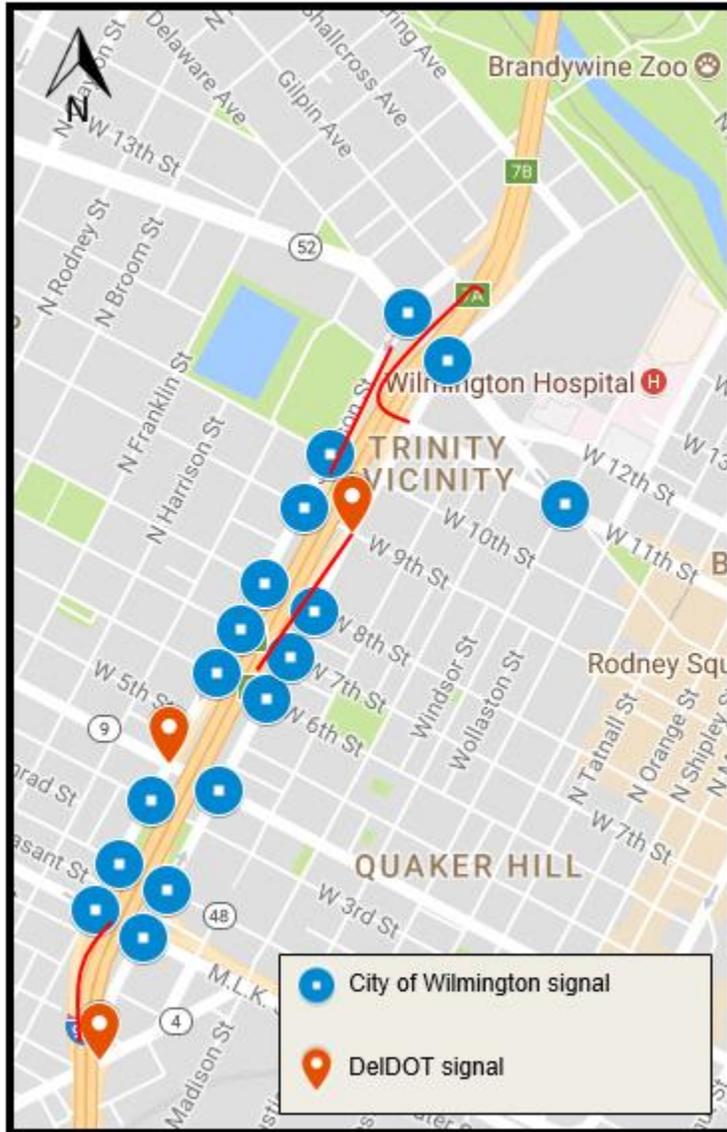
Signals along these detour routes will be prioritized for timing adjustments to account for the changes in traffic. **Figures 26 through 32** identify these detour route signals by construction phase.

Figure 26 – Traffic Signals along Detour Routes for Phase 1A Ramp Closures



- Intersections:
1. N Adams St @ 9th St
 2. N Adams St @ 8th St
 3. N Adams St @ 7th St
 4. N Adams St @ 6th St
 5. N Adams St @ 4th St
 6. N Adams St @ 2nd St
 7. N Jackson St @ 2nd St
 8. N Jackson St @ MLK Blvd
 9. N Adams St @ MLK Blvd

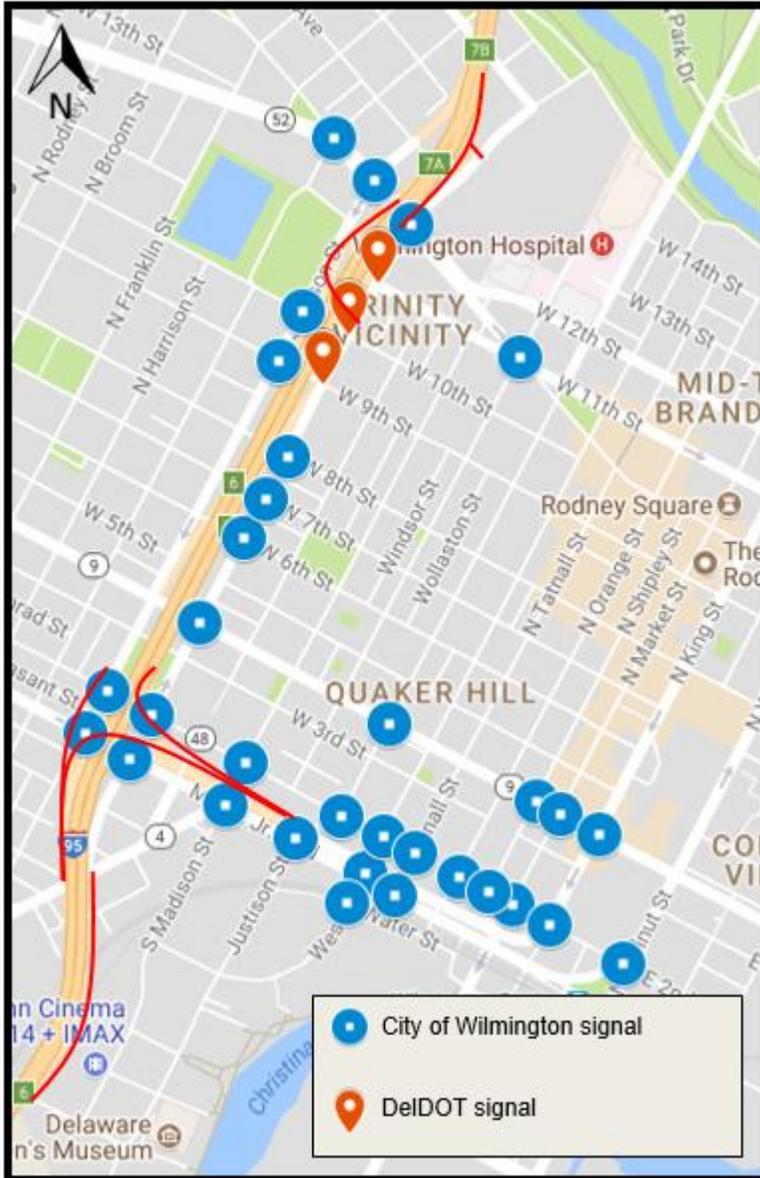
Figure 27 – Traffic Signals along Detour Routes for Phases 1B & 1C Ramp Closures



