Blue Water Bridge Plaza

FINAL TRAFFIC ANALYSIS REPORT

Version 3.1

September 2023

Prepared for:

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EXECUTIVE SUMMARY

The Blue Water Bridge (BWB) Plaza Study, located in the City of Port Huron, Michigan, evaluates the impacts within the roadway network that are expected to result from the proposed plaza expansion. An overview of the study area is provided in **Figure ES-1**.

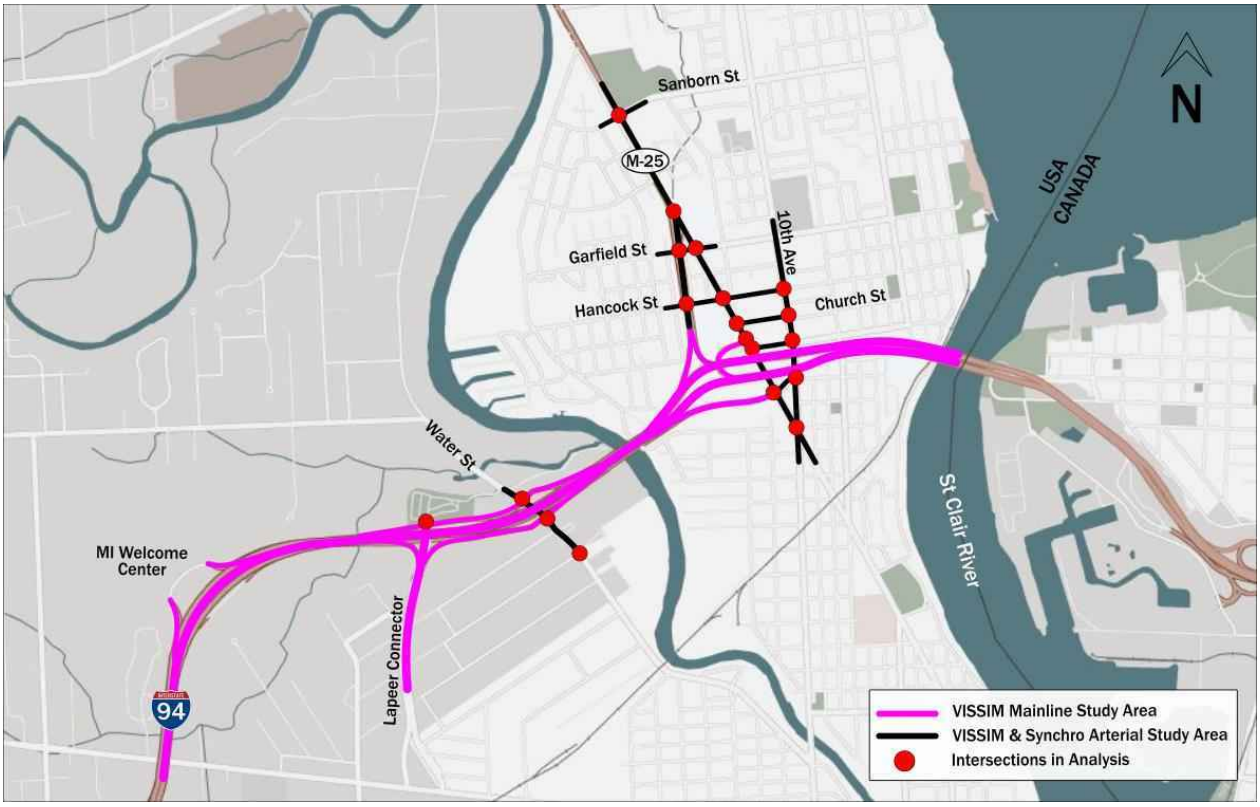

Figure ES-1: Study Area Limits

The evaluation uses calibrated VISSIM models to analyze AM and PM peak period conditions during Existing, Future No-Build (FNB), and Build conditions in accordance with the *Michigan Department of Transportation (MDOT) VISSIM Protocol Manual* (Version 1.1, August 2020). The calibrated VISSIM models ensured that the results were reliable and could be used to compare the FNB and Build conditions, referred to as the 2045 Refined Alternative.

The 2045 Refined Alternative proposes modifications to the BWB Plaza and reconfiguration of the I-94/I-69 Business Loop (BL) (Pine Grove) at 10th Avenue at intersection. Regarding the BWB Plaza, local access via the loop ramp from I-94/I-69 BL (Pine Grove) to Canada is proposed to be removed and relocated west via the I-94/I-69 Connector. Additionally, toll booths on I-94/I-69 eastbound are proposed to be relocated upstream, prior to the merge of traffic from the I-94/I-69 Connector and I-

94/I-69 eastbound. After passing through the toll booths, vehicles travel around a circular loop with access to the relocated Duty Free store, before arriving at the outbound inspection area. On I-94/I-69 westbound, the orientation and lane assignments of the Primary Inspection Lanes (PILs) are proposed to be adjusted from the existing configuration to allow trucks to be processed on the right and passenger vehicles (POV) processed on the left. This eliminates a weave between trucks and POVs that currently occurs at the Canadian plaza. **Figure ES-2** and **Figure ES-3** display the existing and proposed layouts. A detailed VISSIM PIL layout of the proposed BWB Plaza is provided in **Appendix C.**

The analysis results show that the proposed 2045 Refined Alternative modifications are not expected to result in adverse effects to traffic operations. In terms of travel times and speeds, the 2045 Refined Alternative performs comparable to the FNB. **Table ES-1** highlights that vehicles on I-94/I-69 and I-94/I-69 BL/M-25 (Pine Grove) in the 2045 Refined Alternative are expected to travel within five miles per hour (mph) of vehicles in the FNB. Speeds on I-94/I-69 eastbound near the BWB Plaza are the lone exception, due to the construction of the loop around the relocated Duty Free store, as well as the relocation of toll booths upstream. The additional 0.5 miles of travel distance, as well as the reduced speed of 20 mph on the loop, result in longer travel times and speeds in the 2045 Refined Alternative.

Figure ES-2: Existing Layout

Figure ES-3: Proposed Layout

Table ES-1: Future Travel Time and Speed Comparisons

Segment Name	Distance (mi)	Posted Speed (mph)	FNB				2045 Refined Alternative			
			Travel Time (seconds)		Diff from Posted Speed (mph)		Travel Time (seconds)		Diff from Posted Speed (mph)	
			AM	PM	AM	PM	AM	PM	AM	PM
I-94/I-69 EB to west of Lapeer Conn	0.81	70	42	43	-1	-2	42	43	-2	-2
I-94/I-69 EB to west of Toll Facility	1.72*	70**	90	91	-1	-1	247	263	-38	-46
I-94/I-69 WB to east of Water St	0.55	55	41	41	-7	-7	39	39	-7	-4
I-94/I-69 WB to east of Welcome Center	1.04	70	60	60	-8	-8	60	60	-8	-8
I-94/I-69 WB – end	0.90	70	47	47	-1	-1	47	47	-1	-1
I-94/I-69 BL (Pine Grove) NB – 10th Ave to Hancock St	0.49	35	70	76	-10	-12	84	75	-14	-12
M-25 (Pine Grove) NB – Hancock St to Sanborn St	0.67	35	88	84	-8	-6	90	93	-8	-9
M-25 (Pine Grove) SB – Sanborn St to Hancock St	0.69	35	87	85	-7	-6	101	84	-11	-6
I-94/I-69 BL (Pine Grove) SB – Hancock St to 10th Ave	0.47	35	72	77	-12	-13	71	63	-10	-6

NOTE: Green Cells (0-5 mph difference); Yellow Cells (6 – 10 mph difference); Red Cells (10+ mph difference)
* Distance of travel time segment in 2045 Refined Alternative is 2.21 miles due to construction of circular loop
** Design speed on the loop is 20 mph

Table ES-2 displays that the 2045 Refined Alternative is expected to experience similar, and in some cases, greater volume throughput at the BWB Plaza than the FNB.

Table ES-2: BWB Toll Plaza Peak Hour Volume Throughput

Location	AM (number of vehicles)			PM (number of vehicles)		
	FNB	2045 Refined Alt	Diff	FNB	2045 Refined Alt	Diff
I-94/I-69 WB Cars	142	140	-2	177	226	+49
I-94/I-69 WB Cars – NEXUS	27	26	-1	40	43	+3
I-94/I-69 WB Trucks – FAST Lane	47	45	-2	43	43	0
I-94/I-69 WB Trucks (North Facility)	60	58	-2	49	47	-2
I-94/I-69 WB Trucks (South Facility)	94	93	-1	79	80	+1
I-94/I-69 EB Toll Both (Outbound to Canada)	221	232	+11	442	475	+33

Operations along Hancock Street are significant in assessing the effect of proposed modifications, as approximately 200 additional PM peak hour vehicles are expected to use Hancock Street to access the on-ramp to the BWB. The following improvements are recommended to mitigate adverse traffic operational impacts:

- I-94/I-69 Connector at Hancock Street
    - Convert the westbound left-turn movement from permissive only to a permissive-protected signal phase to prevent the queue on Hancock Street from extending to the I-94/I-69 BL/M-25 (Pine Grove) intersection due to vehicles accessing the eastbound on-ramp to the BWB plaza utilizing Hancock Street.
    - Allow the eastbound left-turn movement, which is currently restricted, through the addition of a protected left-turn to provide vehicles an additional route to travel northbound and avoid delay at the I-94/I-69 BL/M-25 (Pine Grove) and Hancock Street intersection.
    - The LOS results in **Table ES-3** demonstrate these modifications will maintain intersection operations and accommodate the additional traffic.

On I-94/I-69 BL (Pine Grove), the intersection with 10th Avenue is proposed to be reconfigured into two split intersections. The north 10th Avenue intersection will align with the relocated I-94/I-69 eastbound off-ramp terminal. The south 10th Avenue intersection will tee directly to I-94/I-69 BL (Pine Grove). The intersection LOS analysis indicates that the reconfiguration of I-94/I-69 BL (Pine Grove) and 10th Avenue is

expected to result in less delay at the intersection of I-94/I-69 BL (Pine Grove) at 10th Avenue as shown in **Table ES-3.**

Table ES-3 also indicates the overall intersection operations at I-94/I-69 BL (Pine Grove) and the I-94/I-69 eastbound off-ramp ramp remain largely the same. Delay on the eastbound through and right-turn movements increases slightly due to the addition of 10th Avenue at this intersection. However, the overall intersection operations remain unchanged at Level of Service C (LOS C).

Table ES-3: Future Alternatives Intersection LOS Comparison

Intersection	AM Peak Hour LOS		PM Peak Hour LOS	
	FNB	Build	FNB	Build
I-94/I-69 Connector at Hancock St	C	B	B	C
I-94/I-69 BL/M-25 (Pine Grove) at Hancock St	C	C	B	B
I-94/I-69 BL (Pine Grove) at 10th Ave	B	B	C	B
I-94/I-69 BL (Pine Grove) at I-94/I-69 EB Off-Ramp	C	C	C	B

In conclusion, the analysis of the FNB and 2045 Refined Alternative VISSIM models have led to the following findings:

- Operations on the I-94/I-69 mainline will not be adversely impacted due to proposed modifications at the BWB Plaza.
- Operations on I-94/I-69 BL/M-25 (Pine Grove) will not be adversely impacted due to proposed modifications on I-94/I-69 BL/M-25 (Pine Grove) related to the realignment of the I-94/I-69 eastbound off-ramp, 10th Avenue, or the relocation of the I-94/I-69 eastbound entrance ramp to access the BWB.

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1 INTRODUCTION

The Blue Water Bridge (BWB) Plaza Study, located in the City of Port Huron, Michigan, evaluates the impacts within the roadway network that are expected to result from the proposed plaza expansion. The proposed plaza expansion is a refinement from two layouts previously submitted. The first layout was submitted in March 2009 as part of the BWB Plaza Study Final Environmental Impact Statement. The second layout was submitted in December 2013 as part of the BWB Master Plan Update Final Report. This proposed plaza expansion layout will be referred to as the 2045 Refined Alternative throughout this study.

The purpose of this report is twofold. Firstly, the report provides an overview of the micro-simulation methodology, assumptions, and data collection implemented for the BWB Plaza Study. Secondly, the report documents the existing year (2019) traffic calibration and base conditions, and compares the performance of the design year (2045) peak period VISSIM models in the study area during the AM and PM peak time periods from 6:15 AM – 9:15 AM and 3:30 PM – 6:30 PM, respectively.

The traffic calibration and analysis for the BWB Plaza follows the guidelines provided in the *Michigan Department of Transportation (MDOT) VISSIM Protocol Manual* (Version 1.1, August 2020) and occurred in three distinct phases: data collection, existing traffic analysis, and future traffic analysis. The components that make up each of these three phases can be found in **Figure 1**, and are discussed in detail later in this report.

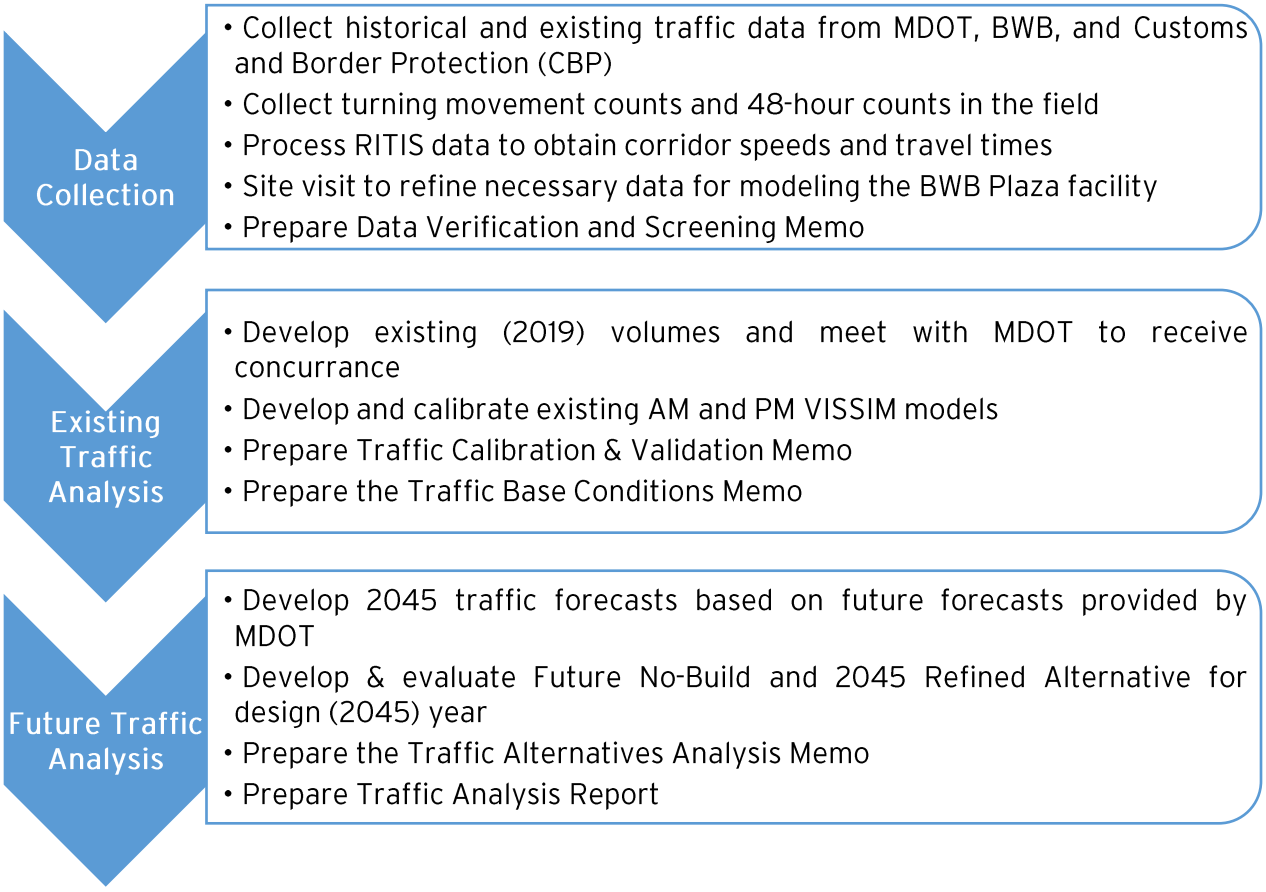


Figure 1: Traffic Analysis Phases

This report incorporates all previous work completed under the following interim technical memorandums:

1. *VISSIM Modeling Methodology and Assumptions Memorandum* – June 2022
2. *Data Verification and Screening Memorandum* – June 2022
3. *Traffic Calibration and Validation Memorandum* – July 2022
4. *Traffic Base Conditions Memo* – July 2022
5. *Alternative Analysis Memo* – November 2022

2 STUDY AREA

The study area is defined by both its geographical limits and the time periods which need to be evaluated. These are described in the following sections.

2.1 Spatial Limits

The BWB Plaza Study area incorporates Interstate 94/69 (I-94/I-69) from just west of the Michigan Welcome Center interchange to the middle of the BWB bridge over the St.

Clair River. The study includes four interchanges along I-94/I-69 at the Michigan Welcome Center, Lapeer Connector, Water Street, and I-94/I-69 Business Loop (BL)/M-25 (Pine Grove Avenue).

The I-94/I-69 westbound ramps at the Michigan Welcome Center are included in the VISSIM network but the I-94/I-69 eastbound ramps are not included. The I-94/I-69 eastbound ramps are designated for authorized vehicles only and traffic into and out of the interchange is not expected to influence the operations on I-94/I-69 eastbound. The I-94/I-69 ramps to and from the BWB Plaza are also included in the analysis network as well as the arterial network along I-94/I-69 BL/M-25 (Pine Grove), I-94/I-69 Connector, and 10th Avenue as shown in **Figure 2.**

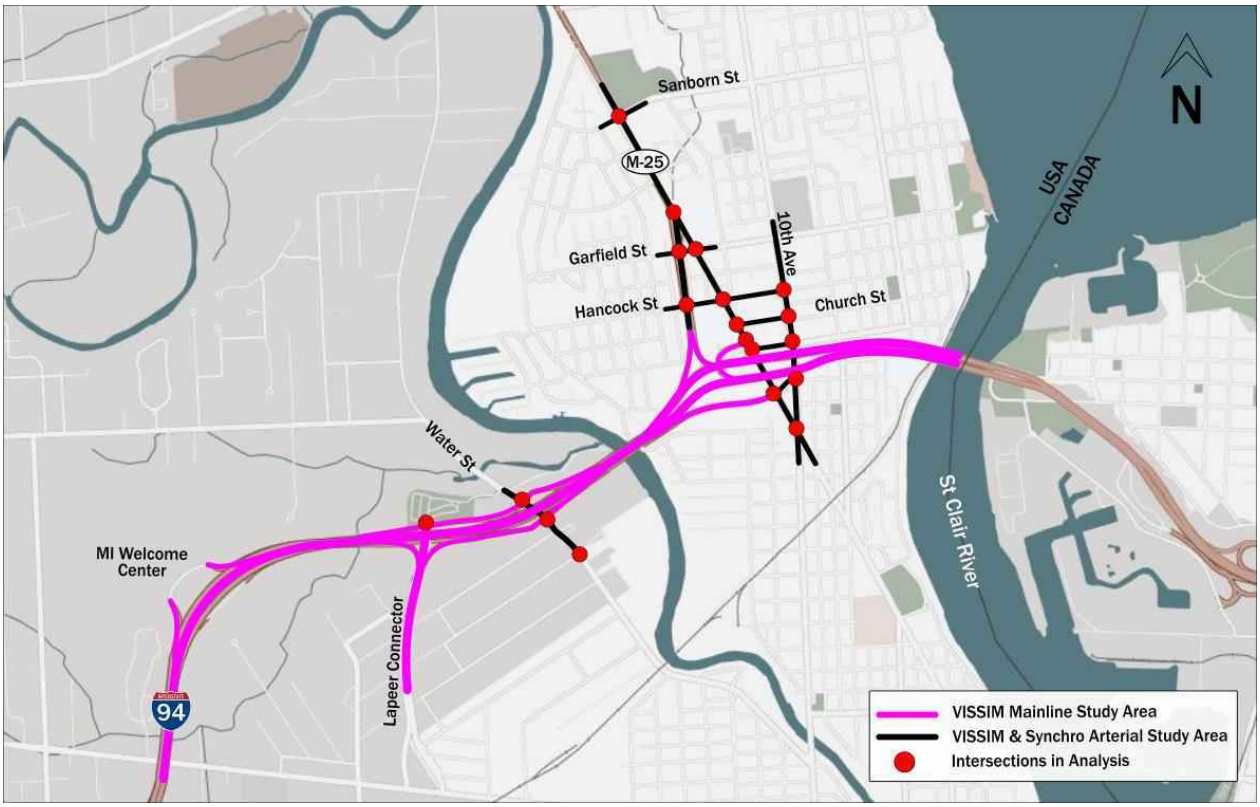


Figure 2: Study Area Limits

In addition to the VISSIM network analysis, a Synchro (Version 11) analysis was conducted for Water Street, I-94/I-69 BL/M-25 (Pine Grove), and 10th Avenue to determine existing and future conditions. The Synchro analysis helped determine any mitigation measures needed based on the VISSIM analysis. **Table 1** summarizes the complete list of intersections included in the VISSIM and Synchro analysis.

Table 1: List of Study Area Intersections

Street 1 Name	Street 2 Name	Control Type	VISSIM	Synchro
Lapeer Connector	I-94/I-69 WB Service Drive	Unsignalized	X	
Water Street	I-94/I-69 WB ramp	Signalized	X	X
Water Street	I-94/I-69 EB ramp	Signalized	X	X
Water Street	Campau Avenue	Unsignalized	X	X
I-94/I-69 BL (Pine Grove)	10th Avenue	Signalized	X	X
I-94/I-69 BL (Pine Grove)	I-94/I-69 EB Ramp/Harker Street	Signalized	X	X
I-94/I-69 BL (Pine Grove)	Elmwood Street	Unsignalized	X	X
I-94/I-69 BL (Pine Grove)	On-Ramp to BWB Toll Booth	Signalized	X	X
I-94/I-69 BL (Pine Grove)	Church Street	Unsignalized	X	X
I-94/I-69 BL/M-25 (Pine Grove)	Hancock Street	Signalized	X	X
I-94/I-69 BL (Pine Grove)	Garfield Street	Unsignalized	X	X
M-25 (Pine Grove)	I-94/I-69 Connector	Signalized	X	X
M-25 (Pine Grove)	Sanborn Street	Signalized	X	X
I-94/I-69 Connector	Garfield Street	Unsignalized	X	X
I-94/I-69 Connector	Hancock Street	Signalized	X	X
10th Avenue	Hancock Street	Signalized	X	X
10th Avenue	Church Street	Unsignalized	X	X
10th Avenue	Elmwood Street	Unsignalized	X	X
10th Avenue	Harker Street	Unsignalized	X	X

3 DATA COLLECTION & DEVELOPMENT

Data was collected for both traffic counts and vehicle speeds within the network. They are described in the following sections.

3.1 Data Collection Sources

Data was collected from the following sources:

- 2022 traffic counts – Counts collected on March 22, 2022 or April 5, 2022 for this project

- Historical traffic counts – as provided by the MDOT Transportation Data Management System (TDMS)
- BWB toll facility data including traffic counts with vehicle classification for 2019 and 2021 – Customs and Border Protection (CBP), BWB, and MDOT
- Speed and Travel Time Data – Regional Integrated Transportation Information System (RITIS)
- BWB Plaza Dwell Times – Collected in the field on May 5, 2022 for this project
- Signal timing permits – MDOT and City of Port Huron
- Growth rates for 2045 traffic forecasts – as provided by the MDOT Bureau of Transportation Planning

3.2 Traffic Counts

Historical traffic counts were obtained from the MDOT TDMS. The historical counts were largely collected between 2017 and 2019. Preference was given to counts from years prior to 2020 due to the COVID-19 pandemic and restrictions on travel in the nearby area as a result. The MDOT historical counts were compiled and used to compare against traffic count data that was collected in March/April 2022.

The BWB data included both traffic volume and vehicle classification for the entire 2019 and 2021 calendar years. The data included the primary inspection lanes (PIL) as well as the toll booths. The PIL data included all inbound trips into the United States of America (USA) and the toll booth data included all outbound trips to Canada.

The historical MDOT count locations as well as turning movement counts (TMC) and 48-hour segment counts collected in March/April 2022 are shown on the study area map in **Appendix A** and a list of the 2022 traffic count locations are provided in **Table 2**. **Figure 3** below also gives a summary of the count locations. The goal of the traffic data comparison is to develop a balanced traffic volume network that represents pre-pandemic conditions. The historical MDOT count data (pre-pandemic) were given priority when establishing the existing balanced volume set and the traffic counts collected in March/April 2022 were prioritized when establishing turning movement percentages at the intersections within the study area. Refer to **Section 4.2** for additional details regarding the decision to prioritize pre-pandemic volumes.

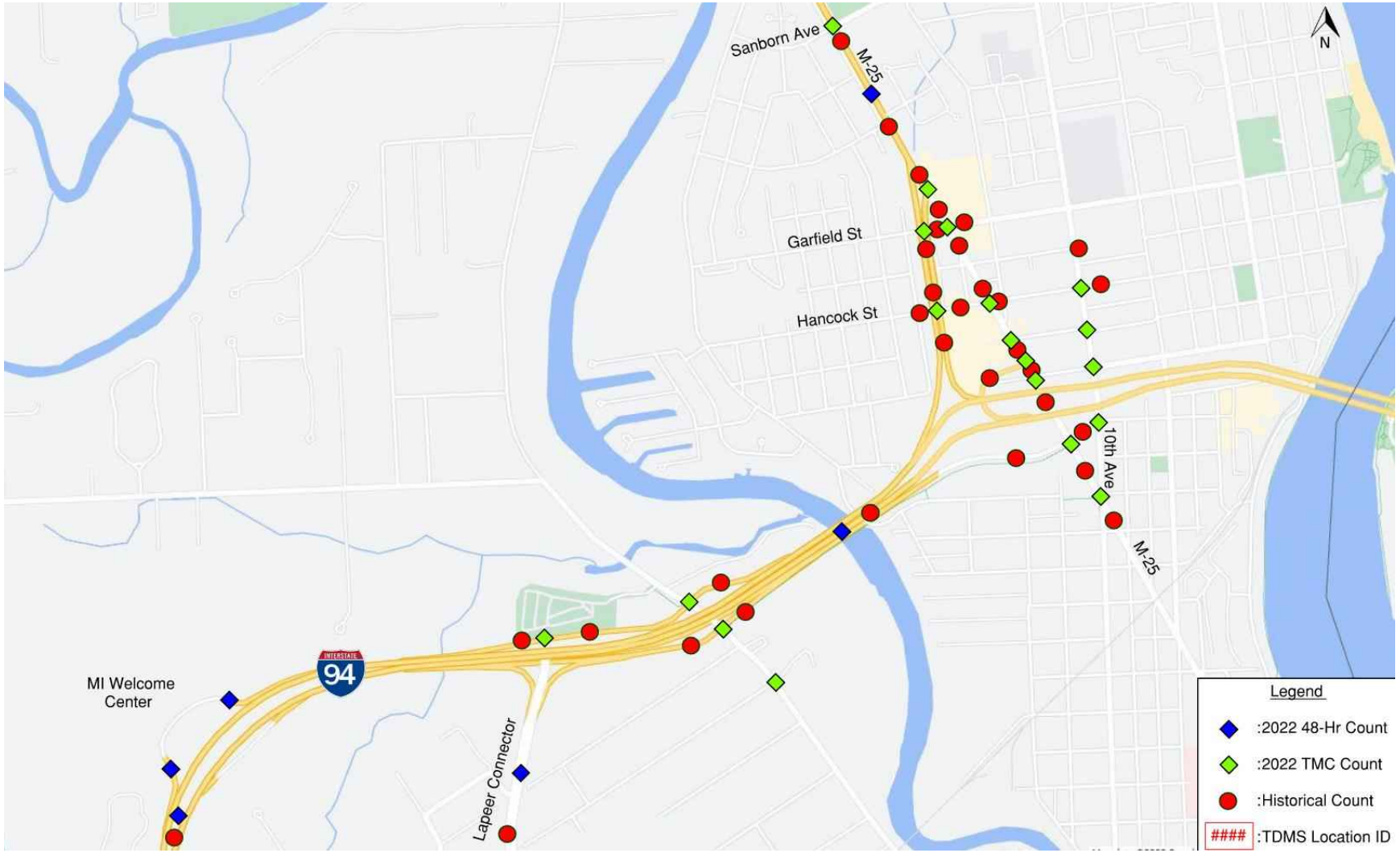


Figure 3: Traffic Count Locations

Table 2: Collected Counts in March/April 2022

Count #	Count Location	Count Type	Count Date
1	Lapeer Connector at I-94/I-69 WB Service drive	TMC	3/22/22
2	Water Street at I-94/I-69 WB Service Drive	TMC	3/22/22
3	Water Street at I-94/I-69 EB Service Drive	TMC	3/22/22
4	Water Street at Campau Avenue	TMC	3/22/22
5	I-94/I-69 BL (Pine Grove) at 10th Avenue	TMC	3/22/22
6	I-94/I-69 BL (Pine Grove) at I-94/I-69 EB ramp	TMC	3/22/22
7	I-94/I-69 BL (Pine Grove) at Elmwood Street	TMC	3/22/22
8	I-94/I-69 BL (Pine Grove) at BWB toll plaza ramp	TMC	3/22/22
9	I-94/I-69 BL (Pine Grove) at Church Street	TMC	3/22/22
10	I-94/I-69 BL/M-25 (Pine Grove) at Hancock Street	TMC	3/22/22
11	M-25 (Pine Grove) at Garfield Street	TMC	3/22/22
12	M-25 (Pine Grove) at I-94/I-69 Connector	TMC	3/22/22
13	M-25 (Pine Grove) at Sanborn Street	TMC	3/22/22
14	I-94/I-69 Connector at Garfield Street	TMC	3/22/22
15	I-94/I-69 Connector at Hancock Street	TMC	3/22/22
16	10th Avenue at Hancock Street	TMC	4/5/22
17	10th Avenue at Church Street	TMC	4/5/22
18	10th Avenue at Elmwood Street	TMC	4/5/22
19	10th Avenue at Harker Street	TMC	4/5/22
20	I-94/I-69 Mainline Count (West of MI Welcome Center)	48-hour	4/5/22
21	I-94/I-69 WB off-ramp at MI Welcome Center	48-hour	4/5/22
22	I-94/I-69 WB on-ramp at MI Welcome Center	48-hour	4/5/22
23	Lapeer Connector (South of I-94)	48-hour	4/5/22
24	I-94/I-69 Mainline (over the Black River)	48-hour	4/5/22
25	M-25 (Pine Grove) between Sanborn Street and Brandywine Lane	48-hour	4/5/22

3.3 Speed Data Collection

Speed data for the I-94/I-69 mainline segments and the I-94/I-69 BL/M-25 (Pine Grove) corridor within the operational study area, depicted in **Figure 4** and **Figure 5**, were collected from RITIS.

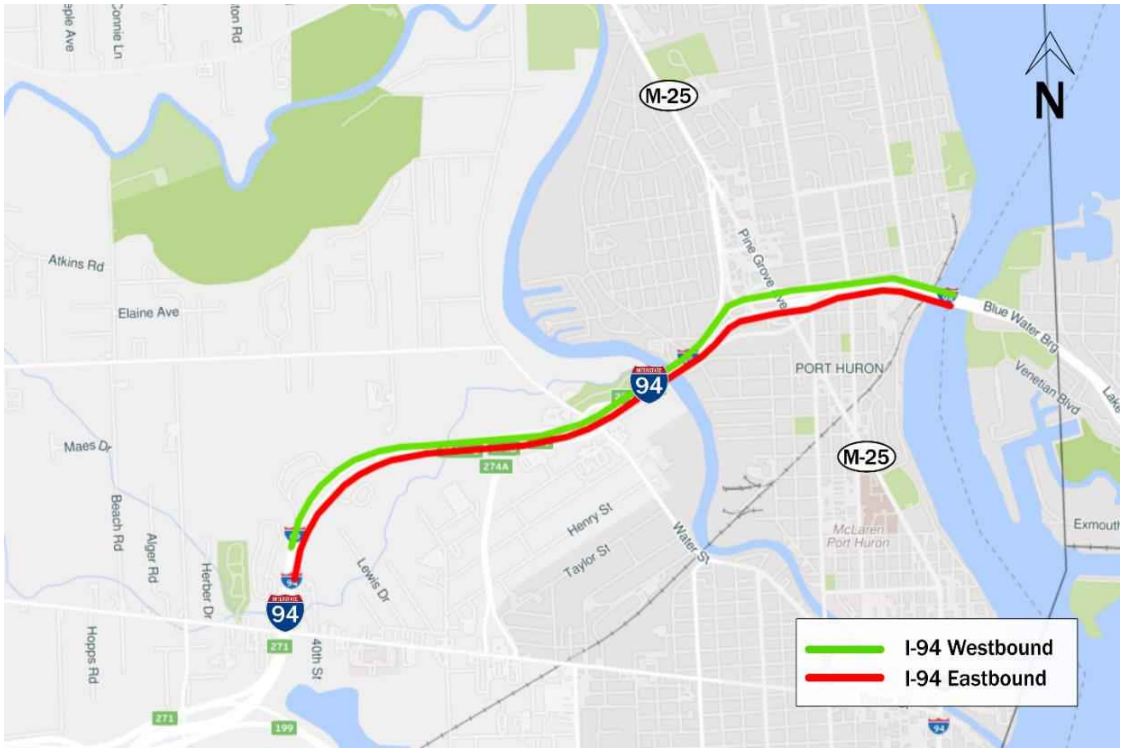


Figure 4: RITIS Speed Segment for I-94/I-69 mainline

Figure 5: RITIS Speed Segment for I-94/I-69 BL (Pine Grove)

Speed data was collected from September 2019 to November 2019, which corresponds to the same time period as the traffic count data used to establish the base condition for analysis at the BWB Plaza for the PIL and toll booths. Speed data collected during this three-month span were compared to speeds collected during the same three-month span in 2020 and 2021 to determine any effects of the COVID-19 pandemic and validate the decision that pre-pandemic volumes should be used when establishing the existing volume set. The speed data comparison is provided in **Appendix B .**

Speed data was collected in 15-minute increments from 6:15 AM – 9:15 AM and 3:30 PM – 6:30 PM, which corresponded to peak periods for the entire study area. Median speeds, as well as 15th and 85th percentile speeds, were determined in 15-minute intervals for each segment for purposes of identifying a range of speeds expected in the typical morning and afternoon periods with no unexpected delays due to incidents, adverse weather conditions, and construction. The 15th and 85th percentile speeds represent approximately one standard deviation from the median.

3.4 Field Collected BWB Plaza Dwell Times

A field visit was performed on May 5th, 2022 to understand the BWB plaza operations for both the PILs and toll booths as well as the local traffic conditions within the study area. During the site visit, observations were documented, and dwell times were collected for the PIL and toll booths for both passenger cars and trucks. A summary of the dwell times collected in the field are provide in **Table 3**. The field collected dwell times were implemented in the VISSIM model to simulate a vehicle being processed at the BWB Plaza for both inbound and outbound. Fast and Secure Trade (FAST) and NEXUS percentages were calculated using data provided by CBP and BWB and were also implemented in the VISSIM model. NEXUS is a "trusted traveler" program designed to decrease the time it takes to cross the U.S./Canada border. BWB Plaza facility configuration and details regarding car, truck, NEXUS, and FAST lanes can be found in **Appendix C.**

Table 3: Dwell Times for VISSIM Modeling

Facility	Vehicle Type	Dwell Times (seconds)		
		Minimum	Maximum	Average
Primary Inspection Lanes (Inbound from Canada)	Passenger Car	15	120	52
	Passenger Car – NEXUS	6	15	11
	Truck	20	426	86
	Truck – FAST	35	152	67
Toll Booths (Outbound to Canada)	Passenger Car	17	21	19
	Truck	14	20	16

4 DATA VERIFICATION AND SCREENING

Traffic counts were collected on March 22, 2022 and April 5, 2022 at TMC and 48-hour segment locations within the study area as detailed in **Table 2**. A verification of the field collected traffic counts was completed to confirm accuracy of the data based on any influence from weather events, roadway incidents, or nearby construction projects. Due to the current COVID-19 pandemic, counts collected in the field were compared to historical counts from MDOT's TDMS site. The goal of the comparison was to identify any noticeable discrepancies between the counts collected during the COVID-19 pandemic and historical counts within the study area. A data screening was also performed for speed data collected along the I-94/I-69 and I-94/I-69 BL/M-25 (Pine Grove) corridors to compare pre-pandemic (2019) travel speeds to similar time periods in 2021 and 2022.

4.1 Traffic Data Verification

The data collected in 2022 consisted of 19 TMC locations. A check was performed on the data to confirm no discrepancies or missing data were included prior to the comparison against historical data. The TMC locations in close proximity were reviewed to confirm no discrepancies in traffic volume. The I-94/I-69 mainline traffic data were quality checked to confirm no missing or outlier data.

The data collected in the field on March 22, 2022 consisted of the 15 TMC locations as identified in **Table 2**. The remaining traffic counts were collected on April 5, 2022 for the four remaining TMC locations on 10th Avenue and the 48-hour segment locations within the study area. Construction on I-94/I-69 BL/M-25 (Pine Grove) began on April 5, 2022 from BWB to M-136. The construction on April 5th consisted of shutting down

the two northbound lanes on I-94/I-69 BL/M-25 (Pine Grove) as well as the two-way left-turn lane, allowing one lane of traffic in each direction between BWB and M-136. The 10 count locations taken during the I-94/I-69 BL/M-25 (Pine Grove) construction are shown in **Table 4**. After reviewing the data, the traffic counts along Lapeer Connector were within 10% of the historical counts even with the construction along I-94/I-69 BL/M-25 (Pine Grove). The traffic counts along 10th Avenue were consistent between nearby intersections. The sole count that appeared affected by the construction was Count #25 in **Table 4**. The 48-hour count was located on M-25 (Pine Grove) between Sanborn Street and Brandywine Lane. The count was reduced to a 24-hour count due to the construction and was compared against the recently collected TMCs from March 22, 2022. As a result, Count #25 was not used in the traffic volume comparison as the data appears to be altered due to the construction along I-94/I-69 BL/M-25 (Pine Grove).

Table 4: Data Validation for Traffic Counts Collected During Construction on I-94/I-69 BL/M-25 (Pine Grove) (April 5, 2022)

Count #	Count Location	Count Type	Notes
16	10th Avenue at Hancock Street	TMC	Limited historical data along 10th Avenue for comparison purposes. Traffic volumes between intersections was consistent and used in the volume balancing stage.
17	10th Avenue at Church Street	TMC	
18	10th Avenue at Elmwood Street	TMC	
19	10th Avenue at Harker Street	TMC	
20	I-94/I-69 Mainline Count (West of MI Welcome Center)	48-hour	Counts compare well to historical data
21	I-94/I-69 WB off-ramp at MI Welcome Center	48-hour	No discrepancy in the collected data
22	I-94/I-69 WB on-ramp at MI Welcome Center	48-hour	No discrepancy in the collected data
23	Lapeer Connector (South of I-94)	48-hour	Counts compare well to historical data
24	I-94/I-69 Mainline (over the Black River)	48-hour	Reduced to a 24-hour count due to construction. However, counts compare well to historical data.
25	M-25 (Pine Grove) between Sanborn Street and Brandywine Lane	48-hour	Reduced to a 24-hour count due to construction. Priority to be given to the TMC data collected on 3/22/22 and historical counts along I-94/I-69 BL/M-25 (Pine Grove)

4.2 Traffic Data Comparison

Due to the COVID-19 pandemic, traffic volumes collected in the field must be verified and compared to historical counts within the study area. Historic counts at several high traffic locations such as the I-94/I-69 mainline, I-94/I-69 ramps, and I-94/I-69 BL/M-25 (Pine Grove) were compared with collected counts from 2022. Historical counts from MDOT's TDMS were compiled from as early as 2015 and up to 2019 and were used to compare the validity of 2022 field counts.

The comparison concluded that in several high traffic volume locations throughout the network, the 2022 collected counts were shown to be lower than MDOT's historical count data. In fact, the only high traffic volume location that experienced greater traffic volumes in 2022 compared to previous years was the Lapeer Connector. The trend indicates the possibility that traffic within the study area, as a whole, has not fully rebounded to pre-pandemic traffic volumes. As a result, preference was given to MDOT historical counts when establishing the existing AM and PM peak hour volumes. Consequently, because majority of the counts came from 2019, the existing year was established as 2019. **Appendix A** provides a study area map with the 2022 counts locations as well as MDOT historical count locations with each TDMS location ID number. **Appendix A** also includes a series of traffic count tables comparing the MDOT historical count data to the 2022 field collected count. The count data that is being prioritized in the volume balancing of the network is highlighted in each table in **Appendix A.**

Regarding data on the BWB Plaza, it was determined to use data from October 2019 as it matched closely with the surrounding historical MDOT data. The 2021 volume at PIL and toll booths were noticeably lower due to the COVID-19 pandemic and restrictions on travel. The peak period comparison data is shown in **Appendix A** for the BWB Plaza facility as well as other key locations within the study area.

4.3 Speed Data Comparison

In order to assess the speed data validity, pre-COVID-19 speed data from September 2019 to November 2019 was compared with speed data from September 2020 to November 2020 and September 2021 to November 2021. As seen in **Appendix B** the speed data trends from September 2019 to November 2019 indicate that speeds on I-94/I-69 are noticeably lower than speeds during the same period in 2020 and 2021. Additionally, the lower speeds in 2019 correspond to the higher traffic volumes observed during 2019. The speeds on I-94/I-69 BL/M-25 (Pine Grove) are comparable

in all three data sets. A summary of the speed comparisons is illustrated below in **Appendix B .**

4.4 Volume Balancing and Heavy Vehicle Percentages

After the traffic volume comparison was completed for the study area and a prioritized count was established at specific locations, a process of volume balancing the network took place for the existing volume set. The historical MDOT traffic volumes were mostly prioritized throughout the network in order to establish pre-pandemic traffic volumes. The TMC data collected in March/April 2022 was used to establish turning movement count percentages at specific intersection during the volume balancing process.

After the traffic volumes were balanced for existing AM and PM peak hour, comparisons were made throughout the network to check if the balanced existing AM and PM volume sets match with the historical MDOT data as well as recent 2018 data collected along M-25 (Pine Grove) as part of the *M-25 (Pine Grove) Optimized Conditions Analysis Memo* (MDOT JN 201863) located in **Appendix D**. The balanced volume set represents pre-pandemic conditions throughout the study area. The existing AM and PM peak hour volumes as well as the existing daily volumes are provided in **Appendix E** and represent the existing volumes to be used in the existing VISSIM analysis.

The passenger car and heavy goods vehicle (HGV) percentages were also determined based on the traffic data available within the study area. The Federal Highway Administration (FHWA) classifies vehicles into 13 classes. Classes 1 to 3 correspond to passenger vehicles, while Classes 4 to 13 correspond to HGVs. For the counts collected for this project, vehicles were classified as either, lights, buses, or trucks. Lights corresponded with passenger vehicles, while the sum of buses and trucks corresponded with HGVs. All entry links into the VISSIM network utilized a vehicle composition based on a percentage of passenger cars and heavy vehicles (trucks). The HGV percentages for some of the major roadways within the BWB Plaza study network are shown in **Table 5.** A complete table of the entry links in the VISSIM network and the given AM and PM HGV percentages are included in **Appendix F.**

Table 5: HGV Percentages

Location (Entry Link in VISSIM Network	AM Peak HGV%	PM Peak HGV%
I-94/I-69 EB (West of the MI Welcome Center)	16%	17%
Lapeer Connector NB	5%	1%
M-25 (Pine Grove) SB (north of Sanborn Street)	3%	2%
M-25 (Pine Grove) NB (south of 10th Avenue)	3%	1%
I-94/I-69 WB (over Blue Water Bridge)	55%	39%

5 VISSIM MODEL DEVELOPMENT

VISSIM version 11.00-14 was chosen as the mobility analysis tool for this project to understand the corridor-wide impacts of the BWB Tolling Facility as well as the freeway and arterial networks. A micro-simulation model is beneficial as it provides insight on the effects of subtle geometric characteristics, lane-specific conditions, operational "choke points", local driver behavior, and variations in volume over the peak hour, among other corridor attributes. The VISSIM model outputs data that can be applied with Highway Capacity Manual (HCM), 6th Edition level of service (LOS) criteria to analyze traffic operations in addition to other measures of effectiveness (MOEs). The traffic calibration and analysis for the BWB Plaza follows the guidelines provided in the *MDOT VISSIM Protocol Manual* (Version 1.1, August 2020). For modeling purposes, the AM and PM peak periods were divided into 15-minute seeding, pre-peak hour, peak hour, and post peak hour time segments as listed in **Table 6.** Based on traffic data, volume builds during the pre-peak hours and dissipates during the post peak hours. A seeding interval of 15 minutes was selected to properly load the network. Additional information regarding VISSIM model development is available in **Appendix G.**

Table 6: Intervals for VISSIM Models

Interval	AM	PM
Seeding Time	6:00-6:15	3:15-3:30
Pre Peak	6:15-7:15	3:30-4:30
Peak Hour	7:15-8:15	4:30-5:30
Post Peak	8:15-9:15	5:30-6:30

5.1 BWB Plaza Facility Assumptions

The BWB Plaza facility includes primary inspection lanes for vehicles entering the USA from Canada as well as toll booths for vehicles leaving the USA to enter Canada. Based on discussions with BWB and MDOT, the operations at the facility can change on a daily basis due to a number of different factors such as number of lanes open, staff availability, Canadian Plaza operations, readiness of drivers at the primary inspection lanes/toll booths, etc. Due to the number of variables associated with the BWB Plaza facility certain assumptions were made when modeling the plaza in order to simulate the operations. The assumptions for the BWB Plaza facility include the following:

- All primary inspection lanes are open for processing (fully staffed)
- FAST and NEXUS percentages were calculated using data provided by CBP and BWB. BWB Plaza facility configuration and details regarding car, truck, NEXUS, and FAST lanes can be found in **Appendix C.**
- Dwell time at the primary inspection lanes and the toll booths were collected in the field and time distributions were created for car, heavy vehicle, and vehicles enrolled in the FAST/NEXUS program.
- The delay at the primary inspection lanes and the toll booths were field verified. Furthermore, discussions with staff members during a site visit helped determine typical delay and queue lengths in the AM and PM peak periods.
- As this analysis is being conducted to inform potential improvements on the United States side of the BWB, the Canadian border inspections were not included in the VISSIM model network. The eastbound delay and queues stemming from the Canadian plaza operations were not accounted for in the traffic analysis.
- The traffic calibration and validation of the toll facility largely compared the vehicle throughput from historical data and the VISSIM model. Due to the number of variables involved in plaza operations the vehicle throughput comparison was the most important. The delay at the facility was compared between the field data and VISSIM model results to make sure the delay and queue lengths are reasonable for the AM and PM peak periods.

6 CALIBRATION AND VALIDATION

The existing AM and PM VISSIM micro-simulation models were initially run ten times with each run having a different seed number and both VISSIM models using a simulation resolution of 10-time steps per simulation second. Given that each seed number creates slightly different traffic conditions, it was necessary to confirm that the results produced by the VISSIM models are representative of the true mean. The number of simulation model runs was determined using the following equation:

$$N = \left(2 * t_{0.025,N-1} \frac{S}{R}\right)^2$$

Where:

- N is the required number of simulation runs
- R = 95-Percent confidence interval for the true mean
- $t_{0.025,N-1}$ = Student's t-statistic for 95-percent confidence – two-sided error of 2.5 percent with N-1 degrees of freedom
- S = Standard deviation of selected Measure of Effectiveness (MOE) sample

The results of this analysis provided in **Table 7** indicates the minimum number of simulation runs required for the existing, Future No-Build (FNB), and 2045 Refined Alternative VISSIM models to produce statistically significant results. Since the largest recommended sample size was 8.83, it was determined that the calibrated results produced from ten simulation runs was statistically significant.

Table 7: AM & PM Confidence Intervals and Minimum Simulation Runs

Route	Time Period	Travel Time (s)	Standard Deviation (s)	Min Required Runs
AM Peak				
I-94/I-69 EB Mainline	6:15-7:15	132.95	1.01	0.47
	7:15-8:15	133.10	1.05	0.51
	8:15-9:15	132.86	1.05	0.51
I-94/I-69 WB Mainline	6:15-7:15	148.27	0.94	0.33
	7:15-8:15	148.84	0.89	0.29
	8:15-9:15	148.78	0.96	0.34
M-25 (Pine Grove) NB Mainline	6:15-7:15	153.89	3.17	3.47
	7:15-8:15	161.26	3.93	4.85
	8:15-9:15	160.47	3.09	3.04
M-25 (Pine Grove) SB Mainline	6:15-7:15	155.06	3.17	3.42
	7:15-8:15	162.65	3.67	4.17
	8:15-9:15	158.58	3.37	3.70
PM Peak				
I-94/I-69 EB Mainline	3:30-4:30	133.33	0.74	0.25
	4:30-5:30	133.24	0.74	0.25
	5:30-6:30	133.01	0.68	0.21
I-94/I-69 WB Mainline	3:30-4:30	148.38	0.84	0.26
	4:30-5:30	148.53	0.95	0.34
	5:30-6:30	147.80	0.75	0.21
M-25 (Pine Grove) NB Mainline	3:30-4:30	155.31	3.61	4.43
	4:30-5:30	156.68	5.15	8.83
	5:30-6:30	148.85	3.36	4.18
M-25 (Pine Grove) SB Mainline	3:30-4:30	157.84	4.57	6.87
	4:30-5:30	155.92	4.32	6.27
	5:30-6:30	154.39	4.50	6.97

Highlighted Cell = maximum number of runs

6.1 Driver Behavior

The "Wiedemann 99" car following model was used for freeway links along I-94, while the "Wiedemann 74" car following model was used on connecting arterial streets. The VISSIM default driving behavior parameters were used throughout the study area.

6.2 Calibration and Validation Results

Modeled traffic volumes were compared to the balanced existing year target volumes using the GEH statistic to verify that all mainline and ramp segments, local roadways, and the sum of all segment flows within the calibration area were within the tolerances shown in **Table 8**.

Table 8: Throughput Traffic Volume Calibration Criteria

Criteria	Acceptable Targets
GEH < 3.0	All MDOT facility segments within the calibration area
GEH < 3.0	All entry and exit locations within the calibration area
GEH < 3.0	All entrance and exit ramps within the calibration area
GEH < 5.0	At least 85% of applicable local roadway segments
Sum of all segment flows within the calibration area	Within 5%

*The GEH statistic is computed as follows:

$$GEH = \sqrt{\frac{2 \times (m-c)^2}{(m+c)}}$$

Where:
m = output traffic throughput volumes from the VISSIM model (veh/h/ln)
c = traffic throughput volumes based on field data (veh/h/ln).

This comparison was conducted for the AM and PM three-hour peak periods and are summarized in **Table 9**. As illustrated in **Appendix H**, each hour in the peak period was evaluated separately when calculating the GEH. The results indicate that every mainline and ramp segment results in a GEH of 3 or less. Due to the location of the toll booths and primary inspection lanes on the I-94/I-69 mainline, the vehicle throughput comparison at these locations was conducted along with the general I-94/I-69 mainline comparison. Refer to **Appendix H** for detailed information regarding calibrated GEH information.

Table 9: Mainline Network GEH Statistics

Criteria	AM Peak Period		PM Peak Period	
	Ramps	I-94/I-69 Mainline	Ramps	I-94/I-69 Mainline
Locations with GEH < 3.0	48	96	48	96
Locations with GEH ≥ 3.0	0	0	0	0
% Compliance	100%	100%	100%	100%
Calibrated?	Yes	Yes	Yes	Yes

The local roadway network links were also compared between the balanced volume set and the vehicle throughput in VISSIM. The traffic calibration criteria requires at least 85% of the local roadway network to have a GEH of less than five. The results for the local roadway network are provided in **Table 10** and indicate the local roadway network meets the traffic calibration criteria.

Table 10: Local Roadway Network GEH Statistics

Criteria	Local Roadway Links	
	AM Peak Period	PM Peak Period
Locations with GEH < 5.0	519	519
Locations with GEH ≥ 5.0	0	0
% Compliance	100%	100%
Calibrated?	Yes	Yes

In addition to specific mainline segment and intersection analysis, the entire volume from the VISSIM models were compared to the balanced volume set for the analysis periods. There was minimal difference between the volumes input into the network from traffic forecasts, and the overall vehicle throughput from VISSIM. Overall, vehicle throughput from VISSIM was within the 5% threshold for both the AM and PM peak periods and meets the traffic calibration criteria. The analysis is provided in **Table 11.**

Table 11: Traffic Volume Validation

Period	Balanced Volumes			VISSIM Volumes	
	Total	Lower Bound (-5%)	Upper Bound (+5%)	Total	% Difference
AM	39,048	37,096	41,001	38,635	1.1%
PM	54,126	51,420	56,832	53,213	1.7%

After the VISSIM model was verified to have sufficient throughput traveling in the network, the travel times across the entire peak period were analyzed. As shown in **Table 12**, in both the AM and PM peak periods, 100% of the travel time segments displayed a travel time within 20% of the travel times observed in RITIS on freeways and within 30% of travel times observed on arterials. The speed heat maps in **Appendix I** display that average speeds of all segments recorded in VISSIM during the AM and PM three-hour peak period match speeds retrieved from RITIS. Refer to **Appendix I** detailed AM and PM travel time results and speed graphs.

Table 12: Travel Time Segments Criteria

	AM Peak Period	PM Peak Period
Travel Time Segments Meeting Criteria	27	27
Travel Time Segments Not Meeting Criteria	0	0
Total % of Travel Times Meeting Criteria	100%	100%
Calibrated?	Yes	Yes

7 RESULTS ANALYSIS

After calibrating the existing AM and PM VISSIM models, they were used as a baseline to identify existing operational concerns within the study area. The existing calibrated VISSIM models were used to obtain the existing analysis results for both freeway segments and intersections within the study area. MOEs used to analyze traffic conditions include density, volume, speed, and travel times for freeway segments, as well as delay for signalized and unsignalized intersections. The freeway density and intersection delay also correspond to a LOS.

LOS is a simplified method of describing how a freeway segment or intersection is performing operationally. The LOS thresholds provided by the Highway Capacity Manual (HCM), 6th Edition, are displayed in **Table 13**. The Michigan Department of Transportation (MDOT) considers LOS A through LOS D desirable for Michigan state roadways. Freeway segments and intersections operating at LOS E and F indicate unstable flow, traffic volume near or exceeding capacity, and potential operational breakdowns.

Table 13: HCM Level of Service Thresholds

LOS	Freeway Segments			Intersections	
	Mainline Density (pc/mi/ln)	Merge/Diverge Density (pc/mi/ln)	Weaving Segment (pc/mi/ln)	Signalized Avg. Delay (sec/veh)	Unsignalized Avg. Delay (sec/veh)
A	< 11	< 10	< 10	< 10	< 10
B	11-18	10-20	10-20	10-20	10-15
C	18-26	20-28	20-28	20-35	15-25
D	26-35	28-35	28-35	35-55	25-35
E	35-45	> 35	35-43	55-80	35-50
F	> 45 Demand Exceeds Capacity	Demand Exceeds Capacity	> 43 Demand Exceeds Capacity	> 80	> 50

Additionally, to properly study the impacts of the 2045 Refined Alternative, the average and maximum queues were collected at the Blue Water Bridge Toll Facility and intersections. A complete overview of the MOEs analyzed from the VISSIM model are listed in **Table 14**.

Table 14: MOEs Measured

MOE	Freeway	Intersection	BWB Toll Facility
Volume	X		X
Density/LOS	X		
Speed	X		
Delay / LOS		X	X
Travel Times	X		X
Avg. Queues		X	X
Max. Queues		X	X

7.1 Freeway MOEs

The MOEs (density, volume, speed) for each freeway segment are depicted graphically in **Appendix J.** The results were averaged over the ten simulation runs and summarize the max 15-minute density, hourly volumes, and average hourly speeds during the peak hours of 7:15 AM – 8:15 AM and 4:30 PM – 5:30 PM. **Table 15** summarizes the mainline densities and LOS along the I-94/I-69 mainline and service drives.

The MOEs in **Appendix J** and **Table 15** were compared against the LOS thresholds contained in **Table 13**. The appropriate LOS designation was assigned to each MOE. It should be noted that the lane schematic results in **Appendix J** and the results in **Table 15** may slightly vary as the figures analyze the traffic conditions by lane while **Table 15** takes the average conditions of each segment.

