



Traffic Technical Memorandum

Montgomery Park District Transportation Plan
Portland, OR

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1 Introduction

Portland Bureau of Transportation (PBOT) is developing the “Montgomery Park District Transportation Plan” (MPD Transportation Plan) in northwest Portland. The plan presents recommendations for implementing multi-modal transportation alternatives in the study area to accommodate existing and future growth. Transportation improvements include extending the streetcar into the Montgomery Park District area in order to serve the businesses and residences located in the proposed development. This Traffic Technical Memorandum (Tech Memo) is a supporting appendix to the MPD Transportation Plan.

The purpose of this Tech Memo is to identify intersections and movements in the study area that are expected to experience failing Levels of Service (LOS) under future build conditions identified as part of the recommended alternative in the MPD Transportation Plan. The MPD Plan details the nature of the study area roadways.

The scenarios studied by this traffic analysis are summarized as follows:

- Existing – Existing conditions as of the date of the report
- No Build– Future traffic growth in the study area without the proposed changes (construction of the streetcar extension, street network changes, and land use changes)
- Build – Future traffic growth in the study area with construction of the streetcar extension, implementation of street network and land use changes

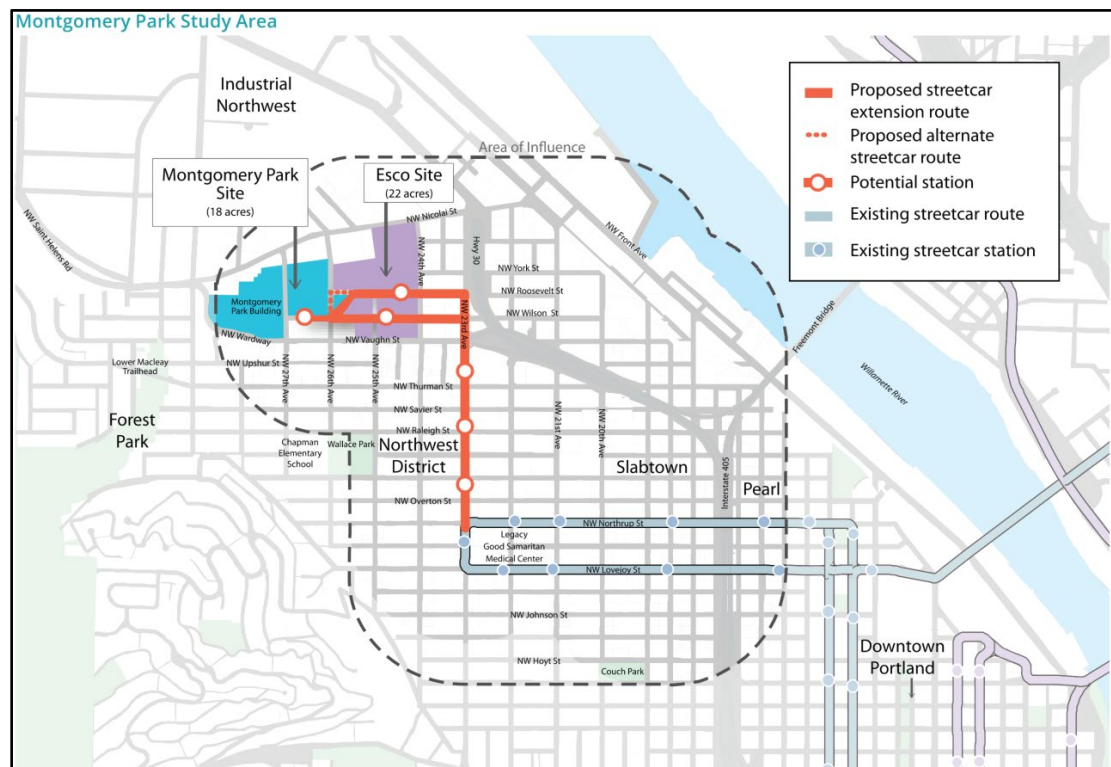
2 Data Collection

2.1.1 Turning Movement Counts

The project study area is shown in **Figure 1**. The following intersections along the preferred alternative were identified for traffic analysis. Peak hour turning movement counts were collected at these intersections in February 2021 and June 2021.