Intersections:

1. Delaware Ave @ N Jackson St
2. Delaware Ave @ N Adams St
3. Delaware Ave @ 11th St
4. N Jackson St @ 10th St
5. N Jackson St @ 9th St
6. N Adams St @ 9th St
7. N Adams St @ 8th St
8. N Jackson St @ 8th St
9. N Jackson St @ 7th St
10. N Adams St @ 7th St
11. N Adams St @ 6th St
12. N Jackson St @ 6th St
13. N Jackson St @ 4th St
14. N Adams St @ 4th St
15. N Jackson St @ 3rd St
16. N Adams St @ 2nd St
17. N Jackson St @ 2nd St
18. N Jackson St @ MLK Blvd
19. N Adams St @ MLK Blvd
20. S Adams St @ Maryland Ave

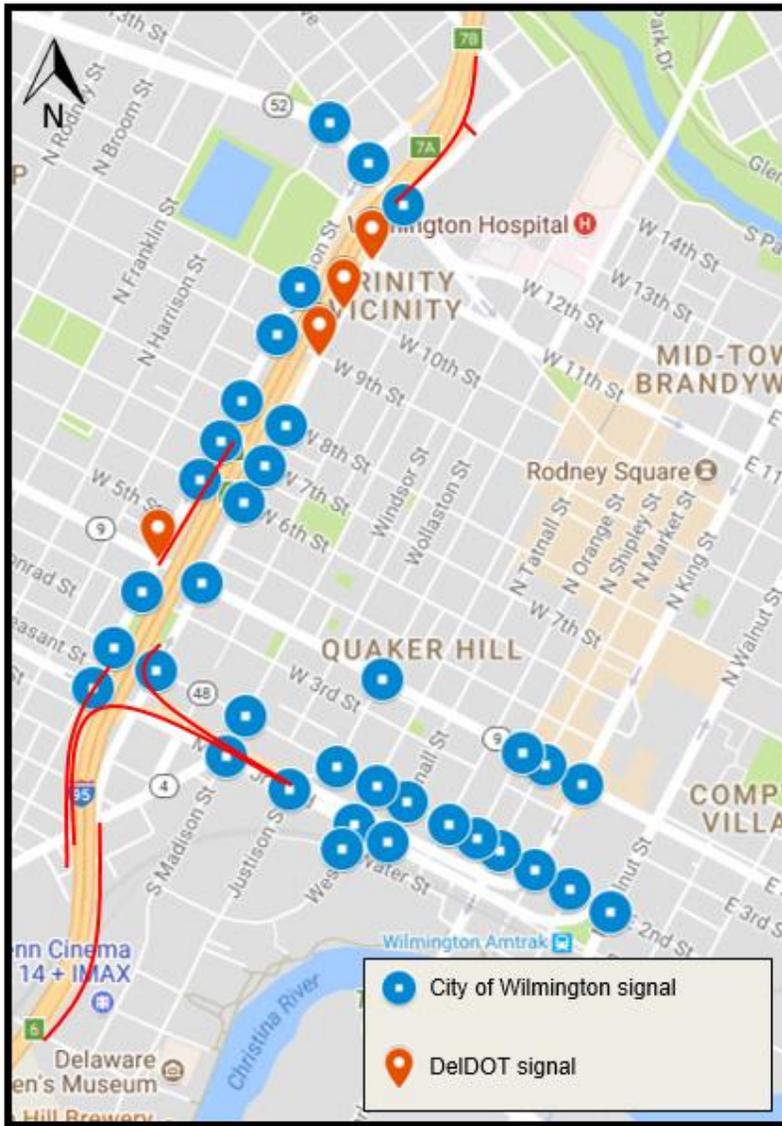
Figure 28 – Traffic Signals along Detour Routes for Phase 2A Ramp Closures