Overall, the I-94/I-69 freeway segments operate with minor congestion or delay. All mainline freeway segments in the AM and PM peak hours operate at LOS A, with the exception of the toll plaza segments. Congestion and delay are to be expected at these locations due to vehicle processing time at the toll booths. Vehicles on the service drives also experience minimal delay, except for where the eastbound service drive terminates at I-94/I-69 BL (Pine Grove). In both the AM and PM peak hour results in **Appendix J**, minor slowdowns are experienced at a few locations. These slowdowns accompany the reduced LOS at locations near the toll plaza as well as on I-94/I-69 eastbound between the I-94/I-69 Connector and the Water Street off-ramp, likely due to weaving movements on the segment between the ramps. The density results in **Table 15** highlight the congestion in specific segments but do not affect the overall operations of the freeway, as a majority of the mainline segments operate at LOS A.

Table 15: Existing Mainline LOS Results

Location	Operation Type	AM		PM	
		Density	LOS	Density	LOS
I-94/I-69 EB Mainline LOS					
I-94/I-69 EB Start	Basic	8.8	A	9.0	A
I-94/I-69 EB diverge to MDOT Maintenance Facility	Diverge	8.9	A	9.0	A
I-94/I-69 EB mainline	Basic	9.0	A	9.1	A
I-94/I-69 EB merge/diverge from MDOT Maintenance Facility/Lapeer Connector	Merge/Diverge	5.5	A	5.6	A
I-94/I-69 EB mainline	Basic	4.5	A	4.7	A
I-94/I-69 EB diverge to 3 lanes	Diverge	3.3	A	3.5	A
I-94/I-69 EB mainline	Basic	1.6	A	2.0	A
I-94/I-69 EB merge with I-94/I-69 BL (Pine Grove) On-ramp	Merge	1.4	A	2.6	A
I-94/I-69 EB Toll Plaza	Basic	16.2	B	29.3	D
I-94/I-69 EB from Toll Plaza to BWB Border (Outbound to Canada)	Basic	2.7	A	4.9	A
I-94/I-69 WB Mainline LOS					
I-94/I-69 WB Border Patrol to BWB Canada Border (Inbound from Canada)	Basic	4.3	A	5.7	A
I-94/I-69 WB South Border Patrol Checkpoint	Basic	7.9	A	5.7	A
I-94/I-69 WB North Border Patrol Checkpoint (Car Lane)	Basic	16.9	B	100.5	F
I-94/I-69 WB North Border Patrol Checkpoint (NEXUS Lane)	Basic	3.2	A	5.4	A
I-94/I-69 WB North Border Patrol Checkpoint (Truck Lane)	Basic	6.2	A	5.1	A
I-94/I-69 WB North Border Patrol Checkpoint (FAST Lane)	Basic	74.5	F	55.5	F
I-94/I-69 WB mainline	Basic	6.3	A	6.7	A
I-94/I-69 WB mainline	Basic	7.0	A	7.5	A
I-94/I-69 WB merge/diverge I-94/I-69 BL (Pine Grove)/Water St.	Merge/Diverge	8.5	A	9.4	A
I-94/I-69 WB Converge 3-2 lane	Merge	5.2	A	5.8	A
I-94/I-69 WB mainline	Basic	6.3	A	7.0	A
I-94/I-69 WB merge/diverge WB service Dr/Welcome Center	Merge/Diverge	4.9	A	5.7	A
I-94/I-69 WB mainline	Basic	7.1	A	8.4	A
I-94/I-69 WB merge from Welcome Center	Merge	4.8	A	5.7	A
I-94/I-69 WB termination	Basic	4.8	A	5.7	A
I-94/I-69 EB Service Drive					
I-94/I-69 EB Service Drive start	Basic	5.9	A	5.9	A
I-94/I-69 EB Service Drive Diverge to 3 lanes (adds Water Street on-ramp)	Diverge	8.5	A	9.7	A
I-94/I-69 EB Service Drive end on I-94/I-69 BL (Pine Grove)	Basic	28.8	D	37.4	E
I-94/I-69 WB Service Drive					
I-94/I-69 WB Service Drive between Water St. & Lapeer Connector	Basic	7.1	A	6.3	A
I-94/I-69 WB Service Drive Lapeer Connector to WB I-94	Basic	2.5	A	3.7	A

- Highlighted rows indicate segments at the BWB Toll Plaza
- Density (veh/h/ln) results extracted from the VISSIM model
- Density results refer to maximum 15-minute density during the peak hour

7.2 Intersection MOEs

Throughout the study area, the delay and LOS for each movement was analyzed to understand traffic operations at each intersection. The VISSIM analysis study area included intersections on Water Street as well as 15 intersections along the I-94/I-69 BL/M-25 (Pine Grove) and 10th Avenue corridors.

7.2.1 VISSIM Study Area Intersection Analysis

A review of the AM and PM intersection results indicate that all intersections and most movements within the study area operate at satisfactory levels (LOS D or better). In the AM peak hour, the eastbound left turn at I-94/I-69 BL/M-25 (Pine Grove) and Hancock Street is the only movement that operates at LOS E or worse. However, only 25 vehicles are expected to make this movement during the peak hour and is not considered a major operational concern.

In the PM peak hour, the eastbound left turn at I-94/I-69 BL/M-25 (Pine Grove) and Hancock Street and the eastbound left turn at M-25 (Pine Grove) and Sanborn Steet operate at LOS E. The delay for this movement does not affect overall intersection delay which operates at LOS A. The more significant delay occurs on the westbound approach at I-94/I-69 BL/M-25 (Pine Grove) and Hancock Street which operates at LOS F. The LOS F is likely attributed to vehicles not having adequate time or space to move into the pocket through/right-turn lane. In addition, this intersection was updated in the last three years with a road diet being implemented on Hancock Street from I-94/I-69 BL/M-25 (Pine Grove) to the I-94/I-69 Connector. The road diet changed the lane configuration of the westbound approach from a shared thru/left turn and a shared thru/right turn to a left turn lane and a shared thru/right. The I-94/I-69 Connector at Hancock Street also operates at LOS D due to a high left turn movement of approximately 260 vehicles coupled with short left turn storage of less than 250 feet.

An overview of VISSIM analysis for the 19 intersections within the study area are contained in **Table 16** and **Table 17**. Detailed results for all intersections within the VISSIM study area can be found in **Appendix K**.

Table 16: Existing AM Intersection LOS Results

Intersection	Northbound				Southbound				Eastbound				Westbound				Total
	L	T	R	App	L	T	R	App	L	T	R	App	L	T	R	App	
I-94/I-69 BL (Pine Grove) at 10th Ave	A	D		B	D	D		D		A	A	A		B	A	B	B
Lapeer Conn at Service Drive WB	A			A									A	A		A	B
I-94/I-69 EB Ramps at Water St		B	A	A	A	A		A	C	C	C	C					B
I-94/I-69 WB Ramps at Water St	A	A		A	A	B		A					C	C	A	C	B
I-94/I-69 EB Ramps at I-94/I-69 BL (Pine Grove)		B	A	B	B	C		C	C	C	C	C					C
Harker St at 10th Ave		A	A	A	A	A		A	B	B	A		A		A	A	A
10th Ave at Church St	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
10th Ave at Hancock St	C	B	A	B	B	B	B	B	C	B	A	B	B	B	A	B	B
M-25 (Pine Grove) at Sanborn St	C	B	B	B	B	A	A	A	D	B	B	D	D	D	A	C	B
M-25 (Pine Grove) at I-94/I-69 Connector		A		A		A		A	D		A	A					A
Garfield St at I-94/I-69 Connector	A	A	A	A	A	A	A	A		B	A	B		B	A	B	A
M-25 (Pine Grove) at Garfield St	A	A	A	A	A	A	A	A	A	B	A	A	B	B	A	B	A
I-94/I-69 BL (Pine Grove) at Elmwood St	A	A	A	A	A	A	A	A	A	B	A	B	A	B	B	B	A
I-94/I-69 BL (Pine Grove) at BWB On-Ramp	A	A		A		A	A	A									A
I-94/I-69 BL (Pine Grove) at Church St	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
I-94/I-69 BL/M-25 (Pine Grove) at Hancock St	C	B	B	B	C	B	B	B	E	C	B	C	C	D	C	D	C
I-94/I-69 Connector at Hancock St	A	B	A	B	A	B	B	B	A	D	A	C	D	D	C	D	D
Water St. at Campau St	A	A		A		A	A	A	B		B	B					A

Table 17: Existing PM Intersection LOS Results

Intersection	Northbound				Southbound				Eastbound				Westbound				Total
	L	T	R	App	L	T	R	App	L	T	R	App	L	T	R	App	
I-94/I-69 BL (Pine Grove) at 10th Ave	D	D		D	D	D		D		B	A	B		B	B	B	C
Lapeer Conn at Service Drive WB	A			A									A	A		A	B
I-94/I-69 EB Ramps at Water St		B	A	B	C	A		B	C	D	C	C					C
I-94/I-69 WB Ramps at Water St	A	A		A	A	B		B					C	C	A	C	B
I-94/I-69 EB Ramps at I-94/I-69 BL (Pine Grove)		A	A	A	C	A		A	C	C	B	C					B
Harker St at 10th Ave		A	A	A	A	A		A	B	B	A		A		A	A	A
10th Ave at Church St	A	A	A	A	A	A	A	A	A	A	A	A	A	B	A	A	A
10th Ave at Hancock St	C	C	B	C	D	B	A	B	B	C	A	B	B	B	A	B	C
M-25 (Pine Grove) at Sanborn St	C	A	A	A	B	A	B	A	E	A	B	D	C	D	C	D	A
M-25 (Pine Grove) at I-94/I-69 Connector		A		A		A		A	D		D	A					A
Garfield St at I-94/I-69 Connector	A	A	A	A	A	A	A	A		A	B	B		B	A	B	A
M-25 (Pine Grove) at Garfield St	A	A	A	A	C	A	A	A	A	A	A	A	C	B	B	B	A
I-94/I-69 BL (Pine Grove) at Elmwood St	A	A	A	A	C	A	A	A	B	B	B	B	A	A	B	B	A
I-94/I-69 BL (Pine Grove) at BWB On-Ramp	A	A		A		A	A	A									A
I-94/I-69 BL (Pine Grove) at Church St	A	A	A	A	D	A	A	A	A	A	A	A	A	A	C	C	A
I-94/I-69 BL/M-25 (Pine Grove) at Hancock St	B	B	A	B	C	B	A	B	E	D	B	D	F	F	F	F	D
I-94/I-69 Connector at Hancock St	A	B	A	B	A	B	B	B	A	D	A	C	D	D	A	D	D
Water St. at Campau St	A	A		A		A	A	A	B		B	A					A

7.2.2 Queue Length Analysis

Queue lengths were also analyzed at each intersection to understand the operations of the study area. Overall, the queue lengths were minimal throughout the network. Queue lengths were not observed to extend to adjacent intersections and congest the network.

An overview of existing queue lengths throughout the network are summarized in **Appendix L .**

7.3 Travel Times

Travel time was also chosen as an MOE for freeway segments, as travel times offer a practical evaluation of operations that are easier to explain to the public than densities and LOS. Travel time segments for the study area included the entire I-94/I-69 corridor as well as the I-94/I-69 BL/M-25 (Pine Grove) corridor. Both I-94/I-69 and I-94/I-69 BL/M-25 (Pine Grove) corridors were broken into smaller segments to understand the freeway and arterial network operations within the study area. The travel time segments for I-94/I-69 and I-94/I-69 BL/M-25 (Pine Grove) are provided in **Table 18.**

Overall, the I-94/I-69 and I-94/I-69 BL/M-25 (Pine Grove) corridors did not experience notable congestion or delays. Vehicles on the I-94/I-69 mainline and I-94/I-69 BL/M-25 (Pine Grove) traveled at near free-flow speeds and vehicles traveling on local routes did not experience significant delay or queueing at traffic signals.

Table 18: Travel Time Results

Segment Name	Distance (mi)	Posted Speed (mph)	Peak Hour Travel Time (seconds)		Peak Hour Average Speed (mph)	
			AM	PM	AM	PM
I-94/I-69 EB to west of Lapeer Conn	0.81	70	42.5	42.7	69	68
I-94/I-69 EB to west of Toll Facility	1.72	70	90.6	90.6	69	69
I-94/I-69 WB to east of Water St	0.55	55	41.2	41.0	48	48
I-94/I-69 WB to east of Welcome Center	1.04	70	60.1	60.3	62	62
I-94/I-69 WB – end	0.90	70	47.1	47.1	69	69
I-94/I-69 BL (Pine Grove) NB - 10th Ave to Hancock St	0.49	35	69.3	72.7	25	24
M-25 (Pine Grove) NB - Hancock St to Sanborn St	0.67	35	87.0	83.4	28	29
M-25 (Pine Grove) SB - Sanborn St to Hancock St	0.69	35	87.1	84.4	28	30
I-94/I-69 BL (Pine Grove) SB - Hancock St to 10th Ave	0.47	35	70.6	72.9	25	23

7.4 Blue Water Bridge Toll Plaza Operations

The Blue Water Bridge Toll Plaza facility was analyzed using three metrics: volume, average queue, and maximum queue.

Based on discussions with MDOT and the CBP, the operations at the facility can vary daily due to a variety of factors such as number of lanes open, staff availability, Canadian Plaza operations, readiness of drivers at the primary inspection lanes/toll booths, etc. As a result, the VISSIM model assumed that cars using the NEXUS lane would use the left most lane while trucks using the FAST lane would utilize the right most lane. An overview of the lane designations is illustrated in **Appendix C.**

The results in **Table 19** summarize the queue lengths at the BWB Toll Plaza. The average queue and maximum queue lengths were strongly influenced by field collected dwell times. For example, despite a high demand of vehicles traveling on I-94/I-69 eastbound toward Canada, the queue lengths are less than vehicles traveling on I-94/I-69 westbound into the United States due to higher dwell times for the primary inspection lanes (PIL).

Table 19: Queue Lengths

Facility	Vehicle Type	AM			PM		
		Volume (Vehicles)	Avg Queue (ft)	Max Queue (ft)	Volume (Vehicles)	Avg Queue (ft)	Max Queue (ft)
I-94/I-69 WB PILs (Inbound from Canada)	Cars	133	22	68	179	73	101
	Cars – NEXUS	26	1	29	40	1	35
	Trucks – FAST Lane	46	353	676	43	223	466
	Trucks (North Facility)	56	27	166	46	39	141
	Trucks (South Facility)	87	134	296	75	90	275
I-94/I-69 EB Toll Booths (Outbound to Canada)	Cars and Trucks	211	29	112	422	42	135

An analysis of the volumes at the BWB Toll Plaza in **Table 20** highlights that the queues resulting from the dwell times are acceptable and reflective of the number of vehicles processed at each station in field conditions as indicated by a GEH of 3 or less. The greatest discrepancy occurs in the PM on I-94/I-69 westbound for passenger vehicle where the VISSIM model processes 37 fewer vehicles than the target volumes based on the existing year forecast. The discrepancy is likely due to the time distribution used to estimate the dwell timings, which was based on only one day of observations in the field. As a result, it is possible that the actual dwell timings vary slightly from the assumed dwell timings in the VISSIM model. Despite the discrepancy, the GEH of 2.8, indicates that the temporary delay does not affect the overall operations of the VISSIM model, and that vehicles eventually reach their destination.

Table 20: BWB Volumes

Location	AM			PM		
	Target Volume (Vehicles)	VISSIM Volume (Vehicles)	GEH	Target Volume (Vehicles)	VISSIM Volume (Vehicles)	GEH
I-94/I-69 EB Toll Both to Canada (Outbound to Canada)	210	211	0.1	425	422	0.2
I-94/I-69 WB Cars	137	134	0.3	216	179	2.8
I-94/I-69 WB Cars – NEXUS	25	25	0.1	40	40	0.1
I-94/I-69 WB Trucks – FAST Lane	51	46	0.7	42	43	0.1
I-94/I-69 WB Trucks (North Facility)	55	56	0.1	46	46	0.1
I-94/I-69 WB Trucks (South Facility)	92	87	0.5	76	75	0.2

8 FUTURE TRAFFIC DATA

Traffic growth rates were provided by the Michigan Department of Transportation's (MDOT) Planning Group for the AM and PM peak periods shown in **Table 21**. The same growth rates were applied for the AM and PM peak periods to develop traffic volumes for the FNB and 2045 Refined Alternative. The proposed BWB Plaza improvements are not expected to result in increased traffic volumes within the study area beyond what is expected in the no-build condition. Refer to **Appendix M** for future volume maps.

Table 21: Recommended Future Growth Rates

Roadway	Yearly Growth	Overall Growth (2019 – 2045)
I-94/I-69 Mainline	0.3%	8.1%
Arterials and Local Streets	0.5%	13.8%

9 FUTURE VISSIM MODEL DEVELOPMENT

The FNB and 2045 Refined Alternative VISSIM models were developed using the calibrated existing base conditions VISSIM model. A summary of the geometric modifications is listed below.

FNB

- Same geometry as existing VISSIM models
- Assumed same dwell times at the outbound and inbound toll booths and inspection areas that were used in the existing base conditions VISSIM model

2045 Refined Alternative

- Primary Inspection Lanes (PILs) on I-94/I-69 westbound – Refer to **Appendix C** for more information
    - PIL orientation for passenger vehicles and trucks have been changed from the existing condition – From south to north, lane orientation converted to:
        - Bus and non-commercial vehicle PIL (one lane)
        - Passenger vehicle PILs (six lanes)
        - Heavy vehicle PILs (ten lanes)
- I-94/I-69 eastbound Toll facility lanes
    - Remove loop ramp from I-94/I-69 BL (Pine Grove) to Canada and replace with a slip ramp from the I-94/I-69 Connector
    - Relocate toll booths upstream, prior to the merge of traffic from the I-94/I-69 Connector and I-94/I-69 eastbound. After being processed at the primary toll facility, vehicles travel around a circular loop with access to the relocated Duty Free store before arriving at the outbound inspection area.
        - Immediately before crossing the BWB, vehicles may be chosen for secondary inspection. Based on the operations at the Ambassador

Bridge as well as the intent of the secondary inspection, a reduced speed area was coded into the VISSIM model at speeds of 8 mph for passenger vehicles and 5 mph for heavy vehicles. An assumption was made that if a vehicle was stopped at the secondary inspection the vehicle would be removed from the travel lane for further inspection.

- M-25 (Pine Grove)
    - Remove driveways west of Church Street and Elmwood Street
        - Relocate parking lot access across from Elmwood Street to north of I-94/I-69 eastbound ramp
    - Relocate the I-94/I-69 eastbound off-ramp further to the south near Scott Avenue
    - Realign 10th Avenue to create a 4-way intersection at I-94/I-69 BL (Pine Grove) with the I-94/I-69 eastbound off-ramp terminal
    - Convert the Harker Street and 10th Avenue intersection to a 3-legged intersection by removing the eastbound approach on Harker Street
    - Reconfigure the I-94/I-69 BL (Pine Grove) and 10th Avenue intersection to a 3-legged intersection by removing southbound approach on 10th Avenue
    - Remove access to I-94/I-69 BL (Pine Grove) from Lyon Street and replace with protected left turn from I-94/I-69 BL (Pine Grove) to 10th Avenue and right turn from 10th Avenue to I-94/I-69 BL (Pine Grove)
- I-94/I-69 Connector
    - Widen the I-94/I-69 Connector to three lanes starting approximately 250 feet north of Hancock Street and continuing south of Hancock Street
        - The right two lanes lead to I-94/I-69 westbound and the left lane leads to the BWB Plaza
        - **Appendix N** details the necessity for the third lane on the I-94/I-69 Connector

Figure 6 illustrates the 2045 Refined Alternative concept layout for the study area.

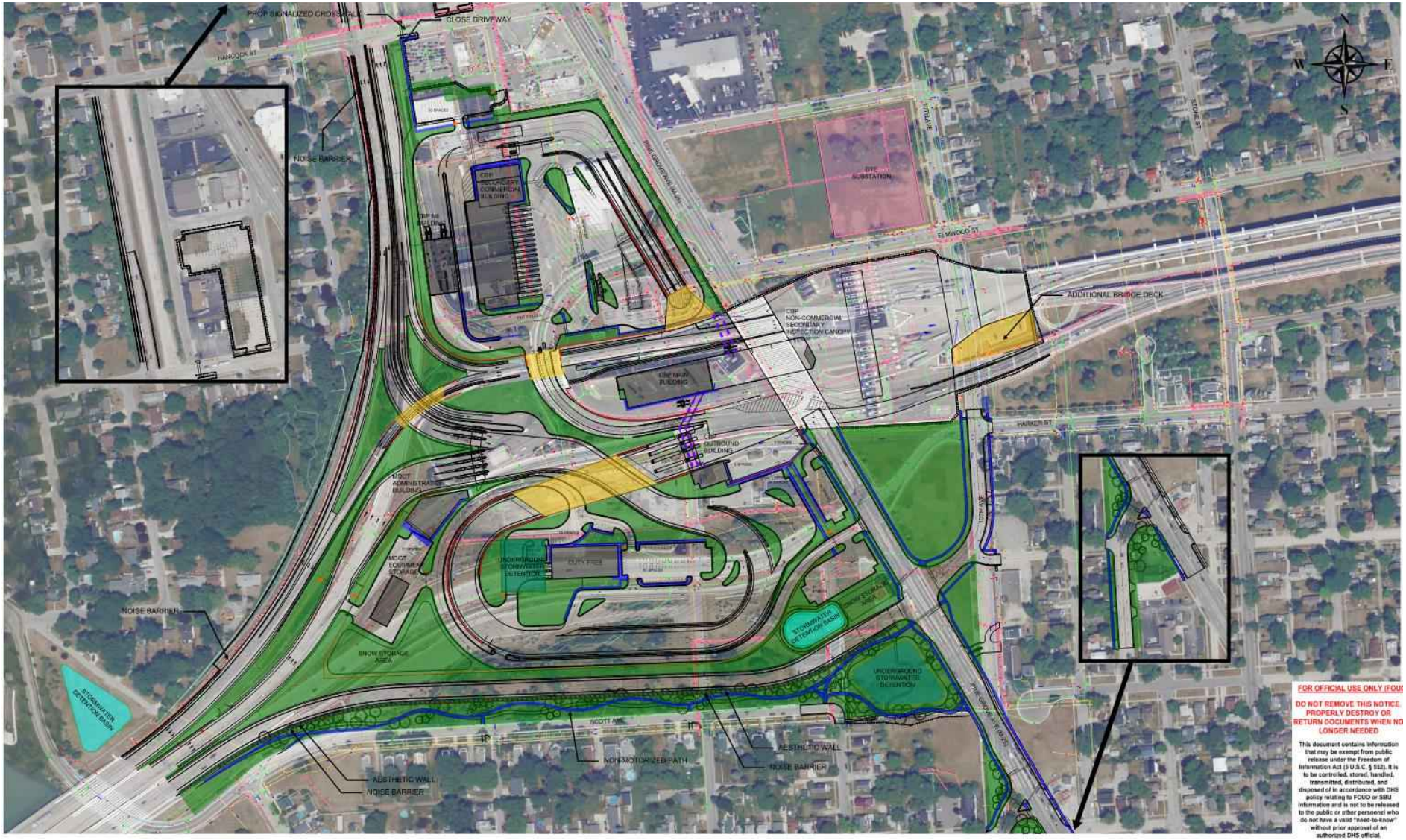


Figure 6: 2045 Refined Alternative Concept Layout

10 FUTURE VISSIM MODEL MEASURES OF EFFECTIVENESS

The MOEs used to describe the operating conditions of the VISSIM models are discussed in the following sub-sections.

10.1 Freeway MOEs

The freeway MOEs (density, volume, speed) for each lane and freeway segment are depicted graphically in **Appendix O**. The results were averaged over ten simulation runs and summarize the max 15-minute density, hourly volumes, and average hourly speeds during the peak hours of 7:15 AM – 8:15 AM and 4:30 PM – 5:30 PM. The color scheme used in these figures reflects the average speed. The density and LOS of each overall segment for the entire study area can be found in **Appendix P**. Results in **Appendix O** and **Appendix P** may vary slightly as the lane schematics in **Appendix O** correspond to the traffic conditions by lane while **Appendix P** reports the average conditions of each segment.

10.1.1 FNB Freeway MOEs

Overall, the I-94/I-69 freeway segments operate with no significant congestion or delay in the No-Build. In both the AM and PM peak hours, near free-flow speeds are experienced on the I-94/I-69 corridor in exception to the area directly before and after the Toll Plaza due to vehicles stopping at the toll booths and inspection areas. **Appendix P** highlights that the overall operations are satisfactory in all FNB scenarios, as every overall segment prior to the Toll Plaza operates at LOS C or better.

10.1.2 2045 Refined Alternative Freeway MOEs

Along the majority of the I-94/I-69 mainline, the Build MOEs are similar to the No-Build MOEs due to a lack of changes in the traffic conditions on the mainline west of the BWB Toll Plaza. The proposed changes at the BWB Toll Plaza caused slightly slower speeds of about 10 mph at the eastbound approach to the BWB Toll Plaza. The decrease in speeds is expected due to the change in geometry approaching the BWB Toll Plaza, as well as relocating the toll booths upstream, prior to the merge of traffic from the I-94/I-69 Connector and I-94/I-69 eastbound.

10.2 Intersection MOEs

The FNB AM and PM VISSIM models were used to identify intersection operational concerns within the study area as well as establish a baseline to compare the results of the 2045 Refined Alternative improvements.

10.2.1 FNB Intersection MOEs

The AM and PM peak hour intersection analysis results from the FNB VISSIM models indicate that all the intersections within the study area are expected to operate at LOS C or better. The most notable congestion occurs on Hancock Street at the I-94/I-69 Connector. The overall intersection operates at LOS C and LOS B in the AM and PM peak hours, respectively, while the eastbound and westbound approaches are expected to operate at LOS E and LOS D in the AM and PM peak hours, respectively. Refer to **Appendix P** for detailed intersection LOS results.

10.2.2 2045 Refined Alternative Intersection MOEs

The 2045 Refined Alternative produced similar operational results compared to the FNB within the study area except along I-94/I-69 BL/M-25 (Pine Grove) due to modifications made as part of the 2045 Refined Alternative. The tables below highlight the differences between the FNB and 2045 Refined Alternative to understand the impact of the proposed modifications.

M-25 (Pine Grove) at 10th Avenue

Converting the I-94/I-69 BL (Pine Grove) and 10th Avenue intersection into a 3-legged intersection is expected to improve operations at the northbound approach and the overall intersection by allocating more green time to each approach while maintaining the existing cycle length. Results are displayed in **Table 22**.

Table 22: Future Alternatives Comparison – I-94/I-69 BL (Pine Grove) at 10th Avenue

AM																	
Alternative	Northbound				Southbound				Eastbound				Westbound				Total
	L	TH	R	App	L	TH	R	App	L	TH	R	App	L	TH	R	App	
FNB	A	D		B	C	D		D		A	A	A		B	A	B	B
2045 Refined Alt	C	A		C						B	A	B	D	B		B	B
PM																	
FNB	D	D		D	D	D		D		B	A	B		C	C	C	C
2045 Refined Alt	C	B		C						A	A	A	B	D		B	B

M-25 (Pine Grove) at I-94/I-69 eastbound Off-Ramp

In the 2045 Refined Alternative, the addition of a westbound approach to the I-94/I-69 BL (Pine Grove) and I-94/I-69 eastbound off-ramp intersection is proposed to make a connection to 10th Avenue. The additional approach at the intersection, as well as other modifications along I-94/I-69 BL (Pine Grove), result in approximately 450 extra vehicles being processed at the intersection during the PM peak hour. The additional demand and phasing at the intersection results in LOS D for the I-94/I-69 eastbound exit through movement. Despite the slightly longer delays, the maximum 15-minute queue on the eastbound approach is expected to be 525 feet in the AM peak hour and expected to be 460 feet in the PM peak hour. The maximum queues only last for a short duration of one or two cycles at the signal, rather than the entire peak hour. Operations on the I-94/I-69 mainline remain unaffected in either peak hour. **Table 23** presents a comparison between the FNB and 2045 Refined Alternative.

Table 23: Future Alternatives Comparison – I-94/I-69 BL (Pine Grove) at I-94/I-69 EB Off-Ramp

AM																	
Alternative	Northbound				Southbound				Eastbound				Westbound				Total
	L	TH	R	App	L	TH	R	App	L	TH	R	App	L	TH	R	App	
FNB		B	A	B	B	C		C	C	C	B	C					C
2045 Refined Alt		B	A	B	C	C		C	B	D	C	C	D			D	C
PM																	
FNB		B	A	B	C	B		B	C	C	B	C					C
2045 Refined Alt		B	A	B	C	B		B	C	D	B	C	D			D	B

10th Avenue at Harker Street

As **Table 24** displays, the removal of the eastbound approach at the 10th Avenue and Harker Street intersection is not expected to affect intersection operations as the FNB and 2045 Refined Alternative operate at LOS A.

Table 24: Future Alternatives Comparison – 10th Avenue at Harker Street

AM																	
Alternative	Northbound				Southbound				Eastbound				Westbound				Total
	L	TH	R	App	L	TH	R	App	L	TH	R	App	L	TH	R	App	
FNB		A	A	A	A	A		A	B	B	A	B	A		A	A	A
2045 Refined Alt					A	A		A	A	A		A	A		A	A	A
PM																	
FNB		A	A	A	A	A		A	B	B	A	B	A		A	A	A
2045 Refined Alt					A	A		A	A	A		A	A		A	A	A

Hancock Street at I-94/I-69 Connector

The impact on operations along Hancock Street at the I-94/I-69 Connector and I-94/I-69 BL/M-25 (Pine Grove) intersections are critical to assess, due to approximately 200 additional PM peak hour vehicles using Hancock Street to access the relocated on-ramp to I-94/I-69 eastbound to access the BWB.

The Hancock Street westbound approach at the I-94/I-69 Connector operates at LOS B in the PM peak hour during FNB conditions. However, without any proposed changes, this movement was projected to worsen in the 2045 Refined Alternative during the PM peak hour with the additional vehicles accessing the relocated on-ramp to I-94/I-69 eastbound. Therefore, in the 2045 Refined Alternative, the westbound left-turn movement is converted from permissive only to a permissive-protected signal phase to limit delay and prevent the queue along Hancock Street from extending to I-94/I-69 BL/M-25 (Pine Grove). A permissive phase refers to when turning vehicles can make a movement but must yield to oncoming traffic. A protected phase allows for the movement to be made without any oncoming traffic. Furthermore, the Hancock Street eastbound left-turn movement at the I-94/I-69 Connector, which is currently restricted, is proposed to be converted to a protected left-turn phase. Permitting this left-turn movement will provide vehicles an additional route to travel northbound and avoid delay at the I-94/I-69 BL/M-25 (Pine Grove) and Hancock Street intersection.

The results in **Table 25** demonstrate that adding a protected eastbound and westbound left-turn phase on Hancock Street at the I-94/I-69 Connector will maintain overall intersection operations even with the additional traffic from the relocation of the I-94/I-69 eastbound on-ramp in the 2045 Refined Alternative.

Table 25: Future Alternatives Comparison – I-94/I-69 Connector at Hancock Street

AM																	
Intersection	Northbound				Southbound				Eastbound				Westbound				Total
	L	TH	R	App	L	TH	R	App	L	TH	R	App	L	TH	R	App	
FNB		B	A	B		C	B	C		C	A	C	E	E	D	E	C
2045 Refined Alt		B	A	B		B	B	B	D	D	B	C	C	C	B	C	B
PM																	
FNB		B	A	B		B	B	B		B	B	B	C	B	B	B	B
2045 Refined Alt		C	B	C		C	C	C	B	D	B	C	B	B	B	B	C

Hancock Street at I-94/I-69 BL/M-25 (Pine Grove)

The Hancock Street at M-25 (Pine Grove) intersection operates similarly under FNB and 2045 Refined Alternative conditions. Due to the heavy northbound M-25 (Pine Grove) demand in the PM peak hour, there is minimal green time available to be allocated to the westbound Hancock Street approach which results in similar delay in both the FNB and 2045 Refined Alternative as shown in **Table 26.**

Table 26: Future Alternatives Comparison – I-94/I-69 BL/M-25 (Pine Grove) at Hancock Street

AM																	
Intersection	Northbound				Southbound				Eastbound				Westbound				Total
	L	TH	R	App	L	TH	R	App	L	TH	R	App	L	TH	R	App	
FNB	C	B	B	B	C	B	B	B	E	C	C	D	D	E	D	E	C
2045 Refined Alt	A	C	C	C	C	C	C	C	D	C	B	C	C	D	C	C	C
PM																	
FNB	B	B	A	B	D	A	A	B	E	D	C	D	D	D	D	D	B
2045 Refined Alt	C	B	A	B	D	A	A	B	D	C	B	C	D	D	D	D	B

Multiple scenarios were considered to alleviate the congestion along westbound Hancock Street at I-94/I-69 BL/M-25 (Pine Grove). However, a preliminary analysis indicated that the proposed modifications would have negative consequences on the overall corridor operations and connectivity or be cost prohibitive. A summary of the scenarios and reasons for not recommending are listed below:

1. One-way pair with westbound Riverview Street and eastbound Hancock Street
    a. Effect – Lack of storage space on Riverview Street causes queues to spill onto M-25 (Pine Grove)
2. One-way pair with eastbound Garfield Street and westbound Hancock Street and diverting traffic to Garfield Street from Hancock Street
    a. Effect – Lack of storage space on Garfield Street causes queues to spill onto M-25 (Pine Grove) and the I-94/I-69 Connector. Additionally, signalizing Garfield Street is not recommended due to the tight spacing with the I-94/I-69 Connector intersection to the north.
3. Expanding Hancock Street to two westbound lanes between 10th Avenue and I-94/I-69 Connector
    a. Effect – Hancock Street would have to operate as a split phase in this scenario. This would decrease available green time on northbound I-94/I-

69 BL/M-25 (Pine Grove) and subsequently increase delay at the I-94/I-69 eastbound off-ramp.

As a result, no changes are currently proposed to I-94/I-69 BL/M-25 (Pine Grove) at Hancock Street due to the following reasons:

- In the PM peak hour, the westbound Hancock Street delay (47 s) is comparable to the delay in FNB (46 s).
- The overall intersection delay remains at LOS C or better.
- In the PM peak hour, the northbound I-94/I-69 BL/M-25 (Pine Grove) approach carries 2150 vehicles compared to 265 vehicles on westbound Hancock Street. As a result, northbound I-94/I-69 BL/M-25 (Pine Grove) was prioritized to prevent delays on I-94/I-69 BL/M-25 (Pine Grove) which would adversely affect operations at the I-94/I-69 eastbound off-ramp at I-94/I-69 BL/M-25 (Pine Grove).
- The queue at westbound Hancock Street does not affect operations at the Hancock Street at 10th Avenue intersection.

10.3 Travel Times

Overall, the travel time results did not indicate any notable congestion or delays in either the FNB or 2045 Refined Alternative. Travel times on the mainline are expected to be near free-flow speeds (within 10 mph of the posted speed) with an exception for the segment near the BWB Toll Plaza.

Table 27 illustrates that travel times between the FNB and 2045 Refined Alternative are comparable throughout the majority of the study area. The most significant differences occur on I-94/I-69 eastbound due to the reconfiguration of the I-94/I-69 eastbound approach to the BWB as discussed in Section 9. The changes, most notably the relocation of the toll booths upstream – as well as the loop around the relocated Duty Free store, leads to longer travel times in the 2045 Refined Alternative. The loop adds approximately 0.5 miles of travel distance for vehicles travelling through the toll booths. The additional travel distance, as well as a reduced speed of 20 mph on the loop, causes longer travel times and slower speeds in the 2045 Refined Alternative as highlighted in Table 27. However, upstream operations on I-94/I-69 eastbound remain unaffected and continue to operate at near free-flow speeds. The 2045 Refined Alternative is also expected to produce slightly longer travel times on I-94/I-69 BL/M-25 (Pine Grove) northbound due to additional traffic volume traveling northbound on I-

94/I-69 BL/M-25 (Pine Grove) to access the BWB via the relocated I-94/I-69 eastbound on-ramp.

Table 27: Future Travel Times Comparison

Segment Name	Distance (mi)	Posted Speed (mph)	FNB				2045 Refined Alternative			
			Travel Time (seconds)		Diff from Posted Speed (mph)		Travel Time (seconds)		Diff from Posted Speed (mph)	
			AM	PM	AM	PM	AM	PM	AM	PM
I-94/I-69 EB to west of Lapeer Conn	0.81	70	42	43	-1	-2	42	43	-2	-2
I-94/I-69 EB to west of Toll Facility	1.72*	70**	90	91	-1	-1	247	263	-38	-46
I-94/I-69 WB to east of Water St	0.55	55	41	41	-7	-7	39	39	-7	-4
I-94/I-69 WB to east of Welcome Center	1.04	70	60	60	-8	-8	60	60	-8	-8
I-94/I-69 WB – end	0.90	70	47	47	-1	-1	47	47	-1	-1
I-94/I-69 BL (Pine Grove) NB – 10th Ave to Hancock St	0.49	35	70	76	-10	-12	84	75	-14	-12
M-25 (Pine Grove) NB – Hancock St to Sanborn St	0.67	35	88	84	-8	-6	90	93	-8	-9
M-25 (Pine Grove) SB – Sanborn St to Hancock St	0.69	35	87	85	-7	-6	101	84	-11	-6
I-94/I-69 BL (Pine Grove) SB – Hancock St to 10th Ave	0.47	35	72	77	-12	-13	71	63	-10	-6

NOTE: Green Cells (0-5 mph difference); Yellow Cells (6 – 10 mph difference); Red Cells (10+ mph difference)
* Distance of travel time segment in 2045 Refined Alternative is 2.21 miles due to construction of circular loop
** Design speed on the loop is 20 mph

10.4 BWB Toll Plaza Operations

Due to the variety of factors affecting operations at the facility, the existing dwell time distributions were maintained for the future VISSIM models. The VISSIM model assumed the lane configuration previously referred to in **Appendix C** on page C-2.

10.4.1 Volume Throughput

Operations on the BWB Toll Plaza facility were examined by comparing volume throughput between the FNB and the 2045 Refined Alternative. The results in **Table 28** indicate that the 2045 Refined Alternative modifications will cause minimal differences when compared to the FNB.

Table 28: BWB Toll Plaza Volume Throughput

Location	AM (number of vehicles)			PM (number of vehicles)		
	FNB	2045 Refined Alt	Diff	FNB	2045 Refined Alt	Diff
I-94/I-69 WB Cars	142	140	-2	177	226	+49
I-94/I-69 WB Cars – NEXUS	27	26	-1	40	43	+3
I-94/I-69 WB Trucks – FAST Lane	47	45	-2	43	43	0
I-94/I-69 WB Trucks (North Facility)	60	58	-2	49	47	-2
I-94/I-69 WB Trucks (South Facility)	94	93	-1	79	80	+1
I-94/I-69 EB Toll Both (Outbound to Canada)	221	232	+11	442	475	+33

10.4.2 Queue Lengths

Average and maximum queue lengths during the peak hours were analyzed in the future scenarios by comparing the queue lengths from the FNB to queue lengths from the 2045 Refined Alternative. The results are summarized in **Table 29** below. Under 2045 Refined Alternative conditions, the PIL and toll booth queue lengths are either shorter than queue lengths observed in the FNB, or within one vehicle (+\- 15 feet) despite higher traffic volume throughout, with the exception of trucks. The north facility PILs for trucks is approximately one to two trucks longer in the 2045 Refined Alternative due to the PILs being reduced from three to two as part of the 2045 Refined Alternative. The queue lengths at the south facility PILs for trucks is reduced in the 2045 Refined Alternative condition. In essence, the comparison highlights that there is not a significant difference between queue lengths in the FNB and 2045 Refined Alternative.

Table 29: BWB Toll Plaza Queue Lengths

Facility	Vehicle Type	AM						PM					
		Avg Queue (ft)			Max Queue (ft)			Avg Queue (ft)			Max Queue (ft)		
		FNB	2045 Refined Alt	Diff	FNB	2045 Refined Alt	Diff	FNB	2045 Refined Alt	Diff	FNB	2045 Refined Alt	Diff
I-94/I-69 WB PILs (Inbound from Canada)	Cars	17	18	+1	57	64	+7	56	30	-26	114	48	-66
	Cars – NEXUS	1	1	0	26	34	+8	1	1	0	34	32	-2
	Trucks – FAST Lane	465	406	-59	804	873	+69	252	210	-42	544	513	-31
	Trucks (North Facility)	54	63	+9	184	272	+88	3	13	+10	63	126	+63
	Trucks (South Facility)	158	114	-44	299	315	+16	76	65	-11	268	256	-12
I-94/I-69 EB Toll Booths (Outbound to Canada)	Cars and Trucks	29	17	-12	132	126	-6	43	29	-14	137	128	-9
I-94/I-69 Conn Toll Booths	Cars and Trucks	NA	4	NA	NA	53	NA	NA	30	NA	NA	121	NA

NOTE: Green Cells (shorter queue in 2045 Refined Alternative); Red Cells (Longer queue in 2045 Refined Alternative)

11 SIGNAL PREEMPTION OPERATION ANALYSIS

A separate analysis was conducted on I-94/I-69 BL (Pine Grove) between the northern 10th Avenue and southern 10th avenue intersections to evaluate the impact signal preemption operations would have on I-94/I-69 BL (Pine Grove) and the I-94/I-69 eastbound off-ramp. **Figure 7** illustrates the two intersections.

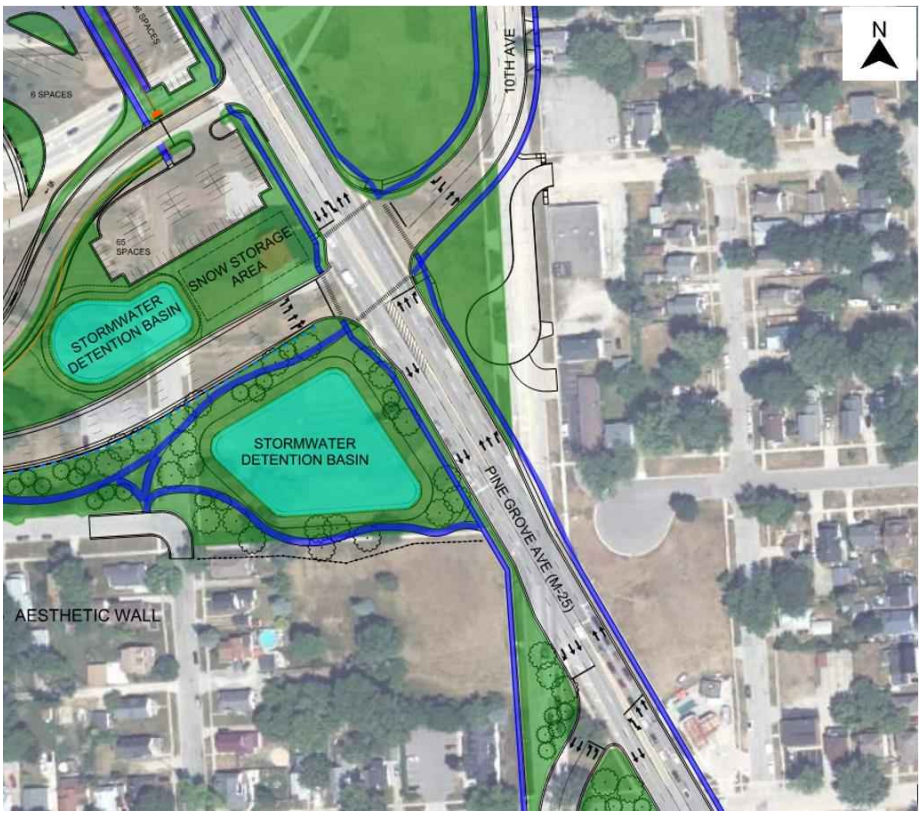


Figure 7: Preemption Operations Analysis Study Area

The analysis simulated a single 20 second all-red phase at both intersections between 5:00 pm and 5:15 pm, the 15-minute peak during the PM peak period. The all-red phases at the intersections were offset by 10 seconds, with the northern 10th Avenue intersection turning red first. The queues lengths at all approaches for the two intersections were recorded and compared to the queue lengths during the same time periods in the default PM peak period. The results in **Table 30** and **Table 31** indicate that in a worst-case scenario, the impacts to the corridor are not long-lasting and operations are expected to recover in about 10 minutes. Furthermore, should preemption be deployed, the preemption parameters can be programmed to favor the off ramp during the recovery, further minimizing the impacts of the signal recovery to this location. Refer to **Appendix R** for further information.

Table 30: Average Queue Lengths (ft) - I-94/I-69 BL (Pine Grove) at I-94/I-69 EB Off-Ramp/10th Ave (North)

Approach	Scenario	5:00 PM	5:03 PM	5:06 PM	5:09 PM	5:12 PM	5:15 PM	5:18 PM	5:21 PM	5:24 PM	5:27 PM
I-94/I-69 BL (Pine Grove) NB	Preemption	60	75	63	88	74	123	71	53	33	45
	Default	58	48	48	52	48	60	39	43	34	48
	Difference	2	26	15	36	27	62	31	10	-1	-4
I-94/I-69 BL (Pine Grove) SB	Preemption	42	61	52	67	50	75	47	33	31	39
	Default	40	46	40	44	45	52	54	30	33	37
	Difference	2	15	12	24	5	23	-7	3	-2	1
10th Ave WB	Preemption	21	24	30	24	34	27	25	27	28	16
	Default	22	24	28	20	32	23	17	22	29	13
	Difference	-1	0	2	4	2	4	8	4	-1	3
I-94/I-69 EB Off-Ramp	Preemption	132	147	136	189	244	257	254	169	119	138
	Default	103	137	127	138	138	128	142	115	112	123
	Difference	28	10	9	51	106	129	112	54	7	15

Table 31: Average Queue Lengths (ft) - M -25 at 10th Ave (South)

Approach	Scenario	5:00 PM	5:03 PM	5:06 PM	5:09 PM	5:12 PM	5:15 PM	5:18 PM	5:21 PM	5:24 PM	5:27 PM
I-94/I-69 BL (Pine Grove) NB	Preemption	44	43	51	57	62	53	38	36	36	30
	Default	42	40	42	42	42	38	33	35	35	29
	Difference	2	3	9	15	20	14	5	2	2	1
I-94/I-69 BL (Pine Grove) SB	Preemption	16	21	26	27	42	44	34	19	17	13
	Default	13	14	19	15	20	17	23	12	15	15
	Difference	3	7	6	12	22	28	11	7	2	-2
10th Ave EB	Preemption	43	50	43	46	49	48	44	43	42	42
	Default	41	47	41	42	43	42	41	40	41	39
	Difference	3	4	2	3	6	5	3	3	1	3

Note: Red cells indicate highest difference in queue length at each approach

In addition to analyzing the impact of signal preemption on queues, the impact of signal preemption on travel times was assessed by analyzing three scenarios:

1. 2045 Future No-Build (existing configuration)
2. 2045 Refined Alternative without signal preemption
3. 2045 Refined Alternative with signal preemption

Travel time was estimated from south of Harker Street on 10th Avenue (north), to north of Lyon Street in each of the three scenarios. The travel time estimate was derived using the distance, posted speed limit, and the movement delay along the emergency route. The delays were based on values output from the VISSM models.

If signal preemption is implemented, emergency vehicles are assumed to travel uninterrupted on I-94/I-69 BL (Pine Grove) between the northern 10th Avenue and southern 10th Avenue intersections. Without signal preemption, emergency vehicles are assumed to be slightly delayed at the I-94/I-69 BL (Pine Grove) and 10th Avenue intersections. **Table 32** indicates the estimated travel times in each scenario.

Table 32: Emergency Travel Time Comparison

Scenario	Travel Time (s)
2045 Future No-Build (existing configuration)	41
2045 Refined Alternative without signal preemption	43
2045 Refined Alternative with signal preemption	28

12 FINDINGS AND RECOMMENDATIONS

The analysis of the FNB and 2045 Refined Alternative VISSIM models have led to several findings and recommendations as summarized below.

- Operations on the I-94/I-69 mainline will not be adversely impacted due to proposed modifications at the BWB Toll Plaza.
- Operations on I-94/I-69 BL (Pine Grove) will not be adversely impacted due to proposed modifications on I-94/I-69 BL (Pine Grove) related to the realignment of the I-94/I-69 eastbound off-ramp, 10th Avenue, or the relocation of the I-94/I-69 eastbound entrance ramp to access the BWB.
- A westbound left-turn protected phase is recommended for the traffic signal at the I-94/I-69 Connector and Hancock Street intersection to prevent the queue from disrupting operations at the I-94/I-69 BL (Pine Grove) and Hancock Street intersection.
- An eastbound left-turn protected phase is recommended for the traffic signal at the I-94/I-69 Connector and Hancock Street intersection to provide vehicles an alternative route to travel northbound.