- NW 23rd Ave. and Roosevelt St. (August 2021)
- NW Nicolai St. and NW Yeon Ave. / US 30 (June 2021)
- NW Nicolai St. and Wardway St. (Feb 2021)
- NW 23rd Ave. and Vaughn St. (June 2021)
- NW 23rd Ave. and Thurman St. (Feb 2021)
- NW 23rd Ave. and Wilson St. (Feb 2021)
- NW 25th Ave. and Vaughn St. (Feb 2021)
- NW 27th Ave. and Vaughn St. (Feb 2021)

Figure 1: Montgomery Park Study Area



(Source: MPD Transportation Plan)

Historic turning movement counts at the study intersections were obtained from the Oregon Department of Transportation (ODOT) and PBOT websites, where available, to compare them to the 2021 counts and identify locations where traffic volumes may have been decreased due to the COVID-19 pandemic. The following historic turning movement counts were available in the project area:

- NW 23rd Ave. and Thurman St. – November 2017 (the week after Thanksgiving)
- NW 25th Ave. and Vaughn St. – May 2016
- NW 27th Ave. and Vaughn St. – May 2016

Raw turning movement counts are included in **Appendix A: Raw Turning Movement Counts**. In general, the historic traffic counts were higher than the 2021 counts but not for all movements. The higher of these two volumes, where applicable, was used for volume development.

2.2 Signal Timings

Existing signal timings for the following intersections were provided by PBOT:

- NW 23rd Ave. and Thurman St.
- NW 23rd Ave. and Vaughn St.
- NW 25th Ave. and Vaughn St.
- NW 27th Ave. and Vaughn St.

- NW Nicolai St. and NW Yeon Ave. / US 30
- NW Nicolai St. and Wardway St.

3 Volume Development

A traffic analysis Methodology Memo was developed to identify the volume development methodology for this project. The methodology included using the *Iterative Method* from the National Cooperative Highway Research Program (NCHRP) Report 765: Analytical Travel Forecasting Approaches for Project-Level Planning and Design to develop future PM turning movement volumes. Based on further discussions with PBOT, the future volume development was revised to use the *Ratio Method* from NCHRP, which deviates from the approved methodology. The previously agreed upon Methodology Memo is included in **Appendix G: Traffic Analysis Methodology Memo**

3.1 Existing Conditions

Historic turning movement counts and Annual Average Daily Traffic (AADT) volumes in the project area were analyzed to determine the appropriate existing conditions volumes to be analyzed by this project.

3.1.1 Peak Hour Determination

The global peak hours for the project area were based on the peak hours of the two major intersections in the study area, NW 23rd Ave. at Vaughn St., and NW Yeon Ave. at Nicolai St. The AM and PM peak hours were determined to be 7:45 – 8:45 AM and 4:30 – 5:30 PM, respectively.

3.1.2 Existing Turning Movement Volumes

ODOT's "Covid-19 Traffic Reports" track the change in traffic across Oregon roadways from the beginning of 2019 through the pandemic. Comparing volumes in the month of June between 2019, 2020, and 2021, these reports show that average weekday traffic in June 2021 is approximately 11 percent higher than the June 2019 volumes. The report also states that, by May 2021, "traffic volumes are approaching pre-Covid volumes." Therefore, it was determined that the turning movement counts obtained for this project in Summer 2021 would not require any adjustments.

The following methodology was adopted to adjust turning movement counts that were obtained in February 2021:

1. The February 2021 counts were compared to historic turning movement counts and the higher volume for each movement was used for the existing conditions analysis to account for a conservative analysis.
2. Study intersections located adjacent to the intersections with the Summer 2021 turning movement counts were increased and adjusted to balance the volumes along the corridor.

The adjusted turning movement volumes used for existing conditions analysis are shown in **Appendix B: Turning Movement Volumes**.

3.2 No-Build and Design Conditions

3.2.1 No-Build Volumes

The design year for the project was determined to be 2040. PBOT provided travel demand model (TDM) data with peak hour, directional future volumes along the roadway segments in the project area for the PM peak hour. These volumes are included in **Appendix C: Travel Demand Model Reports**. An average annual background growth of 0.9 percent for the project area was determined based on the model growth.