Intersections:

1. Delaware Ave @ Van Buren St
2. Delaware Ave @ N Jackson St
3. Delaware Ave @ N Adams St
4. Delaware Ave @ 11th St
5. N Adams St @ 11th St
6. N Adams St @ 10th St
7. N Jackson St @ 10th St
8. N Jackson St @ 9th St
9. N Adams St @ 9th St
10. N Adams St @ 8th St
11. N Adams St @ 7th St
12. N Adams St @ 6th St
13. N Adams St @ 4th St
14. N Adams St @ 2nd St
15. N Jackson St @ 2nd St
16. N Jackson St @ MLK Blvd
17. N Adams St @ MLK Blvd
18. MLK Blvd @ Madison St
19. 2nd St @ Madison St
20. MLK Blvd @ Justison St
21. 2nd St @ Washington St
22. West St @ Water St
23. MLK Blvd @ West St
24. 2nd St @ West St
25. MLK Blvd @ Tatnall St
26. 2nd St @ Tatnall St
27. 2nd St @ Orange St
28. 2nd St @ Shipley St
29. 2nd St @ Market St
30. 2nd St @ King St
31. 2nd St @ Walnut St
32. 4th St @ N King St
33. 4th St @ N Market St
34. 4th St @ N Shipley St
35. 4th St @ Washington St

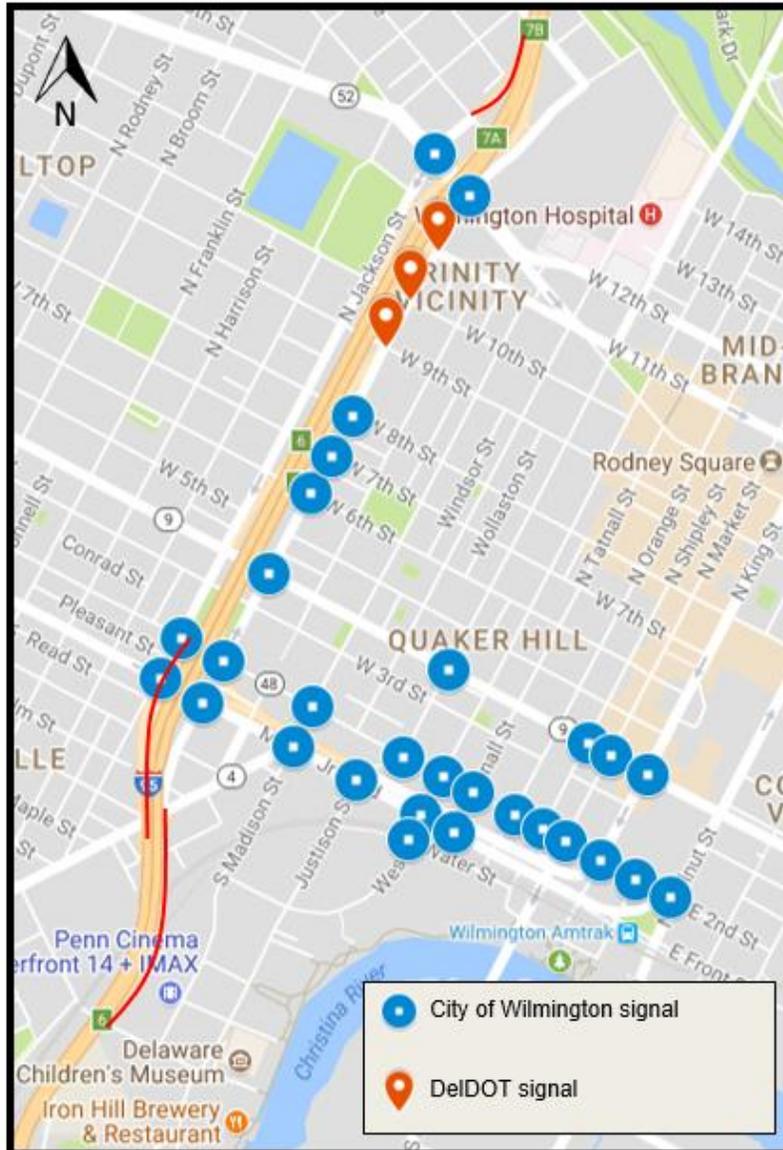
Figure 29 – Traffic Signals along Detour Routes for Phase 2B Ramp Closures



Intersections:

