Cape Fear Memorial Bridge Improvements Study

NCDOT Project HB-0039

Capacity Analysis Report

New Hanover and Brunswick County

February 2024

PREPARED FOR:

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

CAPE FEAR MEMORIAL BRIDGE IMPROVEMENTS STUDY
CAPACITY ANALYSIS

STATE TRANSPORTATION IMPROVEMENT PROJECT HB-0039
NEW HANOVER AND BRUNSWICK COUNTY

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Executive Summary

The North Carolina Department of Transportation (NCDOT) proposes to construct STIP HB-0039, which involves replacing and widening Bridge No. 640013 (Cape Fear Memorial Bridge) over the Cape Fear River on US 17/76/421 in Brunswick and New Hanover County. These improvements may include widening and interchange improvements within the study area. To alleviate traffic congestion, the current roadway and intersection geometries are under consideration for improvements. The primary objective of this capacity analysis is to assess traffic conditions in the base year (2023) and future year (2050) of the project study area with and without improvements using the TransModeler traffic simulation software (Version 6.1, Build 8655) to determine the anticipated impact of the proposed improvements within the study area. The two potential alternatives analyzed in this report are:

- **Alternative A** – Widen US 17/76/421 to 6 lanes from US 17/74/NC 133 to Front Street utilizing a new movable bridge with 65' clearance. This alternative also includes improvements to S Front Street including widening to 4 lanes from the U-5734 project limits to Front Street at US 17/76/421 WB On Ramp and a new signal at Front Street at US 17/76/421 WB On Ramp.
- **Alternative B** – Widen US 17/76/421 to 6 lanes from US 17/74/NC 133 to Front Street and removing access at 3rd Street and 4th Street. The removal of access to 3rd Street and 4th Street was due to limitations in the roadway geometry as the bridge is anticipated to be constructed with a clearance of 135 feet versus the 65-foot clearance in Alternative A. Due to the reduced access, turn lane improvements were proposed along S 5th Avenue to accommodate future traffic volumes. As part of this alternative, the S Front Street ramp intersections were reconfigured to allow the on and off ramps via one roundabout intersection to be located at the existing S Front Street and US 17/76 On Ramp. In addition, the Front Street was proposed to be widened to 4 lanes from U-5734 project limits to US 17/76/421 WB On Ramp.

2023 No-Build Scenario

The analysis of the 2023 conditions along the corridor showed 2 freeway sections out of the 12 operate at Level of Service (LOS_S) E or LOS_S F during each the AM and the PM peak hours (the failing segments were in the eastbound direction for the AM and westbound direction for the PM). The model had an average vehicle speed of 40.7 mph and 39.5 mph during the AM and PM peak hours, respectively. All intersections analyzed operated at an overall LOS_S D or better, indicating acceptable overall operations. During the AM peak hour, all of the lane groups at signalized intersections operated acceptably at a LOS_S D or better, except at the intersection of Wooster Street and 3rd Street, which had one lane group operating at LOS_S E. During the PM peak hour, all signalized intersections had at least one lane group operating at a LOS_S E or LOS_S F with the exception of Dawson Street at 3rd Street. At times, this resulted in longer queuing that spilled beyond the storage capacity of the lane but was not significant enough to affect operations at adjacent intersections.

2050 No-Build Scenario

The 2050 No-Build analysis was performed to show the impacts on traffic operations of the projected traffic volumes in the study area if no improvements are made to the roadway network. During the AM and PM peak hours, respectively, 7 of the 12 and 10 of the 12 freeway segments experienced LOS_S E or worse. The model had an average vehicle speed of 30.7 mph and 30.1 mph during the AM and PM peak hours, respectively. Based on a review of the intersection analysis, all intersections had at least one lane group that was found to operate at LOS_S E or LOS_S F during either the AM and PM peak hours. A review of the queuing data and model animation found that queuing is expected to impact the freeway and surrounding arterials with queues along Front Street, 3rd Street, Wooster Street, and US 17/76 anticipated to extend outside of the study network during the AM and PM peak hours.

2050 Build Alternative A Scenario

The 2050 Build Alternative A analysis was performed to show the impacts on traffic operations of the projected traffic volumes in the study area with Alternative A improvements made to the roadway network. During the AM and PM peak hours, 6 of the 11 freeway segments experienced LOS_S E or worse. The model had an average vehicle speed of 36.3 mph and 35.1 mph during the AM and PM peak hours, respectively. The overall LOS_S for the signalized intersections in the 2050 Future Year Build Alternative A analysis shows that 1 of the 5 signalized intersections operate unacceptably at a LOS_S E or worse in the AM peak hour and 3 of the 5 intersections operate unacceptably in the PM peak hour. A review of the queuing data and model animation found that queuing is expected to impact the freeway and surrounding arterials as minimal improvements were able to be made along 3rd Street and 5th Street. It showed that multiple turn bay storage lengths were not sufficient to contain all turning movement queues during the AM and PM peak hours. Based on the heavy volumes and heavy queues along 3rd Street, queueing was noted to extend beyond the study network in both the northbound and southbound directions. This queuing on 3rd Street was shown to impact queuing and delays along Wooster Street as well as along the eastbound US 17/76, causing queues to spillback along the freeway.

2050 Build Alternative B Scenario

The 2050 Build Alternative B analysis was performed to show the impacts on traffic operations of the projected traffic volumes in the study area with Alternative B improvements made to the roadway network. During the AM and PM peak hours, respectively, 3 of the 11 and 2 of the 11 freeway segments experienced LOS_S E or worse. The model had an average vehicle speed of 39.0 mph and 35.6 mph during the AM and PM peak hours, respectively. The overall LOS_S for the signalized intersections in the 2050 Future Year Build Alt 2 Analysis shows that both signalized intersections operate unacceptably at a LOS_S E or worse in each the AM and PM peak hour, except the intersection of US 17/76 (Wooster Street) and S 5th Avenue during the AM peak hour. It should be noted that 2 signalized intersections were removed as part of this alternative, which is expected to overall reduce delays experienced along the corridor but may show slightly higher delays at the remaining signalized intersections due to the increased turning movement traffic expected at these intersections. A review of the queuing data and model animation found that queuing is expected to impact the freeway and surrounding arterials. It showed that the

southbound left-turn bay storage length at the intersection of US 17/76 (Dawson Street) and S 5th Avenue was not sufficient to contain all turning movement queues during the AM and PM peak hours. Queuing was not shown to extend to the S Front Street ramps along US 17/76. During the PM peak hour, heavy queuing is expected on the westbound approach at the intersection of US 17/76 (Wooster Street) and S 5th Avenue, as well as on the northbound approach at the intersection of US 17/76 Ramps and S Front Street.

Conclusions

Based on the results of the analysis, operations along the Cape Fear Memorial Bridge corridor and at adjacent study area intersections are expected to deteriorate by the year 2050 without any proposed improvements. As discussed in **Section 8.8**, freeway densities as well as queues at intersections within the study area would experience large increases between the 2023 year and 2050 year analyses. These increases would cause higher densities along the freeway which creates stop and go conditions through most of the model.

Alternative A and Alternative B are expected to provide relief to the roadway network based on analysis findings. Alternative A results indicate a reduction in VHT of 411.3 hours and an increase in network travel speed of 5.3 mph on average, as compared to 2050 No-Build conditions. Alternative B results indicate a reduction in VHT of 592.1 hours and an increase in network travel speed of 6.9 mph on average, as compared to 2050 No-Build conditions. Queuing was also shown to improve between 2050 No-Build and 2050 Build (Alternative A and Alternative B) conditions throughout the study area.

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1. Project Background

HDR Engineering, Inc. of the Carolinas (HDR) has been retained by the State of North Carolina Department of Transportation (NCDOT) to develop and evaluate traffic operations for NCDOT Project Number HB-0039 in New Hanover County and Brunswick County. The HB-0039 project proposes replacing and widening Bridge No. 640013 (Cape Fear Memorial Bridge) over the Cape Fear River on US 17/76/421. As part of this study, improvements were considered along the Front Street, 3rd Street, and 5th Avenue corridors in Wilmington. This study also encompasses the analysis for the trumpet interchange with US 74/421 ramps along US 17/76/421 west of the Cape Fear River.

1.1 Purpose of Technical Memorandum

The purpose of this technical memorandum is to quantify existing and future traffic conditions with and without the proposed project to provide a comparison of level of service (LOS) with the future-year build alternatives. LOS is determined using data from *TransModeler* traffic simulation software (Version 6.1, Build 8655) and then compared to Highway Capacity Manual (HCM) 6 thresholds. *TransModeler* tracks individual vehicle movements and interactions and quantifies overall intersection delays more realistically than typical HCM methods, but for the purposes of this analysis the LOS criteria are based on HCM 6 metrics. This report is limited to traffic engineering measures of effectiveness (MOE's) and does not account for any financial metrics, including cost of ROW acquisition, structures, inflation adjustment, etc.

1.2 Study Area Description

US 17/76, a four-lane median-divided facility, is the primary east-west route that traverses to/from Wilmington. US 17 is a major regional route as it runs north-south along the eastern coast of South Carolina and North Carolina, passing through a number of major cities along the route, such as Charleston, Myrtle Beach, Wilmington, Jacksonville, and New Bern. US 421 is a major regional route, running in a north-south direction going to/from Greensboro.

The study area includes two interchanges along the corridor with one entirely free flow in nature. Forecasted volumes along US 17/76/421 over the Cape Fear Memorial Bridge indicate up to 65,200 vehicles per day within the study area in the year 2023, a number that is forecasted to increase to 94,900 by the year 2050. The project study area includes the following intersections and can be seen in **Figure 1**:

- US 17/76 On-Ramp and S Front Street
- US 17/76 Off-Ramp and S Front Street
- US 17/76 (Wooster Street) and US 17 BUS (S 3rd Street)
- US 17/76 (Dawson Street) and US 421 (S 3rd Street)
- US 17/76 (Dawson Street) and S 4th Street
- US 17/76 (Wooster Street) and S 5th Avenue
- US 17/76 (Dawson Street) and S 5th Avenue

2. Description of Scenarios Analyzed

The scenarios evaluated as part of this study include the following:

- 2023 No-Build
- 2050 No-Build
- 2050 Build Alternative A
- 2050 Build Alternative B

2.1 2023 Base Year No-Build Scenario

The 2023 No-Build scenario reflects the base year traffic volumes and roadway network configuration within the study area and will serve as a “baseline” with which to compare with the future-year scenarios. No calibration was performed on this model but a check of the volumes produced within the model was performed to verify the requisite volumes were produced. The 2023 No-Build volumes were based on the traffic forecast provided by NCDOT.

2.2 2050 Future Year No-Build Scenario

The 2050 No-Build scenario reflects the same roadway network configuration as in the 2023 No-Build Scenario with the inclusion of the improvements made to Front Street as part of the U-5734 project which is assumed to be completed by 2050. The projected future year traffic volumes based on traffic forecasts provided by NCDOT.

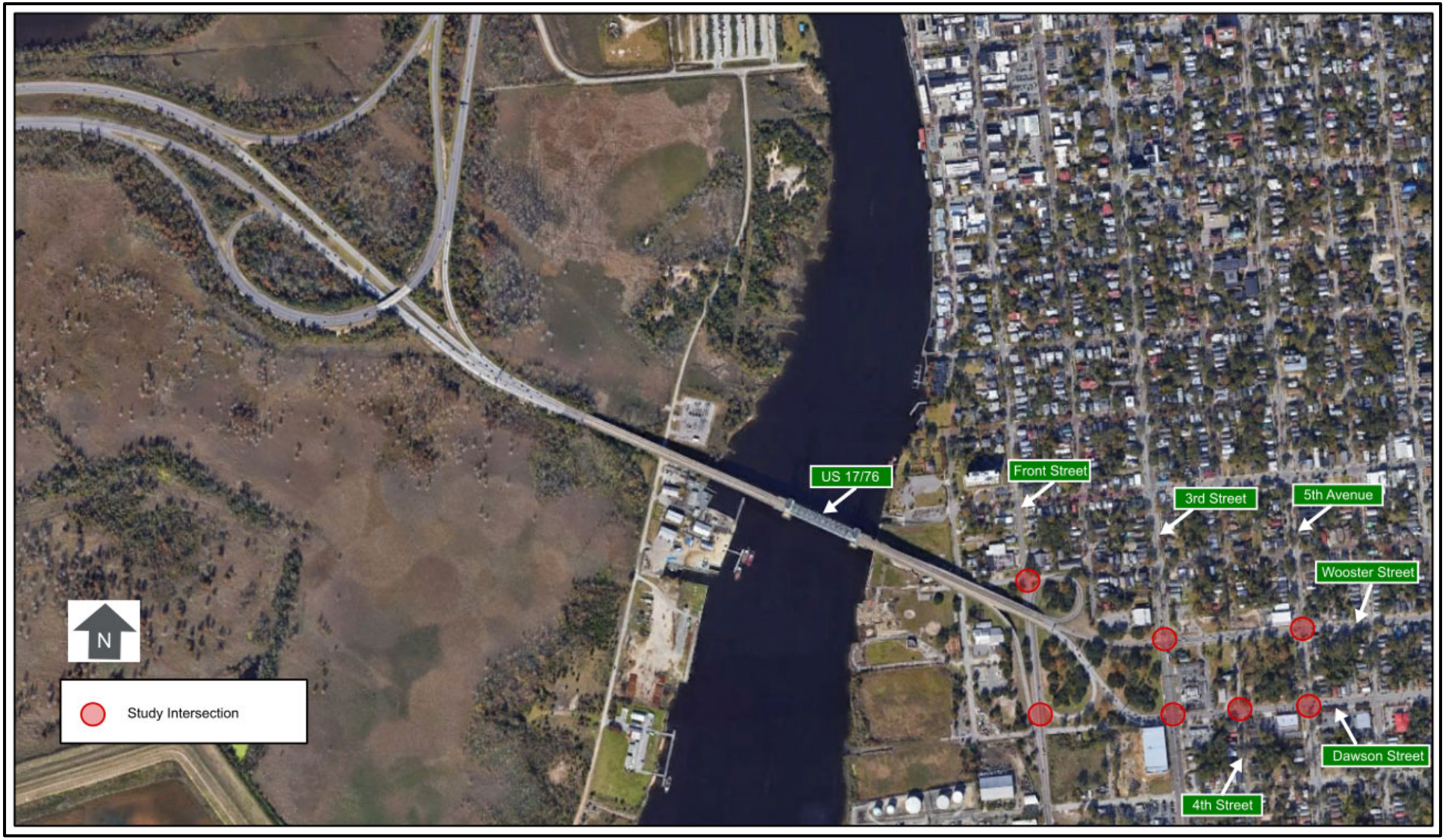
2.3 2050 Future Year Build Alternative A Scenario

The 2050 Build Alternative A scenario includes widening Cape Fear Memorial Bridge to 6 lanes. The new Cape Fear Memorial Bridge is anticipated to be constructed to the south of its current location. This alternative also includes improvements to S Front Street including widening S Front Street to four lanes within the interchange of the interchange and improvements to the ramp terminals. Additional improvements were considered along 3rd Street and 5th Avenue but were eliminated due to the impacts to the historic district. Traffic volumes for the 2050 Build Alternative A utilized the same volumes as the 2050 Future Year No-Build. Refer to **Section 9** of the report for further details on the proposed design.

2.4 2050 Future Year Build Alternative B Scenario

The 2050 Build Alternative B scenario includes widening Cape Fear Memorial Bridge to 6 lanes and removing access at 3rd Street and 4th Street. The removal of access to 3rd Street and 4th Street was due to limitations in the roadway geometry as the bridge is anticipated to be constructed with a clearance of 135 feet versus the 65-foot clearance in Alternative A. The new Cape Fear Memorial Bridge is anticipated to be constructed to the south of its current location. Due to the reduced access, turn lane improvements are proposed along S 5th Avenue to accommodate future traffic volumes. As part of this alternative, the S Front Street ramp intersections were reconfigured to allow the on and off ramps via one roundabout intersection to be located at the existing S Front Street and US 17/76 On Ramp. Future year Alternative B traffic volumes based the forecast provided by NCDOT that was developed assuming reduced connectivity to 3rd Street and 4th Street. Refer to **Section 9** of the report for further details on the proposed design.

Figure 1: Project Study Area



3. Methodology

The analysis of the US 17/76/421 corridor was performed using *TransModeler*. *TransModeler* is a microscopic, behavior based multi-purpose traffic simulation program that was selected for this project due to the complexity of the project and the need to be able to analyze the interaction of signals and interchanges along the corridor. The microscopic model was developed for the 2023 and 2050 scenarios and was developed from data collected for the transportation network. The model was then visually validated against observations of the study corridor made in the field on September 20, 2023, during peak hour conditions. This microscopic simulation model was developed in accordance with the NCDOT Congestion Management Simulation Guidelines.

4. Measures of Effectiveness

Measures of Effectiveness (MOE) are system performance statistics produced by the simulation to show the improvement that a particular alternative would have over the base network conditions. As the analysis in this report only includes the no-build scenarios, the MOE's will be used to determine the need for further study of this corridor.

Traffic conditions in each scenario were quantified using the MOE's as specified by *NCDOT Congestion Management Simulation Guidelines*.

- Arterial MOE's
    - Average control delay (in seconds per vehicle) and LOS, for each lane group approaching an intersection in addition to the whole intersection (weighted according to flow rate)
    - Average queue length (in feet), for each lane group approaching an intersection
    - Spillback rate (time of spillback as a percentage of the total analysis time), for each lane group approaching an intersection
    - Maximum queue length (in feet), for each approach to an intersection
- Freeway MOE's
    - Average Density (in vehicles per lane per mile) for each freeway segment.
- Network MOE's
    - Vehicle Hours Traveled (VHT)
    - Vehicle Miles Traveled (VMT)
    - Average Speed (in miles per hour)
    - Average Delay (in hours)
- Corridor MOE's
    - Travel Time (in minutes)
    - Travel Speeds (in miles per hour)

MOE's are reported for all lane groups at signalized intersections, and only those lane groups with conflicting movements at two-way stop control (TWSC) intersections. LOS and the associated thresholds of average control delay for both types of intersections are summarized in **Table 1**.

Table 1: LOS for Interrupted Flow Facilities*

LOS	Signalized Intersections (s)	TWSC Intersections (s)
A	≤ 10	≤ 10
B	> 10-20	> 10-15
C	> 20-35	> 15-25
D	> 35-55	> 25-35
E	> 55-80	> 35-50
F	> 80, and/or v/c > 1.00	> 80, and/or v/c > 1.00

*Based on *Highway Capacity Manual (HCM) 6th Edition* Exhibits 19-8 and 20-2

Average control delay in the Highway Capacity Manual (HCM) is derived differently from that of the reported MOE's from microsimulation. Thus, as an indication that level of service in the context of this report is not explicitly HCM-compliant, it is denoted as LOS_S.

Freeways have multiple sets of thresholds for LOS and depend on the type of freeway segment being considered. The first set of thresholds for LOS are for basic freeway segments and are shown in **Table 2**. The second set of thresholds for LOS are for merge or diverge segments and are shown in **Table 3**. The type of freeway segment is determined by *TransModeler* in the Freeway LOS output.

Table 2: LOS for Uninterrupted Flow Freeway Facilities*

LOS	Freeway Segment Density (veh/ln/mi)
A	≤ 11
B	> 11-18
C	> 18-26
D	> 26-35
E	> 35-45
F	> 45, and/or v/c > 1.00

*Based on *Highway Capacity Manual (HCM) 6th Edition* Exhibit 12-15

Table 3: LOS for Freeway Merge/Diverge Facilities*

LOS	Freeway Segment Density (veh/ln/mi)
A	≤ 10
B	> 10-20
C	> 20-28
D	> 28-35
E	> 35
F	v/c > 1.00

*Based on *Highway Capacity Manual (HCM) 6th Edition* Exhibit 14-3

For this report, an acceptable LOS is defined as LOS D or better while unacceptable or failing LOS is defined as LOS E or LOS F for both freeway and intersection LOS.

For this report, the Corridor MOE's were developed for the eastbound and westbound movements along US 17/76 from the western edge of the study area to the eastern edge of the study area.

5. Traffic Volume Development

Traffic volume forecasts for the scenarios (2023 No-Build, 2050 Build Alternative 1, and 2050 Build Alternative 2) used in this analysis were provided by NCDOT (**Appendix A**). For this report, 2050 Future Year No-Build and Build Alternative A utilize the 2050 Build Alternative 1 Forecast while Build Alternative B utilizes the 2050 Build Alternative 2 Forecast. The traffic volume forecasts were then inserted into NCDOT's *Intersection Analysis Utility* (IAU) spreadsheet tool to determine the peak hour turning movement volumes (**Appendix B**). Several existing low-volume intersections were not included in the forecast report, and the K-factors and D-factors (which together convert the daily volumes to the peak hour volumes) vary along segments within the study area.

All the volume scenarios utilized an O-D Matrix developed from the forecasted IAU traffic volumes. Volumes for the interchanges were developed by balancing the volumes against the nearest intersections with imbalances being pushed off network where possible. The volumes used in the network can be seen in **Appendix B**.

An O-D Matrix was necessary for these scenarios due to the complexity of the roadways being analyzed. To develop the O-D Matrix, the IAU traffic volumes were input into a model with optimized signal timings. The model was then run for ten runs to allow all traffic to proceed through the network by the end of the model. The Trip Statistics O-D Matrix output report and the outputs were averaged across all ten runs. The O-D Matrix from the model was then adjusted to eliminate mid-block volume imbalances by pushing the imbalance to a boundary node utilizing engineering judgement to select the appropriate boundary node. Any volumes maintaining the same origin and destination node were rerouted through engineering judgement to exit the model through an appropriate new destination node. To balance out the rerouted volume, other O-D pairs were adjusted to maintain the proper turning movements throughout the network. This adjusted O-D Matrix was then input into their respective models for use as the traffic volume input.

6. Deviation from Default Values

No adjustments were made to the default values provided by NCDOT as a part of this study.

7. 2023 Base Year No-Build Analysis

7.1 Model Geometry

Aerial photographs from NC OneMap (New Hanover County and Brunswick County, 2023 imagery; http://nconemap.org/) were used as a background to develop the model network and were verified with newer aerial photographs from Google Earth. The limits of the model include US 17/76 from US 74 / 421 to S 5th Avenue. The existing lane configurations used in the model can be seen in **Figure 2.**

Figure 2: Existing Lane Configurations

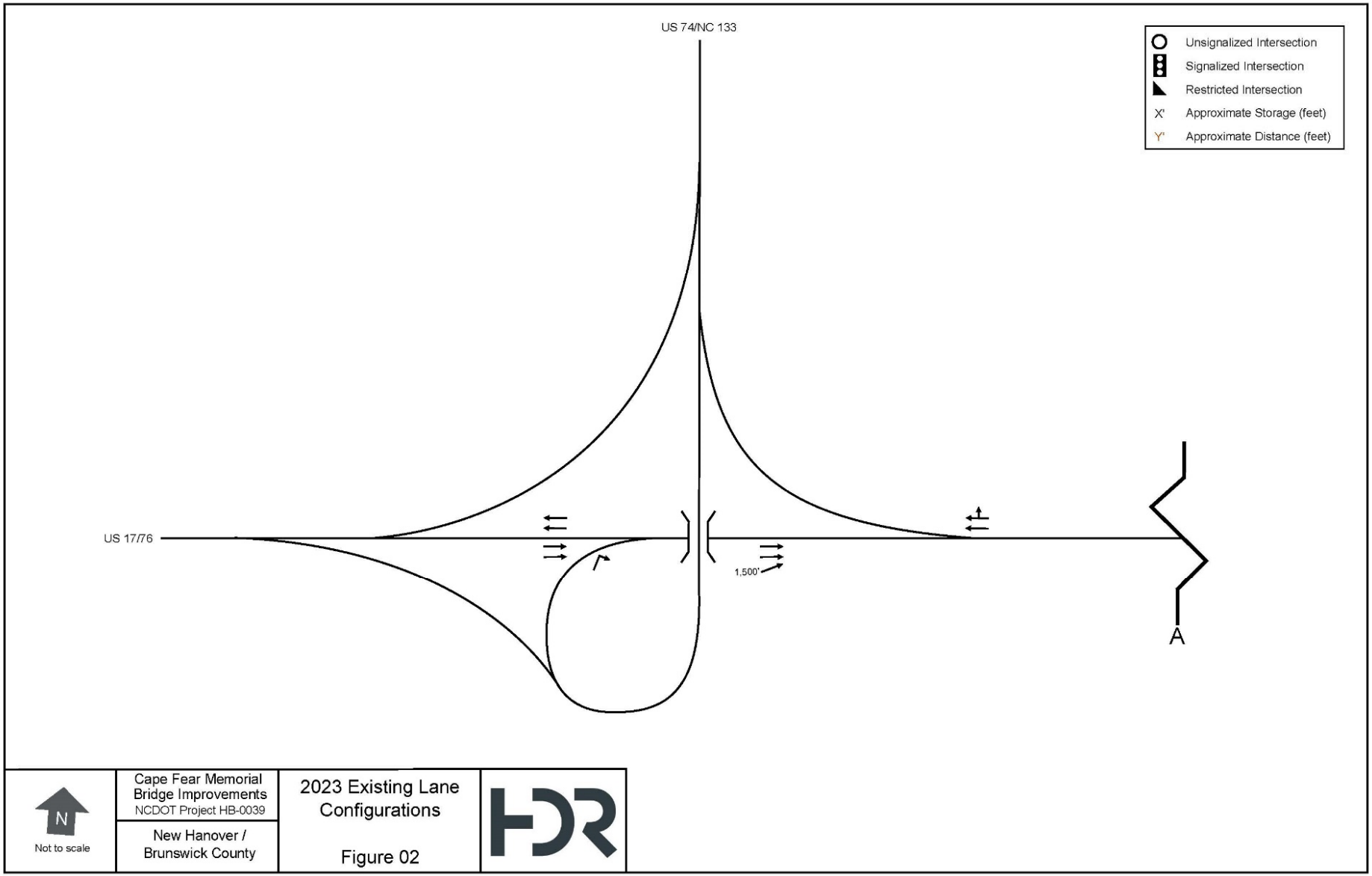
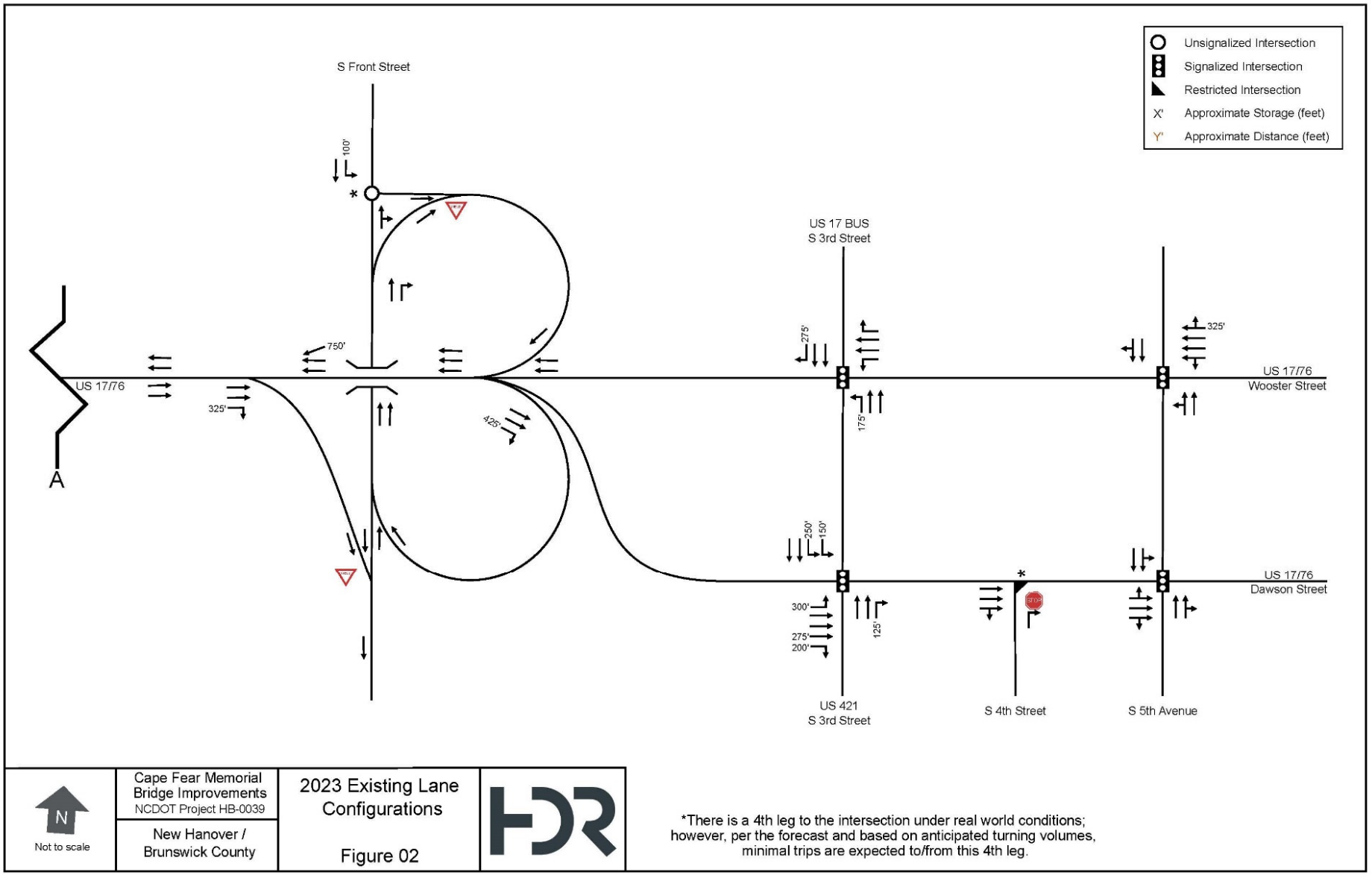


Figure 2: Existing Lane Configurations (cont'd)



7.2 Model Parameters

The base year no-build model uses the Level NCDOT default parameters file for *TransModeler*. Additionally, the model was set to be a one hour model with a 15 minute warm-up (seeding) period for each of the two peak hour time periods. This was done to ensure the model was properly seeded at the start of the runs while also ensuring that the model captured the entirety of the congestion period.

7.3 Intersections

The geometric layout for the intersections was coded based on the aerial photographs of the area. The base timings were coded based on the default guidelines presented in NCDOT Congestion Management Simulation Guidelines**.** The signal detectors were coded according to the Simulation Guidelines. For all signals in the study area, the minimum green, yellow, and all red timings from the signal control plan were entered into *TransModeler* and then the corridor optimization tool in *TransModeler* was used to replicate the coordinated condition.

As HCM 6 does not include methodology for determining the control delay of yield movements, it was decided in conjunction with NCDOT guidelines that these movements would be included in the signal and modeled with right turn on red allowed at the intersection of Wooster Street and 3rd Street. By modeling the movement in this manner, the control delay can be collected for these movements which will allow for better comparison of scenarios throughout the study.

7.3.1 Signal Optimization

As noted above, the intersections were optimized as coordinated signals where each arterial corridor was optimized separately. Once the signal timings were optimized for the model network, the signal timings were reviewed by the analyst to verify they were operating as expected.

7.4 Volume Data and Vehicle Routing

Traffic demand and vehicle inputs for the model were described in **Section 5**. The turning movement volumes for the 2023 base year analysis can be found in the IAU spreadsheets located in **Appendix B**. The output volumes from the model were compared against the input turning movement volumes to verify that the model is producing the necessary volumes. These checks can be found in **Appendix C**.

7.5 Outputs and Measures of Effectiveness

After running the simulation, the output statistics from the model runs were used to analyze the traffic conditions of the roadway network. Nodes for the delay and queue analysis as well as the links for the spillback queue analysis were defined into selection sets to create the analysis outputs needed. The MOE's used in the analysis are detailed in **Section 4** and are summarized in **Section 7.7**.

7.6 Simulation and Run Controls

The simulation software requires run control parameters be input into the model to help deliver a customized model for the local area which includes the random seed sequence. The random seed sequence varies each run in a multi-run simulation that is usually close to the average of all the runs but is completely different than the rest. After review of a ten-run scenario, it was determined that the default parameters and ten simulation runs recommended by NCDOT's *TransModeler* Guidelines would be sufficient for this project.

7.7 2023 Base Year No-Build Model Results

The output data was collected for the model via the Output Data manager and the Delay, Queue, Queue Spillback, and Freeway LOS reports. The outputs were collected to develop the MOE's described in **Section 4** and are summarized in the following pages.

7.7.1 Network Results

The results for the Network MOE's are summarized in **Table 4.** As described in **Section 4**, the network results were pulled from the Network Delay reports. The total vehicle hours traveled (VHT) was 502.2 hours and 558.8 hours during the AM and PM peak hours, respectively, with an average speed of 40.7 mph and 39.5 mph. The total vehicle miles traveled (VMT) was 19,213.8 miles and 20,418.9 miles during the AM and PM peak hours, respectively.

7.7.2 Corridor Results

The results for the Corridor MOE's are summarized in **Table 5.** In the eastbound direction, the corridor was found to operate with an average travel time of 3.77 minutes and 3.65 minutes in the AM and PM peak hours, respectively. In addition, the eastbound direction was found to operate at 40 mph and 41 mph in the AM and PM Peak hours, respectively. In the westbound direction, the corridor was found to operate with an average travel time of 3.52 minutes and 3.76 minutes in the AM and PM peak hours, respectively. In addition, the eastbound direction was found to operate at 42 mph and 39 mph in the AM and PM Peak hours, respectively.

7.7.3 Freeway Results

The results for the Freeway MOE's are summarized in **Table 6.** As described in **Section 4**, the freeway results were pulled from the Freeway LOS reports. During the AM peak hour, 2 of the 12 freeway segments experienced LOS_S E with the failing segments being in the eastbound direction along US 17/76/421. During the PM peak hour, 2 of the 12 segments experienced LOS_S E with the failing segments being in the westbound direction along US 17/76/421.

7.7.4 Arterial/Intersection Results

The results for the intersection analysis for intersections within the study area are summarized in **Table 7**. The overall LOS_S for the 4 total signalized intersections in the 2023 Base Year No-Build Analysis shows that all intersections in the AM and PM peak hours operate acceptably overall at a LOS_S D or better.

During the AM peak hour, all of the lane groups at signalized intersections operated acceptably at a LOS_S D or better, except at the intersection of Wooster Street at 3rd Street, which had one lane group operating at LOS_S E. During the PM peak hour, all signalized intersections had at least one lane group operating at a LOS_S E or worse with the exception of Dawson Street at 3rd Street.

Analysis was also done on the one unsignalized intersection along the corridor [Dawson Street and S 4th Street]. After a review of the analysis, it was found that the intersection was anticipated to operate acceptably during both time periods.