Appendix A – Traffic Count Comparison

Traffic Count Locations

Sanborn Ave
77-6710
I-94/I-69 BL/
M-25 (Pine Grove)
77-6637
77-0049
77-6713
Garfield St
77-6791
77-6640
Hancock St
77-6687
77-6734
77-0218
77-0132/
77-0095
77-0175
77-0117
77-0217
77-0177
77-0115
77-6722
Lapeer Connector
77-0141
MI Welcome
Center
INTERSTATE 94
INTERSTATE 69
77-6636
77-6712
77-6708
77-6626
77-6750
77-0040
77-0039
77-6758
77-5222
77-5271
77-6759
77-0037
10th Ave
77-0026
77-6624
77-6761
I-94/I-69 BL/
M-25 (Pine Grove)
N

Legend

:2022 48-Hr Count

:2022 TMC Count

:Historical Count

:TDMS Location ID

Traffic Count Locations

I-94/I-69 Mainline

I-94/I-69 Mainline West of Welcome Center					
Bound	Data Source	Location ID	Date	AM	PM
EB	TDMS	77-0141_NB	12/11/2019	2326	3280
	Collected	N/A	4/4/2022	-	2970
	Collected	N/A	4/5/2022	2273	3061
	Collected	N/A	4/6/2022	2153	-
WB	TDMS	77-0141_SB	12/11/2019	2458	3275
	Collected	N/A	4/4/2022	-	3070
	Collected	N/A	4/5/2022	2645	2881
	Collected	N/A	4/6/2022	2544	-

I-94/I-69 Mainline at the Black River					
Bound	Data Source	Location ID	Date	AM	PM
EB	TDMS	77-0132_NE	1/22/2019	325	684
	TDMS	77-0132_NE	10/10/2018	498	827
	Collected	N/A	4/4/2022 to 4/5/2022	385	673
WB	TDMS	77-0132_SW	1/22/2019	2293	4162
	TDMS	77-0132_SW	10/10/2018	3694	4739
	Collected	N/A	4/4/2022 to 4/5/2022	3352	4251

I-94/I-69 EB Ramp to I-94/I-69 BL/M-25 (Pine Grove)					
Bound	Data Source	Location ID	Date	AM	PM
EB Exit Ramp	TDMS	77-0026	1/22/2019	1757	3625
	TDMS	77-0026	10/10/2018	3037	4221
	TDMS	77-0026	6/5/2018	3020	4177
	TDMS	77-0026	8/1/2017	2610	3872
	Count	77-0026	3/22/22 and 3/23/22	2678	3939

BWB Toll Facility					
Bound	Data Source	Location ID	Date	AM	PM
EB (Canada Bound)	TDMS	77-6109_EB	10/17/2019	598	1468
	Toll Facility	N/A	March 2019	377	1342
	Toll Facility	N/A	April 2019	403	1188
	Toll Facility	N/A	March 2021	252	675
	Toll Facility	N/A	April 2021	262	646
WB (US Bound)	TDMS	77-6109_WB	10/17/2019	894	1325
	Toll Facility	N/A	March 2019	622	1150
	Toll Facility	N/A	April 2019	657	1188
	Toll Facility	N/A	March 2021	498	579
	Toll Facility	N/A	April 2021	493	542

I-94/I-69 BL/M-25 (Pine Grove)

M-25 Between Sandborn St and Brandywine Ln					
Bound	Data Source	Location ID	Date	AM	PM
NB	TDMS	77-6637_NW	3/22/2022	2132	4691
	TDMS	77-6637_NW	6/4/2019	2394	4770
	TDMS	77-6637_NW	6/28/2016	2113	4702
	TDMS	77-6710_NW	10/27/2015	2085	4791
	Collected	N/A	4/4/2022	-	4045
	Collected	N/A	4/5/2022	3152	-
SB	TDMS	77-6637_SE	3/22/2022	3209	4169
	TDMS	77-6637_SE	6/4/2019	3751	4535
	TDMS	77-6637_SE	6/28/2016	3372	4522
	TDMS	77-6710_SE	10/27/2015	3473	4373
	Collected	N/A	4/4/2022	-	4475
	Collected	N/A	4/5/2022	2191	-

Lapeer Connector					
Bound	Data Source	Location ID	Date	AM	PM
NB	TDMS	77-6722_NB	12/7/2021	447	1371
	TDMS	77-6722_NB	4/24/2018	546	1307
	Collected	N/A	4/4/2022	-	1449
	Collected	N/A	4/5/2022	531	1394
	Collected	N/A	4/6/2022	568	-
SB	TDMS	77-6722_SB	12/7/2021	719	1036
	TDMS	77-6722_SB	4/24/2018	951	1062
	Collected	N/A	4/4/2022	-	1188
	Collected	N/A	4/5/2022	1007	1085
	Collected	N/A	4/6/2022	982	-

I-94/I-69 BL/M-25 (Pine Grove) at EB On to BWB					
Bound	Data Source	Location ID	Date	AM	PM
EB (Canada Bound)	TDMS	77-0218	4/17/2018	144	454
	Collected	N/A	3/23/2022 to 3/24/2022	54	179

I-94/I-69 Connector to I-94/I-69 BL/M-25 (Pine Grove)					
Bound	Data Source	Location ID	Date	AM	PM
NB	TDMS	77-6734_NB	6/12/2018	250	259
	TDMS	77-6734_NB	10/27/2015	218	265
	Collected	N/A	3/23/2022 to 3/24/2022	59	43
SB	TDMS	77-6734_SB	6/12/2018	2905	3902
	TDMS	77-6734_SB	10/27/2015	2450	3560
	Collected	N/A	3/23/2022 to 3/24/2022	2630	3504

Note: Highlighted cells refer to data chosen for forecasted data

Note: Volumes shown are peak period volumes

* Peak Period: 6:00 AM to 9:00 AM, 3:00 PM to 6:00 PM

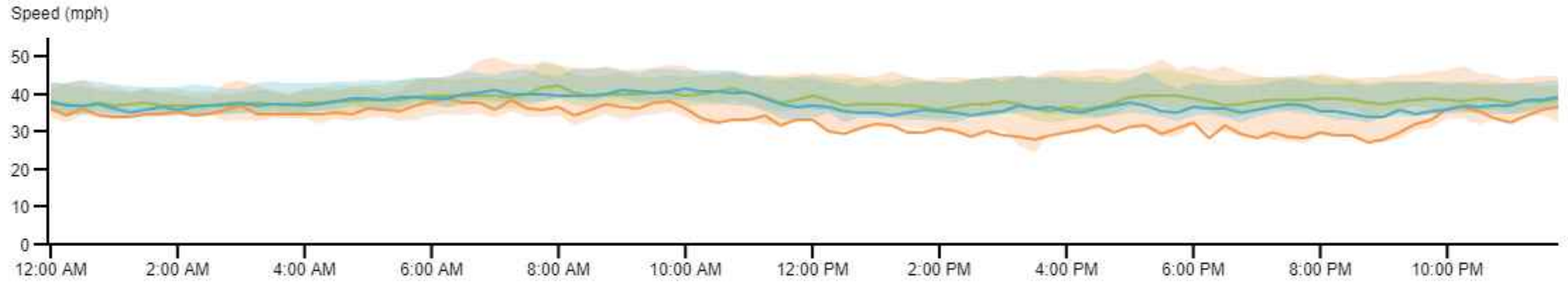
** Peak Period: 6:30 AM to 9:30 AM, 3:00 PM to 6:00 PM

Appendix B – Speed Data Verification

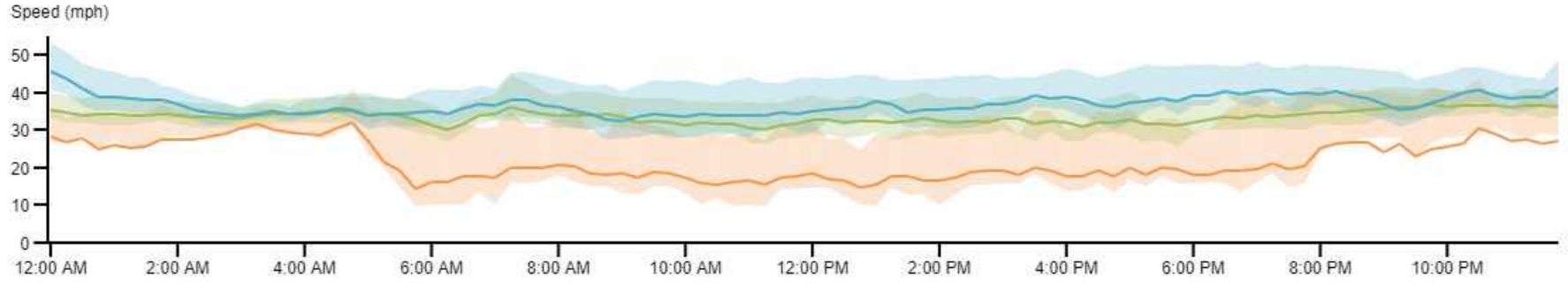
Speed for I-69/I-94

Averaged per fifteen minutes for September 03, 2019 through November 21, 2019 (Every Tuesday, Wednesday, and Thursday), September 01, 2020 through November 19, 2020 (Every Tuesday, Wednesday, and Thursday), and September 01, 2021 through November 18, 2021 (Every Tuesday, Wednesday, and Thursday)

Eastbound



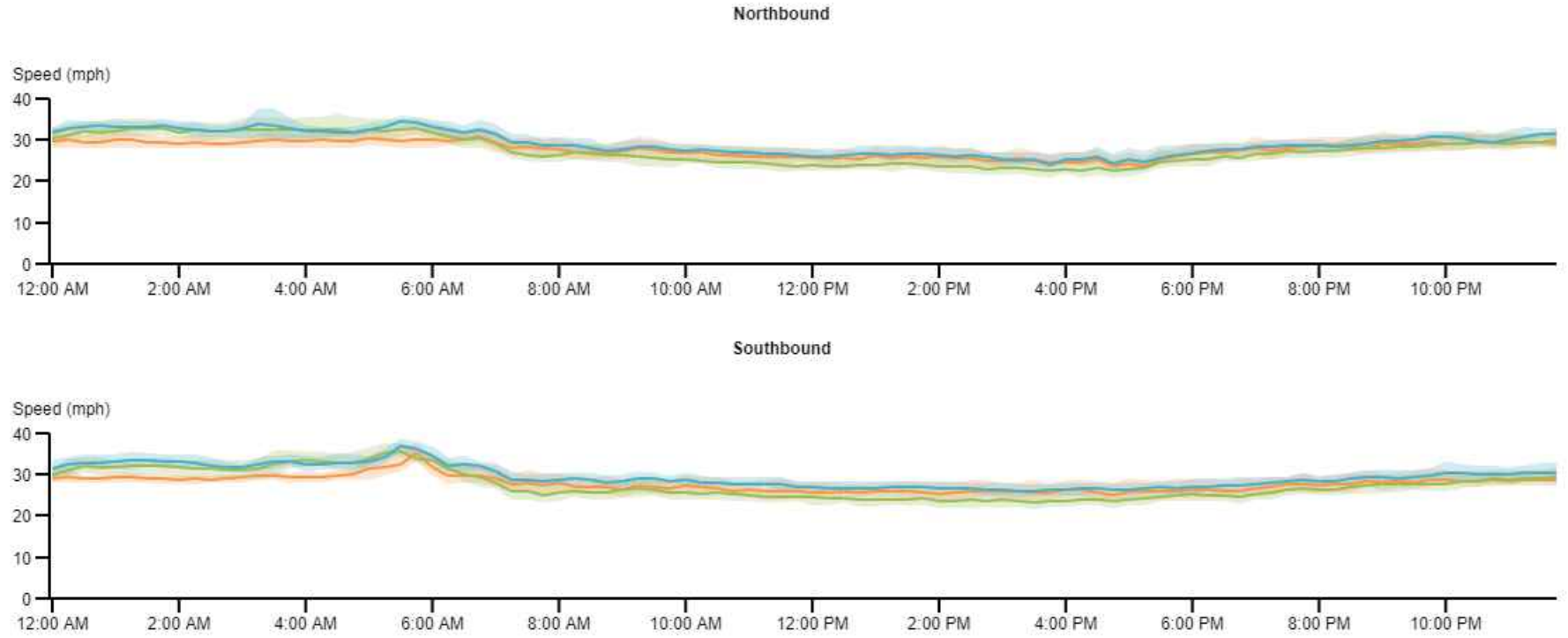
Westbound



- September 01, 2020 through November 19, 2020 (Every Tuesday, Wednesday, and Thursday) - INRIX
- September 01, 2020 through November 19, 2020 (Every Tuesday, Wednesday, and Thursday) 25th and 75th percentile - INRIX
- September 01, 2021 through November 18, 2021 (Every Tuesday, Wednesday, and Thursday) - INRIX
- September 01, 2021 through November 18, 2021 (Every Tuesday, Wednesday, and Thursday) 25th and 75th percentile - INRIX
- September 03, 2019 through November 21, 2019 (Every Tuesday, Wednesday, and Thursday) - INRIX
- September 03, 2019 through November 21, 2019 (Every Tuesday, Wednesday, and Thursday) 25th and 75th percentile - INRIX

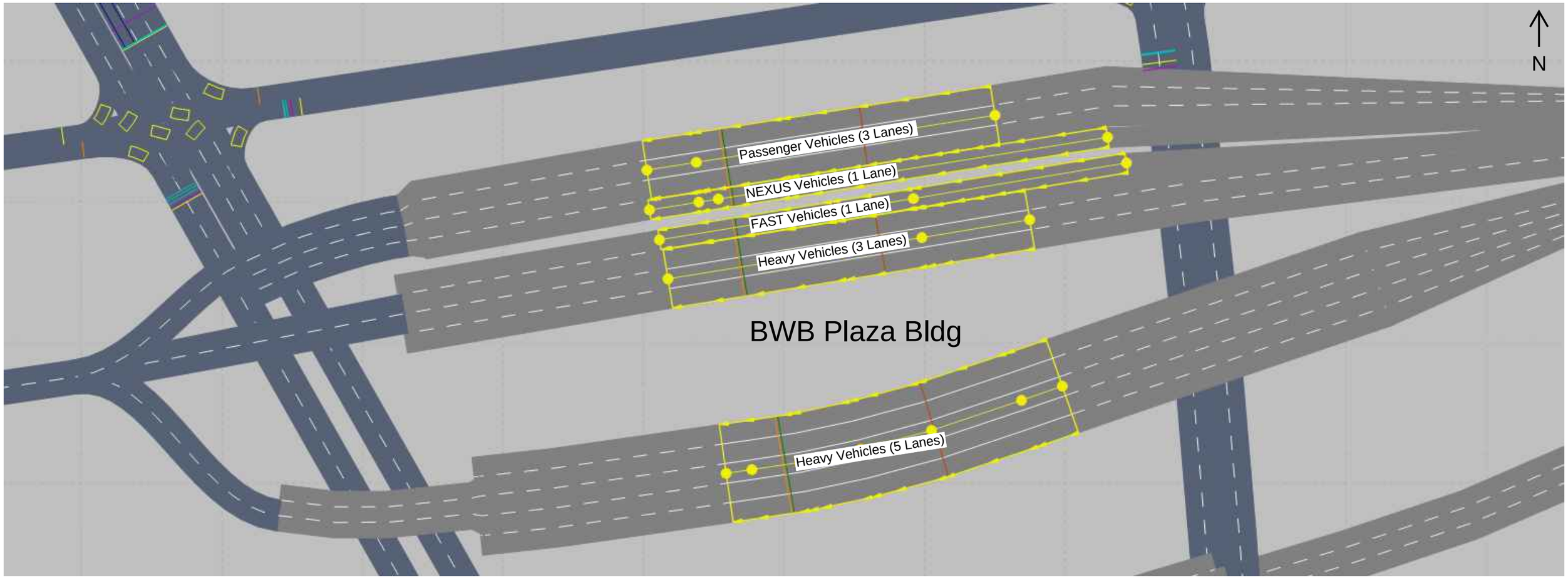
Speed for M-25 between I-94/I-69/Hancock St and Holland Ave and I-69-BL

Averaged per fifteen minutes for September 03, 2019 through November 21, 2019 (Every Tuesday, Wednesday, and Thursday), September 01, 2020 through November 19, 2020 (Every Tuesday, Wednesday, and Thursday), and September 01, 2021 through November 18, 2021 (Every Tuesday, Wednesday, and Thursday)



- September 01, 2020 through November 19, 2020 (Every Tuesday, Wednesday, and Thursday) - INRIX
- September 01, 2020 through November 19, 2020 (Every Tuesday, Wednesday, and Thursday) 25th and 75th percentile - INRIX
- September 01, 2021 through November 18, 2021 (Every Tuesday, Wednesday, and Thursday) - INRIX
- September 01, 2021 through November 18, 2021 (Every Tuesday, Wednesday, and Thursday) 25th and 75th percentile - INRIX
- September 03, 2019 through November 21, 2019 (Every Tuesday, Wednesday, and Thursday) - INRIX
- September 03, 2019 through November 21, 2019 (Every Tuesday, Wednesday, and Thursday) 25th and 75th percentile - INRIX

Appendix C - BWB Plaza Facility Configuration



Existing & Future No-Build Westbound Blue Water Bridge Toll Plaza Lane Breakdown

Passenger Vehicles

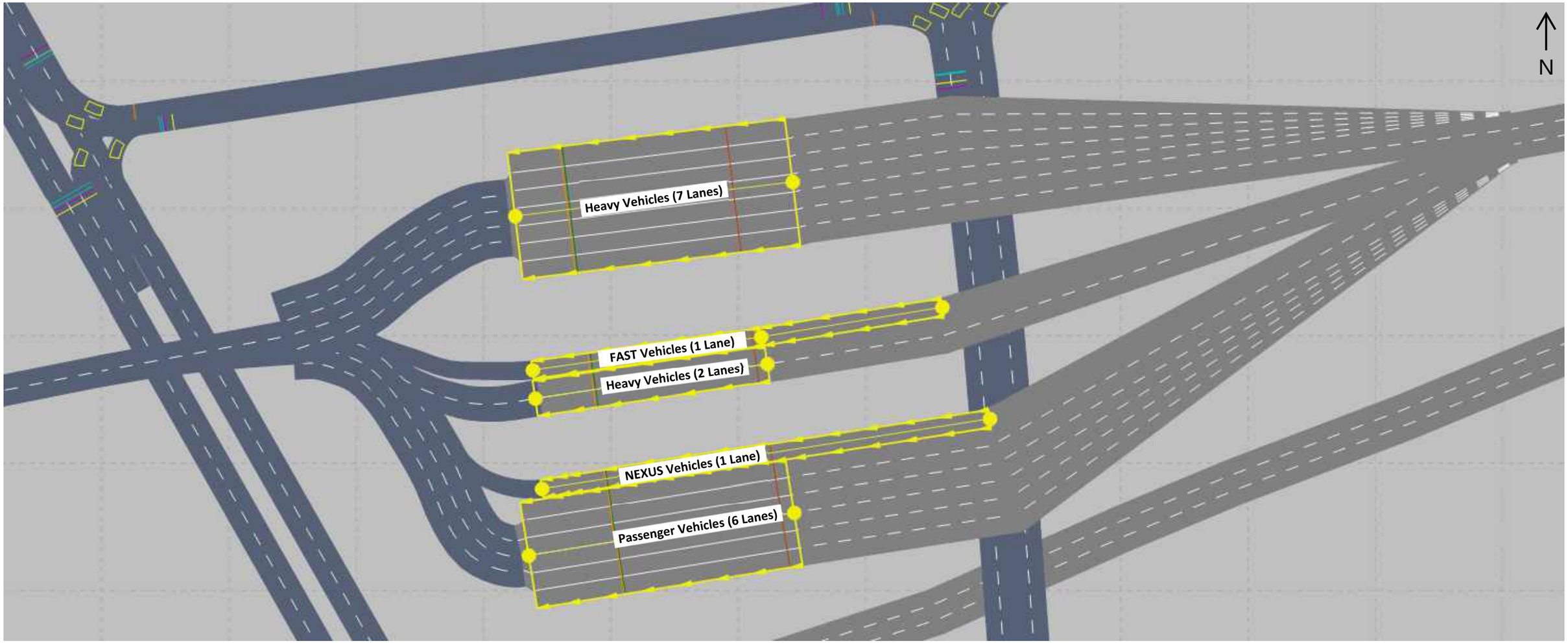
- Passenger vehicle routing choice was developed using data collected by the US Customs and Border Protection.
- Counts indicated that 15.49% of passenger vehicles used the NEXUS lane and the remaining 84.51% used the remaining 3 standard passenger vehicle lanes.
- For VISSIM routing 15.49% of passenger vehicles were routed to the NEXUS lane and the remaining 84.51% were routed to the remaining 3 standard passenger vehicle lanes.
- Routing is entered into VISSIM as shown below

Count: 2	VehRoutDec	No	Name	Formula	DestLink	DestPos	RelFlow(0)
1	66	1	Standard Passenger Vehicle		10: I-94...	125.009	0.845
2	66	2	NEXUS		10: I-94...	121.046	0.155

Heavy Vehicles

- Passenger vehicle routing choice was developed using data collected by the US Customs and Border Protection.
- Counts indicated that 25.71% of heavy vehicles used the FAST lane and the remaining 74.29% used the remaining 8 standard passenger vehicle lanes.
- For VISSIM routing 25.71% of heavy vehicles were routed to the FAST lane, and the remaining 74.29% were split amongst the northern and southern heavy vehicle routes proportionate to the number of lanes in each route.
- Routing is entered into VISSIM as shown below

Count: 3	VehRoutDec	No	Name	Formula	DestLink	DestPos	RelFlow(0)
1	59	1	Heavy Vehicle (North)		10: I-94...	109.184	0.279
2	59	2	Heavy Vehicle (South)		10: I-94...	117.527	0.464
3	59	3	FAST		10: I-94...	114.641	0.257



Future Westbound Blue Water Bridge Toll Plaza Lane Breakdown

Notes

- As displayed above, the Preferred Build Alternative models only differed from the Existing and Future No-Build models in terms of lane geometry at the BWB Toll Plaza.
- The same vehicle distributions from the Existing and Future No-Build Models as seen on B-1 were used for vehicle routings in the Preferred Build Alternative models.

Appendix D – M-25 (Pine Grove) Optimized Conditions Analysis Memo

Memo

To:	Travis Phillips, Region Signals Engineer, MDOT Bay Region
From:	Adam McArthur, Senior Engineer, SNC Lavalin-Atkins
CC:	Nivas Dammalapati, Project Manager, SNC Lavalin- Atkins
Date:	August 21, 2018
Subject:	MDOT JN #201863 – M-25 Traffic Signal Optimization – Optimized Conditions Review

1. Introduction

The following memo is a summary of existing and optimized conditions analysis for 22 signals along the M-25 corridor in Port Huron, Michigan. Measures of effectiveness (MOEs) are provided for each scenario examined along with supporting text. Figure 1 below shows the location of each signal along the study corridor. In addition to the 22 corridor signals, two adjacent corridor MDOT signals were included for better coordination: M-136 (Pine Grove Ave) at Krafft and the I-94 Off/On Ramps at Hancock.

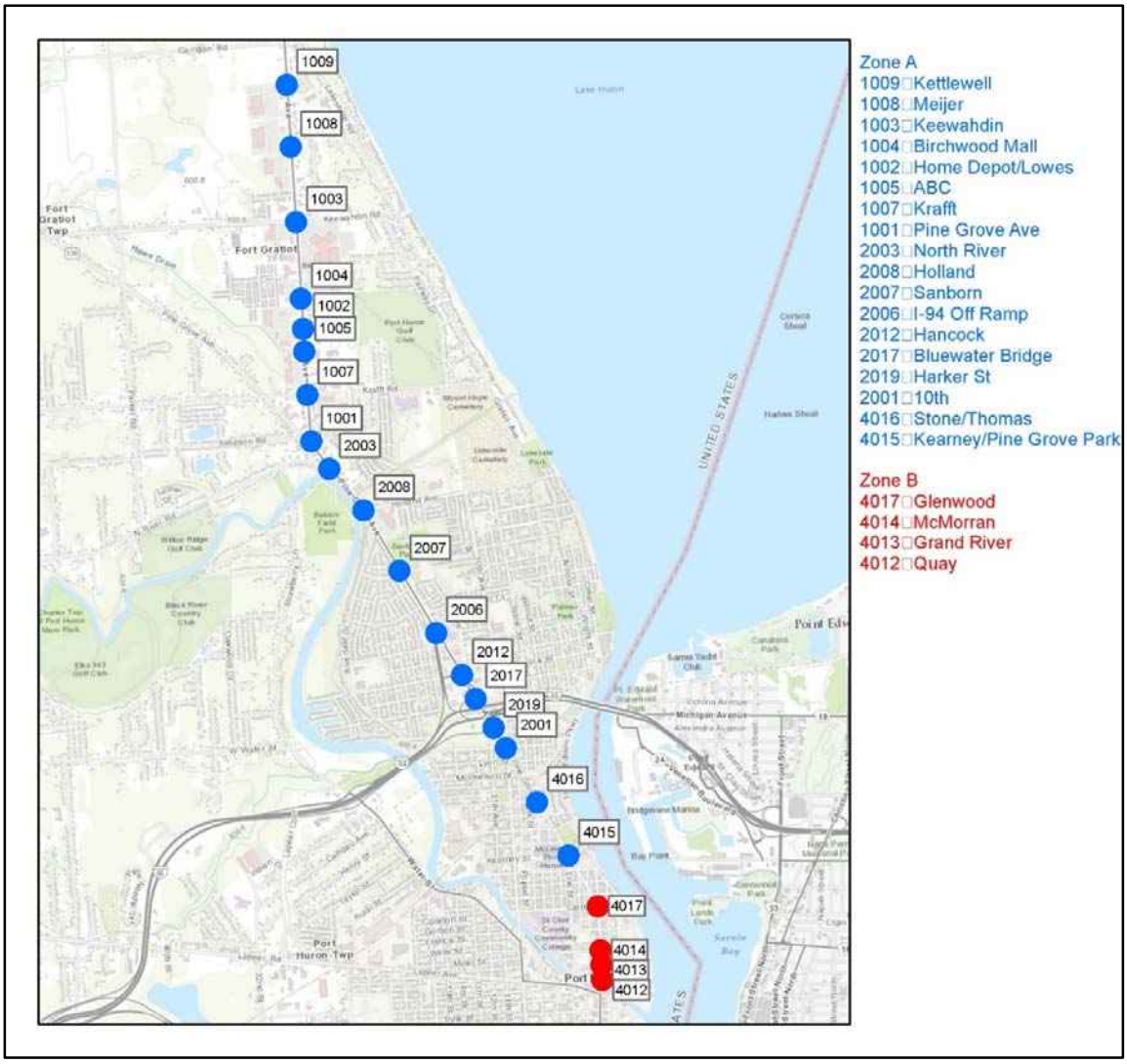


Figure 1- Project Signal Locations

Memo

1.1. Data Collection

Synchro models were provided by MDOT for 17 of the 22 intersections studied, where they included traffic counts and existing signal timing for each peak period studied. These models were part of a previous optimization project where multiple cycle lengths were tested and considered. As such, the models with the lowest cycle length number were used as the existing condition for these 17 intersections as a basis of comparison, with the following five intersections added per MDOT's request:

- 77032-01-012 – Quay Street
- 77032-01-013 – Grand River Avenue
- 77032-01-014 – McMorran Boulevard
- 77032-01-015 – Kearney Street/Pine Grove Park Drive
- 77032-01-017 – Glenwood Avenue

For these five intersections, the Atkins team conducted field reviews and collected turning movement counts. In addition, condition diagrams were developed for each of the five intersections reviewed by the Atkins team and are included with the count information as an attachment to this report.

2. Initial Cycle Length Selection

For initial screening, clearance intervals were first updated for the five intersections collected by the Atkins team for the model. This included the 4 locations that comprise Zone B, along with intersection 4015 as shown in Figure 1. Next, the *Synchro* cycle length optimization tools were used to determine three feasible operations scenarios. This process included a manual review of the MOEs provided by *Synchro* to select three different cycle length combinations based on total delay, total stops, delay per vehicle, and dilemma vehicles. Once candidate cycle lengths were selected, the automatic optimization tools in Synchro were used to provide a proximate result of optimized conditions. From there, SimTraffic was used to simulate both existing and optimized scenarios, where three simulation runs were performed and averaged to obtain MOEs results. The results of this process are described below.

2.1. AM Peak

During the initial screening process and after a review of existing signal phasing, the corridor was divided into two zones for assessment:

- Zone A – Pine Grove Park Dr & Kearney St to Kettlewell
- Zone B – Quay St to Glenwood Avenue

This was largely attributed to the split phase operation at the Kearney Street, Stone Street and 10th Avenue intersections at the southern end of Zone A. In addition, the Zone B signals are pretimed with no pushbuttons and exhibit considerable pedestrian activity, while Zone A includes pushbuttons and doesn't appear to have as many pedestrians according to the models received from MDOT. Moreover, the intersections designated as Zone B are closely spaced and subject to similar surrounding land use near downtown Port Huron. SimTraffic MOE results are provided for AM Peak Hour for each scenario in Table 1 on the next page.

Memo

Table 1 – AM Peak SimTraffic MOE Results

Zone	MOE's	Optimized Cycle Length			Existing
		70	80	90/80	80/100
A	Total Delay (hr)	91.8	93.5	101.3	96.2
	Total Stops	10,737	10,467	10,590	11,214
	Travel Time (hr)	253.8	254.8	259.9	257.5
	Avg. Speed (mph)	23	23	22	23
Cycle Length		**70**	**80**	**80**	**70**
B	Total Delay (hr)	6.2	5.7	6.2	6.3
	Total Stops	1,002	909	1,031	1,029
	Travel Time (hr)	19.3	19.1	19.1	19.5
	Avg. Speed (mph)	17	18	17	17

As shown, the 80-second cycle length exhibits fewer stops and lower total delay for Zone A when compared to the existing model. Similarly, 70-second cycle provides lower total delay when compared to the 80-second and existing models. However, there are more total stops here when compared to the 80-second model, which suggests progression bandwidth is limited. Moreover, the 80-second cycle length provides the best MOEs for all four measures considered in Zone B. That said, selecting the 80-second cycle length for both Zones A and B provides the best opportunity for progression along the corridor, while minimizing total delay and stops when compared with existing conditions. Supporting documentation is provided in the attachments.

2.2. Off-Peak

A similar assessment was conducted for the off peak model, where the two-zone analysis scheme was maintained. Table 2 shows the SimTraffic MOE results for the off peak time period.

Table 2 - Off Peak SimTraffic MOE Results

Zone	MOE's	Optimized Cycle Length			Existing
		70	80	90	80
A	Total Delay (hr)	147.9	152.2	150.1	142.2
	Total Stops	16,522	16,600	15,464	14,847
	Travel Time (hr)	352.9	357	349.3	346.5
	Avg. Speed (mph)	21	21	21	22
Cycle Length		**70**	**80**	**90**	**70**
B	Total Delay (hr)	10.9	11.3	11.8	11.9
	Total Stops	1,862	1,671	1,674	1,943
	Travel Time (hr)	30.6	30.8	31.7	32.2
	Avg. Speed (mph)	16	16	16	16

Results were less apparent here for Zone A when compared to existing conditions. For example, the 80-second cycle as optimized by the Synchro algorithm provides poor MOE performance, where the existing model exhibits the best performance among the scenarios

considered for the same 80-second cycle length. These results are attributed to the Synchro optimization algorithms, which tend to consider both directions at each intersection over prioritizing one direction for progression by default. This was confirmed during the manual optimization process, where the 80-second cycle length was found to offer the best performance compared to the 70-second cycle length. More information regarding that process is provided in Section 3. For Zone B, an 80-second cycle length appeared to provide the fewest number of stops which indicates the best opportunity for coordination.

2.3. PM Peak

The final condition considered was the PM Peak Hour. Again, a two-zone assessment was performed to determine the best combination of cycle lengths as necessary. SimTraffic MOE results for PM peak are provided for each scenario in Table 3 below.

Table 3 - PM Peak SimTraffic MOE Results

Zone	MOE's	Optimized Cycle Length			Existing
		90	**90**	**100**	**90**
A	Total Delay (hr)	258.2	193	194.6	200.0
	Total Stops	17,155	18,035	17,978	19,402
	Travel Time (hr)	492.6	426.8	422.1	448.9
	Avg. Speed (mph)	17	20	20	20
Cycle Length		**70**	**80**	**80**	**70**
B	Total Delay (hr)	13.5	13.1	13.6	12.6
	Total Stops	2,003	1,807	1,888	2,043
	Travel Time (hr)	34.8	33.7	34.7	33.1
	Avg. Speed (mph)	15	15	15	15

As shown, separate cycle lengths for each zone were found to provide the best overall conditions for each scenario. For Zone A, 90- and 100-second cycle lengths were the most competitive according to the Synchro tools. For Zone B, only 80- and 70- second cycle lengths were considered, since a 90-second cycle length for Zone B was tested and found to increase total delay and stops according to SimTraffic. As a result, the combination of 100- and 80-seconds for Zone A and B respectively, provides the best compromise between total delay and stops for the corridor.

Memo

3. Final Cycle Length Selection/Optimization Results

Once the initial cycle lengths were selected, a more in-depth assessment was conducted with engineering oversight at each intersection to achieve the most efficient operation. Priority was given to the major corridor operation, with additional emphasis of achieving LOS C or better for minor approaches.

3.1. AM Peak

Table 4 provides the final optimization results for the AM peak period.

Table 4 - AM Peak SimTraffic Optimization Results

Zone	MOE's	Optimized Cycle Length	Existing
		80	**80/100**
A	Total Delay (hr)	89.8	96.2
	Total Stops	10,149	11,214
	Travel Time (hr)	249	257.5
	Avg. Speed (mph)	23	23
Cycle Length		**80**	**70**
B	Total Delay (hr)	5.1	6.3
	Total Stops	855	1,029
	Travel Time (hr)	18.1	19.5
	Avg. Speed (mph)	18	17

Considerable improvements were realized across both zones with the 80 sec cycle length, for all four MOEs studied. Total delay improved by 6.7 percent to 89.8 hours and by 19.0 percent to 5.1 hours for Zones A and B, respectively. Total Stops also improved greatly by an average of 10.1 percent across both zones.

3.2. Off Peak

Table 5 provides the final optimization results for the off peak period on the next page.

Memo

Table 5 - Off Peak SimTraffic Optimization Results

Zone	MOE's	Optimized Cycle Length	Existing
		80	80
A	Total Delay (hr)	138.1	142.2
	Total Stops	14,464	14,847
	Travel Time (hr)	342.0	346.5
	Avg. Speed (mph)	22	22
Cycle Length		80	70
B	Total Delay (hr)	10.6	11.9
	Total Stops	1,660	1,943
	Travel Time (hr)	30.1	32.2
	Avg. Speed (mph)	16	16

During manual optimization, a 70-second cycle length for the entire corridor was found to not be feasible as it increased total stops and delay while reducing average speed when compared to the model received from MDOT. In addition, the 70-second cycle time was not feasible for maintaining progression and servicing pedestrians crossing M-25 from the minor approaches. As a result, an 80-second cycle length was used for both Zones A and B, where reductions of 2.9 and 10.9 percent in total delay were realized for each zone, respectively. More importantly, Zone B shows improved results to the existing condition after clearance interval updates.

3.3. PM Peak

Table 6 provides the final optimization results for the PM peak period.

Table 6 - PM Peak SimTraffic Optimization Results

Zone	MOE's	Optimized Cycle Length	Existing
		100	90
A	Total Delay (hr)	196.7	200.0
	Total Stops	18,102	19,402
	Travel Time (hr)	427.3	448.9
	Avg. Speed (mph)	20	20
Cycle Length		80	70
B	Total Delay (hr)	11.2	12.6
	Total Stops	1,759	2,043
	Travel Time (hr)	31.9	33.1
	Avg. Speed (mph)	16	15

Results were positive for both zones, where a total delay improvement of approximately 8 percent was realized for the entire corridor. Zone B had the greatest overall improvement where total delay and stops exhibited 11.1 and 13.9 percent reductions, respectively. These results indicate the corridor is operating with better progression because of optimization.

Memo

4. Summary

Atkins has completed review and optimization of 22 signals in Port Huron, MI. As a result, the AM, Off Peak and PM peak hours exhibit lower total delay with 11.3, 2.1 and 8.0 percent reductions, respectively. In addition, total stops would be decreased for all three peak hours, indicating better overall progression for the corridor. Table 7 below shows the end results of optimization.

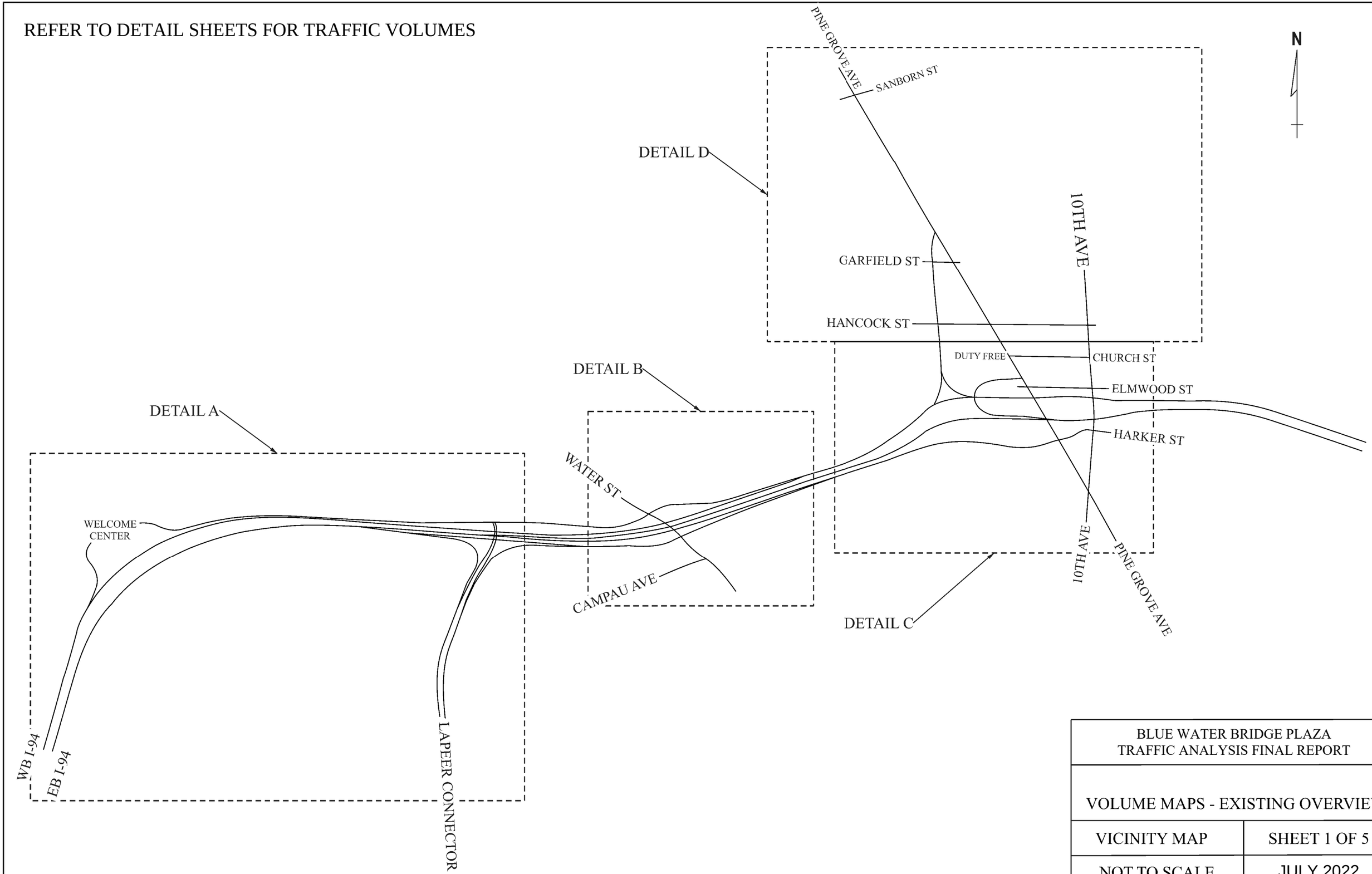
Table 7 - Final Optimization Results

Zone	MOE	Optimized	Existing	%-Improvement
AM Peak Period				
A	Total Delay (hr)	89.8	96.2	6.7%
	Total Stops	10,149	11,214	9.5%
	Travel Time (hr)	249.0	257.5	3.3%
	Avg. Speed (mph)	23	23	-
B	Total Delay (hr)	5.1	6.3	19.0%
	Total Stops	855	1,029	16.9%
	Travel Time (hr)	18.1	19.5	7.2%
	Avg. Speed (mph)	18	17	5.6%
Off Peak Period				
A	Total Delay (hr)	138.1	142.2	2.9%
	Total Stops	14,464	14,847	2.6%
	Travel Time (hr)	342.0	346.5	1.3%
	Avg. Speed (mph)	22	22	-
B	Total Delay (hr)	10.6	12.6	15.9%
	Total Stops	1,660	2,043	18.7%
	Travel Time (hr)	30.1	33.1	9.1%
	Avg. Speed (mph)	16	15	-
PM Peak Period				
A	Total Delay (hr)	196.7	200.0	1.7%
	Total Stops	18,102	19,402	6.7%
	Travel Time (hr)	427.3	448.9	4.8%
	Avg. Speed (mph)	20	20	-
B	Total Delay (hr)	11.2	12.6	11.1%
	Total Stops	1,759	2,043	13.9%
	Travel Time (hr)	31.9	33.1	3.6%
	Avg. Speed (mph)	16	15	6.3%

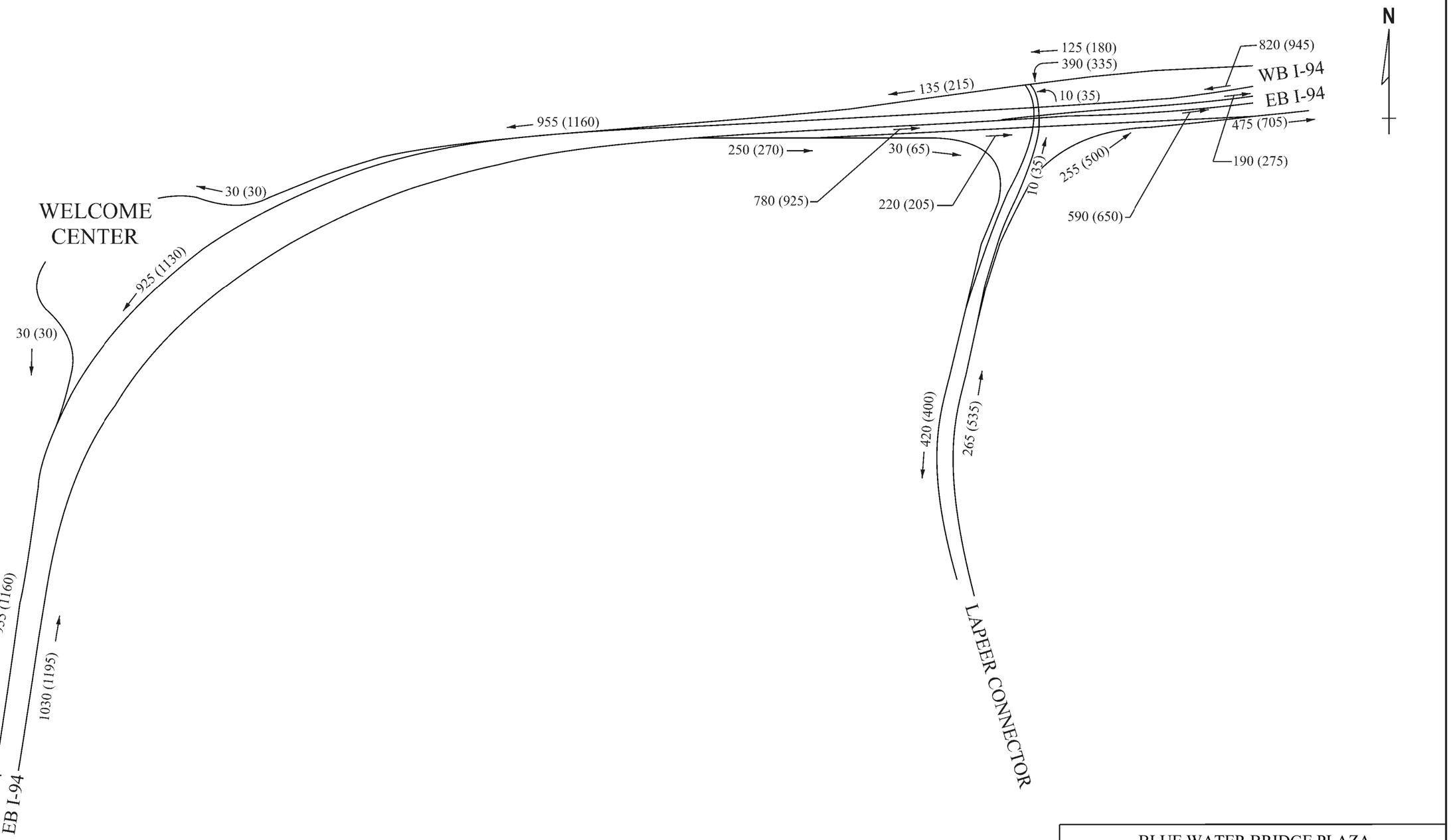
Please contact Adam McArthur at (586) 489-2664 with any questions regarding this memo.

Appendix E – Existing Volume Maps

REFER TO DETAIL SHEETS FOR TRAFFIC VOLUMES



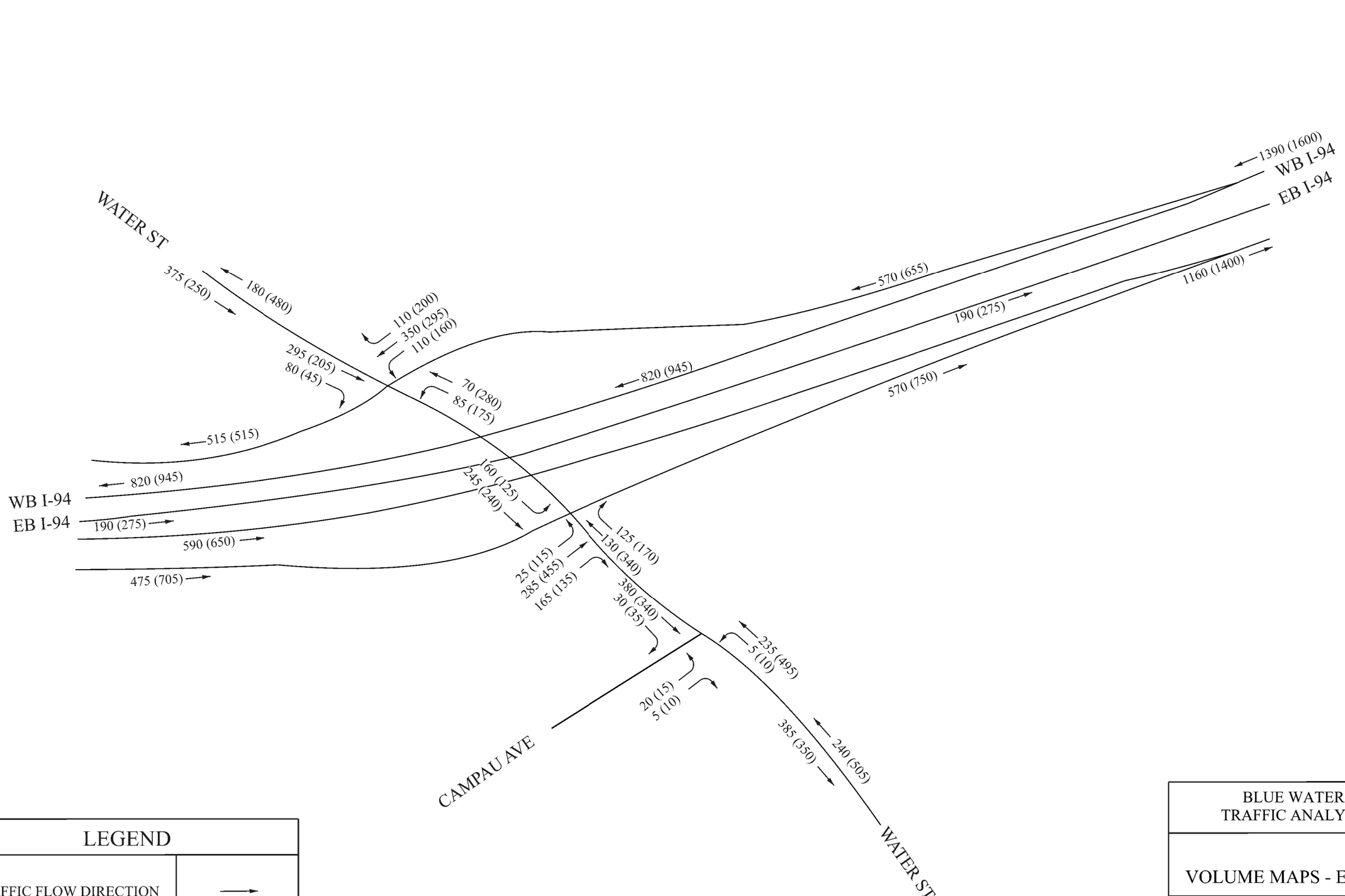
BLUE WATER BRIDGE PLAZA TRAFFIC ANALYSIS FINAL REPORT	
VOLUME MAPS - EXISTING OVERVIEW	
VICINITY MAP	SHEET 1 OF 5
NOT TO SCALE	JULY 2022



LEGEND	
TRAFFIC FLOW DIRECTION	→
HOURLY TRAFFIC VOLUMES	AM (PM)

REFER TO DETAIL SHEETS FOR TRAFFIC VOLUMES

BLUE WATER BRIDGE PLAZA TRAFFIC ANALYSIS FINAL REPORT	
VOLUME MAPS - EXISTING OVERVIEW	
DETAIL A	SHEET 2 OF 5
NOT TO SCALE	JULY 2022



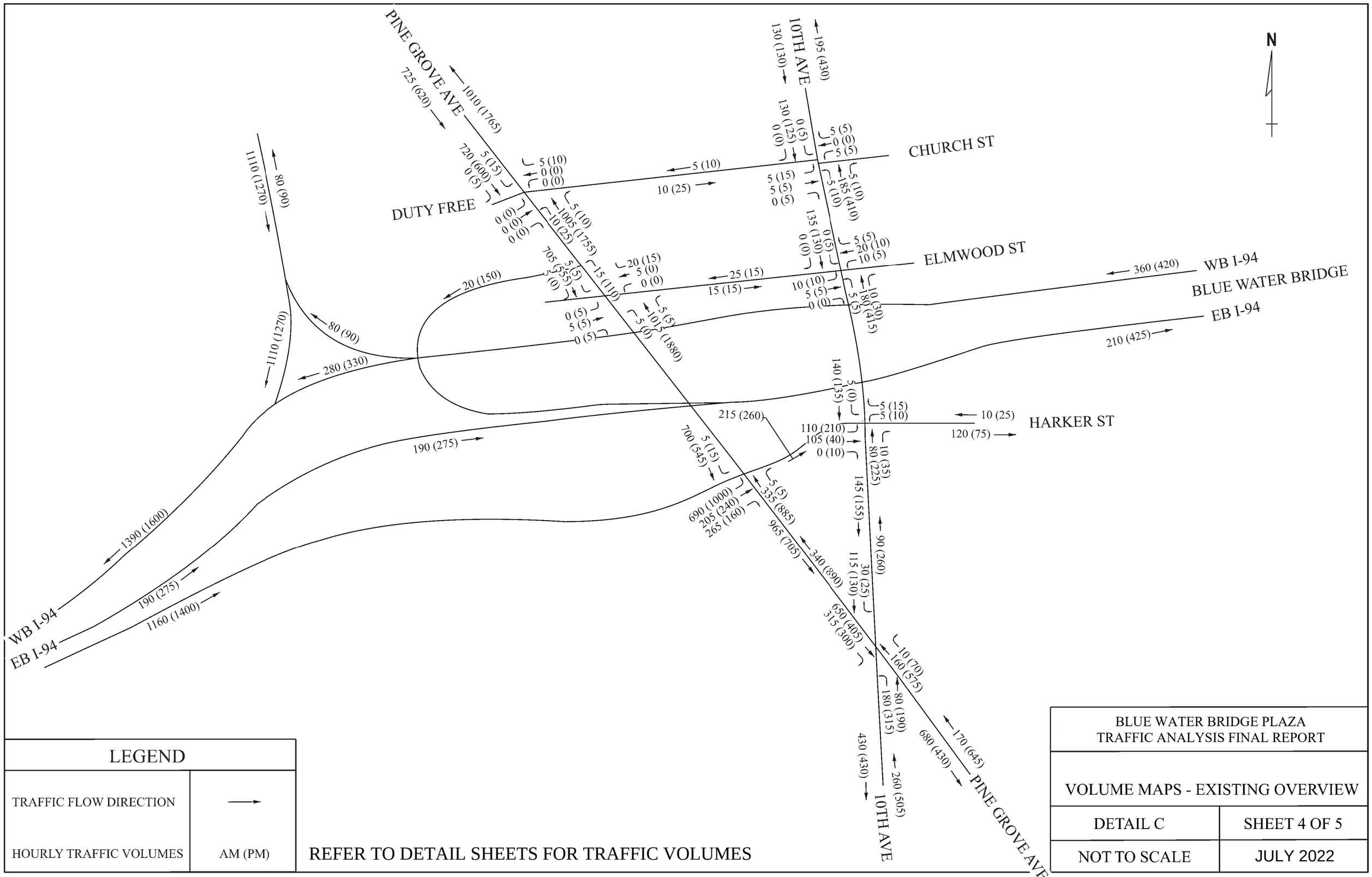
LEGEND	
TRAFFIC FLOW DIRECTION	→
HOURLY TRAFFIC VOLUMES	AM (PM)

REFER TO DETAIL SHEETS FOR TRAFFIC VOLUMES

BLUE WATER BRIDGE PLAZA
TRAFFIC ANALYSIS FINAL REPORT

VOLUME MAPS - EXISTING OVERVIEW

DETAIL B	SHEET 3 OF 5
NOT TO SCALE	JULY 2022

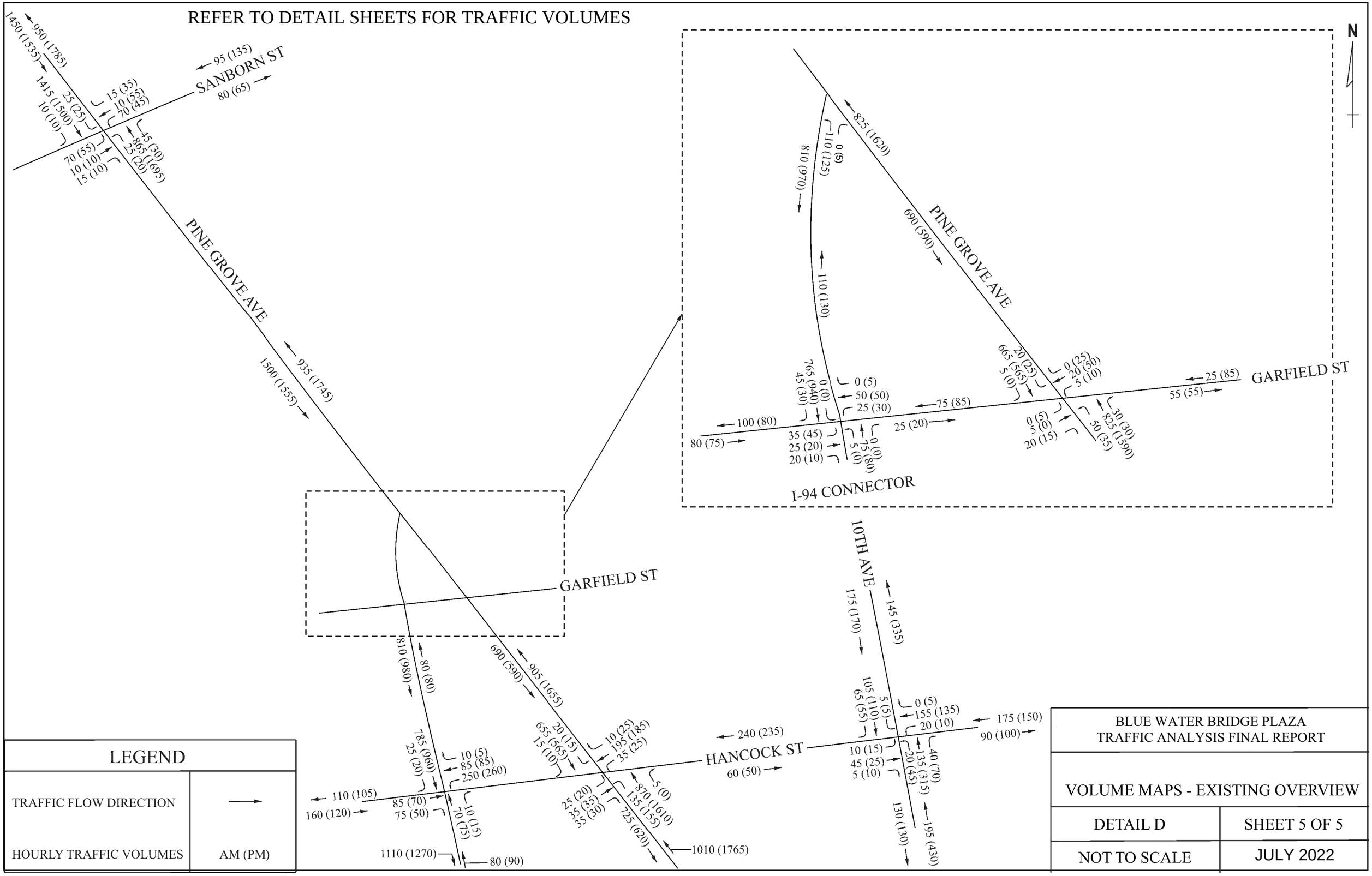


LEGEND	
TRAFFIC FLOW DIRECTION	→
HOURLY TRAFFIC VOLUMES	AM (PM)

REFER TO DETAIL SHEETS FOR TRAFFIC VOLUMES

BLUE WATER BRIDGE PLAZA TRAFFIC ANALYSIS FINAL REPORT	
VOLUME MAPS - EXISTING OVERVIEW	
DETAIL C	SHEET 4 OF 5
NOT TO SCALE	JULY 2022

REFER TO DETAIL SHEETS FOR TRAFFIC VOLUMES



LEGEND	
TRAFFIC FLOW DIRECTION	→
HOURLY TRAFFIC VOLUMES	AM (PM)

BLUE WATER BRIDGE PLAZA
TRAFFIC ANALYSIS FINAL REPORT

VOLUME MAPS - EXISTING OVERVIEW

DETAIL D	SHEET 5 OF 5
NOT TO SCALE	JULY 2022

Appendix F – HGV Percentages

Heavy Vehicle Percentages for BWB Plaza Study Area

Location (Entry Link into VISSIM)	AM Peak HV %	PM Peak HV %
I-94/I-69 EB West of MI Welcome Center	16%	17%
WB On Ramp from MI Welcome Center	87%	70%
NB Lapeer Connector	5%	1%
NB Water Street	6%	0%
SB Water Street	1%	1%
NB 10th Ave	2%	0%
EB Hancock St	8%	0%
EB Garfield St	1%	0%
EB Sanborn St	0%	0%
SB I-94/I-69 BL/M-25 (Pine Grove)	3%	2%
WB Sanborn St	4%	1%
EB Church St (Duty Free Lot)	0%	0%
EB Elmwood (US Customs Lot)	0%	33%
WB Garfield St	3%	2%
WB Hancock St	2%	0%
WB Church St	0%	0%
WB Elmwood (US Customs Lot)	0%	0%
WB Harker	13%	0%
NB I-94/I-69 BL/M-25 (Pine Grove)	3%	1%
SB 10th Ave	2%	1%
I-94/I-69 WB (Blue Water Bridge)	55%	39%
EB Campau	19%	0%

Note: some sidestreets show elevated HV% due to low total volumes

Appendix G – VISSIM Model Development

1 INTRODUCTION

VISSIM version 11.00-14 was chosen as the mobility analysis tool for this project to understand the corridor-wide impacts of the BWB Tolling Facility as well as the freeway and arterial networks. A micro-simulation model is beneficial as it provides insight on the effects of subtle geometric characteristics, lane-specific conditions, "choke points", local driver behavior, and variations in volume over the peak hour, among other corridor attributes. The VISSIM model outputs data that can be applied with Highway Capacity Manual (HCM) 6th Edition level of service (LOS) criteria to analyze traffic operations in addition to other MOEs.

2 VISSIM MODEL SPEED AND GEOMETRICS

This section describes the methods used to develop the basic components of the VISSIM model.

2.1 Network Geometrics

Network geometrics were modeled using scaled aerial imagery from Bing Maps. The mainline roads were modeled to reflect the project study area. For decision points on the mainline, 2500 feet is used as a default lane change distance. Practical modeling limits based on the proposed project limits were established in conjunction with MDOT and extended to the limits shown in Figure 2. The extension was intended to capture potential queue spillback during congestion as well as determine any impacts to nearby freeway and arterial roadways.

2.2 Desired Speed Decisions

Desired speed decisions were placed at every network input and every location with a speed limit change. Speed distributions were determined using INRIX data for I-94/I-69 and posted speeds for side streets and freeway ramps. Cars and heavy goods vehicles (HGVs) were assigned their own speed distributions on the freeway since HGVs must adhere to a lower speed limit. For freeway ramps and connecting arterial streets, there was no difference in the speed distributions assigned to cars and HGVs.

2.3 Reduced Speed Areas

Reduced speed areas were placed at every intersection turning movement. Heavy vehicles were assigned a lower speed than cars. Left turns and channelized right turns were given slightly higher speeds than traditional right turns. Reduced speed areas were also used anywhere with an advisory speed sign. These locations are

predominantly at freeway entrance and exit ramps. On system-to-system ramps with no advisory speed signs, engineering judgment and field observations were used to determine whether a reduced speed area is needed.

2.4 Intersections

Both signalized and unsignalized intersections exist within the study area. Both intersection types were coded to include conflict areas, priority rules, and stop signs as necessary. Signalized intersections were coded based on signal timings from local agencies. The process for defining the intersections is described herein.

- Conflict areas were used at every intersection and other potential conflict point.
- Priority rules will only be used in locations where conflict areas could not effectively simulate a yield condition.
- Stop signs were placed in the VISSIM model based on field data collected.

2.5 Toll Facility Model Features

The toll facility on the USA side was included in the VISSIM model to replicate operations on an average weekday AM and PM peak period. Through discussions with BWB and MDOT, the operations at the preliminary inspection lanes and the toll lanes change daily based on the number of lanes open, number of staff available at the plaza, Canadian Plaza operations, responsiveness of drivers providing payment, etc. Due to the many variables affecting the dwell time at both the entry into the USA (preliminary inspection lanes) and exit to Canada (toll facility), the dwell times collected at the plaza were used to establish dwell times for all types of vehicles. The vehicles included passenger cars, heavy vehicles, vehicles involved in the Free and Secure Trade (FAST) program, and vehicles in the NEXUS programs to simulate the variations of dwell times at the entry and exit facilities.

3 TRAFFIC VOLUME & COMPOSITION INPUTS

3.1 Vehicle Routing – Static

Static routing was used in the VISSIM models to establish vehicle routing on the freeway as well as the turning movements at intersections.

3.1.1 Traffic Volumes

The 15-minute demand vehicle inputs were coded into the VISSIM models at all entry points into the network. The 15-minute distributions for the vehicle inputs were based on traffic count data at each entry point.

3.1.2 Vehicle Composition

A Car and heavy vehicle composition for each of the peak period VISSIM models were developed at each of the vehicle inputs into the network and were applied to the entirety of each peak period. Due to the operations at the toll facility, additional vehicle compositions were made for trucks involved in the FAST program as well as passenger cars involved in the NEXUS program. The percentage of vehicles involved in these programs were obtained from BWB and CBP. The wait time at the toll facility was less for vehicles involved in the FAST and NEXUS programs and the separate vehicle compositions allowed dwell times to be less when compared to vehicles that are not enrolled in the programs.

3.1.3 Vehicle Definitions

The Car and HGV distribution vehicle fleets available in the "NorthAmericanDefault.inp" file were used for all VISSIM models in this study.

3.1.4 Driver Behavior

The "Wiedemann 99" car following model was used for freeway links along I-94, while the "Wiedemann 74" car following model was used on connecting arterial streets. The VISSIM default driving behavior parameters were used within the study area.

Adjustments to lane change distances were performed as needed to replicate congestion per the speed data.

