Memorandum

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Subject: K Street NW Traffic Analysis
REVISED Existing Conditions Vissim Calibration Memorandum

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Introduction

This memorandum summarizes the assumptions and results of the 2019 Existing Conditions year Vissim model calibration procedure for the **K Street NW Traffic Analysis** following the agreed-upon methodology as documented in the analysis framework document (dated January 9, 2019). The AM and PM Existing Conditions models have been calibrated to the agreed upon calibration thresholds and to reasonably replicate the observed traffic conditions.

Modeling Assumptions

The following sections summarize the modeling protocols and calibration assumptions prevalent in the K Street NW Existing Conditions models.

Study Area

The model study area is defined by the following elements:

- The extents of the study area are K Street NW, from 22nd Street NW to 9th Street NW.
- Additional intersections one block north and south of K Street NW are modeled at 21st Street NW, 17th Street NW (west)/Connecticut Avenue NW, 16th Street NW, 15th Street NW (west) at L Street NW only, and 14th Street NW.
- In total, the study area includes 25 intersections along K Street NW and the aforementioned side streets.

- Pedestrian crosswalks are coded at the intersections, and pedestrian volumes are included as inputs according to collected data.
- All transit stops are included in the model and coded according to available data from WMATA and field observations.
- Bicycle and scooter movements are not included along K Street NW where dedicated bicycle lanes are not present. If calibration cannot be achieved, these movements were to be added into the model at that point (Reference: DDOT meeting 12/09/2019).
    - Calibration was achieved without consideration of these movements. Additional bicycle demand and routes will be discussed as part of the development of 2025 build volumes.
- All dedicated cycle tracks and bike lanes within the study area are coded into the model. These include: the two-way cycle track on the west side of 15th Street NW (west), bi-directional bike lanes on 11th Street NW, and single-direction bike lanes on 12th Street NW (northbound) and 10th Street NW (southbound).

Geometry Coding

- **Lane Width**
    - All basic links are coded with standard 11-foot lanes.
    - Right and left dedicated turning bays that are coded with a width of 10 feet.
- **Basemap**
    - An aerial basemap is used because the Bing imagery available through Vissim was not sufficient for model development.
- **Bicycle lanes**
    - Bicycle lanes are coded with 7.5 foot lanes.
- **Pedestrian Crosswalks**
    - Crosswalks are coded with a width of 7.5 feet per direction to match the approximate 15-foot width of the full crosswalks along K Street NW.
        - Queueing areas were made sufficiently large to allow for adequate pedestrian storage space.
- **Service Lanes**
    - Service lanes are modeled as one lane in each direction (i.e., not considering the second lane used for parallel parking/loading zones).
    - Blocks with heavy parking density (e.g., garage or on-street parking spaces) were identified during volume balancing and were represented as driveways in the Vissim model.
    - Midblock access points to service lanes are modeled as “right-in/right-out”. Although observed in the field, left-turn movements into and out of the service lanes were not coded in the model.

Signal Coding

- **Signal Timing**
    - Signal timing was derived from the DDOT-provided Synchro file and dial sheets.

- **Vehicle Signals**
  - Signal heads are placed on stop bars or as close as possible.
  - Vehicle detectors are not coded because all signals are operating as pre-timed (i.e., on Max Recall).
  - Leading left-turn movements combined with permitted left turns are modeled using the "OR" signal group.
  - All other overlapping phases (i.e., right turning movements) are modeled using overlaps coded directly into the RBC file.
  - Leading pedestrian intervals (LPI) are represented by an overlap associated with the parent signal group. In that overlap, the "delay green" with the maximum split for the LPI (i.e., three seconds) is activated. Parent signal group splits are set to the total split of the vehicle phase plus the LPI, or three seconds greater than the vehicle split coded in Synchro. This would represent the summation of phases 1 and 2 or phases 5 and 6 as shown in the ring and barrier graphic below for mainline K Street NW at 16th Street NW, captures from the Synchro files provided by DDOT.

- **Pedestrian Signals**
  - Pedestrian signals are placed outside of the traveled right-of-way to avoid overlap with vehicle movements.
  - Pedestrian detectors are not coded because Ped Recall is activated on all study area intersections.
  - Rest on walk is coded in RBC timing plan to allow pedestrians maximum walk time until the countdown begins. Pedestrians will not traverse the crosswalk once the countdown starts per default Vissim pedestrian signal settings.

Traffic Operations

- **Conflict Control**
  - Pedestrian conflicts are controlled with Priority Rules to clearly define the yield-to-pedestrian zones over the crosswalk and achieve realistic behavior.
  - Intersection "Keep Clear" movements are controlled with Priority Rules.
  - Protected-Permissive left-turns are controlled with Conflict Areas.
    - In certain cases, these were converted to Priority Rules during calibration to achieve realistic behavior.
  - Entry and exit from service lanes on slip ramps are controlled with Priority Rules.
- **Turning Travel Speeds**
  - Reduced Speed Areas are coded at all right and left-turning movements.
  - Right turns at intersections: linear distribution between 9-13 mph (labeled Right Turn distribution in model).
  - Left turns at intersections: linear distribution between 13-17 mph (labeled Left Turn distribution in model).
- **Network Travel Speed**

- The K Street NW network has a consistent posted speed limit of 25 mph throughout the corridor. Therefore, the 25mph desired speed distribution is associated with vehicle classes directly and Desired Speed Decision objects are not used to assign regular posted speed.
- The 25-mph speed distribution is a linear distribution between 22-30 mph.

- **External Congestion Coding**
  - External congestion was prevalent during the PM Peak Period and videos from travel time runs show spillback from network termini affected traffic flow.
    - Westbound K Street NW west of 21st Street NW, congestion in the tunnel under Washington Circle.
      - Coded to be 6mph for the full PM analysis period as supported by field data.
    - Congestion at 17th Street NW southbound on both sides of Farragut Square.
      - 17th Street NW (west) congestion was replicated with speed reductions on the southbound and westbound departure of I Street NW and 17th Street NW (west). Speed reductions started at 20mph for the seeding period and decreased to 6mph for the peak period.
      - 17th Street NW (east) congestion was replicated with speed reductions on the southbound departure of K Street NW and 17th Street NW (east). Speed reductions started at 20mph for the seeding period and decreased to 6mph for the peak period.
    - Congestion at 15th Street NW southbound.
      - 15th Street NW congestion was replicated with speed reductions on the southbound departure of K Street NW and 15th Street NW (west). Speed reductions started at 20mph for the seeding period and decreased to 6mph for the peak period.
    - Congestion at 14th Street NW southbound.
      - 14th Street NW congestion was replicated with speed reductions on the southbound and westbound departure of I Street NW and 14th Street NW. Speed reductions started at 20mph for the seeding period and decreased to 7mph for the peak period.
  - These terminal conditions were represented with time-dependent Desired Speed Decision objects in the Vissim models.

Vehicle 2D & 3D Models

- **Vehicle Displays**
  - All passenger cars are displayed in a scale of red colors not associated with specific vehicle types.
  - All heavy vehicles are displayed in a brown color.
  - All buses are displayed in a blue/green color based on their operator.
    - WMATA Metrobuses are **Navy Blue**
    - Circulator Buses are **Light Blue**

        - MTA Buses are **Dark Teal**
        - MCI Loudoun Buses are **Light Teal**
    - While the simulation is running:
        - A bus that is **black**, is delayed.
        - A bus that is **white**, is loading/unloading.
- **Vehicle Compositions**
    - The collected ATR count data from the 1400 Block of K Street NW were used as the primary source for identifying the proportion of different vehicle types.
    - The AM and PM vehicle percentages were assumed to be consistent and the two days of data collection were aggregated together.
    - Vehicle Compositions:
        - **Cars = 95%**
            - A selection of smaller vehicle 2D/3D models were added to better represent the passenger car vehicle fleet (i.e., vehicle lengths) along K Street NW.
            - The extra *.vd3 design files are included in the model folder.
        - **HGV = 5%**, including light trucks
            - HGV, 22-ft = 71%
            - HGV, 34-ft = 15%
            - HGV, 46-ft = 14%

Inputs and Routing

- Vehicle inputs are assigned to the model in 15-minute increments. The relative flow of vehicles during these time periods are based on available TMC data.
- In locations where TMC data were not available for the full analysis period, the proportional demand of a neighboring intersection was used.
    - The traffic flows outside of the peak hour were normalized to better represent demand build-up towards and dissipation after the peak hour.
- The following figures illustrate demand curves from a sample of network input locations.

Figure 1 AM Demand Curves

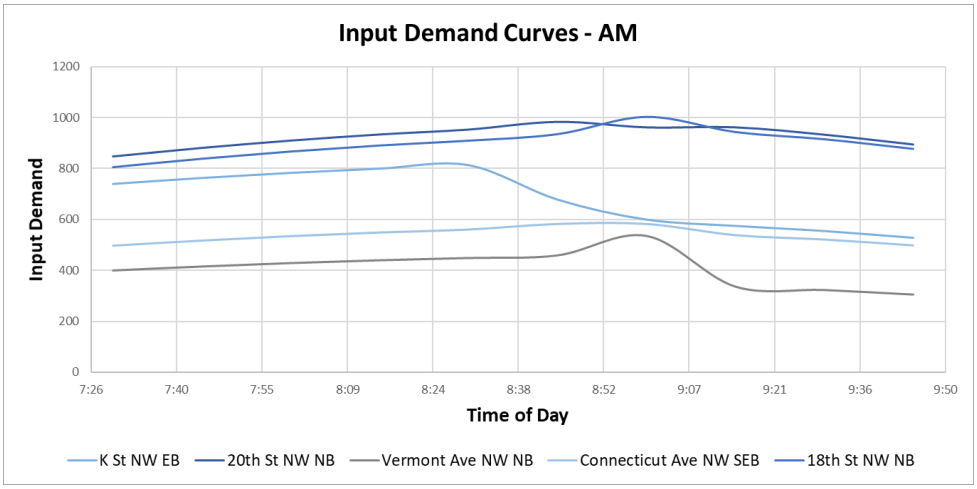
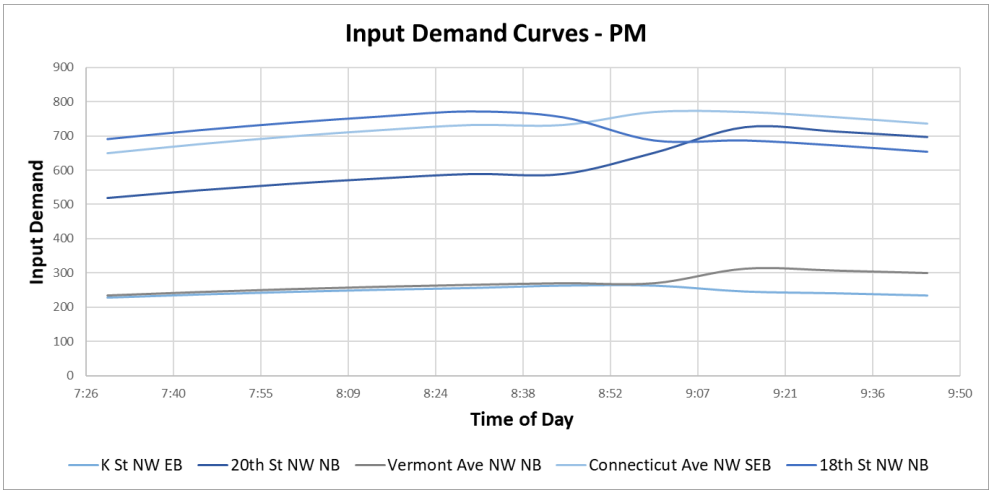


Figure 2 PM Demand Curves



- Inputs and routes were developed from the approved Existing Conditions balanced volumes submitted on February 5, 2020.
- Network routing was developed using a relay-routing system between each decision point (i.e., intersection and service road slip lane).

Public Transportation

- Transit routes were coded using current transit route maps and schedules. Entry time into the network and average headway between buses on each route were coded based on the scheduled stop times at the nearest upstream bus stop to the entry link.
- Dummy links—coded with a transparent fill and red outline—connect side streets along I Street NW and L Street NW in order to connect consecutive transit routes. These links are only used by buses to maintain uniform routes.
- Bus dwell times were derived from data collected in the field and provided by WMATA.
    - WMATA and Circulator buses follow the same empirical distribution derived from WMATA dwell time data.
        - Separate distributions were created for each peak period (i.e., AM, PM) and travel direction (i.e., eastbound, westbound, and north/southbound).
        - Dwell times less than five seconds were removed from consideration to calculate more reasonable average dwell times.
        - Unique distributions were created for stops that showed a higher dwell time average and standard deviation.
            - AM, eastbound K Street NW and Connecticut Avenue
            - AM, eastbound K Street NW and 20th Street NW
            - AM, westbound K Street NW and Connecticut Avenue
        - **Attachment C** contains the WMATA average and standard deviation of dwell times.
    - Loudon County and MTA buses follow a different empirical distribution derived from field observations.
- Bus vehicle 2D/3D models were represented with two vehicle models:

    - MTA/MCI Loudon County, bus length = 45ft.
    - WMATA/Circulator, bus length = 41ft.
- Bus vehicles were modeled with a more conservative acceleration and deceleration profile to match their vehicle size.
- Right-Turn-On-Red (RTOR) was restricted for buses. This is coded using a signal head on the right-turn connector that is only active for Bus vehicle types.
- Based on field-observed behavior, buses were restricted to the right lane to prevent unrealistic overtaking and lane changing.
    - Lanes coded in the model with a **blue** color indicate bus lane restrictions. Blocks where buses are required to complete a left-turn are not restricted.

Pedestrian and Bicycle Inputs

- Pedestrian and Bicycle inputs were developed from field data collected at intersections.
- Pedestrian and Bicycles are only modeled in their dedicated facilities: crosswalks and bicycle lanes. Bicycles are not modeled in vehicle lanes.