A review of the queuing data and model animation found that queuing along the arterials did not substantially affect traffic. It did show that some turn bay storage lengths were not sufficient to contain all turning movement queues during the AM and PM peak hours. This consisted of the following movements:

- Northbound left-turn lane at 3rd Street and Wooster Street
- Southbound left-turn lane at 3rd Street and Dawson Street

Table 4: 2023 No-Build Network Statistics

Time	Vehicle Hours Traveled (VHT)	Vehicle Miles Traveled (VMT)	Average Speed (mph)	Total Delay (hrs)
AM	502.2	19,213.8	40.7	132.2
PM	558.8	20,418.9	39.5	163.6

Table 5: 2023 No-Build Corridor Summary

O-D	Description	TRAVEL TIMES (min)		TRAVEL SPEEDS (mph)	
		8:00-9:00	17:00-18:00	8:00-9:00	17:00-18:00
100-106	US 17 / 74 / 76 / NC 133 West of US 74 / 421 / NC 133 to US 17 / 76 (Dawson Street) east of 5th Avenue	3.77	3.65	39.77	41.12
105-100	US 17 / 76 (Wooster Street) east of 5th Avenue to US 17 / 74 / 76 / NC 133 West of US 74 / 421 / NC 133	3.52	3.76	42.06	39.32

Table 6: 2023 No-Build Freeway Segment LOS_s Summary

Order	Street Name	Analysis Type	Location	DENSITY (vplpm)		LOSs	
				AM	PM	AM	PM
1	US 17 / 74 / 76 / NC 133 EB	Basic	West of US 74 / 421 / NC 133 Off Ramp	19.5	15.4	C	B
2	US 17 / 76 / 421 EB	Basic	Between US 74 / 421 / NC 133 Off Ramp and US 74 / 421 / NC 133 On Ramp	27.4	21.9	D	C
3	US 17 / 76 / 421 EB	Basic	US 74 / 421 / NC 133 On Ramp	23.0	18.2	C	C
4	US 17 / 76 / 421 EB	Basic	Between US 74 / 421 / NC 133 On Ramp and SB Front Street Off Ramp	41.1	32.3	E	D
5	US 17 / 76 / 421 EB	Diverge	SB Front Street Off Ramp	38.3	30.2	E	D
6	US 17 / 76 EB	Basic	Between SB Front Street Off Ramp and NB Front Street Off Ramp	25.3	21.4	C	C
7	US 17 / 76 EB	Basic	NB Front Street Off Ramp	18.1	16.0	C	B
8	US 17 / 76 / 421 WB	Basic	Front Street On Ramp	18.6	30.3	C	D
9	US 17 / 76 / 421 WB	Basic	Between Front Street On Ramp and US 74 / 421 / NC 133 Off Ramp	26.6	40.4	D	E
10	US 17 / 76 / 421 WB	Diverge	US 74 / 421 / NC 133 Off Ramp	25.8	37.7	C	E
11	US 17 / 76 / 421 WB	Basic	Between US 74 / 421 / NC 133 Off Ramp and US 74 / 421 / NC 133 On Ramp	17.3	27.7	B	D
12	US 17 / 74 / 76 / NC 133 WB	Basic	West of US 74 / 421 / NC 133 On Ramp	18.8	28.1	C	D

Table 7: 2023 No-Build Intersection LOSs Summary

Signalized Intersections

Intersection No.	Intersection	Approach	Lane Group	Delay[1] (s) AM	Delay[1] (s) PM	Level of Service[2] AM	Level of Service[2] PM	95th Queue (ft)/Spillback Rate AM		95th Queue (ft)/Spillback Rate PM		Maximum Queue Length (ft) AM	Maximum Queue Length (ft) PM
30	US 17 BUS (S 3rd Street), US 421 (S 3rd & US 17 / 76 EB	***Overall***		***23.4***	***25.7***	***C***	***C***						
		US 17 BUS (S 3rd Street) SB	L	45.6	50.3	D	D	31.2	0%	53.0	0%	164.0	215.9
		US 17 BUS (S 3rd Street) SB	T	18.5	15.9	B	B	10.5	0%	42.4	0%	164.0	215.9
		US 421 (S 3rd Street) NB	T	24.8	41.1	C	D	96.7	0%	89.2	0%	277.6	354.3
		US 421 (S 3rd Street) NB	R	23.9	26.5	C	C	41.5	0%	31.5	0%	277.6	354.3
		US 17 / 76 EB EB	L	20.9	34.3	C	C	35.5	0%	40.8	0%	360.3	298.6
		US 17 / 76 EB EB	T	22.1	19.5	C	B	79.4	0%	45.4	0%	360.3	298.6
		US 17 / 76 EB EB	R	20.4	19.0	C	B	29.3	0%	28.8	0%	360.3	298.6
40	US 17 / 76 (Wooster Street), US 17 BUS (& US 76 WB-421 NB-17 BUS SB	***Overall***		***23.3***	***29.2***	***C***	***C***						
		US 17 BUS (S 3rd Street) SB	T	39.6	41.5	D	D	69.9	0%	117.0	0%	257.9	346.1
		US 17 BUS (S 3rd Street) SB	R	17.7	31.9	B	C	13.8	0%	60.6	0%	257.9	346.1
		US 17 / 76 (Wooster Street) WB	L	13.6	17.8	B	B	14.6	0%	28.8	0%	360.4	426.6
		US 17 / 76 (Wooster Street) WB	T	17.3	24.2	B	C	44.8	0%	92.7	0%	360.4	426.6
		US 17 / 76 (Wooster Street) WB	R	15.4	17.2	B	B	26.0	0%	31.9	0%	360.4	426.6
		US 17 BUS (S 3rd Street) NB	L	63.7	67.4	E	E	144.1	3%	148.1	12%	357.2	608.2
		US 17 BUS (S 3rd Street) NB	T	14.2	19.4	B	B	18.2	0%	39.4	0%	357.2	608.2
60	US 17 / 76 (Dawson Street) & S 5th Avenue	***Overall***		***4.6***	***8.1***	***A***	***A***						
		S 5th Avenue SB	LT	37.2	56.7	D	E	12.9	0%	33.1	0%	84.9	119.3
		S 5th Avenue SB	T	34.2	38.5	C	D	5.6	0%	11.8	0%	84.9	119.3
		S 5th Avenue NB	T	38.8	42.2	D	D	8.4	0%	10.9	0%	83.2	84.0
		S 5th Avenue NB	TR	37.6	39.1	D	D	10.2	0%	12.6	0%	83.2	84.0
		US 17 / 76 (Dawson Street) EB	LT	2.1	3.0	A	A	3.3	0%	1.5	0%	0.0	234.3
		US 17 / 76 (Dawson Street) EB	T	1.7	2.4	A	A	2.9	0%	1.2	0%	0.0	234.3
		US 17 / 76 (Dawson Street) EB	TR	1.5	2.3	A	A	2.4	0%	1.2	0%	0.0	234.3
70	US 17 / 76 (Wooster Street) & S 5th Avenue	***Overall***		***7.5***	***9.8***	***A***	***A***						
		S 5th Avenue SB	T	38.7	42.5	D	D	14.0	0%	28.2	0%	85.4	115.5
		S 5th Avenue SB	TR	37.7	44.5	D	D	15.0	0%	27.1	0%	85.4	115.5
		US 17 / 76 (Wooster Street) WB	LT	3.7	4.7	A	A	0.3	0%	7.3	0%	119.7	186.9
		US 17 / 76 (Wooster Street) WB	T	5.1	5.3	A	A	2.4	0%	18.3	0%	119.7	186.9
		US 17 / 76 (Wooster Street) WB	TR	3.2	4.3	A	A	0.8	0%	6.9	0%	119.7	186.9
		S 5th Avenue NB	LT	39.1	57.3	D	E	10.7	0%	20.0	0%	79.2	121.3
		S 5th Avenue NB	T	30.6	44.5	C	D	6.5	0%	13.8	0%	79.2	121.3

Unsignalized Intersections[3]

Intersection No.	Intersection	Approach	Lane Group	Delay[1] (s) AM	Delay[1] (s) PM	Level of Service[2] AM	Level of Service[2] PM	95th Queue (ft)/Spillback Rate AM		95th Queue (ft)/Spillback Rate PM		Maximum Queue Length (ft) AM	Maximum Queue Length (ft) PM
50	US 17 / 76 (Dawson Street) & S 4th Street	S 4th Street NB	R	13.2	13.5	B	B	0.4	0%	0.3	0%	14.4	8.3
		US 17 / 76 (Dawson Street) EB	T	1.0	0.7	A	A	0.0	0%	0.0	0%	0.0	0.0
		US 17 / 76 (Dawson Street) EB	TR	0.6	0.4	A	A	0.0	0%	0.0	0%	0.0	0.0

Notes:

1 Delay shown is the 95th percentile worst case control delay for the full 60-minute simulation period as derived from the 10 random seed simulations

2 Level of Service shown is Simulation based and calculated in a manner that is consistent with the HCM Methodologies

3 Results for unsignalized intersections include only the movements that have conflicting flow and thus have the potential to incur control delay

8. 2050 Future-Year No-Build Analysis

8.1 Model Parameters

All driver behaviors and parameters used in the 2023 Existing Year No-Build analysis were utilized in the future year analysis.

8.2 Design Assumptions and Model Network

The model network was revised along Front Street to the south of the interchange with US 17/76/421 to match the proposed conditions for U-5734. U-5734 proposes to improve Front Street to a 4-lane roadway from US 421 (Burnett Boulevard) to the interchange with US 17/76/421. No additional design assumptions beyond those assumed in the base year analysis were used in the future year analysis. The 2050 Future-Year No-Build lane configurations used in the model can be seen in **Figure 3.**

8.3 Volume Data

The volume data development was described in **Section 5** and is based on the turning movement volumes shown in the IAU spreadsheets located in **Appendix B**. Vehicle loading utilized an O-D Matrix based routing and were loaded onto the network based on NCDOT Congestion Management Simulation Guidelines.

8.4 Signal Timings and Operations

No changes to base signal timing inputs were made from the base year analysis. The signals were re-optimized in accordance with the methodology used in the base year analysis and described in **Section 7.3.1**.

8.5 Measures of Effectiveness

The MOE's pulled for the 2050 Future Year No-Build model were the same MOE's extracted from the 2023 Base Year No-Build Model. The MOE's used are described in **Section 4**.

8.6 Simulation Run Control

The simulation run controls were identical to those used in the 2023 Base Year No-Build Model. The simulation run controls for the base year model can be found in **Section 7.6**.

Figure 3: 2050 No-Build Lane Configurations

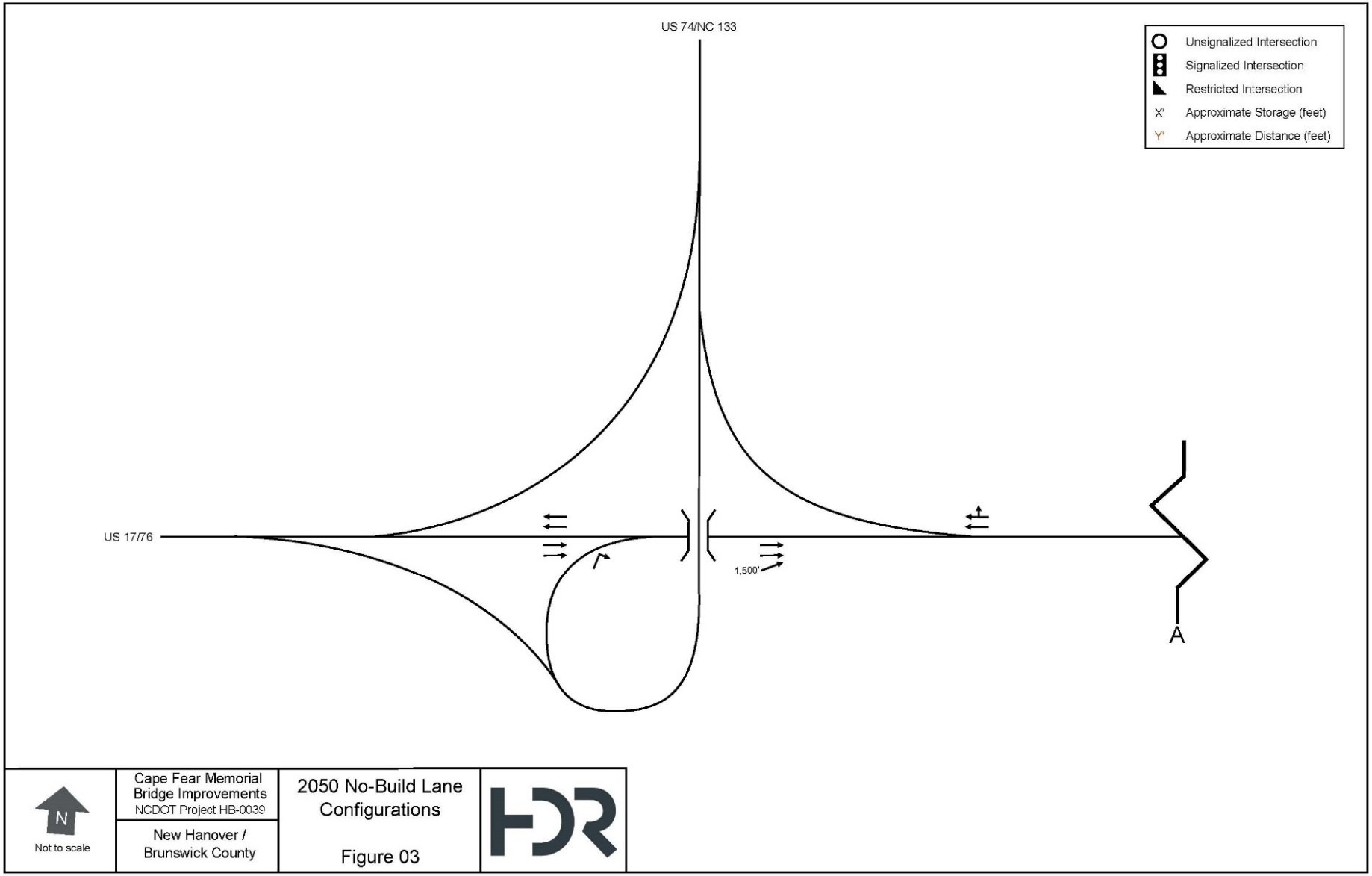
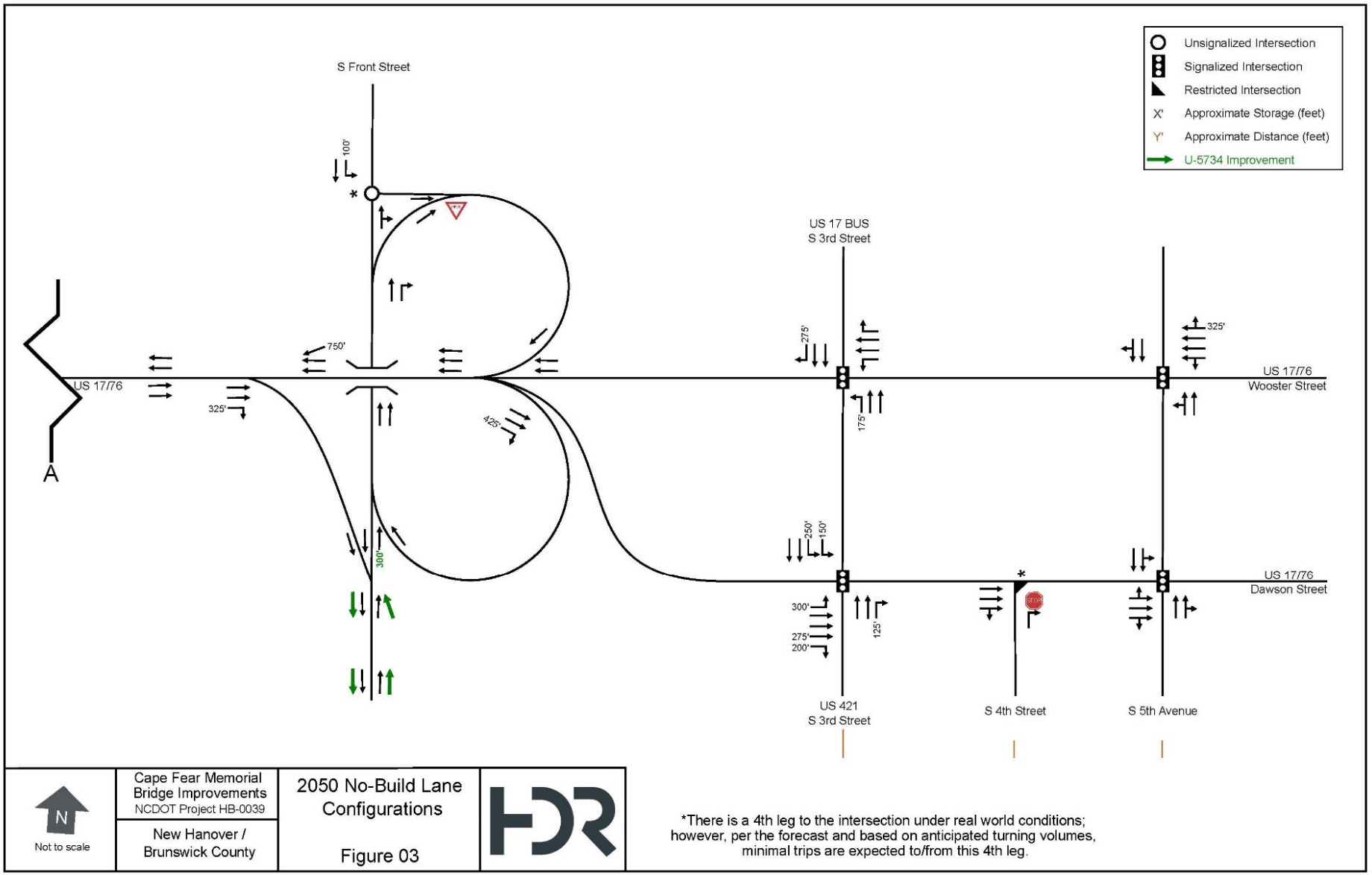


Figure 3: 2050 No-Build Lane Configurations (cont'd)



8.7 2050 Future-Year No-Build Model Results

The output data was collected for the model via the Output Data manager and the Delay, Queue, Queue Spillback, and Freeway LOS reports. The outputs were collected to develop the MOE's described in **Section 4** and are summarized in the following pages.

8.7.1 Network Results

The results for the Network MOE's are summarized in **Table 8.** As described in **Section 4**, the network results were pulled from the Network Delay reports. The VHT was 984.4 hours and 1291.0 hours during the AM and PM peak hours, respectively, with an average speed of 30.7 mph and 30.1 mph. The total vehicle miles traveled (VMT) was 24,288.2 miles and 25,984.7 miles during the AM and PM peak hours, respectively.

8.7.4 Corridor Results

The results for the Corridor MOE's are summarized in **Table 9.** In the eastbound direction, the corridor was found to operate with an average travel time of 7.98 minutes and 5.32 minutes in the AM and PM peak hours, respectively. In addition, the eastbound direction was found to operate at 22 mph and 30 mph in the AM and PM peak hours, respectively. In the westbound direction, the corridor was found to operate with an average travel time of 4.19 minutes and 5.33 minutes in the AM and PM peak hours, respectively. In addition, the eastbound direction was found to operate at 36 mph and 30 mph in the AM and PM peak hours, respectively.

8.7.2 Freeway Results

The results for the Freeway MOE's are summarized in **Table 10.** As described in **Section 4**, the freeway results were pulled from the Freeway LOS reports. During the AM peak hour, 7 of the 12 freeway segments experienced LOS_S E or worse. This consists of all eastbound sections along US 17/76/421 EB from the western edge to the Off Ramp to SB Front Street and along US 17/76/421 WB over the Cape Fear River. During the PM peak hour, 10 of the 12 segments operate at a failing condition, which consists of all segments along US 17/76/421 EB and the US 17/76/421 WB segments from the Front Street On Ramp to the US 74/421/NC 133 Off Ramp.

8.7.3 Arterial/Intersection Results

The results for the intersection analysis for intersections within the study area are summarized in **Table 11**. The overall LOS_S for the 4 total signalized intersections in the 2050 Base Year No-Build Analysis shows that only the intersection of Dawson Street at 5th Avenue is anticipated to operate acceptably at a LOS_S D or better in the AM and PM peak hours. All other intersections are expected to operate at an overall LOS_S E or LOS_S F during at least one of the peak hours. Based on a review of the intersection analysis, all intersections had at least one lane group that was found to operate at LOS_S E or LOS_S F during one of the peak hours.

Analysis was also completed on the one unsignalized intersection along the corridor [Dawson Street and S 4th Street]. After a review of the analysis, it was found that the intersection was anticipated to operate acceptably during the AM and PM peak hours.

A review of the queuing data and model animation found that queuing is expected to impact the freeway and surrounding arterials. Queuing along Front Street was observed to queue outside of the study network during the AM and PM peak hours due to the loop ramp being over capacity. It also showed that some turn bay storage lengths were not sufficient to contain all turning movement queues during the AM and PM peak hours. This consisted of the following movements:

- Northbound left-turn lane at US 17 BUS (S 3rd Street) and US 17/76 (Wooster Street)
- Northbound right-turn lane at US 17 BUS (S 3rd Street) and US 17/76 (Dawson Street)
- Southbound left-turn lane at US 17 BUS (S 3rd Street) and US 17/76 (Dawson Street)

Based on the heavy volumes and heavy queues along S 3rd Street, queueing was noted to extend beyond the study network in both the northbound and southbound directions. This queuing on S 3rd Street was shown to impact queuing and delays along Wooster Street and onto eastbound US 17/76/421, causing queues to spillback along the freeway.

Table 8: 2050 No-Build Network Statistics

Time	Vehicle Hours Traveled (VHT)	Vehicle Miles Traveled (VMT)	Average Speed (mph)	Total Delay (hrs)
AM	984.4	24,288.0	30.7	518.3
PM	1,291.0	25,984.7	30.1	796.6

Table 9: 2050 No-Build Corridor Summary

O-D	Description	TRAVEL TIMES (min)		TRAVEL SPEEDS (mph)	
		8:00-9:00	17:00-18:00	8:00-9:00	17:00-18:00
100-106	US 17 / 74 / 76 / NC 133 West of US 74 / 421 / NC 133 to US 17 / 76 (Dawson Street) east of 5th Avenue	7.98	5.32	22.48	30.13
105-100	US 17 / 76 (Wooster Street) east of 5th Avenue to US 17 / 74 / 76 / NC 133 West of US 74 / 421 / NC 133	4.19	5.33	35.88	29.83

Table 10: 2050 No-Build Freeway Segment LOS_s Summary

Order	Street Name	Analysis Type	Location	DENSITY (vplpm)		LOSs	
				AM	PM	AM	PM
1	US 17 / 74 / 76 / NC 133 EB	Basic	West of US 74 / 421 / NC 133 Off Ramp	60.9	38.9	F	E
2	US 17 / 76 / 421 EB	Basic	Between US 74 / 421 / NC 133 Off Ramp and US 74 / 421 / NC 133 On Ramp	80.8	59.3	F	F
3	US 17 / 76 / 421 EB	Basic	US 74 / 421 / NC 133 On Ramp	75.3	56.8	F	F
4	US 17 / 76 / 421 EB	Basic	Between US 74 / 421 / NC 133 On Ramp and SB Front Street Off Ramp	73.3	67.3	F	F
5	US 17 / 76 / 421 EB	Diverge	SB Front Street Off Ramp	58.2	58.9	F	F
6	US 17 / 76 EB	Basic	Between SB Front Street Off Ramp and NB Front Street Off Ramp	30.9	95.0	D	F
7	US 17 / 76 EB	Basic	NB Front Street Off Ramp	29.5	66.1	D	F
8	US 17 / 76 / 421 WB	Basic	Front Street On Ramp	26.8	42.9	D	E
9	US 17 / 76 / 421 WB	Basic	Between Front Street On Ramp and US 74 / 421 / NC 133 Off Ramp	40.0	47.8	E	F
10	US 17 / 76 / 421 WB	Diverge	US 74 / 421 / NC 133 Off Ramp	36.2	45.4	E	F
11	US 17 / 76 / 421 WB	Basic	Between US 74 / 421 / NC 133 Off Ramp and US 74 / 421 / NC 133 On Ramp	24.7	32.8	C	D
12	US 17 / 74 / 76 / NC 133 WB	Basic	West of US 74 / 421 / NC 133 On Ramp	24.9	34.5	C	D

Table 11: 2050 No-Build Intersection LOS$_S$ Summary

Signalized Intersections

Intersection No.	Intersection	Approach	Lane Group	Delay[1] (s) AM	Delay[1] (s) PM	Level of Service[2] AM	Level of Service[2] PM	95th Queue (ft)/Spillback Rate AM		95th Queue (ft)/Spillback Rate PM		Maximum Queue Length (ft) AM	Maximum Queue Length (ft) PM
30	US 17 BUS (S 3rd Street), US 421 (S 3rd & US 17 / 76 EB	***Overall***		***58.5***	***105.7***	***E***	***F***						
		US 17 BUS (S 3rd Street) SB	L	39.5	39.8	D	D	36.9	0%	27.0	0%	254.8	396.5
		US 17 BUS (S 3rd Street) SB	T	18.6	16.2	B	B	30.0	0%	28.6	0%	254.8	396.5
		US 421 (S 3rd Street) NB	T	143.4	319.2	F	F	539.1	6%	763.0	12%	1610.6	1648.8
		US 421 (S 3rd Street) NB	R	113.0	228.5	F	F	170.5	1%	316.3	6%	1610.6	1648.8
		US 17 / 76 EB EB	L	45.9	88.9	D	F	131.7	0%	111.1	0%	549.1	1131.9
		US 17 / 76 EB EB	T	29.1	73.2	C	E	120.6	0%	172.0	0%	549.1	1131.9
		US 17 / 76 EB EB	R	27.0	70.9	C	E	51.8	0%	119.3	0%	549.1	1131.9
40	US 17 / 76 (Wooster Street), US 17 BUS (& US 76 WB-421 NB-17 BUS SB	***Overall***		***55.1***	***98.5***	***E***	***F***						
		US 17 BUS (S 3rd Street) SB	T	171.8	356.0	F	F	512.8	0%	1097.7	17%	1057.1	1700.9
		US 17 BUS (S 3rd Street) SB	R	108.6	364.2	F	F	250.0	0%	838.8	30%	1057.1	1700.9
		US 17 / 76 (Wooster Street) WB	L	21.9	25.2	C	C	26.5	0%	57.4	0%	1030.2	2271.5
		US 17 / 76 (Wooster Street) WB	T	52.6	48.1	D	D	126.9	0%	219.8	6%	1030.2	2271.5
		US 17 / 76 (Wooster Street) WB	R	24.8	21.4	C	C	40.2	0%	54.4	0%	1030.2	2271.5
		US 17 BUS (S 3rd Street) NB	L	52.9	45.8	D	D	182.6	9%	114.9	12%	673.3	898.3
		US 17 BUS (S 3rd Street) NB	T	16.8	16.1	B	B	102.0	1%	44.2	1%	673.3	898.3
60	US 17 / 76 (Dawson Street) & S 5th Avenue	***Overall***		***7.3***	***12.9***	***A***	***B***						
		S 5th Avenue SB	LT	51.7	67.7	D	E	27.0	0%	57.3	0%	93.4	338.4
		S 5th Avenue SB	T	34.7	29.2	C	C	10.3	0%	26.7	0%	93.4	338.4
		S 5th Avenue NB	T	36.4	43.8	D	D	12.6	0%	28.3	0%	127.6	180.1
		S 5th Avenue NB	TR	36.0	41.3	D	D	21.7	0%	38.5	0%	127.6	180.1
		US 17 / 76 (Dawson Street) EB	LT	1.8	4.7	A	A	3.8	0%	9.7	0%	134.3	27.3
		US 17 / 76 (Dawson Street) EB	T	2.0	4.6	A	A	4.0	0%	8.4	0%	134.3	27.3
		US 17 / 76 (Dawson Street) EB	TR	2.1	4.6	A	A	4.7	0%	9.6	0%	134.3	27.3
70	US 17 / 76 (Wooster Street) & S 5th Avenue	***Overall***		***15.9***	***73.6***	***B***	***E***						
		S 5th Avenue SB	T	35.1	40.9	D	D	23.0	0%	46.2	0%	150.0	165.2
		S 5th Avenue SB	TR	35.0	41.5	D	D	28.3	0%	53.1	0%	150.0	165.2
		US 17 / 76 (Wooster Street) WB	LT	5.8	81.4	A	F	22.5	0%	164.6	1%	296.2	1682.2
		US 17 / 76 (Wooster Street) WB	T	16.5	85.8	B	F	73.6	0%	434.8	6%	296.2	1682.2
		US 17 / 76 (Wooster Street) WB	TR	5.9	59.1	A	E	25.4	0%	31.1	0%	296.2	1682.2
		S 5th Avenue NB	LT	68.6	141.6	E	F	35.8	0%	67.5	0%	143.1	178.4
		S 5th Avenue NB	T	40.4	62.3	D	E	23.2	0%	40.0	0%	143.1	178.4

Unsignalized Intersections[3]

Intersection No.	Intersection	Approach	Lane Group	Delay[1] (s) AM	Delay[1] (s) PM	Level of Service[2] AM	Level of Service[2] PM	95th Queue (ft)/Spillback Rate AM		95th Queue (ft)/Spillback Rate PM		Maximum Queue Length (ft) AM	Maximum Queue Length (ft) PM
50	US 17 / 76 (Dawson Street) & S 4th Street	S 4th Street NB	R	24.6	20.2	C	C	0.4	0%	0.5	0%	13.6	13.6
		US 17 / 76 (Dawson Street) EB	T	0.3	1.9	A	A	0.0	0%	0.3	0%	0.0	0.0
		US 17 / 76 (Dawson Street) EB	TR	0.2	2.6	A	A	0.0	0%	0.0	0%	0.0	0.0

Notes:

1 Delay shown is the 95th percentile worst case control delay for the full 60-minute simulation period as derived from the 10 random seed simulations

2 Level of Service shown is Simulation based and calculated in a manner that is consistent with the HCM Methodologies

3 Results for unsignalized intersections include only the movements that have conflicting flow and thus have the potential to incur control delay

9. 2050 Future-Year Build Alternative A / Alternative B Analysis

9.1 Model Parameters

All driver behaviors and parameters used in the 2050 Future Year No-Build analysis were utilized in the future year analysis.

9.2 Alternative Designs

The 2050 Build Alternative A scenario includes the following improvements from the 2050 Future Year No-Build network:

- Widening US 17/76/421 to 6 lanes from US 74/421/NC 133 to Front Street. The new Cape Fear Memorial Bridge is anticipated to be constructed to the south of its current location with a 65-foot clearance.
- Widening of Front Street to 4 lanes from US 17/76/421 to the connection with U-5734.
- The loop ramp from US 17/76/421 EB to NB Front Street was realigned to become a stop-controlled intersection. This realignment eliminated the existing weave condition while maintaining access to the north.
- Widen the US 17/76/421 WB On Ramp from Front Street from one lane to two lanes with one of the lanes being used as an add lane condition for US 17/76/421 WB.
- Upgrade Front Street at US 17/76/421 WB On Ramp to a traffic signal with the removal of access to Queen Street.
- Improve the northbound approach to Front Street at US 17/76/421 WB On Ramp to one thru lane with dual right turn lanes.

The 2050 Build Alternative B scenario the following improvements from the 2050 Future Year No-Build network:

- Widening US 17/76/421 to 6 lanes from US 74/421/NC 133 to Front Street and removing access at 3rd Street and 4th Street. The removal of access to 3rd Street and 4th Street was due to limitations in the roadway geometry as the bridge is anticipated to be constructed with a clearance of 135 feet versus the 65-foot clearance in Alternative A.
- Widen the US 17/76/421 WB On Ramp from Front Street from one lane to two lanes with one of the lanes being used as an add lane condition for US 17/76/421 WB.
- Remove the loop ramp from US 17/76/421 EB to Front Street NB due to geometric constraints.
- Realign the US 17/76/421 EB Off Ramp to Front Street into a loop configuration that follows the alignment of Queen Street and tie into Front Street at the existing intersection of Front Street at US 17/76/421 WB On Ramp.
- Improve the intersection of Front Street at US 17/76/421 WB On Ramp to a roundabout with a single northbound right turn bypass lane and dual bypass right turn lanes for the eastbound right turn.

- Reduce southbound Front Street to a single lane approach at the intersection of Front Street and US 17/76/421.
- Improve Front Street from the intersection of Front Street at US 17/76/421 WB On ramp to the U-5734 project limits to 4 lanes with a southbound acceleration lane exiting the roundabout for approximately 775 before merging.
- Add a 150’ turn lane for the northbound left turn from 5th Avenue onto westbound Wooster Street.
- Add A 150’ turn lane for the southbound left turn lane from 5th Avenue onto eastbound Dawson Street.