3.2 VISSIM Model Data Collection

VISSIM is equipped with several different tools to measure the performance of the network. These data collection devices are described in the following sections with information on how they were utilized for the BWB Plaza Study.

3.2.1 Nodes

Nodes with "evaluation" activated were placed at every intersection. For the VISSIM models, data was aggregated in 15-minute increments. Each node counts the number of vehicles that make each turning movement and records delay by intersection,

approach, and turning movement. This data was used to determine how closely the traffic volumes in the VISSIM model are reflected the actual counted network volumes and provided intersection LOS information.

3.2.2 Travel Time Segments

To measure vehicle travel times over a given roadway segment in VISSIM, start and stop lines are placed at the beginning and end of the desired travel time segment. VISSIM then measures the amount of time elapsed for each car from the time the car crosses the start line to the time it crosses the stop line. Travel time segments on the I-94/I-69 mainline within the project limits were used to compare against measured travel times in RITIS. Additionally, travel time segments were collected along I-94/I-69 BL/M-25 (Pine Grove) for calibration purposes and to measure the effect of proposed modifications in the Build scenarios. Refer to **Appendix I** for the travel time segments schematics.

3.2.3 Link Evaluation

Link evaluation was active for all freeway links and will capture metrics such as average speed, density, and volume. These metrics can be used to determine the level of service (LOS) for each segment as defined in the HCM. Evaluations were not active for connectors since their length is negligible.

3.2.4 Vehicle Volumes

Traffic volumes in the network were measured on an hourly basis for each mainline segment, ramp segment, entry point and exit point of the VISSIM models. These volumes were compared to the traffic count data using the GEH statistic. The GEH statistic is a universal formula used to compare two sets of data. Acceptable GEH values are listed in **Table F-1.**

Table F-1: Throughput Traffic Volume Calibration Criteria

Criteria	Acceptable Targets
GEH < 3.0	All MDOT facility segments within the calibration area
GEH < 3.0	All entry and exit locations within the calibration area
GEH < 3.0	All entrance and exit ramps within the calibration area
GEH < 5.0	At least 85% of applicable local roadway segments
Sum of all segment flows within the calibration area	Within 5%

*The GEH statistic is computed as follows:

$$GEH = \sqrt{\frac{2 \times (m-c)^2}{(m+c)}}$$

Where:
m = output traffic throughput volumes from the VISSIM model (veh/h/ln)
c = traffic throughput volumes based on field data (veh/h/ln).

3.2.5 Facility Speeds

Speed data from the VISSIM models were compared to speed data obtained from RITIS for the I-94/I-69 mainline and I-94/I-69 BL/M-25 (Pine Grove) corridor. This comparison was made in the form of a heat map using speeds for 15-minute intervals. Calibration was determined based on the analyst's judgment and was documented for MDOT concurrence.

Appendix H – Volume Calibration Data

I-94 Mainline Volume - Calibration Data (AM)

Roadway	Mainline				Target			Vissim			Warmup				Peak				Cooldown			
	Forecast ID	Link	Description	Type	Warmup	Peak	Cooldown	Warmup	Peak	Cooldown	Difference	OK?	GEH	OK?	Difference	OK?	GEH	OK?	Difference	OK?	GEH	OK?
I-94 EB Mainline	1002	1	I-94 EB west of MDOT Maintenance Facility	Mainline	670	1030	876	659	1029	884	-10	OK	0.39	OK	-1	OK	0.03	OK	9	OK	0.29	OK
	1002	146	I-94 EB mainline west of MDOT Maintenance Facility	Mainline	670	1030	876	658	1029	884	-11	OK	0.44	OK	-1	OK	0.03	OK	9	OK	0.29	OK
	1002	145	I-94 EB mainline Between MDOT Maintence Facility Ramps	Mainline	670	1030	876	656	1028	885	-14	OK	0.54	OK	-2	OK	0.06	OK	9	OK	0.30	OK
	1002	2	I-94 EB mainline merge from MDOT maintenance facility	Mainline	670	1030	876	653	1026	884	-17	OK	0.65	OK	-4	OK	0.14	OK	8	OK	0.28	OK
	1002	3	I-94 EB mainline west of Lapeer Connector	Mainline	670	1030	876	653	1027	886	-16	OK	0.63	OK	-3	OK	0.09	OK	10	OK	0.34	OK
	1009	4	I-94 EB mainline east of Lapeer Connector exit	Mainline	507	780	663	496	782	665	-11	OK	0.51	OK	2	OK	0.09	OK	2	OK	0.09	OK
	1009	5	I-94 EB mainline east of Lapeer Connector	Mainline	507	780	663	494	781	665	-13	OK	0.58	OK	1	OK	0.04	OK	2	OK	0.06	OK
	1029	6	I-94 EB mainline east of exit to Service Drive	Mainline	124	190	162	116	191	152	-8	OK	0.71	OK	1	OK	0.05	OK	-9	OK	0.74	OK
	1109	133	I-94 EB mainline merge from Pine Grove Ave & BWB Toll Plaza	Mainline	137	210	179	127	211	170	-10	OK	0.83	OK	1	OK	0.09	OK	-8	OK	0.64	OK
	1109	158	I-94 EB mainline merge from Pine Grove Ave & BWB Toll Plaza	Toll	137	210	179	126	211	170	-10	OK	0.91	OK	1	OK	0.09	OK	-8	OK	0.62	OK
	1109	8	I-94 EB mainline to BWB at border	Mainline	137	210	179	125	210	172	-12	OK	1.05	OK	0	OK	0.02	OK	-7	OK	0.52	OK
I-94 WB Mainline	1110	9	I-94 WB mainline between Border Patrol and BWB Border	Mainline	234	360	364	220	359	364	-14	OK	0.92	OK	-1	OK	0.07	OK	0	OK	0.00	OK
	1110	152	I-94 WB mainline at North Border Patrol checkpoint (Cars only)	PIL	89	137	138	80	134	140	-9	OK	0.95	OK	-3	OK	0.26	OK	1	OK	0.11	OK
	1110	160	NEXUS Lane	PIL	16	25	25	16	25	25	-1	OK	0.20	OK	0	OK	0.08	OK	0	OK	0.08	OK
	1110	161	Fast Lane	PIL	33	51	51	31	46	46	-2	OK	0.31	OK	-5	OK	0.71	OK	-5	OK	0.74	OK
	1110	153	I-94 WB mainline at South Border Patrol checkpoint (Trucks only)	PIL	60	92	93	52	87	92	-7	OK	0.98	OK	-4	OK	0.47	OK	-1	OK	0.08	OK
	1110	154	I-94 WB mainline at North Border Patrol checkpoint (Trucks only)	PIL	36	55	56	36	56	56	1	OK	0.09	OK	1	OK	0.09	OK	0	OK	0.01	OK
	1110	10	I-94 WB West of Border Patrol diverge to M-25	Mainline	234	360	364	213	344	357	-21	OK	1.40	OK	-16	OK	0.84	OK	-6	OK	0.33	OK
	1032	13	I-94 WB mainline West of Border Patrol between m-25 on/off ramps	Mainline	182	280	283	165	269	277	-17	OK	1.28	OK	-11	OK	0.68	OK	-6	OK	0.37	OK
	1028	15	I-94 WB merge with M-25	Mainline	907	1390	1216	910	1362	1205	3	OK	0.10	OK	-28	OK	0.75	OK	-11	OK	0.33	OK
	1028	16	I-94 WB mainline offramp to Water St.	Mainline	907	1390	1216	902	1357	1202	-5	OK	0.17	OK	-33	OK	0.90	OK	-14	OK	0.41	OK
	1008	18	I-94 WB mainline west of exit to Water St	Mainline	537	820	663	541	799	706	4	OK	0.16	OK	-21	OK	0.73	OK	43	OK	1.65	OK
	1008	19	I-94 WB mainline west of exit to Water St	Mainline	537	820	663	541	799	707	4	OK	0.19	OK	-21	OK	0.73	OK	44	OK	1.67	OK
	1005	21	I-94 WB mainline exit to welcome center & merge from I-94 WB serve road	Mainline	625	955	794	624	933	828	0	OK	0.01	OK	-22	OK	0.71	OK	34	OK	1.18	OK
	1111	23	I-94 WB mainline between welcome center ramps	Mainline	605	925	765	605	898	803	0	OK	0.02	OK	-27	OK	0.88	OK	38	OK	1.35	OK
	1001	25	I-94 WB mainline merge from welcome center	Mainline	625	955	794	626	924	831	1	OK	0.04	OK	-31	OK	1.01	OK	37	OK	1.29	OK
	1001	147	I-94 WB mainline to Lapeer Road overpass	Mainline	625	955	794	624	925	831	-1	OK	0.04	OK	-30	OK	0.97	OK	37	OK	1.29	OK
I-94 EB Service Drive	1018	111	I-94 EB service drive diverge from I-94 EB mainline	Mainline	384	590	502	376	590	513	-8	OK	0.39	OK	0	OK	0.02	OK	12	OK	0.53	OK
	1030	112	I-94 EB service drive merge from Water Street	Mainline	754	1160	986	762	1152	1029	8	OK	0.29	OK	-8	OK	0.25	OK	43	OK	1.35	OK
	1030	135	I-94 EB Service Road to M-25 intersection	Mainline	754	1160	986	755	1142	1029	1	OK	0.02	OK	-18	OK	0.52	OK	43	OK	1.34	OK
I-94 WB Service Drive	1006	40	I-94 WB serivce drive merge to I-94 WB mainline	Mainline	88	135	131	85	135	122	-3	OK	0.35	OK	0	OK	0.04	OK	-9	OK	0.81	OK
	1017	39	I-94 WB service drive between Lapeer Connector and Water St.	Mainline	335	515	500	362	508	454	27	OK	1.44	OK	-7	OK	0.31	OK	-46	OK	2.10	OK
I-94 EB Ramps	1010	105	I-94 EB off-ramp to Lapeer Connector	Ramp	20	30	29	18	29	26	-1	OK	0.24	OK	-1	OK	0.21	OK	-3	OK	0.53	OK
	1014	106	I-94 EB ramp from Lapeer Connector	Ramp	128	255	247	125	254	264	-3	OK	0.25	OK	-1	OK	0.05	OK	17	OK	1.04	OK
	1013	104	I-94 EB off-ramp to Water St.	Ramp	143	220	213	138	214	194	-5	OK	0.39	OK	-6	OK	0.41	OK	-19	OK	1.33	OK
	1019	107	I-94 EB Water St. off ramp merge with Lapeer Connector Ramp	Ramp	238	475	461	261	468	458	24	OK	1.49	OK	-7	OK	0.34	OK	-3	OK	0.13	OK
	1019	108	I-94 EB Water St. off ramp merge with Lapeer Connector Ramp Offramp to Water St	Ramp	309	475	461	259	464	456	-50	OK	2.97	OK	-11	OK	0.50	OK	-5	OK	0.24	OK
	1027	109	Water Street on-ramp	Ramp	371	570	553	392	555	514	21	OK	1.10	OK	-15	OK	0.62	OK	-39	OK	1.70	OK
	1027	110	Water Street on-ramp to I-94 EB Service Road	Ramp	371	570	553	393	558	515	22	OK	1.14	OK	-12	OK	0.50	OK	-38	OK	1.65	OK
	1099	26	I-94 EB on-ramp from M-25 to BWB Toll Plaza	Ramp	13	20	19	12	20	17	-1	OK	0.18	OK	0	OK	0.06	OK	-2	OK	0.56	OK
I-94 WB Ramps	1003	24	I-94 WB on-ramp from Welcome Center	Ramp	20	30	29	24	29	24	4	OK	0.96	OK	-1	OK	0.20	OK	-5	OK	0.97	OK
	1004	22	I-94 WB off-ramp to Welcome Center	Ramp	20	30	29	20	30	27	1	OK	0.12	OK	0	OK	0.08	OK	-2	OK	0.30	OK
	1006	40	I-94 WB on-ramp from I-94 WB Service Drive	Ramp	88	135	131	85	135	122	-3	OK	0.35	OK	0	OK	0.04	OK	-9	OK	0.81	OK
	1026	50	I-94 WB off-ramp to Water st.	Ramp	371	570	553	367	561	502	-3	OK	0.18	OK	-9	OK	0.37	OK	-51	OK	2.22	OK
	1034	129	I-94 WB on-ramp from M-25	Ramp	725	1110	933	753	1090	926	27	OK	1.01	OK	-20	OK	0.61	OK	-7	OK	0.24	OK
	1035	11	I-94 WB off-ramp to M-25	Ramp	52	80	78	48	75	82	-4	OK	0.53	OK	-5	OK	0.60	OK	4	OK	0.47	OK

Note: PIL refers to Primary Inspection Lanes for vehicles entering the United States from Canada

	6:15 AM - 7:15 AM	7:15 AM - 8:15 AM	8:15 AM - 9:15 AM	Total
Total Segments	48	48	48	144
Calibrate Segments	48	48	48	144
Uncalibrated Segments	0	0	0	0
Calibrated Segments %	100%	100%	100%	100%

I-94 Mainline Volume - Calibration Data (PM)

Roadway	Mainline				Target			Vissim			Warmup				Peak				Cooldown			
	Forecast ID	Link	Description	Type	Warmup	Peak	Cooldown	Warmup	Peak	Cooldown	Difference	OK?	GEH	OK?	Difference	OK?	GEH	OK?	Difference	OK?	GEH	OK?
I-94 EB Mainline	1002	1	I-94 EB west of MDOT Maintenance Facility	Mainline	1195	1195	956	1149	1194	974	-46	OK	1.34	OK	-1	OK	0.04	OK	18	OK	0.59	OK
	1002	146	I-94 EB mainline west of MDOT Maintenance Facility	Mainline	1195	1195	956	1149	1194	975	-46	OK	1.34	OK	-1	OK	0.03	OK	19	OK	0.61	OK
	1002	145	I-94 EB mainline Between MDOT Maintence Facility Ramps	Mainline	1195	1195	956	1150	1193	976	-45	OK	1.32	OK	-2	OK	0.05	OK	20	OK	0.65	OK
	1002	2	I-94 EB mainline merge from MDOT maintenance facility	Mainline	1195	1195	956	1149	1191	976	-46	OK	1.35	OK	-4	OK	0.12	OK	20	OK	0.65	OK
	1002	3	I-94 EB mainline west of Lapeer Connector	Mainline	1195	1195	956	1150	1193	978	-45	OK	1.31	OK	-2	OK	0.06	OK	22	OK	0.71	OK
	1009	4	I-94 EB mainline east of Lapeer Connector exit	Mainline	925	925	740	894	917	752	-31	OK	1.02	OK	-8	OK	0.25	OK	12	OK	0.44	OK
	1009	5	I-94 EB mainline east of Lapeer Connector	Mainline	925	925	740	893	916	752	-32	OK	1.05	OK	-9	OK	0.29	OK	12	OK	0.45	OK
	1029	6	I-94 EB mainline east of exit to Service Drive	Mainline	275	275	220	267	264	225	-8	OK	0.46	OK	-11	OK	0.65	OK	5	OK	0.37	OK
	1109	133	I-94 EB mainline merge from Pine Grove Ave & BWB Toll Plaza	Mainline	425	425	340	421	421	356	-4	OK	0.21	OK	-4	OK	0.18	OK	16	OK	0.83	OK
	1109	158	I-94 EB mainline merge from Pine Grove Ave & BWB Toll Plaza	Toll	425	425	340	420	421	357	-5	OK	0.23	OK	-4	OK	0.18	OK	17	OK	0.93	OK
	1109	8	I-94 EB mainline to BWB at border	Mainline	425	425	340	419	420	360	-6	OK	0.31	OK	-5	OK	0.22	OK	20	OK	1.05	OK
I-94 WB Mainline	1110	9	I-94 WB mainline between Border Patrol and BWB Border	Mainline	420	420	336	392	419	309	-28	OK	1.40	OK	-1	OK	0.05	OK	-27	OK	1.50	OK
	1110	152	I-94 WB mainline at North Border Patrol checkpoint (Cars only)	PIL	216	216	173	175	177	181	-42	OK	3.00	OK	-39	OK	2.80	OK	8	OK	0.60	OK
	1110	160	NEXUS Lane	PIL	40	40	32	37	39	30	-2	OK	0.40	OK	-1	OK	0.10	OK	-1	OK	0.25	OK
	1110	161	Fast Lane	PIL	42	42	34	40	42	31	-2	OK	0.27	OK	0	OK	0.05	OK	-3	OK	0.50	OK
	1110	153	I-94 WB mainline at South Border Patrol checkpoint (Trucks only)	PIL	76	76	61	67	75	58	-9	OK	1.03	OK	-1	OK	0.17	OK	-2	OK	0.30	OK
	1110	154	I-94 WB mainline at North Border Patrol checkpoint (Trucks only)	PIL	46	46	37	47	46	34	1	OK	0.19	OK	1	OK	0.11	OK	-3	OK	0.52	OK
	1110	10	I-94 WB West of Border Patrol diverge to M-25	Mainline	420	420	336	365	379	335	-55	OK	2.76	OK	-41	OK	2.04	OK	-1	OK	0.05	OK
	1032	13	I-94 WB mainline West of Border Patrol between m-25 on/off ramps	Mainline	330	330	264	287	297	263	-43	OK	2.45	OK	-33	OK	1.85	OK	-1	OK	0.04	OK
	1028	15	I-94 WB merge with M-25	Mainline	1594	1600	1415	1530	1572	1437	-64	OK	1.62	OK	-28	OK	0.69	OK	22	OK	0.59	OK
	1028	16	I-94 WB mainline offramp to Water St.	Mainline	1594	1600	1415	1526	1567	1433	-68	OK	1.73	OK	-33	OK	0.82	OK	18	OK	0.48	OK
	1008	18	I-94 WB mainline west of exit to Water St	Mainline	939	945	891	906	927	851	-33	OK	1.10	OK	-18	OK	0.60	OK	-40	OK	1.37	OK
	1008	19	I-94 WB mainline west of exit to Water St	Mainline	939	945	891	909	929	850	-30	OK	1.00	OK	-16	OK	0.54	OK	-41	OK	1.38	OK
	1005	21	I-94 WB mainline exit to welcome center & merge from I-94 WB serve road	Mainline	1154	1160	1063	1112	1140	1040	-42	OK	1.24	OK	-20	OK	0.58	OK	-23	OK	0.71	OK
	1111	23	I-94 WB mainline between welcome center ramps	Mainline	1124	1130	1039	1078	1110	1014	-46	OK	1.39	OK	-20	OK	0.60	OK	-25	OK	0.77	OK
	1001	25	I-94 WB mainline merge from welcome center	Mainline	1154	1160	1063	1102	1140	1044	-52	OK	1.56	OK	-20	OK	0.59	OK	-19	OK	0.60	OK
	1001	147	I-94 WB mainline to Lapeer Road overpass	Mainline	1154	1160	1063	1101	1143	1044	-53	OK	1.57	OK	-17	OK	0.50	OK	-19	OK	0.59	OK
I-94 EB Service Drive	1018	111	I-94 EB service drive diverge from I-94 EB mainline	Mainline	650	650	520	627	653	529	-23	OK	0.89	OK	3	OK	0.10	OK	9	OK	0.41	OK
	1030	112	I-94 EB service drive merge from Water Street	Mainline	1400	1400	1120	1373	1403	1143	-27	OK	0.73	OK	3	OK	0.07	OK	23	OK	0.68	OK
	1030	135	I-94 EB Service Road to M-25 intersection	Mainline	1400	1400	1120	1374	1392	1147	-26	OK	0.69	OK	-8	OK	0.22	OK	27	OK	0.81	OK
I-94 WB Service Drive	1006	40	I-94 WB serivce drive merge to I-94 WB mainline	Mainline	215	215	172	206	214	191	-9	OK	0.62	OK	-1	OK	0.09	OK	19	OK	1.44	OK
	1017	39	I-94 WB service drive between Lapeer Connector and Water St.	Mainline	515	515	412	505	515	462	-10	OK	0.45	OK	0	OK	0.02	OK	50	OK	2.38	OK
I-94 EB Ramps	1010	105	I-94 EB off-ramp to Lapeer Connector	Ramp	65	65	52	60	67	54	-5	OK	0.61	OK	2	OK	0.20	OK	2	OK	0.31	OK
	1014	106	I-94 EB ramp from Lapeer Connector	Ramp	500	500	400	484	500	359	-16	OK	0.70	OK	0	OK	0.02	OK	-41	OK	2.10	OK
	1013	104	I-94 EB off-ramp to Water St.	Ramp	205	205	164	195	207	172	-10	OK	0.68	OK	2	OK	0.15	OK	8	OK	0.65	OK
	1019	107	I-94 EB Water St. off ramp merge with Lapeer Connector Ramp	Ramp	705	705	564	679	706	533	-26	OK	1.00	OK	1	OK	0.05	OK	-31	OK	1.34	OK
	1019	108	I-94 EB Water St. off ramp merge with Lapeer Connector Ramp Offramp to Water St	Ramp	705	705	564	675	700	530	-30	OK	1.16	OK	-5	OK	0.20	OK	-34	OK	1.46	OK
	1027	109	Water Street on-ramp	Ramp	750	750	600	748	744	612	-2	OK	0.07	OK	-6	OK	0.23	OK	12	OK	0.49	OK
	1027	110	Water Street on-ramp to I-94 EB Service Road	Ramp	750	750	600	750	747	610	0	OK	0.02	OK	-3	OK	0.10	OK	10	OK	0.42	OK
	1099	26	I-94 EB on-ramp from M-25 to BWB Toll Plaza	Ramp	150	150	120	153	157	129	3	OK	0.25	OK	7	OK	0.58	OK	9	OK	0.79	OK
I-94 WB Ramps	1003	24	I-94 WB on-ramp from Welcome Center	Ramp	30	30	24	29	29	26	-1	OK	0.17	OK	-1	OK	0.18	OK	2	OK	0.40	OK
	1004	22	I-94 WB off-ramp to Welcome Center	Ramp	30	30	24	34	29	26	4	OK	0.64	OK	-1	OK	0.23	OK	2	OK	0.48	OK
	1006	40	I-94 WB on-ramp from I-94 WB Service Drive	Ramp	215	215	172	206	214	191	-9	OK	0.62	OK	-1	OK	0.09	OK	19	OK	1.44	OK
	1026	50	I-94 WB off-ramp to Water st.	Ramp	655	655	524	633	647	589	-22	OK	0.85	OK	-8	OK	0.31	OK	65	OK	2.75	OK
	1034	129	I-94 WB on-ramp from M-25	Ramp	1264	1270	1151	1249	1270	1170	-15	OK	0.43	OK	0	OK	0.00	OK	19	OK	0.55	OK
	1035	11	I-94 WB off-ramp to M-25	Ramp	90	90	72	79	82	72	-11	OK	1.22	OK	-8	OK	0.86	OK	0	OK	0.03	OK

Note: PIL refers to Primary Inspection Lanes for vehicles entering the United States from Canada

	3:30 PM - 4:30 PM	4:30 PM - 5:30 PM	5:30 PM - 6:30 PM	Total
Total Segments	48	48	48	144
Calibrate Segments	48	48	48	144
Uncalibrated Segments	0	0	0	0
Calibrated Segments %	100%	100%	100%	100%

Intersection Volume - Calibration Data (AM)

Intersection		Target			Vissim			Warmup			Peak			Cooldown		
Int Name	Mvmt	Warmup	Peak	Cooldown	Warmup	Peak	Cooldown	Difference	GEH	OK?	Difference	GEH	OK?	Difference	GEH	OK?
M-25 @ 10th St	EBT	423	650	631	438	649	557	15	0.72	OK	-1	0.03	OK	-73	3.00	OK
	EBR	205	315	306	210	317	256	5	0.36	OK	2	0.13	OK	-50	2.98	OK
	WBT	98	160	202	94	155	201	-4	0.43	OK	-5	0.37	OK	-1	0.07	OK
	WBR	6	10	13	6	13	13	0	0.10	OK	3	0.79	OK	0	0.00	OK
	NBL	117	180	175	160	175	160	43	3.63	OK	-5	0.35	OK	-15	1.16	OK
	NBT	52	80	78	61	83	68	9	1.17	OK	3	0.33	OK	-10	1.13	OK
	SBL	20	30	24	24	24	24	4	0.90	OK	-6	1.15	OK	0	0.07	OK
	SBT	75	115	91	96	111	96	21	2.30	OK	-4	0.41	OK	5	0.55	OK
Lapeer Conn @ Service Drive WB	WBL	254	390	378	276	385	356	22	1.37	OK	-5	0.24	OK	-22	1.15	OK
	WBT	81	125	121	80	131	107	-1	0.14	OK	6	0.50	OK	-14	1.33	OK
	NBL	7	10	10	6	7	11	-1	0.41	OK	-3	1.03	OK	2	0.50	OK
I-94 EB Ramps @ Water St	EBL	16	25	24	13	23	19	-4	0.99	OK	-2	0.48	OK	-5	1.13	OK
	EBT	185	285	276	156	275	279	-30	2.26	OK	-10	0.58	OK	3	0.15	OK
	EBR	107	165	160	95	176	159	-12	1.19	OK	11	0.82	OK	-1	0.11	OK
	NBT	85	130	126	111	131	109	26	2.63	OK	1	0.12	OK	-17	1.55	OK
	NBR	81	125	121	106	122	110	24	2.51	OK	-3	0.27	OK	-12	1.08	OK
	SBL	104	160	155	136	159	133	32	2.92	OK	-1	0.05	OK	-23	1.88	OK
	SBT	159	245	238	192	240	215	33	2.47	OK	-5	0.34	OK	-23	1.51	OK
I-94 WB Ramps @ Water St	WBL	72	110	107	73	104	98	2	0.18	OK	-6	0.55	OK	-9	0.86	OK
	WBT	228	350	340	226	351	317	-2	0.13	OK	1	0.04	OK	-22	1.22	OK
	WBR	72	110	107	62	113	88	-9	1.13	OK	3	0.32	OK	-19	1.93	OK
	NBT	46	70	68	48	69	55	3	0.37	OK	-1	0.12	OK	-13	1.60	OK
	NBL	55	85	82	74	85	74	19	2.33	OK	0	0.04	OK	-8	0.96	OK
	SBT	192	295	286	258	293	251	67	4.43	OK	-2	0.12	OK	-35	2.12	OK
	SBL	52	80	78	61	79	74	9	1.17	OK	-1	0.15	OK	-4	0.41	OK
I-94 EB Ramps @ M-25	EBL	449	690	669	453	684	628	4	0.20	OK	-6	0.23	OK	-41	1.62	OK
	EBT	133	205	199	129	205	184	-4	0.35	OK	0	0.02	OK	-15	1.07	OK
	EBR	172	265	257	176	261	236	4	0.30	OK	-4	0.23	OK	-21	1.32	OK
	NBT	204	335	423	248	326	357	44	2.90	OK	-9	0.50	OK	-66	3.32	OK
	NBR	3	5	6	4	5	4	1	0.28	OK	0	0.15	OK	-2	1.06	OK
	SBL	3	5	4	3	7	5	0	0.14	OK	2	0.82	OK	1	0.62	OK
	SBT	459	700	551	472	707	578	13	0.61	OK	7	0.25	OK	27	1.12	OK
Harker St @ 10th St	EBL	72	110	107	68	114	99	-4	0.45	OK	4	0.41	OK	-8	0.79	OK
	EBT	68	105	102	68	103	94	0	0.00	OK	-2	0.23	OK	-8	0.76	OK
	EBR	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	WBL	3	5	5	4	3	4	1	0.27	OK	-2	1.19	OK	-1	0.24	OK
	WBR	3	5	5	4	5	4	0	0.14	OK	0	0.15	OK	-1	0.57	OK
	NBT	52	80	78	59	84	70	7	0.94	OK	4	0.44	OK	-7	0.84	OK
	NBR	7	10	10	8	11	11	2	0.56	OK	1	0.41	OK	1	0.40	OK
	SBL	3	5	5	4	5	6	1	0.27	OK	0	0.00	OK	1	0.36	OK
	SBT	91	140	136	117	135	115	26	2.50	OK	-5	0.46	OK	-21	1.89	OK
10th Ave @ Elmwood	EBL	7	10	10	8	13	10	2	0.56	OK	3	0.88	OK	0	0.10	OK
	EBT	3	5	5	3	4	3	-1	0.44	OK	-1	0.64	OK	-2	0.75	OK
	EBR	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	WBL	7	10	10	9	9	6	2	0.81	OK	-1	0.21	OK	-3	1.19	OK
	WBT	13	20	19	16	18	19	3	0.73	OK	-2	0.46	OK	-1	0.17	OK
	WBR	3	5	5	5	6	4	2	0.75	OK	1	0.29	OK	-1	0.40	OK
	NBL	3	5	5	2	6	3	-1	0.60	OK	1	0.29	OK	-2	0.75	OK
	NBT	117	180	175	122	186	162	5	0.48	OK	6	0.44	OK	-13	0.97	OK
	NBR	7	10	10	6	11	9	-1	0.30	OK	1	0.31	OK	-1	0.34	OK
	SBL	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	SBT	88	135	131	111	130	114	24	2.36	OK	-5	0.41	OK	-17	1.53	OK
	SBR	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
10th Ave @ Church St	EBL	3	5	5	6	7	5	3	1.18	OK	2	0.82	OK	0	0.21	OK
	EBT	3	5	5	2	5	3	-2	0.95	OK	0	0.00	OK	-2	0.75	OK
	EBR	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	WBL	3	5	5	3	4	3	0	0.14	OK	-1	0.64	OK	-2	0.75	OK
	WBT	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	WBR	3	5	5	4	4	5	1	0.27	OK	-1	0.31	OK	0	0.08	OK
	NBL	3	5	5	4	6	5	1	0.39	OK	1	0.43	OK	0	0.21	OK
	NBT	120	185	179	127	193	168	7	0.63	OK	8	0.58	OK	-12	0.89	OK
	NBR	3	5	5	3	6	3	0	0.00	OK	1	0.56	OK	-2	1.13	OK
	SBL	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	SBT	85	130	126	108	127	111	24	2.40	OK	-3	0.29	OK	-15	1.42	OK
	SBR	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
10th Ave @ Hancock St	EBL	7	10	10	8	10	9	2	0.64	OK	0	0.11	OK	-1	0.23	OK
	EBT	29	45	44	36	47	40	7	1.18	OK	2	0.29	OK	-4	0.62	OK
	EBR	3	5	5	4	3	5	1	0.52	OK	-2	0.82	OK	0	0.08	OK
	WBL	13	20	19	17	19	15	4	0.91	OK	-1	0.30	OK	-5	1.15	OK
	WBT	101	155	150	129	157	135	28	2.61	OK	2	0.16	OK	-15	1.26	OK
	WBR	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	NBL	13	20	19	12	21	17	-2	0.43	OK	1	0.22	OK	-3	0.64	OK
	NBT	88	135	131	97	141	121	9	0.96	OK	6	0.54	OK	-10	0.86	OK
	NBR	26	40	39	28	40	41	2	0.38	OK	0	0.05	OK	2	0.35	OK
	SBL	3	5	5	6	4	2	3	1.18	OK	-1	0.47	OK	-3	1.33	OK
	SBT	68	105	102	87	105	92	18	2.07	OK	0	0.03	OK	-10	1.04	OK
	SBR	42	65	63	55	64	58	12	1.76	OK	-1	0.17	OK	-5	0.69	OK
M-25 @ Sanborn St	EBL	46	70	68	59	70	56	14	1.87	OK	0	0.04	OK	-12	1.51	OK
	EBT	7	10	10	8	12	12	2	0.64	OK	2	0.51	OK	2	0.60	OK
	EBR	10	15	15	12	13	14	2	0.68	OK	-2	0.44	OK	-1	0.24	OK
	WBL	46	70	68	59	69	65	13	1.80	OK	-1	0.08	OK	-3	0.31	OK
	WBT	7	10	10	11	11	9	4	1.37	OK	1	0.31	OK	0	0.12	OK
	WBR	10	15	15	11	13	9	1	0.31	OK	-2	0.63	OK	-6	1.62	OK
	NBL	16	25	24	18	21	24	2	0.36	OK	-4	0.83	OK	0	0.05	OK
	NBT	562	865	839	592	854	850	30	1.25	OK	-11	0.38	OK	11	0.37	OK
	NBR	29	45	44	30	41	40	0	0.05	OK	-4	0.56	OK	-3	0.51	OK
	SBL	16	25	20	15	19	20	-2	0.38	OK	-6	1.20	OK	0	0.07	OK
	SBT	927	1415	1114	924	1412	1126	-3	0.09	OK	-3	0.07	OK	12	0.36	OK
	SBR	7	10	8	9	11	5	2	0.62	OK	1	0.21	OK	-3	1.32	OK

Intersection Volume - Calibration Data (AM)

Intersection		Target			Vissim			Warmup			Peak			Cooldown		
Int Name	Mvmt	Warmup	Peak	Cooldown	Warmup	Peak	Cooldown	Difference	GEH	OK?	Difference	GEH	OK?	Difference	GEH	OK?
M-25 @ I-94 Connector	EBL	72	110	107	74	115	109	3	0.29	OK	5	0.47	OK	3	0.25	OK
	EBR	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	NBT	536	825	800	577	800	798	41	1.72	OK	-25	0.87	OK	-3	0.09	OK
	SBT	452	690	543	462	709	554	10	0.47	OK	19	0.71	OK	11	0.47	OK
Garfield St @ I-94 Connector	EBT	16	25	24	23	22	22	6	1.42	OK	-3	0.55	OK	-2	0.40	OK
	EBR	13	20	19	19	19	16	6	1.39	OK	-1	0.23	OK	-4	0.89	OK
	WBT	33	50	49	37	56	44	5	0.76	OK	6	0.78	OK	-5	0.71	OK
	WBR	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	NBL	3	5	5	3	3	5	0	0.00	OK	-2	0.82	OK	0	0.08	OK
	NBT	49	75	73	47	78	78	-2	0.29	OK	3	0.38	OK	6	0.64	OK
	NBR	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	SBL	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	SBT	501	765	602	500	742	625	-1	0.03	OK	-23	0.85	OK	23	0.93	OK
	SBR	29	45	35	29	39	29	0	0.05	OK	-6	0.93	OK	-6	1.12	OK
M-25 @ Garfield St	EBL	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	EBT	3	5	5	5	4	5	1	0.64	OK	-1	0.64	OK	0	0.07	OK
	EBR	13	20	19	18	18	18	5	1.27	OK	-2	0.38	OK	-2	0.40	OK
	WBL	3	5	5	3	5	5	0	0.14	OK	0	0.15	OK	0	0.07	OK
	WBT	13	20	19	18	19	14	5	1.27	OK	-1	0.30	OK	-5	1.32	OK
	WBR	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	NBL	33	50	49	34	53	49	2	0.26	OK	3	0.37	OK	1	0.12	OK
	NBT	536	825	800	577	800	798	41	1.73	OK	-25	0.87	OK	-3	0.09	OK
	NBR	20	30	29	17	27	27	-3	0.71	OK	-3	0.63	OK	-2	0.33	OK
	SBL	13	20	16	12	21	17	-1	0.28	OK	1	0.15	OK	1	0.16	OK
	SBT	436	665	524	446	682	534	10	0.48	OK	17	0.64	OK	10	0.42	OK
	SBR	3	5	4	3	7	4	0	0.14	OK	2	0.94	OK	0	0.17	OK
M-25 @ Elmwood St	EBL	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	EBT	3	5	5	3	4	4	0	0.14	OK	-1	0.47	OK	-1	0.40	OK
	EBR	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	WBL	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	WBT	3	5	5	3	5	5	0	0.00	OK	0	0.15	OK	0	0.08	OK
	WBR	13	20	19	15	19	17	2	0.53	OK	-1	0.23	OK	-2	0.48	OK
	NBL	3	5	5	3	7	5	0	0.14	OK	2	0.69	OK	0	0.07	OK
	NBT	660	1015	985	683	984	960	24	0.91	OK	-31	0.99	OK	-25	0.80	OK
	NBR	3	5	5	4	7	5	1	0.52	OK	2	0.94	OK	0	0.07	OK
	SBL	3	5	4	3	5	4	0	0.14	OK	0	0.15	OK	0	0.16	OK
	SBT	462	705	555	476	717	580	14	0.62	OK	12	0.44	OK	25	1.05	OK
	SBR	3	5	4	5	4	5	2	0.77	OK	-1	0.31	OK	1	0.32	OK
M-25 @ BWB On-Ramp	NBL	10	15	15	10	12	15	0	0.08	OK	-3	0.72	OK	0	0.12	OK
	NBT	663	1020	989	699	1002	978	36	1.36	OK	-18	0.58	OK	-11	0.36	OK
	SBT	468	715	563	483	727	589	15	0.70	OK	12	0.43	OK	26	1.07	OK
	SBR	3	5	4	3	6	2	0	0.15	OK	1	0.29	OK	-2	0.94	OK
M-25 @ Church St	EBL	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	EBT	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	EBR	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	WBL	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	WBT	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	WBR	3	5	5	4	6	6	1	0.27	OK	1	0.43	OK	1	0.36	OK
	NBL	7	10	10	6	11	13	0	0.10	OK	1	0.21	OK	3	0.98	OK
	NBT	653	1005	975	688	985	959	35	1.35	OK	-20	0.62	OK	-16	0.51	OK
	NBR	3	5	5	4	6	5	0	0.14	OK	1	0.43	OK	0	0.21	OK
	SBL	3	5	4	4	6	3	1	0.53	OK	1	0.43	OK	-1	0.35	OK
	SBT	472	720	567	488	732	591	16	0.73	OK	12	0.45	OK	24	1.00	OK
	SBR	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
M-25 @ Hancock St	EBL	16	25	24	19	26	26	3	0.60	OK	1	0.20	OK	2	0.35	OK
	EBT	23	35	34	30	30	32	8	1.46	OK	-5	0.94	OK	-2	0.34	OK
	EBR	23	35	34	26	33	29	3	0.56	OK	-2	0.34	OK	-5	0.88	OK
	WBL	23	35	34	30	33	35	7	1.32	OK	-2	0.40	OK	1	0.12	OK
	WBT	127	195	189	157	195	166	30	2.50	OK	0	0.02	OK	-23	1.74	OK
	WBR	7	10	10	8	10	10	2	0.64	OK	0	0.10	OK	0	0.10	OK
	NBL	88	135	131	79	134	121	-9	0.93	OK	-1	0.06	OK	-10	0.89	OK
	NBT	566	870	844	607	843	838	41	1.70	OK	-27	0.92	OK	-6	0.20	OK
	NBR	3	5	5	4	9	4	1	0.52	OK	4	1.40	OK	-1	0.24	OK
	SBL	13	20	16	14	21	16	1	0.27	OK	1	0.29	OK	0	0.08	OK
	SBT	429	655	516	440	670	531	11	0.52	OK	15	0.58	OK	15	0.64	OK
	SBR	10	15	12	10	15	13	0	0.00	OK	0	0.09	OK	1	0.19	OK
I-94 Connector @ Hancock St	EBL	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	EBT	55	85	82	68	81	75	13	1.65	OK	-4	0.40	OK	-7	0.84	OK
	EBR	49	75	73	64	78	65	15	2.00	OK	3	0.38	OK	-8	0.93	OK
	WBL	163	250	243	169	251	213	6	0.47	OK	1	0.04	OK	-30	1.95	OK
	WBT	55	85	82	62	83	85	7	0.85	OK	-2	0.18	OK	3	0.28	OK
	WBR	7	10	10	9	11	7	2	0.81	OK	1	0.41	OK	-3	1.06	OK
	NBL	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	NBT	46	70	68	41	71	76	-4	0.65	OK	1	0.08	OK	8	0.92	OK
	NBR	7	10	10	6	8	12	0	0.10	OK	-2	0.67	OK	3	0.79	OK
	SBL	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	SBT	514	785	618	518	756	639	4	0.18	OK	-29	1.03	OK	21	0.84	OK
	SBR	16	25	20	17	26	21	1	0.31	OK	1	0.13	OK	1	0.15	OK
Water St. @ Campau St	EBL	13	20	19	18	19	17	5	1.15	OK	-1	0.15	OK	-3	0.64	OK
	EBR	3	5	5	3	4	3	0	0.00	OK	-1	0.31	OK	-2	1.13	OK
	NBL	3	5	5	4	5	3	0	0.14	OK	0	0.15	OK	-2	0.75	OK
	NBT	153	235	228	200	234	203	47	3.54	OK	-1	0.09	OK	-25	1.68	OK
	SBT	247	380	369	270	384	341	23	1.42	OK	4	0.19	OK	-28	1.48	OK
	SBR	20	30	29	16	30	34	-4	0.83	OK	0	0.00	OK	5	0.93	OK

Intersection Volume - Calibration Data (PM)

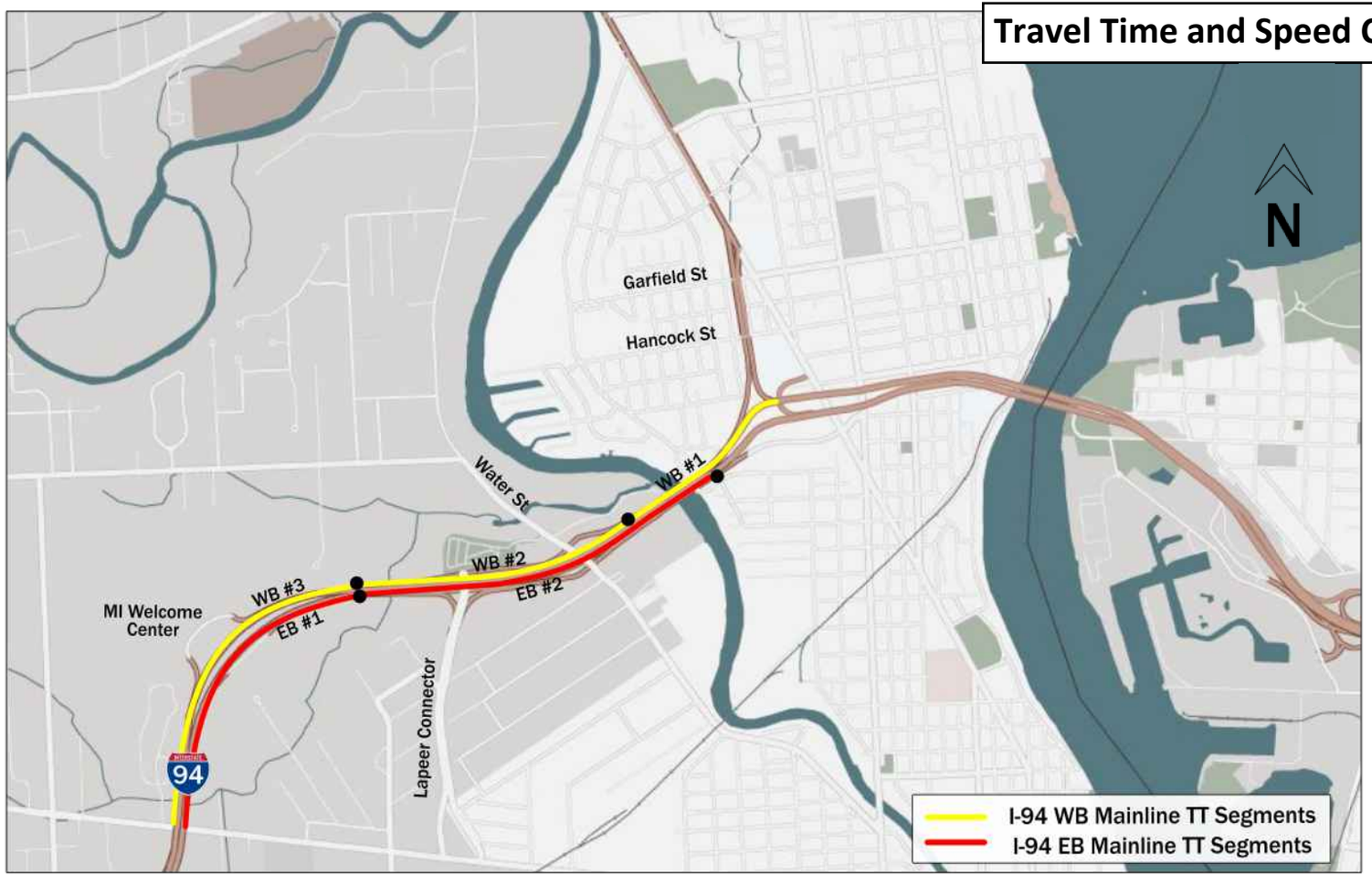
Intersection		Target			Vissim			Warmup			Peak			Cooldown		
Int Name	Mvmt	Warmup	Peak	Cooldown	Warmup	Peak	Cooldown	Difference	GEH	OK?	Difference	GEH	OK?	Difference	GEH	OK?
M-25 @ 10th St	EBT	405	405	324	414	408	383	9	0.44	OK	3	0.13	OK	59	3.16	OK
	EBR	300	300	240	295	303	269	-5	0.29	OK	3	0.19	OK	29	1.82	OK
	WBT	622	575	395	618	574	401	-4	0.16	OK	-1	0.04	OK	6	0.30	OK
	WBR	76	70	48	80	67	48	4	0.40	OK	-3	0.36	OK	0	0.05	OK
	NBL	315	315	252	334	320	285	19	1.03	OK	5	0.26	OK	33	2.03	OK
	NBT	190	190	152	195	182	176	5	0.38	OK	-8	0.61	OK	24	1.90	OK
	SBL	25	25	20	27	22	21	2	0.34	OK	-3	0.69	OK	1	0.15	OK
	SBT	130	130	104	137	122	127	7	0.63	OK	-8	0.71	OK	23	2.17	OK
Lapeer Conn @ Service Drive WB	WBL	335	335	268	325	345	305	-10	0.56	OK	10	0.52	OK	37	2.17	OK
	WBT	180	180	144	172	187	156	-8	0.62	OK	7	0.54	OK	12	0.95	OK
	NBL	35	35	28	35	34	28	0	0.04	OK	-1	0.17	OK	0	0.06	OK
I-94 EB Ramps @ Water St	EBL	115	115	92	100	114	91	-15	1.45	OK	-1	0.09	OK	-1	0.10	OK
	EBT	455	455	364	442	454	343	-13	0.61	OK	-1	0.03	OK	-21	1.13	OK
	EBR	135	135	108	142	138	100	7	0.55	OK	3	0.29	OK	-8	0.75	OK
	NBT	340	340	272	350	332	308	10	0.55	OK	-8	0.44	OK	36	2.13	OK
	NBR	170	170	136	183	176	148	13	0.98	OK	6	0.48	OK	12	1.03	OK
	SBL	125	125	100	131	127	109	6	0.55	OK	2	0.18	OK	9	0.88	OK
	SBT	240	240	192	239	233	218	-1	0.08	OK	-7	0.46	OK	26	1.79	OK
I-94 WB Ramps @ Water St	WBL	160	160	128	155	151	143	-5	0.40	OK	-9	0.69	OK	15	1.32	OK
	WBT	295	295	236	278	311	265	-18	1.03	OK	16	0.90	OK	29	1.85	OK
	WBR	200	200	160	196	197	181	-5	0.32	OK	-3	0.24	OK	21	1.58	OK
	NBT	280	280	224	267	267	245	-14	0.82	OK	-13	0.77	OK	21	1.37	OK
	NBL	175	175	140	182	179	154	7	0.54	OK	4	0.30	OK	14	1.18	OK
	SBT	205	205	164	218	208	181	13	0.91	OK	3	0.23	OK	17	1.29	OK
	SBL	45	45	36	41	40	44	-4	0.65	OK	-5	0.77	OK	8	1.26	OK
I-94 EB Ramps @ M-25	EBL	1000	1000	800	995	1006	814	-6	0.17	OK	6	0.20	OK	14	0.48	OK
	EBT	240	240	192	246	237	192	6	0.38	OK	-3	0.19	OK	0	0.02	OK
	EBR	160	160	128	157	169	126	-3	0.24	OK	9	0.70	OK	-2	0.15	OK
	NBT	958	885	608	949	888	686	-9	0.29	OK	3	0.09	OK	78	3.05	OK
	NBR	5	5	3	4	3	3	-2	0.73	OK	-2	0.82	OK	0	0.20	OK
	SBL	15	15	12	19	16	13	4	0.91	OK	1	0.34	OK	1	0.19	OK
	SBT	545	545	436	553	543	525	8	0.35	OK	-2	0.10	OK	89	4.06	OK
Harker St @ 10th St	EBL	210	210	168	214	208	166	4	0.24	OK	-2	0.14	OK	-2	0.13	OK
	EBT	40	40	32	45	42	34	5	0.80	OK	2	0.36	OK	2	0.29	OK
	EBR	10	10	8	10	8	8	-1	0.16	OK	-2	0.79	OK	0	0.12	OK
	WBL	10	10	8	10	10	10	0	0.08	OK	0	0.00	OK	2	0.77	OK
	WBR	15	15	12	16	14	12	1	0.13	OK	-1	0.26	OK	0	0.10	OK
	NBT	225	225	180	235	218	190	10	0.66	OK	-7	0.45	OK	10	0.71	OK
	NBR	35	35	28	39	34	32	4	0.70	OK	-1	0.11	OK	4	0.73	OK
	SBL	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	SBT	135	135	108	145	128	128	10	0.87	OK	-7	0.61	OK	20	1.84	OK
10th Ave @ Elmwood	EBL	10	10	8	15	12	10	5	1.41	OK	2	0.51	OK	2	0.56	OK
	EBT	5	5	4	4	3	4	-1	0.35	OK	-2	0.82	OK	0	0.16	OK
	EBR	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	WBL	5	5	4	6	5	3	1	0.43	OK	0	0.00	OK	-1	0.35	OK
	WBT	10	10	8	8	9	9	-2	0.58	OK	-1	0.21	OK	1	0.23	OK
	WBR	5	5	4	6	5	5	1	0.43	OK	0	0.15	OK	1	0.47	OK
	NBL	5	5	4	4	5	3	-1	0.60	OK	0	0.15	OK	-1	0.73	OK
	NBT	415	415	332	429	409	340	14	0.67	OK	-6	0.31	OK	8	0.42	OK
	NBR	30	30	24	33	27	24	3	0.45	OK	-3	0.56	OK	0	0.07	OK
	SBL	5	5	4	5	5	5	-1	0.23	OK	0	0.15	OK	1	0.62	OK
	SBT	130	130	104	138	123	125	8	0.65	OK	-7	0.62	OK	21	1.93	OK
	SBR	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
10th Ave @ Church St	EBL	15	15	12	19	14	16	4	1.03	OK	-1	0.26	OK	4	0.99	OK
	EBT	5	5	4	4	6	4	-1	0.47	OK	1	0.29	OK	0	0.00	OK
	EBR	5	5	4	7	6	5	2	0.63	OK	1	0.29	OK	1	0.32	OK
	WBL	5	5	4	3	3	4	-2	1.00	OK	-2	1.00	OK	0	0.17	OK
	WBT	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	WBR	5	5	4	5	5	4	0	0.11	OK	0	0.00	OK	0	0.16	OK
	NBL	10	10	8	12	8	9	2	0.60	OK	-2	0.55	OK	1	0.34	OK
	NBT	410	410	328	426	408	340	16	0.79	OK	-2	0.08	OK	12	0.67	OK
	NBR	10	10	8	11	9	5	1	0.23	OK	-1	0.44	OK	-3	1.03	OK
	SBL	5	5	4	8	3	3	3	1.00	OK	-2	1.00	OK	-1	0.53	OK
	SBT	125	125	100	132	119	122	7	0.57	OK	-6	0.54	OK	22	2.09	OK
	SBR	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
10th Ave @ Hancock St	EBL	15	15	12	13	14	14	-2	0.53	OK	-1	0.26	OK	2	0.64	OK
	EBT	25	25	20	27	23	21	2	0.44	OK	-2	0.48	OK	1	0.22	OK
	EBR	10	10	8	12	7	11	2	0.67	OK	-3	1.03	OK	3	1.07	OK
	WBL	10	10	8	11	7	10	1	0.23	OK	-3	1.15	OK	2	0.56	OK
	WBT	135	135	108	136	140	119	1	0.11	OK	5	0.40	OK	11	1.00	OK
	WBR	5	5	4	6	4	5	1	0.53	OK	-1	0.31	OK	1	0.62	OK
	NBL	45	45	36	46	52	37	1	0.11	OK	7	0.96	OK	1	0.17	OK
	NBT	315	315	252	330	301	266	15	0.84	OK	-14	0.80	OK	14	0.89	OK
	NBR	70	70	56	74	74	57	4	0.50	OK	4	0.47	OK	1	0.18	OK
	SBL	5	5	4	8	4	2	3	1.00	OK	-1	0.64	OK	-2	1.15	OK
	SBT	110	110	88	115	108	105	5	0.49	OK	-2	0.16	OK	17	1.73	OK
	SBR	55	55	44	54	56	47	-1	0.17	OK	1	0.13	OK	3	0.49	OK
M-25 @ Sanborn St	EBL	55	55	44	55	55	47	0	0.00	OK	0	0.00	OK	3	0.44	OK
	EBT	10	10	8	12	10	10	2	0.53	OK	0	0.11	OK	2	0.56	OK
	EBR	10	10	8	10	9	9	0	0.08	OK	-1	0.44	OK	1	0.34	OK
	WBL	45	45	36	50	42	42	5	0.69	OK	-3	0.45	OK	6	1.01	OK
	WBT	55	55	44	56	60	51	1	0.07	OK	5	0.62	OK	7	1.06	OK
	WBR	35	35	28	36	31	30	1	0.17	OK	-4	0.76	OK	2	0.37	OK
	NBL	20	20	16	17	16	14	-4	0.82	OK	-4	0.86	OK	-2	0.52	OK
	NBT	1695	1695	1356	1729	1697	1384	34	0.82	OK	2	0.05	OK	28	0.75	OK
	NBR	30	30	24	31	30	26	1	0.14	OK	0	0.06	OK	2	0.33	OK
	SBL	25	25	24	21	22	25	-4	0.83	OK	-3	0.55	OK	1	0.27	OK
	SBT	1490	1500	1411	1493	1499	1418	3	0.08	OK	-1	0.02	OK	7	0.19	OK
	SBR	10	10	9	14	7	9	4	1.02	OK	-3	1.03	OK	0	0.11	OK

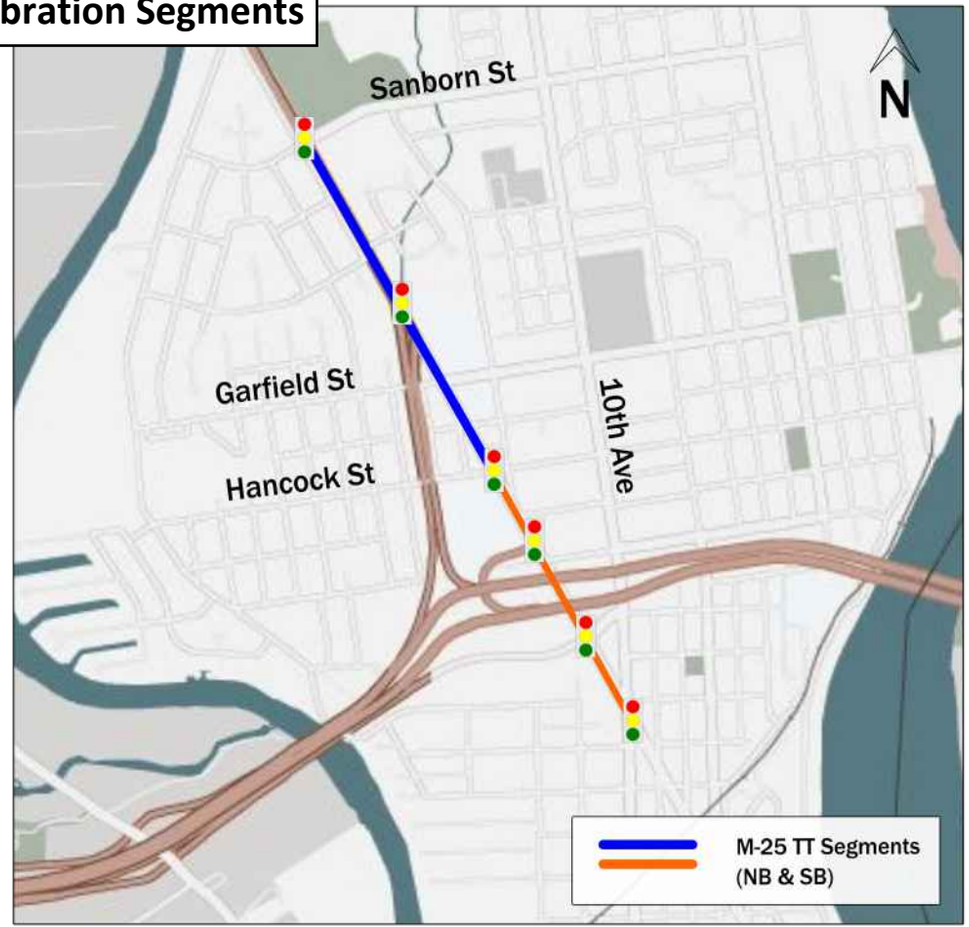
Intersection Volume - Calibration Data (PM)