1. Delaware Ave @ Van Buren St
2. Delaware Ave @ N Jackson St
3. Delaware Ave @ N Adams St
4. N Adams St @ 11th St
5. N Adams St @ 10th St
6. N Jackson St @ 10th St
7. N Jackson St @ 9th St
8. N Adams St @ 9th St
9. N Adams St @ 8th St
10. N Jackson St @ 8th St
11. N Jackson St @ 7th St
12. N Adams St @ 7th St
13. N Adams St @ 6th St
14. N Jackson St @ 6th St
15. N Adams St @ 4th St
16. N Jackson St @ 4th St
17. N Jackson St @ 3rd St
18. N Adams St @ 2nd St
19. N Jackson St @ 2nd St
20. N Jackson St @ MLK Blvd
21. MLK Blvd @ Madison St
22. 2nd St @ Madison St
23. MLK Blvd @ Justison St
24. 2nd St @ Washington St
25. West St @ Water St
26. MLK Blvd @ West St
27. 2nd St @ West St
28. MLK Blvd @ Tatnall St
29. 2nd St @ Tatnall St
30. 2nd St @ Orange St
31. 2nd St @ Shipley St
32. 2nd St @ Market St
33. 2nd St @ King St
34. 2nd St @ Walnut St
35. 4th St @ N King St
36. 4th St @ N Market St
37. 4th St @ N Shipley St
38. 4th St @ Washington St

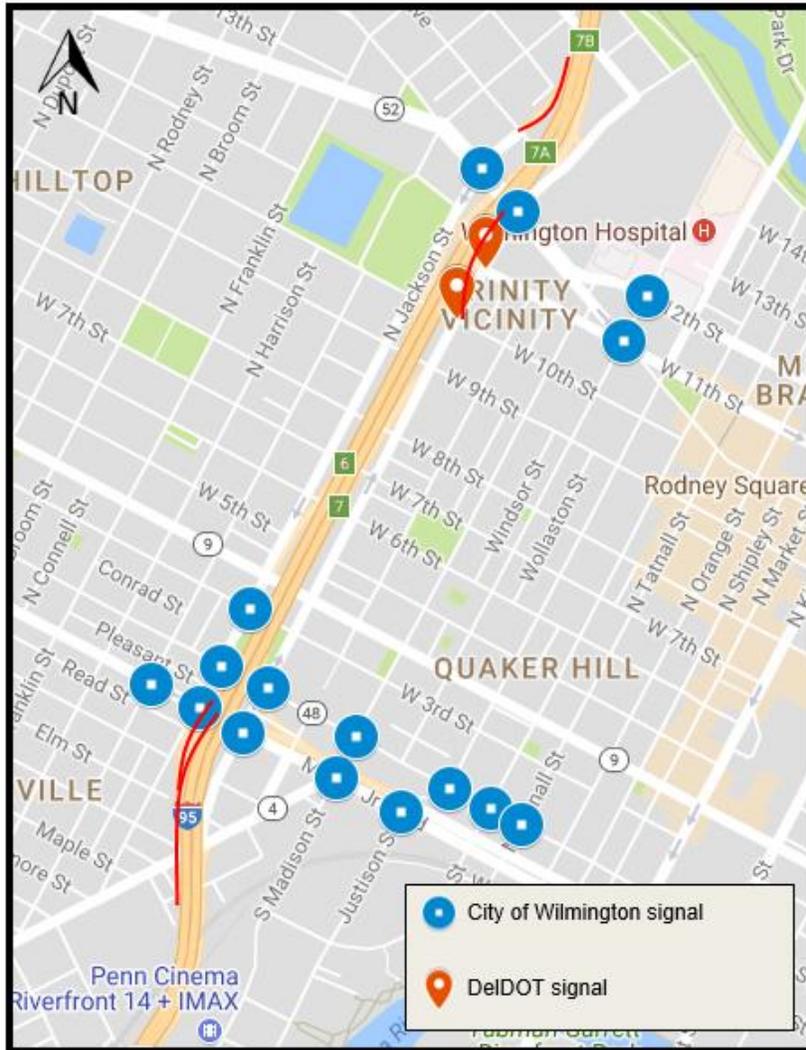
Figure 30 – Traffic Signals along Detour Routes for Phase 3A Ramp Closures



Intersections:

1. Delaware Ave @ N Jackson St
2. Delaware Ave @ N Adams St
3. N Adams St @ 11th St
4. N Adams St @ 10th St
5. N Adams St @ 9th St
6. N Adams St @ 8th St
7. N Adams St @ 7th St
8. N Adams St @ 6th St
9. N Adams St @ 4th St
10. N Adams St @ 2nd St
11. N Jackson St @ 2nd St
12. N Jackson St @ MLK Blvd
13. N Adams St @ MLK Blvd
14. MLK Blvd @ Madison St
15. 2nd St @ Madison St
16. MLK Blvd @ Justison St
17. 2nd St @ Washington St
18. West St @ Water St
19. MLK Blvd @ West St
20. 2nd St @ West St
21. MLK Blvd @ Tatnall St
22. 2nd St @ Tatnall St
23. 2nd St @ Orange St
24. 2nd St @ Shipley St
25. 2nd St @ Market St
26. 2nd St @ King St
27. 2nd St @ Walnut St
28. 4th St @ N King St
29. 4th St @ N Market St
30. 4th St @ N Shipley St
31. 4th St @ Washington St