Proposed concepts can be found in **Appendix D**. The 2050 Build Alternative A lane configurations used in the model can be seen in **Figure 4** and the 2050 Build Alternative B lane configurations used in the model can be seen in **Figure 5.**

Figure 4: 2050 Build Alternative A Lane Configurations

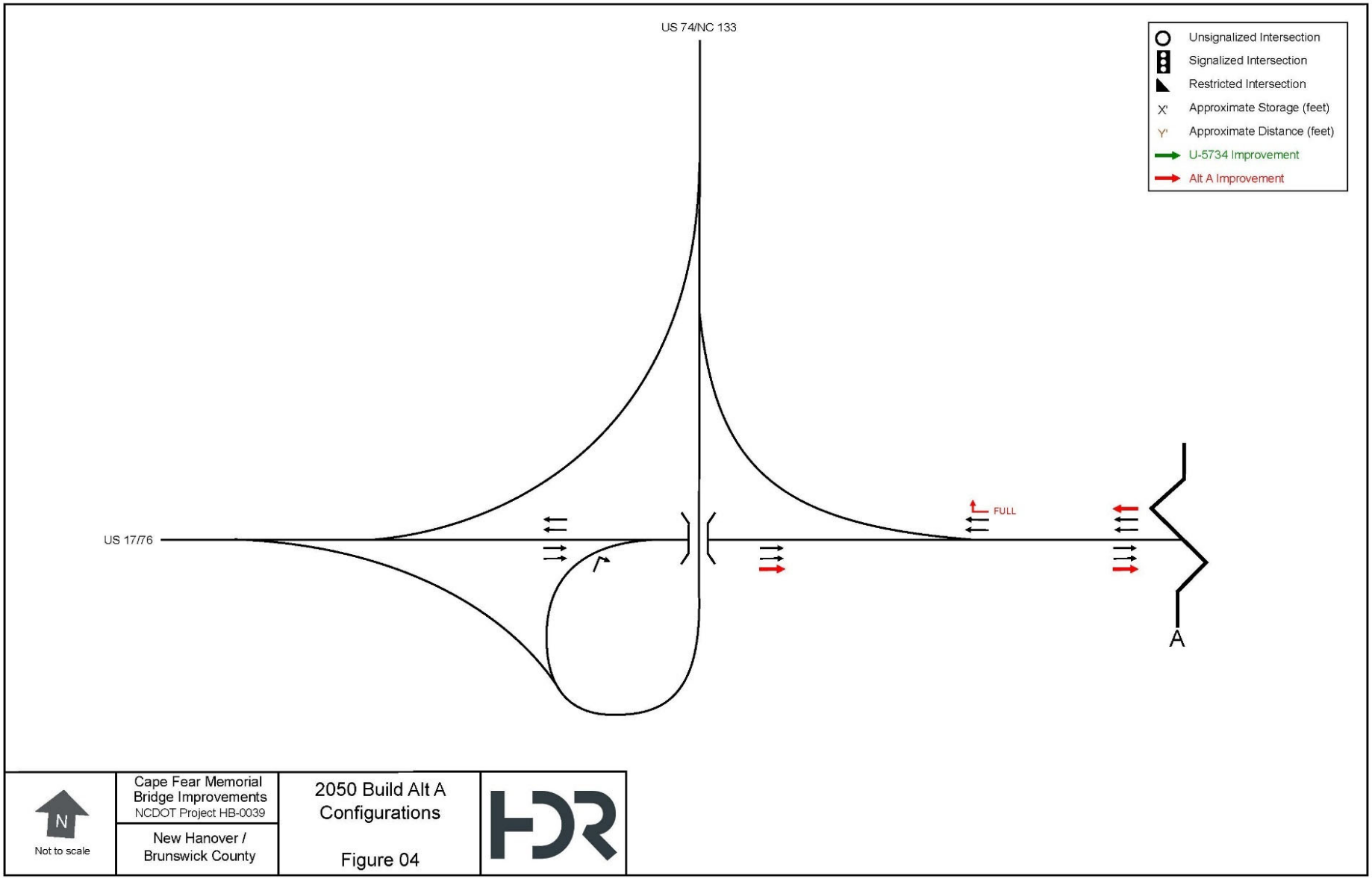


Figure 4: 2050 Build Alternative A Lane Configurations

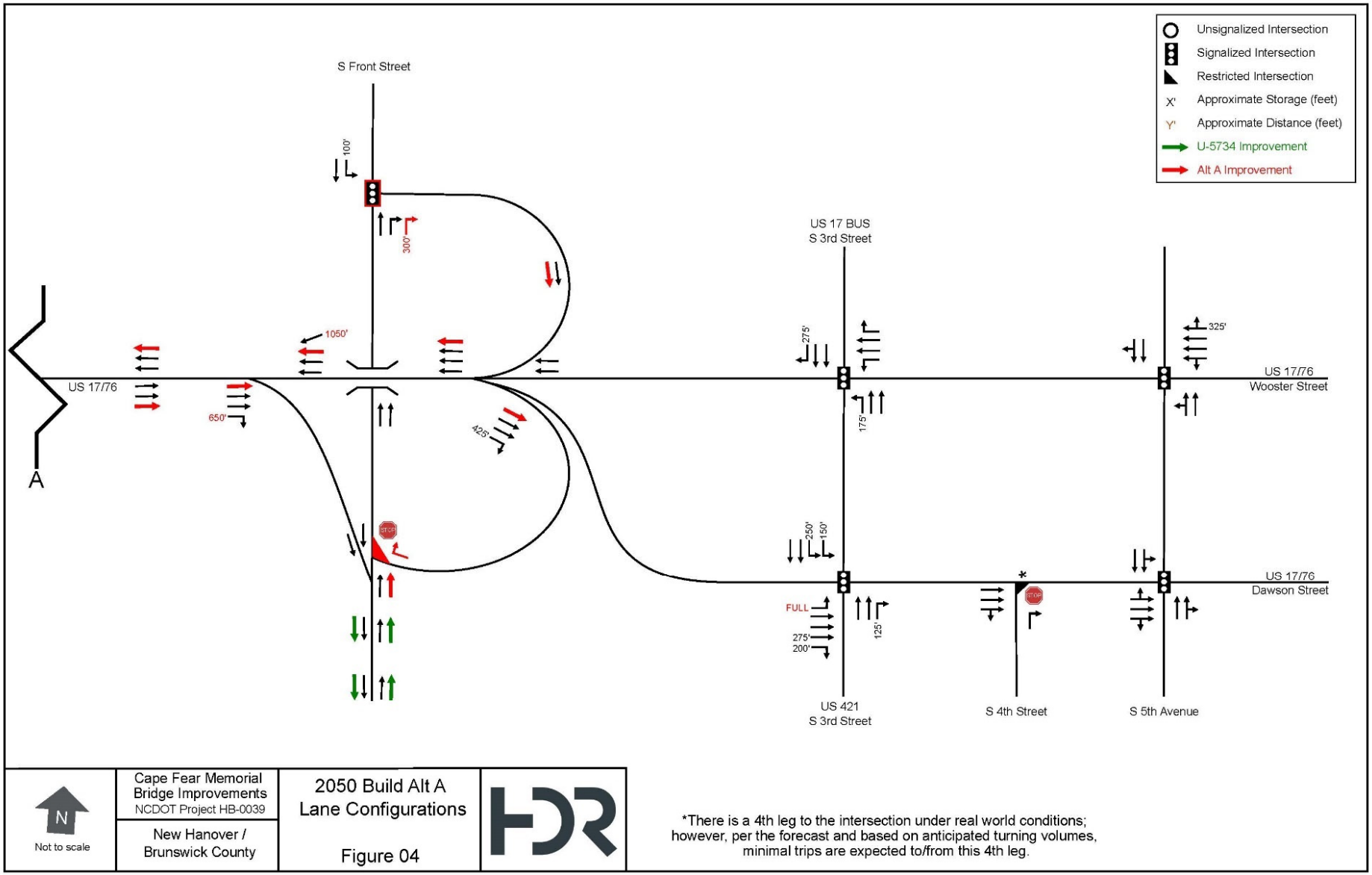


Figure 5: 2050 Build Alternative B Lane Configurations

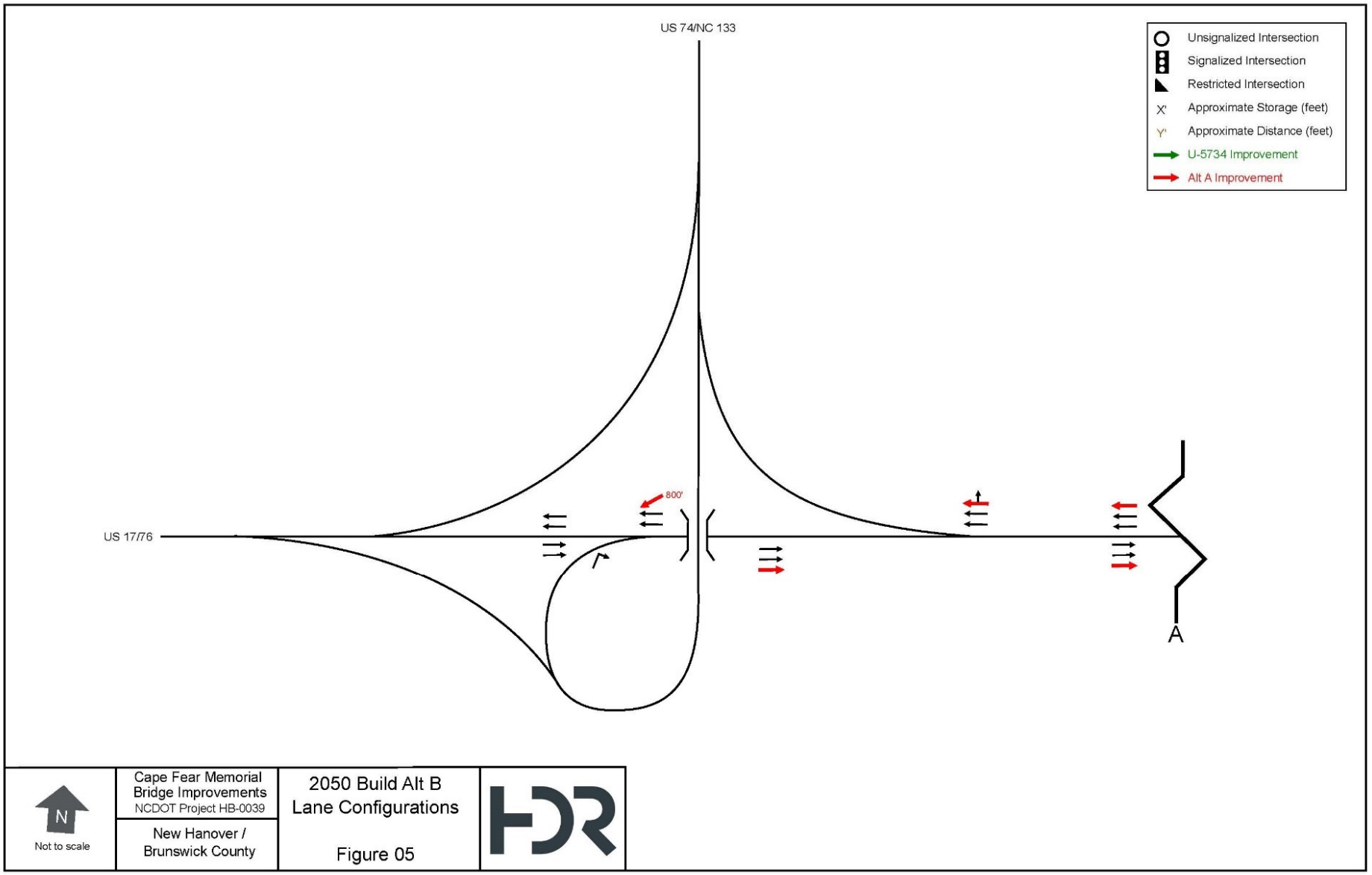
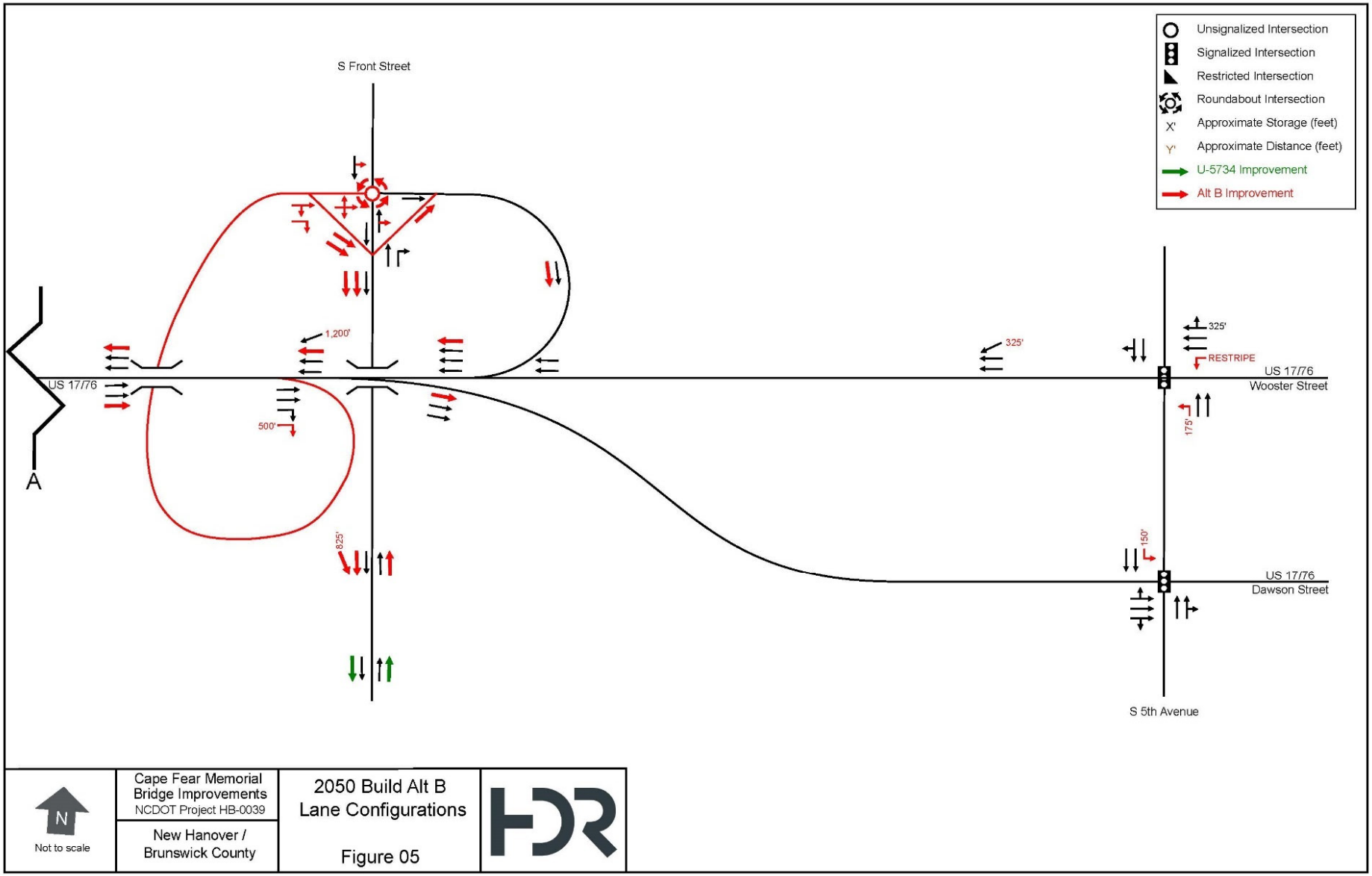


Figure 5: 2050 Build Alternative B Lane Configurations (cont'd)



9.3 Volume Data

The volume data development was described in **Section 5** and is based on the turning movement volumes can be found in the IAU spreadsheets located in **Appendix B**. The O-D Matrix for Alternative A utilized the O-D Matrix from the 2050 Future Year No-Build. The O-D Matrix for Alternative B was developed utilizing the methodology described in **Section 5** as the proposed condition resulted in differing vehicle routing as was proposed in Alternative A. Vehicles were loaded onto the network based on NCDOT Congestion Management Simulation Guidelines.

9.4 Signal Timings and Operations

The base signal timing inputs from the 2023 No-Build Analysis were utilized in the Build Alternative A model. The signals were re-optimized in accordance with the methodology used in the base year and future year analysis and described in **Section 7.3.1**. Alternative A included a new proposed signalized intersection at Front Street and US 17/76/421 WB On Ramp. This location was optimized as an isolated intersection in accordance with NCDOT Congestion Management Simulation Guidelines. It should also be noted that Build Alternative B includes the removal of 3rd Street from the model as the location is now anticipated to be an overpass which removes the signalized intersections of 3rd Street at Dawson Street and 3rd Street at Wooster Street.

In Alternative B, the westbound right turn from US 17/76/421 EB Off Ramp to NB Front Street was restricted to the right lane only as the model produced unrealistic delays and queues due to merging that was occurring along NB Front Street. In reviewing the simulation, vehicles were able to utilize the right lane and merge over to complete the through move that was desired without impacts to Front Street operations.

9.5 Measures of Effectiveness

The MOE's pulled for the 2050 Future Year No-Build model were the same MOE's extracted from the 2050 Future Year No-Build Model. The MOE's used are described in **Section 4**.

9.6 Simulation Run Control

The simulation run controls were identical to those used in the 2050 Future Year No-Build Model. The simulation run controls for the base year model can be found in **Section 7.6**.

9.7 2050 Future-Year Build Alternative A Model Results

The output data was collected for the model via the Output Data manager and the Trip Statistics, Delay, Queue, Queue Spillback, and Freeway LOS reports. The outputs were collected to develop the MOE's described in **Section 4** and are summarized in the following pages.

9.7.1 Network Results

The results for the Network MOE's are summarized in **Table 12.** As described in **Section 4**, the network results were pulled from the Network Delay reports. The total VHT was 813.5 hours and 1,050.6 hours during the AM and PM peak hours, respectively, with an average speed of 36.3 mph and 35.1 mph. The total vehicle miles traveled (VMT) was 26,060.6 miles and 27,796.0 miles during the AM and PM peak hours, respectively. Each of these metrics indicate an improvement over the 2050 Future Year No-Build and show that the proposed alternative is processing vehicles more efficiently throughout the network.

9.7.2 Corridor Results

The results for the Corridor MOE's are summarized in **Table 13.** In the eastbound direction, the corridor was found to operate with an average travel time of 4.98 minutes and 4.52 minutes in the AM and PM peak hours, respectively. In addition, the eastbound direction was found to operate at 32 mph and 34 mph in the AM and PM peak hours, respectively. In the westbound direction, the corridor was found to operate with an average travel time of 4.16 minutes and 5.50 minutes in the AM and PM peak hours, respectively. In addition, the eastbound direction was found to operate at 36 mph and 29 mph in the AM and PM peak hours, respectively. In general, travel time and speeds in both directions saw an improvement along the corridor. The PM peak hour remained relatively consistent in the westbound direction for this alternative as there were minimal changes proposed in this project that allow for improvement to occur as most of the delays were found to be at the signals.

9.7.3 Freeway Results

The results for the Freeway MOE's are summarized in **Table 14.** During the AM peak, 6 of the 11 freeway segments experienced LOS_S E or worse. This consists of all eastbound sections along US 17/76/421 EB with the exception of the westernmost segment. During the PM peak hour, 6 of the 11 segments operating at a failing condition. US 17/76/421 EB was found to experience failing PM conditions from the SB Front Street off Ramp to the NB Front Street Off Ramp while US 17/76/421 WB had LOS_S E operations from west of the Front Street On Ramp to the western edge of the model. When compared to the No-Build, traffic densities along the corridor were found to be reduced which indicates that traffic is experiencing less congestion due to the proposed improvements. The failing segments included in the analysis were found to be due to capacity restrictions located outside of the intended scope of the project including at the intersections with 3rd Street and the interchange with US 74/421/NC 133.

9.7.4 Arterial/Intersection Results

The results for the intersection analysis for intersections within the study area are summarized in **Table 15**. The overall LOS_S for the 5 total signalized intersections in the 2050 Future Year Build Alternative A analysis shows that 2 intersections operate unacceptably at a LOS_S E or worse in the AM peak hour and 3 intersections operate unacceptably in the PM peak hour. The new signalized intersection of US 17/76/421 WB On Ramp and Front Street was found to operate at acceptably at LOS_S A in the AM Peak hour and LOS_S B in the PM peak hour. The following intersections were found to operate at LOS_S E or LOS_S F in at least one peak hour:

- US 17 BUS (S 3rd Street) and US 17/76 EB
- US 17/76 (Wooster Street) and US 17 BUS (S 3rd Street)
- US 17/76 (Wooster Street) and S 5th Avenue

Analysis was also completed on the two unsignalized intersection along the corridor [Dawson Street at S 4th Street and US 17/76/421 EB Off Ramp at NB Front Street]. After a review of the analysis, it was found that the northbound right turn at 4th Street was anticipated to reach LOS_S E during the AM peak hour. All other movements at both intersections were found to operate acceptably during the AM and PM peak hours. As the scope of the project is a bridge replacement project, capacity improvements to reduce delays along US 17/76 (Dawson Street) and US 17/76 (Wooster Street) were limited to minimize impacts within the study area.

A review of the queuing data and model animation found that queuing is expected to impact the freeway and surrounding arterials. It showed that some turn bay storage lengths were not sufficient to contain all turning movement queues during the AM and PM peak hours. This consisted of the following movements:

- Northbound left-turn lane at 3rd Street and Wooster Street
- Northbound right-turn lane at 3rd Street and Dawson Street
- Southbound left-turn lane at 3rd Street and Dawson Street

Based on the heavy volumes and heavy queues along 3rd Street, queueing was noted to extend beyond the study network in both the northbound and southbound directions. This queuing on 3rd Street was shown to impact queuing and delays along Wooster Street as well as along the eastbound US 17/76/421 causing queues to spillback along the freeway.

9.8 2050 Future-Year Build Alternative B Model Results

The output data was collected for the model via the Output Data manager and the Delay, Queue, Queue Spillback, and Multilane Highway LOS reports. The outputs were collected to develop the MOE's described in Section 4 and are summarized in the following pages.

9.8.1 Network Results

The results for the Network MOE's are summarized in **Table 16.** As described in **Section 4**, the network results were pulled from the Network Delay reports. The total VHT was 737.9 hours and 945.3 hours during the AM and PM peak hours, respectively, with an average speed of 39.0 mph and 35.6 mph. The total vehicle miles traveled (VMT) was 26,688.3 miles and 28,309.7 miles during the AM and PM peak hours, respectively. Each of these metrics indicate an improvement over the 2050 Future Year No-Build and show that the proposed alternative is processing vehicles more efficiently throughout the network.

9.8.2 Corridor Results

The results for the Corridor MOE's are summarized in **Table 17.** In the eastbound direction, the corridor was found to operate with an average travel time of 4.28 minutes and 4.16 minutes in the AM and PM peak hours, respectively. In addition, the eastbound direction was found to operate at 36 mph and 37 mph in the AM and PM peak hours, respectively. In the westbound direction, the corridor was found to operate with an average travel time of 3.68 minutes and 5.77 minutes

in the AM and PM peak hours, respectively. In addition, the eastbound direction was found to operate at 41 mph and 28 mph in the AM and PM peak hours, respectively. In general, travel time and speeds in both directions saw an improvement along the corridor. The PM peak hour remained relatively consistent in the westbound direction for this alternative as there were minimal changes proposed in this project that allow for improvement to occur as most of the delays were found to be at the signals. Additionally, the increased traffic along 5th Street is anticipated to reduce operations at each of the signalized intersections which made for some of the reduced operations during the PM peak hour.

9.8.3 Freeway Results

The results for the Freeway MOE's are summarized in **Table 18**. As described in **Section 4**, the freeway results were pulled from the Freeway LOS reports. During the AM peak, 3 of the 11 freeway segments experienced LOS_S E or worse. This consists of the eastbound sections along US 17/76/421 EB from the Cape Fear River crossing to the US 74/41/NC 133 On Ramp. During the PM peak hour, 2 of the 11 segments operate at a failing condition with both segments occurring on WB US 17/76/421 from the US 74/421/NC 133 On Ramp to the west. When compared to the No-Build, traffic densities and LOS along the corridor were found to be reduced which indicates that traffic is experiencing less congestion due to the proposed improvements. The failing segments included in the analysis were found to be due to capacity restrictions located outside of the intended scope of the project including at the intersections with 3rd Street and the interchange with US 74/421/NC 133

9.8.4 Arterial/Intersection Results

The results for the intersection analysis for intersections within the study area are summarized in **Table 19**. The overall LOS_S for the 2 total signalized intersections in the 2050 Future Year Build Alternative B Analysis shows that both signalized intersections operate unacceptably at an overall LOS_S E or worse in each the AM and PM peak hour, except the intersection of US 17/76 (Wooster Street) and S 5th Avenue during the AM peak hour. It should be noted that 2 signalized intersections were removed as part of this alternative, which is expected to overall reduce delays experienced along the corridor but may show slightly higher delays at the remaining signalized intersections, because more turning movement traffic is expected at these intersections because of the removal of the other 2 signals.

Analysis was also completed on the one roundabout intersection, added as a result of this alternative [S Front Street and US 17/76/421 Ramps]. After a review of the analysis, it was found that the northbound approach (S Front Street) was found to operate at LOS_S F during the PM Peak hour. On review of the data, the delay appeared to be caused by the high variability in the delays produced by each model run likely caused by the heavy free flow right turn movement. A review of the queues and model simulations showed minimal queueing along the approach is anticipated at the roundabout itself and is does not appear to operate as the delay data indicates. During the AM peak hour, all approaches are expected to operate at LOS_S A, and all other approaches are expected to operate acceptably during the PM peak hour. As the scope of the project is a bridge replacement project, capacity improvements to reduce delays along US 17/76 (Dawson Street) and US 17/76 (Wooster Street) were limited to minimize impacts within the study area.

A review of the queuing data and model animation found that queuing is expected to impact the freeway and surrounding arterials. It showed that the southbound left-turn bay storage length at the intersection of Dawson Street and S 5th Avenue was not sufficient to contain all turning movement queues during the AM and PM peak hours. Queuing was not shown to extend to the S Front Street ramps along US 17/76/421. During the PM peak hour, heavy queuing is expected on the westbound approach at the intersection of Wooster Street and S 5th Avenue, as well as on the northbound approach at the intersection of US 17/76 Ramps and S Front Street.

Table 12: 2050 Build Alternative A Network Statistics

Time	Vehicle Hours Traveled (VHT)	Vehicle Miles Traveled (VMT)	Average Speed (mph)	Total Delay (hrs)
AM	813.5	26,060.6	36.3	318.4
PM	1,050.6	27,796.0	35.1	519.1

Table 13: 2050 Build Alternative A Corridor Summary

O-D	Description	TRAVEL TIMES (min)		TRAVEL SPEEDS (mph)	
		8:00-9:00	17:00-18:00	8:00-9:00	17:00-18:00
100-106	US 17 / 74 / 76 / NC 133 West of US 74 / 421 / NC 133 to US 17 / 76 (Dawson Street) east of 5th Avenue	4.98	4.52	32.03	34.31
105-100	US 17 / 76 (Wooster Street) east of 5th Avenue to US 17 / 74 / 76 / NC 133 West of US 74 / 421 / NC 133	4.16	5.50	36.19	29.22

Table 14: 2050 Build Alternative A Freeway Segment LOS_s Summary

Order	Street Name	Analysis Type	Location	DENSITY (vplpm)		LOSs	
				AM	PM	AM	PM
1	US 17 / 74 / 76 / NC 133 EB	Basic	West of US 74 / 421 / NC 133 Off Ramp	30.3	21.9	D	C
2	US 17 / 76 / 421 EB	Basic	Between US 74 / 421 / NC 133 Off Ramp and US 74 / 421 / NC 133 On Ramp	47.2	33.0	F	D
3	US 17 / 76 / 421 EB	Basic	US 74 / 421 / NC 133 On Ramp	48.9	25.9	F	C
4	US 17 / 76 / 421 EB	Basic	Between US 74 / 421 / NC 133 On Ramp and SB Front Street Off Ramp	60.5	33.5	F	D
5	US 17 / 76 / 421 EB	Diverge	SB Front Street Off Ramp	56.5	47.8	F	F
6	US 17 / 76 EB	Basic	Between SB Front Street Off Ramp and NB Front Street Off Ramp	65.1	63.9	F	F
7	US 17 / 76 EB	Basic	NB Front Street Off Ramp	56.6	50.8	F	F
8	US 17 / 76 / 421 WB	Basic	Front Street On Ramp	18.0	30.8	B	D
9	US 17 / 76 / 421 WB	Basic	Between Front Street On Ramp and US 74 / 421 / NC 133 Off Ramp	23.9	35.9	C	E
10	US 17 / 76 / 421 WB	Basic	Between US 74 / 421 / NC 133 Off Ramp and US 74 / 421 / NC 133 On Ramp	24.8	39.0	C	E
11	US 17 / 74 / 76 / NC 133 WB	Basic	West of US 74 / 421 / NC 133 On Ramp	25.3	38.4	C	E

Table 15: 2050 Build Alternative A Intersection LOSs Summary

Signalized Intersections

Intersection No.	Intersection	Approach	Lane Group	Delay[1] (s) AM	Delay[1] (s) PM	Level of Service[2] AM	Level of Service[2] PM	95th Queue (ft)/Spillback Rate AM		95th Queue (ft)/Spillback Rate PM		Maximum Queue Length (ft) AM	Maximum Queue Length (ft) PM
20	S Front Street & US 17 / 76 WB On-Ramp	***Overall***		***3.0***	***15.2***	***A***	***B***						
		S Front Street SB	L	15.3	24.8	B	C	3.8	0%	47.2	0%	37.9	157.1
		S Front Street SB	T	0.0	1.4	A	A	0.0	0%	0.0	0%	37.9	157.1
		S Front Street NB	T	3.8	6.4	A	A	12.0	0%	38.3	0%	169.8	397.8
		S Front Street NB	R	2.6	21.1	A	C	8.8	0%	107.5	0%	169.8	397.8
30	US 17 BUS (S 3rd Street), US 421 (S 3rd & US 17 / 76 EB	***Overall***		***75.4***	***102.0***	***E***	***F***						
		US 17 BUS (S 3rd Street) SB	L	38.1	40.1	D	D	34.9	0%	30.0	0%	235.7	347.4
		US 17 BUS (S 3rd Street) SB	T	19.0	17.1	B	B	31.2	0%	29.5	0%	235.7	347.4
		US 421 (S 3rd Street) NB	T	144.2	316.4	F	F	567.8	7%	836.1	13%	1637.3	1695.6
		US 421 (S 3rd Street) NB	R	116.8	236.1	F	F	183.4	2%	306.9	5%	1637.3	1695.6
		US 17 / 76 EB EB	L	48.4	51.8	D	D	148.8	0%	109.0	0%	1673.1	1523.4
		US 17 / 76 EB EB	T	73.3	79.1	E	E	314.0	1%	195.4	0%	1673.1	1523.4
		US 17 / 76 EB EB	R	56.5	71.2	E	E	82.9	0%	135.0	0%	1673.1	1523.4
40	US 17 / 76 (Wooster Street), US 17 BUS (& US 76 WB-421 NB-17 BUS SB	***Overall***		***53.2***	***98.6***	***D***	***F***						
		US 17 BUS (S 3rd Street) SB	T	150.6	360.8	F	F	486.4	0%	1100.5	19%	983.3	1685.9
		US 17 BUS (S 3rd Street) SB	R	103.8	365.5	F	F	243.9	0%	811.7	25%	983.3	1685.9
		US 17 / 76 (Wooster Street) WB	L	20.5	24.8	C	C	27.4	0%	54.0	0%	1106.2	1975.0
		US 17 / 76 (Wooster Street) WB	T	53.7	48.0	D	D	126.6	0%	214.8	6%	1106.2	1975.0
		US 17 / 76 (Wooster Street) WB	R	35.6	22.4	D	C	57.5	0%	56.0	0%	1106.2	1975.0
		US 17 BUS (S 3rd Street) NB	L	54.1	45.5	D	D	189.9	11%	110.8	14%	933.5	1065.4
		US 17 BUS (S 3rd Street) NB	T	18.7	15.2	B	B	120.8	5%	47.7	1%	933.5	1065.4
60	US 17 / 76 (Dawson Street) & S 5th Avenue	***Overall***		***8.9***	***14.5***	***A***	***B***						
		S 5th Avenue SB	LT	127.2	110.0	F	F	79.6	0%	94.4	0%	163.1	521.1
		S 5th Avenue SB	T	33.1	27.6	C	C	11.2	0%	26.3	0%	163.1	521.1
		S 5th Avenue NB	T	36.4	42.5	D	D	13.1	0%	27.0	0%	111.0	157.6
		S 5th Avenue NB	TR	36.6	40.7	D	D	22.2	0%	38.2	0%	111.0	157.6
		US 17 / 76 (Dawson Street) EB	LT	1.6	4.7	A	A	3.6	0%	10.4	0%	136.3	35.2
		US 17 / 76 (Dawson Street) EB	T	1.9	4.8	A	A	4.0	0%	9.7	0%	136.3	35.2
		US 17 / 76 (Dawson Street) EB	TR	1.9	4.4	A	A	5.1	0%	8.9	0%	136.3	35.2
70	US 17 / 76 (Wooster Street) & S 5th Avenue	***Overall***		***17.6***	***80.7***	***B***	***F***						
		S 5th Avenue SB	T	38.0	42.0	D	D	21.6	0%	48.1	0%	152.4	164.9
		S 5th Avenue SB	TR	37.9	40.9	D	D	31.0	0%	52.9	0%	152.4	164.9
		US 17 / 76 (Wooster Street) WB	LT	6.6	92.8	A	F	27.2	0%	180.2	1%	337.7	1740.6
		US 17 / 76 (Wooster Street) WB	T	19.5	95.5	B	F	73.6	0%	441.4	5%	337.7	1740.6
		US 17 / 76 (Wooster Street) WB	TR	5.6	65.5	A	E	23.3	0%	29.2	0%	337.7	1740.6
		S 5th Avenue NB	LT	70.4	120.3	E	F	37.8	0%	63.4	0%	143.6	170.1
		S 5th Avenue NB	T	43.1	63.4	D	E	24.3	0%	39.4	0%	143.6	170.1

Unsignalized Intersections[3]

Intersection No.	Intersection	Approach	Lane Group	Delay[1] (s) AM	Delay[1] (s) PM	Level of Service[2] AM	Level of Service[2] PM	95th Queue (ft)/Spillback Rate AM		95th Queue (ft)/Spillback Rate PM		Maximum Queue Length (ft) AM	Maximum Queue Length (ft) PM
22	S Front Street & US 17 / 76 EB Off-Ramp to NB Front	S Front Street SB	T	0.0	0.0	A	A	0.0	0%	0.0	0%	0.0	0.0
		US 17 / 76 EB Off-Ramp WB	R	8.1	31.6	A	D	3.4	0%	4.3	0%	43.4	38.9
		S Front Street NB	T	0.1	2.9	A	A	0.0	0%	11.8	2%	0.0	390.0
50	US 17 / 76 (Dawson Street) & S 4th Street	S 4th Street NB	R	37.1	23.6	E	C	0.8	0%	0.5	0%	15.5	13.3
		US 17 / 76 (Dawson Street) EB	T	0.2	1.5	A	A	0.0	0%	0.4	0%	0.0	0.0
		US 17 / 76 (Dawson Street) EB	TR	0.9	1.0	A	A	0.0	0%	0.0	0%	0.0	0.0

Notes:

1 Delay shown is the 95th percentile worst case control delay for the full 60-minute simulation period as derived from the 10 random seed simulations

2 Level of Service shown is Simulation based and calculated in a manner that is consistent with the HCM Methodologies

3 Results for unsignalized intersections include only the movements that have conflicting flow and thus have the potential to incur control delay

Table 16: 2050 Build Alternative B Network Statistics

Time	Vehicle Hours Traveled (VHT)	Vehicle Miles Traveled (VMT)	Average Speed (mph)	Total Delay (hrs)
AM	737.9	26,688.3	39.0	209.8
PM	945.3	28,309.7	35.6	389.4

Table 17: 2050 Build Alternative B Corridor Summary

O-D	Description	TRAVEL TIMES (min)		TRAVEL SPEEDS (mph)	
		8:00-9:00	17:00-18:00	8:00-9:00	17:00-18:00
100-106	US 17 / 74 / 76 / NC 133 West of US 74 / 421 / NC 133 to US 17 / 76 (Dawson Street) east of 5th Avenue	4.28	4.16	35.76	36.67
105-100	US 17 / 76 (Wooster Street) east of 5th Avenue to US 17 / 74 / 76 / NC 133 West of US 74 / 421 / NC 133	3.68	5.77	40.60	28.38

Table 18: 2050 Build Alternative B Freeway Segment LOS$_s$ Summary

Order	Street Name	Analysis Type	Location	DENSITY (vplpm)		LOSs	
				AM	PM	AM	PM
1	US 17 / 74 / 76 / NC 133 EB	Basic	West of US 74 / 421 / NC 133 Off Ramp	28.5	21.7	D	C
2	US 17 / 76 / 421 EB	Basic	Between US 74 / 421 / NC 133 Off Ramp and US 74 / 421 / NC 133 On Ramp	41.9	32.5	E	D
3	US 17 / 76 / 421 EB	Basic	US 74 / 421 / NC 133 On Ramp	41.9	25.5	E	C
4	US 17 / 76 / 421 EB	Basic	Between US 74 / 421 / NC 133 On Ramp and Front Street Off Ramp	55.0	30.5	F	D
5	US 17 / 76 / 421 EB	Basic	Front Street Off Ramp	28.9	23.9	D	C
6	US 17 / 76 EB	Basic	East of Front Street Off Ramp	19.9	16.8	C	B
7	US 17 / 76 / 421 WB	Basic	Front Street On Ramp	19.4	26.6	C	D
8	US 17 / 76 / 421 WB	Diverge	Between Front Street On Ramp and US 74 / 421 / NC 133 Off Ramp	21.8	31.2	C	D
9	US 17 / 76 / 421 WB	Basic	Between US 74 / 421 / NC 133 Off Ramp and US 74 / 421 / NC 133 On Ramp (3 Lane)	19.5	33.8	C	D
10	US 17 / 76 / 421 WB	Basic	Between US 74 / 421 / NC 133 Off Ramp and US 74 / 421 / NC 133 On Ramp (2 Lane)	27.1	42.5	D	E
11	US 17 / 74 / 76 / NC 133 WB	Basic	West of US 74 / 421 / NC 133 On Ramp	26.5	37.7	D	E

Table 19: 2050 Build Alternative B Intersection LOSs Summary

Signalized Intersections

Intersection No.	Intersection	Approach	Lane Group	Delay[1] (s) AM	Delay[1] (s) PM	Level of Service[2] AM	Level of Service[2] PM	95th Queue (ft)/Spillback Rate AM		95th Queue (ft)/Spillback Rate PM		Maximum Queue Length (ft) AM	Maximum Queue Length (ft) PM
60	US 17 / 76 (Dawson Street) & S 5th Avenue	***Overall***		***57.1***	***65.8***	***E***	***E***						
		S 5th Avenue SB	L	95.3	59.2	F	E	224.3	13%	160.7	8%	735.6	814.4
		S 5th Avenue SB	T	32.2	35.7	C	D	38.0	0%	41.8	0%	735.6	814.4
		S 5th Avenue NB	T	83.9	105.1	F	F	203.3	0%	210.0	0%	786.2	658.7
		S 5th Avenue NB	TR	136.8	122.2	F	F	296.1	0%	216.7	0%	786.2	658.7
		US 17 / 76 EB EB	LT	41.1	64.1	D	E	152.9	0%	236.2	0%	795.6	1132.2
		US 17 / 76 EB EB	T	36.5	63.7	D	E	134.5	0%	222.0	0%	795.6	1132.2
		US 17 / 76 EB EB	TR	46.1	86.9	D	F	136.2	0%	248.7	0%	795.6	1132.2
70	US 17 / 76 (Wooster Street) & S 5th Avenue	***Overall***		***37.9***	***144.8***	***D***	***F***						
		S 5th Avenue SB	T	106.5	364.5	F	F	231.5	0%	726.6	9%	625.2	1835.5
		S 5th Avenue SB	TR	61.2	262.4	E	F	120.2	0%	546.6	6%	625.2	1835.5
		US 17 / 76 (Wooster Street) WB	L	24.8	103.8	C	F	27.3	0%	150.3	0%	651.1	1682.2
		US 17 / 76 (Wooster Street) WB	T	27.6	124.0	C	F	117.9	0%	406.9	3%	651.1	1682.2
		US 17 / 76 (Wooster Street) WB	TR	30.4	116.9	C	F	90.6	0%	273.5	2%	651.1	1682.2
		S 5th Avenue NB	L	61.8	91.3	E	F	76.8	0%	142.3	1%	246.5	247.8
		S 5th Avenue NB	T	18.6	18.0	B	B	18.9	0%	26.1	0%	246.5	247.8

Roundabouts

Intersection No.	Intersection	Approach	Lane Group	Delay[1] (s) AM	Delay[1] (s) PM	Level of Service[2] AM	Level of Service[2] PM	95th Queue (ft)/Spillback Rate AM		95th Queue (ft)/Spillback Rate PM		Maximum Queue Length (ft) AM	Maximum Queue Length (ft) PM
20	S Front Street & US 17 / 76 Ramps Roundabout	S Front Street SWB	T	2.5	5.5	A	A	0.0	0%	0.0	0%	0.0	21.6
		S Front Street NB	T	6.8	78.8	A	F	11.1	0%	22.1	0%	122.1	115.5
		US 17 / 76 EB Off-Ramp SEB	T	3.7	33.7	A	D	2.3	0%	60.4	0%	32.7	334.3

Notes:

1 Delay shown is the 95th percentile worst case control delay for the full 60-minute simulation period as derived from the 10 random seed simulations

2 Level of Service shown is Simulation based and calculated in a manner that is consistent with the HCM Methodologies

3 Results for unsignalized intersections include only the movements that have conflicting flow and thus have the potential to incur control delay

10. Conclusions and Recommendations

Based on the results of the analysis, operations along the Cape Fear Memorial Bridge corridor and at adjacent study area intersections are expected to deteriorate by the year 2050 without any proposed improvements. As discussed in **Section 8.8**, freeway densities as well as queues at intersections within the study area would experience large increases between the 2023 year and 2050 year analyses. These increases would cause higher densities along the freeway which creates stop and go conditions through most of the model.