Calibration Adjustments

- **Driving Behavior**
    - The Wiedemann 1974 Car-Following model was used on all links, saved in the driving behavior container: “Basic Freeway Segments”.
    - The driving behavior parameters were adjusted based on the lead vehicle type; specifically, to alter driving behavior when following a bus versus a passenger car or heavy vehicle.
        - When the lead vehicle is a car, the Wiedemann 1974 parameters were kept at default: AX = 6.56ft, BX Add = 2, BX Mult = 3.
        - When the lead vehicle is a bus, the Wiedemann 1974 parameters were altered to be: AX = 8.00ft, BX Add = 2.2, BX Mult = 3.2.
        - All links in the model use this driving behavior container unless otherwise described below.
    - Driving behavior differences between different vehicles were accounted for with the acceleration and deceleration parameters associated with each vehicle 2D/3D model.
    - An additional driving behavior container: “Oversaturated Arterial Segments” was defined and used in the AM model for two eastbound segments with a significant amount of lane changing.
        - Wiedemann 1974 parameters were adjusted to: AX = 7ft, BX Add = 2, BX Mult = 3.
        - Cooperative Lane Change was activated with a maximum speed difference of 8 mph and maximum collision time of 10 seconds.
        - The minimum headway required for lane changing was reduced to 1.2 feet.
        - Links with this behavior are represented in the model with a **purple** color.
- **Priority Rules**

  - This model is very sensitive to changes in parameter values for priority rules, especially those involving pedestrians. Thus, iterative adjustments were made to the influence area of pedestrian conflict areas to more realistically match field conditions.
    - For example, the eastbound right-turn movement from K Street NW to 15th Street NW (west) was a very sensitive location due to the heavy volume of pedestrians traveling in this area.
    - Bus behavior around pedestrians was also shown to be highly sensitive to pedestrian movements. Due to the reduced acceleration and deceleration parameters for bus vehicle types, buses are even more susceptible to varying delays. This behavior is especially prevalent at 17th Street NW, 15th Street NW, and Connecticut Avenue.
  - Priority Rules were used to model "Keep Clear" through intersections on a case-by-case basis based on queueing.
  - In a few locations, priority rules were used in place of conflict areas to control left-turn gap acceptance (e.g., eastbound left turn at 15th Street NW (west) in the AM).
- **Combine Routes**
  - In locations where routes were too close to a decision and vehicles were unable to make realistic movements to follow their designated routes, the Vissim "combine routes" feature was used (e.g., routes were combined in the eastbound direction on K Street NW between Connecticut Avenue NW and 17th Street NW (east)).
- **Bus Stop Lengths and Dwell Time**
  - Field observations indicated buses will often allow boarding and alighting in bunches; therefore, bus stop lengths were extended in specific locations to account for this behavior.
    - Example locations where this behavior is exhibited in the model includes:
      - Eastbound between 18th Street NW and Connecticut Avenue NW.
      - Eastbound between 16th Street NW and 15th Street NW (west)
      - Eastbound and westbound between Vermont Avenue NW and 14th Street NW.
      - Westbound between 14th Street NW and 13th Street NW.
  - Similarly, bus dwell times were adjusted from the default distributions for each operator based on stop location. At locations with evidence of significant bus activity, the dwell time distribution was adjusted according to the WMATA dwell time data. Evidence of these differences in dwell time are provided in **Attachment C**.
- **Demand Profile before and after the Peak Hour**
  - Since traffic counts were not collected during the full simulation period for all intersections, and because throughput is not always indicative of true demand, demand curves were normalized with congestion buildup and dissipation based on the balanced peak hour volumes in the AM and PM models.

  - Iterative adjustments to the demand rate in the build-up and dissipation periods were tested in both peak period models.
- **Parking Lots**
  - In both AM and PM field observations, cars were observed to be parallel parked on K Street NW between 10th Street NW and 11th Street NW.
  - Parallel parking vehicles were modeled to represent the reduction in capacity through that block. The assumption was made that the parked vehicles would remain consistent throughout the study period.
    - These vehicles appear in the simulation model in a white color. The "Parking Lot" attribute can be activated to identify the parking spots.

Model Results

The complete set of model results are provided in **Attachment A: AM Existing Conditions Calibration Results** and **Attachment B: PM Existing Conditions Calibration Results**. The calibration summary tables are provided below in **Table 1** and **Table 2** for AM and PM, respectfully. As shown, each model is meeting the calibration thresholds agreed upon in the Framework document.

The models were calibrated to individual link-level throughput, based on approach volumes at each intersection. As shown in **Table 1** and **Table 2**, most links fell within the specified volume criteria and met the required GEH statistic. This validates that the model is processing a sufficiently similar amount of throughput at every intersection as demonstrated in the field.

Next, the models were calibrated to overall network throughput focused on the K Street NW corridor. This statistic validates that on a corridor-level a sufficiently similar number of vehicles are traversing the study area intersections. As shown in **Table 1** and **Table 2**, the percent difference in throughput and GEH statistic meet required thresholds.

Field travel time runs were conducted for the full extent of the K Street NW corridor (i.e. east of 10th Street NW to west of 21st Street NW). In each peak period, 12 to 13 runs were completed, and these runs were averaged for model calibration[1]. Therefore, simulated travel times were calibrated by assigning travel time segments to match these field travel runs in the Vissim model (i.e., end-to-end travel times of the K Street NW corridor), creating an apples-to-apples comparison for model calibration. The Vissim-reported end-to-end travel times are averaged from a sample of 100 to 200 vehicles. This sample is sufficient for comparing against the measured field conditions.

While segment-by-segment average travel times were not collected in the field, they were computed in Vissim (please reference page 12 of **Attachment A** and **Attachment B**). These segment-by-segment travel times can be used to compare with future build scenarios. However, these travel times do not include delays incurred by vehicles on the service lanes, which will be a consideration for future build scenarios.

Finally, bottleneck locations and queue impacts were confirmed to be adequately calibrated from a numeric comparison of intersection queue lengths on the K Street NW mainline and qualitative observations of model performance. The queue data collected in the field were not comprehensive. As determined in the Data Collection Plan, field observers walked the K Street NW corridor and captured spot queue lengths for three cycles before proceeding to the next intersection. Therefore, these queues are estimates and the maximum queue lengths during the peak hour may not be captured[2].

The quantitative comparison between observed maximum queue and Vissim-reported average and maximum queue are provided on page 18 of **Attachment A** and **Attachment B**. A variety of statistics are shown to compare the queue lengths. At a corridor-level, the queues captured in

[1] Please reference the **K Street NW Data Collection Memorandum** for information on travel time data collection.
[2] Please reference the **K Street NW Data Collection Memorandum** for information on queue data collection.

the model reflect the queue observations reported in the **K Street NW Data Collection Memorandum**.

Along this corridor, bottleneck locations can be defined as locations with frequent bus bunching, a large proportion of vehicle turning movements, or heavy pedestrian activity. The following list describes key field observed characteristics of the network that are captured in the calibrated Vissim models in the AM and PM peak periods.

- **Eastbound K Street NW between Connecticut Avenue NW and 17th Street NW (east) in AM and PM**. The pedestrian volumes at the intersection of 17th Street NW (east) caused significant impact to queuing for the eastbound right-turn movement, which is a shared movement with the through travel lane. This delay was exacerbated by bus turning movements, which were more conservative than vehicles due to their size and different acceleration capabilities.
- **Westbound K Street NW between Connecticut Avenue NW and 17th Street NW (east) in AM and PM**. The large number of buses and observed boarding activity due to the proximity to the Farragut North Metrorail station resulted in noticeable congestion and bus bunching. The queueing from this short block was observed to spill back to upstream blocks.
- **Eastbound K Street NW between 16th Street NW and 15th Street NW (west) in AM**. The eastbound left-turning movement at 15th Street NW (west) causes significant congestion. The model showed sensitivity to driver aggressiveness making this left turning movement. This block is worsened by the two bus stops that incur frequent bus bunching activities. This congestion is shown to cause queue spillback in the upstream blocks.
- **Westbound K Street NW between 15th Street NW (west) and Vermont Avenue in PM**. The short block between 15th Street NW (west) and Vermont Avenue NW, paired with the heavy westbound left-turn volume at 15th Street NW (west) results in queues that spill back to upstream intersections.
- **Bottlenecks and congestion outside of the study area in the PM peak** played a large role in model calibration. Significant delays in the tunnel beneath Washington Circle were the result of speed reductions observed during data collection on K Street NW in the westbound direction. Travel time run data recorded travel speeds in this segment to be between 4 and 7 mph through most of the peak period. In addition, review of travel time runs (i.e., dash camera video) and queue data from the PM peak period show numerous bottlenecks and spillback queues from side streets (e.g., Connecticut Avenue NW, 17th Street NW (west and east), 15th Street NW (west), and 14th Street NW). The model adequately represents these external bottlenecks, and these conditions will be transferrable to future build models.

The number of required random seeds were determined from the VDOT Sample Size Tool, which uses FHWA Traffic Analysis Toolbox guidance to assess the variability of model runs to determine the number of samples needed to achieve statistically representative average model results. As shown on page 17 of **Attachment A** and **Attachment B**, 10 random seeds (i.e., the minimum required number of random seeds) were deemed appropriate for reporting results. Further checks for network-wide gridlock were performed for all 10 seeds.

Table 1 AM Existing Conditions Calibration Summary

Calibration Item	Basis	Criteria	Value	Target	Criteria Met
Simulated Vehicular Throughput (Individual Links)	**All Segments and Approaches**	Within ± 100 vph for < 700 vph	100%	85%	**Yes**
		Within ± 15% for ≥ 700 vph to < 2,700 vph			
		Within ± 400 vph for ≥ 2,700 vph			
		GEH < 5 for individual link flows	100%	85%	**Yes**
Simulated Vehicular Throughput (Network Wide)	**Total Volume throughout Network on K Street Corridor**	GEH < 4 for total network volume	2.5	4.0	**Yes**
		Within 5% of total network volume	1.3%	5%	**Yes**
Simulated Travel Time	**Travel Time Segments (n=2)**	Within ± 15% for observed travel times on K Street NW	100%	85%	**Yes**
Bottleneck and Queue Impact Verification	**Targeted Critical Locations**	Maximum observed queue lengths will be compared with simulated queue lengths at critical intersection approaches. Since full peak period observations of queues were not collected, this comparison will be qualitative.	Qualitative observations of field conditions and simulated conditions are consistent.		**Yes**
Required Sample Size			10		

Table 2 PM Existing Conditions Calibration Summary

Calibration Item	Basis	Criteria	Value	Target	Criteria Met
Simulated Vehicular Throughput (Individual Links)	**All Segments and Approaches**	Within ± 100 vph for < 700 vph	100%	85%	**Yes**
		Within ± 15% for ≥ 700 vph to < 2,700 vph			
		Within ± 400 vph for ≥ 2,700 vph			
		GEH < 5 for individual link flows	100%	85%	**Yes**
Simulated Vehicular Throughput (Network Wide)	**Total Volume throughout Network on K Street Corridor**	GEH < 4 for total network volume	2.6	4.0	**Yes**
		Within 5% of total network volume	-1.4%	5%	**Yes**
Simulated Travel Time	**Travel Time Segments (n=2)**	Within ± 15% for observed travel times on K Street NW	100%	85%	**Yes**
Bottleneck and Queue Impact Verification	**Targeted Critical Locations**	Maximum observed queue lengths will be compared with simulated queue lengths at critical intersection approaches. Since full peak period observations of queues were not collected, this comparison will be qualitative.	Qualitative observations of field conditions and simulated conditions are consistent.		**Yes**
Required Sample Size			10		

2025 Future Build Models

Upon DDOT approval of the Existing Conditions models, the 2025 model development will begin. As agreed upon in the Scope of Work, the existing condition model results will be used as the No-Build model for comparison. This is a reasonable assumption based on the decision to maintain Existing Conditions volumes with re-routing for the 2025 Build scenarios (decision at bi-weekly meeting, March 3, 2020). The calibrated demand curve used to assign proportional volumes throughout the simulation period in the existing AM and PM models will be used to assign volumes in future conditions.

The development of these models will be consistent with the calibrated behaviors and parameters from existing conditions. Modifications will be made as needed to alter the network for the design alternatives. Engineering judgement will be used, and justifications will be given for such changes.

In consideration of future conditions model development, it is important to note that queuing was observed on service lanes to make right turning movements. In the absence of these service lanes in future build scenarios, these queues will be propagated to the mainline traffic stream. However, bottlenecks caused by bus traffic and left-turns will be removed; therefore, it is difficult to predict the magnitude of the impact before testing. In addition, as the demand of bicyclists increases in future years, the delay incurred by conflicting vehicle movements is estimated to increase. This is supported by the sensitivity exhibited by the model to pedestrian and bicycle demand in existing conditions.

Attachment A: AM Existing Conditions Calibration Results

AM Existing Conditions Model Calibration Summary

AM Peak Hour: 8:30AM-9:30AM
AM Peak Period: 8:00AM-10:00AM

Calibration Item	Basis	Criteria	Value	Target	Criteria Met
Simulated Vehicular Throughput (Individual Links)	**All Segments and Approaches**	Within ± 100 vph for < 700 vph	100%	85%	Yes
		Within ± 15% for ≥ 700 vph to < 2,700 vph			
		Within ± 400 vph for ≥ 2,700 vph			
		GEH < 5 for individual link flows	100%	85%	Yes
Simulated Vehicular Throughput (Network Wide)	**Total Volume throughout Network on K Street Corridor**	GEH < 4 for total network volume	2.5	4.0	Yes
		Within 5% of total network volume	1.3%	5%	Yes
Simulated Travel Time	**Travel Time Segments (n=2)**	Within ± 15% for observed travel times on K Street NW	100%	85%	Yes
Bottleneck and Queue Impact Verification	**Targeted Critical Locations**	Maximum observed queue lengths will be compared with simulated queue lengths at critical intersection approaches. Since full peak period observations of queues were not collected, this comparison will be qualitative.			Yes
Required Sample Size			10		

**Findings Represent Results from 10 Simulation Runs*

Kimley»Horn

Intersection Volume Calibration

AM Peak Hour: 8:30AM-9:30AM

85% of All Intersection Approaches within the following Volume Criteria	Number of Approaches		Passing Approaches		Percent	Target	Target Met
Within ± 100 vph for < 700 vph	76	103	76	103	100%	85%	Yes
Within ± 15% for ≥ 700 vph to < 2,700 vph	27		27				
Within ± 400 vph for ≥ 2,700 vph	0		0				

#	Intersection	Approach	Movement	Balanced Count (vph)		Vissim Throughput (vph)		Difference (vph)		Difference (%)	
1	K Street NW and 22nd Street NW	NB	LT - SL	3	274	3	268	0	-6	0%	-2%
			TH	205		197		-8		-4%	
			RT - SL	66		68		2		3%	
		EB	TH	666	666	666	666	0	0	0%	0%
		WB	TH	527	527	523	523	-4	-4	-1%	-1%
		EB Service Lane	LT	49	350	50	355	1	5	2%	1%
			TH	301		305		4		1%	
		WB Service Lane	UT	67	312	68	321	1	9	1%	3%
			TH	101		110		9		9%	
			RT	144		143		-1		-1%	
		Intersection		2,129		2,133		4		0%	
2	K Street NW and 21st Street NW	SB	LT - SL	21	594	21	605	0	11	0%	2%
			LT	41		52		11		27%	
			TH	357		359		2		1%	
			RT	72		72		0		0%	
			RT - SL	103		101		-2		-2%	
		EB	TH	621	666	625	669	4	3	1%	0%
			TH - SL	39		38		-1		-3%	
			RT	6		6		0		0%	
		WB	LT	27	506	31	507	4	1	15%	0%
			TH	451		448		-3		-1%	
			TH - SL	28		28		0		0%	
		EB Service Lane	TH - ML	22	310	22	314	0	4	0%	1%
			TH	154		158		4		3%	
			RT	134		134		0		0%	
		WB Service Lane	TH - ML	4	108	4	121	0	13	0%	12%
			TH	104		117		13		13%	
		Intersection		2,184		2,216		32		1%	
3	K Street NW and 20th Street NW	NB	LT - SL	22	964	22	982	0	18	0%	2%
			LT	58		57		-1		-2%	
			TH	792		807		15		2%	
			RT	41		46		5		12%	
			RT - SL	51		50		-1		-2%	
		EB	LT	14	761	13	780	-1	19	-7%	2%
			TH	733		753		20		3%	
			TH - SL	14		14		0		0%	
		WB	TH	445	457	459	470	14	13	3%	3%
			TH - SL	2		2		0		0%	
			RT	10		9		-1		-10%	
		EB Service Lane	TH - ML	7	122	7	121	0	-1	0%	-1%
			TH	115		114		-1		-1%	
		WB Service Lane	TH - ML	2	203	3	219	1	16	50%	8%
			TH	36		37		1		3%	
			RT	165		179		14		8%	
		Intersection		2,507		2,572		65		3%	