The following methodologies were used to determine the 2040 no-build volumes for this study:

1. For intersections with two-way streets, the *NCHRP Report 765 Ratio Method* was used to develop future PM turning movement volumes. This methodology was applied to the following intersections:
 - NW 23rd Ave. and Thurman St.
 - NW 23rd Ave. and Vaughn St.
 - NW 23rd Ave. and Wilson St.
 - NW Yeon Ave. and Nicolai St.
 - NW 25th Ave. and Vaughn St.
2. For intersections with one-way streets, or at locations where the TDM had no future volumes, existing turning movement volumes were grown at a rate of 0.9 percent per year to determine 2040 no-build PM peak hour volumes. This methodology was applied to the following intersections:
 - NW 23rd Ave. and York St.
 - NW 23rd Ave. and Roosevelt St.
 - NW 27th Ave. and Vaughn St.
 - NW Nicolai St. and Wardway St.

The no-build TDM showed a decrease in peak hour traffic along Nicolai St. compared to the 2021 volumes. For the purpose of this planning study, the 2021 volumes at the NW Nicolai St. and Wardway St. intersection were grown at an average rate of 0.9 percent per year to obtain the future no-build volumes, with the exception of traffic going to and from Wardway St. This intersection is not failing under no-build conditions and with residual capacity on NW Nicolai St., it was assumed that this section of Wardway St. is unlikely to see much growth in the future. Therefore, the no-build volumes were assumed to match existing counts.

3. AM Peak Hour Volumes

The TDM for no-build conditions was only developed for the PM peak hour. In order to estimate the traffic impacts of the two critical study area intersections, the design year intersection volumes for the AM peak hour were developed for NW 23rd Ave. at Vaughn St. and NW Yeon Ave. at Nicolai St. intersections.

For the purpose of this planning study, the existing AM peak hour volumes at these two intersections were grown at an average rate of 0.9 percent per year to obtain the future no-build volumes.

4. Additional adjustments were made at the following intersections as described:

- NW Nicolai St and Yeon Ave

Westbound departing link volume from future Build TDM data was used instead of the *NCHRP Report 765 Ratio Method* due to unreasonably high growth.

The future no-build volumes analyzed for this project are shown in **Appendix B: Turning Movement Volumes**.

3.2.2 Build Volumes

The design year for the project was determined to be 2040. PBOT provided travel demand model (TDM) data with peak hour, directional future volumes along the roadway segments in the project area for the PM peak hour. The build volumes sheets from the TDM are included in **Appendix C: Travel Demand Model Reports**.

The future build conditions assume the implementation of the hybrid land-use plan, which includes the Montgomery Park Master Plan in the study area, and growth was projected using the provided TDM data. As part of this plan, the streetcar or comparable transit service will be extended into the Montgomery Park district, going north-bound along NW 23rd Avenue, west-bound along Roosevelt St., southwest-bound through the ESCO site after passing approximately NW 25th Ave, west-bound along Wilson St. to the layover, east-bound along Wilson St., and south-bound on NW 23rd Ave. in the study area.

As part of this alternative, the southbound left turn at the intersection of NW 23rd Ave. and Vaughn St. will be eliminated. For the AM peak hour, where no TDM data was provided, this left turn volume is assumed to use the intersection of NW Yeon Ave. and Nicolai St. to access US 30 and I-405.

The TDM was developed to reflect a previous version of the Montgomery Park Master Plan where the streetcar extension was proposed along York Street, with York Street being converted into a one-way street going westbound. This lane configuration was retained for the traffic analysis since York Street currently carries higher traffic volumes when compared to Roosevelt Street and would therefore provide for a conservative traffic analysis in the study area.

The following methodologies were used to determine the 2040 build volumes for this study, similar to the no-build volumes:

1. For intersections with two-way streets, the *NCHRP Report 765 Ratio Method* was used to develop future PM turning movement volumes. This methodology was applied to the following intersections:
 - NW 23rd Ave. and Thurman St.
 - NW 23rd Ave. and Vaughn St.
 - NW 23rd Ave. and Wilson St.
 - NW Yeon Ave. and Nicolai St.