Alternative A and Alternative B are expected to provide relief to the roadway network based on analysis findings. Alternative A results indicate a reduction in VHT of 411.3 hours and an increase in network travel speed of 5.3 mph on average, as compared to 2050 No-Build conditions. Alternative B results indicate a reduction in VHT of 592.1 hours and an increase in network travel speed of 6.9 mph on average, as compared to 2050 No-Build conditions. Queuing was also shown to improve between 2050 No-Build and 2050 Build (Alternative A and Alternative B) conditions throughout the study area.

Appendix

Appendix A:
Traffic Volume Forecasts

Clearbox Forecast Group, PLLC

MEMORANDUM

To: Trace Howell, North Carolina Department of Transportation

From: Craig R. Gresham, P.E.
Clearbox Forecast Group, PLLC

Date: September 27th, 2023

Subject: Traffic Forecast – Cape Fear Memorial Bridge Replacement (NCDOT Project HB-0039)

Please find attached an amended 2023/2050 traffic forecast for NCDOT Project HB-0039. This forecast was originally reviewed and approved by NCDOT Transportation Planning Division on May 15th, 2023. **This amended forecast updates intersection volumes at South 3rd Street/South 5th Avenue and Wooster/Dawson Street for Future Build 2 scenario only. No other forecast volumes have been updated as a part of this amendment.**

This forecast provides 2023 Base Year Build and 2050 Future Year Build for two six-lane build scenarios for the replacement of the existing bridge. Previously prepared Traffic Forecasts for NCDOT Projects U-4738 and U-5734 were consulted during the development of this forecast.

This forecast assumes all projects documented in the adopted 2045 "Cape Fear Moving Forward 2045" Metropolitan Transportation Plan (MTP) for the Wilmington area. This forecast was requested for use in the project development activities associated with the project. This traffic forecast includes Average Annual Daily Traffic (AADT) estimates for the three scenarios for the 2023 Base Year and 2050 Future Year listed in Table 1.

Table 1. Traffic Forecast Scenarios

Forecast Scenario		Year	Forecast Scenario
1	Base Year No-Build (BYNB)	2023	Existing Road Network
2	Future Year Build 1 (FYBD1)	2050	Existing Road Network plus 2045 Wilmington MPO MTP Fiscally-Constrained Projects and Subject Project (Widen Cape Fear Memorial Bridge to Six Lanes)
3	Future Year Build 2 (FYBD2)	2050	Existing Road Network plus 2045 Wilmington MPO MTP Fiscally-Constrained Projects and Subject Project (Widen Cape Fear Memorial Bridge to Six Lanes) with no access at S. 3rd Street or S. 4th Street

The following basic assumptions were made to complete this forecast.

***Travel Demand Model**:* This forecast utilizes the Wilmington MPO 2045 Travel Demand Model (TransCAD 7) as a tool to determine Base Year and Future Year volumes.

Fiscally Constrained: The Wilmington MPO Model was run using the Wilmington 2045 MTP adopted on November 18th, 2020. 2045 MTP Projects in the vicinity of the study area were reviewed and considered as part of the traffic forecast development.

Forecast Methodology: The 2023 base year build and 2050 future year build volumes generally included the development of diversion rates between like model years with different scenarios. The compound annual growth rates or diversion rates were then applied to the AADT volumes from another scenario to develop initial volumes for each scenario. Engineering judgment adjustments were applied as needed to prepare balanced forecasts.

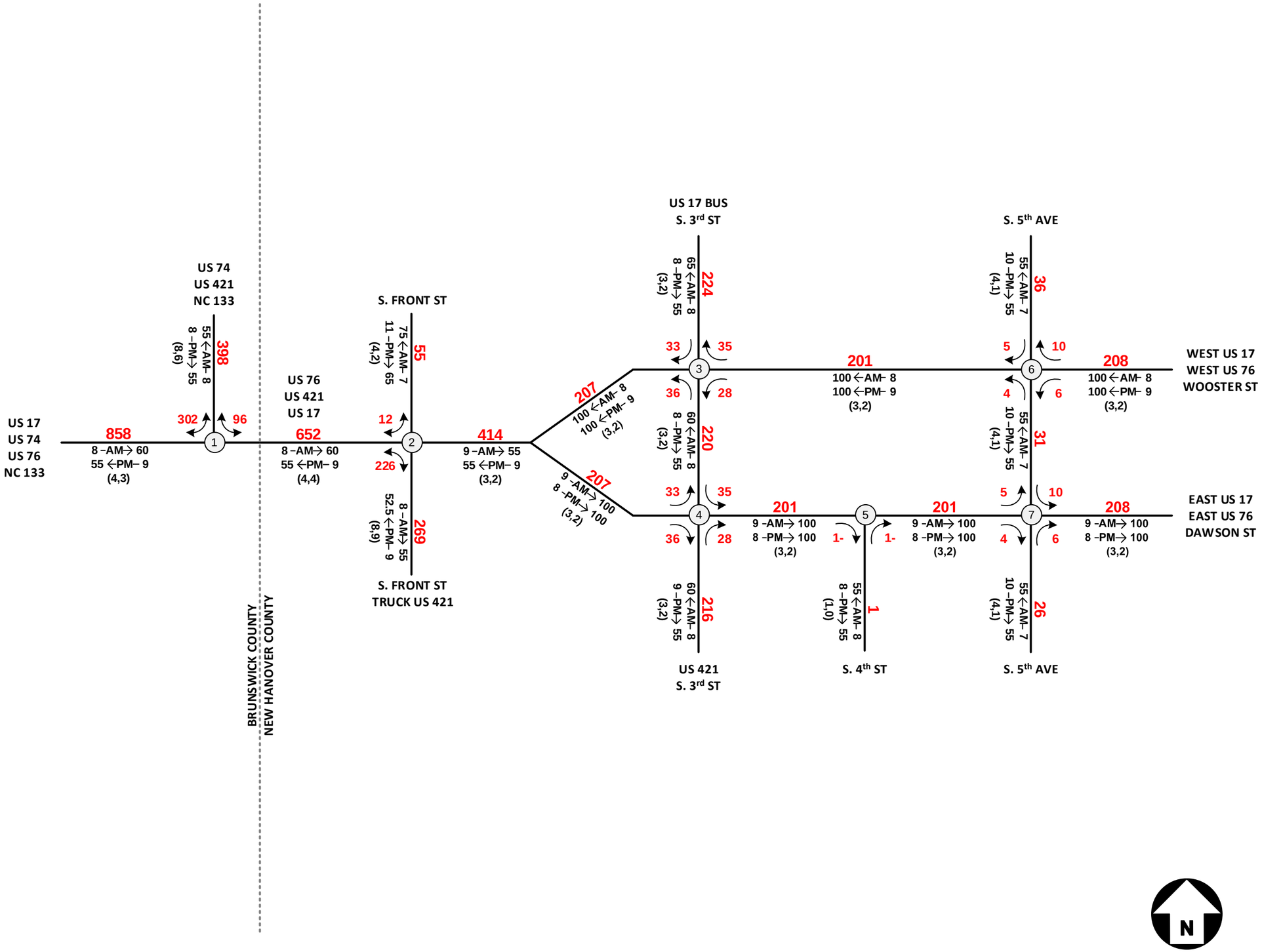
Interpolation: Straight-line interpolation may be used. AADT volumes may be extrapolated for up to two years immediately following 2050. If it is determined that any of these assumptions have become inconsistent with the project and surrounding area activity, please request updated projections for this project.

Please contact me for any further assistance at 919-651-8010 or craig@clearboxforecast.com

Craig Gresham, P.E.

Clearbox Forecast Group, PLLC

cc: FILE (Brunswick County, NCDOT TIP Project HB-0039)
Keith Dixon, NCDOT Transportation Planning Branch



LEGEND

###	No. of Vehicles Per Day in 100s
1-	Less than 50 vpd
X	Movement Prohibited
K –AM→ D D ←PM– K (d, t)	
K	Design Hour Factor (%)
PM	PM Peak Period
AM	AM Peak Period
D	Peak Hour Directional Split (%)
→	Indicates Direction of D
(d, t)	Duals, TT-STs (%)

2023 AVERAGE ANNUAL DAILY TRAFFIC

BASE YEAR NO-BUILD
SHEET 1 OF 1

NC TIP: HB-0039

COUNTY: New Hanover/ Brunswick

WBS: 50603.1.1

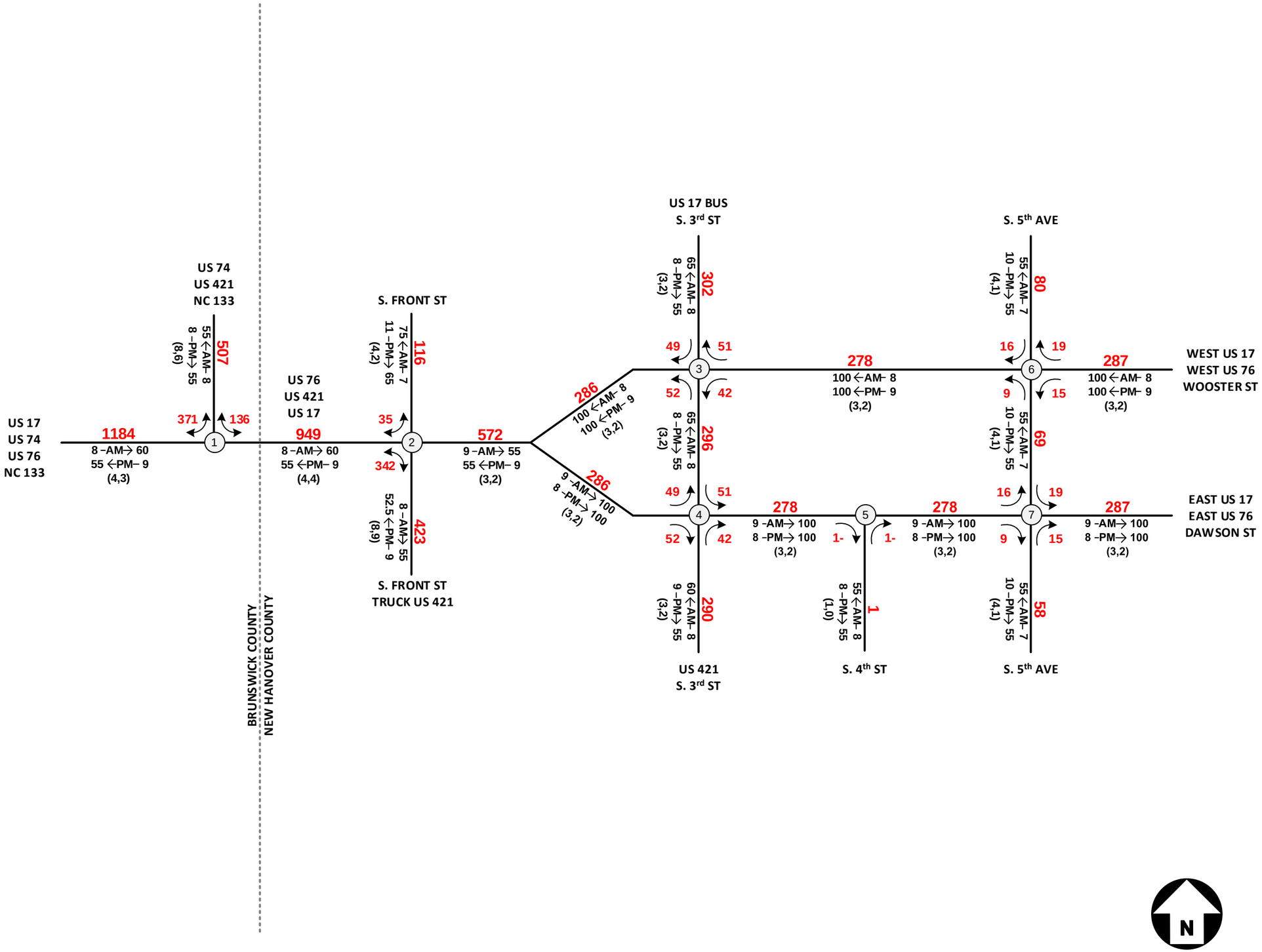
DATE: May 2023

DIVISION: 3

PREPARED BY: Clearbox Forecast Group

LOCATION: WILMINGTON, NC

PROJECT: REPLACE BRIDGE 640013 (CAPE FEAR MEMORIAL BRIDGE) OVER CAPE FEAR RIVER IN NEW HANOVER COUNTY



LEGEND

###	No. of Vehicles Per Day in 100s
1-	Less than 50 vpd
X	Movement Prohibited
K –AM→ D D ←PM– K (d, t)	
K	Design Hour Factor (%)
PM	PM Peak Period
AM	AM Peak Period
D	Peak Hour Directional Split (%)
→	Indicates Direction of D
(d, t)	Duals, TT-STs (%)

2050 AVERAGE ANNUAL DAILY TRAFFIC

FUTURE YEAR BUILD 1
SHEET 1 OF 1

NC TIP: HB-0039

COUNTY: New Hanover/ Brunswick

WBS: 50603.1.1

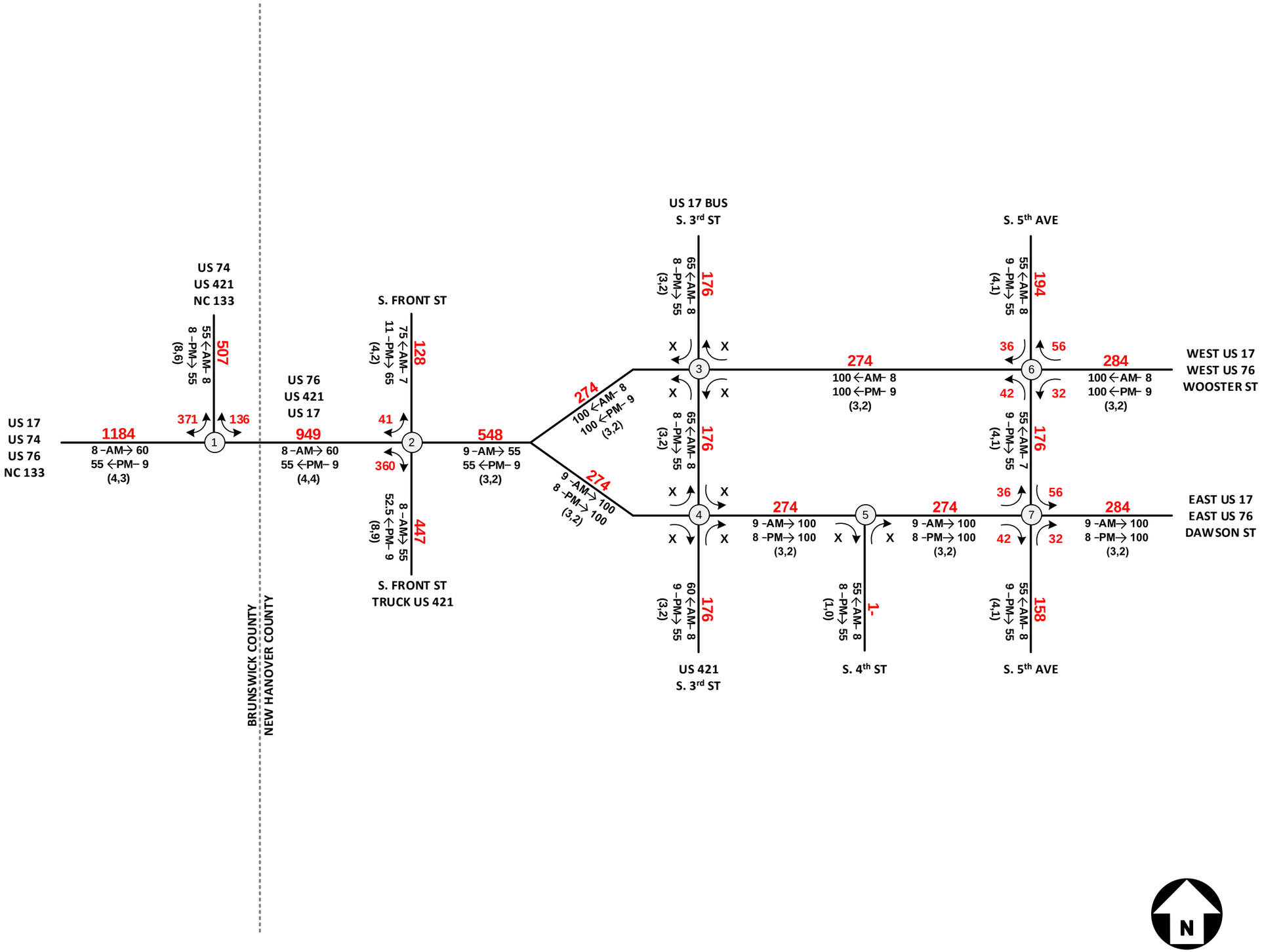
DATE: May 2023

DIVISION: 3

PREPARED BY: Clearbox Forecast Group

LOCATION: WILMINGTON, NC

PROJECT: REPLACE BRIDGE 640013 (CAPE FEAR MEMORIAL BRIDGE) OVER CAPE FEAR RIVER IN NEW HANOVER COUNTY



LEGEND

###	No. of Vehicles Per Day in 100s
1-	Less than 50 vpd
X	Movement Prohibited
K –AM→ D D ←PM– K (d, t)	
K	Design Hour Factor (%)
PM	PM Peak Period
AM	AM Peak Period
D	Peak Hour Directional Split (%)
→	Indicates Direction of D
(d, t)	Duals, TT-STs (%)

2050 AVERAGE ANNUAL DAILY TRAFFIC

FUTURE YEAR BUILD 2
SHEET 1 OF 1

NC TIP: HB-0039

COUNTY: New Hanover/ Brunswick

WBS: 50603.1.1

DATE: September 2023

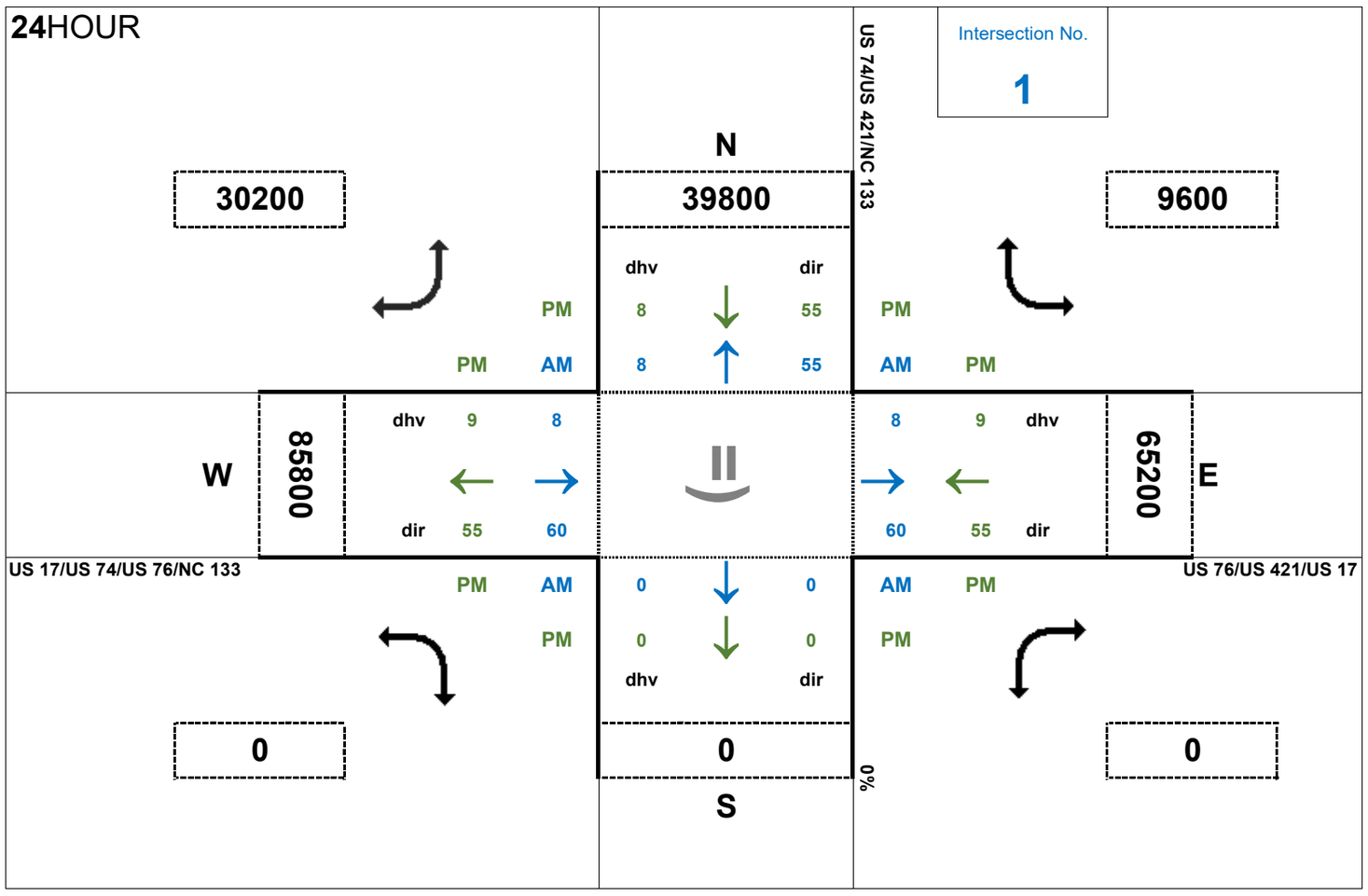
DIVISION: 3

PREPARED BY: Clearbox Forecast Group

LOCATION: WILMINGTON, NC

PROJECT: REPLACE BRIDGE 640013 (CAPE FEAR MEMORIAL BRIDGE) OVER CAPE FEAR RIVER IN NEW HANOVER COUNTY

Appendix B:
IAU Spreadsheets



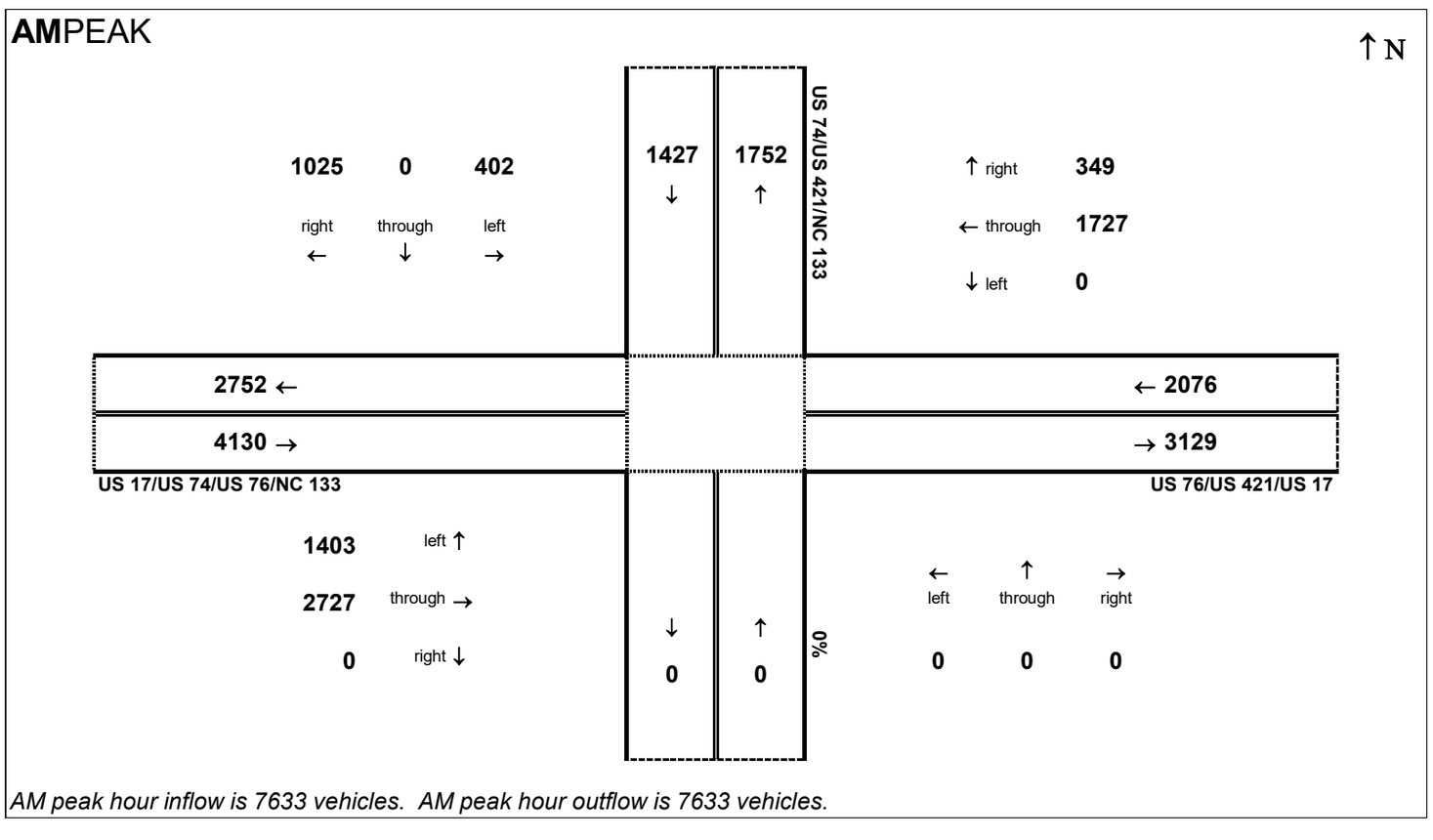
Peak Hour Volume Breakouts Report:
US 74/US 421/NC 133 at US 76/US 421/US 17

Traffic Forecast Release Date:

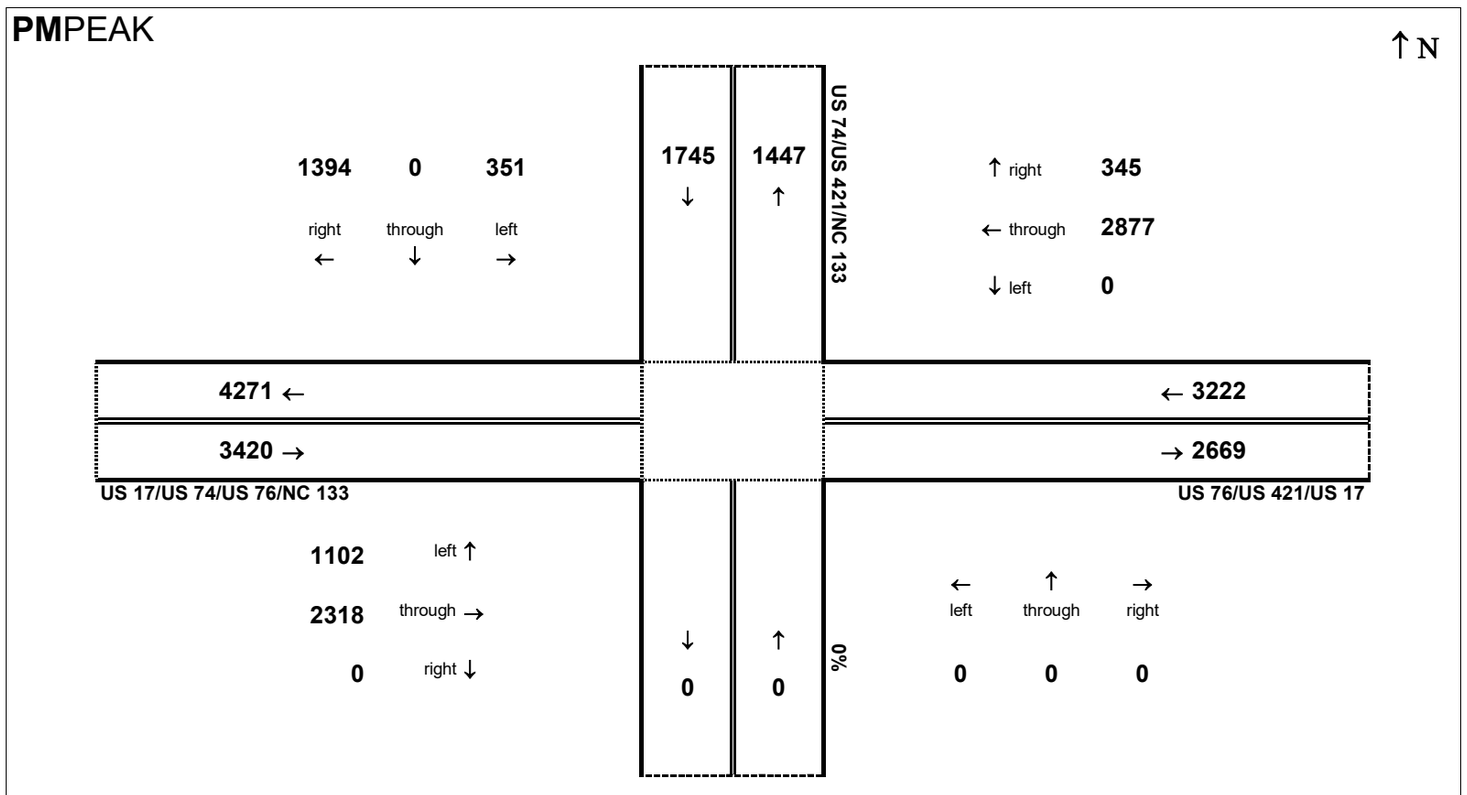
May-23

Traffic Data Year:
1/1/2023

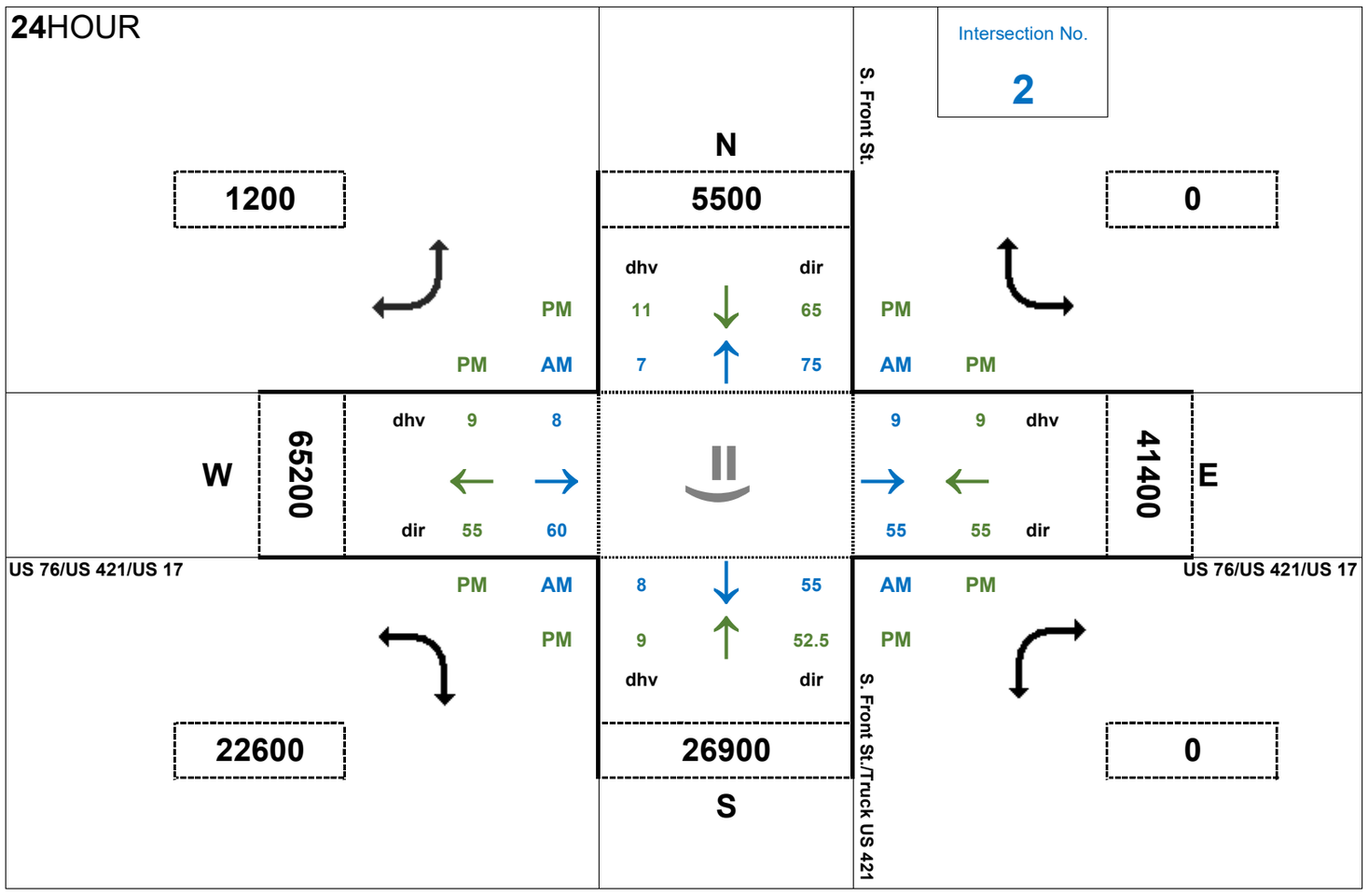
Project:
HB-0039 2023 NB

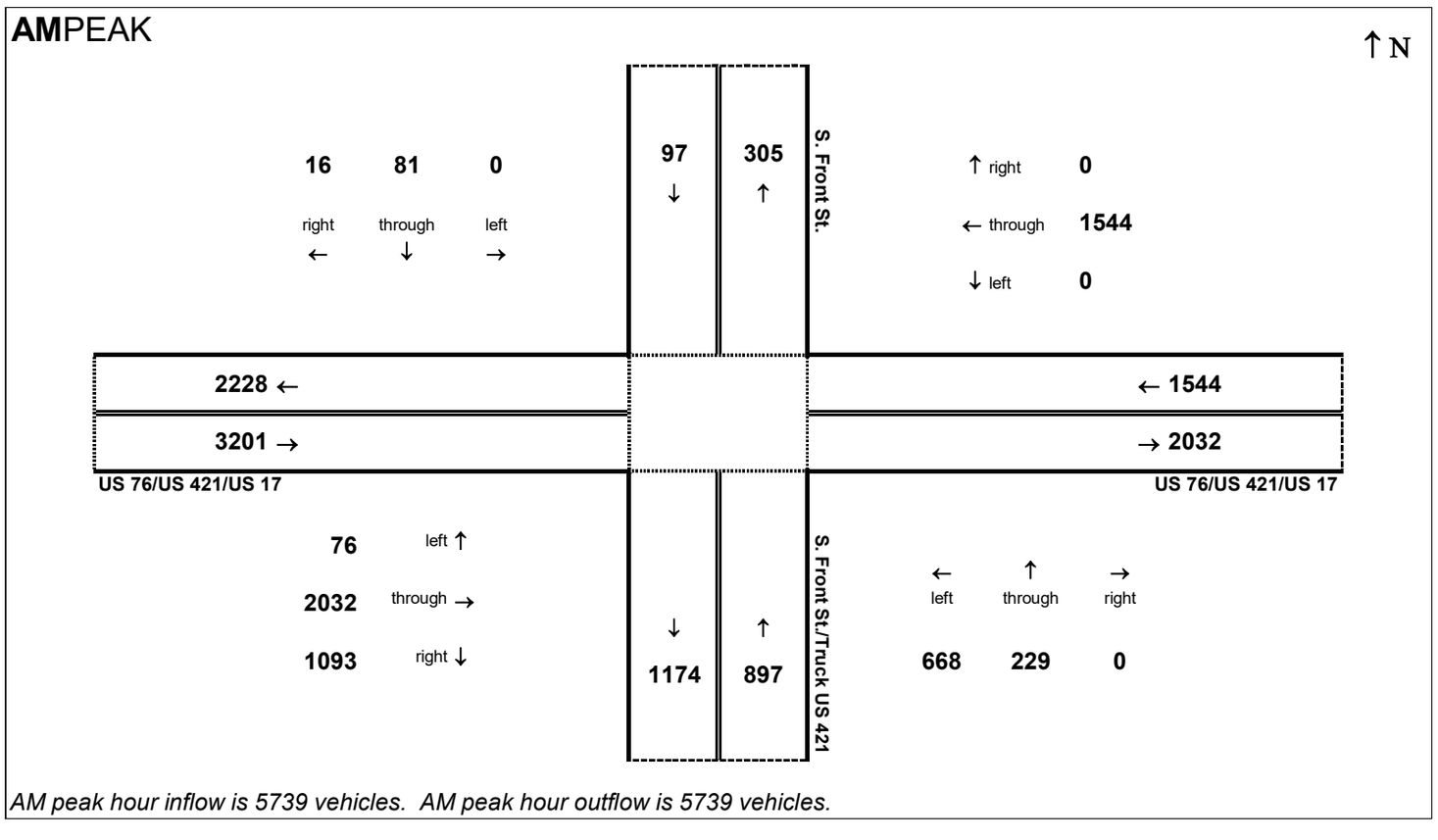


AM peak hour inflow is 7633 vehicles. AM peak hour outflow is 7633 vehicles.