#	Intersection	Approach	Movement	Balanced Count (vph)		Vissim Throughput (vph)		Difference (vph)		Difference (%)	
4	K Street NW and 19th Street NW	SB	LT - SL	15	522	14	529	-1	7	-7%	1%
			LT	42		45		3		7%	
			TH	383		390		7		2%	
			RT	26		26		0		0%	
			RT - SL	56		54		-2		-4%	
		EB	TH	730	745	755	770	25	25	3%	3%
			TH - SL	7		7		0		0%	
			RT	8		8		0		0%	
		WB	LT	32	543	49	587	17	44	53%	8%
			TH	505		524		19		4%	
			TH - SL	6		14		8		133%	
		EB Service Lane	TH - ML	6	220	5	211	-1	-9	-17%	-4%
			TH	45		41		-4		-9%	
			RT	169		165		-4		-2%	
		WB Service Lane	TH	60	60	61	61	1	1	2%	2%
		Intersection		2,090		2,158		68		3%	
5	K Street NW and 18th Street NW	NB	LT - SL	9	947	9	990	0	43	0%	5%
			LT	57		60		3		5%	
			TH	788		807		19		2%	
			RT	47		66		19		40%	
			RT - SL	46		48		2		4%	
		EB	LT	5	667	4	683	-1	16	-20%	2%
			TH	652		669		17		3%	
			TH - SL	10		10		0		0%	
		WB	TH	615	622	660	667	45	45	7%	7%
			TH - SL	6		5		-1		-17%	
			RT	1		2		1		100%	
		EB Service Lane	TH - ML	3	43	3	45	0	2	0%	5%
			TH	40		42		2		5%	
		WB Service Lane	TH	29	167	28	161	-1	-6	-3%	-4%
			RT	138		133		-5		-4%	
		Intersection		2,446		2,546		100		4%	
6	K Street NW and Connecticut Avenue	NB	TH	710	764	739	802	29	38	4%	5%
			RT	54		63		9		17%	
		SB	LT - SL	6	628	11	644	5	16	83%	3%
			TH	478		489		11		2%	
			RT	34		30		-4		-12%	
			RT - SL	110		114		4		4%	
		EB	LT	1	608	1	637	0	29	0%	5%
			TH	604		633		29		5%	
			TH - SL	3		3		0		0%	
		WB	LT	1	817	2	864	1	47	100%	6%
			TH	737		781		44		6%	
			TH - SL	76		77		1		1%	
			RT	3		4		1		33%	
		EB Service Lane	TH - ML	3	94	3	94	0	0	0%	0%
			RT	91		91		0		0%	
		WB Service Lane	RT	132	132	143	143	11	11	8%	8%
		Intersection		3,043		3,184		141		5%	

#	Intersection	Approach	Movement	Balanced Count (vph)		Vissim Throughput (vph)		Difference (vph)		Difference (%)	
7	K Street NW and 17th Street NW (east)	NB	LT - SL	3	59	2	58	-1	-1	-33%	-2%
			LT	4		4		0		0%	
			TH	38		39		1		3%	
			RT	7		6		-1		-14%	
			RT - SL	7		7		0		0%	
		SB	LT - SL	5	337	5	338	0	1	0%	0%
			LT	37		37		0		0%	
			TH	181		182		1		1%	
			RT	73		68		-5		-7%	
			RT - SL	41		46		5		12%	
		EB	LT	2	667	1	700	-1	33	-50%	5%
			TH	535		559		24		4%	
			TH - SL	31		29		-2		-6%	
			RT	99		111		12		12%	
		WB	LT	1	758	1	810	0	52	0%	7%
			TH	732		782		50		7%	
			TH - SL	25		27		2		8%	
		WB Service Lane	TH - ML	8	117	8	118	0	1	0%	1%
			TH	63		66		3		5%	
			RT	46		44		-2		-4%	
		Intersection		1,938		2,024		86		4%	
8	K Street NW and 16th Street NW	NB	LT - SL	1	335	2	337	1	2	100%	1%
			LT	2		2		0		0%	
			TH	308		309		1		0%	
			RT	16		15		-1		-6%	
			RT - SL	8		9		1		13%	
		SB	LT	67	649	87	698	20	49	30%	8%
			TH	453		472		19		4%	
			RT	78		87		9		12%	
			RT - SL	51		52		1		2%	
		EB	LT	3	505	4	521	1	16	33%	3%
			TH	495		511		16		3%	
			TH - SL	5		4		-1		-20%	
			RT	2		2		0		0%	
		WB	TH	561	589	606	632	45	43	8%	7%
			TH - SL	23		21		-2		-9%	
			RT	5		5		0		0%	
		EB Service Lane	TH - ML	1	52	1	55	0	3	0%	6%
			TH	11		13		2		18%	
			RT	40		41		1		3%	
		WB Service Lane	TH - ML	1	189	1	200	0	11	0%	6%
			TH	42		41		-1		-2%	
			RT	146		158		12		8%	
		Intersection		2,319		2,443		124		5%	
9	K Street NW and 15th Street NW (west)	NB	LT - SL	9	410	9	418	0	8	0%	2%
			LT	21		24		3		14%	
			TH	364		368		4		1%	
			RT	16		17		1		6%	
		SB	LT	5	120	4	119	-1	-1	-20%	-1%
			TH	77		78		1		1%	
			RT	16		16		0		0%	
			RT - SL	22		21		-1		-5%	
		EB	LT	71	592	70	623	-1	31	-1%	5%
			TH	520		553		33		6%	
			TH - SL	1		0		-1		-100%	
		WB	LT	28	941	25	987	-3	46	-11%	5%
			TH	893		935		42		5%	
			TH - SL	15		22		7		47%	
			RT	5		5		0		0%	
		EB Service Lane	TH - ML	3	35	4	35	1	0	33%	0%
			RT	32		31		-1		-3%	
		WB Service Lane	TH	57	238	59	239	2	1	4%	0%
			RT	181		180		-1		-1%	
		Intersection		2,336		2,421		85		4%	

#	Intersection	Approach	Movement	Balanced Count (vph)		Vissim Throughput (vph)		Difference (vph)		Difference (%)	
10	K Street NW and Vermont Avenue	NB	LT - SL	55	444	57	453	2	9	4%	2%
			LT	117		123		6		5%	
			TH	199		200		1		1%	
			RT	33		31		-2		-6%	
			RT - SL	40		42		2		5%	
		SB	LT - SL	12	111	11	106	-1	-5	-8%	-5%
			LT	24		25		1		4%	
			RT	50		46		-4		-8%	
			RT - SL	25		24		-1		-4%	
		EB	LT	45	544	42	576	-3	32	-7%	6%
			TH	452		486		34		8%	
			TH - SL	47		48		1		2%	
		WB	TH	764	805	804	844	40	39	5%	5%
			TH - SL	40		39		-1		-3%	
			RT	1		1		0		0%	
		WB Service Lane	TH - ML	10	184	11	184	1	0	10%	0%
			TH	111		112		1		1%	
			RT	63		61		-2		-3%	
		Intersection		2,088		2,163		75		4%	
11	K Street NW and 14th Street NW	NB	LT - SL	60	875	61	928	1	53	2%	6%
			LT	148		162		14		9%	
			TH	617		653		36		6%	
			RT	50		52		2		4%	
		SB	LT	31	664	30	670	-1	6	-3%	1%
			TH	567		579		12		2%	
			RT	40		37		-3		-8%	
			RT - SL	26		24		-2		-8%	
		EB	LT	3	458	3	492	0	34	0%	7%
			TH	433		452		19		4%	
			RT	22		37		15		68%	
		WB	LT	2	647	1	679	-1	32	-50%	5%
			TH	617		645		28		5%	
			TH - SL	24		28		4		17%	
			RT	4		5		1		25%	
		EB Service Lane	TH - ML	3	100	4	102	1	2	33%	2%
			RT	97		98		1		1%	
		WB Service Lane	TH	73	175	73	174	0	-1	0%	-1%
			RT	102		101		-1		-1%	
		Intersection		2,919		3,045		126		4%	
12	K Street NW and 13th Street NW	NB	LT - SL	29	591	26	605	-3	14	-10%	2%
			LT	144		151		7		5%	
			TH	384		395		11		3%	
			RT	33		32		-1		-3%	
			RT - SL	1		1		0		0%	
		SB	LT	20	975	23	999	3	24	15%	2%
			TH	854		877		23		3%	
			RT	65		62		-3		-5%	
			RT - SL	36		37		1		3%	
		EB	TH	372	517	366	529	-6	12	-2%	2%
			RT	145		163		18		12%	
		WB	LT	9	488	11	517	2	29	22%	6%
			TH	454		481		27		6%	
			TH - SL	20		19		-1		-5%	
			RT	5		6		1		20%	
		WB Service Lane	TH - ML	4	151	4	151	0	0	0%	0%
			TH	47		48		1		2%	
			RT	100		99		-1		-1%	
		Intersection		2,722		2,801		79		3%	

#	Intersection	Approach	Movement	Balanced Count (vph)		Vissim Throughput (vph)		Difference (vph)		Difference (%)	
13	K Street NW and 12th Street NW	NB	LT - SL	64	909	67	954	3	45	5%	5%
			LT	191		217		26		14%	
			TH	574		592		18		3%	
			RT	80		78		-2		-3%	
		EB	LT	90	417	88	416	-2	-1	-2%	0%
			TH	327		328		1		0%	
		WB	TH	310	418	318	423	8	5	3%	1%
			TH - SL	62		59		-3		-5%	
			RT	46		46		0		0%	
		EB Service Lane	TH - ML	11	11	9	9	-2	-2	-18%	-18%
		Intersection		1,755		1,802		47		3%	
14	K Street NW and 11th Street NW	NB	LT	101	362	109	370	8	8	8%	2%
			TH	214		217		3		1%	
			RT	47		44		-3		-6%	
		SB	LT	13	553	11	552	-2	-1	-15%	0%
			TH	435		433		-2		0%	
			RT	105		108		3		3%	
		EB	LT	72	352	73	352	1	0	1%	0%
			TH	178		177		-1		-1%	
			RT	102		102		0		0%	
		WB	LT	39	257	40	255	1	-2	3%	-1%
			TH	197		193		-4		-2%	
			RT	21		22		1		5%	
		Intersection		1,524		1,529		5		0%	
15	K Street NW and 10th Street NW	SB	LT	24	448	26	443	2	-5	8%	-1%
			TH	260		255		-5		-2%	
			RT	164		162		-2		-1%	
		EB	TH	99	232	99	230	0	-2	0%	-1%
			RT	133		131		-2		-2%	
		WB	LT	9	112	9	115	0	3	0%	3%
			TH	103		106		3		3%	
		Intersection		792		788		-4		-1%	
16	K Street NW and 9th Street NW	SB	TH	941	1,065	958	1,085	17	20	2%	2%
			RT	124		127		3		2%	
		EB	RT	65	65	66	66	1	1	2%	2%
		Intersection		1,130		1,151		21		2%	
17	L Street NW and 21st Street NW	SB	LT	177	626	173	629	-4	3	-2%	0%
			TH	449		456		7		2%	
		EB	TH	784	929	786	923	2	-6	0%	-1%
			RT	145		137		-8		-6%	
		Intersection		1,555		1,552		-3		0%	
18	Pennsylvania Avenue NW and 21st Street NW	SB	LT	105	524	109	531	4	7	4%	1%
			TH	391		391		0		0%	
			RT	28		31		3		11%	
		EB	TH	722	836	702	814	-20	-22	-3%	-3%
			RT	114		112		-2		-2%	
		WB	LT	123	397	130	410	7	13	6%	3%
			TH	274		280		6		2%	
		Intersection		1,757		1,755		-2		0%	
19	L Street NW and Connecticut Avenue	NB	TH	667	846	701	882	34	36	5%	4%
			RT	179		181		2		1%	
		SB	TH	566	566	577	577	11	11	2%	2%
		EB	LT	88	875	85	875	-3	0	-3%	0%
			TH	725		726		1		0%	
			RT	62		64		2		3%	
		Intersection		2,287		2,334		47		2%	
20	I Street NW and 17th Street NW (west)	NB	LT	135	765	142	799	7	34	5%	4%
			TH	630		657		27		4%	
		SB	TH	479	571	490	583	11	12	2%	2%
			RT	92		93		1		1%	
		WB	LT	368	1,283	362	1,289	-6	6	-2%	0%
			TH	781		781		0		0%	
			RT	134		146		12		9%	
		Intersection		2,619		2,671		52		2%	

#	Intersection	Approach	Movement	Balanced Count (vph)		Vissim Throughput (vph)		Difference (vph)		Difference (%)	
21	L Street NW and 16th Street NW	NB	TH	327	462	335	472	8	10	2%	2%
			RT	135		137		2		1%	
		SB	LT	245	845	240	881	-5	36	-2%	4%
			TH	600		641		41		7%	
		EB	LT	159	750	153	734	-6	-16	-4%	-2%
			TH	542		530		-12		-2%	
			RT	49		51		2		4%	
		Intersection		2,057		2,087		30		1%	
22	I Street NW and 16th Street NW	NB	LT	69	256	67	247	-2	-9	-3%	-4%
			TH	187		180		-7		-4%	
		SB	TH	192	495	203	511	11	16	6%	3%
			RT	303		308		5		2%	
		WB	LT	19	1,069	23	1,115	4	46	21%	4%
			TH	902		941		39		4%	
			RT	148		151		3		2%	
		Intersection		1,820		1,873		53		3%	
23	L Street NW and 15th Street NW (west)	NB	TH	555	625	561	630	6	5	1%	1%
			RT	70		69		-1		-1%	
		SB	LT	41	105	43	102	2	-3	5%	-3%
			TH	64		59		-5		-8%	
		EB	LT	159	793	157	783	-2	-10	-1%	-1%
			TH	578		568		-10		-2%	
			RT	56		58		2		4%	
		Intersection		1,523		1,515		-8		-1%	
24	L Street NW and 14th Street NW	NB	TH	504	726	524	752	20	26	4%	4%
			RT	222		228		6		3%	
		SB	LT	111	707	112	724	1	17	1%	2%
			TH	596		612		16		3%	
		EB	LT	36	618	36	616	0	-2	0%	0%
			TH	514		518		4		1%	
			RT	68		62		-6		-9%	
		Intersection		2,051		2,092		41		2%	
25	I Street NW and 14th Street NW	NB	LT	311	1,135	314	1,154	3	19	1%	2%
			TH	824		840		16		2%	
		SB	TH	622	688	643	709	21	21	3%	3%
			RT	66		66		0		0%	
		WB	LT	88	915	90	973	2	58	2%	6%
			TH	776		808		32		4%	
			RT	51		75		24		47%	
		Intersection		2,738		2,836		98		4%	