- NW 25th Ave. and Thurman St.
2. For intersections with one-way streets, or at locations where the TDM had no future volumes, existing turning movement volumes were grown at a rate of 0.9 percent per year to determine 2040 no-build PM peak hour volumes. This methodology was applied to the following intersections:
 - NW Nicolai St. and Wardway St.
 3. Build volumes for NW 23rd at York Ave. and Roosevelt St. were determined by initially using TDM turning volumes before reducing them to balance between Nicolai St. and Vaughn St.
 4. Additional adjustments were made at the following intersections as described:
 - NW 23rd Ave and Wilson St

Turning movement counts at this intersection were determined using the *NCHRP Report 765 Ratio Method*, except for the westbound left turn. This movement was determined by growing the existing westbound left turn volumes at the rate of 0.9percent per year in order to balance network volumes along the corridor.
 - NW 23rd Ave and York St

Turning movement volumes were determined using the TDM turning movement counts since the TDM model was adjusted to account for the streetcar traveling on this roadway. The turning movement volumes were then adjusted to balance network volumes along the corridor.
 - NW Nicolai St and Yeon Ave

Westbound departing link volume from future Build TDM data was used instead of the *NCHRP Report 765 Ratio Method* due to unreasonably high growth.
 5. AM Peak Hour Volumes

The TDM for build conditions was only developed for the PM peak hour. In order to estimate the traffic impacts of the two critical study area intersections, the design year intersection volumes for the AM peak hour were developed for NW 23rd Ave at Vaughn Street and NW Yeon Ave at Nicolai Street intersections.

For the purpose of this planning study, the existing AM peak hour volumes at these two intersections were grown at an average rate of 0.9 percent per year to obtain the future build volumes.

The southbound left turn at the intersection of NW 23rd Ave and Vaughn Street is proposed to be eliminated under future build conditions. With no TDM data provided for the AM peak hour, this volume was assumed to use the intersection of NW Yeon Ave and Nicolai Street. The westbound, southbound and eastbound volumes at NW Yeon Ave and Nicolai Street were adjusted accordingly.

The future build volumes analyzed for this project are shown in **Appendix B: Turning Movement Volumes**.

4 Traffic Analysis

A traffic analysis Methodology Memo was developed to identify the traffic analysis methodology and measures of effectiveness (MOEs) for this project. The Methodology Memo is included in **Appendix G: Traffic Analysis Methodology Memo**.

The existing, no-build, and build condition volumes developed as described under Section 3 were analyzed using Synchro 10, a traffic analysis and signal optimization software that replicates Highway Capacity Manual (HCM) methodologies. Signalized intersection results were obtained from the HCM 2000 report in Synchro and unsignalized intersection results were obtained from the HCM 2010 report in Synchro.

4.1 Existing Conditions

Table 1 and **Table 2** show the results of the analysis for the existing conditions AM and PM peak hours, respectively. The detailed HCM reports for each of the study intersections are included in **Appendix D: Existing Conditions Synchro Reports**.

Table 1. Existing Intersection Performance (AM Peak)

Intersection	Control Type	Intersection v/c	Intersection Delay	Intersection LOS	Failing approaches
<i>Units</i>		<i>s/veh</i>			<i>v/c > 1</i>
NW Vaughn & NW 23rd Ave	Signalized	0.64	30.7	C	SBL
NW Nicolai & NW Yeon Ave	Signalized	0.65	14.6	B	v/c < 1

Table 2. Existing Intersection Performance (PM Peak)

Intersection	Control Type	Intersection v/c	Intersection Delay	Intersection LOS	Failing approaches
<i>Units</i>		<i>s/veh</i>			<i>v/c > 1</i>
NW Nicolai & Wardway St	Signalized	0.38	19.6	B	v/c < 1
NW Wilson & NW 23rd Ave	TWSC*	N/A	19.4	E**	v/c < 1
NW Vaughn & NW 23rd Ave	Signalized	0.66	43.2	D	SBL
NW Thurman & NW 23rd Ave	Signalized	0.58	48.5	D	SB
NW Vaughn & NW 27th Ave	Signalized	0.4	11.4	C	v/c < 1
NW Vaughn & NW 25th Ave	Signalized	0.50	13.9	B	v/c < 1
NW Nicolai & NW Yeon Ave	Signalized	0.66	14.1	B	v/c < 1
NW York & NW 23rd Ave	AWSC*	N/A	7.3	A**	v/c < 1
NW Roosevelt & NW 23rd Ave	TWSC*	N/A	1.5	A**	v/c < 1

* AWSC – All-way STOP Control; TWSC – Two-way STOP Control

**Note: Intersection delay for AWSC and TWSC intersections are based on worst stop-controlled movement at the intersection.