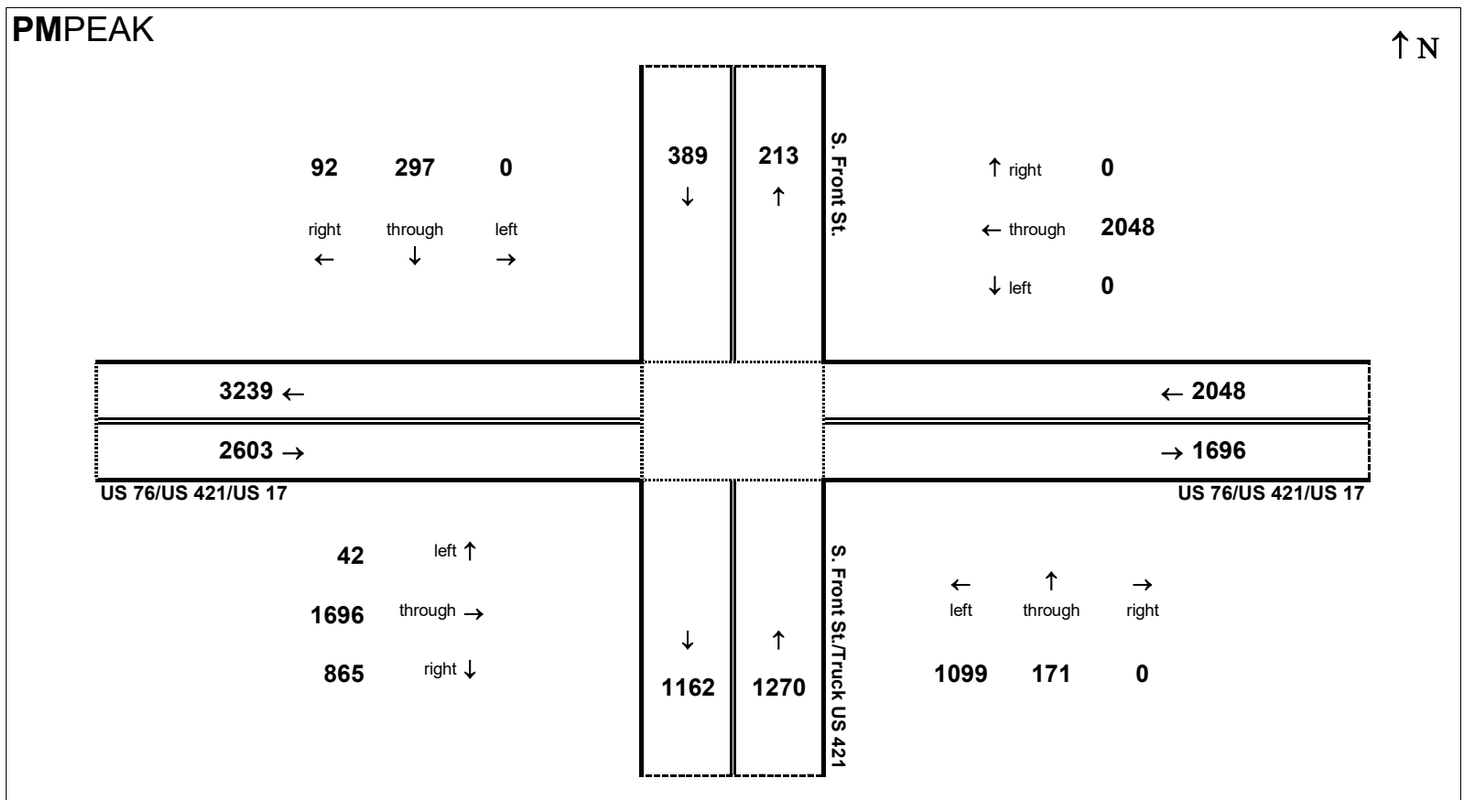


PM peak hour inflow is 8387 vehicles. PM peak hour outflow is 8387 vehicles.





AM peak hour inflow is 5739 vehicles. AM peak hour outflow is 5739 vehicles.



PM peak hour inflow is 6310 vehicles. PM peak hour outflow is 6310 vehicles.

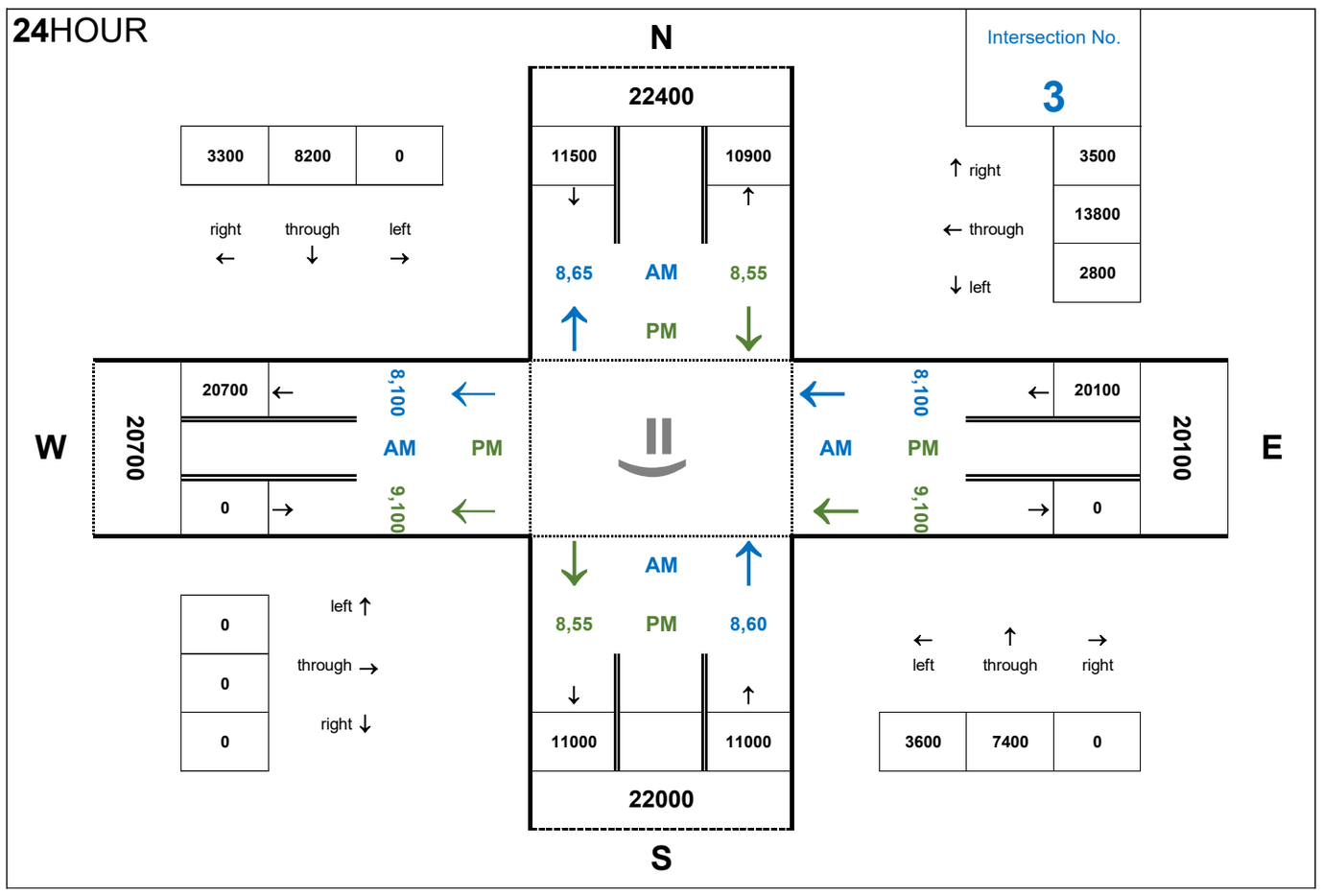
Peak Hour Volume Breakouts Report:
S. Front St. at US 76/US 421/US 17

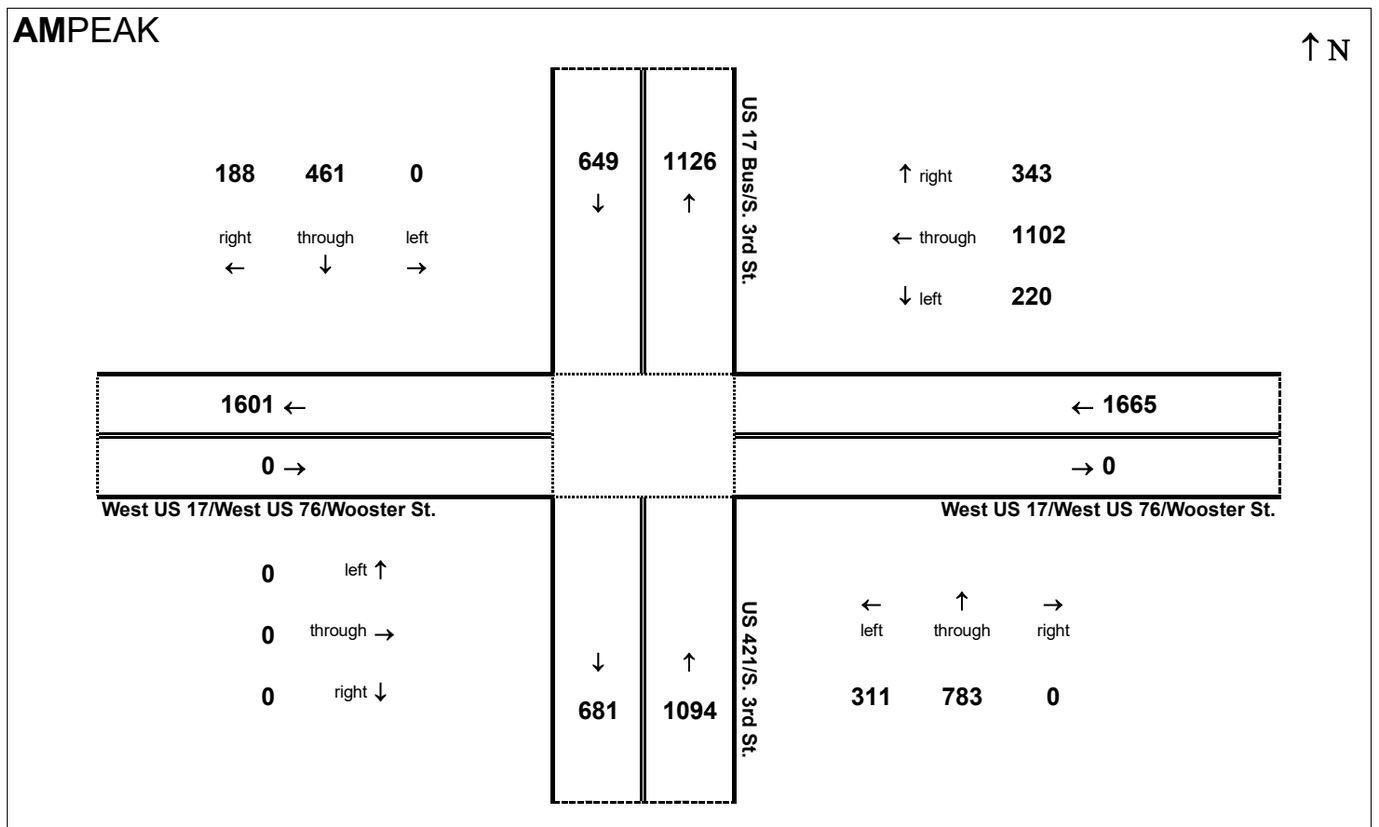
Traffic Forecast Release Date:

May-23

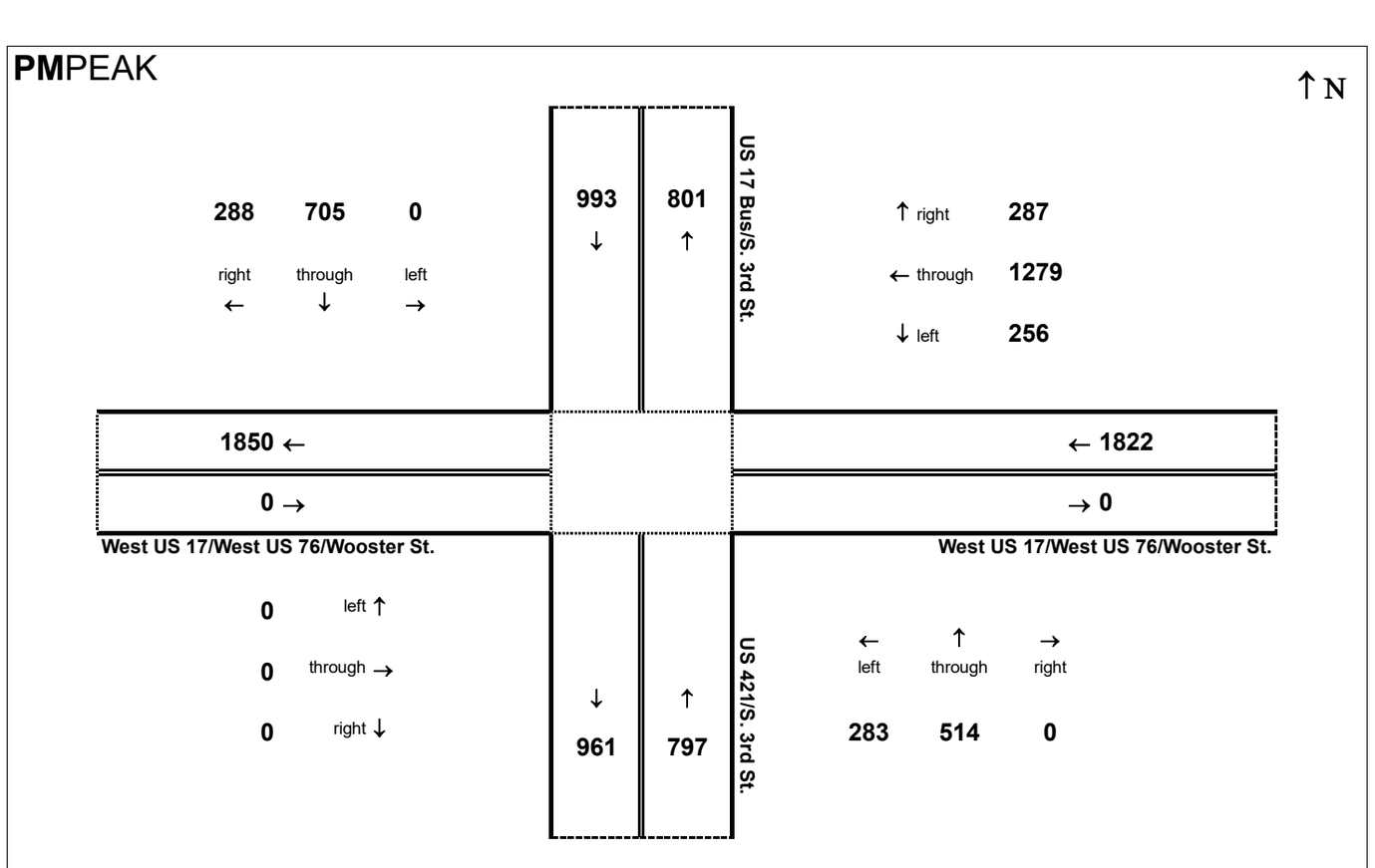
Traffic Data Year:
1/1/2023

Project:
HB-0039 2023 NB





AM peak hour inflow is 3408 vehicles. AM peak hour outflow is 3408 vehicles.



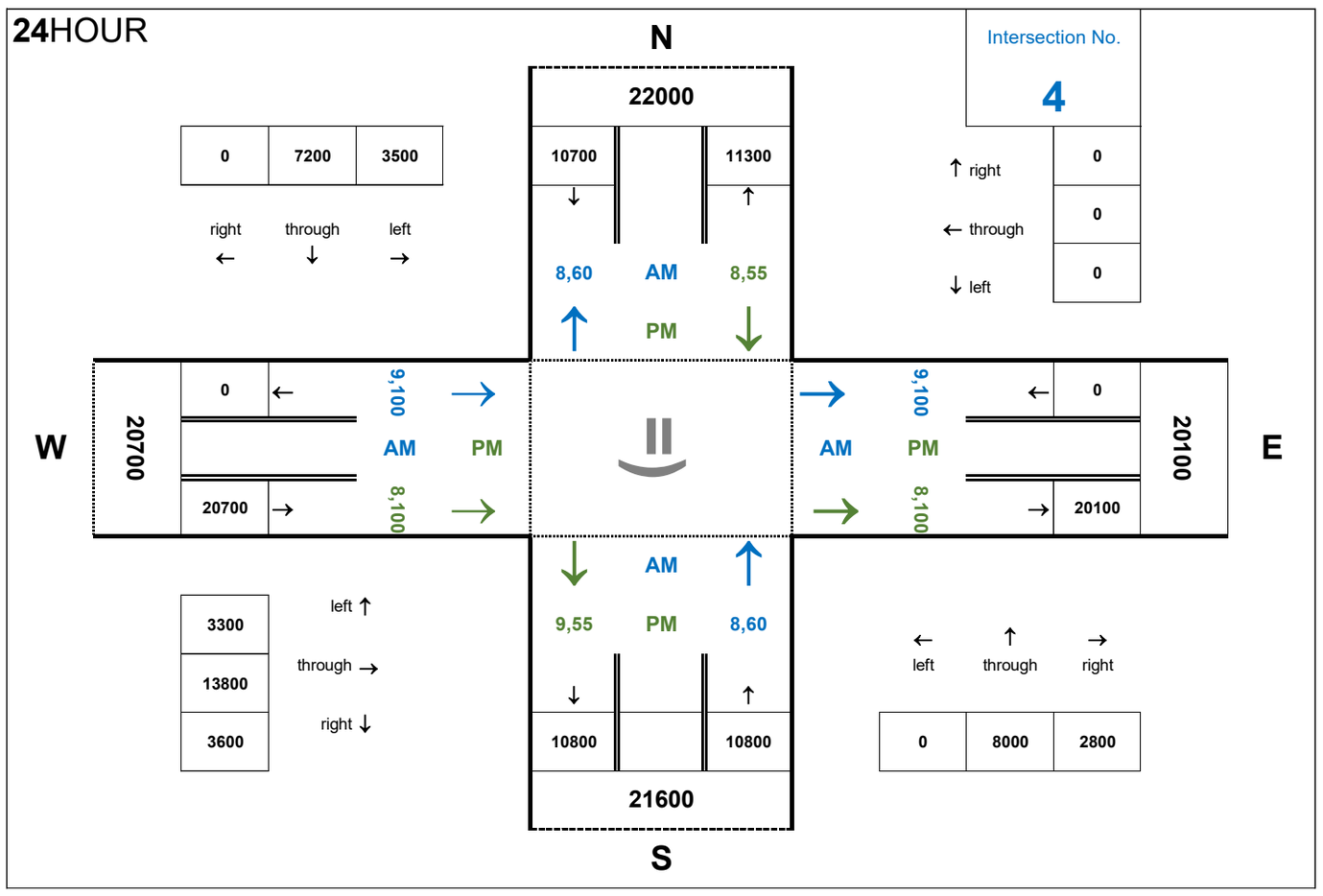
PM peak hour inflow is 3612 vehicles. PM peak hour outflow is 3612 vehicles.

Peak Hour Volume Breakouts Report:
S. 3rd St. at West US 17/West US 76/Wooster St.

Traffic Forecast Release Date:
May-23

Traffic Data Year:
1/1/2023

Project:
HB-0039 2023 NB

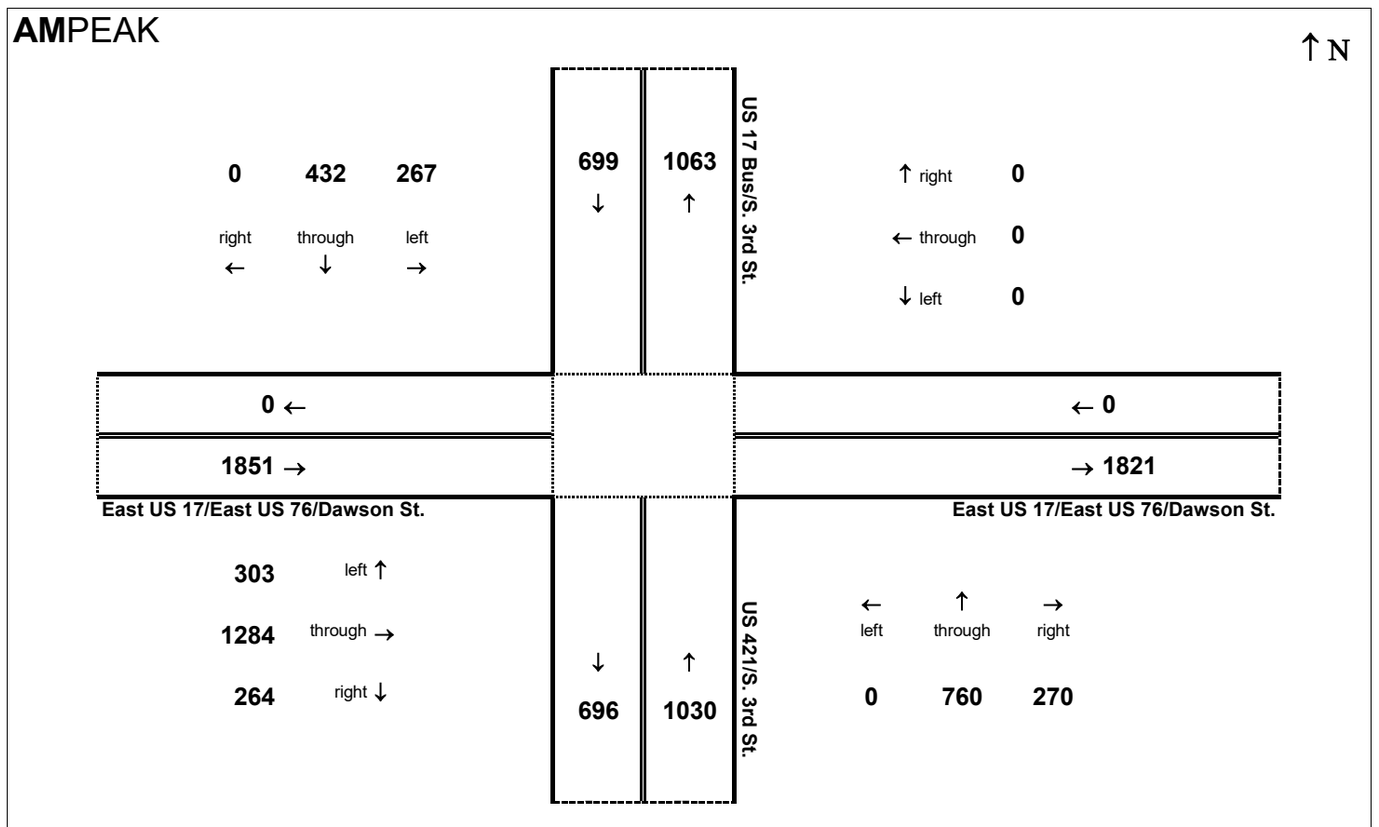


Peak Hour Volume Breakouts Report:
S. 3rd St. at East US 17/East US 76/Dawson St.

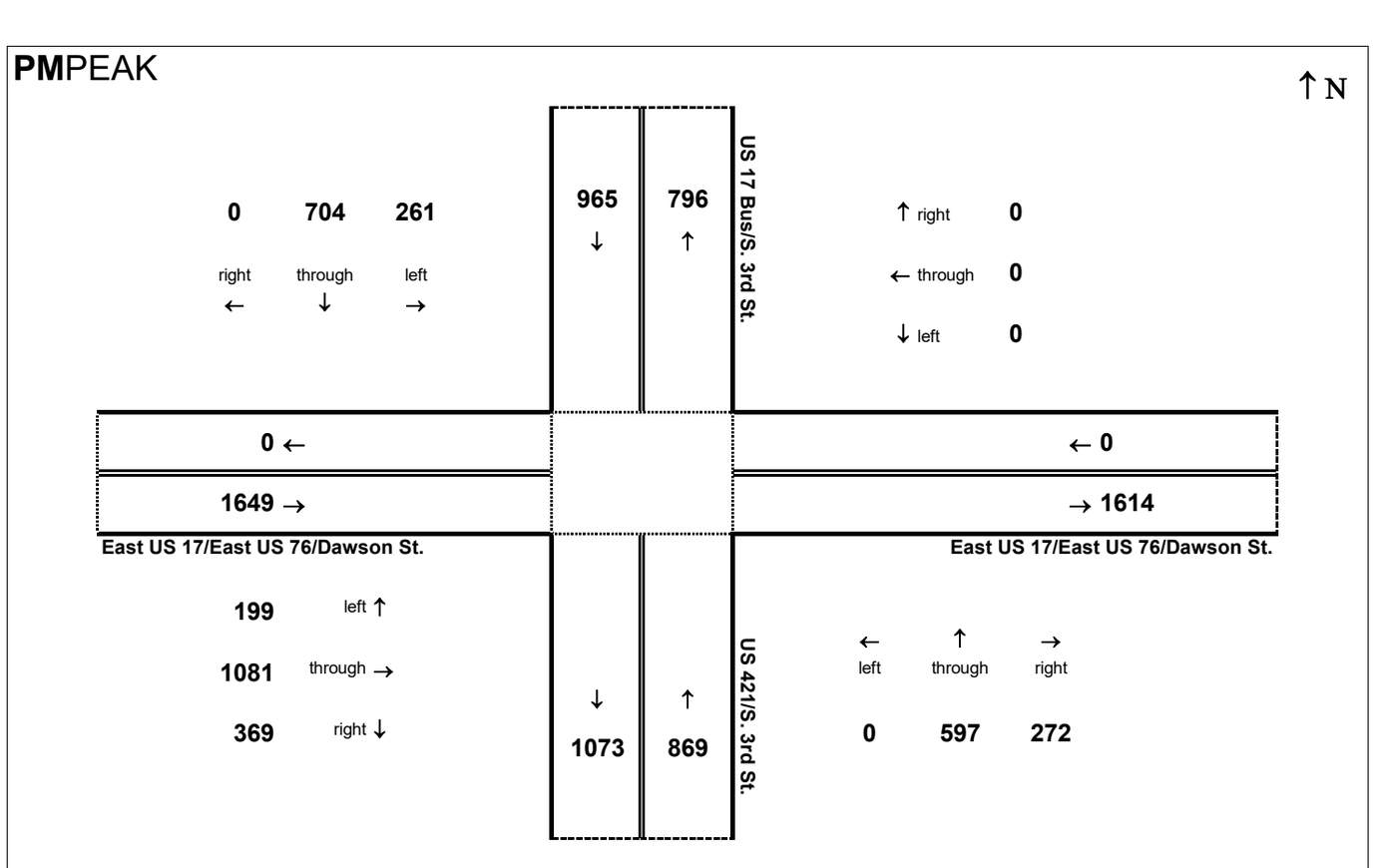
Traffic Forecast Release Date:
May-23

Traffic Data Year:
1/1/2023

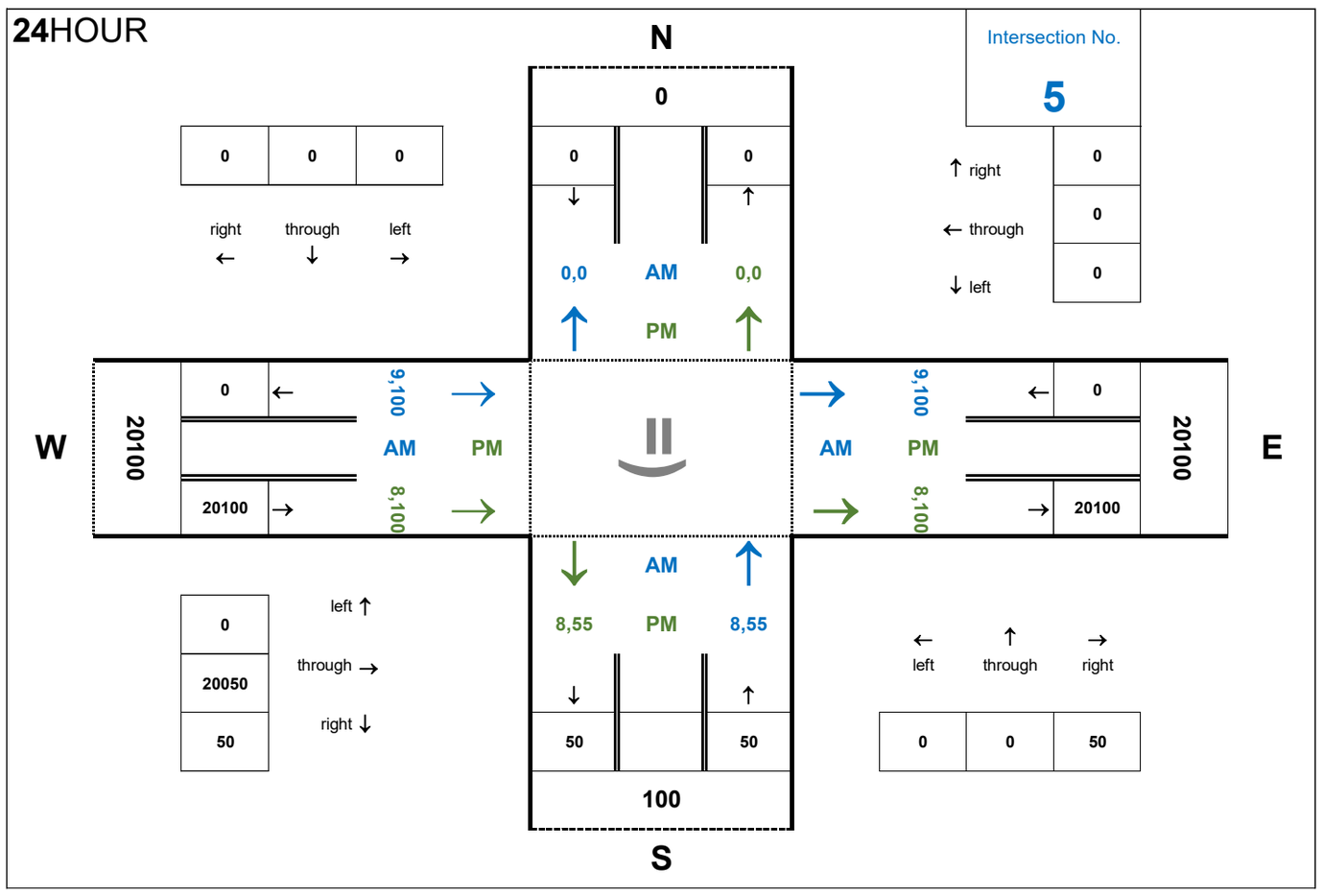
Project:
HB-0039 2023 NB

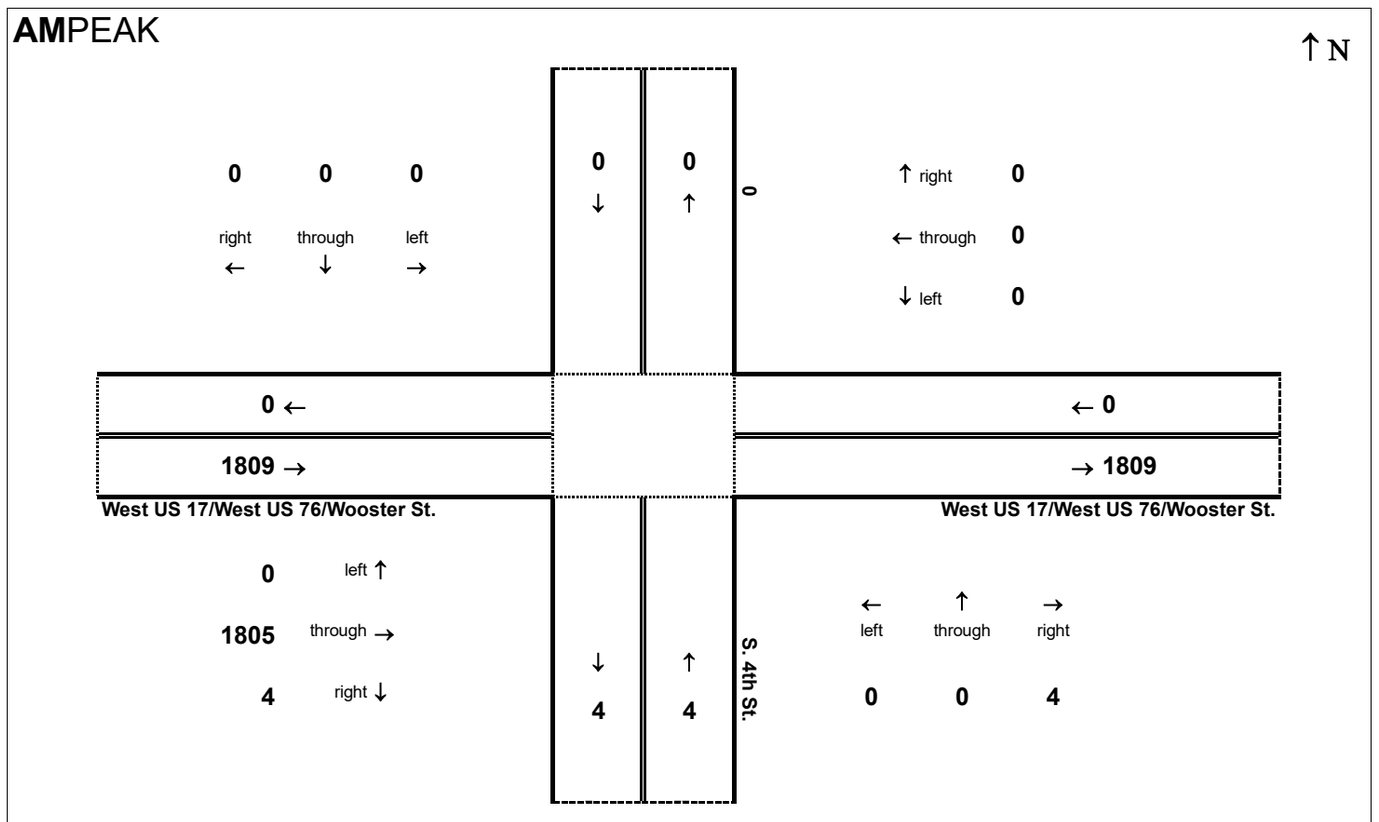


AM peak hour inflow is 3580 vehicles. AM peak hour outflow is 3580 vehicles.