Intersection		Target			Vissim			Warmup			Peak			Cooldown		
Int Name	Mvmt	Warmup	Peak	Cooldown	Warmup	Peak	Cooldown	Difference	GEH	OK?	Difference	GEH	OK?	Difference	GEH	OK?
M-25 @ I-94 Connector	EBL	125	125	100	119	124	112	-6	0.57	OK	-1	0.06	OK	12	1.17	OK
	EBR	5	5	4	4	4	3	-1	0.47	OK	-1	0.47	OK	-1	0.35	OK
	NBT	1620	1620	1296	1650	1620	1305	30	0.74	OK	0	0.01	OK	9	0.26	OK
	SBT	585	585	468	593	584	571	8	0.32	OK	-1	0.06	OK	103	4.53	OK
Garfield St @ I-94 Connector	EBT	20	20	16	22	18	18	2	0.49	OK	-2	0.46	OK	2	0.56	OK
	EBR	10	10	8	10	5	10	0	0.08	OK	-5	1.69	OK	2	0.67	OK
	WBT	50	50	40	53	51	42	3	0.38	OK	1	0.09	OK	2	0.36	OK
	WBR	5	5	4	4	5	5	-1	0.47	OK	0	0.15	OK	1	0.32	OK
	NBL	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	NBT	80	80	64	74	75	70	-6	0.68	OK	-5	0.53	OK	6	0.69	OK
	NBR	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	SBL	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	SBT	934	940	884	934	939	875	-1	0.02	OK	-1	0.02	OK	-9	0.30	OK
	SBR	30	30	28	27	25	24	-3	0.56	OK	-5	0.95	OK	-4	0.85	OK
M-25 @ Garfield St	EBL	5	5	4	6	4	5	1	0.32	OK	-1	0.31	OK	1	0.62	OK
	EBT	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	EBR	15	15	12	17	14	13	2	0.38	OK	-1	0.26	OK	1	0.19	OK
	WBL	10	10	8	10	11	7	0	0.08	OK	1	0.21	OK	-1	0.37	OK
	WBT	50	50	40	49	48	43	-1	0.11	OK	-2	0.29	OK	3	0.52	OK
	WBR	25	25	20	27	25	25	2	0.30	OK	0	0.00	OK	5	1.12	OK
	NBL	35	35	28	35	38	26	-1	0.08	OK	3	0.50	OK	-2	0.32	OK
	NBT	1590	1590	1272	1618	1590	1272	28	0.69	OK	0	0.01	OK	0	0.01	OK
	NBR	30	30	24	30	32	22	-1	0.09	OK	2	0.42	OK	-2	0.42	OK
	SBL	25	25	20	21	27	24	-4	0.89	OK	2	0.39	OK	4	0.78	OK
	SBT	565	565	452	577	560	552	12	0.48	OK	-5	0.20	OK	100	4.46	OK
	SBR	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
M-25 @ Elmwood St	EBL	5	5	4	4	3	5	-1	0.60	OK	-2	0.82	OK	1	0.32	OK
	EBT	5	5	4	7	5	4	2	0.82	OK	0	0.15	OK	0	0.17	OK
	EBR	5	5	4	5	4	4	-1	0.23	OK	-1	0.31	OK	0	0.17	OK
	WBL	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	WBT	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	WBR	15	15	12	12	14	11	-3	0.82	OK	-1	0.17	OK	-1	0.20	OK
	NBL	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	NBT	1880	1880	1504	1821	1772	1400	-59	1.37	OK	-108	2.52	OK	-104	2.73	OK
	NBR	5	5	4	8	6	5	3	1.00	OK	1	0.43	OK	1	0.47	OK
	SBL	5	5	4	5	3	5	0	0.11	OK	-2	0.82	OK	1	0.62	OK
	SBT	555	555	444	568	551	537	13	0.55	OK	-4	0.18	OK	93	4.20	OK
	SBR	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
M-25 @ BWB On-Ramp	NBL	110	110	88	115	118	94	5	0.47	OK	8	0.75	OK	6	0.66	OK
	NBT	1790	1790	1432	1837	1790	1417	47	1.10	OK	0	0.01	OK	-15	0.41	OK
	SBT	560	560	448	574	554	542	14	0.57	OK	-6	0.25	OK	94	4.22	OK
	SBR	40	40	32	38	44	32	-2	0.28	OK	4	0.62	OK	0	0.06	OK
M-25 @ Church St	EBL	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	EBT	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	EBR	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	WBL	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	WBT	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	WBR	10	10	8	12	9	9	2	0.53	OK	-1	0.44	OK	1	0.34	OK
	NBL	25	25	20	30	27	19	5	0.91	OK	2	0.33	OK	-1	0.15	OK
	NBT	1755	1755	1404	1795	1753	1390	40	0.94	OK	-2	0.06	OK	-14	0.37	OK
	NBR	10	10	8	12	10	8	2	0.67	OK	0	0.00	OK	0	0.12	OK
	SBL	15	15	12	18	15	16	3	0.62	OK	0	0.09	OK	4	1.15	OK
	SBT	600	600	480	613	596	575	13	0.52	OK	-4	0.16	OK	95	4.14	OK
	SBR	5	5	4	6	5	6	1	0.22	OK	0	0.00	OK	2	1.03	OK
M-25 @ Hancock St	EBL	20	20	16	19	21	20	-2	0.34	OK	1	0.22	OK	4	0.87	OK
	EBT	35	35	28	38	30	34	3	0.42	OK	-5	0.94	OK	6	1.02	OK
	EBR	30	30	24	32	26	27	2	0.27	OK	-4	0.69	OK	3	0.53	OK
	WBL	25	25	20	24	27	22	-1	0.15	OK	2	0.33	OK	2	0.44	OK
	WBT	185	185	148	188	186	170	3	0.18	OK	1	0.05	OK	22	1.72	OK
	WBR	25	25	20	20	28	28	-5	1.00	OK	3	0.65	OK	8	1.57	OK
	NBL	155	155	124	161	154	135	6	0.44	OK	-1	0.11	OK	11	1.00	OK
	NBT	1610	1610	1288	1643	1607	1266	33	0.81	OK	-3	0.07	OK	-22	0.62	OK
	NBR	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	SBL	15	15	12	16	14	13	1	0.13	OK	-1	0.35	OK	1	0.28	OK
	SBT	565	565	452	578	564	550	13	0.55	OK	-1	0.06	OK	98	4.39	OK
	SBR	10	10	8	12	9	9	2	0.60	OK	-1	0.21	OK	1	0.23	OK
I-94 Connector @ Hancock St	EBL	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	EBT	70	70	56	74	68	64	4	0.47	OK	-2	0.20	OK	8	1.03	OK
	EBR	50	50	40	50	51	45	0	0.04	OK	1	0.19	OK	5	0.72	OK
	WBL	260	260	208	259	264	224	-1	0.06	OK	4	0.23	OK	16	1.09	OK
	WBT	85	85	68	94	85	85	9	0.95	OK	0	0.04	OK	17	1.98	OK
	WBR	5	5	4	6	4	6	1	0.22	OK	-1	0.31	OK	2	0.76	OK
	NBL	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	NBT	75	75	60	69	71	63	-7	0.77	OK	-4	0.43	OK	3	0.42	OK
	NBR	15	15	12	13	12	13	-2	0.47	OK	-3	0.72	OK	1	0.19	OK
	SBL	0	0	0	0	0	0	0	N/A	OK	0	N/A	OK	0	N/A	OK
	SBT	954	960	903	950	955	883	-5	0.15	OK	-5	0.17	OK	-20	0.66	OK
	SBR	20	20	19	23	21	16	3	0.70	OK	1	0.15	OK	-3	0.63	OK
Water St. @ Campau St	EBL	15	15	12	18	13	12	3	0.62	OK	-2	0.44	OK	0	0.00	OK
	EBR	10	10	8	7	10	10	-3	0.94	OK	0	0.10	OK	2	0.77	OK
	NBL	10	10	8	10	11	10	-1	0.16	OK	1	0.31	OK	2	0.67	OK
	NBT	495	495	396	517	494	448	22	0.98	OK	-1	0.06	OK	52	2.52	OK
	SBT	340	340	272	344	337	286	4	0.22	OK	-3	0.16	OK	14	0.86	OK
	SBR	35	35	28	34	37	31	-1	0.21	OK	2	0.33	OK	3	0.61	OK

Appendix I – Travel Time and Speed Calibration Data

Travel Time and Speed Calibration Segments





AM Travel Time Calibration Data

Segment Number	Segment Name	Distance (mi)	Distance (mi)	3:30 PM - 4:30 PM					4:30 PM - 5:30 PM					5:30 PM - 6:30 PM				
				Actual (Sec)	Vissim (Sec)	Diff (Sec)	% Diff	OK?	Actual (Sec)	Vissim (Sec)	Diff (Sec)	% Diff	OK?	Actual (Sec)	Vissim (Sec)	Diff (Sec)	% Diff	OK?
1	I-94 EB to west of Lapeer Connector	4269	0.81	41.8	42.3	0.5	1%	OK	41.2	42.5	1.2	3%	OK	41.4	42.7	1.3	3%	OK
2	I-94 EB to west of Toll Facility	9106	1.72	89.2	90.3	1.1	1%	OK	87.9	90.6	2.7	3%	OK	88.3	90.5	2.3	3%	OK
3	I-94 WB to east of Water St	2894	0.55	41.3	41.0	-0.2	-1%	OK	43.4	41.2	-2.2	-5%	OK	42.5	41.6	-0.9	-2%	OK
4	I-94 WB to east of Welcome Center	5492	1.04	55.4	60.1	4.6	8%	OK	57.4	60.1	2.7	5%	OK	57.1	60.3	3.2	6%	OK
5	I-94 WB - end	4745	0.90	45.9	46.9	1.0	2%	OK	46.6	47.1	0.4	1%	OK	46.9	47.2	0.4	1%	OK
6	M-25 NB - 10th Ave to Hancock St	2577	0.49	68.1	64.9	-3.2	-5%	OK	72.2	69.3	-2.9	-4%	OK	73.0	74.3	1.3	2%	OK
7	M-25 NB - Hancock St to Sanborn St	3563	0.67	82.2	81.1	-1.1	-1%	OK	81.6	87.0	5.4	7%	OK	82.1	88.3	6.2	8%	OK
8	M-25 SB - Sanborn St to Hancock St	3668	0.69	67.0	84.8	17.7	26%	OK	71.7	87.1	15.5	22%	OK	72.1	90.2	18.1	25%	OK
9	M-25 SB - Hancock St to 10th Ave	2473	0.47	70.3	63.2	-7.2	-10%	OK	73.3	70.6	-2.7	-4%	OK	73.7	73.7	-0.1	0%	OK

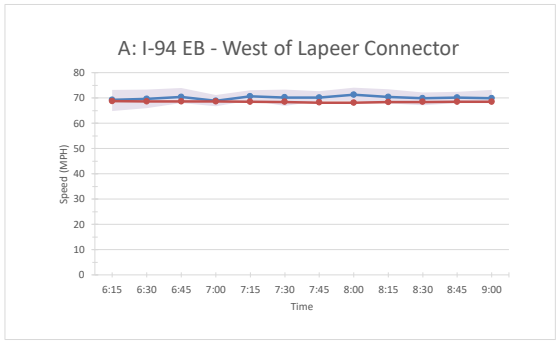
PM Travel Time Calibration Data

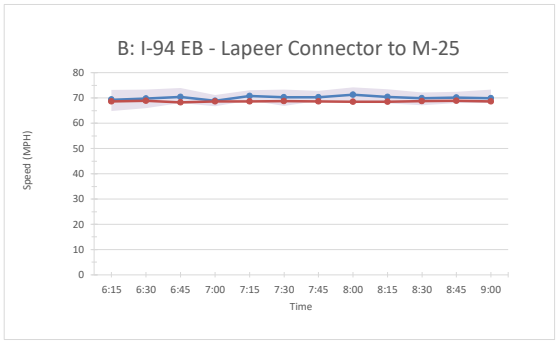
Segment Number	Segment Name	Distance (mi)	Distance (mi)	6:15 AM - 7:15 AM					7:15 AM - 8:15 AM					8:15 AM - 9:15 AM				
				Actual (Sec)	Vissim (Sec)	Diff (Sec)	% Diff	OK?	Actual (Sec)	Vissim (Sec)	Diff (Sec)	% Diff	OK?	Actual (Sec)	Vissim (Sec)	Diff (Sec)	% Diff	OK?
1	I-94 EB to west of Lapeer Connector	4269	0.81	41.5	42.7	1.3	3%	OK	41.4	42.7	1.2	3%	OK	41.5	42.7	1.2	3%	OK
2	I-94 EB to west of Toll Facility	9106	1.72	88.4	90.5	2.1	2%	OK	88.4	90.6	2.2	3%	OK	88.5	90.5	2.0	2%	OK
3	I-94 WB to east of Water St	2894	0.55	41.0	41.0	0.0	0%	OK	41.5	41.0	-0.6	-1%	OK	41.9	41.1	-0.8	-2%	OK
4	I-94 WB to east of Welcome Center	5492	1.04	56.7	60.2	3.5	6%	OK	56.5	60.3	3.8	7%	OK	56.4	60.3	3.9	7%	OK
5	I-94 WB - end	4745	0.90	46.4	47.1	0.7	1%	OK	46.2	47.1	1.0	2%	OK	46.1	47.1	1.0	2%	OK
6	M-25 NB - 10th Ave to Hancock St	2577	0.49	81.9	73.1	-8.8	-11%	OK	83.8	72.7	-11.1	-13%	OK	74.2	72.3	-1.9	-3%	OK
7	M-25 NB - Hancock St to Sanborn St	3563	0.67	84.7	83.5	-1.2	-1%	OK	85.3	83.4	-1.9	-2%	OK	82.0	82.9	1.0	1%	OK
8	M-25 SB - Sanborn St to Hancock St	3668	0.69	75.7	84.5	8.8	12%	OK	75.6	84.4	8.8	12%	OK	75.5	84.7	9.2	12%	OK
9	M-25 SB - Hancock St to 10th Ave	2473	0.47	66.7	72.3	5.6	8%	OK	66.6	72.9	6.3	10%	OK	66.0	71.5	5.5	8%	OK

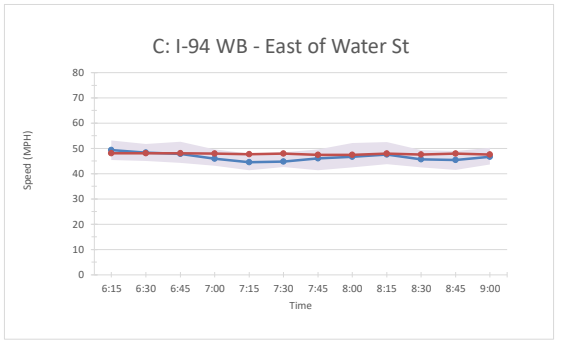
AM Peak Period Speed Comparison

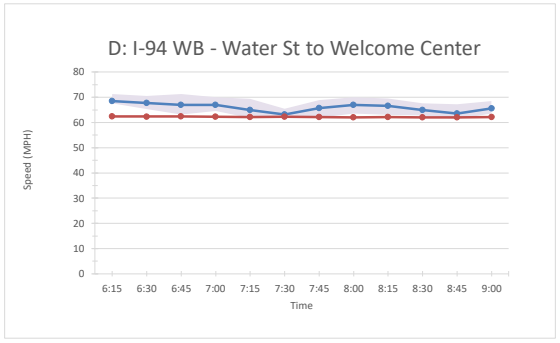
		I-94 EB		I-94 WB			M-25 NB		M-25 SB	
	ID	A	B	C	D	E	F	G	H	I
	Segment	West of Lapeer Connector	Lapeer Connector to M-25	East of Water Street	Water St to Welcome Center	West of Welcome Center	10th Ave to Hancock St	Hancock St to Sanborn St	Sanborn St to Hancock St	Hancock St to 10th Ave
VISSIM Results	3:30 PM	68.80	68.61	48.06	62.36	69.04	26.43	30.85	29.14	28.92
	3:45 PM	68.68	68.89	48.11	62.34	68.78	26.48	30.05	28.84	28.49
	4:00 PM	68.63	68.21	48.08	62.42	68.93	25.29	28.93	28.49	27.31
	4:15 PM	68.61	68.62	48.01	62.27	68.79	24.86	28.14	28.33	24.94
	4:30 PM	68.53	68.62	47.75	62.13	68.63	24.08	28.20	28.17	25.18
	4:45 PM	68.47	68.71	47.96	62.25	68.67	24.91	28.15	27.90	25.35
	5:00 PM	68.22	68.67	47.39	62.14	68.60	23.43	27.96	27.65	24.96
	5:15 PM	68.14	68.52	47.49	61.99	68.45	22.79	27.90	26.86	24.26
	5:30 PM	68.44	68.54	47.93	62.12	68.51	23.05	27.82	27.50	24.55
	5:45 PM	68.47	68.78	47.56	62.04	68.57	23.50	27.66	27.95	24.84
	6:00 PM	68.50	68.88	47.97	62.08	68.49	24.03	28.24	28.08	25.85
	6:15 PM	68.48	68.66	47.55	62.20	68.63	23.53	28.25	28.13	25.45
September 3 - Nov 21, 2019 (INRIX - Average)	3:30 PM	69.33	69.33	49.37	68.54	70.77	25.13	29.62	36.65	26.35
	3:45 PM	69.72	69.72	48.32	67.73	70.30	25.54	29.51	35.69	25.47
	4:00 PM	70.42	70.42	47.78	67.02	70.43	26.19	29.18	35.63	24.53
	4:15 PM	68.87	68.87	45.89	66.93	70.28	26.27	29.94	35.43	25.20
	4:30 PM	70.74	70.74	44.50	64.99	70.42	25.23	29.90	33.20	24.43
	4:45 PM	70.24	70.24	44.75	63.16	66.88	23.88	29.73	32.80	24.52
	5:00 PM	70.23	70.23	46.09	65.69	69.09	24.23	29.93	33.73	23.73
	5:15 PM	71.32	71.32	46.68	66.99	71.23	24.00	29.49	34.44	24.75
	5:30 PM	70.42	70.42	47.63	66.59	69.88	23.26	29.68	33.34	23.76
	5:45 PM	69.89	69.89	45.66	64.98	67.86	24.08	29.71	33.35	23.76
	6:00 PM	70.14	70.14	45.37	63.60	67.12	24.01	29.34	32.40	24.05
	6:15 PM	69.95	69.95	46.74	65.61	69.10	24.95	29.65	33.17	24.72
September 3 - Nov 21, 2019 (INRIX - 15th Percentile)	3:30 PM	64.79	64.79	45.40	67.60	69.34	20.71	24.59	31.75	22.34
	3:45 PM	65.96	65.96	45.03	65.38	68.84	21.52	24.86	32.07	21.73
	4:00 PM	68.02	68.02	44.29	63.17	68.15	22.05	25.47	32.25	22.15
	4:15 PM	66.79	66.79	43.16	64.60	67.69	22.87	26.90	31.80	22.17
	4:30 PM	69.05	69.05	41.38	61.79	68.41	22.21	27.79	30.36	22.07
	4:45 PM	66.84	66.84	42.63	62.03	64.53	20.43	26.98	29.94	22.03
	5:00 PM	68.92	68.92	41.37	61.83	65.84	20.75	27.12	31.10	21.51
	5:15 PM	68.91	68.91	42.53	63.49	67.99	20.88	26.65	31.06	22.91
	5:30 PM	67.86	67.86	43.77	63.07	66.54	18.72	26.76	30.72	21.66
	5:45 PM	67.17	67.17	42.55	62.82	64.67	20.20	27.28	30.99	21.70
	6:00 PM	67.99	67.99	41.56	61.40	64.06	19.52	26.28	29.71	22.16
	6:15 PM	68.02	68.02	43.60	63.52	65.98	21.52	26.18	30.19	21.25
September 3 - Nov 21, 2019 (INRIX - 85th Percentile)	3:30 PM	73.19	73.19	53.17	71.22	73.92	30.55	34.43	41.29	30.73
	3:45 PM	73.32	73.32	51.81	70.53	73.06	30.46	34.31	39.07	29.11
	4:00 PM	73.94	73.94	52.69	71.28	74.21	29.75	32.82	38.73	26.53
	4:15 PM	71.15	71.15	49.58	70.07	73.65	29.52	33.13	38.86	28.42
	4:30 PM	73.12	73.12	48.01	69.35	74.20	27.98	31.93	36.46	26.75
	4:45 PM	73.30	73.30	48.48	65.42	69.69	27.39	32.29	36.22	27.08
	5:00 PM	72.76	72.76	49.64	68.91	72.19	27.61	32.14	36.40	26.17
	5:15 PM	74.16	74.16	52.11	70.04	74.32	27.56	33.12	37.86	26.98
	5:30 PM	73.46	73.46	52.53	69.51	73.68	27.16	33.13	36.36	26.16
	5:45 PM	72.24	72.24	49.40	67.58	70.64	27.86	32.19	36.03	25.92
	6:00 PM	72.41	72.41	49.01	67.23	70.36	28.16	32.38	35.07	25.72
	6:15 PM	73.28	73.28	50.24	68.48	72.49	28.42	32.97	35.82	28.03

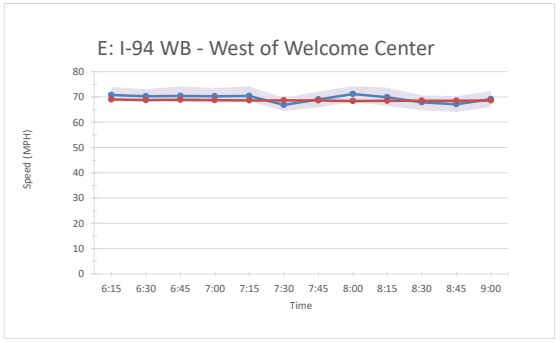
Speed Graphs - AM Peak Period

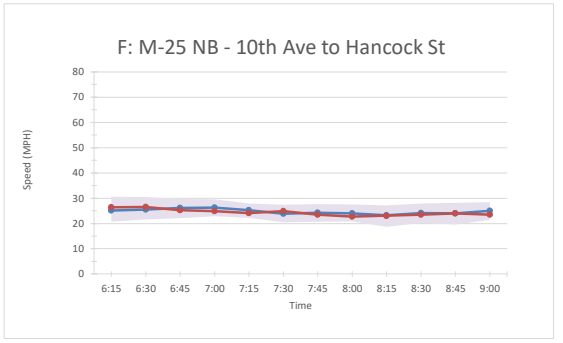


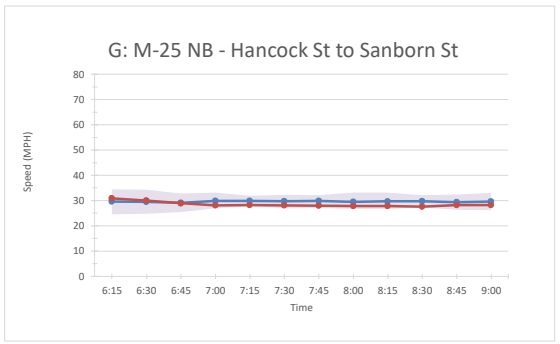


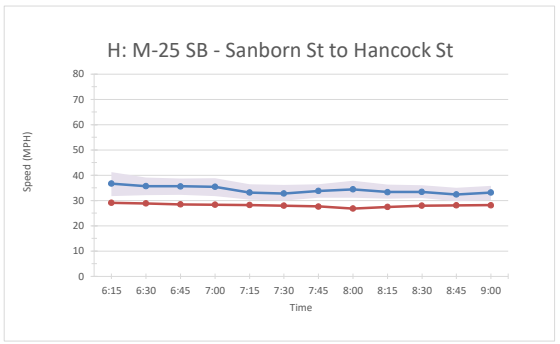


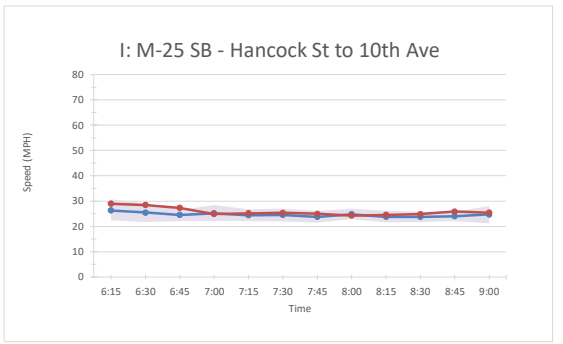










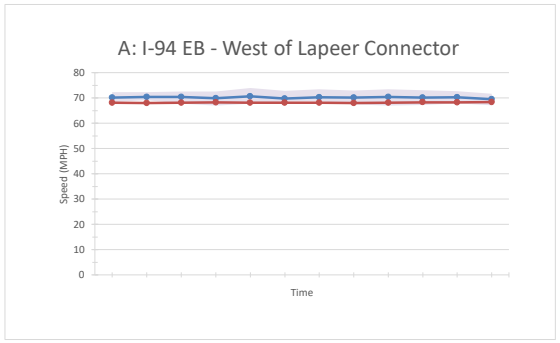


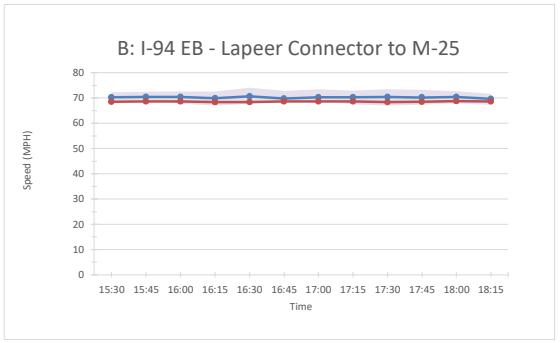
15th-85th Percentile (RITIS) Sep 3 - Nov 21, 2019 (RITIS) VISSIM Speeds

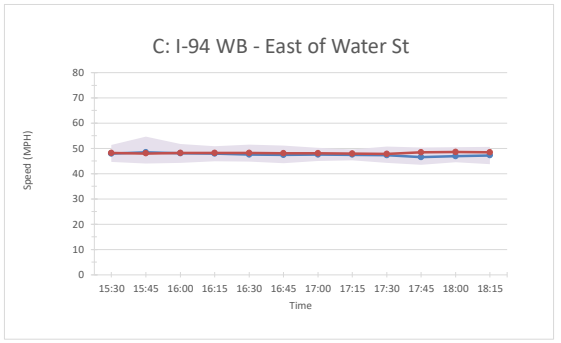
PM Peak Period Speed Comparison

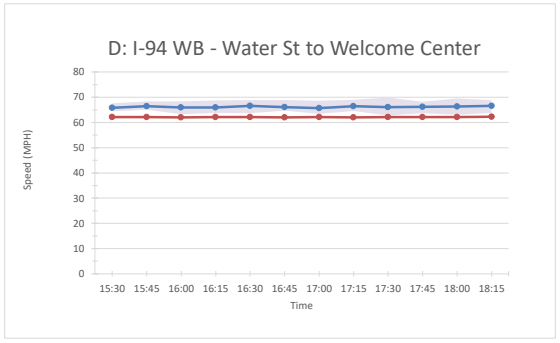
		I-94 EB		I-94 WB			M-25 NB		M-25 SB	
	ID	A	B	C	D	E	F	G	H	I
	Segment	West of Lapeer Connector	Lapeer Connector to M-25	East of Water Street	Water St to Welcome Center	West of Welcome Center	10th Ave to Hancock St	Hancock St to Sanborn St	Sanborn St to Hancock St	Hancock St to 10th Ave
VISSIM Results	3:30 PM	68.10	68.49	48.25	62.16	68.79	23.85	29.77	28.95	25.08
	3:45 PM	68.08	68.65	48.02	62.20	68.63	23.22	29.29	29.22	25.02
	4:00 PM	68.17	68.60	48.15	62.04	68.65	24.25	29.68	29.07	24.31
	4:15 PM	68.23	68.37	48.15	62.18	68.69	24.01	29.51	28.85	24.53
	4:30 PM	68.19	68.38	48.22	62.12	68.68	24.23	29.78	29.35	24.88
	4:45 PM	68.16	68.68	48.14	62.00	68.52	22.23	29.33	29.11	25.88
	5:00 PM	68.19	68.61	48.07	62.15	68.69	23.90	29.60	29.05	25.45
	5:15 PM	68.07	68.64	48.01	62.06	68.74	23.68	29.86	28.94	25.23
	5:30 PM	68.15	68.42	47.82	62.16	68.67	23.88	29.78	29.24	24.90
	5:45 PM	68.35	68.54	48.43	62.16	68.74	24.49	30.06	28.96	25.57
	6:00 PM	68.29	68.74	48.60	62.16	68.82	25.26	30.61	28.95	25.69
	6:15 PM	68.44	68.61	48.50	62.22	68.77	25.58	30.54	29.00	25.89
September 3 - Nov 21, 2019 (INRIX - Average)	3:30 PM	70.23	70.23	47.92	65.81	69.35	22.32	28.85	32.57	24.71
	3:45 PM	70.39	70.39	48.48	66.42	69.87	21.09	28.30	32.80	25.26
	4:00 PM	70.38	70.38	48.08	65.96	69.60	21.38	29.05	33.18	25.88
	4:15 PM	69.87	69.87	48.00	66.01	70.07	21.04	28.52	33.64	25.31
	4:30 PM	70.64	70.64	47.54	66.56	70.53	22.37	28.76	33.34	25.19
	4:45 PM	69.78	69.78	47.41	66.14	69.42	19.43	27.85	32.79	24.84
	5:00 PM	70.29	70.29	47.61	65.73	69.90	22.10	28.64	33.37	25.74
	5:15 PM	70.22	70.22	47.51	66.51	70.47	19.97	28.66	32.75	25.59
	5:30 PM	70.41	70.41	47.30	66.11	69.91	23.48	29.37	33.49	25.61
	5:45 PM	70.22	70.22	46.60	66.21	70.45	24.09	30.64	32.92	25.50
	6:00 PM	70.35	70.35	46.95	66.33	70.09	25.51	29.84	33.12	25.74
	6:15 PM	69.60	69.60	47.25	66.59	70.01	25.27	29.66	33.34	25.32
September 3 - Nov 21, 2019 (INRIX - 15th Percentile)	3:30 PM	68.38	68.38	44.72	64.49	67.22	20.07	25.61	30.22	21.04
	3:45 PM	69.16	69.16	44.09	65.04	68.33	19.18	26.01	30.55	22.50
	4:00 PM	67.73	67.73	44.24	63.27	66.73	18.99	25.69	30.84	22.55
	4:15 PM	67.04	67.04	44.94	63.79	68.13	18.83	25.71	31.33	21.68
	4:30 PM	67.80	67.80	44.83	63.69	68.23	19.95	25.70	30.67	21.45
	4:45 PM	68.67	68.67	44.17	64.67	68.27	16.37	24.38	30.36	21.14
	5:00 PM	68.84	68.84	45.01	63.37	67.41	20.53	25.60	30.39	21.25
	5:15 PM	67.54	67.54	45.25	64.62	68.83	17.37	24.70	29.89	21.25
	5:30 PM	67.03	67.03	44.23	62.80	66.27	20.53	26.32	30.46	22.08
	5:45 PM	67.33	67.33	43.55	63.66	68.15	21.53	27.28	29.73	21.26
	6:00 PM	67.94	67.94	44.58	63.09	67.15	22.78	26.40	30.37	22.11
	6:15 PM	67.19	67.19	43.79	63.84	66.89	21.64	26.73	30.27	21.42
September 3 - Nov 21, 2019 (INRIX - 85th Percentile)	3:30 PM	72.37	72.37	51.40	67.58	71.01	24.55	32.18	34.69	28.31
	3:45 PM	72.39	72.39	54.64	68.31	71.67	23.19	30.10	34.92	28.64
	4:00 PM	72.54	72.54	51.77	68.43	72.00	23.58	32.76	35.30	29.21
	4:15 PM	72.59	72.59	50.87	68.78	72.52	23.58	31.18	37.15	29.52
	4:30 PM	74.02	74.02	51.46	68.88	72.90	25.21	31.57	36.32	29.09
	4:45 PM	72.84	72.84	51.10	68.94	71.36	22.23	30.05	35.68	28.06
	5:00 PM	73.49	73.49	50.26	68.66	72.47	24.25	31.70	36.11	29.70
	5:15 PM	73.01	73.01	49.55	68.99	72.44	22.48	32.59	35.16	29.10
	5:30 PM	73.51	73.51	50.74	69.83	72.58	26.19	32.80	36.64	29.15
	5:45 PM	73.15	73.15	50.34	68.24	73.06	26.89	34.04	36.63	29.73
	6:00 PM	72.69	72.69	50.55	69.45	73.20	28.41	32.94	35.81	29.73
	6:15 PM	71.71	71.71	50.66	68.88	73.29	28.80	32.41	36.01	29.12

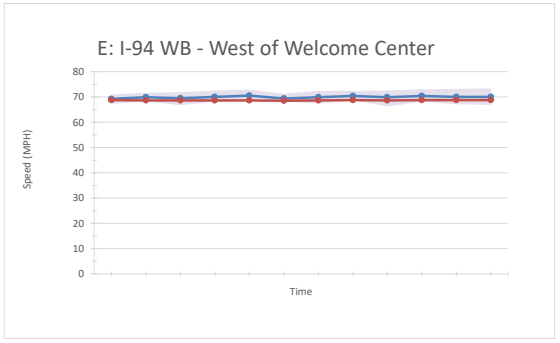
Speed Graphs - PM Peak Period

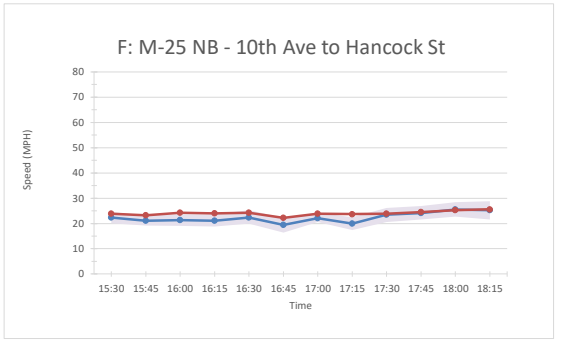


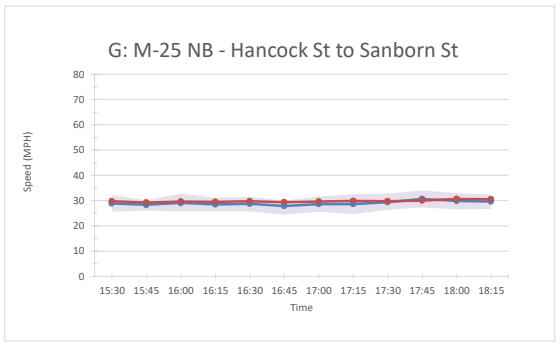


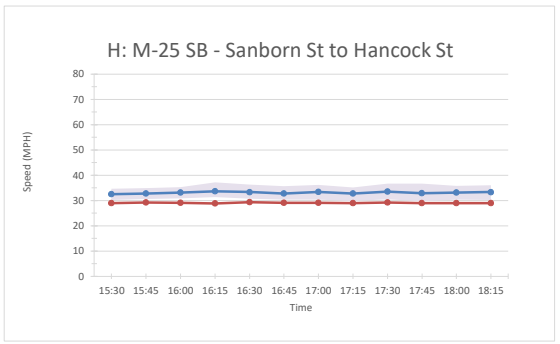


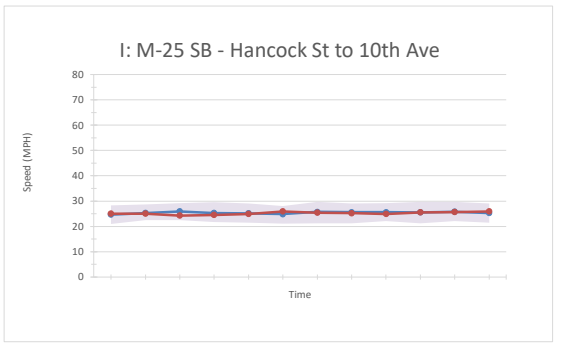










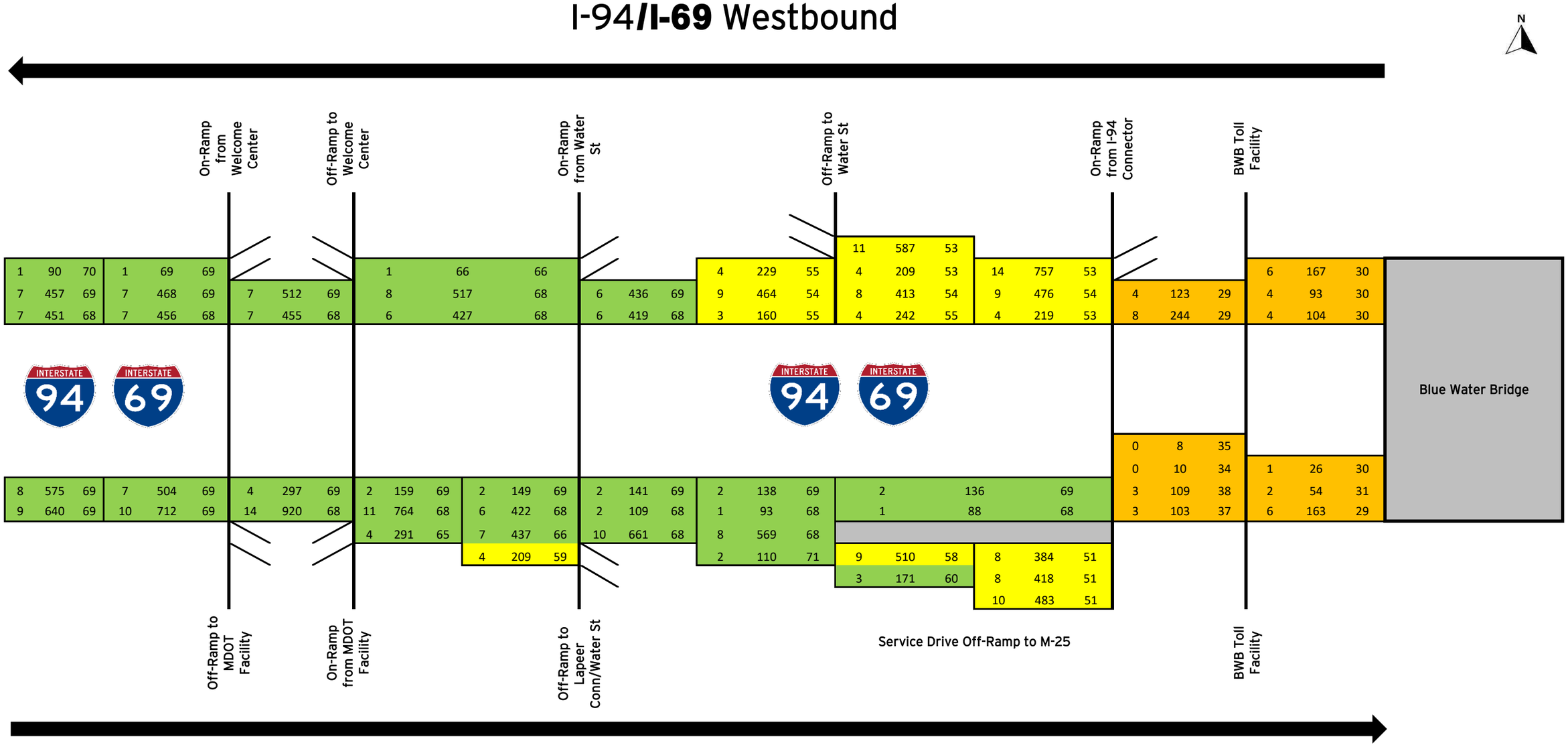


15th-85th Percentile (RITIS) Sep 3 - Nov 21, 2019 (RITIS) VISSIM Speeds

Appendix J – Existing Freeway Measures of Effectiveness

AM Peak Hour Lane Schematic

I-94/**I-69** Westbound

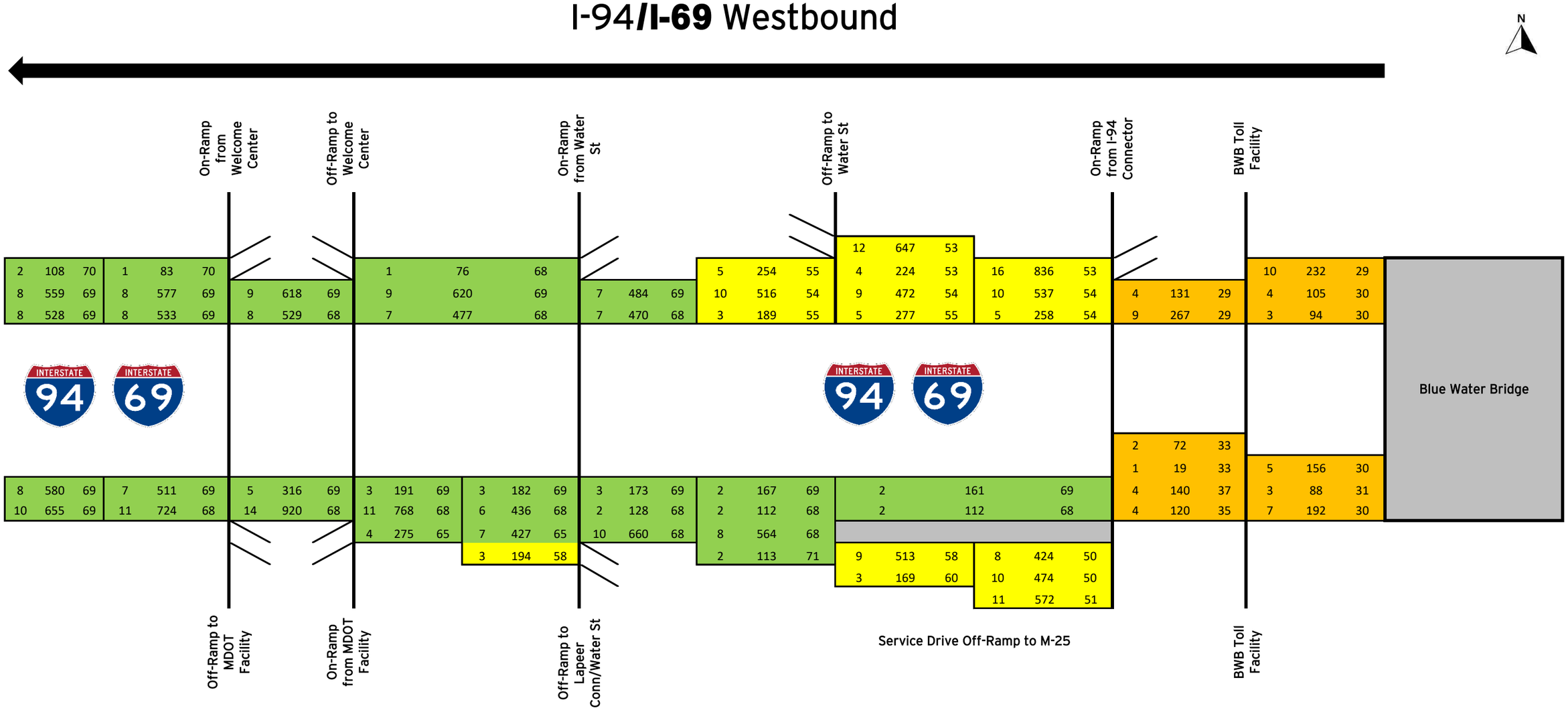


I-94/**I-69** Eastbound

Legend		
Density (veh/ln/mi/hr)	**Volume (veh/ln/hr)**	**Speed (mph)**
XX	XXX	XX
	< 25 mph	
	25 mph - 45 mph	
	45 mph - 60 mph	
	> 60 mph	

PM Peak Hour Lane Schematic

I-94/**I-69** Westbound



I-94/**I-69** Eastbound

Legend		
Density (veh/ln/mi/hr)	**Volume (veh/ln/hr)**	**Speed (mph)**
XX	XXX	XX
	< 25 mph	
	25 mph - 45 mph	
	45 mph - 60 mph	
	> 60 mph	

Appendix K – Existing Intersection Level of Service

Existing Intersection Level of Service

Intersections				AM						PM					
				All		Approach		Intersection		All		Approach		Intersection	
Int ID	Int Name	Mvmt	Sig?	Mvt Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Mvt Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
1	M-25 @ 10th St	EBT	S	8.01	A	7.4	A	12.8	B	13.66	B	10.8	B	22.3	C
		EBR		6.03	A					6.94	A				
		WBT		11.79	B	11.3	B			18.77	B	18.4	B		
		WBR		5.28	A					15.27	B				
		NBL		1.91	A	14.9	B			36.63	D	37.0	D		
		NBT		42.45	D					37.66	D				
		SBL		47.49	D	49.6	D			47.11	D	45.7	D		
		SBT		50.10	D					45.50	D				
2	Lapeer Conn @ Service Drive WB	WBL	S	2.27	A	2.4	A	15.0	B	1.61	A	1.5	A	18.6	B
		WBT		2.79	A					1.19	A				
		NBL		8.17	A	8.2	A			7.90	A	7.9	A		
3	I-94 EB Ramps @ Water St	EBL	S	27.87	C	29.9	C	16.9	B	25.17	C	32.3	C	22.1	C
		EBT		29.34	C					36.80	D				
		EBR		31.04	C					23.21	C				
		NBT		10.74	B	7.0	A			18.27	B	15.4	B		
		NBR		3.91	A					4.40	A				
		SBL		6.41	A	7.5	A			23.26	C	14.5	B		
		SBT		8.18	A					9.71	A				
4	I-94 WB Ramps @ Water St	WBL	S	25.90	C	22.4	C	15.8	B	28.59	C	21.7	C	14.3	B
		WBT		26.67	C					26.56	C				
		WBR		6.19	A					8.85	A				
		NBT		6.43	A	9.1	A			6.14	A	7.4	A		
		NBL		7.06	A					3.04	A				
		SBT		10.36	B	9.2	A			12.85	B	11.7	B		
		SBL		5.08	A					5.59	A				
5	I-94 EB Ramps @ M-25	EBL	S	27.67	C	27.1	C	22.8	C	32.68	C	30.1	C	19.3	B
		EBT		30.58	C					30.13	C				
		EBR		22.77	C					14.82	B				
		NBT		13.74	B	13.8	B			8.99	A	9.3	A		
		NBR		6.42	A					5.77	A				
		SBL		20.00	B	20.3	C			25.03	C	8.3	A		
		SBT		20.28	C					7.81	A				
6	Harker St @ 10th St	EBL	S	12.71	B	12.5	B	8.5	A	13.77	B	13.3	B	6.8	A
		EBT		12.30	B					12.28	B				
		EBR		0.00	A					6.60	A				
		WBL		6.43	A	0.6	A			6.35	A	0.7	A		
		WBR		5.16	A					5.66	A				
		NBT		0.08	A	0.2	A			0.15	A	0.3	A		
		NBR		0.87	A					0.93	A				
		SBL		0.54	A	0.1	A			0.00	A	0.1	A		
		SBT		0.10	A					0.08	A				
8	10th Ave @ Church St	EBL	S	8.43	A	8.3	A	1.8	A	8.14	A	7.8	A	0.8	A
		EBT		7.83	A					6.80	A				
		EBR		0.00	A					0.00	A				
		WBL		8.94	A	8.5	A			5.76	A	8.4	A		
		WBT		8.92	A					10.49	B				
		WBR		6.50	A					7.07	A				
		NBL		0.88	A	0.1	A			1.64	A	0.2	A		
		NBT		0.08	A					0.15	A				
		NBR		0.73	A					0.69	A				
		SBL		0.00	A	0.1	A			3.94	A	0.2	A		
		SBT		0.10	A					0.08	A				
		SBR		0.00	A					0.00	A				
9	10th Ave @ Hancock St	EBL	S	27.60	C	14.4	B	17.1	B	19.80	B	18.9	B	20.7	C
		EBT		12.33	B					22.12	C				
		EBR		5.07	A					6.62	A				
		WBL		19.86	B	14.3	B			16.00	B	18.4	B		
		WBT		13.61	B					18.95	B				
		WBR		0.00	A					5.83	A				
		NBL		30.88	C	19.0	B			29.56	C	20.5	C		
		NBT		19.80	B					20.61	C				
		NBR		9.80	A					13.56	B				
		SBL		17.39	B	14.9	B			42.03	D	15.2	B		
		SBT		17.16	B					17.20	B				
		SBR		10.88	B					9.56	A				
10	M-25 @ Sanborn St	EBL	S	45.73	D	37.5	D	16.4	B	57.21	E	45.2	D	8.5	A
		EBT		10.81	B					7.44	A				
		EBR		18.07	B					10.96	B				
		WBL		35.70	D	33.0	C			34.59	C	36.3	D		
		WBT		43.91	D					44.05	D				
		WBR		9.07	A					23.43	C				
		NBL		31.79	C	12.2	B			29.70	C	4.7	A		
		NBT		11.80	B					4.50	A				
		NBR		11.26	B					4.95	A				
		SBL		15.80	B	6.0	A			19.92	B	5.5	A		
		SBT		5.82	A					5.25	A				
		SBR		9.40	A					14.46	B				

Existing Intersection Level of Service

Intersections				AM						PM					
				All		Approach		Intersection		All		Approach		Intersection	
Int ID	Int Name	Mvmt	Sig?	Mvt Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Mvt Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
11	M-25 @ I-94 Connector	EBL	S	40.91	D	5.7	A	5.9	A	47.51	D	8.1	A	6.8	A
		EBR		0.00	A					42.12	D				
		NBT		0.68	A	2.9	A			5.00	A	4.1	A		
		SBT		5.47	A					1.71	A				
12	Garfield St @ I-94 Connector	EBT	S	11.38	B	11.0	B	6.2	A	6.65	A	14.6	B	7.3	A
		EBR		9.83	A					14.02	B				
		WBT		11.19	B	10.7	B			17.43	B	16.3	B		
		WBR		0.00	A					5.36	A				
		NBL		2.64	A	0.6	A			0.00	A	0.4	A		
		NBT		0.49	A					0.39	A				
		NBR		0.00	A					0.00	A				
		SBL		0.00	A	0.2	A			0.00	A	0.1	A		
		SBT		0.17	A					0.12	A				
		SBR		0.85	A					0.87	A				
13	M-25 @ Garfield St	EBL	S	0.00	A	7.2	A	1.4	A	9.30	A	6.9	A	2.1	A
		EBT		11.38	B					6.65	A				
		EBR		6.32	A					6.10	A				
		WBL		13.43	B	11.7	B			27.54	C	19.0	B		
		WBT		11.19	B					17.43	B				
		WBR		0.00	A					18.37	B				
		NBL		4.38	A	1.0	A			5.15	A	1.2	A		
		NBT		0.73	A					1.10	A				
		NBR		0.96	A					1.30	A				
		SBL		6.35	A	0.5	A			30.24	C	1.6	A		
		SBT		0.35	A					0.21	A				
		SBR		0.89	A					0.00	A				
14	M-25 @ Elmwood St	EBL	S	0.00	A	15.6	B	0.6	A	13.60	B	14.6	B	2.0	A
		EBT		15.55	B					16.77	B				
		EBR		0.00	A					12.79	B				
		WBL		0.00	A	11.6	B			0.00	A	11.7	B		
		WBT		14.77	B					0.00	A				
		WBR		10.84	B					11.73	B				
		NBL		5.56	A	0.3	A			0.00	A	1.8	A		
		NBT		0.25	A					1.83	A				
		NBR		0.39	A					0.69	A				
		SBL		4.12	A	0.1	A			24.74	C	0.2	A		
		SBT		0.10	A					0.07	A				
		SBR		0.06	A					0.00	A				
15	M-25 @ BWB On-Ramp	NBL	S	4.28	A	0.1	A	0.3	A	3.19	A	1.7	A	2.2	A
		NBT		0.15	A					2.16	A				
		SBT		0.48	A	0.5	A			1.97	A	2.2	A		
		SBR		1.44	A					4.70	A				
16	M-25 @ Church St	EBL	S	0.00	A	0.0	A	0.4	A	0.00	A	0.0	A	5.4	A
		EBT		0.00	A					0.00	A				
		EBR		0.00	A					0.00	A				
		WBL		0.00	A	8.5	A			0.00	A	28.4	C		
		WBT		0.00	A					0.00	A				
		WBR		8.50	A					28.39	C				
		NBL		6.51	A	0.4	A			4.57	A	5.3	A		
		NBT		0.32	A					5.34	A				
		NBR		0.46	A					0.50	A				
		SBL		4.25	A	0.3	A			36.07	D	1.2	A		
		SBT		0.32	A					0.30	A				
		SBR		0.00	A					1.36	A				
17	M-25 @ Hancock St	EBL	S	58.80	E	33.0	C	21.4	C	67.67	E	44.5	D	39.8	D
		EBT		29.82	C					50.24	D				
		EBR		15.40	B					19.62	B				
		WBL		30.43	C	41.2	D			136.54	F	204.1	F		
		WBT		43.41	D					213.24	F				
		WBR		34.27	C					207.91	F				
		NBL		25.34	C	15.5	B			14.34	B	17.1	B		
		NBT		13.94	B					17.37	B				
		NBR		15.66	B					0.00	A				
		SBL		27.93	C	14.3	B			26.68	C	11.8	B		
		SBT		13.90	B					11.55	B				
		SBR		14.78	B					8.10	A				
18	I-94 Connector @ Hancock St	EBL	S	0.00	A	22.5	C	39.2	D	0.00	A	24.7	C	36.4	D
		EBT		36.32	D					36.29	D				
		EBR		8.09	A					9.17	A				
		WBL		52.82	D	51.3	D			46.28	D	44.4	D		
		WBT		50.92	D					40.47	D				
		WBR		21.34	C					8.84	A				
		NBL		0.00	A	16.7	B			0.00	A	14.7	B		
		NBT		18.07	B					16.42	B				
		NBR		5.10	A					4.55	A				
		SBL		0.00	A	18.8	B			0.00	A	18.6	B		
		SBT		18.85	B					18.59	B				
		SBR		16.23	B					18.50	B				
19	Water St. @ Campau St	EBL	S	11.25	B	10.4	B	0.8	A	13.10	B	9.1	A	0.8	A
		EBR		14.73	B					10.08	B				
		NBL		2.89	A	0.4	A			3.28	A	0.5	A		
		NBT		0.07	A					0.17	A				
		SBT		0.60	A	0.6	A			0.80	A	0.8	A		
		SBR		0.90	A					0.91	A				