4.2 Future No-Build Conditions

The no-build volumes were modeled in Synchro to estimate future no-build traffic conditions in the study area. The no-build Synchro models reflect existing land use conditions and existing lane configurations with signal timings optimized and coordinated for the forecast 2040 volumes. **Table 3** and **Table 4** show the results of the no-build analysis during the AM and PM peak hours, respectively. The detailed HCM reports for each of the study intersections are included in **Appendix E: No-Build Conditions Synchro Reports**.

Table 3. No-Build Conditions Intersection Performance (AM Peak)

Intersection	Control Type	Intersection v/c	Intersection Delay	Intersection LOS	Failing approaches
Units		s/veh			v/c > 1
NW Vaughn & NW 23rd Ave	Signalized	0.72	33.3	C	v/c < 1
NW Nicolai & NW Yeon Ave	Signalized	0.76	21.8	C	v/c < 1

Table 4. No-Build Conditions Intersection Performance (PM Peak)

Intersection	Control Type	Intersection v/c	Intersection Delay	Intersection LOS	Failing approaches
Units		s/veh			v/c > 1
NW Nicolai & Wardway St	Signalized	0.43	18.1	B	v/c < 1
NW Wilson & NW 23rd Ave	TWSC*	N/A	78.3	F**	v/c < 1
NW Vaughn & NW 23rd Ave	Signalized	0.69	33.9	C	v/c < 1
NW Thurman & NW 23rd Ave	Signalized	0.58	14.6	B	v/c < 1
NW Vaughn & NW 27th Ave	Signalized	0.48	12	B	v/c < 1
NW Vaughn & NW 25th Ave	Signalized	0.58	13.3	B	v/c < 1
NW Nicolai & NW Yeon Ave	Signalized	0.73	14.4	B	v/c < 1
NW York & NW 23rd Ave	AWSC*	N/A	7.2	A**	v/c < 1
NW Roosevelt & NW 23rd Ave	TWSC*	N/A	2.5	A**	v/c < 1

* AWSC – All-way STOP Control; TWSC – Two-way STOP Control

**Note: Intersection delay for AWSC and TWSC intersections are based on worst stop-controlled movement at the intersection.

4.3 Future Build Conditions

The future build volumes were also modeled in Synchro to estimate future build conditions in the study area. **Table 5** and **Table 6** show the results of the build analysis during the AM and PM peak hours, respectively. The detailed HCM reports for each of the study intersections are included in **Appendix F: Build Conditions Synchro Reports**.

The streetcar is currently scheduled to operate every 20 minutes in the AM peak hour and 15 minutes in the PM peak hour. According to the Montgomery Park District Transportation Plan, a streetcar stop is proposed to be located at the intersection of NW 23rd Ave. and Thurman St.

Table 5. Build Conditions Intersection Performance (AM Peak)

Intersection	Control Type	Intersection v/c	Intersection Control Delay	Intersection LOS	Failing approaches
<i>Units</i>		<i>s/veh</i>			<i>v/c > 1</i>
NW Vaughn & NW 23rd Ave	Signalized	0.69	28	C	v/c < 1
NW Nicolai & NW Yeon Ave	Signalized	0.79	20.4	C	v/c < 1

Table 6. Build Conditions Intersection Performance (PM Peak)

Intersection	Control Type	Intersection v/c	Intersection Delay	Intersection LOS	Failing approaches
<i>Units</i>		<i>s/veh</i>			<i>v/c > 1</i>
NW Nicolai & Wardway St	Signalized	0.47	17.8	B	v/c < 1
NW Wilson & NW 23rd Ave	Signalized	0.16	6.9	A	v/c < 1
NW Vaughn & NW 23rd Ave	Signalized	0.74	34.5	C	v/c < 1
NW Thurman & NW 23rd Ave	Signalized	0.74	26.1	C	v/c < 1
NW Vaughn & NW 27th Ave	Signalized	0.51	11.6	B	v/c < 1
NW Vaughn & NW 25th Ave	Signalized	0.46	7.6	A	v/c < 1
NW Nicolai & NW Yeon Ave	Signalized	0.73	15.7	B	v/c < 1
NW York & NW 23rd Ave	AWSC*	N/A	7.3	A**	v/c < 1
NW Roosevelt & NW 23rd Ave	TWSC*	N/A	1.3	A**	v/c < 1

* AWSC – All-way STOP Control; TWSC – Two-way STOP Control

**Note: Intersection delay for AWSC and TWSC intersections are based on worst stop-controlled movement at the intersection.