**Results show the average from 10 simulation runs.*

Intersection Delay and Estimated LOS

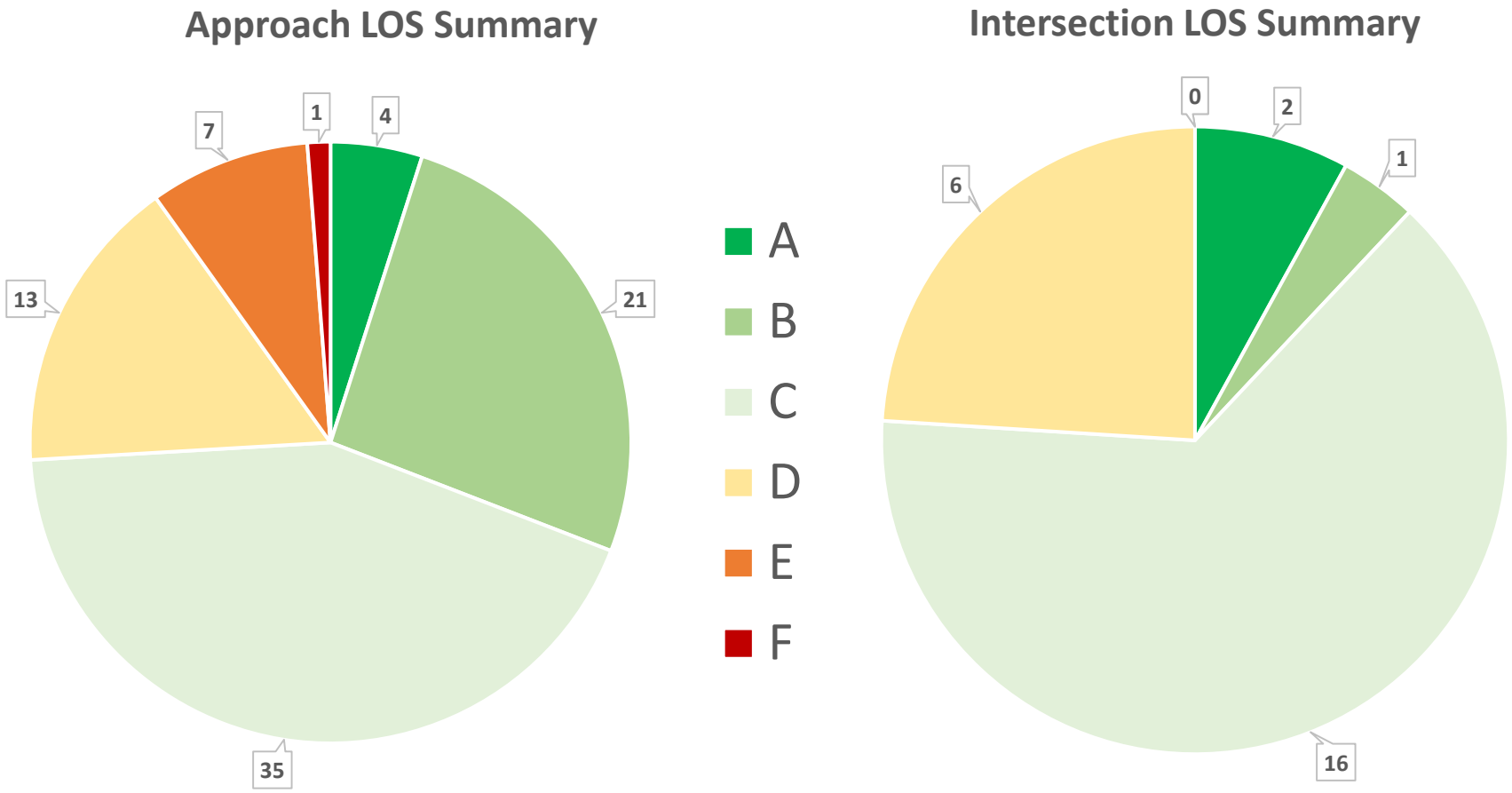
AM Peak Hour: 8:30AM-9:30AM

#	Intersection	Approach	Average Delay (sec/veh)	Approach LOS	Intersection Delay	Intersection LOS
1	K Street NW and 22nd Street NW	NB	38.7	D	8.7	A
		SB	-	-		
		EB Service Lane	6.2	A		
		WB Service Lane	18.0	B		
2	K Street NW and 21st Street NW	NB	-	-	20.5	C
		SB	28.5	C		
		EB	17.3	B		
		WB	10.9	B		
3	K Street NW and 20th Street NW	NB	32.1	C	25.7	C
		SB	-	-		
		EB	15.1	B		
		WB	24.8	C		
4	K Street NW and 19th Street NW	NB	-	-	27.3	C
		SB	31.5	C		
		EB	18.3	B		
		WB	18.8	B		
5	K Street NW and 18th Street NW	NB	35.2	D	24.8	C
		SB	-	-		
		EB	14.9	B		
		WB	21.3	C		
6	K Street NW and Connecticut Avenue	NB	37.5	D	35.0	D
		SB	20.2	C		
		EB	62.1	E		
		WB	16.6	B		
7	K Street NW and 17th Street NW (east)	NB	27.9	C	29.0	C
		SB	47.4	D		
		EB	28.6	C		
		WB	23.8	C		
8	K Street NW and 16th Street NW	NB	36.5	D	29.9	C
		SB	26.9	C		
		EB	39.9	D		
		WB	26.0	C		
9	K Street NW and 15th Street NW (west)	NB	28.8	C	38.2	D
		SB	33.0	C		
		EB	81.3	F		
		WB	19.6	B		
10	K Street NW and Vermont Avenue	NB	54.0	D	36.3	D
		SB	60.3	E		
		EB	16.7	B		
		WB	36.8	D		
11	K Street NW and 14th Street NW	NB	34.1	C	52.4	D
		SB	73.5	E		
		EB	40.5	D		
		WB	76.5	E		
12	K Street NW and 13th Street NW	NB	17.0	B	24.5	C
		SB	28.9	C		
		EB	22.1	C		
		WB	29.5	C		

#	Intersection	Approach	Average Delay (sec/veh)	Approach LOS	Intersection Delay	Intersection LOS
13	K Street NW and 12th Street NW	NB	59.1	E	38.8	D
		SB	-	-		
		EB	13.9	B		
		WB	17.9	B		
14	K Street NW and 11th Street NW	NB	17.3	B	20.4	C
		SB	22.9	C		
		EB	12.0	B		
		WB	31.1	C		
15	K Street NW and 10th Street NW	NB	-	-	20.6	C
		SB	17.8	B		
		EB	24.5	C		
		WB	23.5	C		
16	K Street NW and 9th Street NW	NB	-	-	8.2	A
		SB	5.3	A		
		EB	56.5	E		
		WB	-	-		
17	L Street NW and 21st Street NW	NB	-	-	21.2	C
		SB	23.8	C		
		EB	19.4	B		
		WB	-	-		
18	Pennsylvania Avenue NW and 21st Street NW	NB	-	-	27.5	C
		SB	20.8	C		
		EB	28.7	C		
		WB	33.7	C		
19	L Street NW and Connecticut Avenue	NB	42.2	D	30.0	C
		SB	24.1	C		
		EB	21.5	C		
		WB	-	-		
20	I Street NW and 17th Street NW (west)	NB	21.2	C	28.6	C
		SB	16.3	B		
		EB	-	-		
		WB	38.8	D		
21	L Street NW and 16th Street NW	NB	6.8	A	21.2	C
		SB	24.3	C		
		EB	26.7	C		
		WB	-	-		
22	I Street NW and 16th Street NW	NB	14.3	B	28.4	C
		SB	37.7	D		
		EB	-	-		
		WB	27.2	C		
23	L Street NW and 15th Street NW (west)	NB	9.6	A	13.1	B
		SB	23.8	C		
		EB	14.6	B		
		WB	-	-		
24	L Street NW and 14th Street NW	NB	12.3	B	20.6	C
		SB	22.2	C		
		EB	29.1	C		
		WB	-	-		
25	I Street NW and 14th Street NW	NB	27.7	C	40.4	D
		SB	58.7	E		
		EB	-	-		
		WB	42.2	D		

Intersection Delay and Estimated LOS

AM Peak Hour: 8:30AM-9:30AM



Approach LOS	A	B	C	D	E	F
	4	21	35	13	7	1

Intersection LOS	A	B	C	D	E	F
	2	1	16	6	0	0

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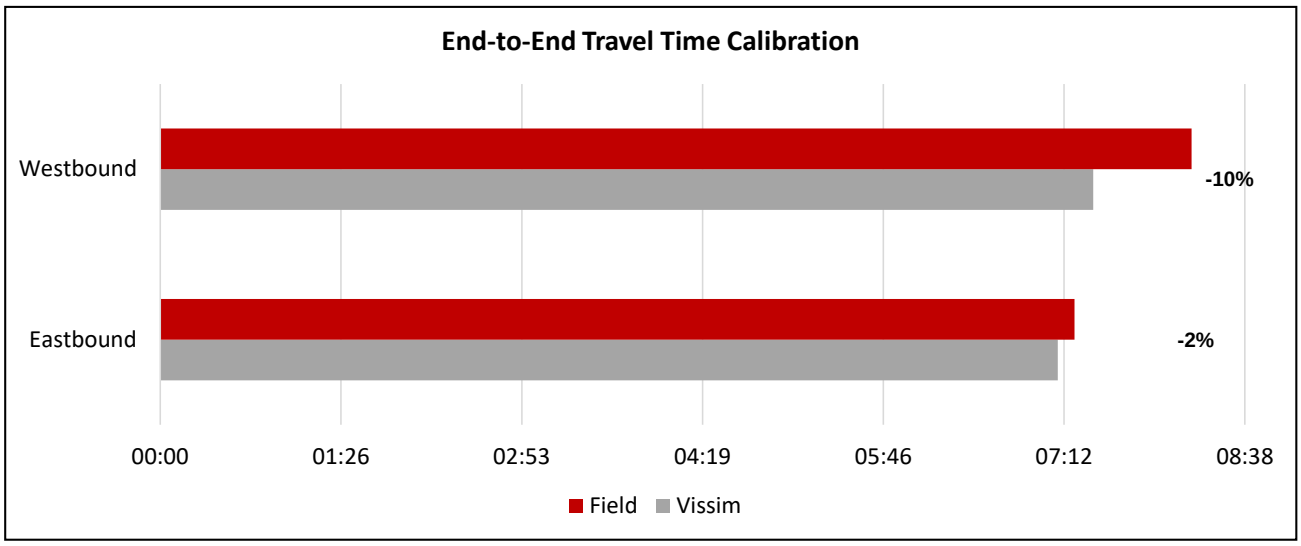
Travel Time | End-to-End Passenger Cars

AM Peak Period: 8:00AM-10:00AM

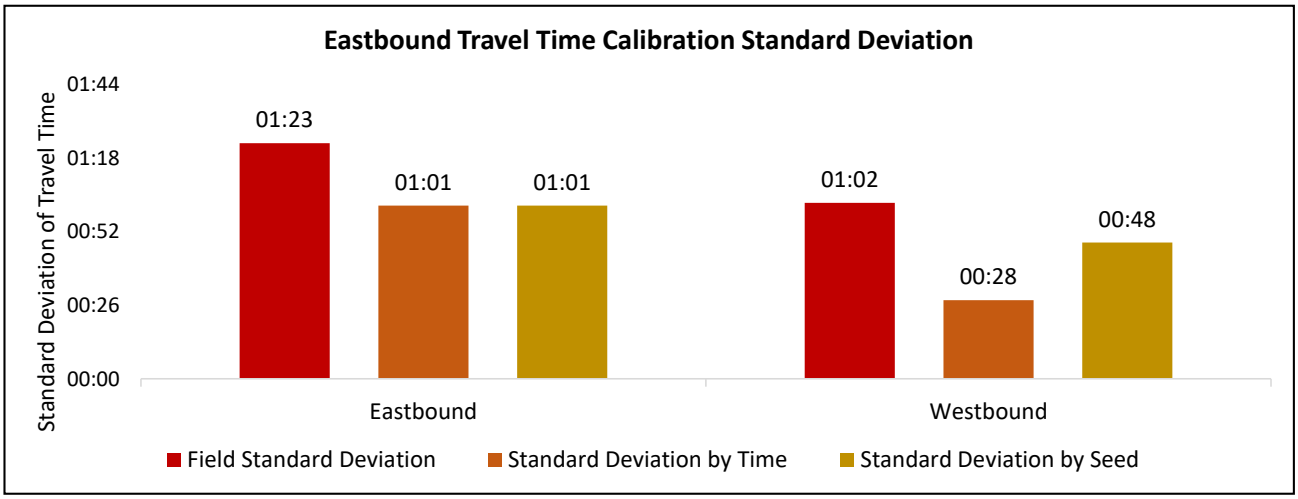
Travel Time Criteria	Number of Segments Passing	Percent	Target	Target Met
85% of Travel Time Segments Within ± 15% for observed travel times on K Street NW	2 of 2	100%	85%	Yes

Passenger Vehicle Travel Time Calibration					
Segment ID	Route	Field	Vissim	Difference	
		(MM:SS)	(MM:SS)	(MM:SS)	(%)
9	Eastbound	07:17	07:09	-00:08	-2%
10	Westbound	08:13	07:26	-00:47	-10%

**Results show the average from 10 simulation runs.*



Passenger Vehicle Travel Time Statistics					
Segment ID	Route	Field/Vissim Vehicle Count	Field Standard Deviation	Standard Deviation by Time	Standard Deviation by Seed
			(MM:SS)	(MM:SS)	(MM:SS)
9	Eastbound	12 / 139	01:23	01:01	01:01
10	Westbound	12 / 100	01:02	00:28	00:48