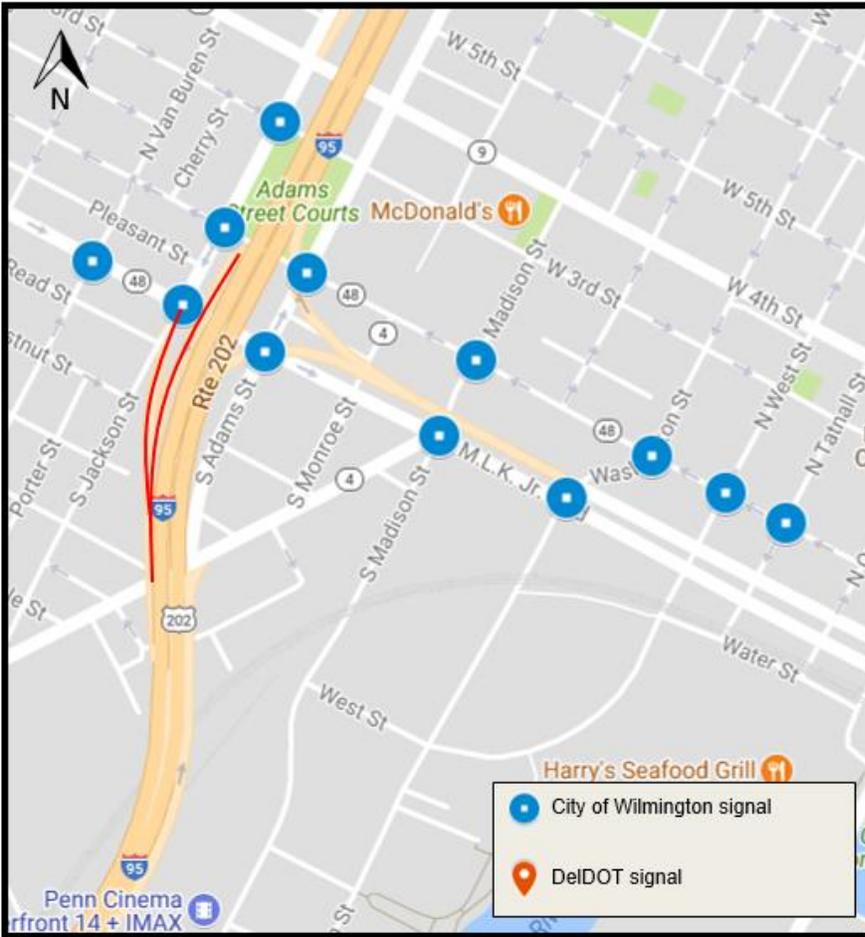
Figure 31 – Traffic Signals along Detour Routes for Phase 3B Ramp Closures



Intersections:

1. Delaware Ave @ N Jackson St
2. Delaware Ave @ N Adams St
3. N Adams St @ 11th St
4. N Adams St @ 10th St
5. N Jackson St @ 3rd St
6. N Adams St @ 2nd St
7. N Jackson St @ 2nd St
8. MLK Blvd @ Van Buren
9. N Jackson St @ MLK Blvd
10. N Adams St @ MLK Blvd
11. MLK Blvd @ Madison St
12. 2nd St @ Madison St
13. MLK Blvd @ Justison St
14. 2nd St @ Washington St
15. 2nd St @ West St
16. 2nd St @ Tatnall St

Figure 32 – Traffic Signals along Detour Routes for Phase 4 Ramp Closures



- Intersections:
1. N Jackson St @ 3rd St
 2. N Adams St @ 2nd St
 3. N Jackson St @ 2nd St
 4. MLK Blvd @ Van Buren
 5. N Jackson St @ MLK Blvd
 6. N Adams St @ MLK Blvd
 7. MLK Blvd @ Madison St
 8. 2nd St @ Madison St
 9. MLK Blvd @ Justison St
 10. 2nd St @ Washington St
 11. 2nd St @ West St
 12. 2nd St @ Tatnall St

To assist in making signal timing adjustments, a *Synchro* model was developed for the signals along the most heavily-impacted corridors – Adams Street, Jackson Street, Lancaster Avenue/Martin Luther King, Jr. Boulevard, and 2nd Street. This model can be used as necessary to analyze expected traffic diversions and improve signal timings and coordination during each phase of construction.

The model has already been used to guide design of the reconstructed 2nd Street on-ramp to southbound I-95 – additional left-turn lanes on Martin Luther King, Jr. Boulevard at Adams Street and on 2nd Street at Adams Street were provided to accommodate the additional demand generated on these roads due to the removal of the Jackson Street leg of the existing on-ramp. The model showed inadequate traffic flow in both existing and design-year conditions, and it was determined that additional left-turn lanes at these locations were required to improve traffic flow and provide the required capacity. Further, signal timing adjustments were also recommended due to the analysis conducted with this model.