Appendix L – Existing Queue Lengths

Existing Queue Lengths

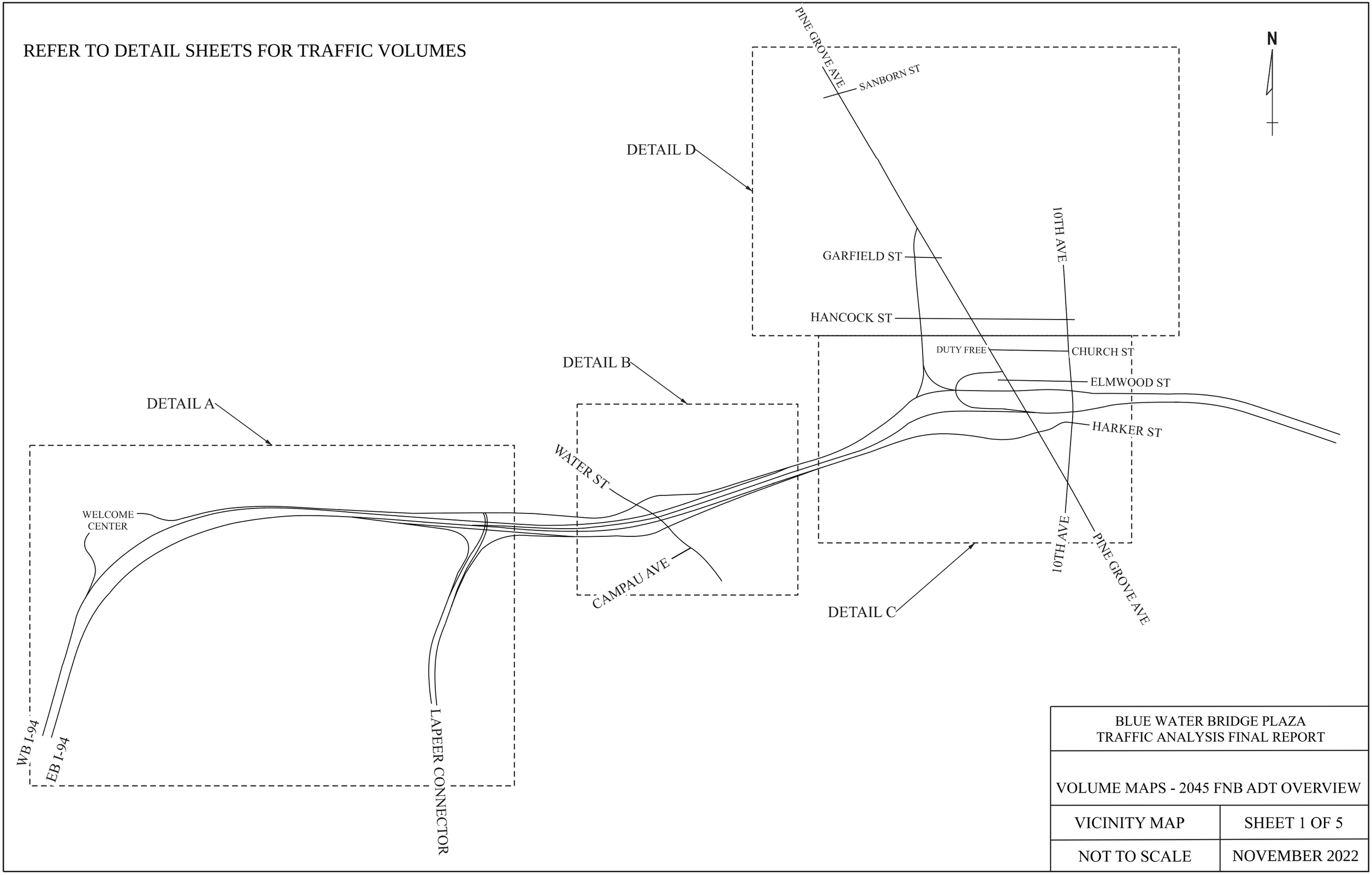
Location	Movement	AM		PM	
		Average Queue (ft)	Max Queue (ft)	Average Queue (ft)	Max Queue (ft)
1: M-25 @ 10th St	WBR	17	112	75	302
	WBT	7	71	52	260
	NBT	20	110	71	245
	NBL	11	95	71	245
	EBT	18	204	23	132
	EBR	1	108	1	60
	SBL	34	128	37	147
	SBT	34	128	37	147
2: Lapeer Conn @ Service Drive WB	WBL	2	100	1	44
	WBT	2	100	1	44
	NBL	1	51	2	56
3: I-94 EB Ramps @ Water St	SBT	10	153	23	179
	SBL	10	153	23	179
	NBT	7	103	36	222
	NBR	16	153	61	272
	EBR	65	259	105	365
	EBL	65	259	105	365
	EBT	65	259	105	365
4: I-94 WB Ramps @ Water St	NBL	3	71	7	145
	NBT	3	71	7	145
	WBT	44	188	40	163
	WBL	44	188	40	163
	WBR	63	221	60	199
	SBT	5	158	2	108
	SBL	15	156	13	129
5: I-94 EB Ramps @ M-25	NBR	38	170	54	260
	NBT	17	113	27	199
	SBL	55	322	15	160
	SBT	55	322	15	160
	EBT	104	386	170	562
	EBL	104	386	170	562
	EBR	130	424	198	601
6: Harker St @ 10th St	NBT	0	0	0	0
	NBR	0	0	0	0
	EBL	19	169	30	210
	EBT	20	171	30	212
	EBR	20	170	30	211
	WBR	0	66	1	62
	WBL	0	43	1	39
	SBL	0	3	0	0
	SBT	0	0	0	0
7: 10th Ave @ Elmwood	NBT	0	0	0	2
	NBL	0	4	0	5
	NBR	0	0	0	2
	WBR	2	67	1	59
	WBT	1	52	1	44
	WBL	1	48	1	40
	EBL	1	55	1	53
	EBT	1	58	1	57
	EBR	1	84	1	83
	SBR	0	0	0	6
	SBL	0	0	0	11
	SBT	0	0	0	0
8: 10th Ave @ Church St	SBL	0	0	0	0
	SBR	0	0	0	10
	SBT	0	0	0	0
	NBL	0	3	0	7
	NBR	0	0	0	2
	NBT	0	0	0	0
	EBT	1	50	1	58
	EBR	1	50	1	58
	EBL	0	39	1	45
	WBT	0	40	0	40
	WBL	0	51	0	51
	WBR	0	55	0	55
9: 10th Ave @ Hancock St	EBT	5	83	5	71
	EBR	8	114	10	100
	EBL	5	83	5	71
	WBT	13	121	10	106
	WBL	13	121	10	106
	WBR	22	148	17	133
	SBL	9	77	9	75
	SBR	22	124	23	122
	SBT	9	77	9	75
	NBR	24	135	51	191
	NBL	13	105	33	156
	NBT	13	105	33	156
10: M-25 @ Sanborn St	WBT	17	106	22	107
	WBR	33	142	43	145
	WBL	17	106	22	107
	EBT	0	19	0	12
	EBL	14	84	14	73
	EBR	22	103	22	92
	NBL	48	371	24	257
	NBR	54	390	30	276
	NBT	48	371	24	257
	SBR	29	320	27	286
	SBL	29	320	27	286
	SBT	29	320	27	286
11: M-25 @ I-94 Connector	EBR	21	129	28	133
	EBL	21	129	28	133
	SBT	12	146	2	62
	NBT	1	39	28	230

Existing Queue Lengths

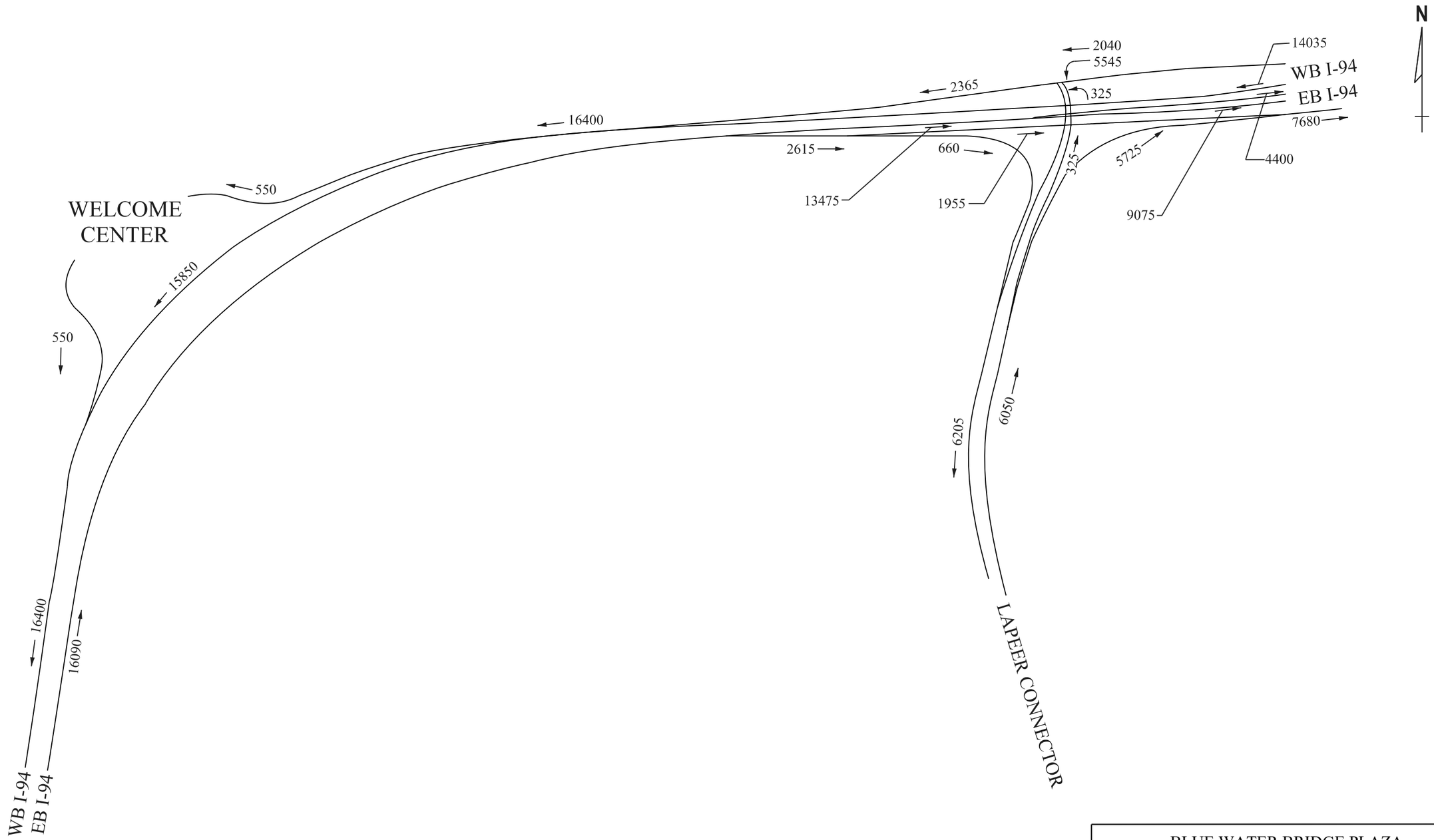
Location	Movement	AM		PM	
		Average Queue (ft)	Max Queue (ft)	Average Queue (ft)	Max Queue (ft)
12: Garfield St @ I-94 Connector	SBT	5	125	6	122
	SBL	5	127	5	124
	SBR	0	14	0	4
	NBT	3	116	3	118
	NBR	0	0	0	0
	NBL	3	116	3	118
	EBL	6	97	5	80
	EBR	5	96	5	80
	EBT	6	97	5	80
	WBR	5	91	5	83
	WBL	6	94	5	83
	WBT	6	94	5	83
13: M-25 @ Garfield St	EBT	1	52	1	43
	EBL	1	50	1	41
	EBR	1	65	1	56
	WBT	1	46	10	85
	WBR	2	73	13	112
	WBL	1	43	8	82
	SBL	1	34	4	58
	SBR	0	2	0	14
	SBT	0	0	0	2
	NBR	0	11	1	38
	NBL	1	52	2	82
	NBT	0	5	1	36
14: M-25 @ Elmwood St	SBT	0	10	0	3
	SBR	0	10	0	20
	SBL	0	24	1	27
	NBT	0	0	4	138
	NBR	0	0	5	152
	NBL	0	13	0	0
	NBT	0	0	0	0
	EBR	0	56	1	80
	EBL	0	33	1	55
	EBT	0	35	1	59
	WBL	1	44	0	0
	WBR	2	68	1	24
	WBT	1	52	0	0
15: M-25 @ BWB On-Ramp	SBR	0	32	3	77
	SBT	0	32	3	77
	NBT	0	0	2	88
	NBL	0	9	0	47
16: M-25 @ Church St	SBT	0	0	0	8
	SBR	0	0	0	0
	SBL	0	10	2	36
	NBL	0	22	27	309
	NBR	0	14	31	338
	NBT	0	8	21	276
	EBR	0	0	0	0
	EBT	0	0	0	0
	EBL	0	0	0	0
	WBL	0	40	0	42
	WBT	0	42	0	44
	WBR	1	63	2	70
17: M-25 @ Hancock St	EBT	17	129	16	107
	EBR	33	175	34	150
	EBL	17	129	16	107
	SBR	42	233	33	191
	SBL	31	201	22	159
	SBT	31	201	22	159
	NBL	58	348	170	543
	NBR	79	387	191	578
	NBT	58	348	170	543
	WBL	5	54	9	63
	WBT	54	225	351	566
	WBR	81	264	389	605
18: I-94 Connector @ Hancock St	NBT	8	95	8	106
	NBL	8	95	8	106
	NBR	17	153	18	166
	SBT	61	308	69	373
	SBR	86	362	96	427
	SBL	61	308	69	373
	EBR	35	176	33	153
	EBL	17	131	14	102
	EBT	17	131	14	102
	WBL	97	288	75	212
	WBR	0	2	0	4
	WBT	97	288	75	212
19: Water St at Campau St	SBT	0	0	0	0
	SBR	0	0	0	0
	NBT	0	0	0	0
	NBL	0	18	0	18
	EBR	2	98	2	70
	EBL	1	65	1	38
20: PIL - inbound (N of Plaza)	I-94 WB Cars	74	134	618	703
	I-94 WB Trucks (North Facility)	27	129	17	106
	I-94 WB Cars – Nexus	1	40	2	70
	I-94 WB Trucks – Fast Lane	478	632	254	423
21: PIL (Inbound - S of Plaza)	I-94 WB Trucks (South Facility)	123	248	89	230
22: Toll Booth - Outbound	I-94 EB Toll Both to Canada	16	93	29	117

Appendix M – Future Volume Maps

REFER TO DETAIL SHEETS FOR TRAFFIC VOLUMES



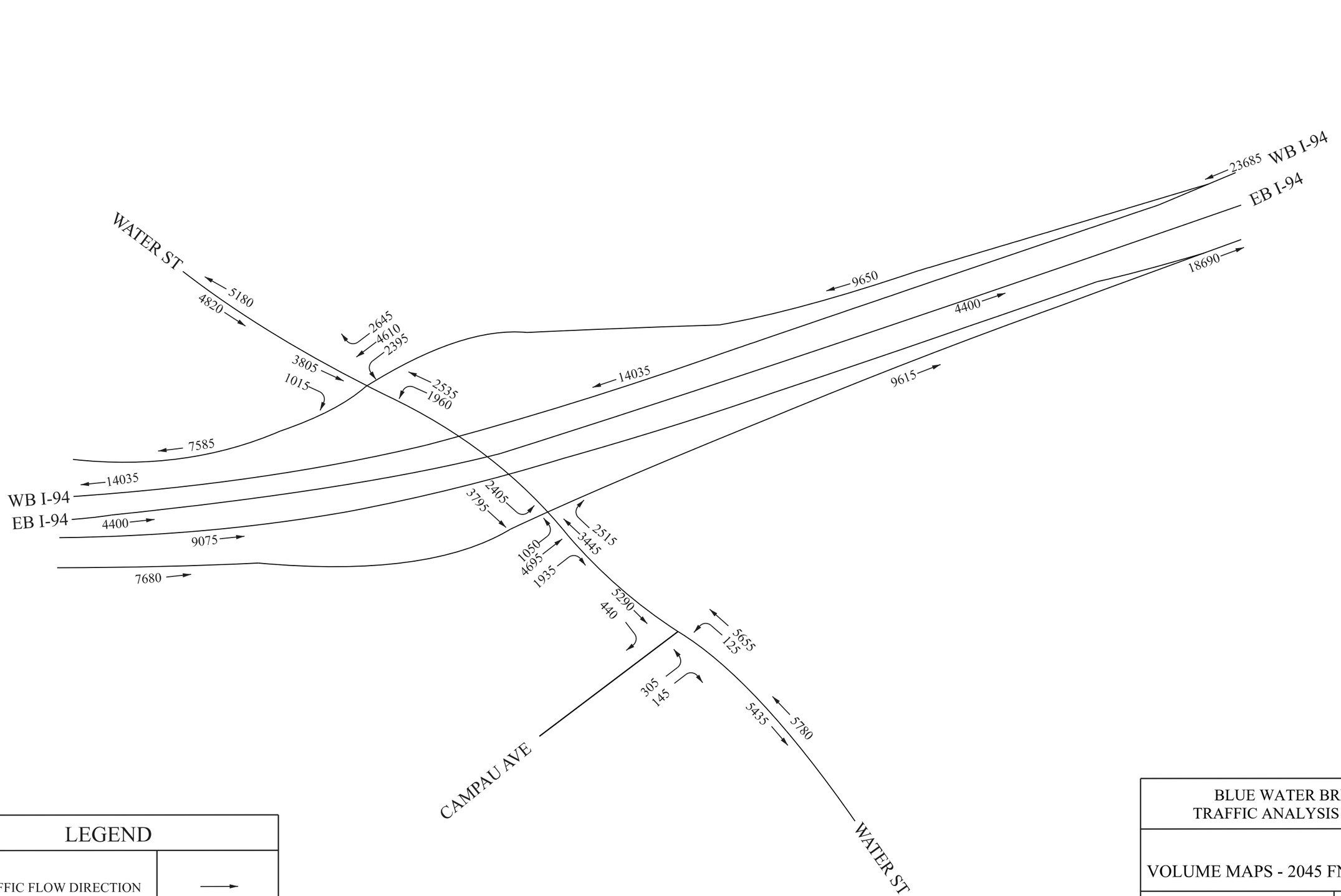
BLUE WATER BRIDGE PLAZA TRAFFIC ANALYSIS FINAL REPORT	
VOLUME MAPS - 2045 FNB ADT OVERVIEW	
VICINITY MAP	SHEET 1 OF 5
NOT TO SCALE	NOVEMBER 2022



LEGEND	
TRAFFIC FLOW DIRECTION	→
DAILY TRAFFIC VOLUMES	ADT

REFER TO DETAIL SHEETS FOR TRAFFIC VOLUMES

BLUE WATER BRIDGE PLAZA TRAFFIC ANALYSIS FINAL REPORT	
VOLUME MAPS - 2045 FNB ADT OVERVIEW	
DETAIL A	SHEET 2 OF 5
NOT TO SCALE	NOVEMBER 2022



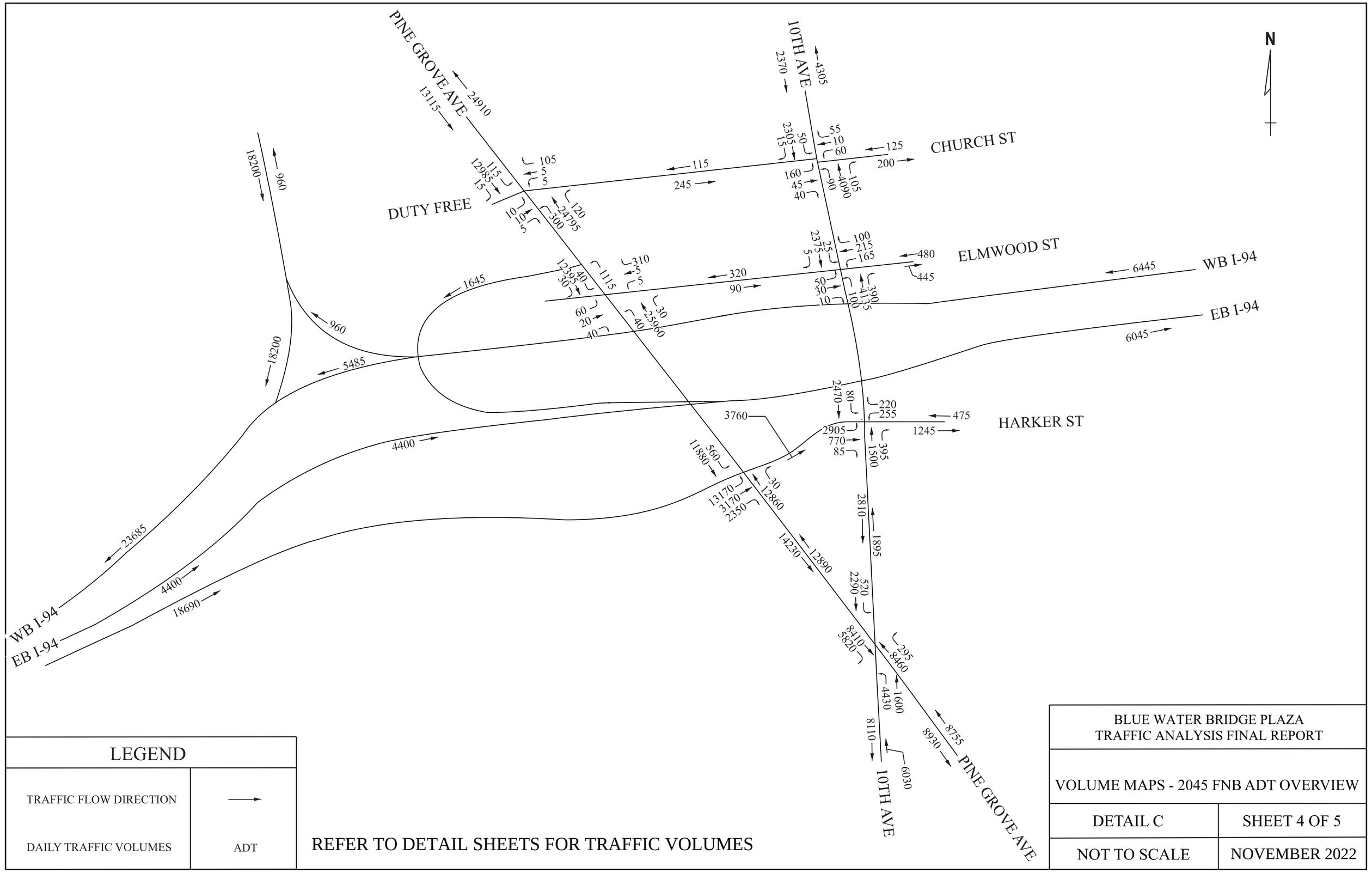
LEGEND	
TRAFFIC FLOW DIRECTION	→
DAILY TRAFFIC VOLUMES	ADT

REFER TO DETAIL SHEETS FOR TRAFFIC VOLUMES

BLUE WATER BRIDGE PLAZA
TRAFFIC ANALYSIS FINAL REPORT

VOLUME MAPS - 2045 FNB ADT OVERVIEW

DETAIL B	SHEET 3 OF 5
NOT TO SCALE	NOVEMBER 2022

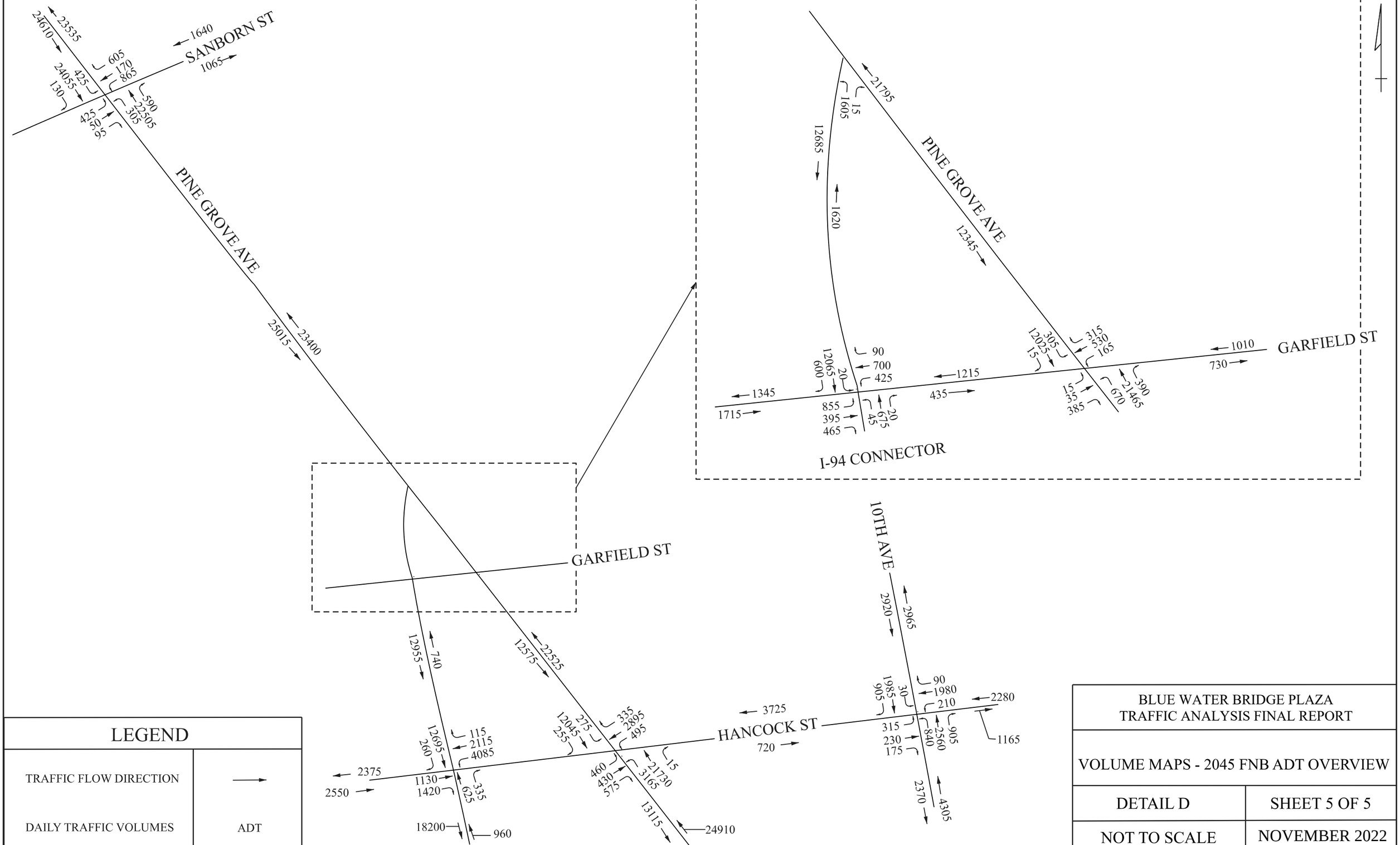


LEGEND	
TRAFFIC FLOW DIRECTION	→
DAILY TRAFFIC VOLUMES	ADT

REFER TO DETAIL SHEETS FOR TRAFFIC VOLUMES

BLUE WATER BRIDGE PLAZA TRAFFIC ANALYSIS FINAL REPORT	
VOLUME MAPS - 2045 FNB ADT OVERVIEW	
DETAIL C	SHEET 4 OF 5
NOT TO SCALE	NOVEMBER 2022

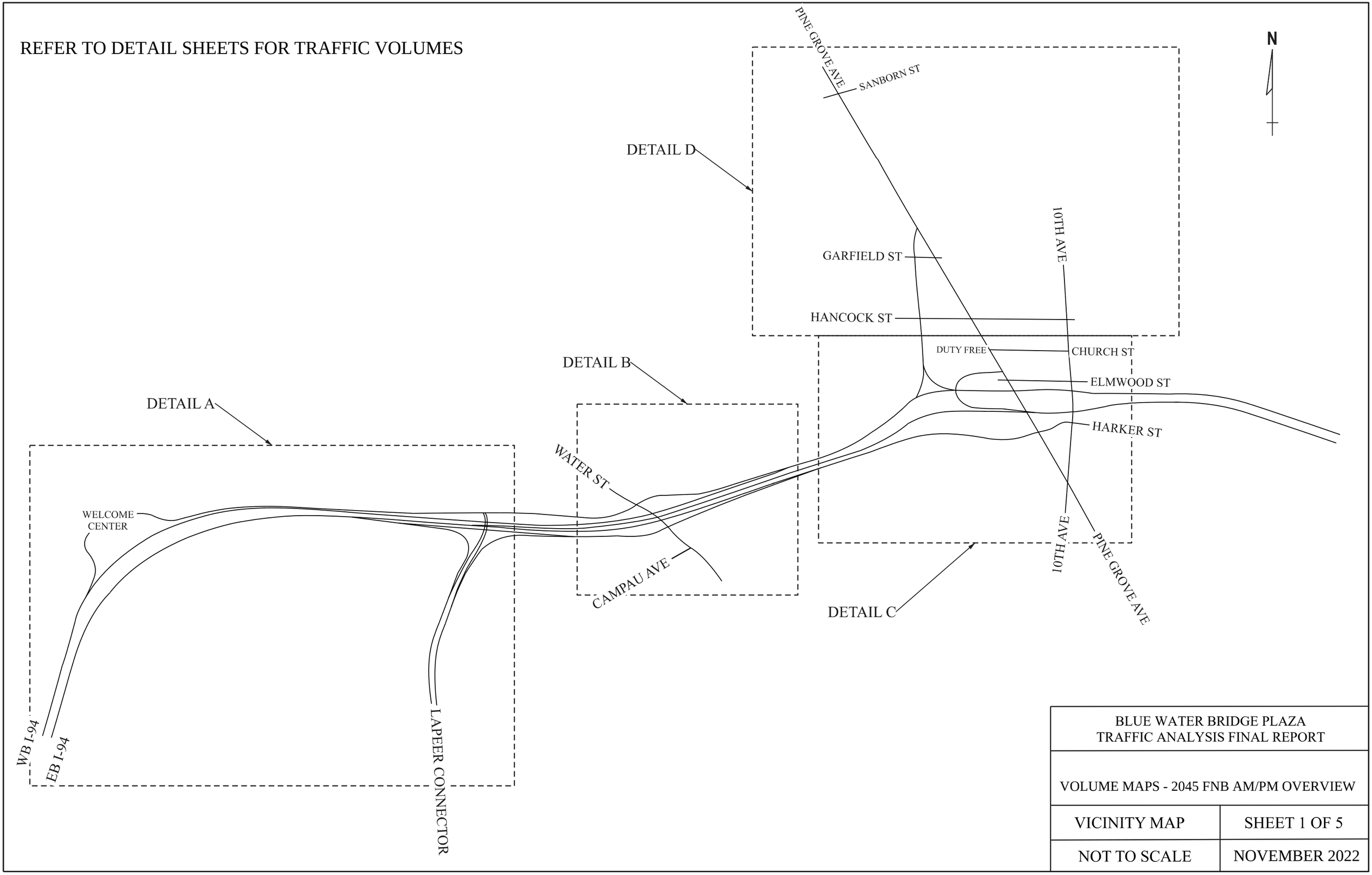
REFER TO DETAIL SHEETS FOR TRAFFIC VOLUMES



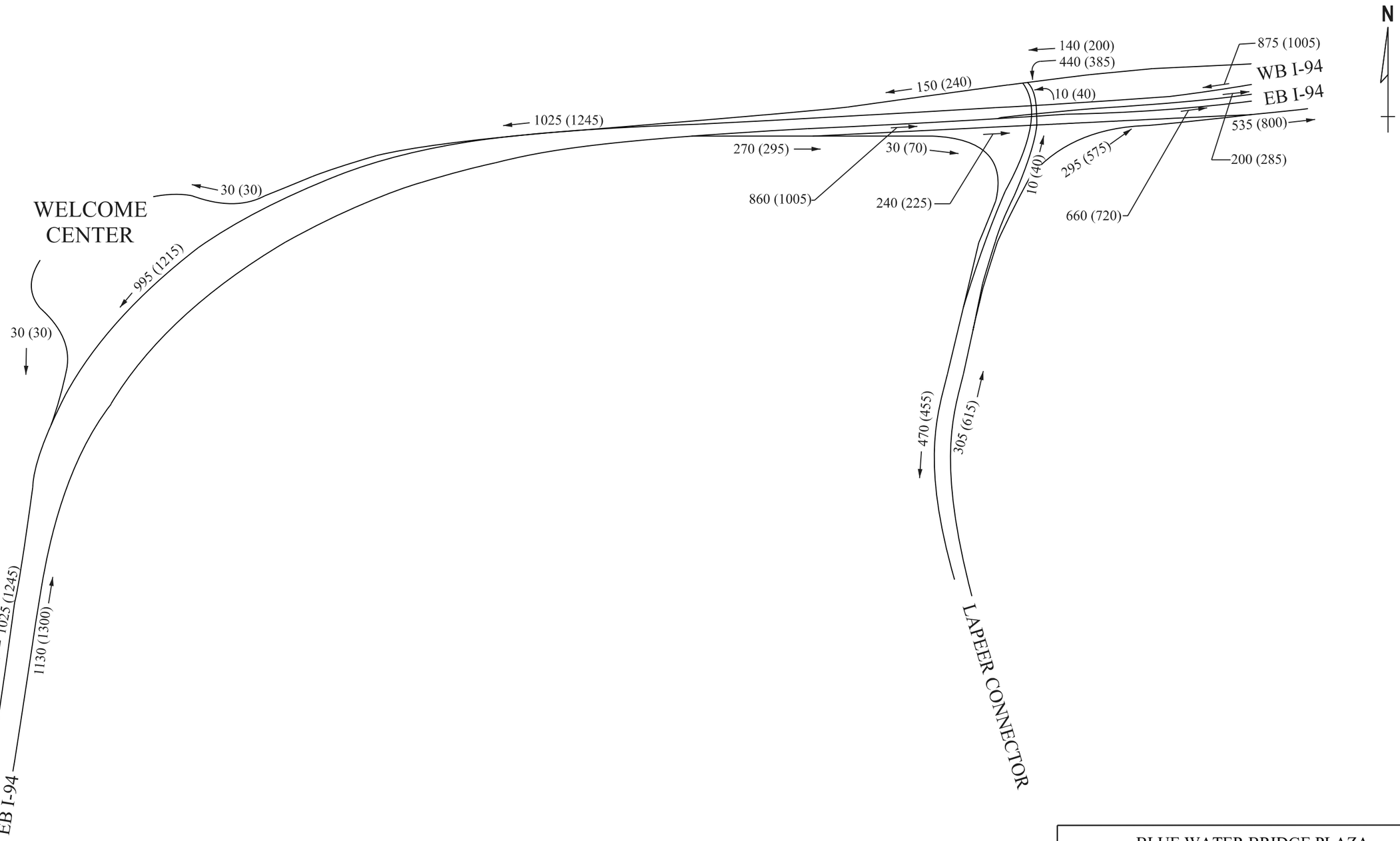
LEGEND	
TRAFFIC FLOW DIRECTION	→
DAILY TRAFFIC VOLUMES	ADT

BLUE WATER BRIDGE PLAZA TRAFFIC ANALYSIS FINAL REPORT	
VOLUME MAPS - 2045 FNB ADT OVERVIEW	
DETAIL D	SHEET 5 OF 5
NOT TO SCALE	NOVEMBER 2022

REFER TO DETAIL SHEETS FOR TRAFFIC VOLUMES



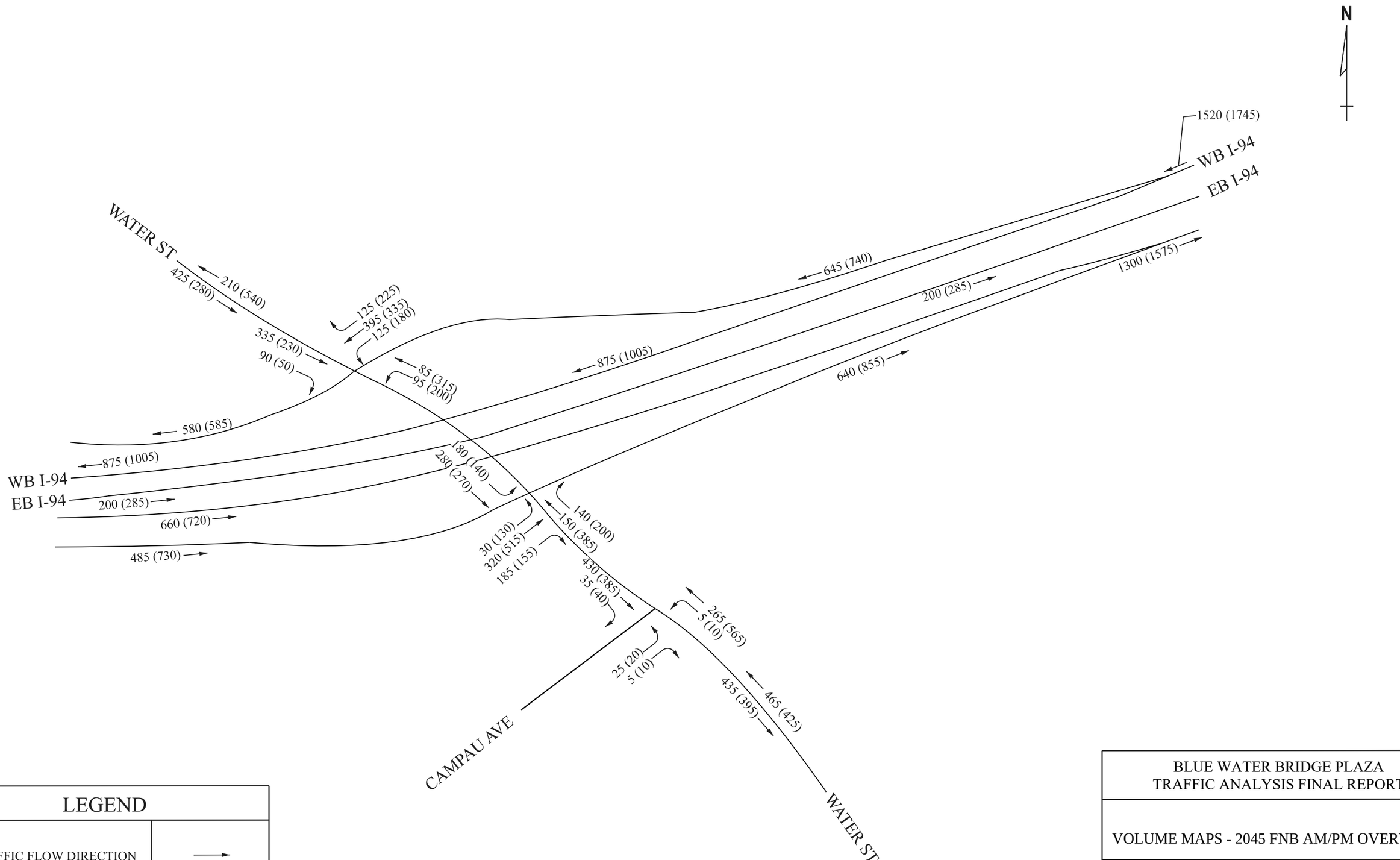
BLUE WATER BRIDGE PLAZA TRAFFIC ANALYSIS FINAL REPORT	
VOLUME MAPS - 2045 FNB AM/PM OVERVIEW	
VICINITY MAP	SHEET 1 OF 5
NOT TO SCALE	NOVEMBER 2022



LEGEND	
TRAFFIC FLOW DIRECTION	→
DAILY TRAFFIC VOLUMES	AM (PM)

REFER TO DETAIL SHEETS FOR TRAFFIC VOLUMES

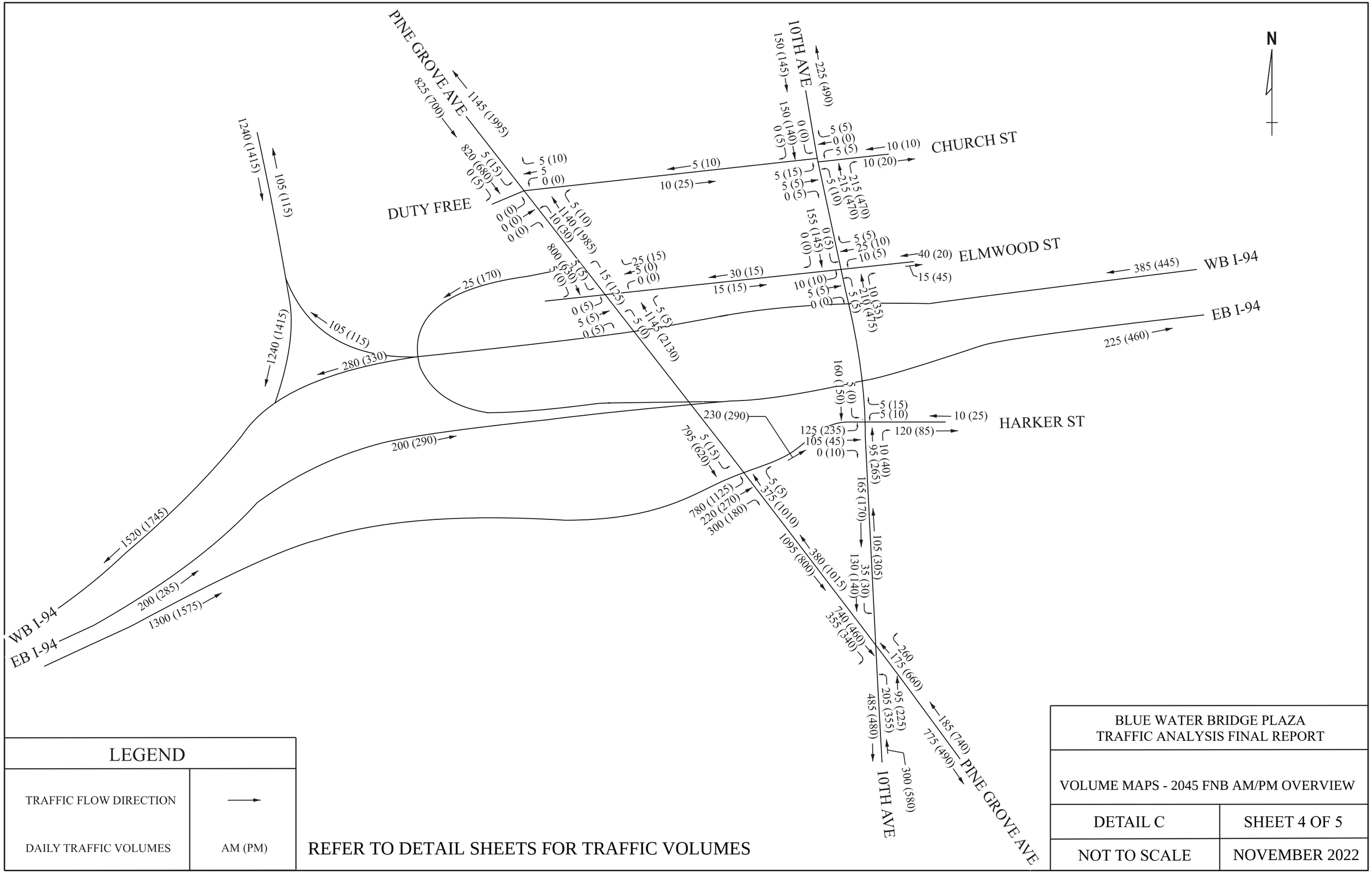
BLUE WATER BRIDGE PLAZA TRAFFIC ANALYSIS FINAL REPORT	
VOLUME MAPS - 2045 FNB AM/PM OVERVIEW	
DETAIL A	SHEET 2 OF 5
NOT TO SCALE	NOVEMBER 2022



LEGEND	
TRAFFIC FLOW DIRECTION	→
DAILY TRAFFIC VOLUMES	AM (PM)

REFER TO DETAIL SHEETS FOR TRAFFIC VOLUMES

BLUE WATER BRIDGE PLAZA TRAFFIC ANALYSIS FINAL REPORT	
VOLUME MAPS - 2045 FNB AM/PM OVERVIEW	
DETAIL B	SHEET 3 OF 5
NOT TO SCALE	NOVEMBER 2022

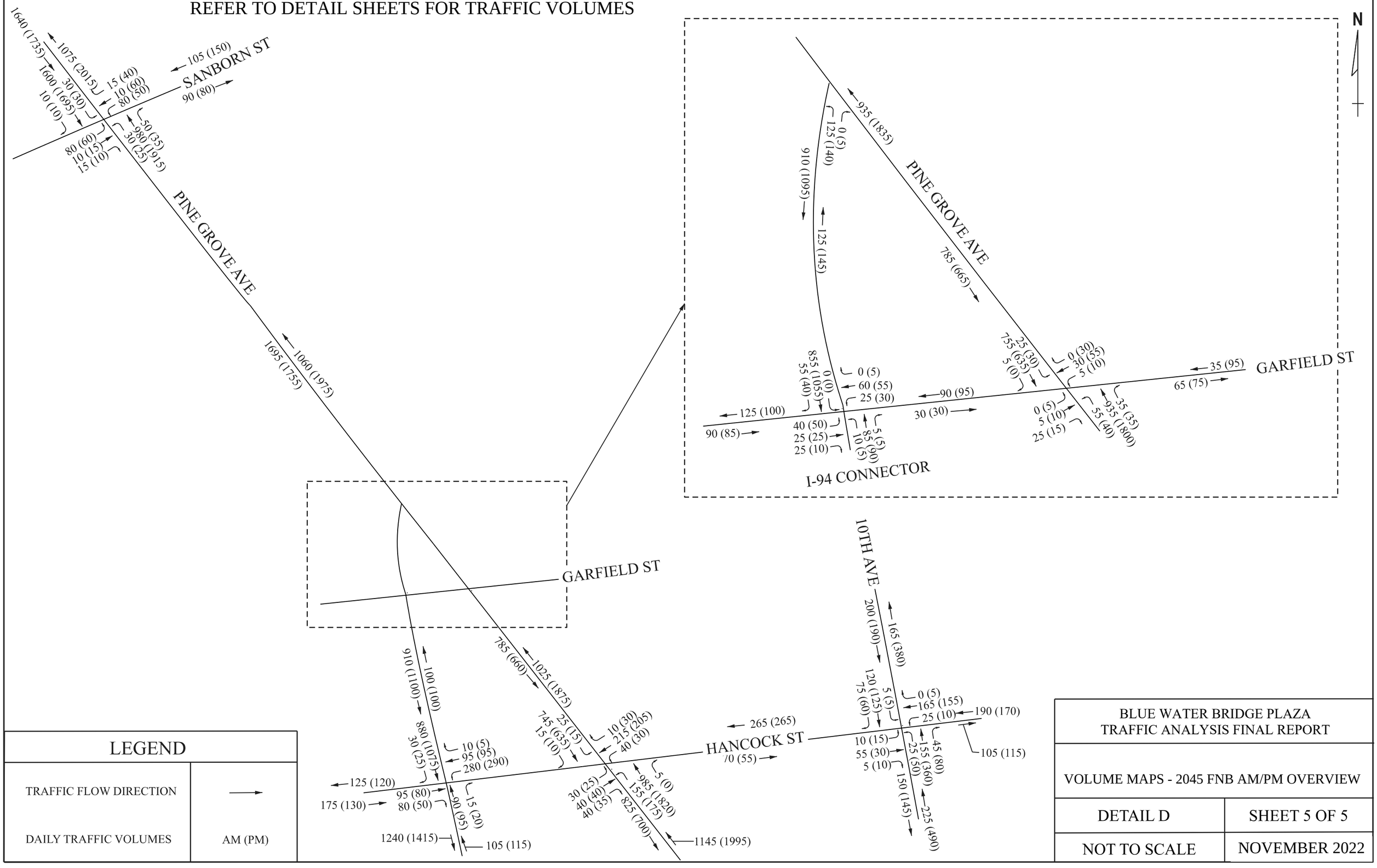


LEGEND	
TRAFFIC FLOW DIRECTION	→
DAILY TRAFFIC VOLUMES	AM (PM)

REFER TO DETAIL SHEETS FOR TRAFFIC VOLUMES

BLUE WATER BRIDGE PLAZA TRAFFIC ANALYSIS FINAL REPORT	
VOLUME MAPS - 2045 FNB AM/PM OVERVIEW	
DETAIL C	SHEET 4 OF 5
NOT TO SCALE	NOVEMBER 2022

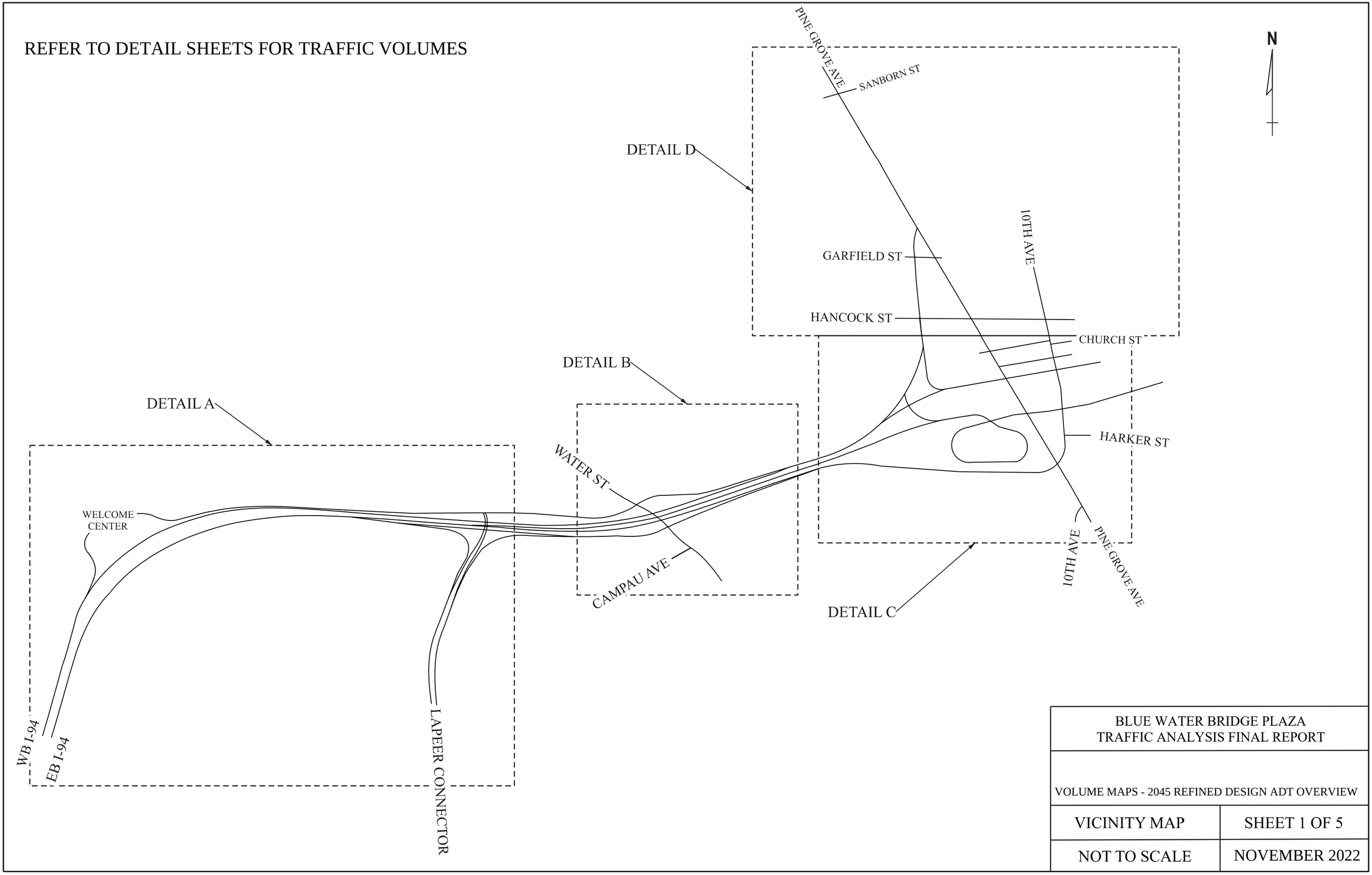
REFER TO DETAIL SHEETS FOR TRAFFIC VOLUMES



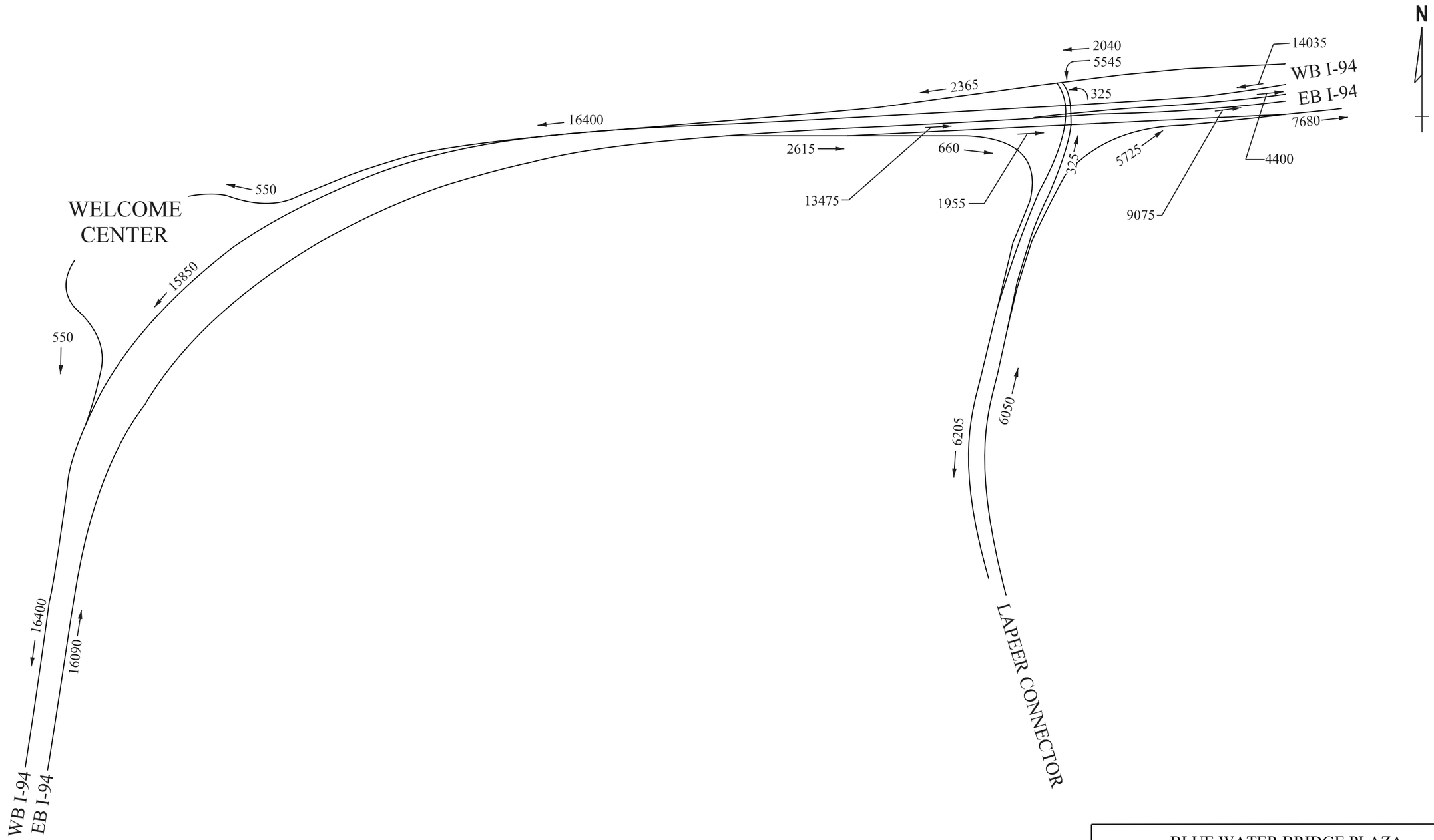
LEGEND	
TRAFFIC FLOW DIRECTION	→
DAILY TRAFFIC VOLUMES	AM (PM)

BLUE WATER BRIDGE PLAZA TRAFFIC ANALYSIS FINAL REPORT	
VOLUME MAPS - 2045 FNB AM/PM OVERVIEW	
DETAIL D	SHEET 5 OF 5
NOT TO SCALE	NOVEMBER 2022

REFER TO DETAIL SHEETS FOR TRAFFIC VOLUMES



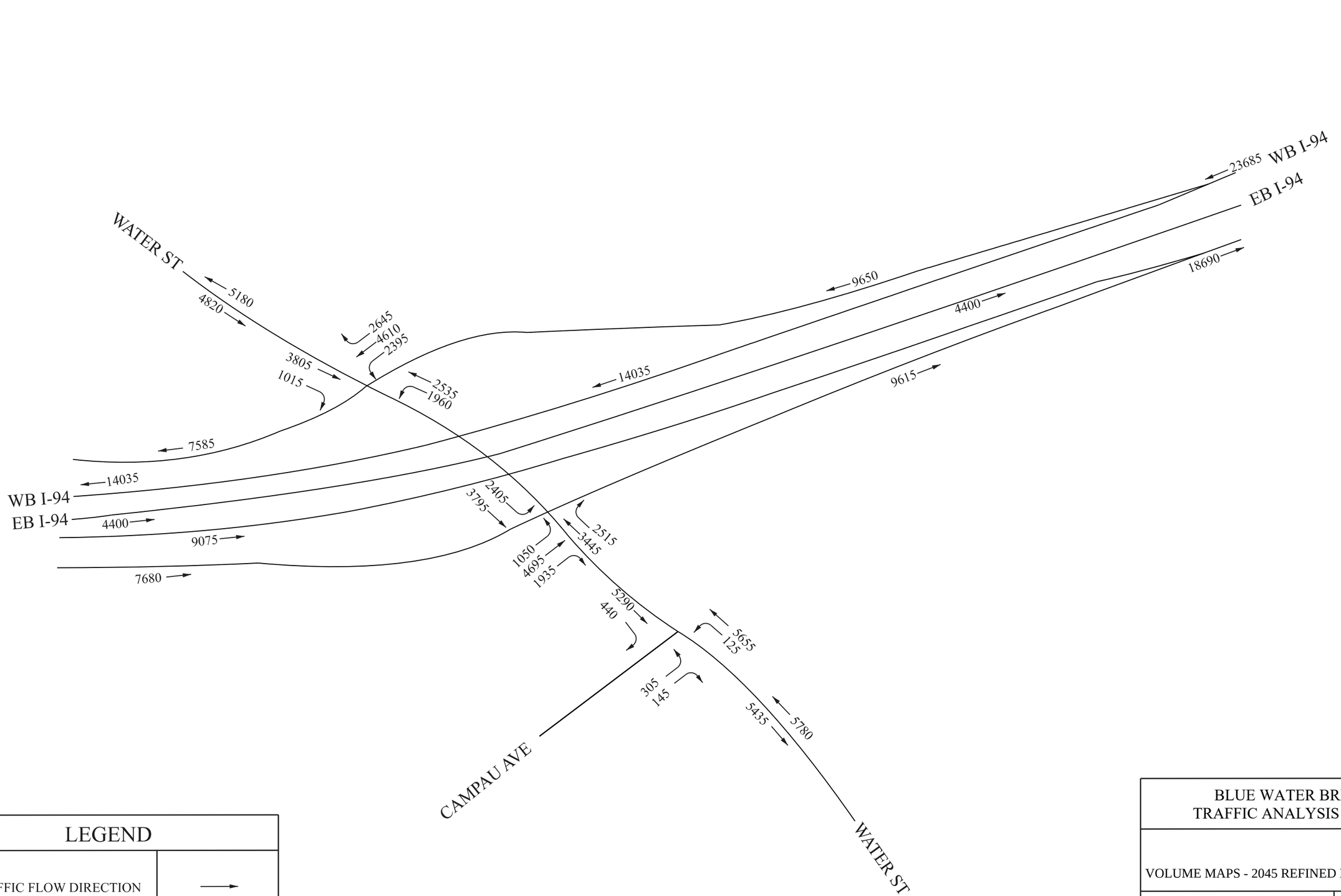
BLUE WATER BRIDGE PLAZA TRAFFIC ANALYSIS FINAL REPORT	
VOLUME MAPS - 2045 REFINED DESIGN ADT OVERVIEW	
VICINITY MAP	SHEET 1 OF 5
NOT TO SCALE	NOVEMBER 2022