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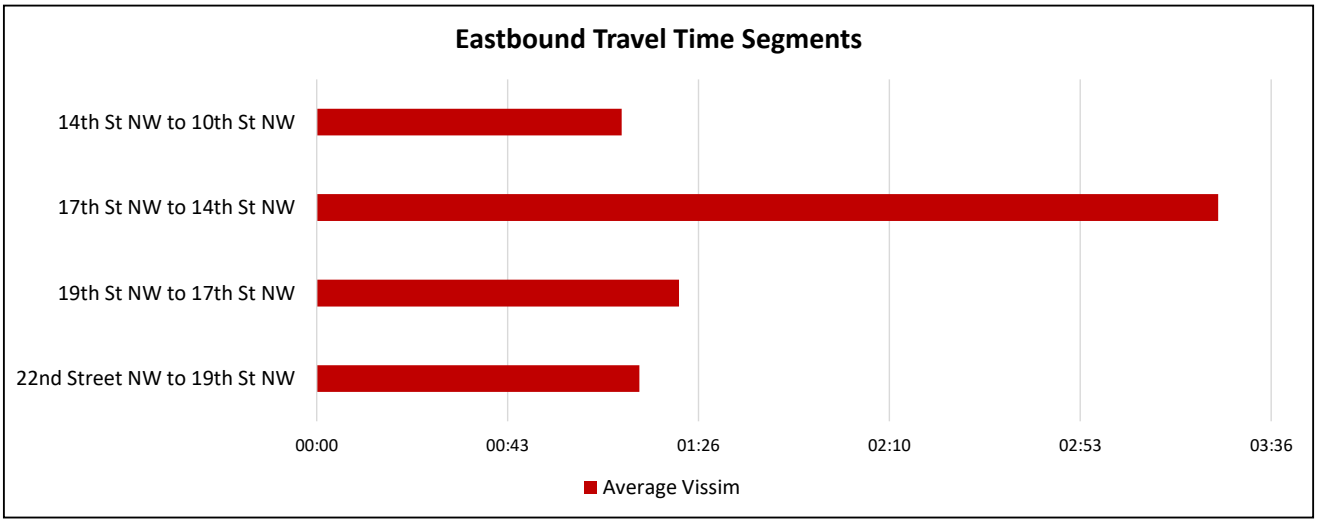
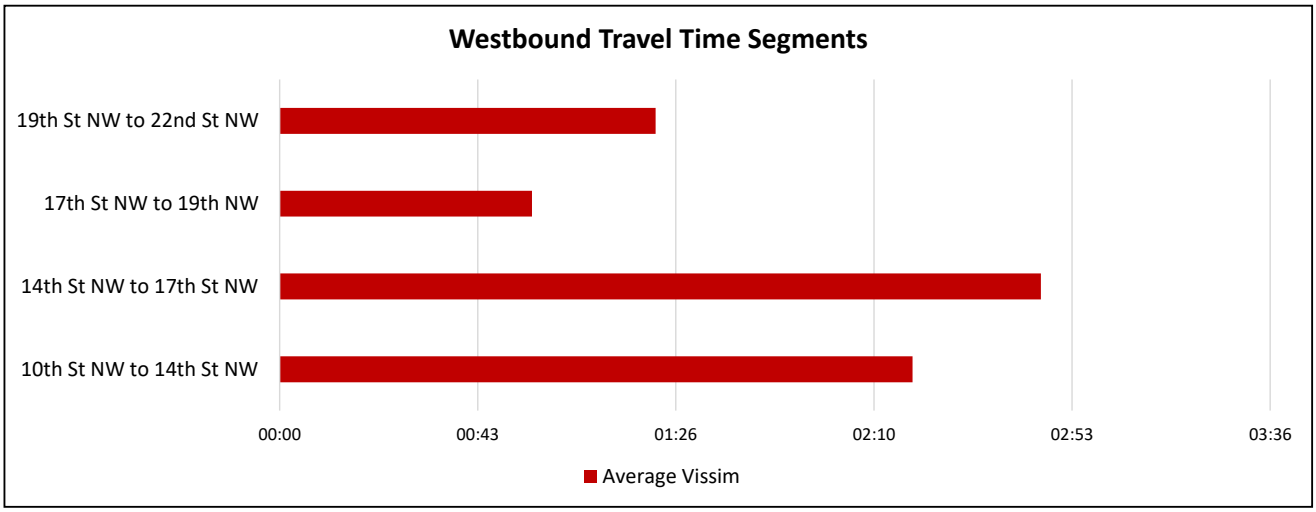
Travel Time | Segment-by-Segment Passenger Cars

AM Peak Period: 8:00AM-10:00AM

Passenger Vehicle Segment-by-Segment Travel Time Comparison					
Segment ID	Route	Vehicle Count	Average Vissim	Standard Deviation by Time[1]	Standard Deviation by Seed[2]
		(MM:SS)	(MM:SS)	(MM:SS)	(MM:SS)
1	22nd Street NW to 19th St NW	1005	01:13	00:04	00:08
2	19th St NW to 17th St NW	931	01:22	00:26	00:26
3	17th St NW to 14th St NW	496	03:24	00:38	00:56
4	14th St NW to 10th St NW	371	01:09	00:03	00:06
Total	**Total Eastbound**	**2803**	**07:08**	**01:10**	**01:36**
5	10th St NW to 14th St NW	495	02:18	00:17	00:34
6	14th St NW to 17th St NW	585	02:46	00:10	00:12
7	17th St NW to 19th NW	873	00:55	00:04	00:06
8	19th St NW to 22nd St NW	646	01:22	00:01	00:04
Total	**Total Westbound**	**2599**	**07:21**	**00:32**	**00:56**

**Results show the average from 10 simulation runs.*





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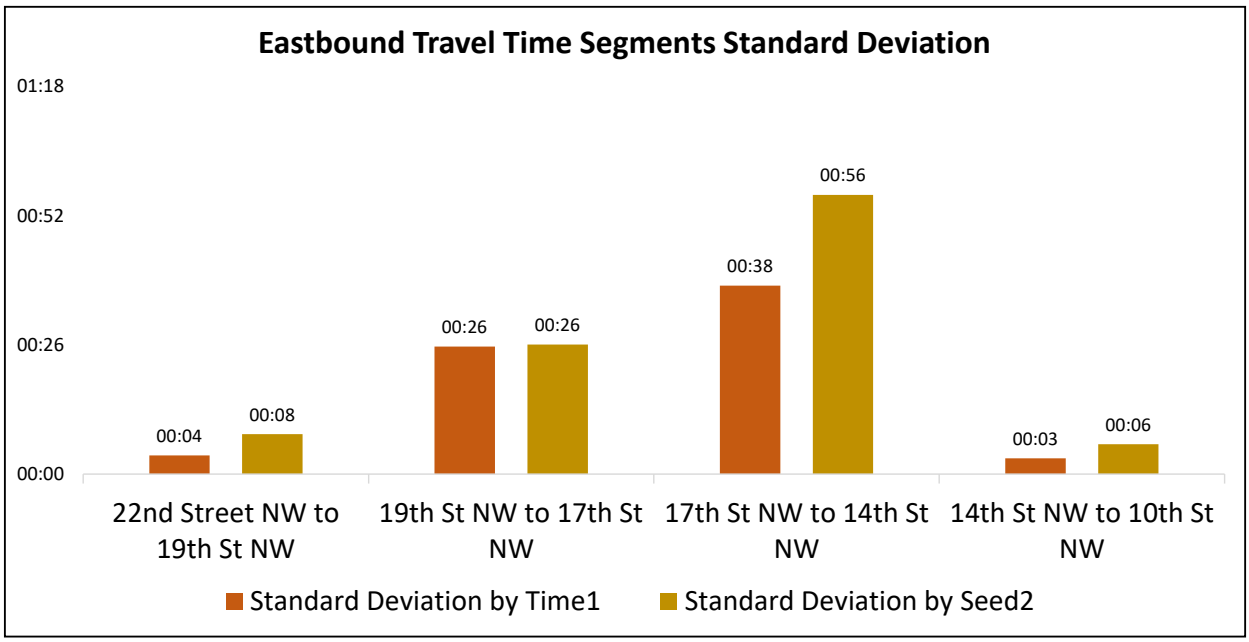
Travel Time | Segment-by-Segment Passenger Cars

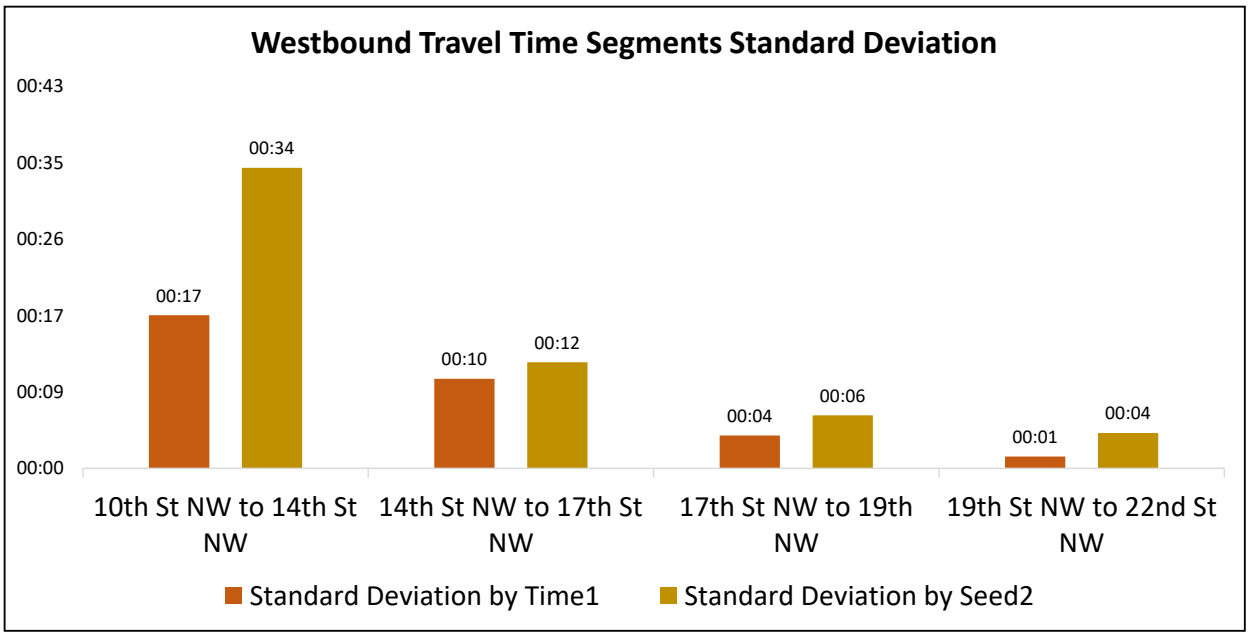
AM Peak Period: 8:00AM-10:00AM

**Travel time results collected throughout the 2-hour peak period at 15-minute intervals.*

[1]Standard deviation by time is standard deviation of the average travel time for all simulation runs in each 15-minute time segment, representing how the average travel time changes throughout the peak period.

[2]Standard deviation by seed is the average standard deviation of travel times for each 15-minute time segment in the peak period, representing the consistency of travel time throughout the peak period.





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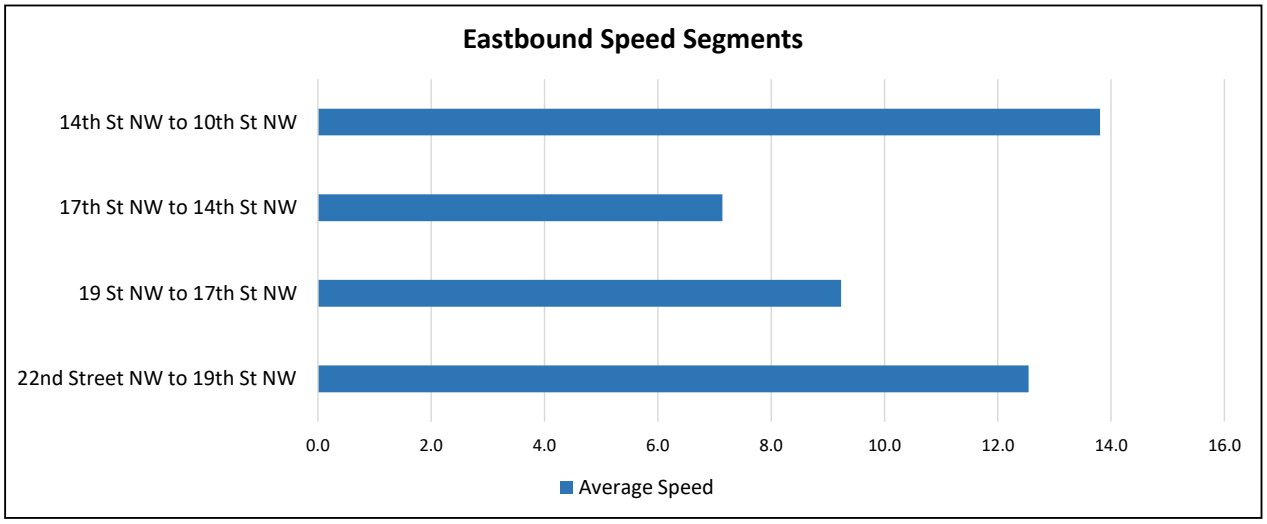
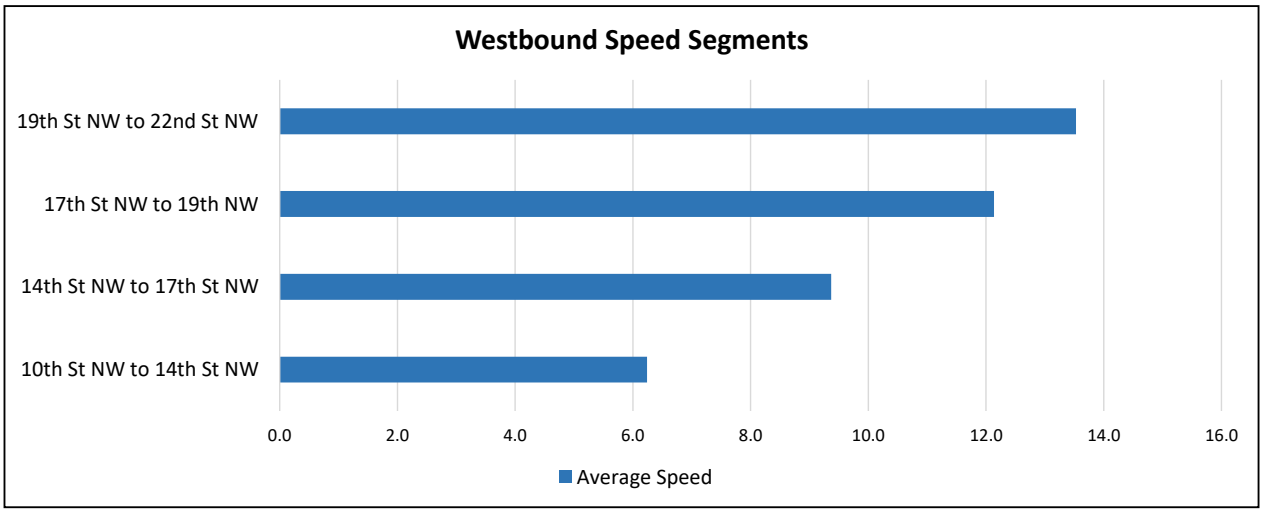
Speed | Segment-by-Segment Passenger Cars

AM Peak Period: 8:00AM-10:00AM

Passenger Vehicle Segment-by-Segment Average Speed Comparison			
Segment ID	Route	Vehicle Count	Average Speed
			MPH
1	22nd Street NW to 19th St NW	1005	12.5
2	19 St NW to 17th St NW	931	9.2
3	17th St NW to 14th St NW	496	7.1
4	14th St NW to 10th St NW	371	13.8
Average Eastbound		**2803**	**10.7**
5	10th St NW to 14th St NW	495	6.2
6	14th St NW to 17th St NW	585	9.4
7	17th St NW to 19th NW	873	12.1
8	19th St NW to 22nd St NW	646	13.5
Average Westbound		**2599**	**10.3**