C. Diversion Routes

During the project, there will be sustained lane closures along mainline I-95, significantly reducing roadway capacity to the point where, during peak hours, delays will occur and motorists will divert to alternate routes as they travel through the Wilmington area. While it is infeasible to anticipate and quantify impacts to every area roadway, primary and alternate diversion routes were identified.

The principal diversion route is I-495 – a six-lane interstate bypassing the entire project area. The southern section of I-495 between I-95 and US 13, which will receive the most diverted traffic from the I-95 lane and ramp closures, operates under capacity by approximately one full lane in each direction, even during the peak periods. **Figures 33** and **34** depict the hourly midweek and weekend traffic volumes in this area, respectively.

Figure 33 – I-495 south of US 13 Midweek Traffic Volumes

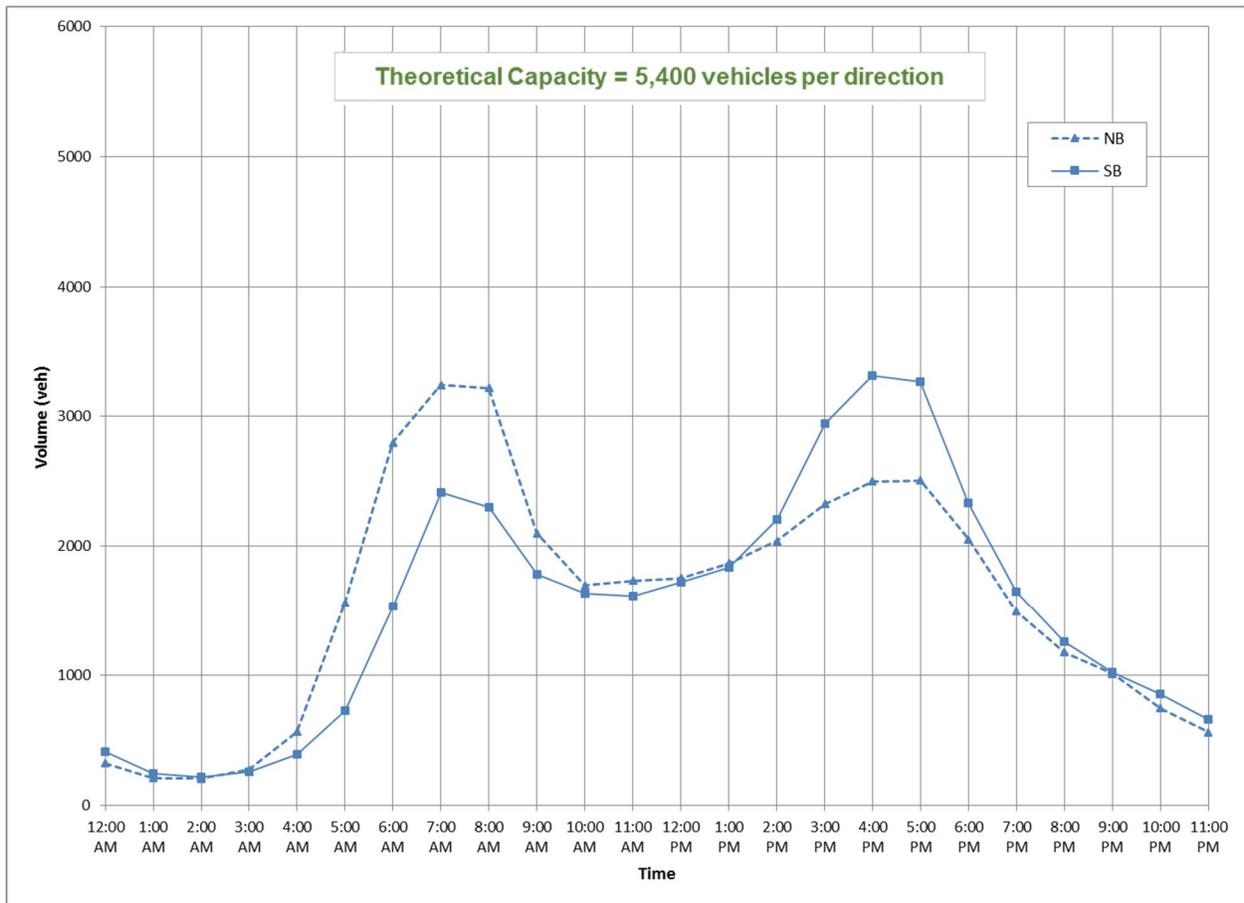
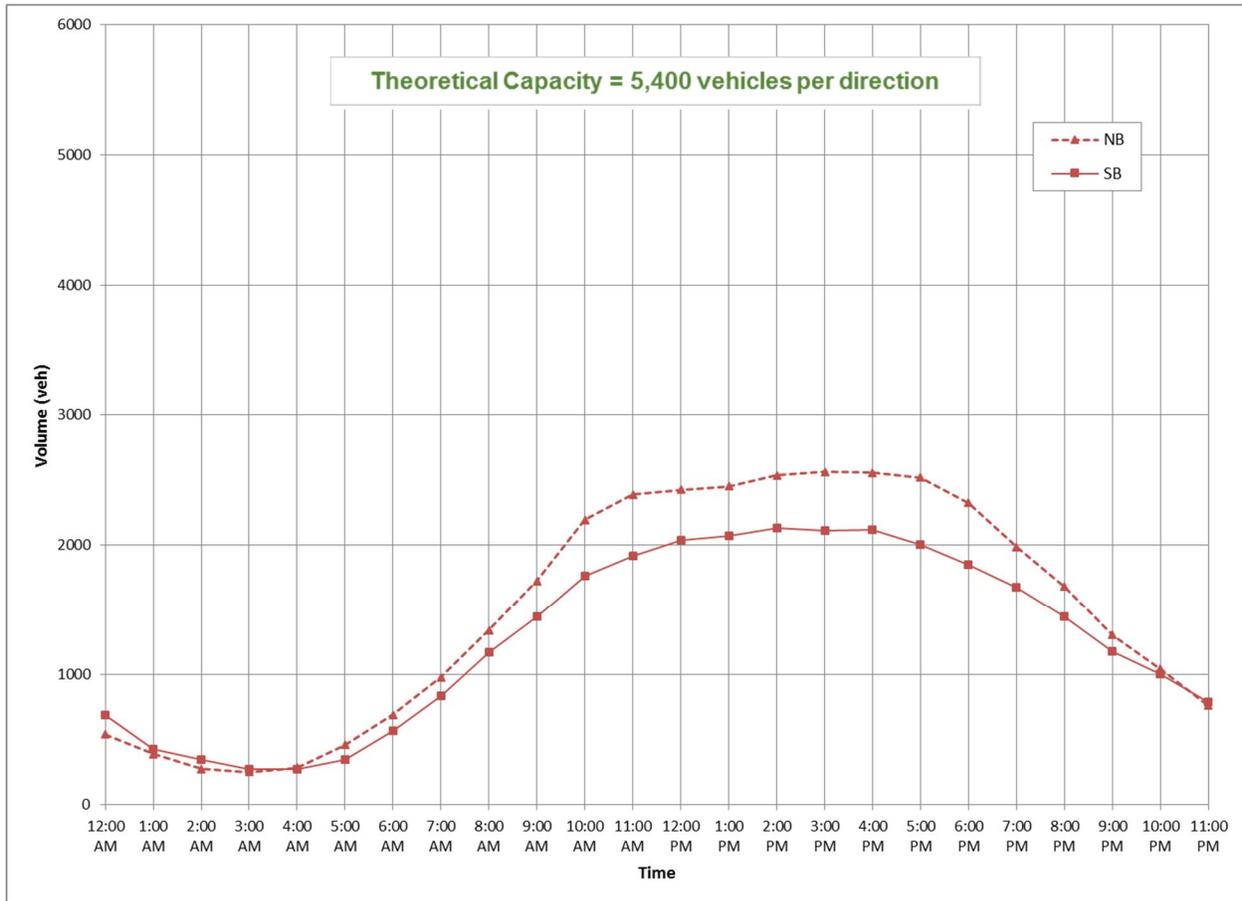