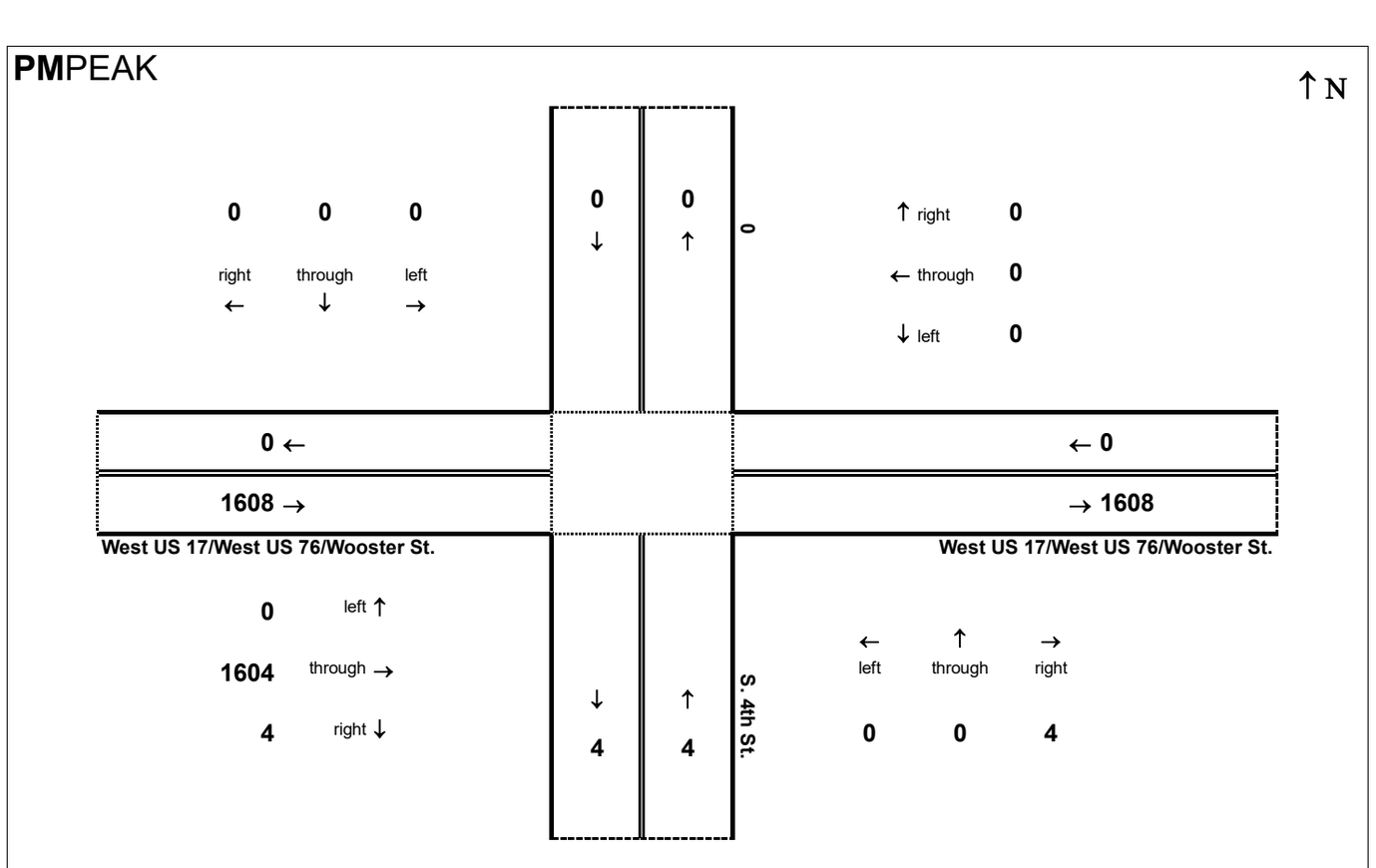


PM peak hour inflow is 3483 vehicles. PM peak hour outflow is 3483 vehicles.





AM peak hour inflow is 1813 vehicles. AM peak hour outflow is 1813 vehicles.



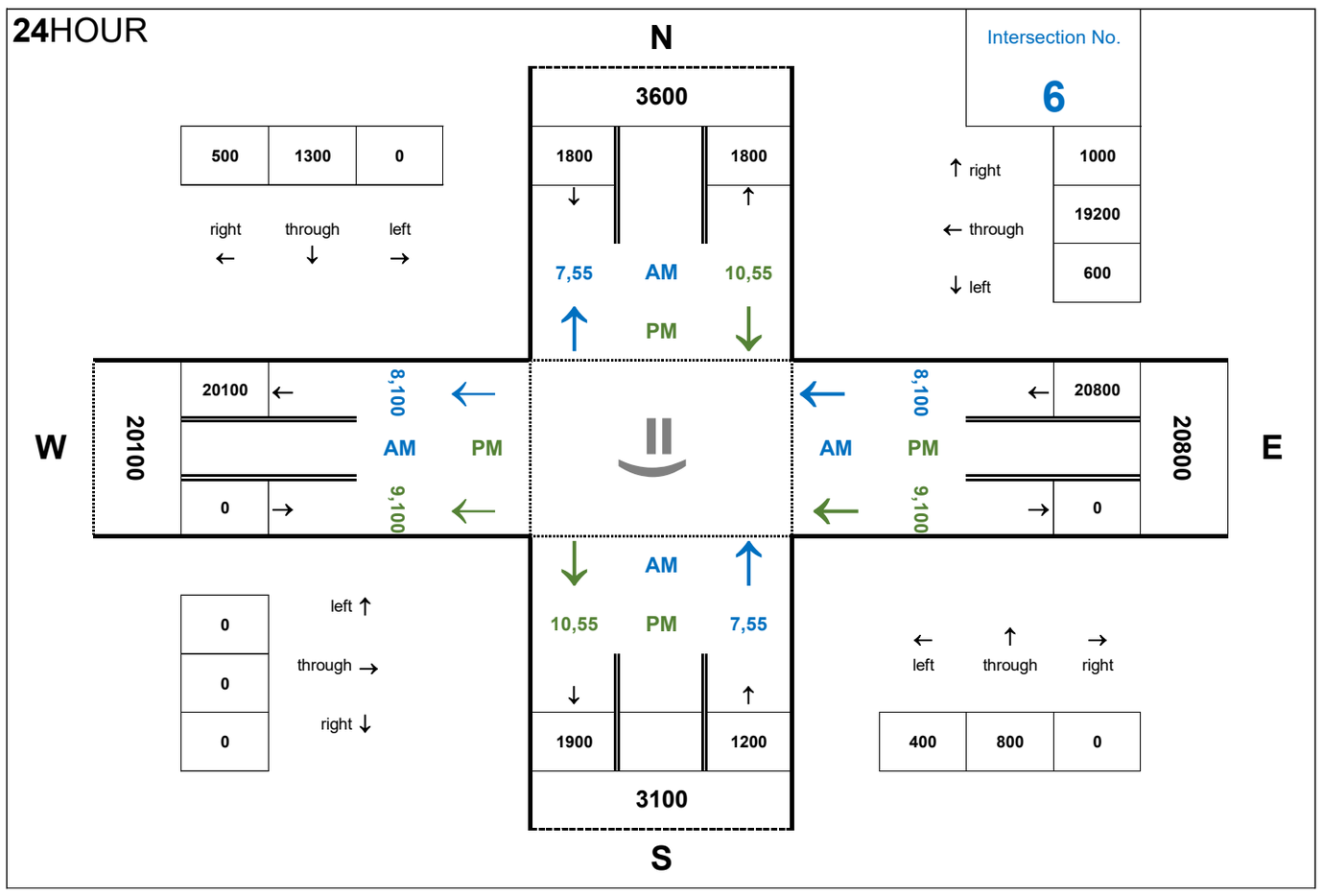
PM peak hour inflow is 1612 vehicles. PM peak hour outflow is 1612 vehicles.

Peak Hour Volume Breakouts Report:
S. 4th St. at East US 17/East US 76/Dawson St.

Traffic Forecast Release Date:
May-23

Traffic Data Year:
1/1/2023

Project:
HB-0039 2023 NB

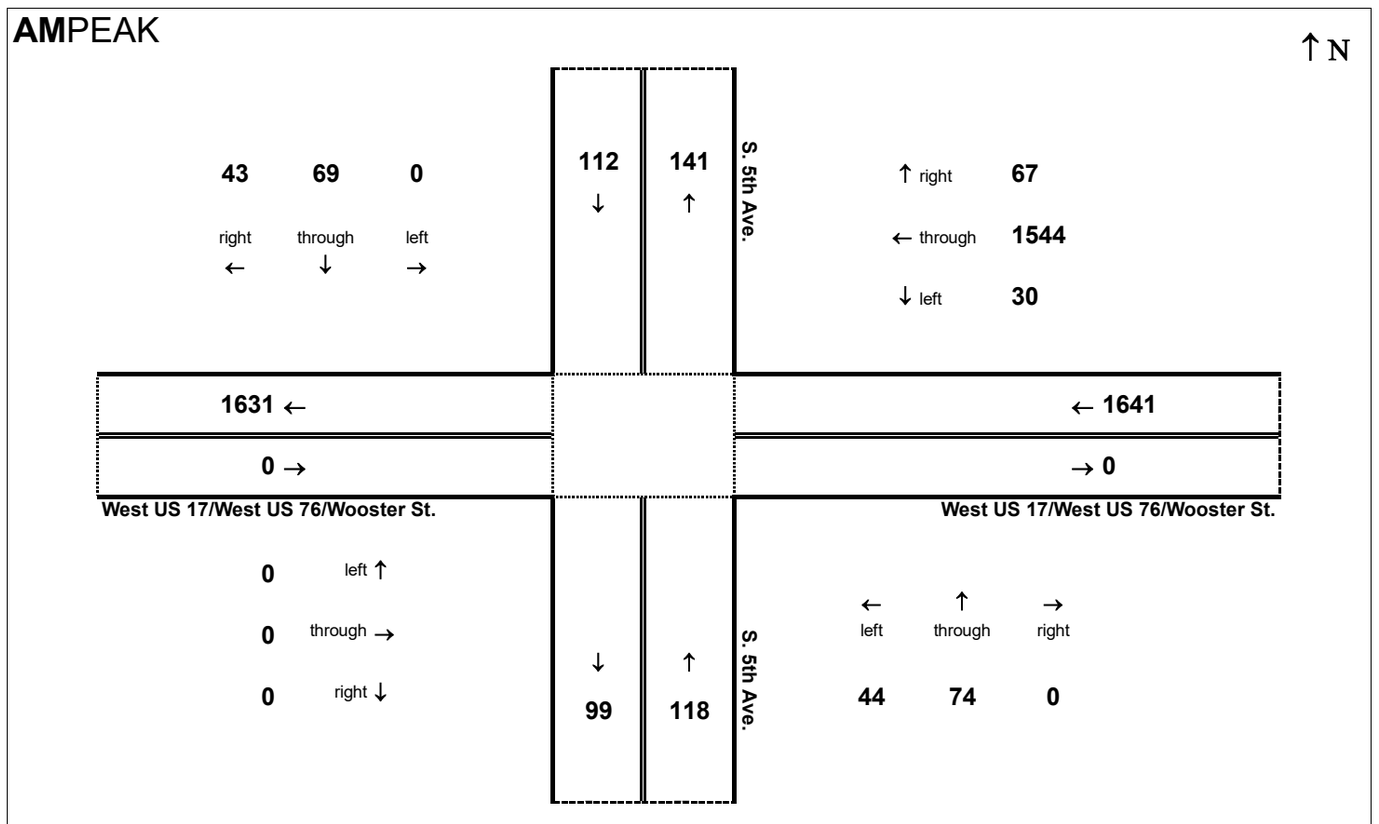


Peak Hour Volume Breakouts Report:
S. 5th Ave. at West US 17/West US 76/Wooster St.

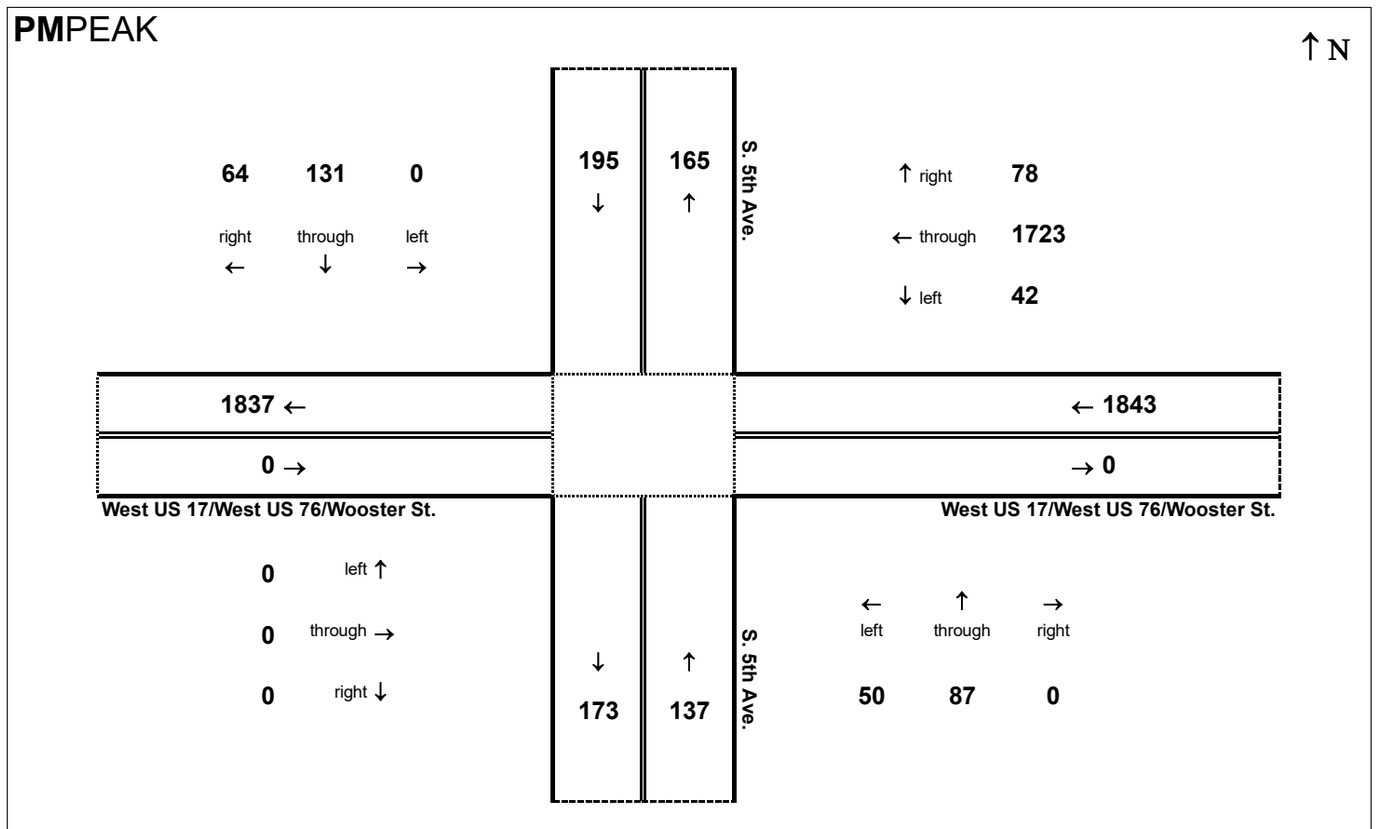
Traffic Forecast Release Date:
May-23

Traffic Data Year:
1/1/2023

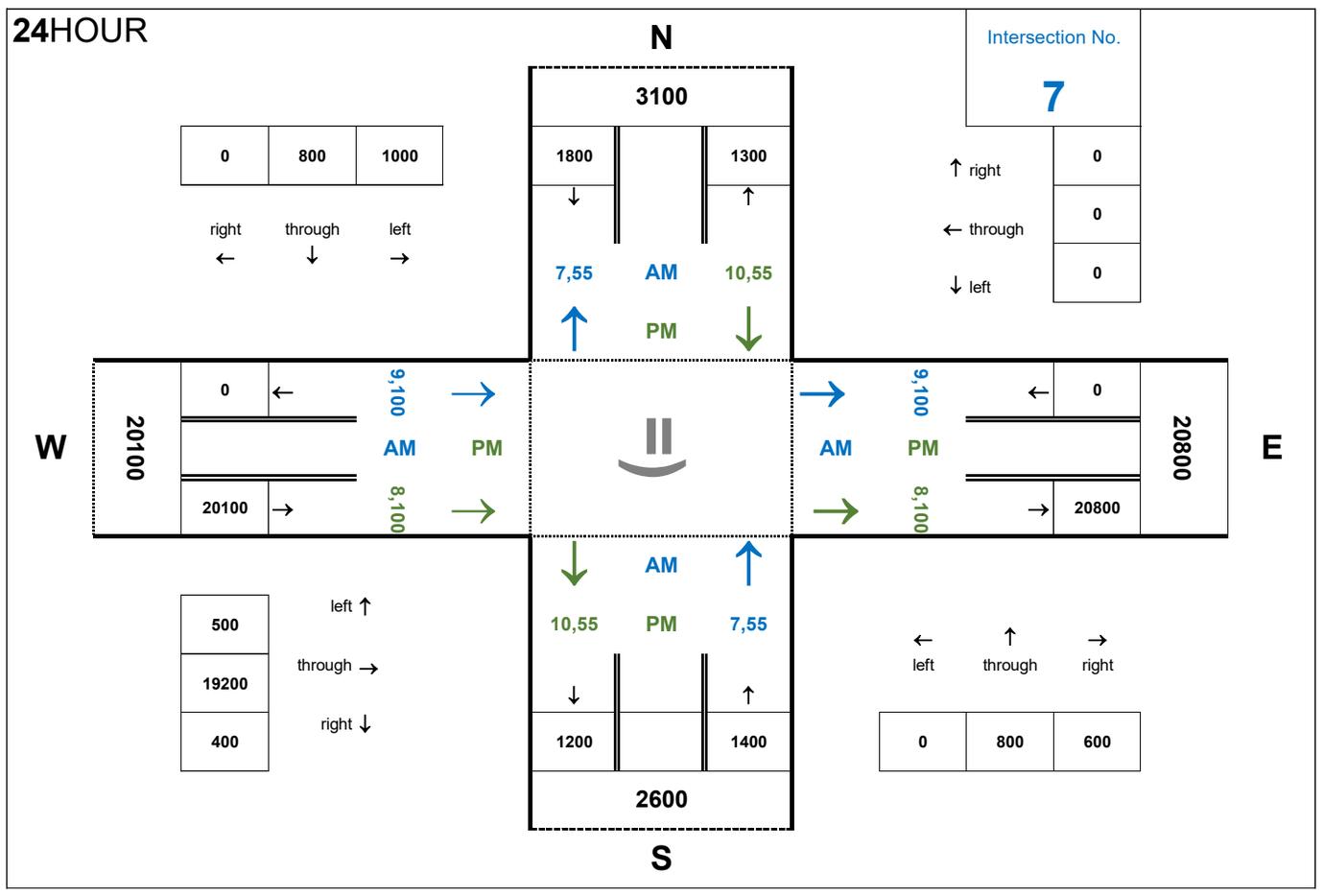
Project:
HB-0039 2023 NB

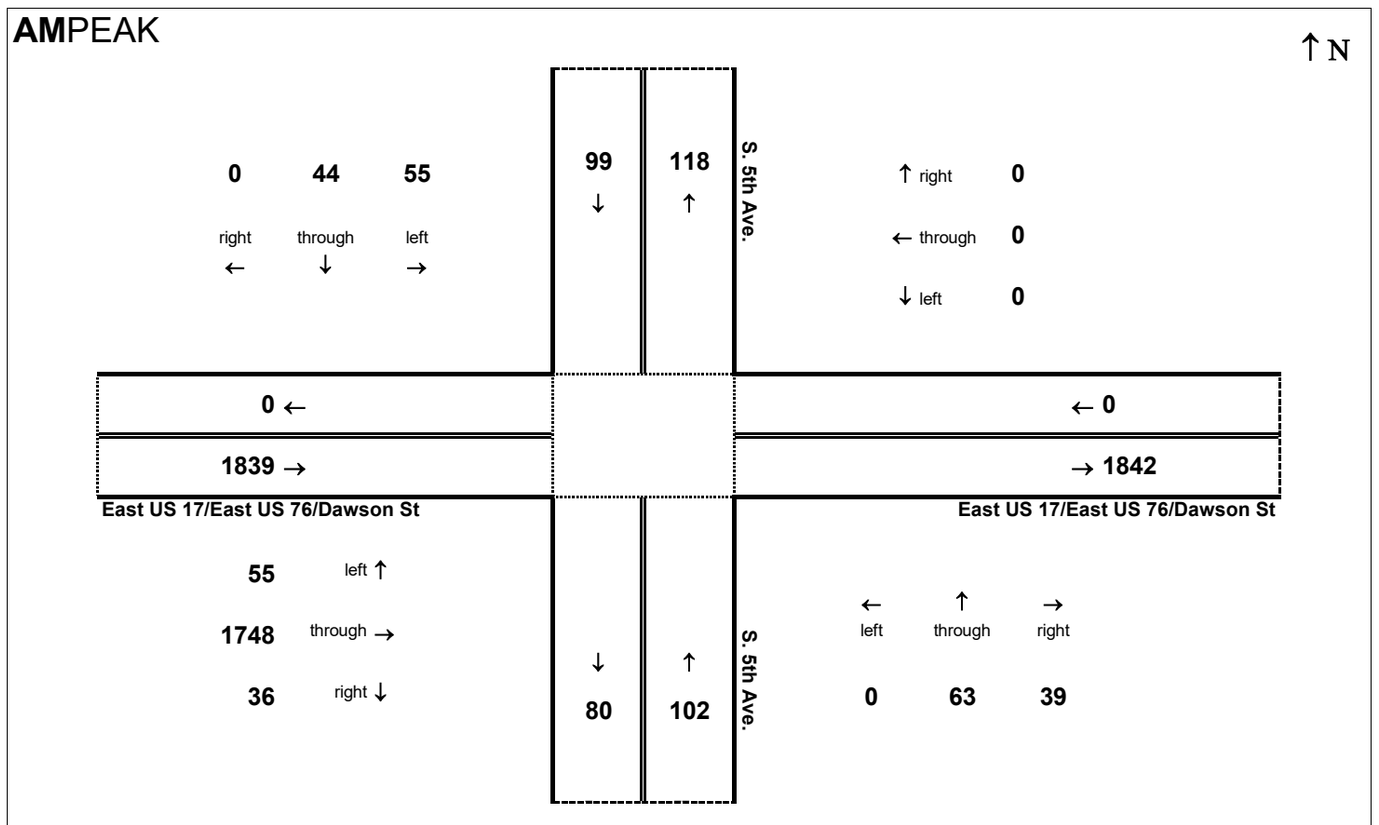


AM peak hour inflow is 1871 vehicles. AM peak hour outflow is 1871 vehicles.

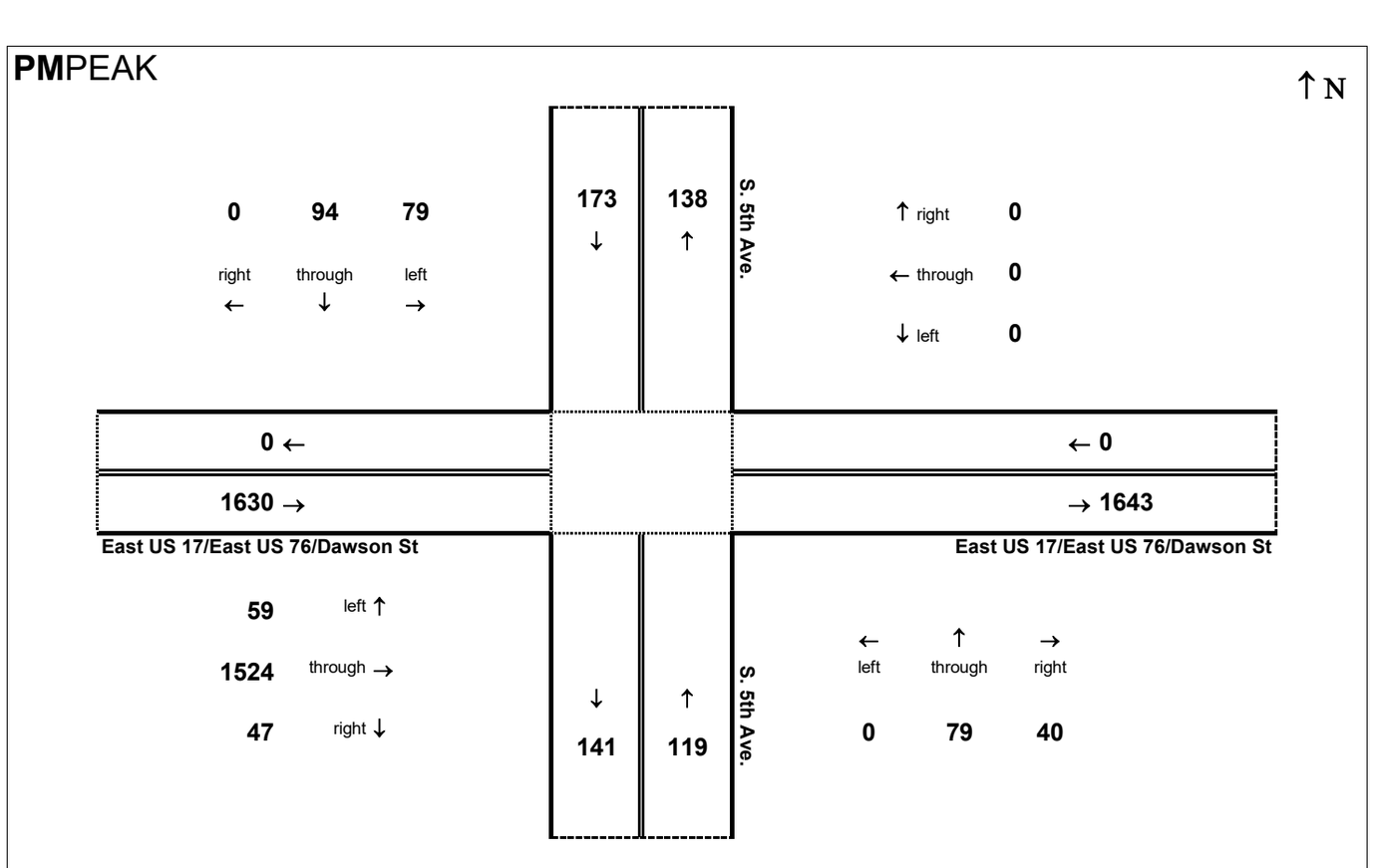


PM peak hour inflow is 2175 vehicles. PM peak hour outflow is 2175 vehicles.





AM peak hour inflow is 2040 vehicles. AM peak hour outflow is 2040 vehicles.



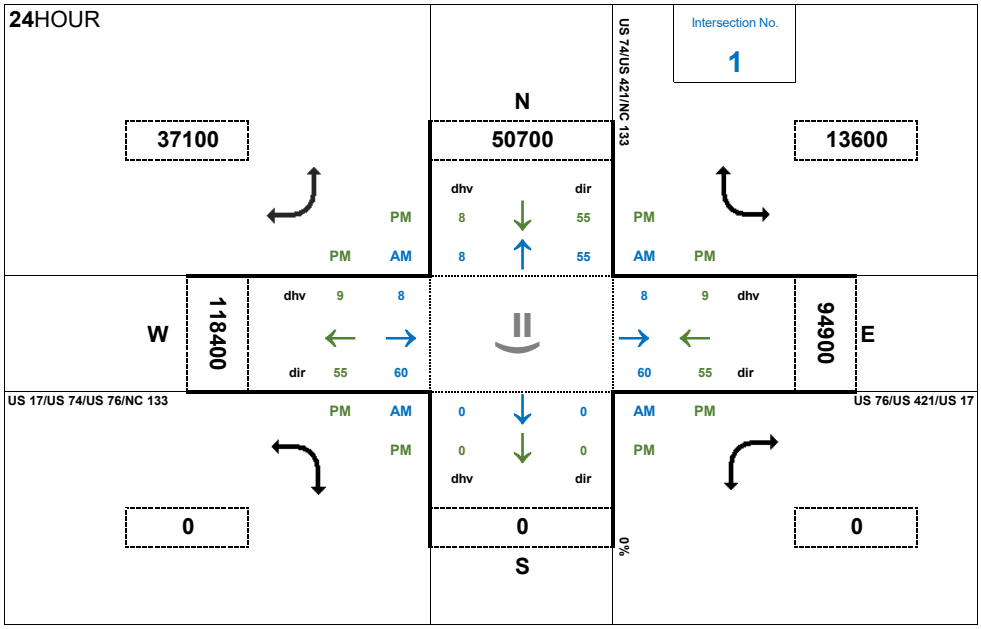
PM peak hour inflow is 1922 vehicles. PM peak hour outflow is 1922 vehicles.

Peak Hour Volume Breakouts Report:
S. 5th Ave. at East US 17/East US 76/Dawson St.

Traffic Forecast Release Date:
May-23

Traffic Data Year:
1/1/2023

Project:
HB-0039 2023 NB



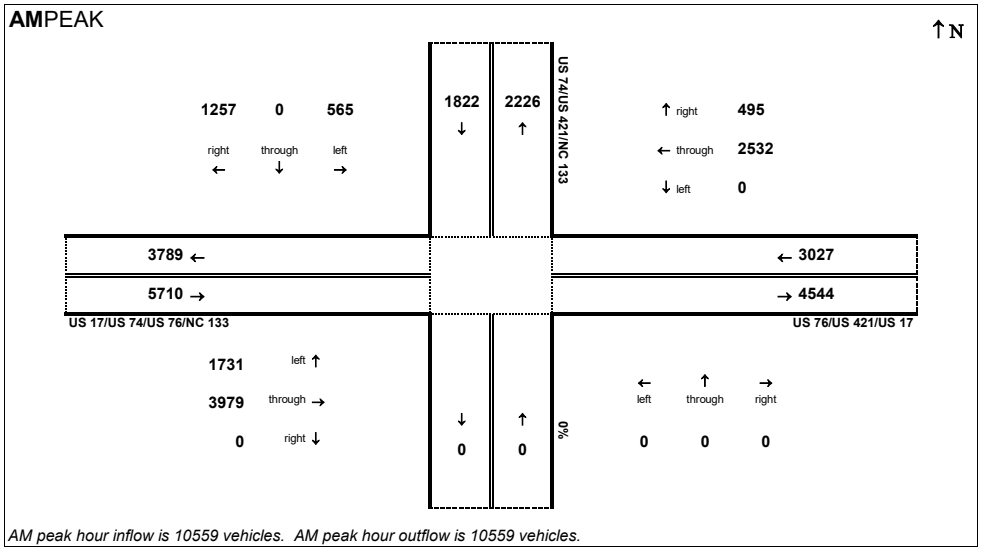
Peak Hour Volume Breakouts Report:
US 74/US 421/NC 133 at US 76/US 421/US 17

Traffic Forecast Release Date:

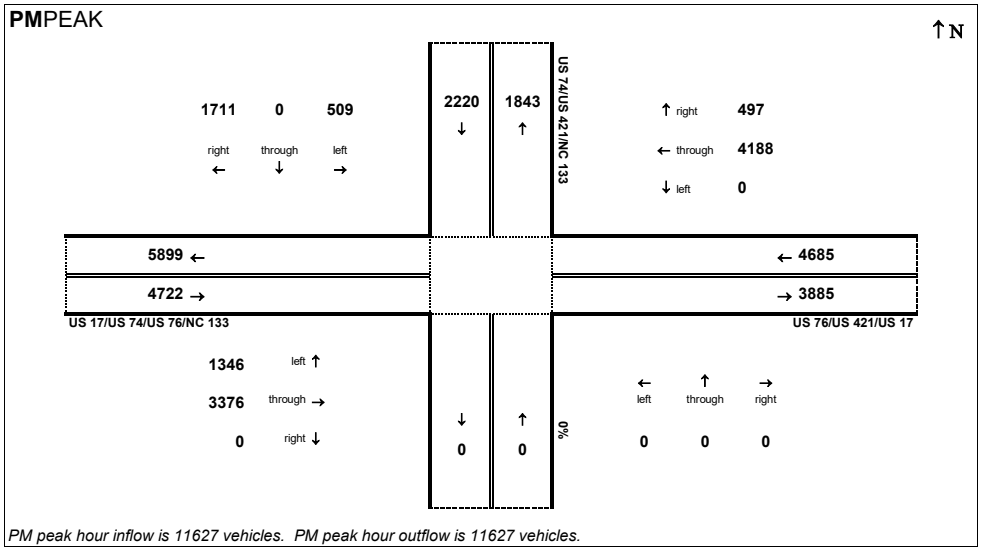
May-23

Traffic Data Year:
1/1/2050

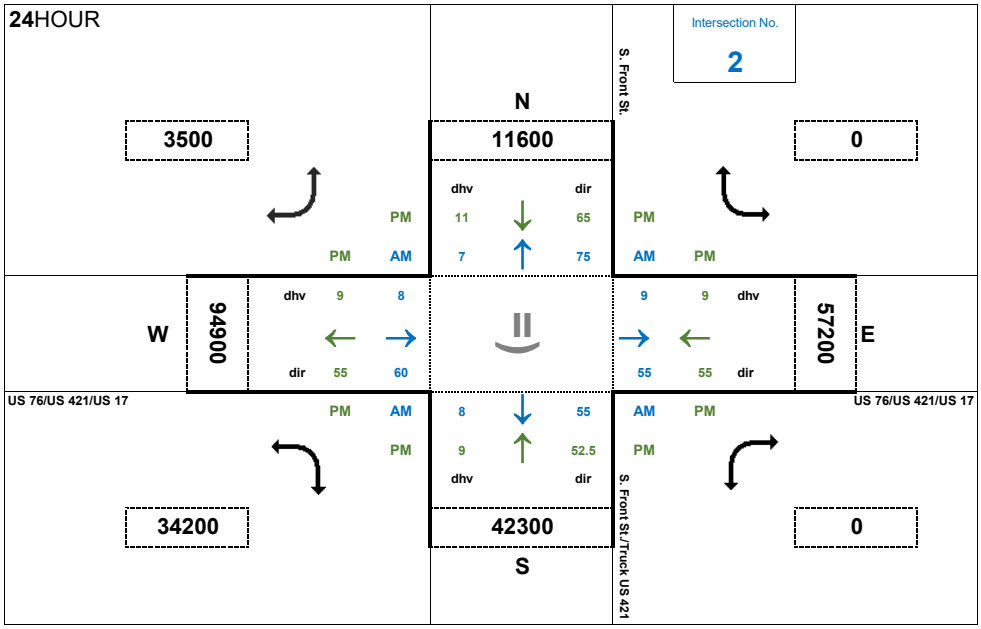
Project:
HB-0039 2050 Build 1



AM peak hour inflow is 10559 vehicles. AM peak hour outflow is 10559 vehicles.