**Results show the average from 10 simulation runs.*





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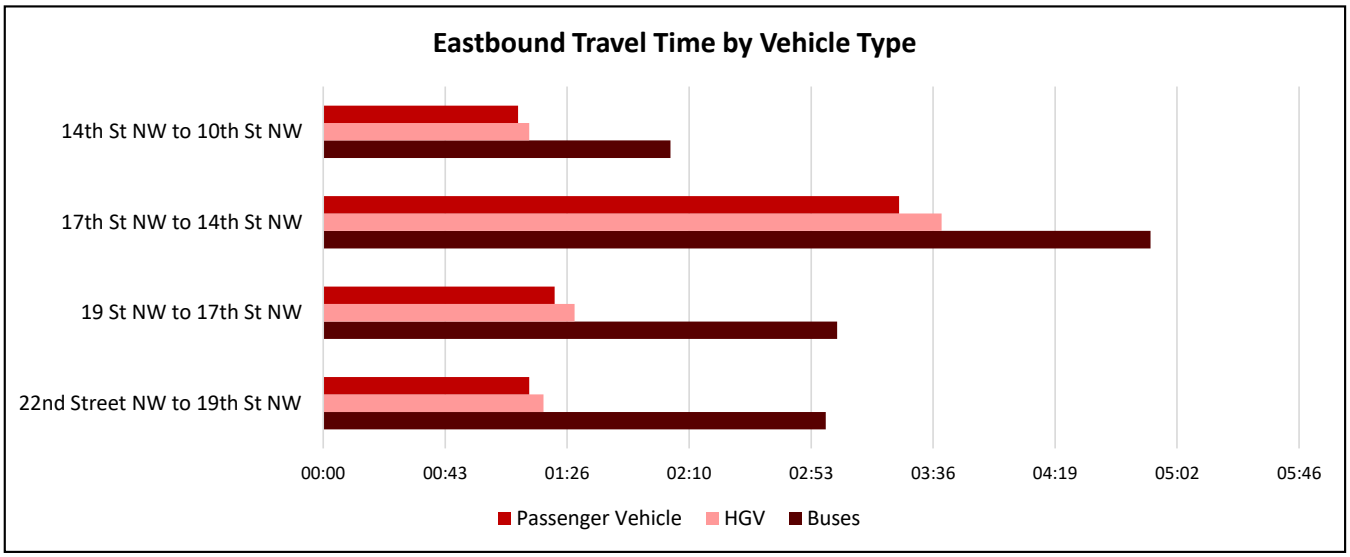
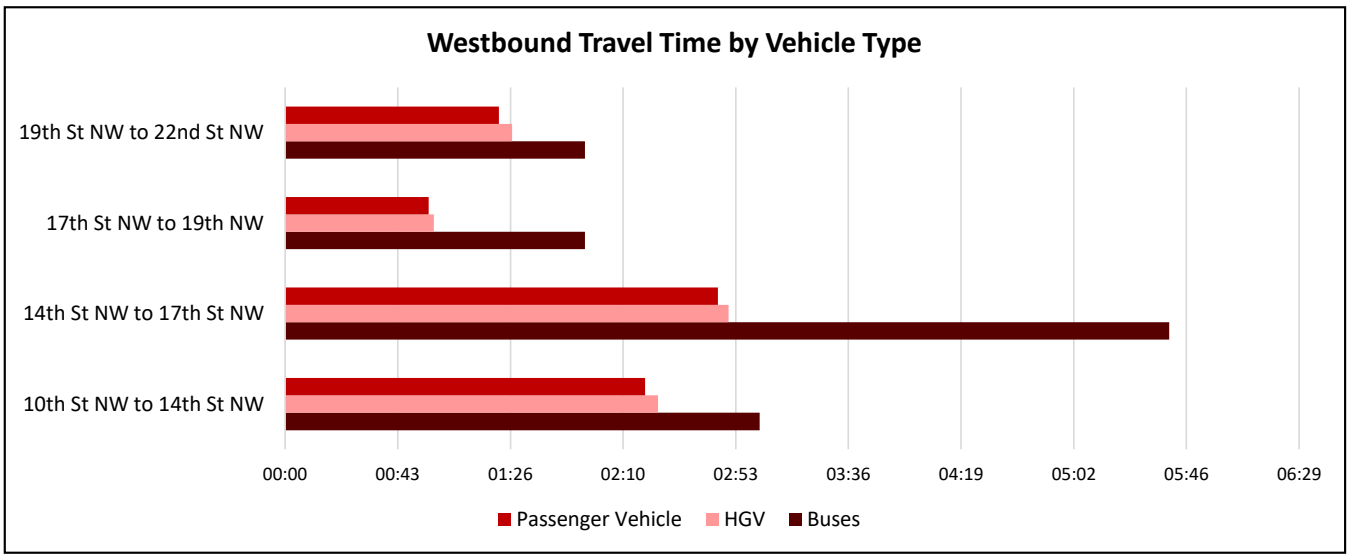
Travel Time | Comparison by Vehicle Type

AM Peak Period: 8:00AM-10:00AM

Travel Time by Vehicle Type				
Segment ID	Route	Passenger Vehicle (MM:SS)	HGV (MM:SS)	Buses (MM:SS)
1	22nd Street NW to 19th St NW	01:13	01:18	02:58
2	19 St NW to 17th St NW	01:22	01:29	03:02
3	17th St NW to 14th St NW	03:24	03:39	04:53
4	14th St NW to 10th St NW	01:09	01:13	02:03
Total	**Total Eastbound**	**07:08**	**07:39**	**12:56**
5	10th St NW to 14th St NW	02:18	02:23	03:02
6	14th St NW to 17th St NW	02:46	02:50	05:39
7	17th St NW to 19th NW	00:55	00:57	01:55
8	19th St NW to 22nd St NW	01:22	01:27	01:55
Total	**Total Westbound**	**07:21**	**07:37**	**12:31**

**Results show the average from 10 simulation runs.*





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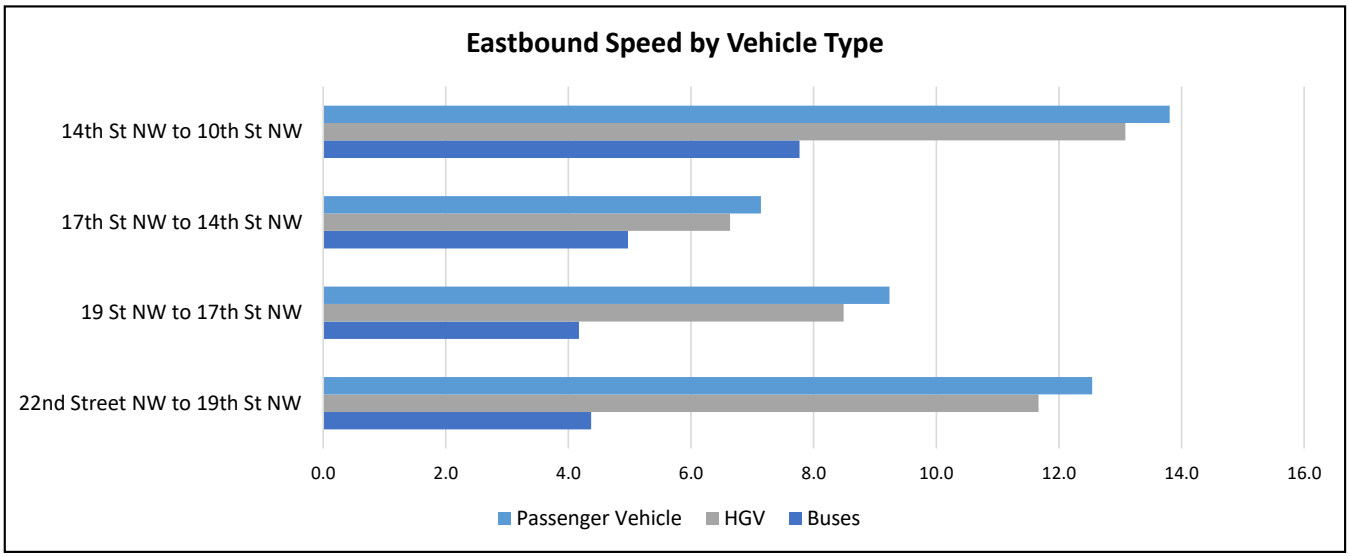
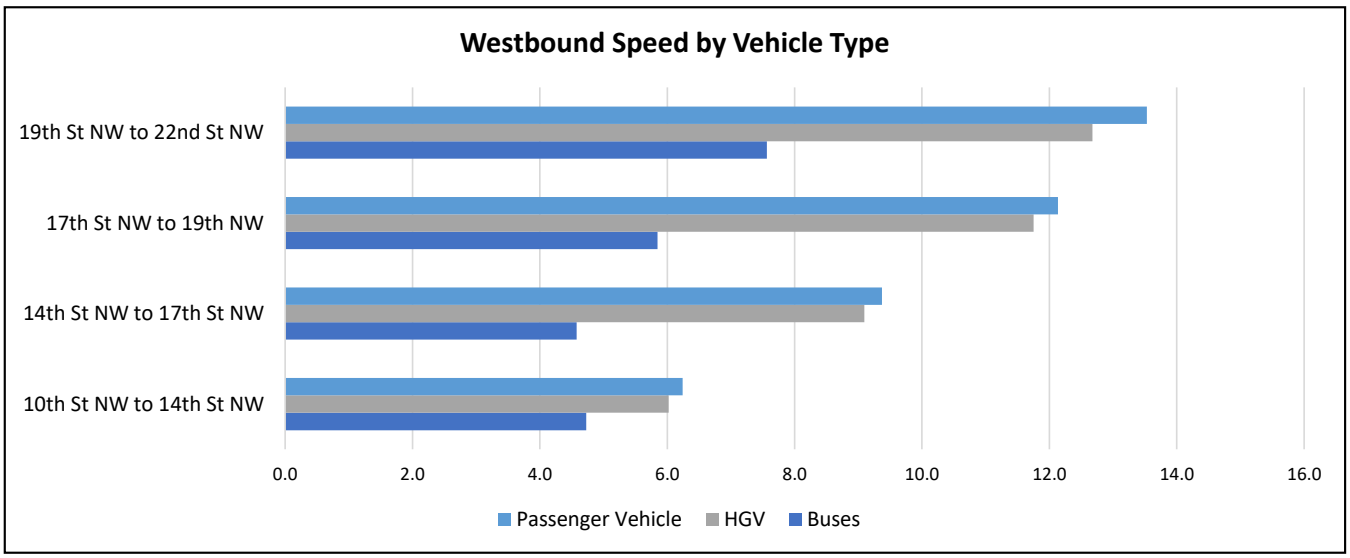
Speed | Comparison by Vehicle Type

AM Peak Period: 8:00AM-10:00AM

Speed by Vehicle Type				
Segment ID	Route	Passenger Vehicle (MM:SS)	HGV (MM:SS)	Buses (MM:SS)
1	22nd Street NW to 19th St NW	12.5	11.7	4.4
2	19 St NW to 17th St NW	9.2	8.5	4.2
3	17th St NW to 14th St NW	7.1	6.6	5.0
4	14th St NW to 10th St NW	13.8	13.1	7.8
Average Eastbound		**10.7**	**10.0**	**5.3**
5	10th St NW to 14th St NW	6.2	6.0	4.7
6	14th St NW to 17th St NW	9.4	9.1	4.6
7	17th St NW to 19th NW	12.1	11.8	5.8
8	19th St NW to 22nd St NW	13.5	12.7	7.6
Average Westbound		**10.3**	**9.9**	**5.7**

**Results show the average from 10 simulation runs.*





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Travel Time | Comparison by Vehicle Type

AM Peak Period: 8:00AM-10:00AM

Number of Vehicles Represented in Travel Time/Speed by Vehicle Type				
Segment ID	Route	Passenger Vehicle	HGV	Buses
		Vehicle Count	Vehicle Count	Vehicle Count
1	22nd Street NW to 19th St NW	1005	52	15
2	19 St NW to 17th St NW	931	51	43
3	17th St NW to 14th St NW	496	28	66
4	14th St NW to 10th St NW	371	22	13
Total	**Total Eastbound**	**2803**	**153**	**137**
5	10th St NW to 14th St NW	495	29	12
6	14th St NW to 17th St NW	585	33	69
7	17th St NW to 19th NW	873	49	105
8	19th St NW to 22nd St NW	646	37	20
Total	**Total Westbound**	**2599**	**148**	**206**

**Total number of vehicles counted in Travel Time runs through the 2-hour peak period.*

GEH of Vehicular Throughput

AM Peak Hour: 8:30AM-9:30AM

GEH Criteria	Value	Percent	Target	Target Met
Total Network Volume with GEH < 4	GEH: 2.5	N/A	4	Yes
Total Network Volume %Difference from Balanced Counts	N/A	1.3%	5%	Yes
85% of individual links below GEH < 5	103 of 103	100%	85%	Yes

Total K Street NW Volume	Sum of balanced counts	Sum of all link flows	Percent Difference	GEH
	34,517	34,976	1.3%	2.5

** Bus volume during peak period added to "Sum of balanced counts"*

Intersection Approaches	Number of Approaches	Number of Segments with GEH < 5	Number of Segments with GEH >5	Percent Compliance
	103	103	0	100%

The GEH statistic is computed using the following formua:

E = Vissim estimated throughput
V = balanced field count:

$$GEH = \sqrt{\frac{(E-V)^2}{(E+V)/2}}$$

Sample Size Determination Tool, Version 2.0

VDOT Virginia Department of Transportation

Step 1: Input number of MOEs (max is 12). Clear out old data.

Step 2: Select type of MOEs

Step 3: Insert simulation results from four random seeds for selected MOEs

User Inputs

Constants

Outputs

Sample Size (N) = Number of Model Runs
Sample Mean (Xs) = (1/N) (X1 + X2 + X3 … + XN)
Sample Standard Deviation (Ss) = √[(Σ(X-Xs)2)/(N-1)]
Sampling Error = t (Ss/√N)
Confidence Level = Xs ± t (Ss/√N)
% of Sample Mean (E) = % Tolerance * Xs Sample Size Needed = [(t)2 * (Ss)2] / (E)2

The "t" statistic is the hypothsized number of standard deviations away from the mean corresponding to the required confidence level and sample size in a t-distribution.