Figure 34 – I-495 south of US 13 Weekend Traffic Volumes



Despite I-495 providing significant diversion capacity, much of the impacted I-95 traffic has origins and destinations in downtown Wilmington and/or north of the city on US 202. For these motorists, I-495 is not a feasible alternative, and other diversion routes are more likely to be used. Routes expected to have significant traffic volume increases include (in order of projected impacts): SR 141, US 13, SR 2, SR 4, SR 9, and SR 3, among others. These diversions will be required primarily due to mainline I-95 lane closures, which occur throughout the entire project, and are less impacted by specific ramp closures during construction phases. Signals along these routes should therefore be optimized to projected traffic increases prior to project commencement. Advanced Traffic Management System (ATMS) plans have been created and included with the semifinal plan submission. The plans depict a system to monitor traffic via ITMS devices along the diversion routes and convey messages and detours to motorists in real-time. Data collected to support the ATMS will include travel times obtained by Bluetooth traffic recorders along I-95, I-495, SR 141, US 13, US 202, SR 2, and SR 4; system loop data along many arterials to assess volume changes; and Wavetronix spot-speed and volume recorders throughout both the interstates and diversion routes.

Additional capacity for diversion traffic will also be provided by the completion of the proposed Christina River Bridge (CRB) prior to performing significant work on the Wilmington Viaduct. DeIDOT tasked WRA with analyzing impacts to the Viaduct project with and without the CRB. The summary report of this effort is provided in **Appendix B**.

IV. Work Zone Impacts Management Strategies

A. Traffic Control Plan

A traffic control plan (TCP) has been developed in accordance with the *DE MUTCD* (see semifinal submission).