PM peak hour inflow is 11627 vehicles. PM peak hour outflow is 11627 vehicles.



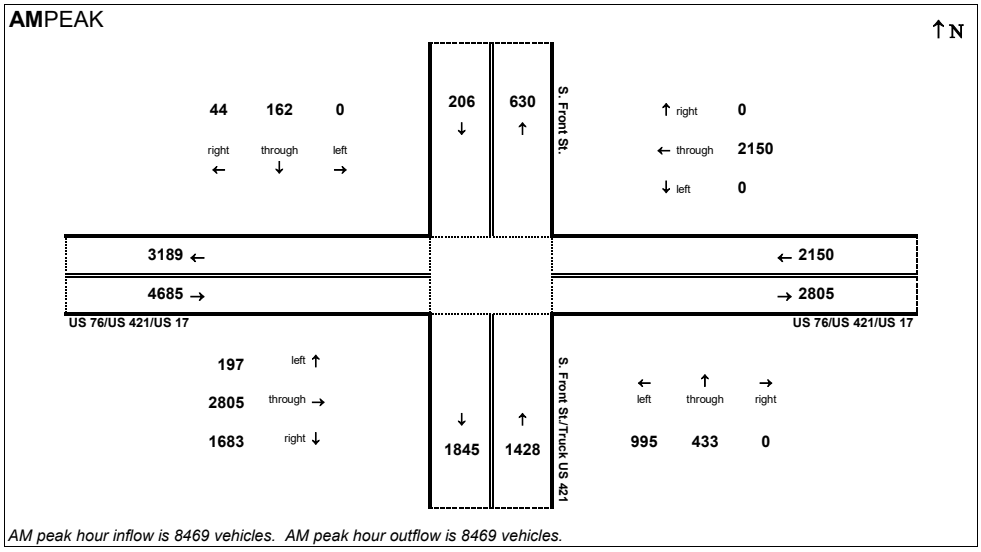
Peak Hour Volume Breakouts Report:
S. Front St. at US 76/US 421/US 17

Traffic Forecast Release Date:

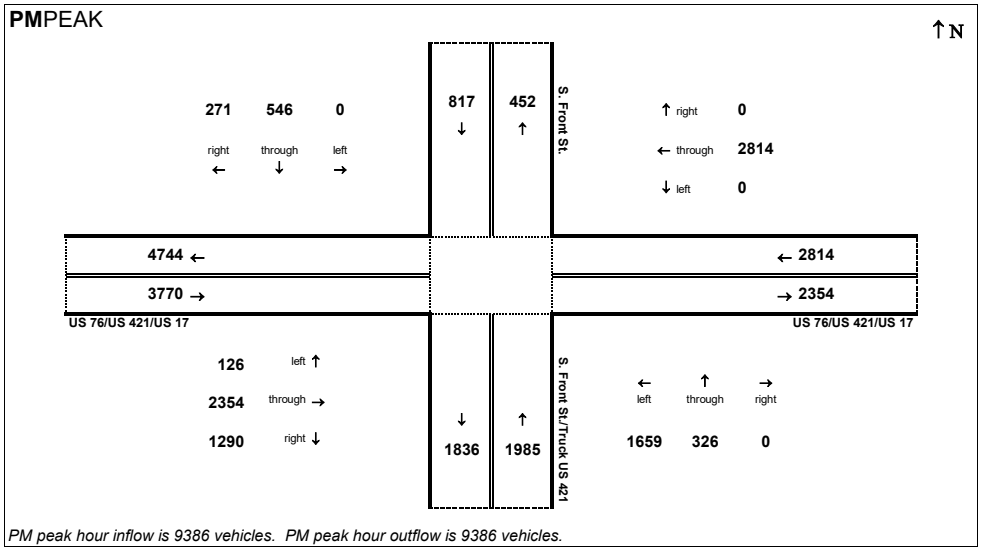
May-23

Traffic Data Year:
1/1/2050

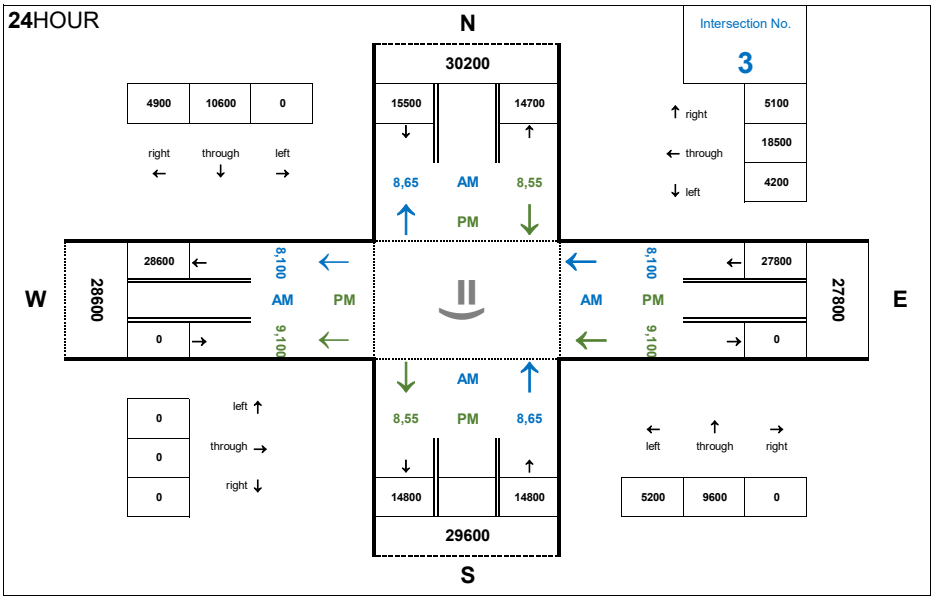
Project:
HB-0039 2050 Build 1

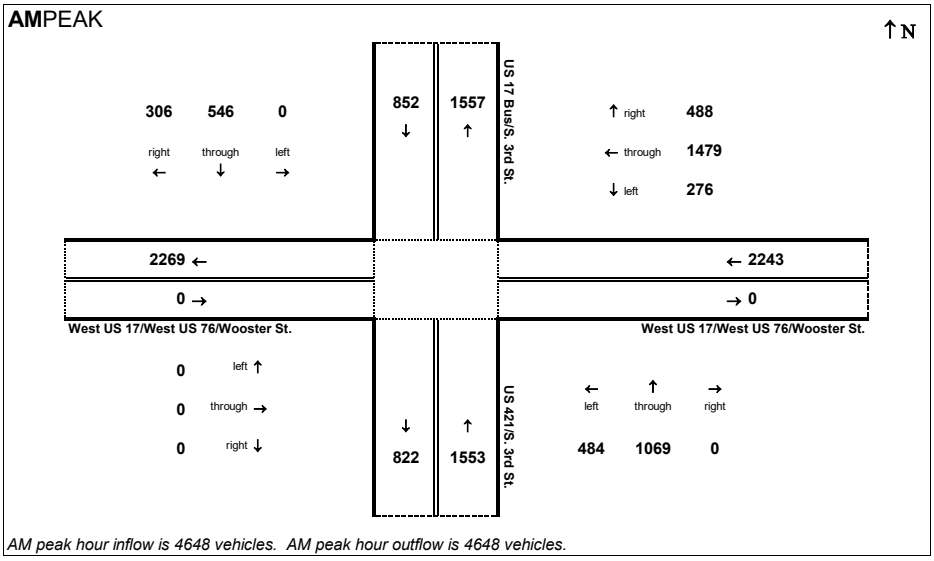


AM peak hour inflow is 8469 vehicles. AM peak hour outflow is 8469 vehicles.

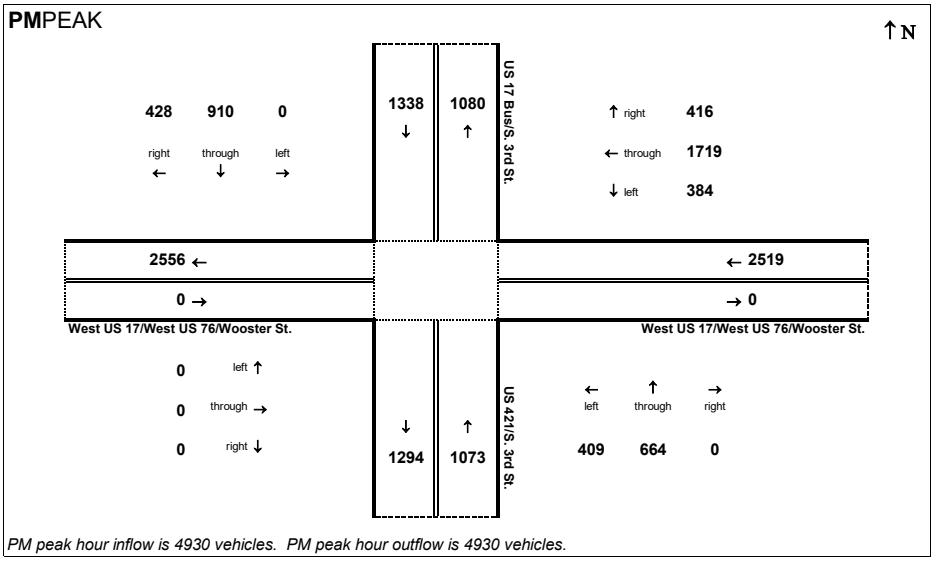


PM peak hour inflow is 9386 vehicles. PM peak hour outflow is 9386 vehicles.





AM peak hour inflow is 4648 vehicles. AM peak hour outflow is 4648 vehicles.



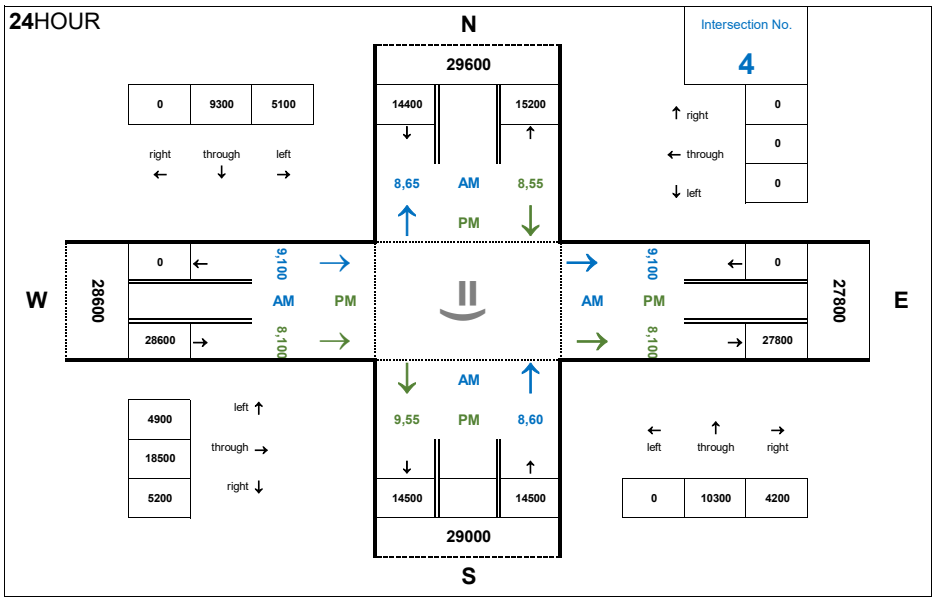
PM peak hour inflow is 4930 vehicles. PM peak hour outflow is 4930 vehicles.

Peak Hour Volume Breakouts Report:
S. 3rd St. at West US 17/West US 76/Wooster St.

Traffic Forecast Release Date:
May-23

Traffic Data Year:
1/1/2050

Project:
HB-0039 2050 Build 1

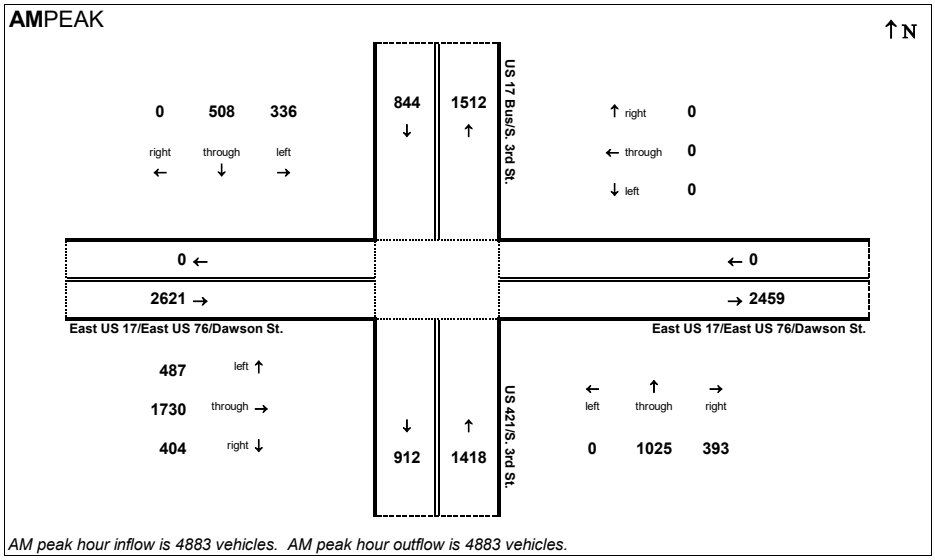


Peak Hour Volume Breakouts Report:
S. 3rd St. at East US 17/East US 76/Dawson St.

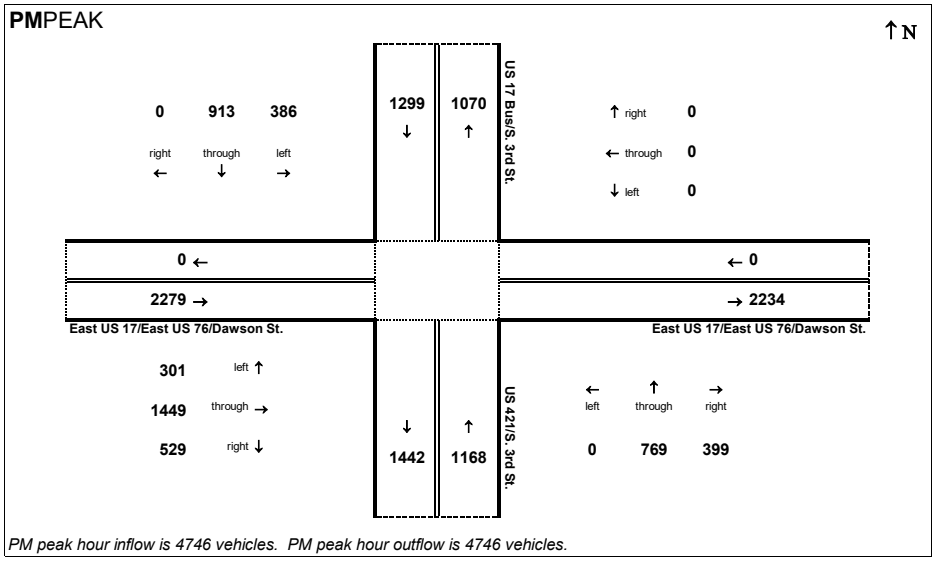
Traffic Forecast Release Date:
May-23

Traffic Data Year:
1/1/2050

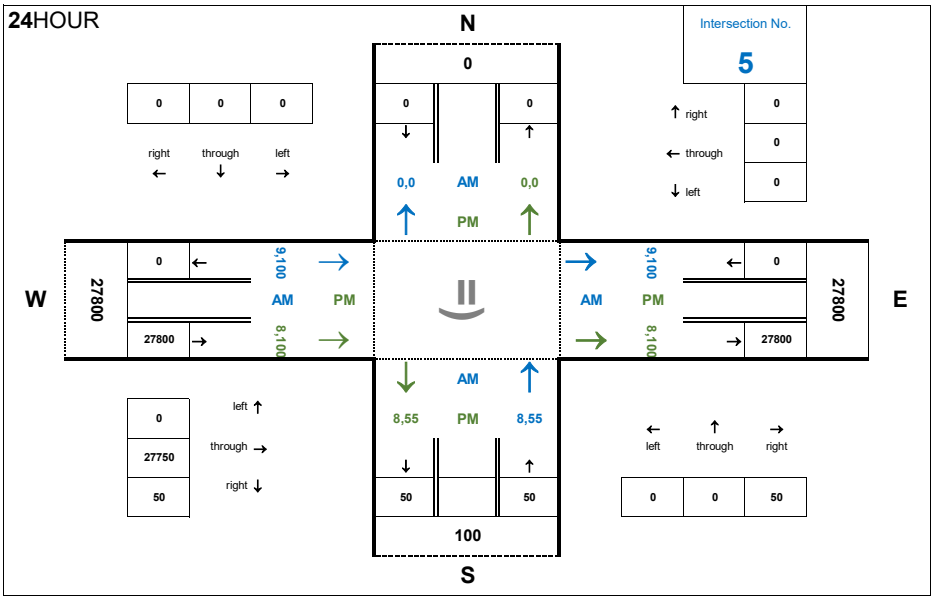
Project:
HB-0039 2050 Build 1

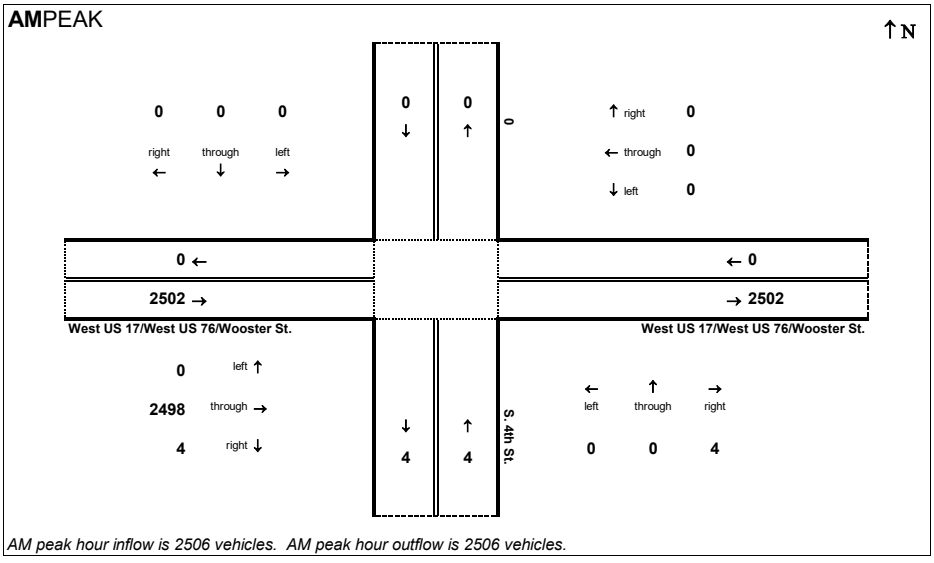


AM peak hour inflow is 4883 vehicles. AM peak hour outflow is 4883 vehicles.

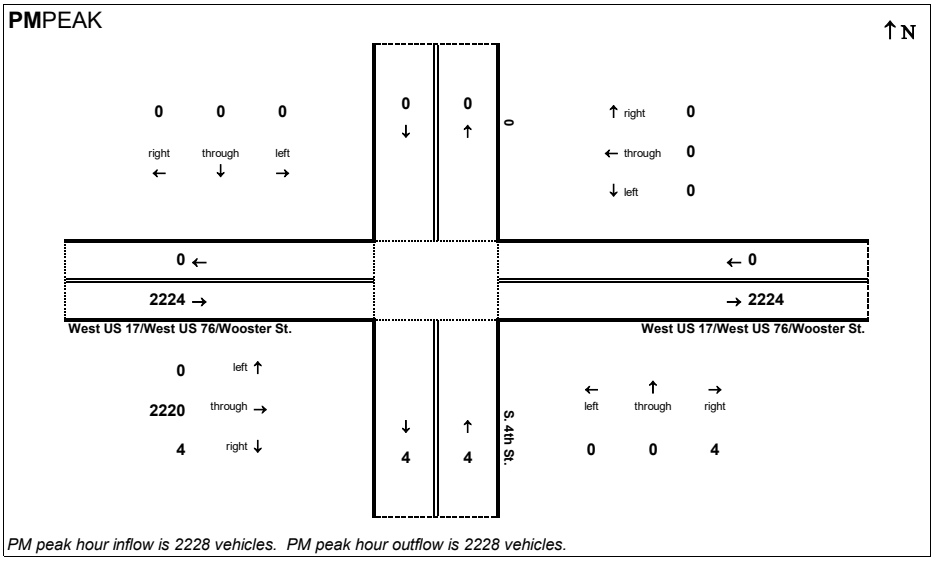


PM peak hour inflow is 4746 vehicles. PM peak hour outflow is 4746 vehicles.





AM peak hour inflow is 2506 vehicles. AM peak hour outflow is 2506 vehicles.



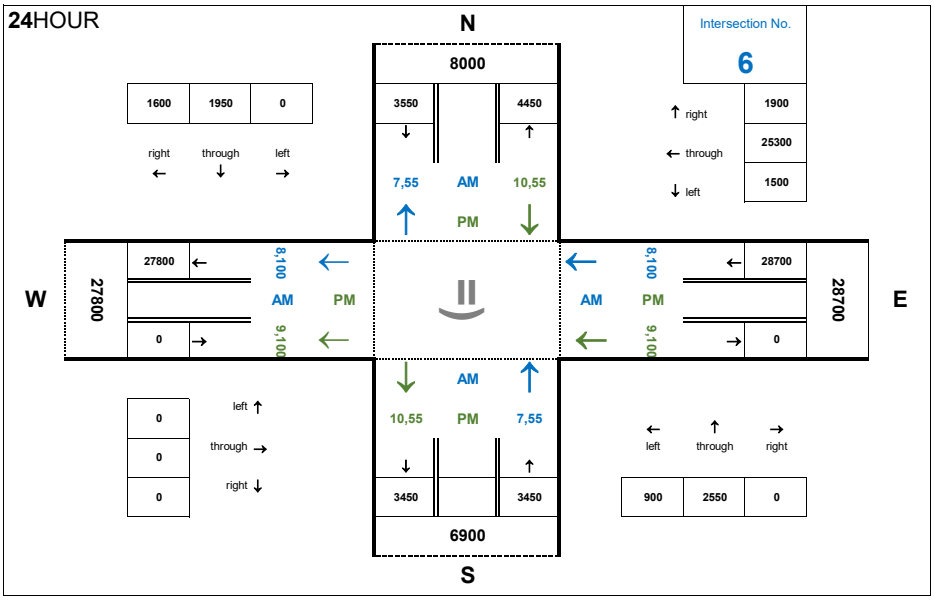
PM peak hour inflow is 2228 vehicles. PM peak hour outflow is 2228 vehicles.

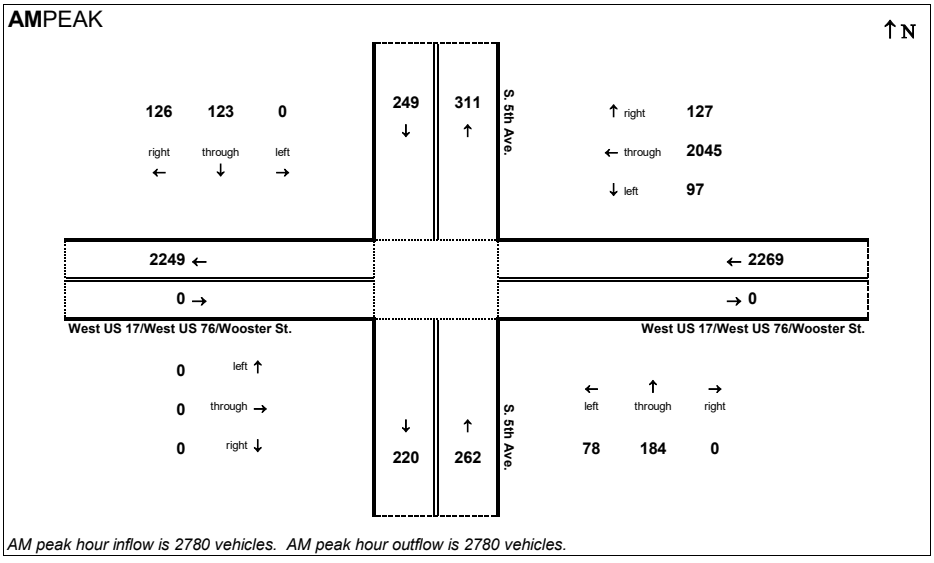
Peak Hour Volume Breakouts Report:
S. 4th St. at East US 17/East US 76/Dawson St.

Traffic Forecast Release Date:
May-23

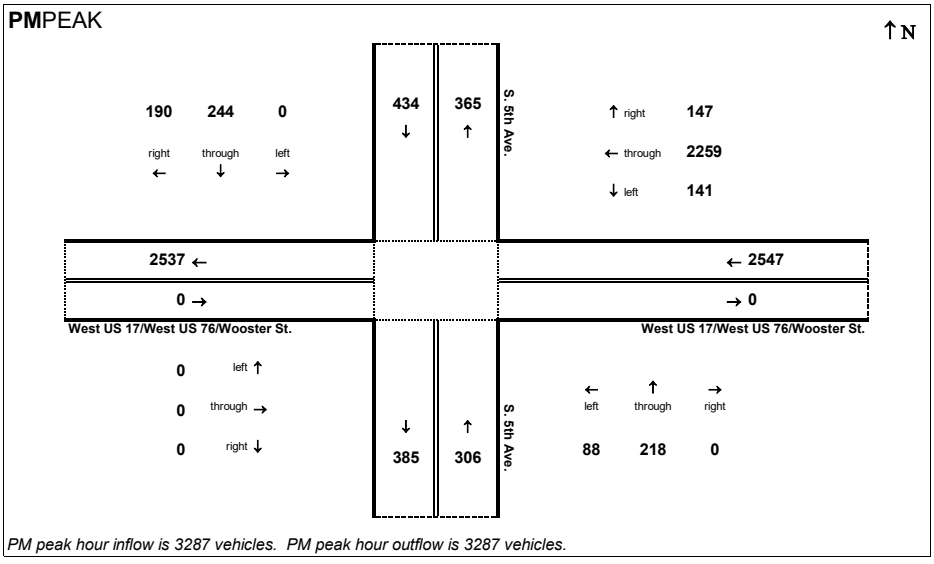
Traffic Data Year:
1/1/2050

Project:
HB-0039 2050 Build 1





AM peak hour inflow is 2780 vehicles. AM peak hour outflow is 2780 vehicles.



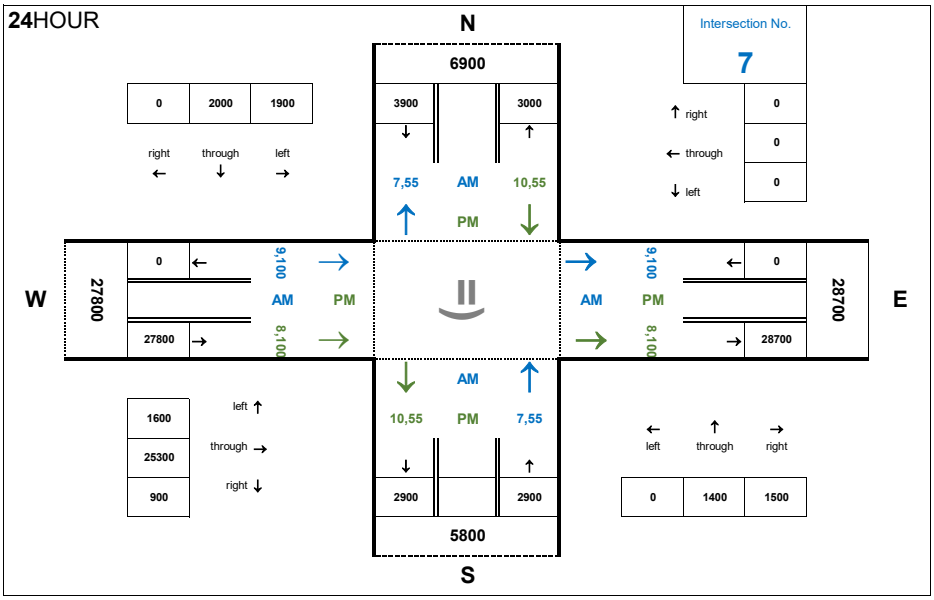
PM peak hour inflow is 3287 vehicles. PM peak hour outflow is 3287 vehicles.

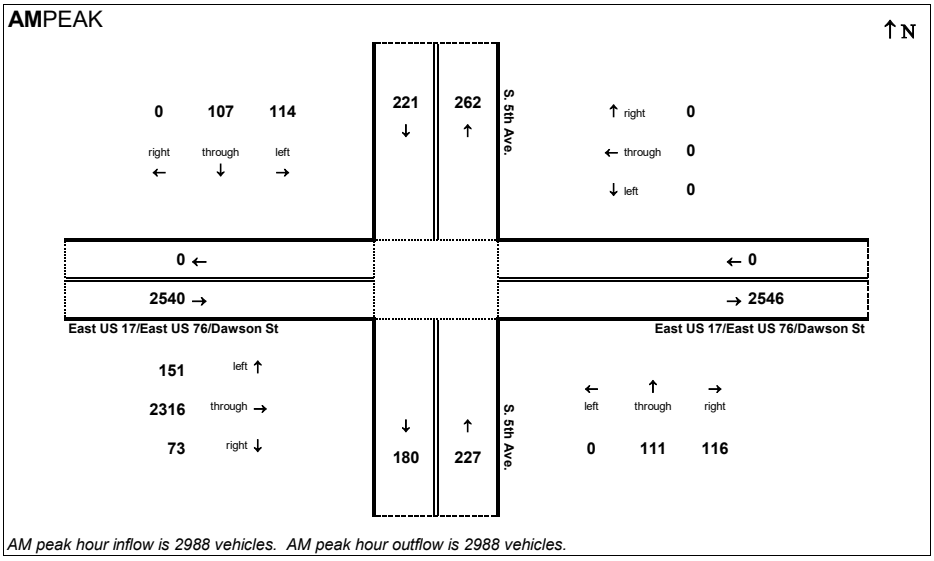
Peak Hour Volume Breakouts Report:
S. 5th Ave. at West US 17/West US 76/Wooster St.

Traffic Forecast Release Date:
May-23

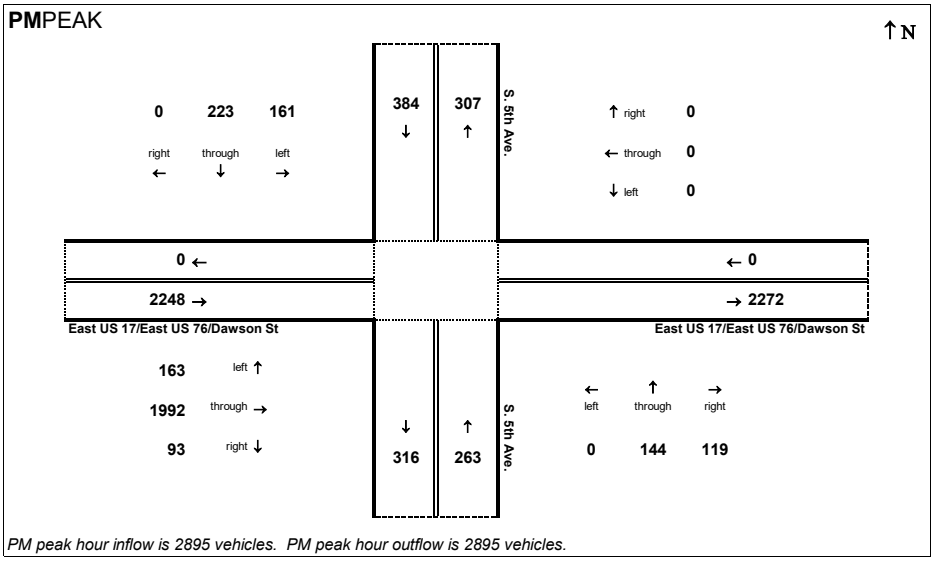
Traffic Data Year:
1/1/2050

Project:
HB-0039 2050 Build 1





AM peak hour inflow is 2988 vehicles. AM peak hour outflow is 2988 vehicles.



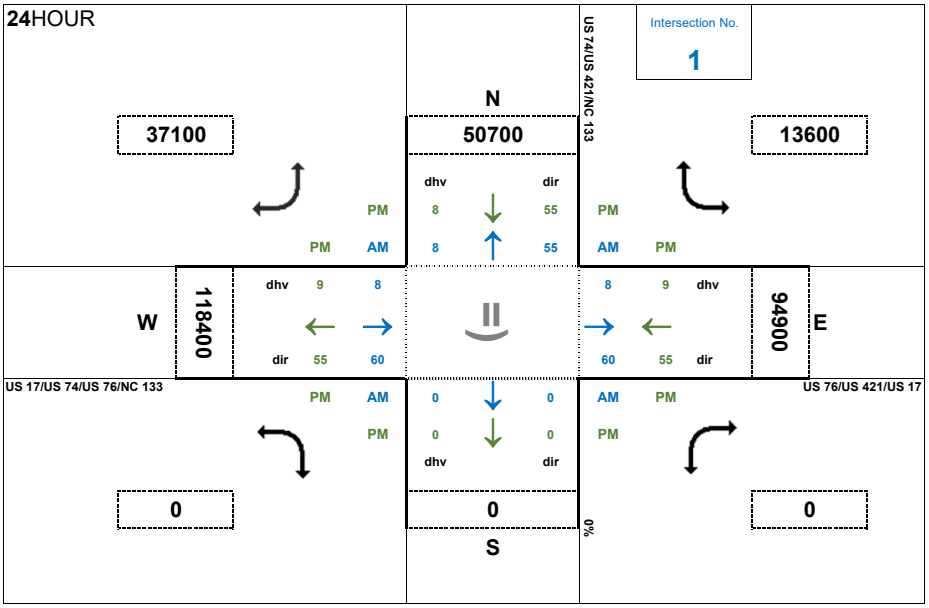
PM peak hour inflow is 2895 vehicles. PM peak hour outflow is 2895 vehicles.

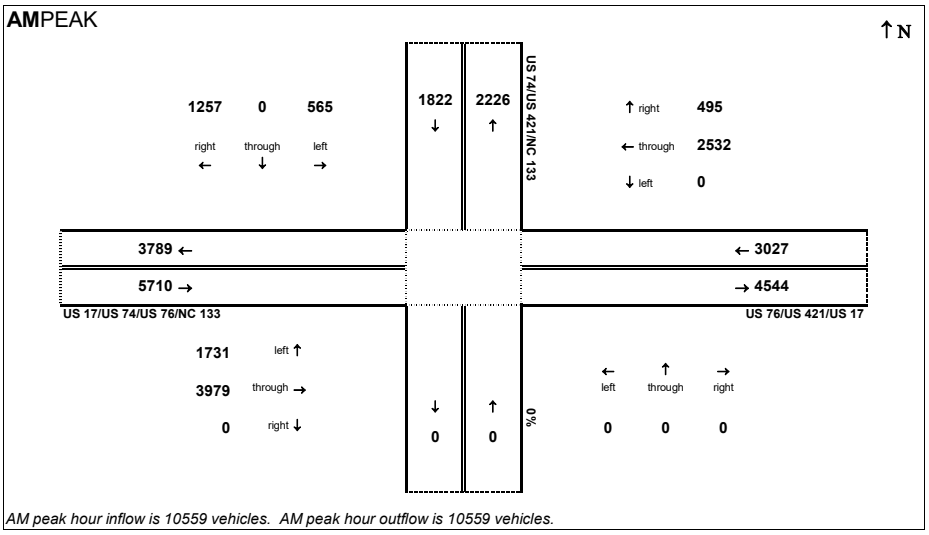
Peak Hour Volume Breakouts Report:
S. 5th Ave. at East US 17/East US 76/Dawson St.