5 Summary

A comparison of intersection operations between future no-build and build conditions is provided in **Table 7** and **Table 8**. The information in these tables matches the MOEs that were identified in the Methodology Memo. According to the Synchro analysis, all study area intersections are operating below a v/c of 0.99, and both ramp terminal intersections are operating below a v/c of 0.85. In addition, all study area intersections are operating at LOS C or better in the future build condition. Due to the close proximity of many of the study area intersections, there are several 95th percentile queue lengths that block upstream intersections as noted in **Table 9**.

Although the analysis indicates that no mitigation is required, Synchro is limited in its capacity to evaluate transit impacts on a corridor, including impacts of a streetcar and the effects of implementing transit signal priority at signalized intersections. It is therefore recommended that detailed micro-simulation be performed during the design stage with updated tuning movement counts to determine the multi-modal traffic impacts of the build alternative.

Table 7. Signalized Intersection v/c Summary

Intersection	Control Type (No-Build)	Control Type (Build)	No-Build AM	No-Build PM	Build AM	Build PM
NW Nicolai & Wardway St	Signalized	Signalized	N/A	0.43	N/A	0.47
NW Wilson & NW 23rd Ave	TWSC*	Signalized	N/A	N/A	N/A	0.16
NW Vaughn & NW 23rd Ave	Signalized	Signalized	0.72	0.69	0.69	0.74
NW Thurman & NW 23rd Ave	Signalized	Signalized	N/A	0.58	N/A	0.74
NW Vaughn & NW 27th Ave	Signalized	Signalized	N/A	0.48	N/A	0.51
NW Vaughn & NW 25th Ave	Signalized	Signalized	N/A	0.58	N/A	0.46
NW Nicolai & NW Yeon Ave	Signalized	Signalized	0.76	0.73	0.79	0.73

* TWSC – Two-way STOP Control

Table 8. Intersection LOS Summary

Intersection	Control Type (No-Build)	Control Type (Build)	No-Build AM	No-Build PM	Build AM	Build PM
NW Nicolai & Wardway St	Signalized	Signalized	N/A	B	N/A	B
NW Wilson & NW 23rd Ave	TWSC*	Signalized	N/A	F**	N/A	A
NW Vaughn & NW 23rd Ave	Signalized	Signalized	C	C	C	C
NW Thurman & NW 23rd Ave	Signalized	Signalized	N/A	B	N/A	C
NW Vaughn & NW 27th Ave	Signalized	Signalized	N/A	B	N/A	B
NW Vaughn & NW 25th Ave	Signalized	Signalized	N/A	B	N/A	A
NW Nicolai & NW Yeon Ave	Signalized	Signalized	C	B	C	B
NW York & NW 23rd Ave	AWSC*	AWSC*	N/A	A**	N/A	A**
NW Roosevelt & NW 23rd Ave	TWSC*	TWSC*	N/A	A**	N/A	A**

* AWSC – All-way STOP Control; TWSC – Two-way STOP Control

**Note: Intersection delay for AWSC and TWSC intersections are based on worst stop-controlled movement at the intersection.



Table 9. Approaches with 95th Percentile Queue Blocking Upstream Intersections

Approaches with 95 th percentile queue blocking upstream intersections					
Intersection	Control Type	No-Build AM	No-Build PM	Build AM	Build PM
		<i>Movements (95th percentile queue length)</i>			
NW Vaughn & NW 23rd Ave	Signalized	*EB (388'), SB (187'), *WB (533'), *NB (113')	EB (378'), *WB (416'), *NB (113), SB (233')	SB (62'), EB (363'), *WB (533'), *NB (92')	*SB (91'), EB (558'), *WB (450'), *NB (215')
NW Nicolai & NW Yeon Ave	Signalized	*EB (105'), *WB (184'), *NB (476'), *SB (660')	*EB (74'), *WB (233'), *NB (593), SB *(413')	*EB (103'), *WB (222'), *NB (508'), *SB (696')	*EB (58'), *WB (241'), *NB (592'), *SB (455')

*95th percentile queue does not block upstream intersection but is reported because the intersection is a ramp terminal.