Inputs

Confidence Interval:	95%
Tolerance Error:	10%
Number of MOEs:	10

Output

Number of Required Runs: **10**

*Minimum number of required runs = 10

Location (optional)	EB K Street	WB K Street	EB (17th/18th)	WB (17th/18th)	EB (13th/14th)	WB (13th/14th)	EB (17th/18th)	WB (17th/18th)	EB (13th/14th)	WB (13th/14th)
Runs (Seeds)	***Travel Time***	***Travel Time***	***Volume***	***Volume***	***Volume***	***Volume***	***Speed***	***Speed***	***Speed***	***Speed***
1	342	333	1399	1691	1042	1319	18.7	18.2	24.7	23.4
2	351	330	1423	1689	1091	1318	18.6	18.2	24.8	21.1
3	335	329	1350	1717	1070	1336	17.6	18.5	24.6	22.9
4	333	313	1400	1634	1063	1368	17.6	18.3	24.5	20.8

**Results from four random seeds*

Statistics

X_s	=	340.3	326.2	1393.0	1682.8	1066.5	1335.3	18.1	18.3	24.6	22.0
S_s	=	8.0	8.6	30.7	34.9	20.2	23.3	0.6	0.1	0.1	1.3
E	=	34.0	32.6	139.3	168.3	106.7	133.5	1.8	1.8	2.5	2.2
t	=	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18
Sampling Error	=	12.71	13.75	48.91	55.55	32.15	37.14	0.98	0.23	0.21	2.01
95% Interval Lower	=	327.6	312.4	1344.1	1627.2	1034.3	1298.1	17.2	18.1	24.4	20.0
95% Interval Upper	=	353.0	339.9	1441.9	1738.3	1098.7	1372.4	19.1	18.5	24.8	24.0
% of Sample Mean	=	3.73%	4.22%	3.51%	3.30%	3.01%	2.78%	5.39%	1.26%	0.86%	9.12%
Sample Size Needed	=	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**

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Intersection Queue Lengths

AM Peak Hour: 8:30AM-9:30AM

Intersection		Approach	Storage (ft)	Max Queue Observed (ft)	Vissim Average Queue (ft)	Vissim Max Queue (ft)	Vissim Max Queue			Vissim Average Queue			Is Max Observed Queue between Average and Max Vissim Queue?
							Queue Difference	% Queue Difference (ft)	% Queue Difference wrt Storage Space[1]	Queue Difference	% Queue Difference (ft)	% Queue Difference wrt Storage Space[1]	
1	K Street NW and 22nd Street NW												
2	K Street NW and 21st Street NW	EB	490	147	38	260	113	77%	23%	-109	-74%	-22%	True
		WB	410	82	17	133	51	62%	12%	-65	-79%	-16%	True
		SB	300	90	82	315	225	250%	75%	-8	-9%	-3%	True
3	K Street NW and 20th Street NW	EB	410	328	74	408	80	24%	20%	-254	-77%	-62%	True
		WB	320	320	56	295	-25	-8%	-8%	-264	-83%	-83%	False
4	K Street NW and 19th Street NW	EB	320	288	90	357	69	24%	22%	-198	-69%	-62%	True
		WB	410	41	50	266	225	549%	55%	9	21%	2%	False
5	K Street NW and 18th Street NW	EB	410	205	44	323	118	58%	29%	-161	-78%	-39%	True
		WB	520	208	109	416	208	100%	40%	-99	-48%	-19%	True
6	K Street NW and Connecticut Avenue	EB	520	364	183	544	180	50%	35%	-181	-50%	-35%	True
		WB	145	145	90	268	123	85%	85%	-55	-38%	-38%	True
		NB	310	155	117	330	175	113%	56%	-38	-25%	-12%	True
		SB	315	63	44	252	189	300%	60%	-19	-30%	-6%	True
7	K Street NW and 17th Street NW (east)	EB	145	131	119	324	193	147%	133%	-12	-9%	-8%	True
		WB	460	322	73	375	53	16%	11%	-249	-77%	-54%	True
		NB	310	31	5	56	25	79%	8%	-26	-85%	-8%	True
		SB	315	95	67	241	146	153%	46%	-28	-30%	-9%	True
8	K Street NW and 16th Street NW	EB	460	230	87	334	104	45%	23%	-143	-62%	-31%	True
		WB	450	225	58	241	16	7%	4%	-167	-74%	-37%	True
		NB	300	150	43	202	52	35%	17%	-107	-71%	-36%	True
		SB	305	153	74	272	119	78%	39%	-79	-51%	-26%	True
9	K Street NW and 15th Street NW (west)	EB	450	360	212	534	174	48%	39%	-148	-41%	-33%	True
		WB	160	160	118	317	157	98%	98%	-42	-26%	-26%	True
		SB	330	66	10	114	48	72%	14%	-56	-85%	-17%	True
10	K Street NW and Vermont Avenue	EB	160	64	34	174	110	171%	69%	-30	-46%	-19%	True
		WB	360	144	141	477	333	231%	92%	-3	-2%	-1%	True
		NB	300	120	70	279	159	133%	53%	-50	-42%	-17%	True
		SB	355	71	18	118	47	67%	13%	-53	-75%	-15%	True
11	K Street NW and 14th Street NW	EB	360	108	96	327	219	203%	61%	-12	-11%	-3%	True
		WB	530	371	203	530	159	43%	30%	-168	-45%	-32%	True
		NB	300	300	67	337	37	12%	12%	-233	-78%	-78%	True
		SB	315	252	128	364	112	44%	35%	-124	-49%	-39%	True
12	K Street NW and 13th Street NW	EB	530	212	72	284	72	34%	14%	-140	-66%	-26%	True
		WB	330	165	84	357	192	116%	58%	-81	-49%	-25%	True
		SB	315	126	74	311	185	147%	59%	-52	-41%	-16%	True
13	K Street NW and 12th Street NW	EB	330	99	21	136	37	38%	11%	-78	-79%	-24%	True
		WB	200	60	28	165	105	175%	52%	-32	-54%	-16%	True
14	K Street NW and 11th Street NW	EB	200	80	13	168	88	110%	44%	-67	-84%	-34%	True
		WB	190	171	60	278	107	63%	56%	-111	-65%	-58%	True
		NB	340	306	22	161	-145	-47%	-43%	-284	-93%	-84%	False
		SB	370	333	28	204	-129	-39%	-35%	-305	-92%	-82%	False
15	K Street NW and 10th Street NW	EB	190	171	28	217	46	27%	24%	-143	-84%	-75%	True
		WB	480	48	14	120	72	151%	15%	-34	-70%	-7%	True
		SB	270	54	30	197	143	264%	53%	-24	-45%	-9%	True
16	K Street NW and 9th Street NW	EB	480	96	23	112	16	16%	3%	-73	-76%	-15%	True

[1] *Percent difference with respect to storage space*

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Intersection Queue Lengths - Service Lanes

AM Peak Hour: 8:30AM-9:30AM

Intersection		Approach	Storage (ft)	Max Queue Observed (ft)	Vissim Average Queue (ft)	Vissim Max Queue (ft)	Vissim Max Queue			Vissim Average Queue			Is Max Observed Queue between Average and Max Vissim Queue?
							Queue Difference	% Queue Difference (ft)	% Queue Difference wrt Storage Space[1]	Queue Difference	% Queue Difference (ft)	% Queue Difference wrt Storage Space[1]	
1	K Street NW and 22nd Street NW	EB	40	0	8	203	203	--	508%	8	--	21%	False
		WB	530	106	26	178	72	68%	14%	-80	-76%	-15%	True
2	K Street NW and 21st Street NW	EB	490	490	53	392	-98	-20%	-20%	-437	-89%	-89%	False
		WB	410	82	18	138	56	68%	14%	-64	-78%	-16%	True
3	K Street NW and 20th Street NW	EB	410	82	30	216	134	164%	33%	-52	-63%	-13%	True
		WB	320	192	51	293	101	52%	31%	-141	-73%	-44%	True
4	K Street NW and 19th Street NW	EB	320	160	97	353	193	120%	60%	-63	-39%	-20%	True
		WB	410	41	3	55	14	35%	3%	-38	-93%	-9%	True
5	K Street NW and 18th Street NW	EB	410	82	1	40	-42	-51%	-10%	-81	-98%	-20%	False
		WB	520	156	17	212	56	36%	11%	-139	-89%	-27%	True
6	K Street NW and Connecticut Avenue	EB	520	52	44	186	134	258%	26%	-8	-15%	-2%	True
		WB	145	145	50	216	71	49%	49%	-95	-65%	-65%	True
7	K Street NW and 17th Street NW (east)	WB	460	92	12	142	50	55%	11%	-80	-87%	-17%	True
8	K Street NW and 16th Street NW	EB	460	46	2	63	17	37%	4%	-44	-95%	-10%	True
		WB	450	135	14	163	28	21%	6%	-121	-90%	-27%	True
9	K Street NW and 15th Street NW (west)	EB	450	0	1	37	37	--	8%	1	--	0%	False
		WB	160	160	50	278	118	74%	74%	-110	-69%	-69%	True
10	K Street NW and Vermont Avenue	WB	360	216	35	253	37	17%	10%	-181	-84%	-50%	True
11	K Street NW and 14th Street NW	EB	360	18	4	91	73	406%	20%	-14	-76%	-4%	True
		WB	530	318	34	196	-122	-38%	-23%	-284	-89%	-54%	False
12	K Street NW and 13th Street NW	WB	330	165	22	223	58	35%	18%	-143	-87%	-43%	True
13	K Street NW and 12th Street NW	EB	330	33	0	27	-6	-17%	-2%	-33	-99%	-10%	False

[1] *Percent difference with respect to storage space*

Network Gridlock Check

Inputs

Confidence Interval:	95%
Tolerance Error:	10%

Runs (Seeds)	*Ave Delay PVs*	*Latend Demand*	*Ave Speed PVs*	*Ave Delay Stop PVs*	*Total Delay PVs*	*PVs Active @ End of Simulation*	*Total PVs Arrived*
1	59.71	0	11.2	44.0	2.6	548	42881
2	62.35	14	10.9	45.6	2.7	631	42646
3	57.05	1	11.5	41.8	2.5	581	42593
4	60.88	0	11.1	44.8	2.6	584	42783
5	60.87	0	11.1	45.0	2.6	607	42467
6	57.32	0	11.5	41.9	2.5	592	42739
7	58.81	0	11.3	43.2	2.5	534	42605
8	60.70	0	11.1	44.6	2.6	589	42730
9	56.92	0	11.5	41.7	2.5	560	42702
10	55.96	0	11.6	41.0	2.4	537	42903

Statistics

X_s	=	59.1	1.5	11.3	43.4	2.6	576.3	42704.9
S_s	=	2.2	4.4	0.2	1.7	0.1	31.3	133.6
E	=	5.9	0.2	1.1	4.3	0.3	57.6	4270.5
t	=	3.18	3.18	3.18	3.18	3.18	3.18	3.18
Sampling Error	=	3.43	7.01	0.35	2.63	0.15	49.82	212.64
95% Interval Lower	=	55.6	-5.5	10.9	40.7	2.4	526.5	42492.3
95% Interval Upper	=	62.5	8.5	11.6	46.0	2.7	626.1	42917.5
% of Sample Mean	=	5.81%	467.11%	3.10%	6.06%	5.76%	8.65%	0.50%

Kimley»Horn

Attachment B: PM Existing Conditions Calibration Results

PM Existing Conditions Model Calibration Summary

PM Peak Hour: 4:45PM-5:45PM
PM Peak Period: 4:15PM-6:15PM

Calibration Item	Basis	Criteria	Value	Target	Criteria Met
Simulated Vehicular Throughput (Individual Links)	**All Segments and Approaches**	Within ± 100 vph for < 700 vph	100%	85%	Yes
		Within ± 15% for ≥ 700 vph to < 2,700 vph			
		Within ± 400 vph for ≥ 2,700 vph			
		GEH < 5 for individual link flows	100%	85%	Yes
Simulated Vehicular Throughput (Network Wide)	**Total Volume throughout Network on K Street Corridor**	GEH < 4 for total network volume	2.6	4.0	Yes
		Within 5% of total network volume	-1.4%	5%	Yes
Simulated Travel Time	**Travel Time Segments (n=2)**	Within ± 15% for observed travel times on K Street NW	100%	85%	Yes
Bottleneck and Queue Impact Verification	**Targeted Critical Locations**	Maximum observed queue lengths will be compared with simulated queue lengths at critical intersection approaches. Since full peak period observations of queues were not collected, this comparison will be qualitative.			Yes
Required Sample Size			10		

**Findings Represent Results from 10 Simulation Runs*

Kimley»Horn

Intersection Volume Calibration

PM Peak Hour: 4:45PM-5:45PM

85% of All Intersection Approaches within the following Volume Criteria	Number of Approaches		Passing Approaches		Percent	Target	Target Met
Within ± 100 vph for < 700 vph	67	103	67	103	100%	85%	Yes
Within ± 15% for ≥ 700 vph to < 2,700 vph	36		36				
Within ± 400 vph for ≥ 2,700 vph	0		0				

#	Intersection	Approach	Movement	Balanced Count (vph)		Vissim Throughput (vph)		Difference (vph)		Difference (%)	
1	K Street NW and 22nd Street NW	NB	LT - SL	13	292	11	269	-2	-23	-15%	-8%
			TH	247		226		-21		-9%	
			RT - SL	32		32		0		0%	
		EB	TH	258	258	255	255	-3	-3	-1%	-1%
		WB	TH	1,043	1,043	1,162	1,162	119	119	11%	11%
		EB Service Lane	LT	21	128	21	150	0	22	0%	17%
			TH	107		129		22		21%	
		WB Service Lane	UT	71	342	71	341	0	-1	0%	0%
			TH	179		181		2		1%	
			RT	92		89		-3		-3%	
		Intersection		2,063		2,177		114		6%	
2	K Street NW and 21st Street NW	SB	LT - SL	33	857	31	829	-2	-28	-6%	-3%
			LT	63		68		5		8%	
			TH	516		499		-17		-3%	
			RT	203		191		-12		-6%	
			RT - SL	42		40		-2		-5%	
		EB	TH	258	258	251	251	-7	-7	-3%	-3%
			TH - SL	0		0		0		-	
			RT	0		0		0		-	
		WB	LT	5	1,049	10	1,018	5	-31	100%	-3%
			TH	1,000		967		-33		-3%	
			TH - SL	44		41		-3		-7%	
		EB Service Lane	TH - ML	44	233	46	251	2	18	5%	8%
			TH	83		96		13		16%	
			RT	106		109		3		3%	
		WB Service Lane	TH - ML	1	215	2	216	1	1	100%	0%
			TH	214		214		0		0%	
		Intersection		2,612		2,565		-47		-2%	
3	K Street NW and 20th Street NW	NB	LT - SL	11	639	9	666	-2	27	-18%	4%
			LT	122		125		3		2%	
			TH	385		391		6		2%	
			RT	62		83		21		34%	
			RT - SL	59		58		-1		-2%	
		EB	LT	18	392	17	408	-1	16	-6%	4%
			TH	369		387		18		5%	
			TH - SL	5		4		-1		-20%	
		WB	TH	874	885	842	851	-32	-34	-4%	-4%
			TH - SL	5		4		-1		-20%	
			RT	6		5		-1		-17%	
		EB Service Lane	TH - ML	3	74	3	71	0	-3	0%	-4%
			TH	71		68		-3		-4%	
		WB Service Lane	TH - ML	1	217	1	219	0	2	0%	1%
			TH	40		43		3		8%	
			RT	176		175		-1		-1%	
		Intersection		2,207		2,215		8		0%	