B. Public Information Plan

Outreach has begun with City of Wilmington officials – to date, WRA has conducted the following meetings:

- Presented the project to Wilmington Initiatives
- Presented the project to the State Chamber of Commerce
- Multiple presentations to the Mayor's staff
 - General Project Overview
 - Two meetings to discuss the new 2nd Street ramp configuration

Additionally, a presentation is scheduled with the Wilmington Committee of 100 on March 1, 2018; and an article was included in Committee of 100 Newsletter.

Working groups will be established during the planning phases of the project, followed by construction advisory groups closer to the project start date.

The following strategies will be used to notify road users of the lane shifts, lane closures, and ramp detours required for the roadway upgrades:

- Portable changeable message signs (PCMSs) shall be installed per the TCP. In addition to the locations depicted in the TCP, PCMSs shall be placed in close proximity to each work area two weeks prior to the start of construction.
- Press releases
- DeIDOT travelers advisory radio station (WTMC - 1380 AM)
- DeIDOT website
- MyDeIDOT e-mail alerts

C. Transportation Operations Plan

The following strategies will be used to mitigate work zone impacts during the lane shifts, lane closures, and ramp detours required for the roadway upgrades:

- Portable changeable message signs (PCMSs) per the TCP
- 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 DeIDOT Construction with a current list of contact information for key field and office personnel, including 24-hour emergency phone numbers, and an updated construction schedule to be forwarded to the TMC.

- Coordination with other construction projects – Prior to and during the project, DeIDOT should coordinate with other simultaneous projects within the work area.
- Coordination with the media – DeIDOT's Community Relations and Construction sections and the TMC will work with the local media to publicize information regarding traffic delays approaching the work zones.
- Detour routes – Detour routes have been developed to minimize impacts to motorists along these routes.
- Safety Officers – DeIDOT's Safety Officer should routinely monitor safety and operations of the work zones and serve as a contact during emergencies.
- 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.

V. TMP Monitoring Requirements

A. Verification of Work Zone Setup

When lane and ramp closures are implemented, the contractor's ATSSA-certified supervisor, DeIDOT Construction, and DeIDOT's Safety Officer should review the maintenance of traffic setup to confirm that it is in compliance with the *DE MUTCD*: Part 6 and the TCP.

B. Monitoring of TMP Performance

During lane closures, DeIDOT should monitor queues and delays approaching the lane closures and identify the need for modifications to the traffic control. Routine work zone reviews should be performed by the contractor's ATSSA-certified supervisor, DeIDOT Construction, and DeIDOT's Safety Officer throughout the duration of the project to ensure that traffic control devices are maintained in accordance with the *DE MUTCD*: Part 6 and the TCP.

Additionally, DeIDOT will utilize its ITMS network to collect data prior to project commencement to establish baseline "before" conditions. During the project, this data can be compared to observed traffic conditions. Areas of concern can be quickly addressed by DeIDOT's TMC and messages and diversions can be communicated to motorists in accordance with the Advanced Traffic Management System. Analyzed data will include real-time travel times obtained by Bluetooth traffic recorders along I-95, I-495, SR 141, US 13, US 202, SR 2, and SR 4; system loop data along many arterials to assess volume changes; and Wavetronix spot-speed and volume recorders throughout both the interstates and diversion routes.

VI. Contingency Plans

Table 5 summarizes the initial emergency contacts for the project in the event of an incident within the work zones. At the preconstruction meeting for this contract and/or immediately prior to construction, the contractor should provide DeIDOT Construction with a current list of contact information for key field and office personnel, including 24-hour emergency phone numbers.

As part of the contingency plan, DeIDOT and contractor staff will meet with emergency responders and setup recurring meetings to discuss the project and impacts.

Table 5 – Initial Emergency Contacts

Name	Title / Agency	Phone Number
Steve Richter	Bridge Design Program Manager – DelDOT	302-760-4809
Jerry Nagyiski	DelDOT	302-659-4072
Marvin Pedigo	North District Safety Officer – DelDOT	302-222-5997
Don Weber	Chief Traffic Operations Engineer – DelDOT	302-659-4651
Transportation Management Center	DelDOT	302-659-4600

VII. TMP Implementation Costs

The preliminary cost for installation and maintenance of traffic control devices in accordance with the traffic control plan is \$13,335,000.

Additional ITMS devices recommended to be installed prior to the beginning of the project (permanent changeable message signs, Wavetronix and Bluetooth traffic data recorders, and CCTV cameras) will cost approximately \$764,000.

VIII. Next Steps

Estimated road user costs should be determined for each project phase, similar to the work that was done to compare the current and previous construction phasing and to calculate user costs specific to the Christina River Bridge. These costs will provide a basis for contractor incentives and disincentives during construction.

ATMS plans need to be updated with the specific logic and thresholds from DelDOT’s ITMS network that are recommended to activate/deactivate each message set.