LEGEND	
TRAFFIC FLOW DIRECTION	→
DAILY TRAFFIC VOLUMES	ADT

REFER TO DETAIL SHEETS FOR TRAFFIC VOLUMES

BLUE WATER BRIDGE PLAZA TRAFFIC ANALYSIS FINAL REPORT	
VOLUME MAPS - 2045 REFINED DESIGN ADT OVERVIEW	
DETAIL A	SHEET 2 OF 5
NOT TO SCALE	NOVEMBER 2022



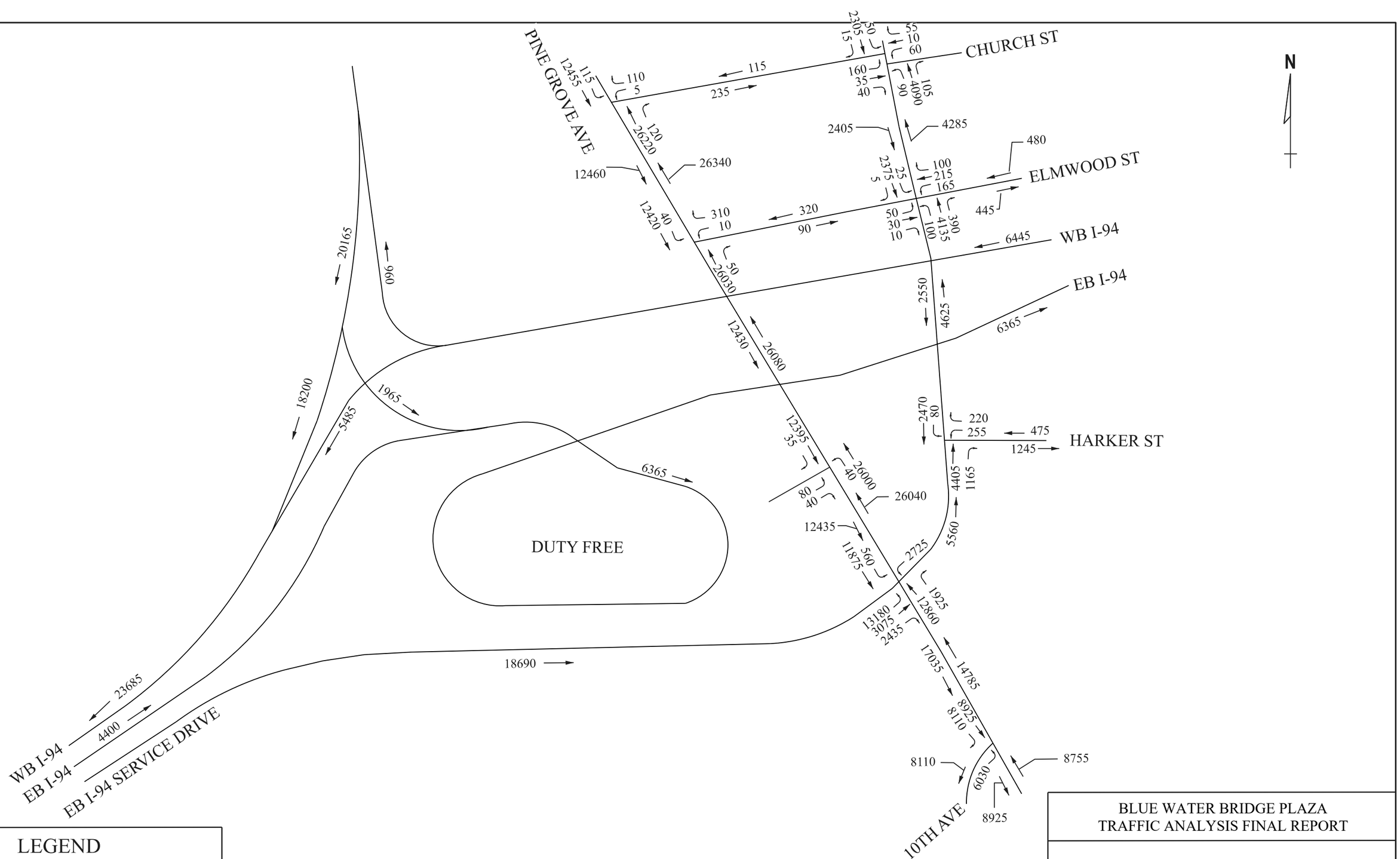
LEGEND	
TRAFFIC FLOW DIRECTION	→
DAILY TRAFFIC VOLUMES	ADT

REFER TO DETAIL SHEETS FOR TRAFFIC VOLUMES

BLUE WATER BRIDGE PLAZA
TRAFFIC ANALYSIS FINAL REPORT

VOLUME MAPS - 2045 REFINED DESIGN ADT OVERVIEW

DETAIL B	SHEET 3 OF 5
NOT TO SCALE	NOVEMBER 2022



LEGEND	
TRAFFIC FLOW DIRECTION	→
DAILY TRAFFIC VOLUMES	AM (PM)

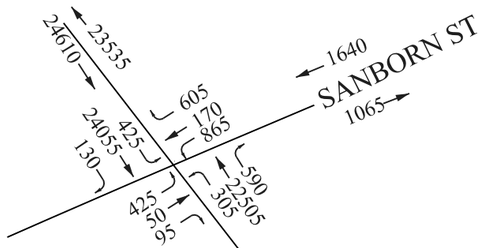
REFER TO DETAIL SHEETS FOR TRAFFIC VOLUMES

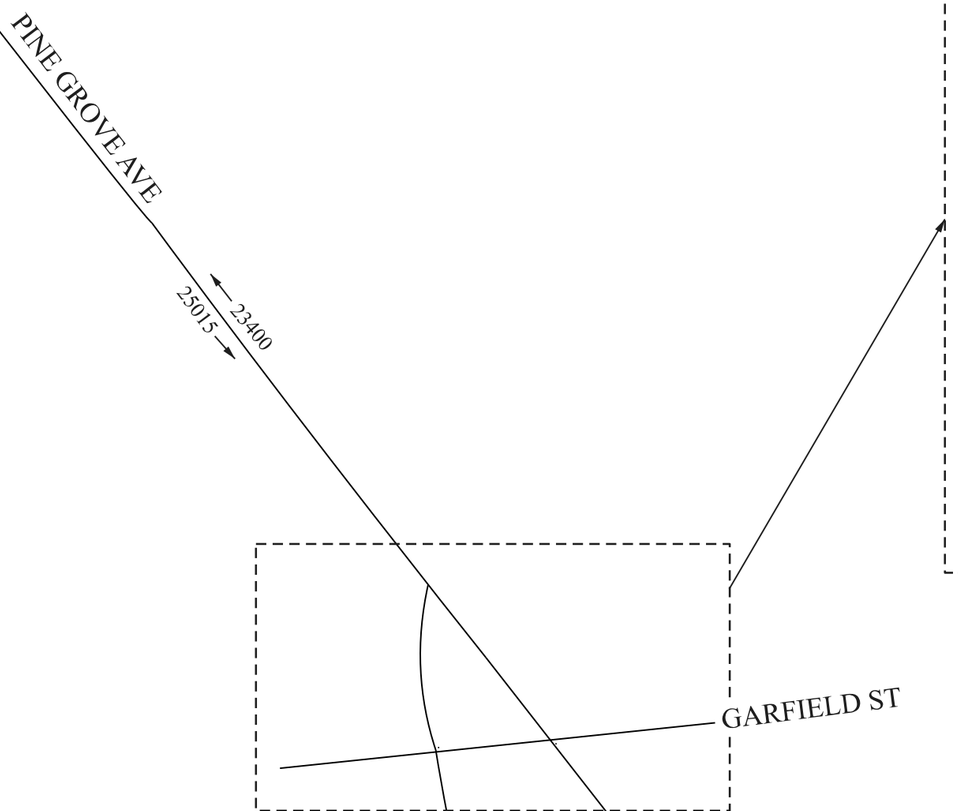
BLUE WATER BRIDGE PLAZA
TRAFFIC ANALYSIS FINAL REPORT

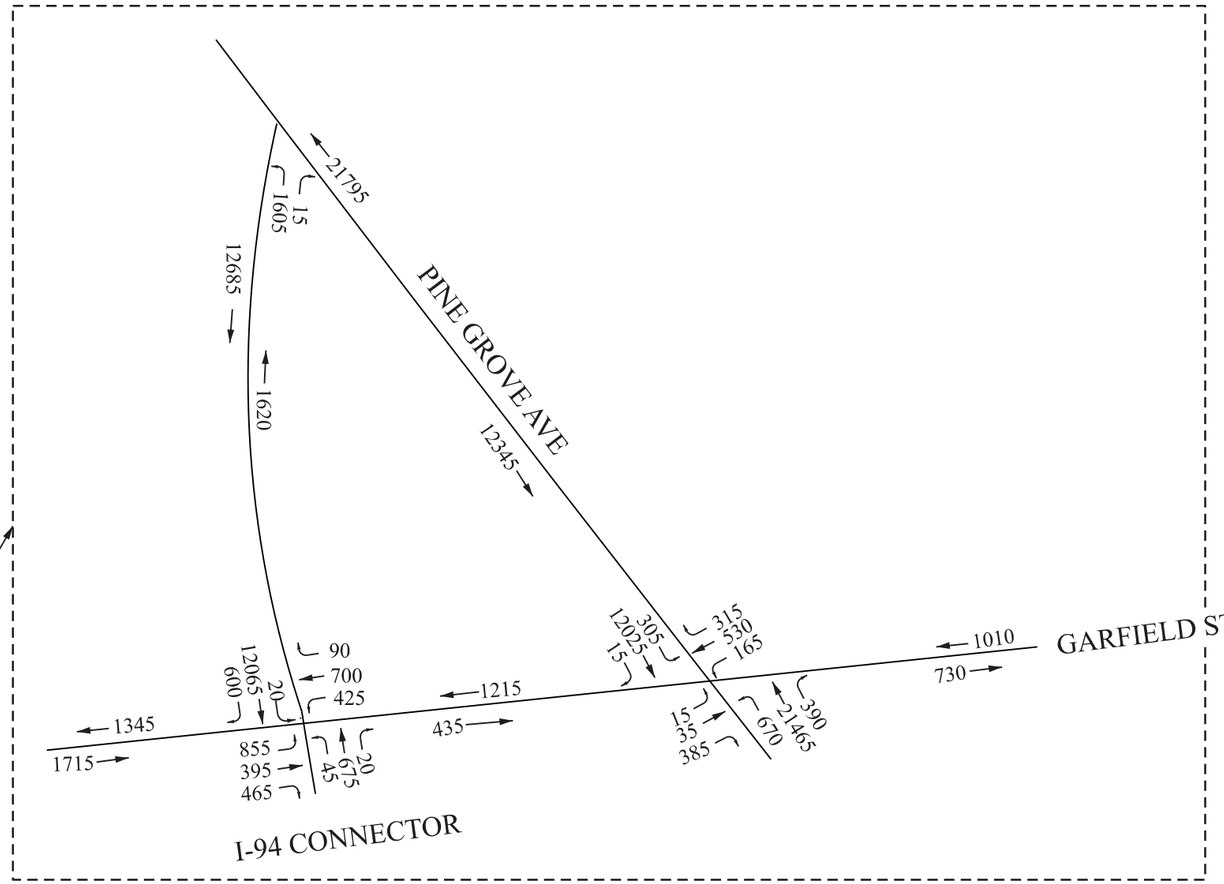
VOLUME MAPS - 2045 REFINED DESIGN ADT OVERVIEW

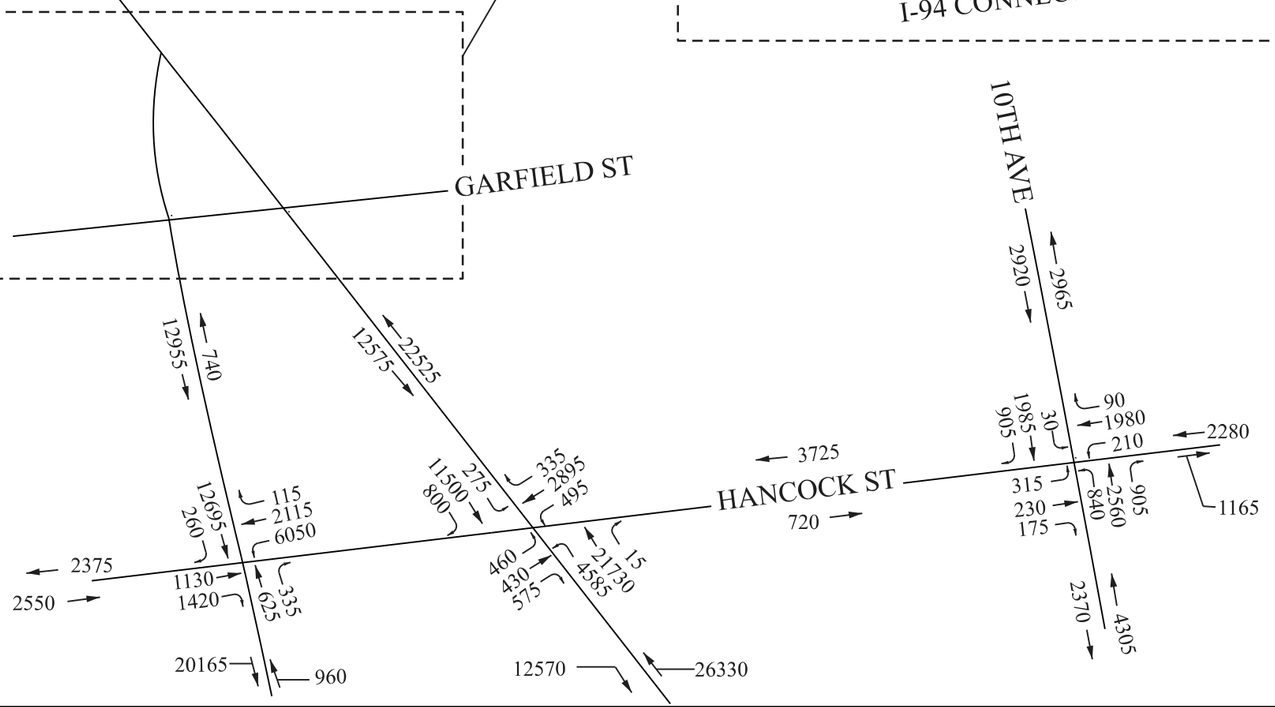
DETAIL C	SHEET 4 OF 5
NOT TO SCALE	NOVEMBER 2022

REFER TO DETAIL SHEETS FOR TRAFFIC VOLUMES









LEGEND

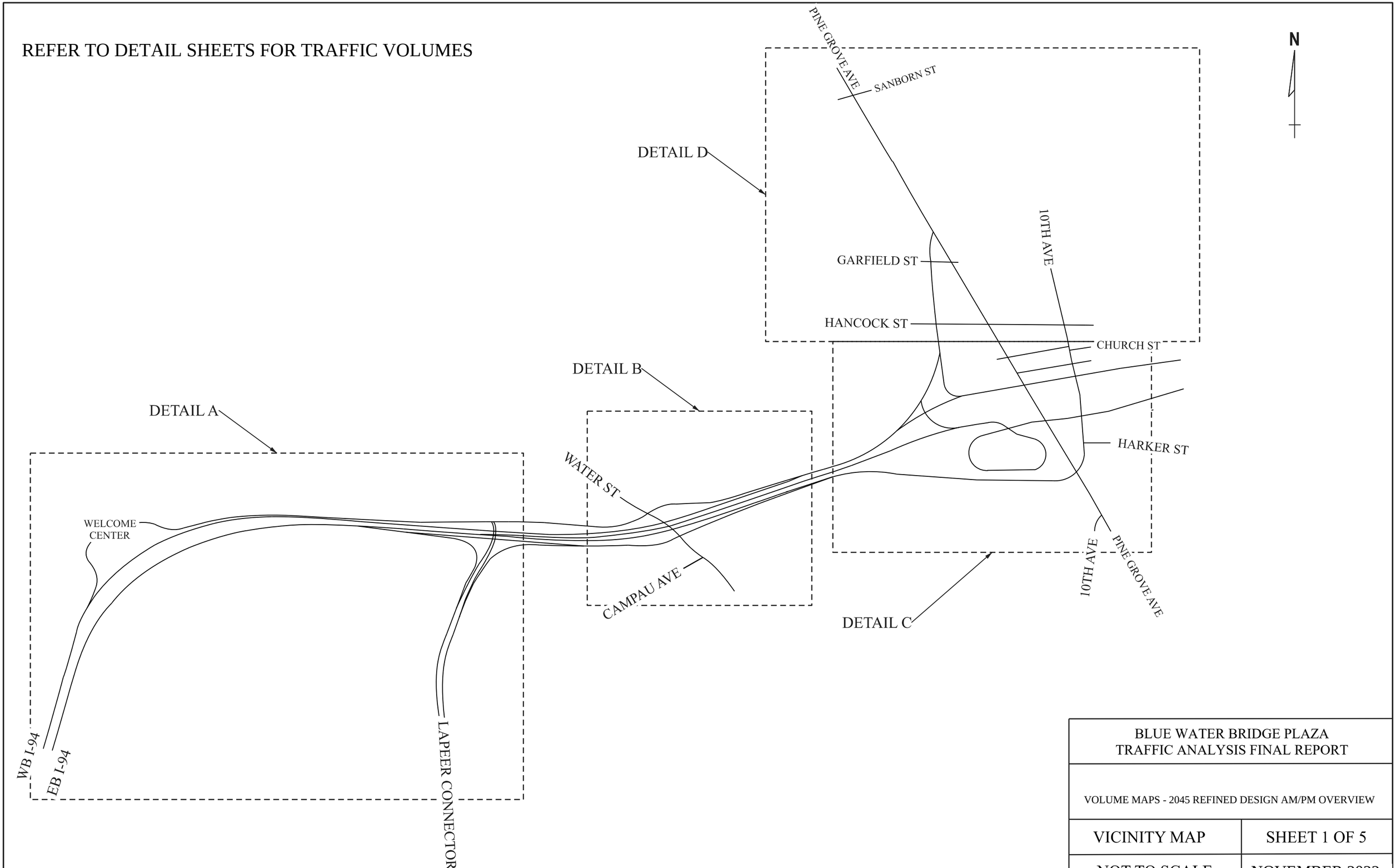
TRAFFIC FLOW DIRECTION	→
DAILY TRAFFIC VOLUMES	ADT

BLUE WATER BRIDGE PLAZA
TRAFFIC ANALYSIS FINAL REPORT

VOLUME MAPS - 2045 REFINED DESIGN ADT OVERVIEW

DETAIL D	SHEET 5 OF 5
NOT TO SCALE	NOVEMBER 2022

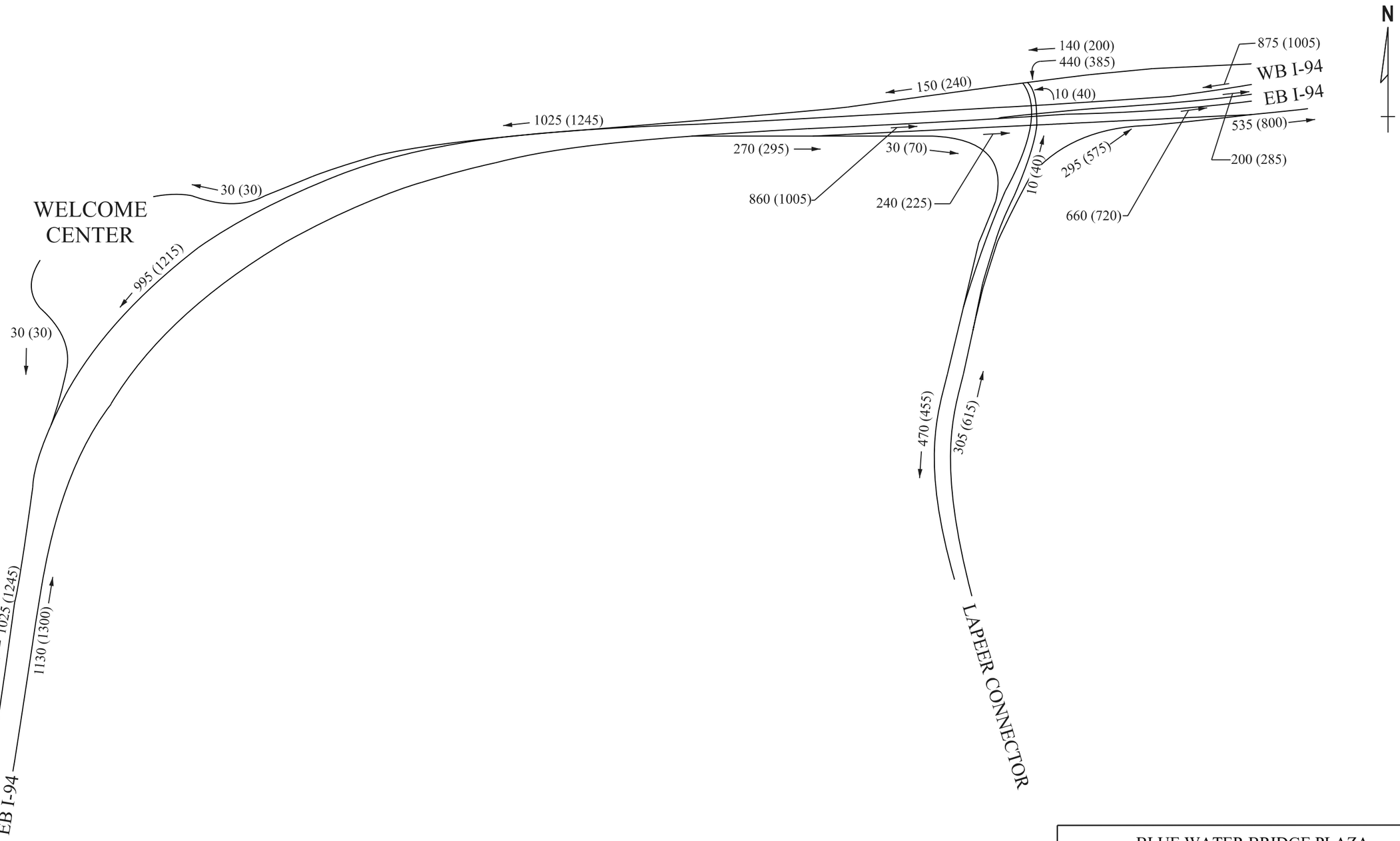
REFER TO DETAIL SHEETS FOR TRAFFIC VOLUMES



BLUE WATER BRIDGE PLAZA
TRAFFIC ANALYSIS FINAL REPORT

VOLUME MAPS - 2045 REFINED DESIGN AM/PM OVERVIEW

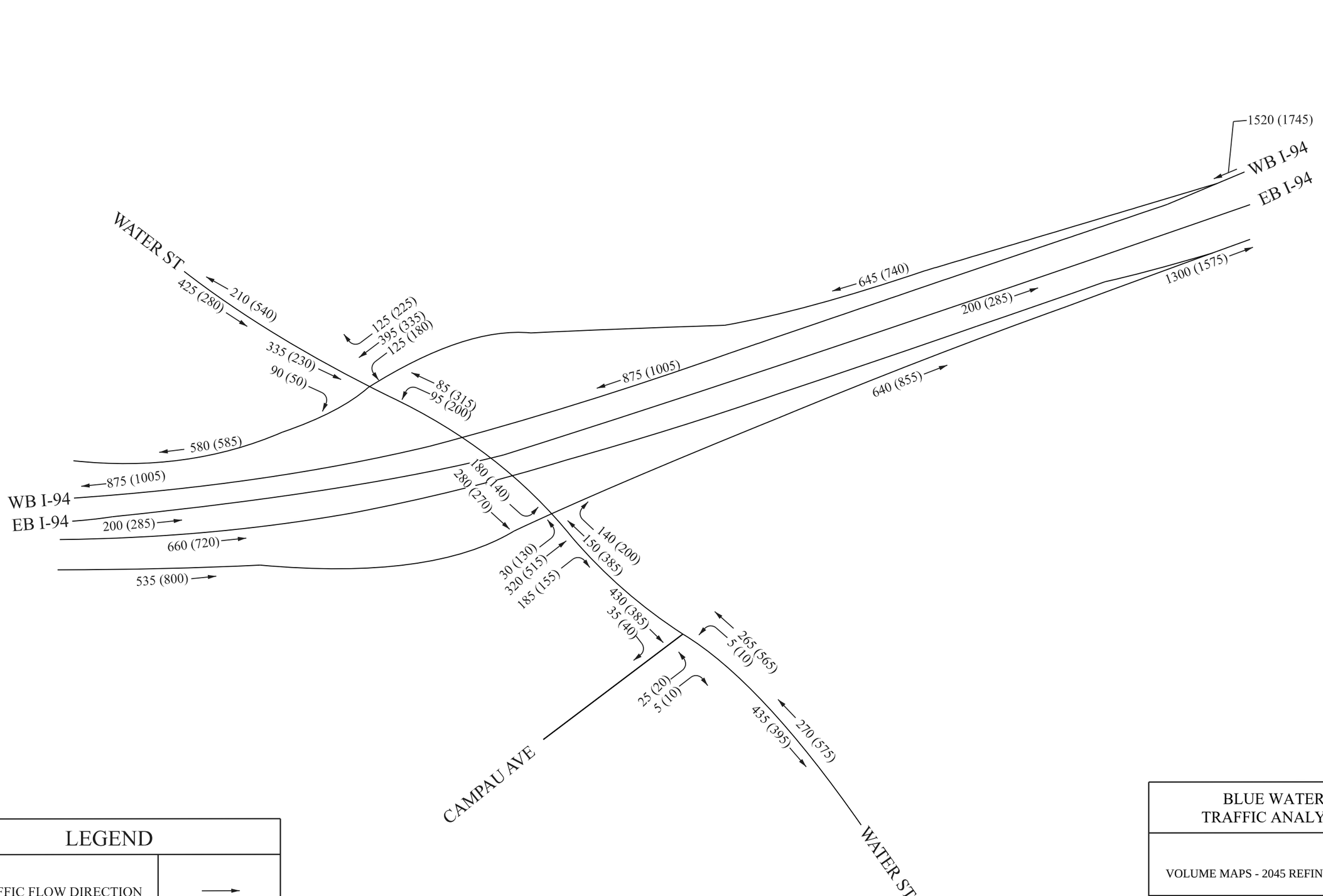
VICINITY MAP	SHEET 1 OF 5
NOT TO SCALE	NOVEMBER 2022



LEGEND	
TRAFFIC FLOW DIRECTION	→
DAILY TRAFFIC VOLUMES	AM (PM)

REFER TO DETAIL SHEETS FOR TRAFFIC VOLUMES

BLUE WATER BRIDGE PLAZA TRAFFIC ANALYSIS FINAL REPORT	
VOLUME MAPS - 2045 REFINED DESIGN AM/PM OVERVIEW	
DETAIL A	SHEET 2 OF 5
NOT TO SCALE	NOVEMBER 2022



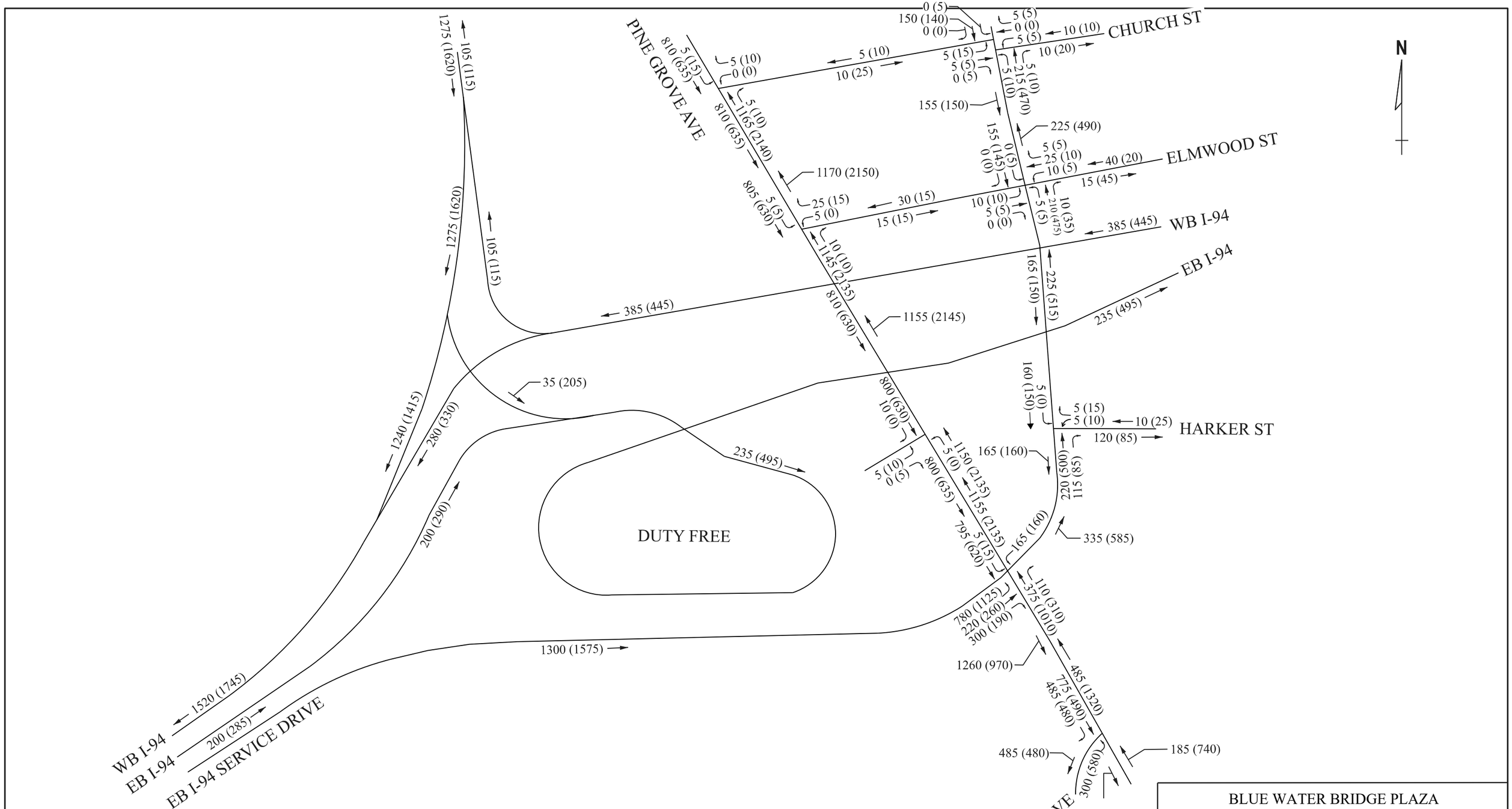
LEGEND	
TRAFFIC FLOW DIRECTION	→
DAILY TRAFFIC VOLUMES	AM (PM)

REFER TO DETAIL SHEETS FOR TRAFFIC VOLUMES

BLUE WATER BRIDGE PLAZA
TRAFFIC ANALYSIS FINAL REPORT

VOLUME MAPS - 2045 REFINED DESIGN AM/PM OVERVIEW

DETAIL B	SHEET 3 OF 5
NOT TO SCALE	NOVEMBER 2022



LEGEND	
TRAFFIC FLOW DIRECTION	→
DAILY TRAFFIC VOLUMES	AM (PM)

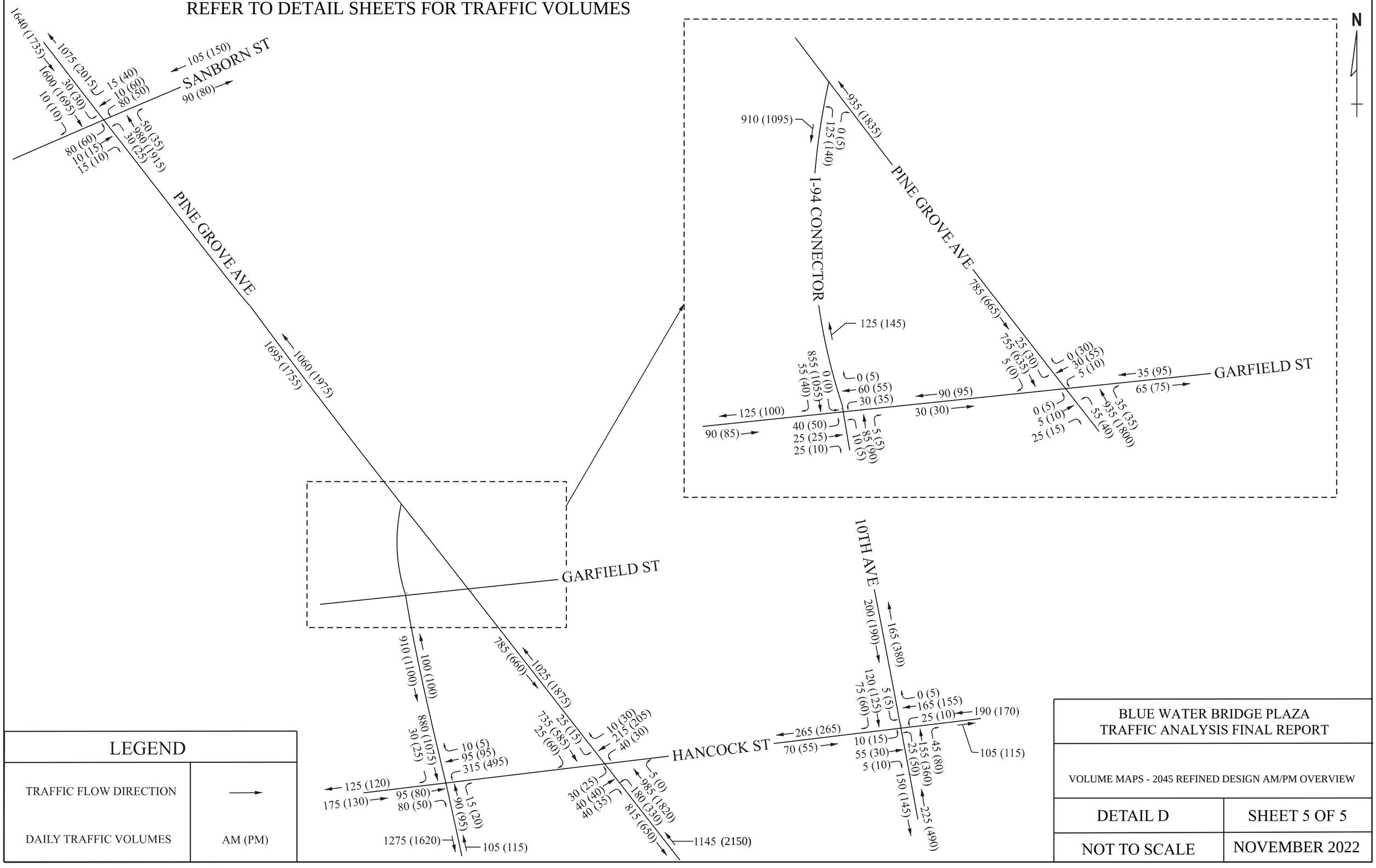
REFER TO DETAIL SHEETS FOR TRAFFIC VOLUMES

BLUE WATER BRIDGE PLAZA
TRAFFIC ANALYSIS FINAL REPORT

VOLUME MAPS - 2045 REFINED DESIGN AM/PM OVERVIEW

DETAIL C	SHEET 4 OF 5
NOT TO SCALE	NOVEMBER 2022

REFER TO DETAIL SHEETS FOR TRAFFIC VOLUMES



LEGEND

TRAFFIC FLOW DIRECTION	→
DAILY TRAFFIC VOLUMES	AM (PM)

BLUE WATER BRIDGE PLAZA
TRAFFIC ANALYSIS FINAL REPORT

VOLUME MAPS - 2045 REFINED DESIGN AM/PM OVERVIEW

DETAIL D	SHEET 5 OF 5
NOT TO SCALE	NOVEMBER 2022

Appendix N – I-94/I-69 Connector Alternative Evaluation

05-17-23

MDOT
Attn: Carrie Warren, MDOT PM

Re: Blue Water Bridge – Hancock and I-94 Connector Alternative Evaluation – Final Draft

Following the Geometric Review of the BWB Base Plans the team received comments from MDOT concerning the lane utilization for the southbound approach along the I-94 Connector at Hancock Street. As a note, under Existing Conditions, the PM queue along the SB Connector to I-94WB is contained within the block just north of Hancock Street. No other queues noted. Under proposed configuration, the Local to Outbound BWB ramp is relocated from Pine Grove Avenue to the I-94/I-69 On-ramp as shown in **Figure 1**. Traffic is expected to be accessed via Hancock Street or the I-94 Connector.

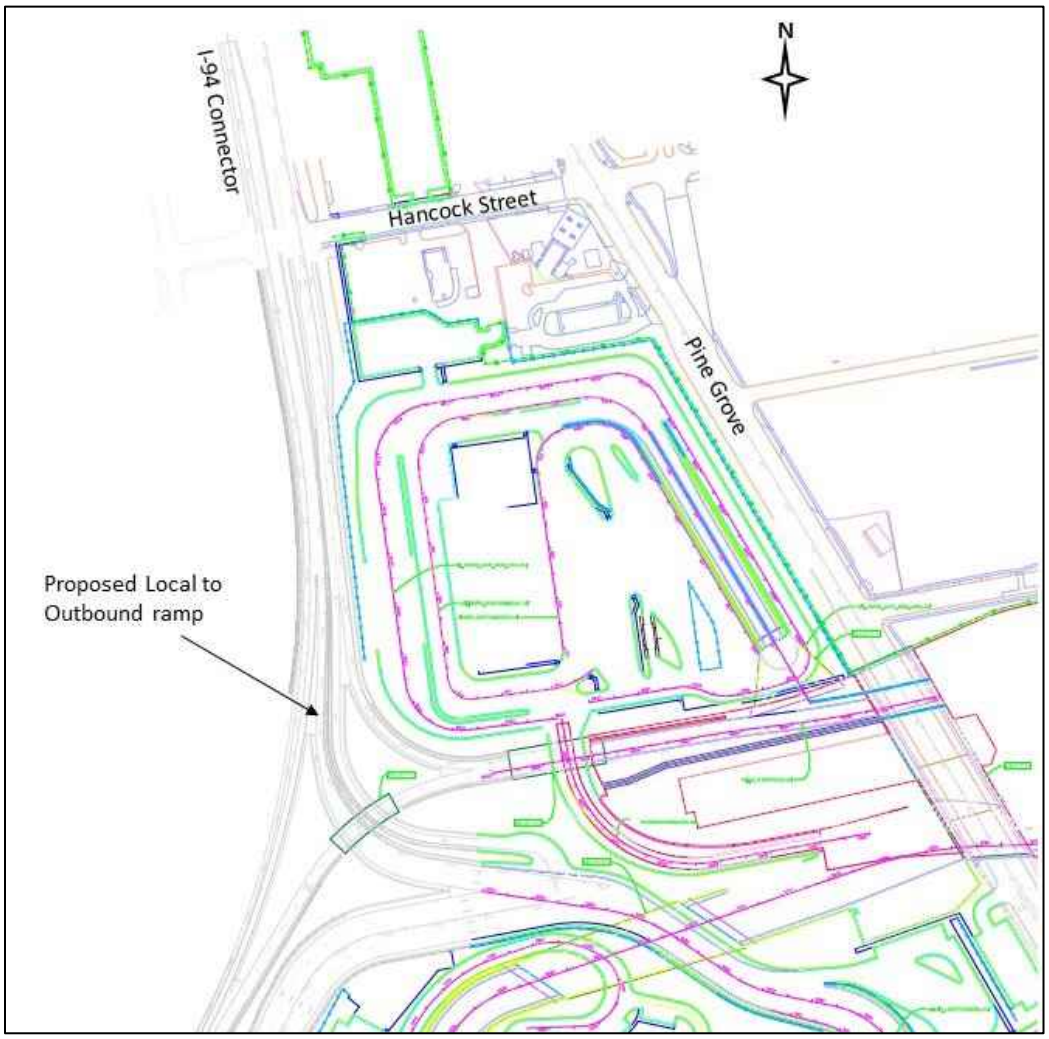


Figure 1: Proposed Blue Water Bridge Plaza

The following presents the impact that lane utilization has on queue lengths along the I-94 Connector. Although Synchro models do not typically model freeway networks the proposed BWB Local to Outbound ramp was added to create a decision point that could easily be tested in Synchro. The following sections model a two-lane section between Hancock and the Outbound ramp, with one lane ramps continuing to Outbound and one lane continuing to I-94/I-69 WB.

Future Build Base Model

This model will be presented as a baseline configuration with no lane utilization factors added. Local outbound traffic has been re-routed to turn left from Pine Grove Avenue onto Hancock Street. Model observations include:

- Vehicles traveling along the SB I-94 Connector are already sensing the drop downstream at the diverge point and making early lane decisions north of Hancock Street.
- Under heavy queuing conditions from the BWB plaza operations vehicles could queue back onto Hancock and the Connector. VISSIM modeling shows this queue to typically be around 125ft but is highly unpredictable during border shut-downs.
- Signal timings were adjusted, however balancing the heavy westbound left turn movement from Hancock Street with the heavy southbound through movement from the I-94 Connector is challenging.

If this configuration is carried forward, it is recommended that the NB left turn lane on Pine Grove Avenue at Hancock Street be restriped to provide more storage and not queue into the NB Pine Grove Avenue travel lanes.

The longest queue along the SB Connector spills back along Pine Grove to just north of Garfield as can be seen in **Figure 2**. No other noticeable queues within the network were found.

Figure 2: I-94 Connector Base Build

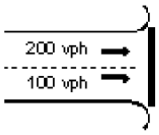
Future Build Base with Lane Utilization Factor

This model follows the Synchro 11 methodology for forced lane utilization and decision distances. **Figure 3** is taken from the Synchro 11 User's Manual on how to calculate Lane Utilization Factors (LUF).

Table 9-2 Lane Utilization Factors

Lane Group Movements	# of Lanes	Lane Utilization Factor
Thru or shared	1	1.00
Thru or shared	2	0.95
Thru or shared	3	0.91
Thru or shared	4+	0.86
Left	1	1.00
Left	2	0.97
Left	3+	0.94
Right	1	1.00
Right	2	0.88
Right	3	0.76

This field can be overridden. If, for example, there is a busy shopping center entrance just after this intersection on the right side, most of the vehicles will be using the right lane and cause a lower lane utilization factor. If the actual per lane volumes are known, the lane utilization factor can be calculated as follows:



$$fLU = \frac{\text{Total App. Vol.}}{(\text{No. of Lanes}) \times (\text{High Lane Vol.})} = \frac{(100 + 200)}{(2 \times 200)} = 0.75$$

f_{LU} = Lane Utilization Factor

Figure 3: Synchro V11 Lane Utilization Factors

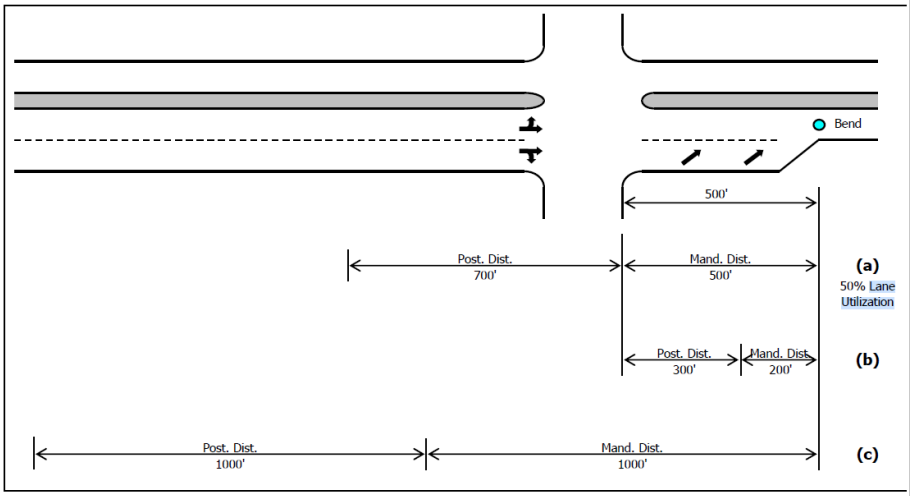


Figure 30-8 Controlling Lane Utilization

Figure 4: Synchro V11 Controlling Lane Utilization Factors

Based on the above guidance the following changes were made to the model:

- Mandatory and positioning distance in the Simulation settings were revised.
- Lane utilization was changed to 0.57 at the diverge point for the I-94 WB ramp and the BWB Local Outbound ramp.

The following observations were noted in the model as seen in **Figure 5**:

- Queuing mirrors the Base model but extends further north along the I-94 Connector onto Pine Grove Avenue at Kennelworth Drive. This complicates the southbound dual right turn movement from Pine Grove Avenue onto the I-94 Connector.
- Additional queuing along westbound Hancock Street is noticed due to changes in signal timings.

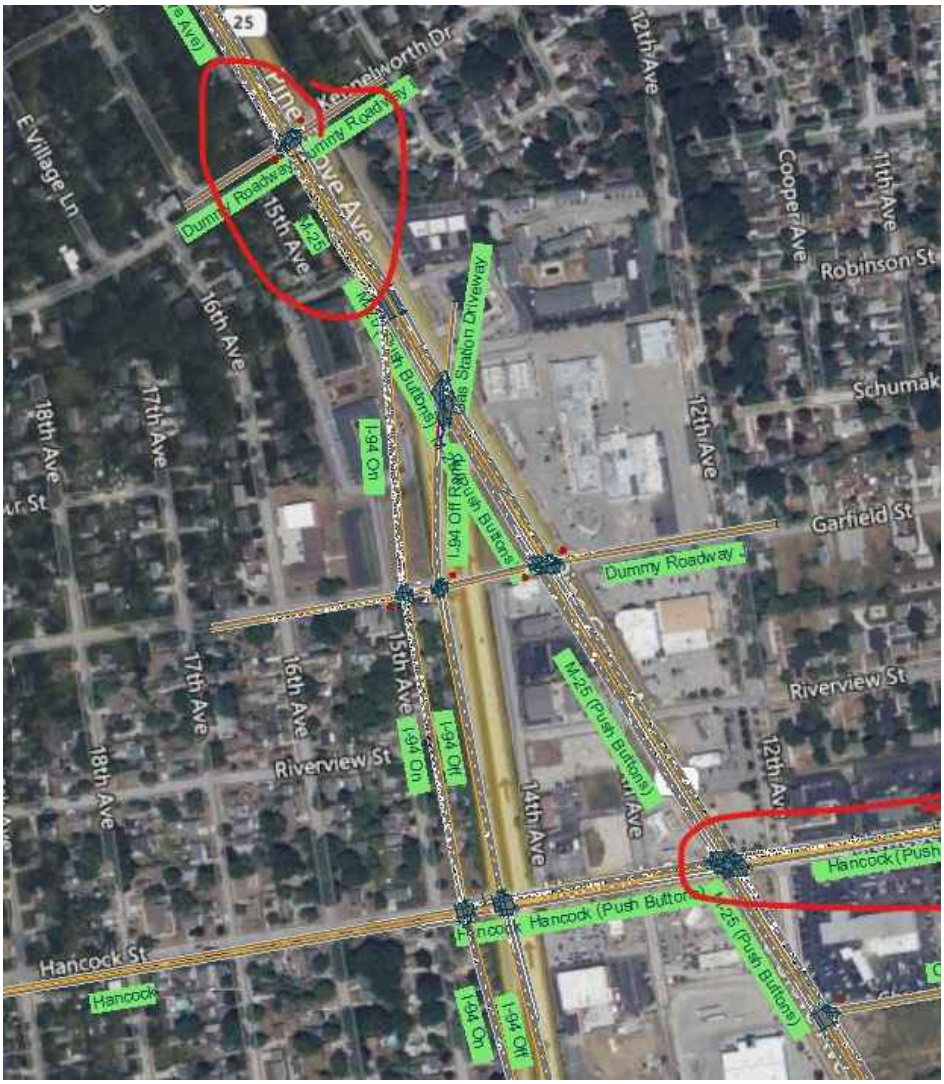


Figure 5: I-94 Connector Base Build with LUF

One-Way Pairs

MDOT requested that the conversion of Hancock Street to one-way eastbound and Riverview one-way westbound be evaluated. The starting model used was the Base model with the one-way pairs converted. Traffic was redistributed from Hancock Street to Riverview Street. Additional redistribution along 10th Street to Riverview Street is expected as well to make the connection between 10th Street and the I-94 Connector.

The following mitigations were implemented:

- Pushbutton needed to cross I-94 Connector south leg at Hancock Street
- SB I-94 Connector right turn lane at Hancock Street
- Pine Grove Avenue SB left onto Hancock was moved to Riverview Street.

The following observations in the model were made:

- The queuing along SB I-94 Connector cannot be resolved with timing or laneage mitigations and spills back to Pine Grove Avenue.
- The shortened distance of Riverview Street between I-94 Connector and Pine Grove Avenue removes about 200 feet of storage (when compared to Hancock Street). Even with the dual left turn lanes at Riverview Street vehicles are selecting lanes in advance.
- With traffic redistribution, the NB left turn at Riverview Street increases to 430 (was 330 at Hancock Street) due to removing the WB through movement on Hancock.

This configuration does not propose enough improvement operationally when balanced with required mitigations and roadway improvements to recommend this change. The conversion also creates a disconnect to the local network from west to east.

Final Proposed Configuration

To reduce queuing onto the I-94 SB Connector, Hancock Street, and Pine Grove Avenue it is recommended that the laneage between Hancock Street and the Local Outbound ramp be increased to a three-lane cross-section with two lanes continuing to I-94/I-69 and a one lane ramp to Local Outbound as shown in **Figure 6.** A short third lane extension (250ft) is also proposed on the I-94 SB Connector north of Hancock to accommodate spillback for the BWB Local Outbound Ramp during rare long queues that could occur during very busy periods or slower Canadian Customs processing. Extending the 3-lane section north of Hancock alleviates the potential for traffic to queue from the plaza, north of Hancock. **Figure 7** shows the proposed lane configuration at the intersection of Hancock and I-94 Connector, including the addition of the EB left turn from Hancock to I-94 Connector northbound.

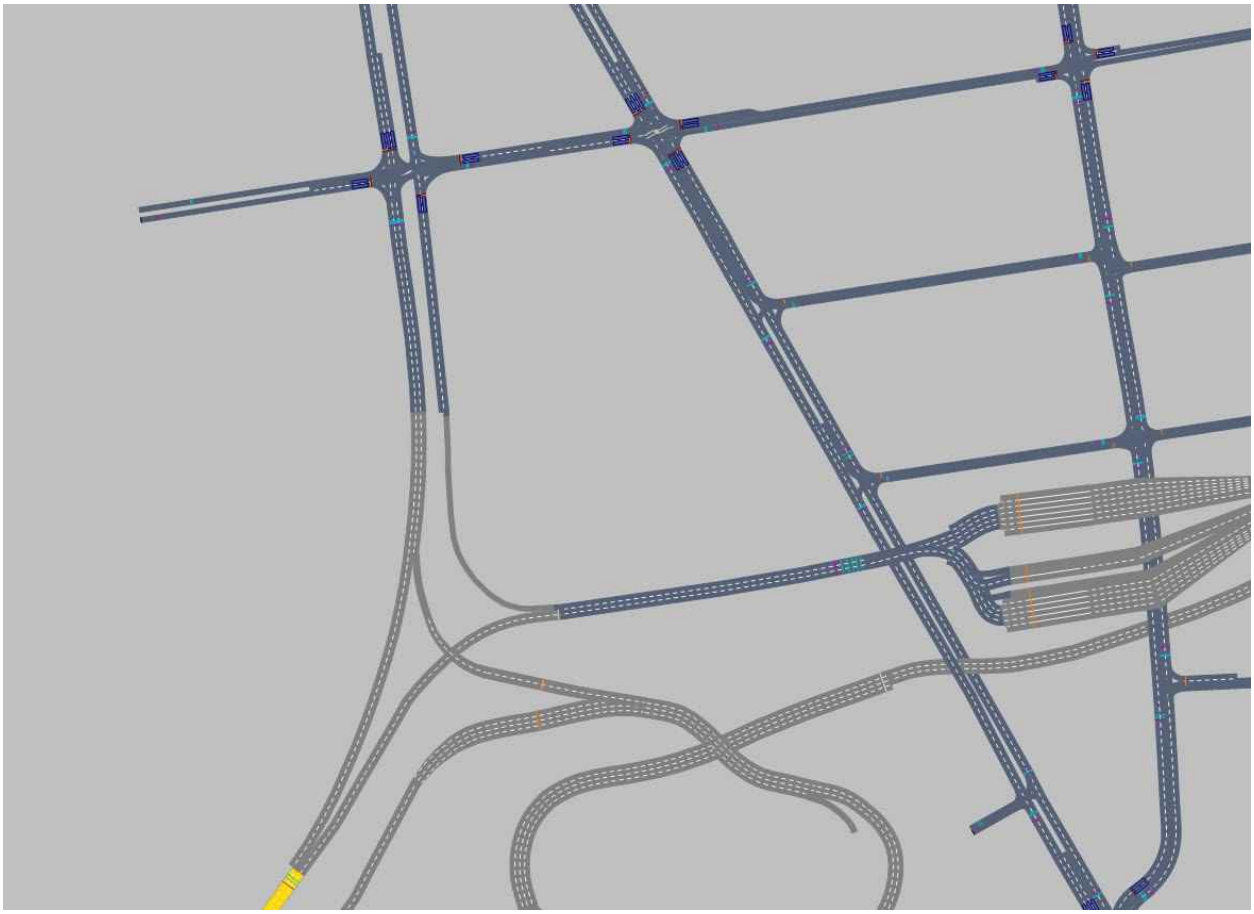


Figure 6: Proposed Lanes between Hancock and Local Outbound Ramp

Figure 7: Proposed Lanes between Hancock and Local Outbound Ramp

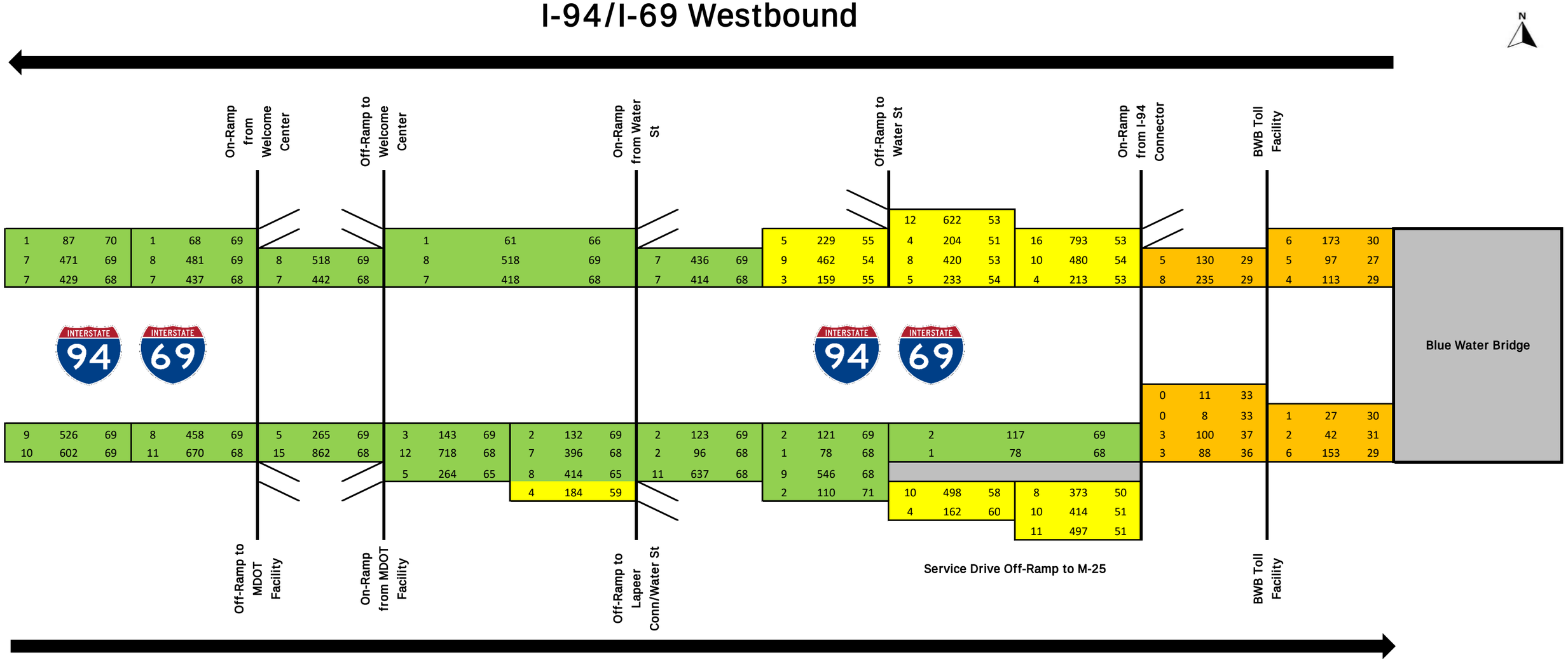
The following observations in the VISSIM model were made:

- The VISSIM model shows future PM peak queue from the tollbooths would be contained on the local Outbound ramp downstream of the gore.
- VISSIM modeling shows the queue from the tollbooths contained on the Local Outbound ramp. It should be noted that queuing is unpredictable during border shutdowns.
- The intersection of the I-94 Connector and Hancock Street operates at a level of service of D or better for all movements except for the PM eastbound left turn, which operates at LOS E. As this movement services a low volume of traffic the level of service was deemed acceptable.