Traffic Forecast Release Date:
May-23

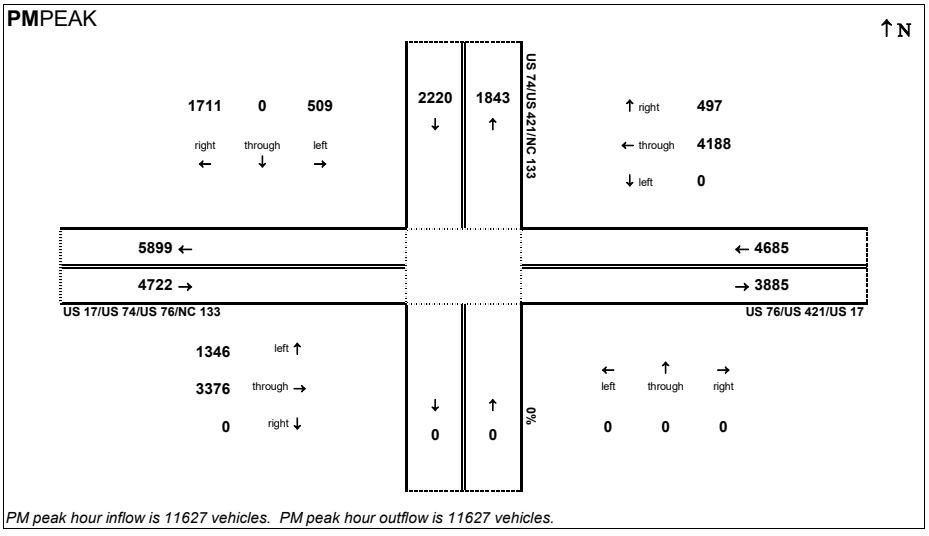
Traffic Data Year:
1/1/2050

Project:
HB-0039 2050 Build 1





AM peak hour inflow is 10559 vehicles. AM peak hour outflow is 10559 vehicles.



PM peak hour inflow is 11627 vehicles. PM peak hour outflow is 11627 vehicles.

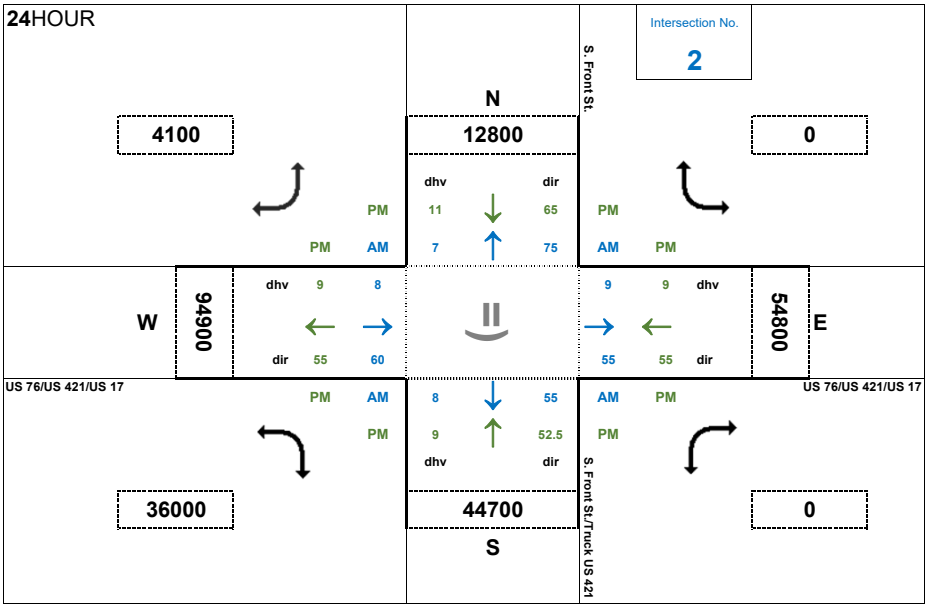
Peak Hour Volume Breakouts Report:
US 74/US 421/NC 133 at US 76/US 421/US 17

Traffic Forecast Release Date:

September-23

Traffic Data Year:
1/1/2050

Project:
HB-0039 2050 Build 2



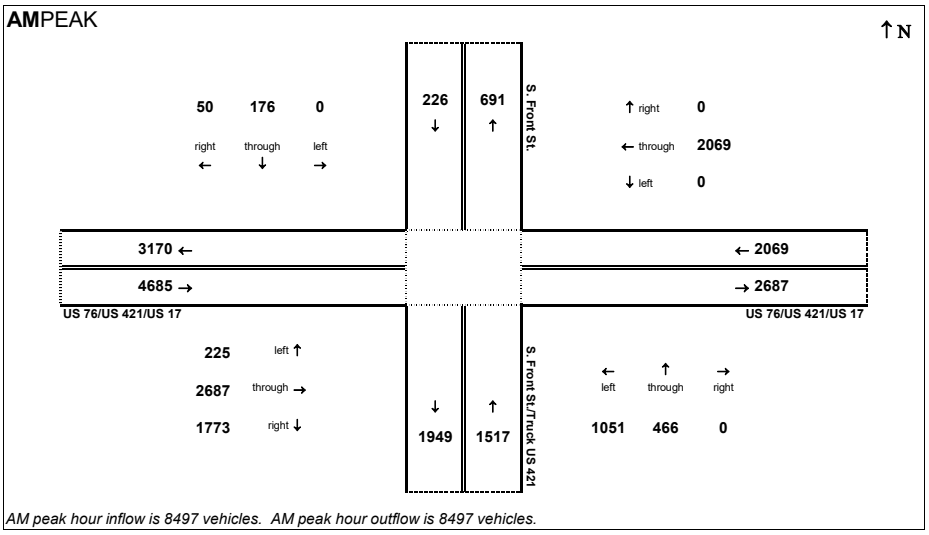
Peak Hour Volume Breakouts Report:
S. Front St. at US 76/US 421/US 17

Traffic Forecast Release Date:

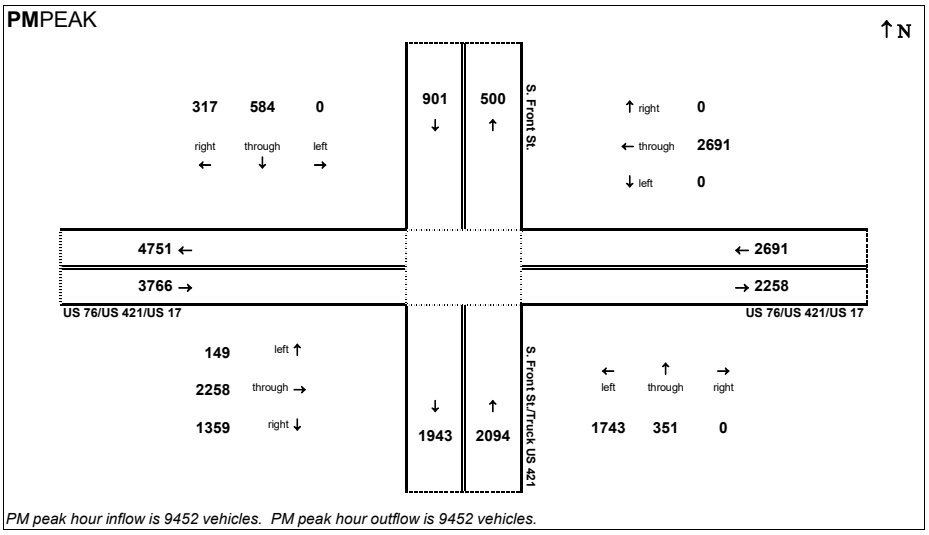
September-23

Traffic Data Year:
1/1/2050

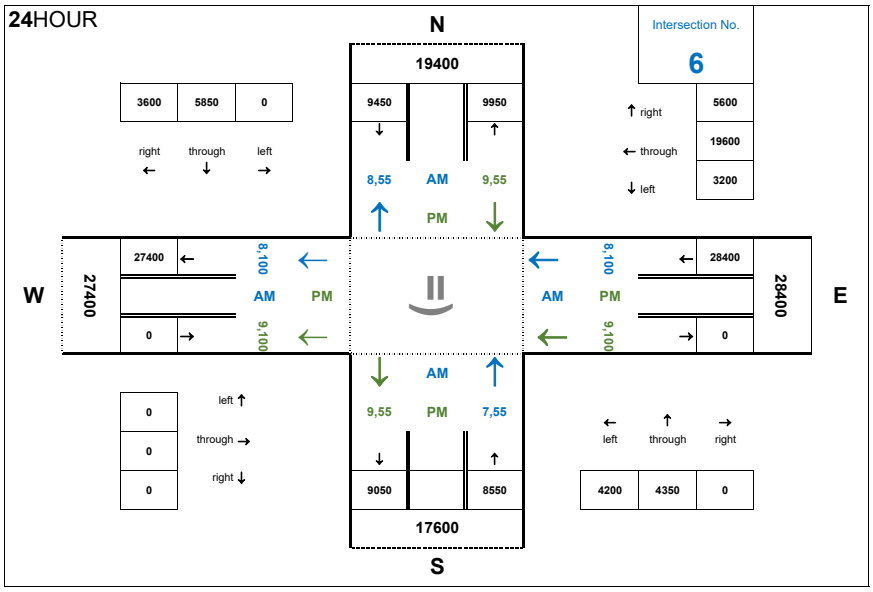
Project:
HB-0039 2050 Build 2

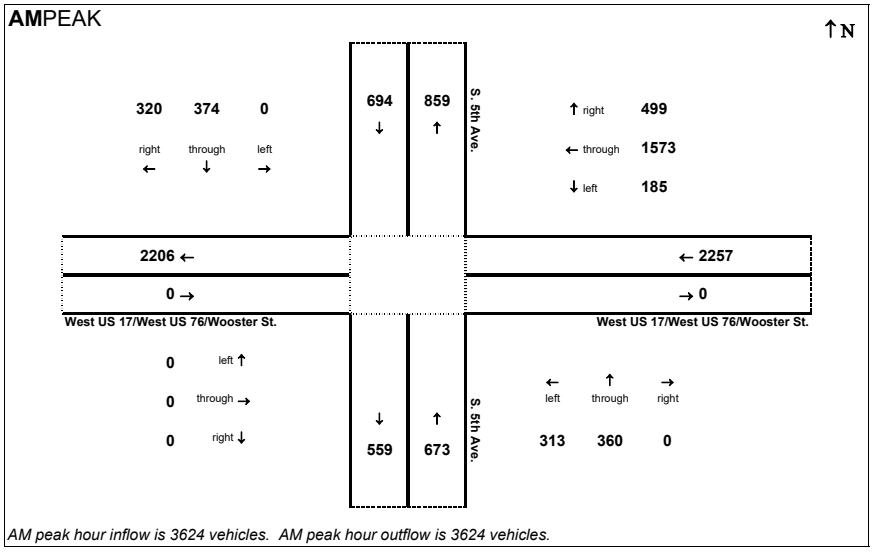


AM peak hour inflow is 8497 vehicles. AM peak hour outflow is 8497 vehicles.

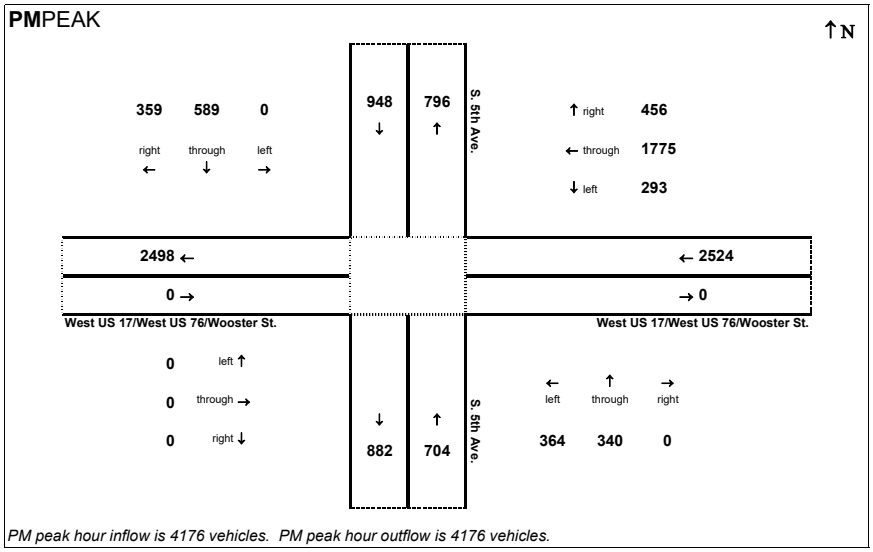


PM peak hour inflow is 9452 vehicles. PM peak hour outflow is 9452 vehicles.





AM peak hour inflow is 3624 vehicles. AM peak hour outflow is 3624 vehicles.



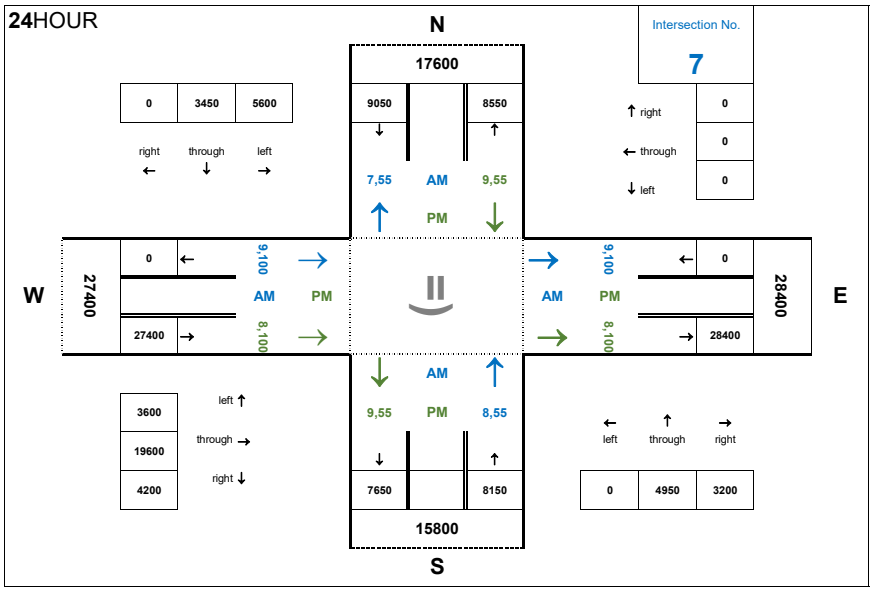
PM peak hour inflow is 4176 vehicles. PM peak hour outflow is 4176 vehicles.

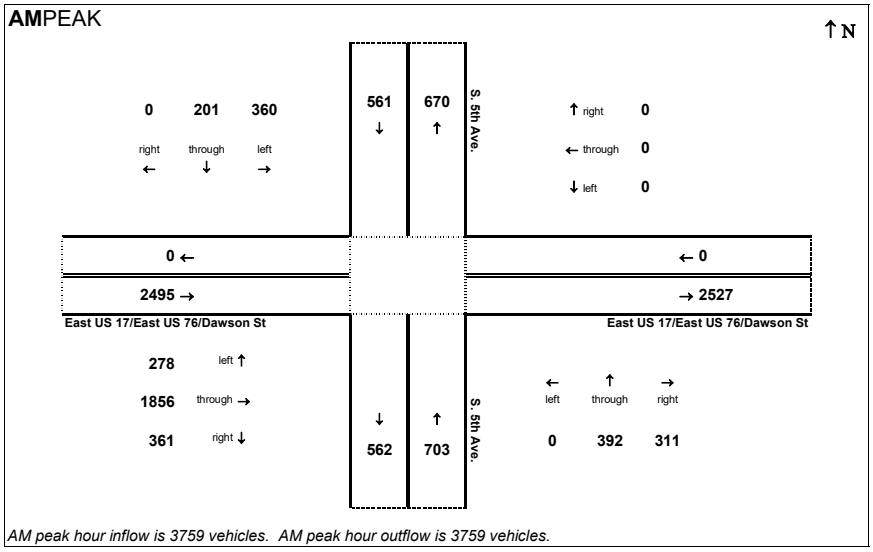
Peak Hour Volume Breakouts Report:
S. 5th Ave. at West US 17/West US 76/Wooster St.

Traffic Forecast Release Date:
September-23

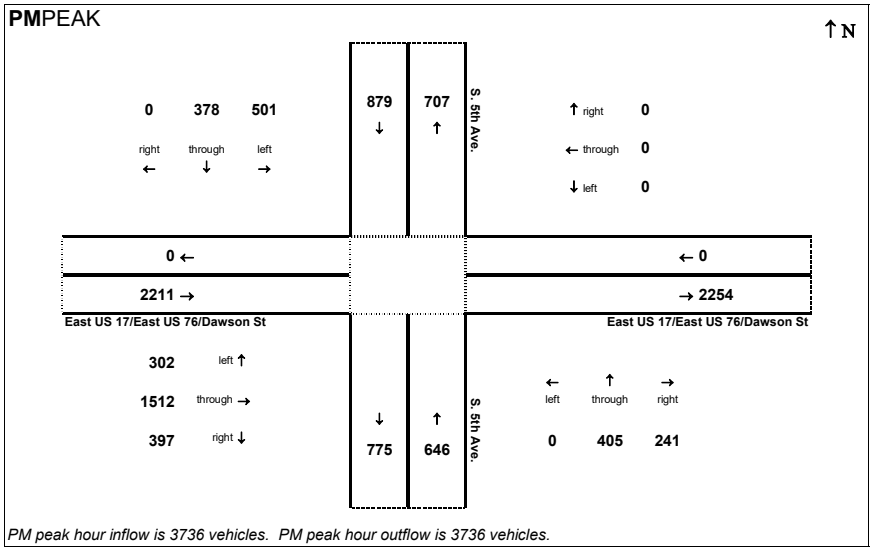
Traffic Data Year:
1/1/2050

Project:
HB-0039 2050 Build 2





AM peak hour inflow is 3759 vehicles. AM peak hour outflow is 3759 vehicles.



PM peak hour inflow is 3736 vehicles. PM peak hour outflow is 3736 vehicles.

Peak Hour Volume Breakouts Report:
S. 5th Ave. at East US 17/East US 76/Dawson St.

Traffic Forecast Release Date:
September-23

Traffic Data Year:
1/1/2050

Project:
HB-0039 2050 Build 2

Appendix C:
Model Volume Validation

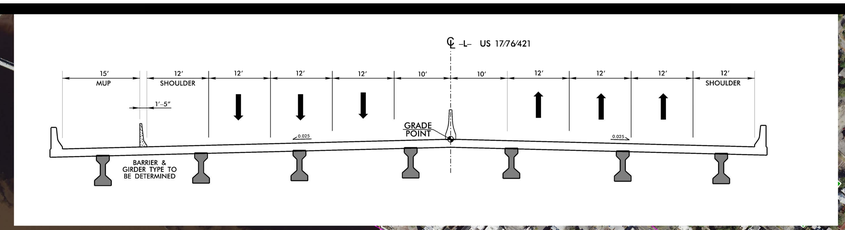
2023 No Build AM GEH Check

Movement	TMC Input	TransModeler Volume	Vol Diff	% Diff	GEH	Vol Threshold	Meet?	GEH Threshold	Meet?
11-WBT	1025	1014	-11	-1.0%	0.3	+/- 15%	Yes	< 5	Yes
11-WBT	1727	1806	79	4.6%	1.9	+/- 15%	Yes	< 5	Yes
12-EBT	2727	2831	104	3.8%	2.0	+/- 400 vph	Yes	< 5	Yes
12-EBT	1403	1400	-3	-0.2%	0.1	+/- 15%	Yes	< 5	Yes
13-SET	402	380	-22	-5.5%	1.1	+/- 100 vph	Yes	< 5	Yes
13-SET	2727	2831	104	3.8%	2.0	+/- 400 vph	Yes	< 5	Yes
14-SET	1403	1401	-2	-0.2%	0.1	+/- 15%	Yes	< 5	Yes
14-NWT	402	380	-22	-5.4%	1.1	+/- 100 vph	Yes	< 5	Yes
15-SBT	402	380	-22	-5.5%	1.1	+/- 100 vph	Yes	< 5	Yes
15-SBT	1025	1018	-7	-0.7%	0.2	+/- 15%	Yes	< 5	Yes
16-SBT	402	380	-22	-5.5%	1.1	+/- 100 vph	Yes	< 5	Yes
16-NBT	1403	1406	3	0.2%	0.1	+/- 15%	Yes	< 5	Yes
17-NBT	349	378	29	8.4%	1.5	+/- 100 vph	Yes	< 5	Yes
17-NBT	1403	1409	6	0.4%	0.2	+/- 15%	Yes	< 5	Yes
18-NWT	1727	1816	89	5.1%	2.1	+/- 15%	Yes	< 5	Yes
18-NWT	349	377	28	8.0%	1.5	+/- 100 vph	Yes	< 5	Yes
20-NBT	305	376	71	23.4%	3.9	+/- 100 vph	Yes	< 5	Yes
28-NBR	668	611	-57	-8.6%	2.3	+/- 100 vph	Yes	< 5	Yes
20-SBL	16	16	-1	-3.1%	0.1	+/- 100 vph	Yes	< 5	Yes
20-SBT	81	80	-1	-1.1%	0.1	+/- 100 vph	Yes	< 5	Yes
21-SBT	1093	1143	50	4.6%	1.5	+/- 15%	Yes	< 5	Yes
21-NBT	897	888	-9	-1.0%	0.3	+/- 15%	Yes	< 5	Yes
21-SBT	81	79	-2	-2.7%	0.2	+/- 100 vph	Yes	< 5	Yes
22-NBT	76	97	21	27.9%	2.3	+/- 100 vph	Yes	< 5	Yes
22-NBT	897	891	-6	-0.7%	0.2	+/- 15%	Yes	< 5	Yes
22-SBT	81	80	-1	-1.7%	0.2	+/- 100 vph	Yes	< 5	Yes
23-SET	1093	1155	62	5.6%	1.8	+/- 15%	Yes	< 5	Yes
23-SET	2108	2060	-49	-2.3%	1.1	+/- 15%	Yes	< 5	Yes
24-NWT	1544	1606	62	4.0%	1.6	+/- 15%	Yes	< 5	Yes
24-WBT	684	624	-60	-8.8%	2.3	+/- 100 vph	Yes	< 5	Yes
27-SET	2032	1958	-74	-3.6%	1.6	+/- 15%	Yes	< 5	Yes
27-SET	76	97	21	28.2%	2.3	+/- 100 vph	Yes	< 5	Yes
30-NBT	760	791	31	4.0%	1.1	+/- 15%	Yes	< 5	Yes
30-NBR	270	265	-5	-1.9%	0.3	+/- 100 vph	Yes	< 5	Yes
30-SBT	432	425	-7	-1.7%	0.4	+/- 100 vph	Yes	< 5	Yes
30-SBL	267	263	-4	-1.6%	0.3	+/- 100 vph	Yes	< 5	Yes
30-EBL	303	321	18	5.9%	1.0	+/- 100 vph	Yes	< 5	Yes
30-EBT	1284	1350	66	5.2%	1.8	+/- 15%	Yes	< 5	Yes
30-EBR	264	263	-1	-0.5%	0.1	+/- 100 vph	Yes	< 5	Yes
40-SBT	461	473	12	2.5%	0.5	+/- 100 vph	Yes	< 5	Yes
40-SBR	188	191	3	1.4%	0.2	+/- 100 vph	Yes	< 5	Yes
40-NBL	311	330	19	6.2%	1.1	+/- 100 vph	Yes	< 5	Yes
40-NBT	783	780	-3	-0.3%	0.1	+/- 15%	Yes	< 5	Yes
40-WBL	220	220	0	0.1%	0.0	+/- 100 vph	Yes	< 5	Yes
40-WBT	1102	1069	-33	-3.0%	1.0	+/- 15%	Yes	< 5	Yes
40-WBR	343	333	-10	-3.0%	0.6	+/- 100 vph	Yes	< 5	Yes
50-NBR	4	4	0	0.0%	0.0	+/- 100 vph	Yes	< 5	Yes
50-EBR	4	11	7	170.0%	2.5	+/- 100 vph	Yes	< 5	Yes
50-EBT	1809	1888	79	4.4%	1.8	+/- 15%	Yes	< 5	Yes
60-SBL	55	40	-15	-27.1%	2.2	+/- 100 vph	Yes	< 5	Yes
60-SBT	44	44	-1	-1.1%	0.1	+/- 100 vph	Yes	< 5	Yes
60-EBL	55	33	-22	-40.2%	3.3	+/- 100 vph	Yes	< 5	Yes
60-EBT	1748	1823	75	4.3%	1.8	+/- 15%	Yes	< 5	Yes
60-EBR	36	34	-2	-6.1%	0.4	+/- 100 vph	Yes	< 5	Yes
60-NBT	63	61	-2	-3.8%	0.3	+/- 100 vph	Yes	< 5	Yes
60-NBR	39	39	0	-0.3%	0.0	+/- 100 vph	Yes	< 5	Yes
70-WBL	30	15	-16	-51.7%	3.3	+/- 100 vph	Yes	< 5	Yes
70-WBT	1544	1557	13	0.8%	0.3	+/- 15%	Yes	< 5	Yes
70-WBR	67	67	0	-0.3%	0.0	+/- 100 vph	Yes	< 5	Yes
70-SBR	43	38	-5	-10.7%	0.7	+/- 100 vph	Yes	< 5	Yes
70-SBT	69	68	-1	-1.0%	0.1	+/- 100 vph	Yes	< 5	Yes
70-NBL	44	23	-21	-47.3%	3.6	+/- 100 vph	Yes	< 5	Yes
70-NBT	74	69	-5	-6.9%	0.6	+/- 100 vph	Yes	< 5	Yes

2023 No Build PM GEH Check

Movement	TMC Input	TransModeler Volume	Vol Diff	% Diff	GEH	Vol Threshold	Meet?	GEH Threshold	Meet?
11-WBT	1394	1374	-20	-1.5%	0.6	+/- 15%	Yes	< 5	Yes
11-WBT	2877	2796	-81	-2.8%	1.5	+/- 400 vph	Yes	< 5	Yes
12-EBT	2318	2295	-23	-1.0%	0.5	+/- 15%	Yes	< 5	Yes
12-EBT	1102	1094	-8	-0.7%	0.2	+/- 15%	Yes	< 5	Yes
13-SET	351	332	-19	-5.3%	1.0	+/- 100 vph	Yes	< 5	Yes
13-SET	2318	2297	-21	-0.9%	0.4	+/- 15%	Yes	< 5	Yes
14-SET	1102	1095	-7	-0.6%	0.2	+/- 15%	Yes	< 5	Yes
14-NWT	351	333	-18	-5.2%	1.0	+/- 100 vph	Yes	< 5	Yes
15-SBT	351	332	-19	-5.5%	1.1	+/- 100 vph	Yes	< 5	Yes
15-SBT	1394	1377	-17	-1.2%	0.5	+/- 15%	Yes	< 5	Yes
16-SBT	351	332	-19	-5.5%	1.1	+/- 100 vph	Yes	< 5	Yes
16-NBT	1102	1101	-1	-0.1%	0.0	+/- 15%	Yes	< 5	Yes
17-NBT	345	329	-16	-4.7%	0.9	+/- 100 vph	Yes	< 5	Yes
17-NBT	1102	1103	1	0.0%	0.0	+/- 15%	Yes	< 5	Yes
18-NWT	2877	2805	-72	-2.5%	1.3	+/- 400 vph	Yes	< 5	Yes
18-NWT	345	330	-16	-4.5%	0.8	+/- 100 vph	Yes	< 5	Yes
20-NBT	213	232	19	8.7%	1.2	+/- 100 vph	Yes	< 5	Yes
28-NBR	1099	1055	-44	-4.0%	1.4	+/- 15%	Yes	< 5	Yes
20-SBL	92	91	-1	-0.7%	0.1	+/- 100 vph	Yes	< 5	Yes
20-SBT	297	296	-1	-0.2%	0.0	+/- 100 vph	Yes	< 5	Yes
21-SBT	865	913	48	5.6%	1.6	+/- 15%	Yes	< 5	Yes
21-NBT	1270	1256	-14	-1.1%	0.4	+/- 15%	Yes	< 5	Yes
21-SBT	297	293	-5	-1.5%	0.3	+/- 100 vph	Yes	< 5	Yes
22-NBT	42	26	-16	-38.8%	2.8	+/- 100 vph	Yes	< 5	Yes
22-NBT	1270	1261	-9	-0.7%	0.3	+/- 15%	Yes	< 5	Yes
22-SBT	297	295	-2	-0.7%	0.1	+/- 100 vph	Yes	< 5	Yes
23-SET	865	922	57	6.5%	1.9	+/- 15%	Yes	< 5	Yes
23-SET	1738	1715	-23	-1.3%	0.6	+/- 15%	Yes	< 5	Yes
24-NWT	2048	2030	-18	-0.9%	0.4	+/- 15%	Yes	< 5	Yes
24-WBT	1191	1145	-46	-3.9%	1.4	+/- 15%	Yes	< 5	Yes
27-SET	1696	1687	-9	-0.5%	0.2	+/- 15%	Yes	< 5	Yes
27-SET	42	26	-16	-39.0%	2.8	+/- 100 vph	Yes	< 5	Yes
30-NBT	597	624	27	4.6%	1.1	+/- 100 vph	Yes	< 5	Yes
30-NBR	272	265	-7	-2.4%	0.4	+/- 100 vph	Yes	< 5	Yes
30-SBT	704	692	-12	-1.7%	0.5	+/- 100 vph	Yes	< 5	Yes
30-SBL	261	265	4	1.5%	0.2	+/- 100 vph	Yes	< 5	Yes
30-EBL	199	217	18	9.1%	1.3	+/- 100 vph	Yes	< 5	Yes
30-EBT	1081	1092	11	1.0%	0.3	+/- 15%	Yes	< 5	Yes
30-EBR	369	365	-4	-1.0%	0.2	+/- 100 vph	Yes	< 5	Yes
40-SBT	705	705	0	0.0%	0.0	+/- 15%	Yes	< 5	Yes
40-SBR	288	317	29	10.1%	1.7	+/- 100 vph	Yes	< 5	Yes
40-NBL	283	333	50	17.5%	2.8	+/- 100 vph	Yes	< 5	Yes
40-NBT	514	509	-6	-1.1%	0.2	+/- 100 vph	Yes	< 5	Yes
40-WBL	256	262	6	2.5%	0.4	+/- 100 vph	Yes	< 5	Yes
40-WBT	1279	1368	89	7.0%	2.4	+/- 15%	Yes	< 5	Yes
40-WBR	287	290	3	1.2%	0.2	+/- 100 vph	Yes	< 5	Yes
50-NBR	4	4	0	2.5%	0.0	+/- 100 vph	Yes	< 5	Yes
50-EBR	4	10	6	147.5%	2.2	+/- 100 vph	Yes	< 5	Yes
50-EBT	1604	1611	7	0.4%	0.2	+/- 15%	Yes	< 5	Yes
60-SBL	79	62	-17	-21.6%	2.0	+/- 100 vph	Yes	< 5	Yes
60-SBT	94	94	0	-0.1%	0.0	+/- 100 vph	Yes	< 5	Yes
60-EBL	59	38	-21	-35.9%	3.0	+/- 100 vph	Yes	< 5	Yes
60-EBT	1524	1539	15	1.0%	0.4	+/- 15%	Yes	< 5	Yes
60-EBR	47	44	-3	-6.4%	0.4	+/- 100 vph	Yes	< 5	Yes
60-NBT	79	76	-3	-3.9%	0.4	+/- 100 vph	Yes	< 5	Yes
60-NBR	40	40	0	1.0%	0.1	+/- 100 vph	Yes	< 5	Yes
70-WBL	42	24	-18	-42.4%	3.1	+/- 100 vph	Yes	< 5	Yes
70-WBT	1723	1838	115	6.7%	2.7	+/- 15%	Yes	< 5	Yes
70-WBR	78	79	1	1.3%	0.1	+/- 100 vph	Yes	< 5	Yes
70-SBR	64	57	-7	-10.6%	0.9	+/- 100 vph	Yes	< 5	Yes
70-SBT	131	133	2	1.2%	0.1	+/- 100 vph	Yes	< 5	Yes
70-NBL	50	28	-22	-43.8%	3.5	+/- 100 vph	Yes	< 5	Yes
70-NBT	87	84	-3	-3.8%	0.4	+/- 100 vph	Yes	< 5	Yes

Appendix D:
Proposed Concepts



421
74
17
76
CAPE FEAR RIVER
USS NORTH CAROLINA
USS NORTH CAROLINA RD
BATTLESHIP RD
110
120
130
140
150
HDB
WILMINGTON DOWNTOWN COMMERCIAL LOCAL HISTORIC DISTRICT
WILMINGTON RESIDENTIAL LOCAL HISTORIC DISTRICT
WILMINGTON HISTORIC DISTRICT
S 2ND ST
NUN ST
CHURCH ST
S FRONT ST
QUEEN ST
S 5TH ST
CASTLE ST
WOOSTER ST
DAWSON ST
S 10TH ST
S 8TH ST
S 7TH ST
S 6TH ST
S 4TH ST
S 3RD ST
KIDDER ST
MEARES ST
WRIGHT ST
MARSTELLAR ST
END BRIDGE
END MUP
MUP
SURRY ST
A
C
D
CAPE FEAR MEMORIAL BRIDGE
MOVABLE BRIDGE
BEGIN BRIDGE
APPROXIMATE CHANNEL LIMITS
CAPE FEAR RIVER
RAILROAD
FUTURE FRONT ST PROJECT
GREENFIELD ST
WILLARD ST
BURNETT BLVD
ALLIGATOR CREEK
ANDREW JACKSON HIGHWAY

ORTHOPHOTO DATA

Imagery Date = 02-02-2020

PRELIMINARY DESIGN
SUBJECT TO CHANGE

LEGEND

- PROPOSED EDGE OF TRAVEL
- PROPOSED CURB & GUTTER, STRUCTURE
- PROPOSED BARRIER
- PROPOSED SIDEWALK
- EXISTING WETLANDS
- HDB WILMINGTON HISTORIC DISTRICT
- HDB WILMINGTON DOWNTOWN COMMERCIAL LOCAL HISTORIC DISTRICT & RESIDENTIAL LOCAL HISTORIC DISTRICT
- MODIFIED TRAFFIC SIGNAL

200 100 0 200 400
SCALE

ALTERNATE A
MOVABLE STRUCTURE
(65' VERTICAL CLEARANCE)
HB-0039
(CAPE FEAR MEMORIAL BRIDGE)
NEW HANOVER AND BRUNSWICK COUNTIES

LEGEND

- PROPOSED EDGE OF TRAVEL
- PROPOSED CURB & GUTTER, STRUCTURE
- PROPOSED BARRIER
- PROPOSED SIDEWALK
- EXISTING WETLANDS
- WILMINGTON HISTORIC DISTRICT
- WILMINGTON DOWNTOWN COMMERCIAL LOCAL HISTORIC DISTRICT & RESIDENTIAL LOCAL HISTORIC DISTRICT
- MODIFIED TRAFFIC SIGNAL

ORTHOPHOTO DATA

Imagery Date = 02-02-2020

PRELIMINARY DESIGN
SUBJECT TO CHANGE

200 100 0 200 400
SCALE

ALTERNATE B
FIXED STRUCTURE
(135' VERTICAL CLEARANCE)
HB-0039
(CAPE FEAR MEMORIAL BRIDGE)
NEW HANOVER AND BRUNSWICK COUNTIES