Appendix O – Future Freeway Segment Measures of Effectiveness

FNB 2045 AM Peak Hour Lane Schematic

I-94/I-69 Westbound



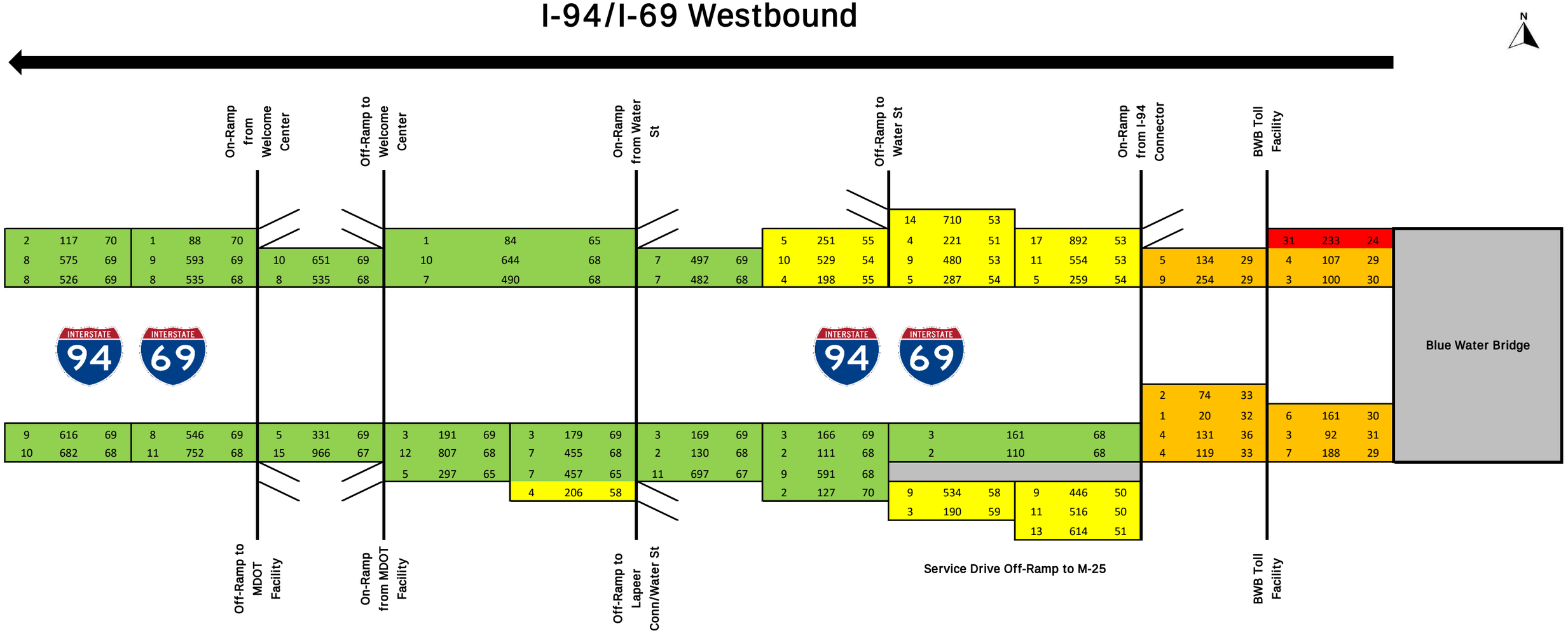
I-94/I-69 Eastbound

O-1

Legend		
Density (veh/ln/mi/hr)	Volume (veh/ln/hr)	Speed (mph)
XX	XXX	XX
	< 25 mph	
	25 mph - 45 mph	
	45 mph - 60 mph	
	> 60 mph	

FNB 2045 PM Peak Hour Lane Schematic

I-94/I-69 Westbound



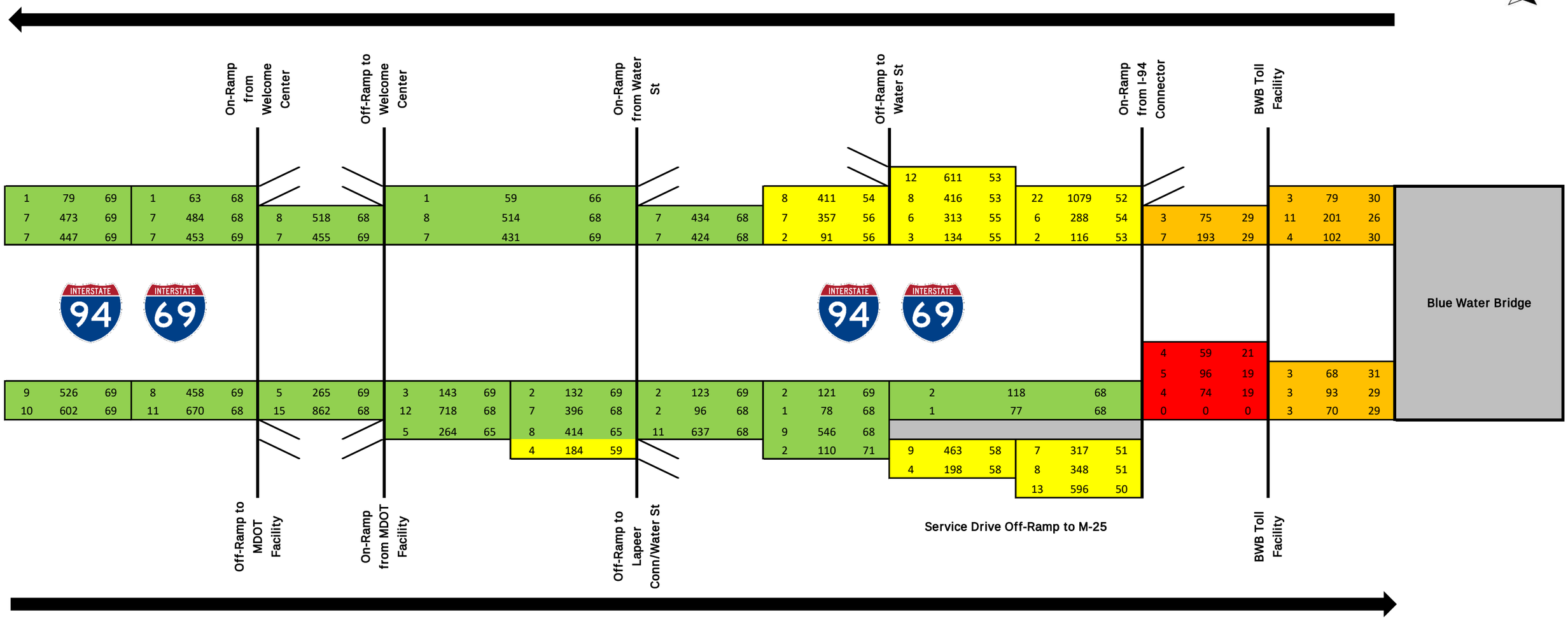
I-94/I-69 Eastbound

O-2

Legend		
Density (veh/ln/mi/hr)	Volume (veh/ln/hr)	Speed (mph)
XX	XXX	XX
	< 25 mph	
	25 mph - 45 mph	
	45 mph - 60 mph	
	> 60 mph	

2045 Refined Alternative AM Peak Hour Lane Schematic

I-94/I-69 Westbound



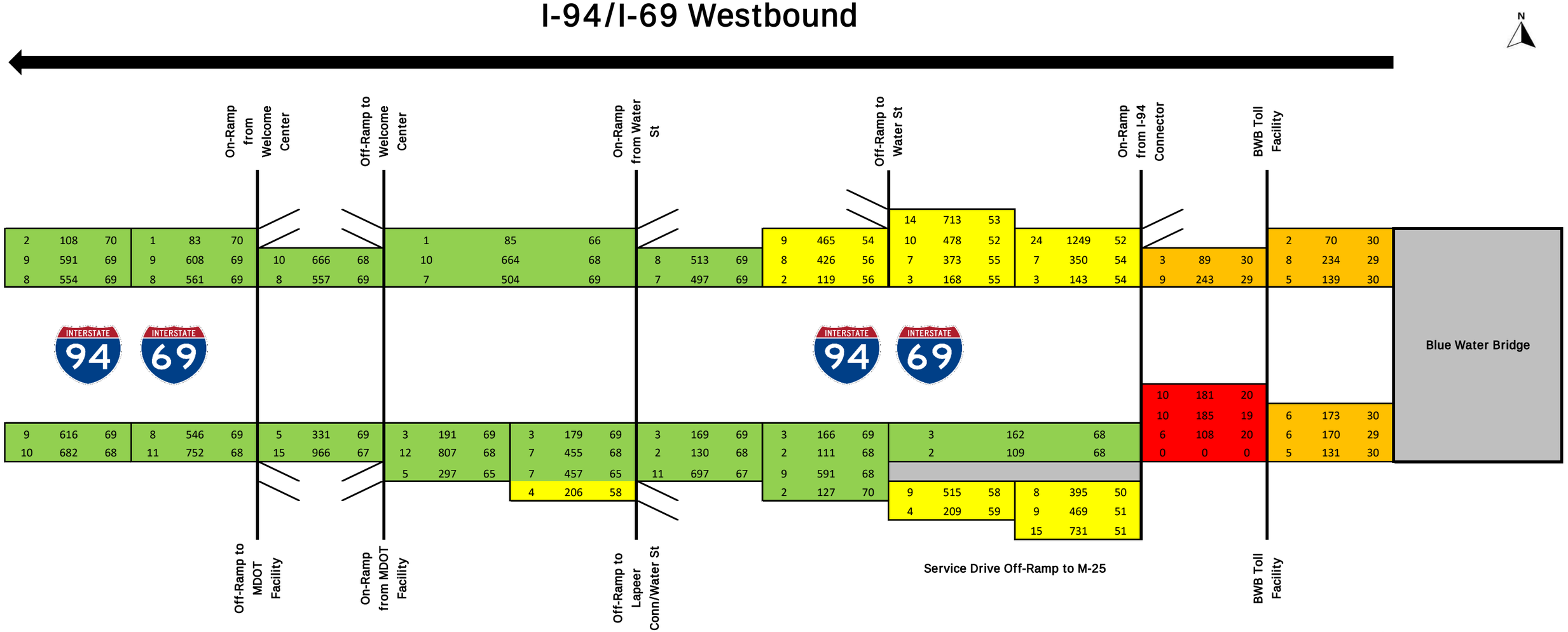
I-94/I-69 Eastbound

O-3

Legend		
Density (veh/ln/mi/hr)	Volume (veh/ln/hr)	Speed (mph)
XX	XXX	XX
	< 25 mph	
	25 mph - 45 mph	
	45 mph - 60 mph	
	> 60 mph	

2045 Refined Alternative PM Peak Hour Lane Schematic

I-94/I-69 Westbound



I-94/I-69 Eastbound

O-4

Legend		
Density (veh/ln/mi/hr)	Volume (veh/ln/hr)	Speed (mph)
XX	XXX	XX
	< 25 mph	
	25 mph - 45 mph	
	45 mph - 60 mph	
	> 60 mph	

Appendix P – Future Freeway Segment Level of Service

Appendix P – Future Freeway Segment Level of Service

Location	Operation Type	Future No-Build - 2045				2045 Refined Alternative			
		AM		PM		AM		PM	
		Density	LOS	Density	LOS	Density	LOS	Density	LOS
I-94/I-69 EB Mainline LOS									
I-94/I-69 EB Start	Basic	9.7	A	9.8	A	9.7	A	9.8	A
I-94/I-69 EB diverge to MDOT Maintenance Facility	Diverge	9.7	A	9.8	A	9.7	A	9.8	A
I-94/I-69 EB mainline	Basic	9.8	A	9.9	A	9.8	A	9.9	A
I-94/I-69 EB merge/diverge from MDOT Maintenance Facility/Lapeer Connector	Merge/Diverge	6.0	A	6.1	A	6.0	A	6.1	A
I-94/I-69 EB mainline	Basic	5.0	A	5.1	A	5.0	A	5.1	A
I-94/I-69 EB diverge to 3 lanes	Diverge	3.7	A	3.7	A	3.7	A	3.7	A
I-94/I-69 EB mainline	Basic	1.7	A	2.1	A	1.7	A	2.1	A
I-94/I-69 EB merge with I-94/I-69 Conn On-ramp	Merge	1.5	A	2.7	A	2.9	A	5.6	A
I-94/I-69 EB Toll Plaza	Basic	16.3	B	30.5	D	4.5	A	8.4	A
I-94/I-69 EB from Toll Plaza to BWB Border	Basic	2.8	A	5.0	A	2.9	A	5.6	A
I-94/I-69 WB Mainline LOS									
I-94/I-69 WB Border Patrol to BWB Canada Border	Basic	4.9	A	12.6	B	5.9	A	5.1	A
I-94/I-69 WB South Border Patrol Checkpoint	Basic	8.3	A	6.2	A	9.6	A	8.7	A
I-94/I-69 WB North Border Patrol Checkpoint (Car Lane)	Basic	20.9	C	100.6	F	17.7	B	50.8	F
I-94/I-69 WB North Border Patrol Checkpoint (NEXUS Lane)	Basic	3.5	A	5.4	A	3.3	A	5.5	A
I-94/I-69 WB North Border Patrol Checkpoint (Truck Lane)	Basic	7.2	A	5.4	A	28.7	D	18.1	C
I-94/I-69 WB North Border Patrol Checkpoint (FAST Lane)	Basic	76.7	F	62.0	F	70.4	F	59.7	F
I-94/I-69 WB mainline	Basic	6.6	A	6.8	A	4.2	A	5.2	A
I-94/I-69 WB mainline	Basic	6.9	A	7.2	A	3.8	A	4.6	A
I-94/I-69 WB merge/Diverge I-94/I-69 BL (Pine Grove)/Water St.	Merge/Diverge	9.2	A	10.3	A	9.3	A	10.4	B
I-94/I-69 WB Converge 3-2 lane	Converge	5.5	A	6.1	A	5.6	A	6.2	A
I-94/I-69 WB mainline	Basic	6.7	A	7.3	A	6.6	A	7.4	A
I-94/I-69 WB merge/diverge WB service Dr/Welcome Center	Merge/Diverge	5.3	A	6.1	A	5.2	A	6.2	A
I-94/I-69 WB mainline	Basic	7.6	A	8.7	A	7.6	A	9.0	A
I-94/I-69 WB merge from Welcome Center	Merge	5.1	A	5.9	A	5.2	A	6.1	A
I-94/I-69 WB termination	Basic	5.1	A	5.9	A	5.2	A	6.1	A
I-94/I-69 EB Service Drive									
I-94/I-69 EB service Drive start	Basic	6.7	A	6.4	A	6.7	A	6.5	A
I-94/I-69 EB service Drive Diverge to 3 lanes (adds Water Street on-ramp)	Diverge	9.5	A	10.8	B	9.3	A	10.8	B
I-94/I-69 EB service Drive end on I-94/I-69 BL (Pine Grove)	Basic	33.8	D	42.8	E	16.3	B	18.7	C
I-94/I-69 WB Service Drive									
I-94/I-69 WB Service Drive between Water St. & Lapeer Connector	Basic	8.0	A	7.3	A	7.5	A	7.2	A
I-94/I-69 WB Service Drive Lapeer Connector to WB I-94/I-69	Basic	2.9	A	4.1	A	2.6	A	4.3	A

- Highlighted rows indicate segments at the BWB Toll Plaza
- Density (veh/h/ln) results extracted from the simulation model

Appendix Q – Future Intersection Level of Service

Future Intersection Level of Service Summary

2045 Future No-Build Alternative - AM

Intersection	Northbound				Southbound				Eastbound				Westbound				Total
	L	TH	R	App	L	TH	R	App	L	TH	R	App	L	TH	R	App	
I-94/I-69 BL (Pine Grove) at 10th Ave	A	D		B	C	D		D		A	A	A		B	A	B	B
Lapeer Conn at Service Drive WB	B			B									A	A		A	A
I-94/I-69 EB Ramps at Water St		B	A	A	A	A		A	C	C	C	C					B
I-94/I-69 WB Ramps at Water St	A	A		A	A	B		B					C	C	A	C	B
I-94/I-69 EB Ramps atI-94/I-69 BL (Pine Grove)		B	A	B	B	C		C	C	C	B	C					C
Harker St at 10th Ave		A	A	A	A	A		A	B	B	A	B	A		A	A	A
10th Ave at Elmwood	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
10th Ave at Church St	A	A	A	A	A	A	A	A	A	B	A	A	A	A	A	A	A
10th Ave at Hancock St	C	B	B	B	B	B	A	B	C	B	A	B	B	B	A	B	B
M-25 (Pine Grove) at Sanborn St	D	B	B	B	B	A	A	A	D	A	B	D	D	D	A	C	B
M-25 (Pine Grove) at I-94/I-69 Conn		A		A		A		A	D		A	A					A
Garfield St at I-94/I-69 Conn	A	A	A	A	A	A	A	A		B	B	B		B	A	B	A
M-25 (Pine Grove) at Garfield St	A	A	A	A	A	A	A	A	A	B	A	A	B	B	A	B	A
I-94/I-69 BL (Pine Grove) at Elmwood St	A	A	A	A	B	A	A	A	A	C	A	C	A	B	B	B	A
I-94/I-69 BL (Pine Grove) at BWB On-Ramp	A	A		A		A	A	A									A
I-94/I-69 BL (Pine Grove) at Church St	A	A	A	A	A	A	A	A	A	A	A	A	A	A	B	B	A
I-94/I-69 BL/M-25 (Pine Grove) at Hancock St	C	B	B	B	C	B	B	B	E	C	C	D	D	E	D	E	C
I-94/I-69 Conn at Hancock St		B	A	B		C	B	C		C	A	C	E	E	D	E	C
Water Street at Campau Street	A	A		A		A	A	A	B		B	B					A

2045 Future No-Build Alternative - PM

Intersection	Northbound				Southbound				Eastbound				Westbound				Total
	L	TH	R	App	L	TH	R	App	L	TH	R	App	L	TH	R	App	
I-94/I-69 BL (Pine Grove) at 10th Ave	D	D		D	D	D		D		B	A	B		C	C	C	C
Lapeer Conn at Service Drive WB	A			A									A	A		A	A
I-94/I-69 EB Ramps at Water St		B	A	B	C	B		B	C	D	C	C					C
I-94/I-69 WB Ramps at Water St	A	A		A	A	B		B					C	C	A	C	B
I-94/I-69 EB Ramps atI-94/I-69 BL (Pine Grove)		B	A	B	C	B		B	C	C	B	C					C
Harker St at 10th Ave		A	A	A	A	A		A	B	B	A	B	A		A	A	A
10th Ave at Elmwood	A	A	A	A	A	A	A	A	A	A	A	A	A	B	A	A	A
10th Ave at Church St	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
10th Ave at Hancock St	C	C	B	B	B	B	A	B	C	B	A	B	B	B	A	B	B
M-25 (Pine Grove) at Sanborn St	C	A	A	A	C	A	A	A	D	A	B	D	D	D	B	C	A
M-25 (Pine Grove) at I-94/I-69 Conn		A		A		A		A	C		C	C					A
Garfield St at I-94/I-69 Conn	A	A	A	A	A	A	A	A		B	B	B		C	A	C	A
M-25 (Pine Grove) at Garfield St	A	A	A	A	C	A	A	A	A	B	A	B	C	C	C	C	A
I-94/I-69 BL (Pine Grove) at Elmwood St	A	A	A	A	B	A	A	A	B	C	A	B	A	A	B	B	A
I-94/I-69 BL (Pine Grove) at BWB On-Ramp	A	A		A		A	A	A									A
I-94/I-69 BL (Pine Grove) at Church St	A	A	A	A	C	A	A	A	A	A	A	A	A	A	C	C	A
I-94/I-69 BL/M-25 (Pine Grove) at Hancock St	B	B	A	B	D	A	A	B	E	D	C	D	D	D	D	D	B
I-94/I-69 Conn at Hancock St		B	A	B		B	B	B		B	B	B	C	B	B	B	B
Water Street at Campau Street	A	A		A		A	A	A	B		A	A					A

2045 Refined Alternative - AM

Intersection	Northbound				Southbound				Eastbound				Westbound				Total
	L	TH	R	App	L	TH	R	App	L	TH	R	App	L	TH	R	App	
I-94/I-69 BL (Pine Grove) at 10th Ave	C	A		C						B	A	B	D	B		B	B
Lapeer Conn at Service Drive WB	A			A									A	A		A	A
I-94/I-69 EB Ramps at Water St		B	A	A	A	A		A	C	C	C	B					B
I-94/I-69 WB Ramps at Water St	A	A		A	C	C		C					C	C	A	C	B
I-94/I-69 EB Ramps atI-94/I-69 BL (Pine Grove)		B	A	B	C	C		C	B	D	C	C	D			D	C
Harker St at 10th Ave					A	A		A	A	A		A	A		A	A	A
10th Ave at Elmwood	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
10th Ave at Church St	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
10th Ave at Hancock St	C	C	B	B	B	B	A	B	C	B	A	B	B	B	A	B	B
M-25 (Pine Grove) at Sanborn St	C	A	A	B	B	A	A	A	D	A	B	D	D	D	A	C	A
M-25 (Pine Grove) at I-94/I-69 Conn		A		A		A		A	D		A	D					A
Garfield St at I-94/I-69 Conn	A	A	A	A	A	A	A	A		B	A	B		B	A	B	A
M-25 (Pine Grove) at Garfield St	A	A	A	A	B	A	A	A	A	B	A	A	B	B	A	B	A
I-94/I-69 BL (Pine Grove) at Elmwood St		A	A	A	A	A		A					A		A	A	A
I-94/I-69 BL (Pine Grove) at BWB Staff Access	A	A		A		A	A	A	B		A	B					A
I-94/I-69 BL (Pine Grove) at Church St		A	A	A	B	A		A					A		B	B	A
I-94/I-69 BL/M-25 (Pine Grove) at Hancock St	A	C	C	C	C	C	C	C	D	C	B	C	C	D	C	C	C
I-94/I-69 Conn at Hancock St		B	A	B		B	B	B	D	D	B	C	C	C	B	C	B
Water St at Campau St	A	A		A		A	A	A	B		A	B					A

2045 Refined Alternative - PM

Intersection	Northbound				Southbound				Eastbound				Westbound				Total
	L	TH	R	App	L	TH	R	App	L	TH	R	App	L	TH	R	App	
I-94/I-69 BL (Pine Grove) at 10th Ave	C	B		C						A	A	A	B	D		B	B
Lapeer Conn at Service Drive WB	A			A									A	A		A	A
I-94/I-69 EB Ramps at Water St		B	A	B	A	B		B	C	D	C	C					C
I-94/I-69 WB Ramps at Water St	A	A		A	C	B		B					C	C	A	C	B
I-94/I-69 EB Ramps atI-94/I-69 BL (Pine Grove)		B	A	B	C	B		B	C	D	B	C	D			D	B
Harker St at 10th Ave					A	A		A	A	A		A	A		A	A	A
10th Ave at Elmwood	A	A	A	A	A	A	A	A	A	A	A	A	A	B	A	A	A
10th Ave at Church St	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
10th Ave at Hancock St	C	B	B	B	B	B	A	B	C	B	A	B	B	B	A	B	B
M-25 (Pine Grove) at Sanborn St	C	A	A	A	D	A	A	A	E	A	B	D	D	D	C	C	A
M-25 (Pine Grove) at I-94/I-69 Conn		A		A		A		A	D		C	D					A
Garfield St at I-94/I-69 Conn	A	A	A	A	A	A	A	A		B	B	B		C	A	C	A
M-25 (Pine Grove) at Garfield St	A	A	A	A	C	A	A	A	A	B	A	B	C	C	C	C	A
I-94/I-69 BL (Pine Grove) at Elmwood St		A	A	A	C	A		A					A		B	B	A
I-94/I-69 BL (Pine Grove) at BWB Staff Access	A	A		A		A	A	A	B		A	B					A
I-94/I-69 BL (Pine Grove) at Church St		A	A	A	D	A		A					A		C	C	A
I-94/I-69 BL/M-25 (Pine Grove) at Hancock St	C	B	A	B	D	A	A	B	D	C	B	C	D	D	D	D	B
I-94/I-69 Conn at Hancock St		C	B	C		C	C	C	B	D	B	C	B	B	B	B	C
Water St at Campau St	A	A		A		A	A	A	B		B	B					A

Future No-Build Intersection Level of Service

Intersections				AM						PM					
				All		Approach		Intersection		All		Approach		Intersection	
Int ID	Int Name	Mvmt	Sig?	Mvt Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Mvt Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
1	I-94/I-69 BL (Pine Grove) at 10th Ave	EBT	S	7.67	A	7.3	A	12.4	B	14.31	B	11.4	B	23.7	C
		EBR		6.41	A					7.48	A				
		WBT		12.18	B	11.8	B			22.27	C	22.1	C		
		WBR		7.32	A					20.20	C				
		NBL		1.83	A	14.8	B			35.84	D	36.1	D		
		NBT		40.96	D					36.56	D				
		SBL		32.38	C	44.5	D			38.43	D	45.5	D		
		SBT		47.46	D					46.99	D				
2	Lapeer Conn at Service Drive WB	WBL	S	3.24	A	3.4	A	3.7	A	1.82	A	1.5	A	2.0	A
		WBT		4.02	A					0.80	A				
		NBL		16.28	B	16.3	B			8.94	A	8.9	A		
3	I-94/I-69 EB Ramps at Water St	EBL	S	20.83	C	30.4	C	17.0	B	22.98	C	34.9	C	23.8	C
		EBT		31.25	C					41.57	D				
		EBR		30.21	C					23.39	C				
		NBT		13.55	B	7.6	A			18.92	B	14.2	B		
		NBR		4.23	A					5.29	A				
		SBL		5.24	A	6.3	A			25.25	C	15.8	B		
		SBT		6.99	A					11.00	B				
4	I-94/I-69 WB Ramps at Water St	WBL	S	28.06	C	23.3	C	16.6	B	25.35	C	20.1	C	13.5	B
		WBT		27.10	C					24.47	C				
		WBR		7.15	A					9.36	A				
		NBT		5.62	A	10.0	A			5.46	A	4.6	A		
		NBL		6.40	A					3.26	A				
		SBT		12.10	B	10.7	B			14.95	B	13.2	B		
		SBL		5.32	A					4.79	A				
5	I-94/I-69 EB Ramps atI-94/I-69 BL (Pine Grove)	EBL	S	29.51	C	27.2	C	23.6	C	31.83	C	29.6	C	20.2	C
		EBT		29.32	C					29.87	C				
		EBR		19.62	B					14.47	B				
		NBT		15.23	B	15.1	B			11.51	B	11.5	B		
		NBR		3.47	A					4.39	A				
		SBL		14.79	B	21.7	C			26.65	C	10.9	B		
		SBT		21.76	C					10.46	B				
6	Harker St at 10th Ave	EBL	S	11.74	B	12.3	B	5.7	A	16.07	B	15.2	B	6.1	A
		EBT		12.99	B					12.28	B				
		EBR		0.00	A					8.54	A				
		WBL		7.10	A	0.5	A			6.64	A	6.3	A		
		WBR		6.00	A					6.11	A				
		NBT		0.08	A	0.2	A			0.18	A	0.3	A		
		NBR		0.75	A					0.86	A				
		SBL		0.52	A	0.1	A			0.00	A	0.1	A		
		SBT		0.10	A					0.07	A				
7	10th Ave at Elmwood	EBL	S	7.85	A	7.6	A	1.2	A	7.89	A	7.7	A	0.7	A
		EBT		6.45	A					7.15	A				
		EBR		0.00	A					0.00	A				
		WBL		9.41	A	9.1	A			8.48	A	9.9	A		
		WBT		9.43	A					12.65	B				
		WBR		6.44	A					6.20	A				
		NBL		1.31	A	0.1	A			1.03	A	0.2	A		
		NBT		0.08	A					0.18	A				
		NBR		0.75	A					0.84	A				
		SBL		0.00	A	0.1	A			4.81	A	0.2	A		
		SBT		0.10	A					0.07	A				
		SBR		0.00	A					0.00	A				
8	10th Ave at Church St	EBL	S	7.10	A	8.3	A	0.5	A	8.31	A	7.5	A	0.5	A
		EBT		10.22	B					8.17	A				
		EBR		0.00	A					4.42	A				
		WBL		7.82	A	6.1	A			7.00	A	6.8	A		
		WBT		0.00	A					0.00	A				
		WBR		4.73	A					6.63	A				
		NBL		1.00	A	0.1	A			0.68	A	0.1	A		
		NBT		0.11	A					0.11	A				
		NBR		0.65	A					1.15	A				
		SBL		0.00	A	0.2	A			2.97	A	0.3	A		
		SBT		0.15	A					0.16	A				
		SBR		0.00	A					0.00	A				
9	10th Ave at Hancock St	EBL	S	20.52	C	15.2	B	16.0	B	22.86	C	17.5	B	17.4	B
		EBT		14.83	B					17.47	B				
		EBR		4.27	A					7.26	A				
		WBL		19.18	B	14.4	B			10.28	B	12.4	B		
		WBT		13.74	B					12.80	B				
		WBR		0.00	A					4.11	A				
		NBL		21.17	C	18.3	B			25.07	C	20.7	C		
		NBT		19.61	B					21.58	C				
		NBR		11.95	B					13.90	B				
		SBL		11.78	B	15.1	B			13.46	B	13.6	B		
		SBT		18.45	B					16.02	B				
		SBR		9.67	A					8.53	A				
10	M-25 (Pine Grove) at Sanborn St	EBL	S	45.51	D	38.1	D	11.1	B	53.90	D	42.4	D	7.3	A
		EBT		7.32	A					9.73	A				
		EBR		16.07	B					16.37	B				
		WBL		36.26	D	33.5	C			37.65	D	34.0	C		
		WBT		38.21	D					39.96	D				
		WBR		9.95	A					19.85	B				
		NBL		43.05	D	13.4	B			31.52	C	4.9	A		
		NBT		12.76	B					4.57	A				
		NBR		11.56	B					5.03	A				
		SBL		17.47	B	6.6	A			26.84	C	6.1	A		
		SBT		6.41	A					5.71	A				
		SBR		6.13	A					6.78	A				

Future No-Build Intersection Level of Service

Intersections				AM						PM					
				All		Approach		Intersection		All		Approach		Intersection	
Int ID	Int Name	Mvmt	Sig?	Mvt Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Mvt Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
11	M-25 (Pine Grove) at I-94/I-69 Conn	EBL	S	39.42	D	5.6	A	5.8	A	32.89	C	32.8	C	5.7	A
		EBR		0.00	A					27.95	C				
		NBT		0.84	A	3.33	A			5.23	A	4.29	A		
		SBT		6.21	A	6.21	A			1.64	A	1.64	A		
12	Garfield St at I-94/I-69 Conn	EBT	S	17.80	B	14.4	B	1.7	A	17.69	B	16.0	B	1.5	A
		EBR		10.82	B					10.54	B				
		WBT		14.34	B	13.3	B			22.01	C	20.9	C		
		WBR		0.00	A					5.76	A				
		NBL		7.27	A	1.2	A			3.71	A	0.6	A		
		NBT		0.48	A					0.47	A				
		NBR		0.56	A					0.51	A				
		SBL		0.00	A	0.2	A			0.00	A	0.2	A		
		SBT		0.18	A					0.14	A				
		SBR		1.32	A					0.86	A				
13	M-25 (Pine Grove) at Garfield St	EBL	S	0.00	A	8.1	A	1.2	A	8.57	A	11.0	B	2.1	A
		EBT		17.80	B					17.69	B				
		EBR		6.59	A					6.91	A				
		WBL		15.24	B	14.5	B			29.93	C	22.7	C		
		WBT		14.34	B					22.01	C				
		WBR		0.00	A					21.84	C				
		NBL		6.10	A	1.2	A			6.98	A	1.1	A		
		NBT		0.86	A					1.02	A				
		NBR		1.13	A					1.24	A				
		SBL		6.25	A	0.6	A			31.09	C	1.7	A		
		SBT		0.36	A					0.20	A				
		SBR		0.50	A					0.00	A				
14	I-94/I-69 BL (Pine Grove) at Elmwood St	EBL	S	0.00	A	35.0	C	0.5	A	17.71	B	16.2	B	0.8	A
		EBT		34.97	C					26.86	C				
		EBR		0.00	A					3.59	A				
		WBL		0.00	A	14.3	B			0.00	A	11.4	B		
		WBT		15.89	B					0.00	A				
		WBR		13.92	B					11.42	B				
		NBL		1.49	A	0.3	A			0.00	A	0.8	A		
		NBT		0.28	A					0.81	A				
		NBR		0.56	A					0.50	A				
		SBL		10.72	B	0.2	A			19.64	B	0.4	A		
		SBT		0.12	A					0.26	A				
		SBR		0.03	A					0.00	A				
15	I-94/I-69 BL (Pine Grove) at BWB On-Ramp	NBL	S	2.36	A	0.1	A	0.3	A	3.46	A	1.4	A	1.7	A
		NBT		0.15	A					1.25	A				
		SBT		0.43	A	0.4	A			2.83	A	2.9	A		
		SBR		1.16	A					3.15	A				
16	I-94/I-69 BL (Pine Grove) at Church St	EBL	S	0.00	A	0.0	A	0.5	A	0.00	A	0.0	A	2.7	A
		EBT		0.00	A					0.00	A				
		EBR		0.00	A					0.00	A				
		WBL		0.00	A	10.2	B			0.00	A	20.8	C		
		WBT		0.00	A					0.00	A				
		WBR		10.20	B					20.83	C				
		NBL		9.87	A	0.5	A			4.06	A	3.3	A		
		NBT		0.45	A					3.32	A				
		NBR		0.36	A					1.49	A				
		SBL		3.63	A	0.3	A			22.55	C	0.8	A		
		SBT		0.32	A					0.33	A				
		SBR		0.00	A					1.14	A				
17	I-94/I-69 BL/M-25 (Pine Grove) at Hancock St	EBL	S	78.49	E	43.0	D	22.1	C	62.25	E	43.9	D	16.3	B
		EBT		31.94	C					47.29	D				
		EBR		20.96	C					25.61	C				
		WBL		43.45	D	68.0	E			40.48	D	46.0	D		
		WBT		73.73	E					48.05	D				
		WBR		49.92	D					38.12	D				
		NBL		33.55	C	15.8	B			18.11	B	12.8	B		
		NBT		13.03	B					12.32	B				
		NBR		14.61	B					0.00	A				
		SBL		26.41	C	12.8	B			45.00	D	10.7	B		
		SBT		12.32	B					9.99	A				
		SBR		15.20	B					8.09	A				
18	I-94/I-69 Conn at Hancock St	EBT		32.96	C	22.1	C	29.8	C	18.60	B	15.3	B	15.8	B
		EBR		9.62	A					10.21	B				
		WBL		61.01	E	59.9	E			21.08	C	19.0	B		
		WBT		60.05	E					13.02	B				
		WBR		35.11	D					10.30	B				
		NBT		17.74	B	16.0	B			15.27	B	13.7	B		
		NBR		5.76	A					5.97	A				
		SBT		20.30	C	20.2	C			15.01	B	15.0	B		
		SBR		17.49	B					14.38	B				
19	Water Street at Campau Street	EBL	S	11.29	B	10.8	B	0.9	A	11.42	B	9.4	A	0.8	A
		EBR		12.34	B					9.60	A				
		NBL		5.96	A	0.5	A			5.41	A	0.5	A		
		NBT		0.20	A					0.18	A				
		SBT		0.59	A	0.6	A			0.75	A	0.8	A		
		SBR		0.83	A					0.95	A				

2045 Refined Alternative Intersection Level of Service

Intersections				AM						PM					
				All		Approach		Intersection		All		Approach		Intersection	
Int ID	Int Name	Mvmt	Sig?	Mvt Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Mvt Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
1	I-94/I-69 BL (Pine Grove) at 10th Ave	EBT	S	14.51	B	11.2	B	14.0	B	9.89	A	8.5	A	15.8	B
		EBR		5.99	A					7.11	A				
		WBT		10.10	B	17.6	B			51.43	D	16.3	B		
		WBL		49.01	D					14.01	B				
		NBL		23.42	C	22.2	C			27.09	C	26.6	C		
		NBR		6.06	A					15.32	B				
2	Lapeer Conn at Service Drive WB	WBL	S	2.62	A	2.4	A	2.5	A	1.57	A	1.3	A	1.8	A
		WBT		1.69	A					0.69	A				
		NBL		8.83	A	8.8	A			8.49	A	8.5	A		
3	I-94/I-69 EB Ramps at Water St	EBL	S	23.53	C	29.0	C	16.6	B	22.98	C	35.9	D	22.1	C
		EBT		29.66	C					43.03	D				
		EBR		28.71	C					23.87	C				
		NBT		11.38	B	7.1	A			15.55	B	11.7	B		
		NBR		3.83	A					4.46	A				
		SBL		5.95	A	6.7	A			8.34	A	10.1	B		
		SBT		7.10	A					11.34	B				
4	I-94/I-69 WB Ramps at Water St	WBL	S	23.95	C	22.3	C	15.9	B	26.70	C	20.6	C	14.2	B
		WBT		27.06	C					25.59	C				
		WBR		6.07	A					8.35	A				
		NBT		5.28	A	6.2	A			6.45	A	6.2	A		
		NBL		7.01	A					5.70	A				
		SBT		11.18	B	9.8	A			14.32	B	12.4	B		
		SBL		4.53	A					4.94	A				
5	I-94/I-69 EB Ramps atI-94/I-69 BL (Pine Grove)	EBL	S	16.77	B	24.8	C	23.3	C	26.02	C	26.7	C	20.0	B
		EBT		42.43	D					35.44	D				
		EBR		33.25	C					18.98	B				
		WBL		35.46	D	35.5	D			37.73	D	37.7	D		
		NBT		12.88	B	11.0	B			15.26	B	13.0	B		
		NBR		4.68	A					5.80	A				
		SBL		20.16	C	26.0	C			26.16	C	13.3	B		
		SBT		26.00	C					12.95	B				
6	Harker St at 10th Ave	EBL	S	0.22	A	0.7	A	0.6	A	0.24	A	0.4	A	0.5	A
		EBT		1.71	A					1.13	A				
		WBL		5.46	A	5.6	A			8.55	A	7.2	A		
		WBR		5.73	A					6.28	A				
		SBL		2.24	A	0.1	A			0.00	A	0.0	A		
		SBT		0.05	A					0.04	A				
7	10th Ave at Elmwood	EBL	S	8.03	A	7.8	A	1.3	A	9.07	A	8.7	A	0.7	A
		EBT		7.21	A					7.69	A				
		EBR		0.00	A					0.00	A				
		WBL		8.44	A	9.0	A			9.18	A	9.5	A		
		WBT		9.73	A					11.71	B				
		WBR		6.27	A					5.83	A				
		NBL		1.29	A	0.3	A			1.28	A	0.3	A		
		NBT		0.22	A					0.24	A				
		NBR		0.60	A					0.80	A				
		SBL		0.00	A	0.0	A			2.06	A	0.1	A		
		SBT		0.05	A					0.04	A				
		SBR		0.00	A					0.00	A				
8	10th Ave at Church St	EBL	S	5.74	A	6.3	A	0.4	A	8.56	A	7.6	A	0.5	A
		EBT		6.92	A					7.22	A				
		EBR		0.00	A					5.17	A				
		WBL		5.16	A	5.5	A			5.66	A	6.7	A		
		WBT		0.00	A					0.00	A				
		WBR		5.87	A					7.60	A				
		NBL		1.41	A	0.2	A			1.01	A	0.2	A		
		NBT		0.11	A					0.15	A				
		NBR		0.92	A					0.66	A				
		SBL		0.00	A	0.2	A			2.31	A	0.2	A		
		SBT		0.16	A					0.18	A				
		SBR		0.00	A					0.00	A				
9	10th Ave at Hancock St	EBL	S	21.01	C	16.1	B	15.4	B	24.58	C	17.8	B	16.2	B
		EBT		15.79	B					16.99	B				
		EBR		6.67	A					8.22	A				
		WBL		16.19	B	13.4	B			10.44	B	12.4	B		
		WBT		12.96	B					12.81	B				
		WBR		0.00	A					4.75	A				
		NBL		22.02	C	18.6	B			23.05	C	18.4	B		
		NBT		20.20	C					19.11	B				
		NBR		11.43	B					12.34	B				
		SBL		17.31	B	13.6	B			13.84	B	13.6	B		
		SBT		16.92	B					16.03	B				
		SBR		7.95	A					8.42	A				
10	M-25 (Pine Grove) at Sanborn St	EBL	S	43.57	D	35.2	D	9.8	A	57.91	E	44.6	D	9.0	A
		EBT		6.77	A					8.58	A				
		EBR		12.72	B					15.70	B				
		WBL		37.56	D	33.6	C			36.69	D	34.5	C		
		WBT		35.77	D					40.14	D				
		WBR		8.11	A					22.63	C				
		NBL		30.82	C	10.3	B			32.94	C	7.7	A		
		NBT		9.75	A					7.40	A				
		NBR		9.61	A					6.57	A				
		SBL		13.95	B	6.3	A			35.08	D	6.7	A		
		SBT		6.12	A					6.10	A				
		SBR		9.48	A					8.05	A				

2045 Refined Alternative Intersection Level of Service

Intersections				AM						PM					
				All		Approach		Intersection		All		Approach		Intersection	
Int ID	Int Name	Mvmt	Sig?	Mvt Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Mvt Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
11	M-25 (Pine Grove) at I-94/I-69 Conn	EBL	S	37.16	D	37.2	D	9.9	A	35.67	D	35.6	D	9.3	A
		EBR		0.00	A					33.75	C				
		NBT		7.68	A	7.7	A			9.71	A	9.7	A		
		SBT		7.96	A	8.0	A			1.61	A	1.6	A		
12	Garfield St at I-94/I-69 Conn	EBT	S	12.06	B	10.9	B	1.4	A	16.75	B	15.6	B	1.5	A
		EBR		9.75	A					11.73	B				
		WBT		14.07	B	14.1	B			21.98	C	20.4	C		
		WBR		0.00	A					4.67	A				
		NBL		5.19	A	0.9	A			3.67	A	0.6	A		
		NBT		0.49	A					0.45	A				
		NBR		0.57	A					0.43	A				
		SBL		0.00	A	0.2	A			0.00	A	0.2	A		
		SBT		0.15	A					0.15	A				
		SBR		0.93	A					0.75	A				
13	M-25 (Pine Grove) at Garfield St	EBL	S	0.00	A	7.9	A	1.7	A	9.99	A	11.2	B	2.4	A
		EBT		12.06	B					16.75	B				
		EBR		7.07	A					7.60	A				
		WBL		14.99	B	14.2	B			28.62	C	23.0	C		
		WBT		14.07	B					21.98	C				
		WBR		0.00	A					23.14	C				
		NBL		6.00	A	1.8	A			3.49	A	1.7	A		
		NBT		1.60	A					1.68	A				
		NBR		1.17	A					1.17	A				
		SBL		10.75	B	0.8	A			21.53	C	1.2	A		
		SBT		0.40	A					0.20	A				
		SBR		0.86	A					0.00	A				
14	I-94/I-69 BL (Pine Grove) at Elmwood St	WBL	S	9.14	A	9.1	A	0.5	A	0.00	A	18.5	B	1.6	A
		WBR		9.15	A					18.52	B				
		NBT		0.30	A	0.3	A			1.83	A	1.8	A		
		NBR		0.89	A					1.52	A				
		SBL		6.65	A	0.5	A			29.03	C	0.4	A		
		SBT		0.49	A					0.18	A				
23	I-94/I-69 BL (Pine Grove) at BWB Staff Access	EBL	S	16.23	B	16.2	B	2.0	A	16.17	B	11.3	B	0.4	A
		EBR		0.00	A					2.27	A				
		NBL		3.06	A	0.3	A			0.00	A	0.4	A		
		NBT		0.29	A					0.42	A				
		SBT		4.39	A	4.4	A			0.31	A	0.3	A		
		SBR		1.56	A					0.00	A				
16	I-94/I-69 BL (Pine Grove) at Church St	WBL	S	0.00	A	10.3	B	1.3	A	0.00	A	25.5	C	4.7	A
		WBR		10.28	B					25.48	C				
		NBT		1.78	A	1.8	A			5.70	A	5.7	A		
		NBR		1.18	A					3.18	A				
		SBL		14.42	B	0.5	A			37.77	D	1.1	A		
		SBT		0.46	A					0.25	A				
17	I-94/I-69 BL/M-25 (Pine Grove) at Hancock St	EBL	S	41.61	D	28.5	C	26.2	C	46.48	D	29.0	C	15.5	B
		EBT		33.69	C					33.86	C				
		EBR		17.96	B					18.85	B				
		WBL		33.98	C	34.6	C			41.99	D	47.2	D		
		WBT		35.03	D					48.62	D				
		WBR		28.44	C					43.45	D				
		NBL		0.00	A	24.9	C			22.51	C	12.6	B		
		NBT		24.91	C					10.76	B				
		NBR		20.02	C					0.00	A				
		SBL		32.74	C	24.8	C			41.04	D	10.2	B		
		SBT		24.58	C					9.82	A				
		SBR		22.71	C					7.35	A				
18	I-94/I-69 Conn at Hancock St	EBL	S	51.29	D	30.6	C	18.8	B	16.08	B	26.0	C	20.1	C
		EBT		37.15	D					36.68	D				
		EBR		19.79	B					15.47	B				
		WBL		26.87	C	25.2	C			15.04	B	15.8	B		
		WBT		20.32	C					19.39	B				
		WBR		17.08	B					16.21	B				
		NBT		17.46	B	16.4	B			24.40	C	22.8	C		
		NBR		9.95	A					15.28	B				
		SBT		13.99	B	13.9	B			21.52	C	21.5	C		
		SBR		11.02	B					20.21	C				
19	Water St at Campau St	EBL	S	11.65	B	11.3	B	0.8	A	11.39	B	11.0	B	0.8	A
		EBR		9.48	A					10.29	B				
		NBL		3.44	A	0.1	A			5.53	A	0.3	A		
		NBT		0.08	A					0.18	A				
		SBT		0.55	A	0.6	A			0.74	A	0.8	A		
		SBR		0.83	A					0.94	A				

Appendix R – 2045 Refined Alternative Signal Preemption Analysis

Blue Water Bridge Plaza Study Refined Alternative Signal Preemption Operations Analysis

DRAFT, July 14, 2023

Introduction

The purpose of this document is to analyze the signal preemption operations for emergency service vehicles on I-94/I-69 BL (Pine Grove) between the northern 10th Avenue and southern 10th Avenue intersections in the design year of 2045. **Figure 1** below illustrates the two intersections.

Figure 1: Preemption Operations Analysis Study Area

This analysis reviewed both impacts to the intersection operations as well as the projected travel times of emergency vehicles.

For the purposes of this analysis, the signal preemption operations entail every movement going red except for the movements utilized by emergency services. **Figure 2** and **Figure 3** shows the status of each phase in the event of an emergency service vehicle traveling northbound and southbound on I-94/I-69 BL (Pine Grove), respectively.

Figure 2: Northbound Signal Preemption Operations

Figure 3: Southbound Signal Preemption Operations

Signal Preemption Intersection Operational Analysis

In order to analyze the effect of signal preemption operations on the corridor, a single 20 second all-red phase was added to both intersections between 5:00 pm and 5:15 pm, the 15-minute peak during the PM peak period. The all-red phases at the intersections were offset by 10 seconds, with the northern 10th Avenue intersection turning red first. The queues lengths at all approaches for the two intersections were recorded and compared to the queue lengths during the same time periods in the default PM peak period. This was completed with the VISSIM models developed for this project. **Table 1** and **Table 2** summarize the average queue lengths at the northern and southern 10th Avenue intersections, respectively. As seen in the model, the queuing quickly recovers from a preemption event.

Blue Water Bridge Plaza Study Refined Alternative Signal Preemption Operations Analysis

DRAFT, July 14, 2023

Signal Preemption Intersection Operational Analysis Results

Table 1: Average Queue Lengths (feet) at I-94/I-69 BL (Pine Grove) @ I-94 EB Off-Ramp/10th Ave (North)

Approach	Scenario	5:00 PM	5:03 PM	5:06 PM	5:09 PM	5:12 PM	5:15 PM	5:18 PM	5:21 PM	5:24 PM	5:27 PM
I-94/I-69 BL (Pine Grove) NB	Preemption	60	75	63	88	74	123	71	53	33	45
	Default	58	48	48	52	48	60	39	43	34	48
	Difference	2	26	15	36	27	62	31	10	-1	-4
I-94/I-69 BL (Pine Grove) SB	Preemption	42	61	52	67	50	75	47	33	31	39
	Default	40	46	40	44	45	52	54	30	33	37
	Difference	2	15	12	24	5	23	-7	3	-2	1
10th Ave WB	Preemption	21	24	30	24	34	27	25	27	28	16
	Default	22	24	28	20	32	23	17	22	29	13
	Difference	-1	0	2	4	2	4	8	4	-1	3
I-94 EB Off-Ramp	Preemption	132	147	136	189	244	257	254	169	119	138
	Default	103	137	127	138	138	128	142	115	112	123
	Difference	28	10	9	51	106	129	112	54	7	15

Table 2: Average Queue Lengths (feet) at I-94/I-69 BL (Pine Grove) @ 10th Ave (South)

Approach	Scenario	5:00 PM	5:03 PM	5:06 PM	5:09 PM	5:12 PM	5:15 PM	5:18 PM	5:21 PM	5:24 PM	5:27 PM
I-94/I-69 BL (Pine Grove) NB	Preemption	44	43	51	57	62	53	38	36	36	30
	Default	42	40	42	42	42	38	33	35	35	29
	Difference	2	3	9	15	20	14	5	2	2	1
I-94/I-69 BL (Pine Grove) SB	Preemption	16	21	26	27	42	44	34	19	17	13
	Default	13	14	19	15	20	17	23	12	15	15
	Difference	3	7	6	12	22	28	11	7	2	-2
10th Ave EB	Preemption	43	50	43	46	49	48	44	43	42	42
	Default	41	47	41	42	43	42	41	40	41	39
	Difference	3	4	2	3	6	5	3	3	1	3

Note: Red cells indicate highest difference in queue length at each approach

Signal Preemption Emergency Vehicle Travel Time Analysis

In addition to analyzing the impact of signal preemption on queues, the impact of signal preemption on travel times was assessed by analyzing three scenarios:

1. 2045 Future No-Build (existing configuration)
2. 2045 Refined Alternative without signal preemption
3. 2045 Refined Alternative with signal preemption

Travel time was estimated from south of Harker Street on 10th Avenue (north), to north of Lyon Street in each of the three scenarios. The travel time estimate was derived using the distance, posted speed limit, and the movement delay along the emergency route. The delays were based on values output from the VISSM models. **Figure 4** illustrates the emergency routes in all three scenarios

Future No-Build Emergency Route | **Refined Alternative Emergency Route**

Figure 4: Emergency Routes

If signal preemption is implemented, emergency vehicles are assumed to travel uninterrupted I-94/I-69 BL (Pine Grove) between the northern 10th Avenue and southern 10th Avenue intersections. Without signal preemption, emergency vehicles are assumed to be slightly delayed at the I-94/I-69 BL (Pine Grove) and 10th Avenue intersections. **Table 3** indicates the estimated travel times in each scenario.

Table 3: Emergency Travel Time Comparison

Scenario	Travel Time (s)
2045 Future No-Build (existing configuration)	41
2045 Refined Alternative without signal preemption	43
2045 Refined Alternative with signal preemption	28

The 28 seconds of travel time for emergency vehicles in the 2045 Refined Alternative when using signal preemption results in a 32% and 35% reduction in travel times compared to the 2045 Future No-Build and the 2045 Refined Alternative without signal preemption, respectively. These results are comparable to a study by the Federal Highway Administration (FHWA)[1] which indicated a reduction in travel time by 14% to 50% and another study by the Mid-Atlantic Universities Transportation Center (MAUTC)[2] which found a 31% reduction in travel times when using signal preemption for emergency vehicles. In addition, the FHWA study also indicated a 70% reduction in collisions involving emergency vehicles when using signal preemption. The safety advantage offered by signal preemption is noteworthy due to the high demand at the 10th Avenue (north) intersection, which also serves as the terminus for I-94 eastbound traffic.

Conclusion

The analysis of signal preemption operations on I-94/I-69 BL (Pine Grove) resulted in several conclusions listed below.

- Impacts to I-94/I-69 BL (Pine Grove) at 10th Avenue (north) are expected to be relatively minor.
    - The most a queue is expected to increase on I-94/I-69 BL (Pine Grove) is nearly 65 feet for I-94/I-69 BL (Pine Grove) northbound from 5:15 pm to 5:18 pm.
    - The most significant impacts are expected on the I-94 eastbound off-ramp where the queue is expected to be nearly 130 feet from 5:15 pm to 5:18 pm and greater than 100 feet from 5:12 pm to 5:21 pm. However, the impacts to the corridor are not long-lasting and operations are expected to recover in about 10 minutes. Furthermore, should preemption be deployed, the preemption parameters can be programmed to favor the off ramp during the recovery, further minimizing the impacts of the signal recovery to this location.
- Impacts to I-94/I-69 BL (Pine Grove) @ 10th Avenue (south) are expected to be minimal.
    - The most a queue is expected to increase by almost 30 feet for I-94/I-69 BL (Pine Grove) southbound from 5:15 pm to 5:18 pm but is expected to recover within three minutes.

[1] "Emergency Vehicle Preemption." *WSDOT Transportation Systems Management and Operations*, tsmowa.org/category/intelligent-transportation-systems/emergency-vehicle-preemption. Accessed 5 July 2023.

[2] Hancock, Kathleen L, and Raj Kishore Kamalanathsharma. US Department of Transportation , Washington DC, 2010*, Congestion-Based Emergency Vehicle Preemption,* https://rosap.ntl.bts.gov/view/dot/25651/dot_25651_DS1.pdf Accessed 5 July 2023.

- Emergency vehicle travel times along I-94/I-69 BL (Pine Grove) are expected to reduce by roughly 35% with signal preemption compared to either the 2045 Future No-Build and the 2045 Refined Alternative.
- Collisions involving emergency vehicles using signal preemption may reduce up to 70% as indicated by an FHWA study