#	Intersection	Approach	Movement	Balanced Count (vph)		Vissim Throughput (vph)		Difference (vph)		Difference (%)	
4	K Street NW and 19th Street NW	SB	LT - SL	6	881	7	892	1	11	17%	1%
			LT	54		54		0		0%	
			TH	683		691		8		1%	
			RT	74		76		2		3%	
			RT - SL	64		64		0		0%	
		EB	TH	429	438	466	474	37	36	9%	8%
			TH - SL	6		5		-1		-17%	
			RT	3		3		0		0%	
		WB	LT	18	869	32	851	14	-18	78%	-2%
			TH	825		791		-34		-4%	
			TH - SL	26		28		2		8%	
		EB Service Lane	TH - ML	0	216	0	219	0	3	-	1%
			TH	40		37		-3		-8%	
			RT	176		182		6		3%	
		WB Service Lane	TH	102	102	100	100	-2	-2	-2%	-2%
		Intersection		2,506		2,536		30		1%	
5	K Street NW and 18th Street NW	NB	LT - SL	1	725	1	750	0	25	0%	3%
			LT	131		135		4		3%	
			TH	486		501		15		3%	
			RT	70		75		5		7%	
			RT - SL	37		38		1		3%	
		EB	LT	1	476	1	504	0	28	0%	6%
			TH	467		496		29		6%	
			TH - SL	8		7		-1		-13%	
		WB	TH	811	813	786	788	-25	-25	-3%	-3%
			TH - SL	1		1		0		0%	
			RT	1		1		0		0%	
		EB Service Lane	TH - ML	3	49	3	47	0	-2	0%	-4%
			TH	46		44		-2		-4%	
		WB Service Lane	TH	10	104	10	101	0	-3	0%	-3%
			RT	94		91		-3		-3%	
		Intersection		2,167		2,190		23		1%	
6	K Street NW and Connecticut Avenue	NB	TH	589	647	621	682	32	35	5%	5%
			RT	56		61		5		9%	
		SB	LT - SL	12	879	12	793	0	-86	0%	-10%
			TH	712		645		-67		-9%	
			RT	74		62		-12		-16%	
			RT - SL	81		74		-7		-9%	
		EB	LT	1	729	1	743	0	14	0%	2%
			TH	728		742		14		2%	
			TH - SL	0		0		0		-	
		WB	LT	28	933	26	915	-2	-18	-7%	-2%
			TH	807		794		-13		-2%	
			TH - SL	96		93		-3		-3%	
			RT	2		2		0		0%	
		EB Service Lane	TH - ML	0	135	0	120	0	-15	-	-11%
			RT	135		120		-15		-11%	
		WB Service Lane	RT	188	188	186	186	-2	-2	-1%	-1%
		Intersection		3,511		3,439		-72		-2%	

#	Intersection	Approach	Movement	Balanced Count (vph)		Vissim Throughput (vph)		Difference (vph)		Difference (%)	
7	K Street NW and 17th Street NW (east)	NB	LT - SL	9	181	9	185	0	4	0%	2%
			LT	28		31		3		11%	
			TH	120		122		2		2%	
			RT	10		10		0		0%	
			RT - SL	14		13		-1		-7%	
		SB	LT - SL	3	329	3	326	0	-3	0%	-1%
			LT	38		38		0		0%	
			TH	169		168		-1		-1%	
			RT	90		85		-5		-6%	
			RT - SL	29		32		3		10%	
		EB	LT	2	796	2	815	0	19	0%	2%
			TH	706		722		16		2%	
			TH - SL	16		16		0		0%	
			RT	72		75		3		4%	
		WB	LT	0	852	0	831	0	-21	-	-2%
			TH	813		794		-19		-2%	
			TH - SL	39		37		-2		-5%	
		WB Service Lane	TH - ML	2	183	2	181	0	-2	0%	-1%
			TH	111		108		-3		-3%	
			RT	70		71		1		1%	
		Intersection		2,341		2,338		-3		0%	
8	K Street NW and 16th Street NW	NB	LT - SL	0	330	0	320	0	-10	-	-3%
			LT	8		9		1		13%	
			TH	280		269		-11		-4%	
			RT	23		24		1		4%	
			RT - SL	19		18		-1		-5%	
		SB	LT	113	551	118	560	5	9	4%	2%
			TH	331		340		9		3%	
			RT	70		65		-5		-7%	
			RT - SL	35		35		0		0%	
		EB	LT	6	615	9	632	3	17	50%	3%
			TH	606		619		13		2%	
			TH - SL	3		4		1		33%	
			RT	0		0		0		-	
		WB	TH	607	661	606	660	-1	-1	0%	0%
			TH - SL	53		53		0		0%	
			RT	0		0		0		-	
		EB Service Lane	TH - ML	2	42	3	42	1	0	50%	0%
			TH	3		3		0		0%	
			RT	37		36		-1		-3%	
		WB Service Lane	TH - ML	2	237	2	240	0	3	0%	1%
			TH	77		73		-4		-5%	
			RT	158		165		7		4%	
		Intersection		2,436		2,454		18		1%	
9	K Street NW and 15th Street NW (west)	NB	LT - SL	8	374	7	380	-1	6	-13%	2%
			LT	40		43		3		8%	
			TH	310		309		-1		0%	
			RT	16		21		5		31%	
		SB	LT	8	244	11	288	3	44	38%	18%
			TH	148		176		28		19%	
			RT	64		73		9		14%	
			RT - SL	24		28		4		17%	
		EB	LT	1	823	1	812	0	-11	0%	-1%
			TH	805		811		6		1%	
			TH - SL	17		0		-17		-100%	
		WB	LT	50	886	46	874	-4	-12	-8%	-1%
			TH	770		749		-21		-3%	
			TH - SL	57		66		9		16%	
			RT	9		13		4		44%	
		EB Service Lane	TH - ML	0	18	0	18	0	0	-	0%
			RT	18		18		0		0%	
		WB Service Lane	TH	34	186	32	187	-2	1	-6%	1%
			RT	152		155		3		2%	
		Intersection		2,531		2,559		28		1%	

#	Intersection	Approach	Movement	Balanced Count (vph)		Vissim Throughput (vph)		Difference (vph)		Difference (%)	
10	K Street NW and Vermont Avenue	NB	LT - SL	19	279	21	280	2	1	11%	0%
			LT	73		71		-2		-3%	
			TH	135		136		1		1%	
			RT	30		28		-2		-7%	
			RT - SL	22		24		2		9%	
		SB	LT - SL	33	170	30	141	-3	-29	-9%	-17%
			LT	47		41		-6		-13%	
			RT	62		48		-14		-23%	
			RT - SL	28		22		-6		-21%	
		EB	LT	84	829	77	839	-7	10	-8%	1%
			TH	673		689		16		2%	
			TH - SL	72		73		1		1%	
		WB	TH	750		758		8		1%	
			TH - SL	32	782	33	791	1	9	3%	1%
			RT	0		0		0		-	
		WB Service Lane	TH - ML	1	176	1	173	0	-3	0%	-2%
			TH	112		111		-1		-1%	
			RT	63		61		-2		-3%	
	Intersection			2,236		2,224		-12		-1%	
11	K Street NW and 14th Street NW	NB	LT - SL	27	729	28	778	1	49	4%	7%
			LT	98		111		13		13%	
			TH	565		598		33		6%	
			RT	39		41		2		5%	
		SB	LT	28	710	27	702	-1	-8	-4%	-1%
			TH	629		626		-3		0%	
			RT	23		21		-2		-9%	
			RT - SL	30		28		-2		-7%	
		EB	LT	4	681	4	695	0	14	0%	2%
			TH	658		671		13		2%	
			RT	19		20		1		5%	
		WB	LT	3	677	4	679	1	2	33%	0%
			TH	660		662		2		0%	
			TH - SL	12		11		-1		-8%	
			RT	2		2		0		0%	
		EB Service Lane	TH - ML	6	202	6	204	0	2	0%	1%
			RT	196		198		2		1%	
		WB Service Lane	TH	116	183	115	180	-1	-3	-1%	-2%
			RT	66		64		-2		-3%	
	Intersection			3,182		3,238		56		2%	
12	K Street NW and 13th Street NW	NB	LT - SL	18	678	18	702	0	24	0%	4%
			LT	170		181		11		6%	
			TH	473		485		12		3%	
			RT	14		15		1		7%	
			RT - SL	3		3		0		0%	
		SB	LT	26	694	25	705	-1	11	-4%	2%
			TH	552		568		16		3%	
			RT	74		71		-3		-4%	
			RT - SL	42		41		-1		-2%	
		EB	TH	625	731	621	739	-4	8	-1%	1%
			RT	91		104		13		14%	
		WB	LT	1	485	1	495	0	10	0%	2%
			TH	463		473		10		2%	
			TH - SL	19		19		0		0%	
			RT	2		2		0		0%	
		WB Service Lane	TH - ML	4	102	4	102	0	0	0%	0%
			TH	52		51		-1		-2%	
			RT	46		47		1		2%	
	Intersection			2,690		2,743		53		2%	

#	Intersection	Approach	Movement	Balanced Count (vph)		Vissim Throughput (vph)		Difference (vph)		Difference (%)	
13	K Street NW and 12th Street NW	NB	LT - SL	41	883	40	866	-1	-17	-2%	-2%
			LT	160		163		3		2%	
			TH	606		593		-13		-2%	
			RT	76		70		-6		-8%	
		EB	LT	142	652	133	650	-9	-2	-6%	0%
			TH	510		517		7		1%	
		WB	TH	308	418	320	426	12	8	4%	2%
			TH - SL	61		57		-4		-7%	
			RT	49		49		0		0%	
		EB Service Lane	TH - ML	3	3	2	2	-1	-1	-33%	-33%
		Intersection		1,956		1,944		-12		-1%	
14	K Street NW and 11th Street NW	NB	LT	152	442	157	443	5	1	3%	0%
			TH	239		238		-1		0%	
			RT	51		48		-3		-6%	
		SB	LT	34	538	32	530	-2	-8	-6%	-1%
			TH	437		427		-10		-2%	
			RT	67		71		4		6%	
		EB	LT	67	548	61	549	-6	1	-9%	0%
			TH	342		324		-18		-5%	
			RT	139		164		25		18%	
		WB	LT	13	225	13	223	0	-2	0%	-1%
			TH	192		190		-2		-1%	
			RT	20		20		0		0%	
		Intersection		1,753		1,745		-8		0%	
15	K Street NW and 10th Street NW	SB	LT	32	445	33	436	1	-9	3%	-2%
			TH	302		293		-9		-3%	
			RT	111		110		-1		-1%	
		EB	TH	180	444	168	421	-12	-23	-7%	-5%
			RT	264		253		-11		-4%	
		WB	LT	37	132	36	130	-1	-2	-3%	-2%
			TH	95		94		-1		-1%	
		Intersection		1,021		987		-34		-3%	
16	K Street NW and 9th Street NW	SB	TH	781	864	804	884	23	20	3%	2%
			RT	83		80		-3		-4%	
		EB	RT	182	182	173	173	-9	-9	-5%	-5%
		Intersection		1,046		1,057		11		1%	
17	L Street NW and 21st Street NW	SB	LT	188	880	192	878	4	-2	2%	0%
			TH	692		686		-6		-1%	
		EB	TH	492	657	483	639	-9	-18	-2%	-3%
			RT	165		156		-9		-5%	
		Intersection		1,537		1,517		-20		-1%	
18	Pennsylvania Avenue NW and 21st Street NW	SB	LT	142	627	139	614	-3	-13	-2%	-2%
			TH	394		386		-8		-2%	
			RT	91		89		-2		-2%	
		EB	TH	554	654	563	662	9	8	2%	1%
			RT	100		99		-1		-1%	
		WB	LT	267	825	264	839	-3	14	-1%	2%
			TH	558		575		17		3%	
		Intersection		2,106		2,115		9		0%	
19	L Street NW and Connecticut Avenue	NB	TH	689	780	723	812	34	32	5%	4%
			RT	91		89		-2		-2%	
		SB	TH	750	750	695	695	-55	-55	-7%	-7%
		EB	LT	151	1,068	146	1,051	-5	-17	-3%	-2%
			TH	788		779		-9		-1%	
			RT	129		126		-3		-2%	
		Intersection		2,598		2,558		-40		-2%	
20	I Street NW and 17th Street NW (west)	NB	LT	58	591	59	617	1	26	2%	4%
			TH	533		558		25		5%	
		SB	TH	803	881	724	793	-79	-88	-10%	-10%
			RT	78		69		-9		-12%	
		WB	LT	442	1,148	443	1,171	1	23	0%	2%
			TH	592		594		2		0%	
			RT	114		134		20		18%	
		Intersection		2,620		2,581		-39		-1%	

#	Intersection	Approach	Movement	Balanced Count (vph)		Vissim Throughput (vph)		Difference (vph)		Difference (%)	
21	L Street NW and 16th Street NW	NB	TH	377	444	371	437	-6	-7	-2%	-2%
			RT	67		66		-1		-1%	
		SB	LT	103	563	103	573	0	10	0%	2%
			TH	460		470		10		2%	
		EB	LT	214	967	215	964	1	-3	0%	0%
			TH	662		657		-5		-1%	
			RT	91		92		1		1%	
		Intersection		1,974		1,974		0		0%	
22	I Street NW and 16th Street NW	NB	LT	32	207	32	201	0	-6	0%	-3%
			TH	175		169		-6		-3%	
		SB	TH	165	369	167	377	2	8	1%	2%
			RT	204		210		6		3%	
		WB	LT	77	965	80	1,000	3	35	4%	4%
			TH	733		765		32		4%	
			RT	155		155		0		0%	
		Intersection		1,541		1,578		37		2%	
23	L Street NW and 15th Street NW (west)	NB	TH	432	472	434	474	2	2	0%	0%
			RT	40		40		0		0%	
		SB	LT	59	211	58	192	-1	-19	-2%	-9%
			TH	152		134		-18		-12%	
		EB	LT	225	1,052	173	1,057	-52	5	-23%	0%
			TH	735		719		-16		-2%	
			RT	92		165		73		79%	
		Intersection		1,735		1,723		-12		-1%	
24	L Street NW and 14th Street NW	NB	TH	518	637	538	657	20	20	4%	3%
			RT	119		119		0		0%	
		SB	LT	77	622	78	630	1	8	1%	1%
			TH	545		552		7		1%	
		EB	LT	71	961	68	950	-3	-11	-4%	-1%
			TH	725		724		-1		0%	
			RT	165		158		-7		-4%	
		Intersection		2,220		2,237		17		1%	
25	I Street NW and 14th Street NW	NB	LT	254	941	256	964	2	23	1%	2%
			TH	687		708		21		3%	
		SB	TH	785	847	754	814	-31	-33	-4%	-4%
			RT	62		60		-2		-3%	
		WB	LT	128	777	127	832	-1	55	-1%	7%
			TH	607		633		26		4%	
			RT	42		72		30		71%	
		Intersection		2,565		2,610		45		2%	

**Results show the average from 10 simulation runs.*

Intersection Delay and Estimated LOS

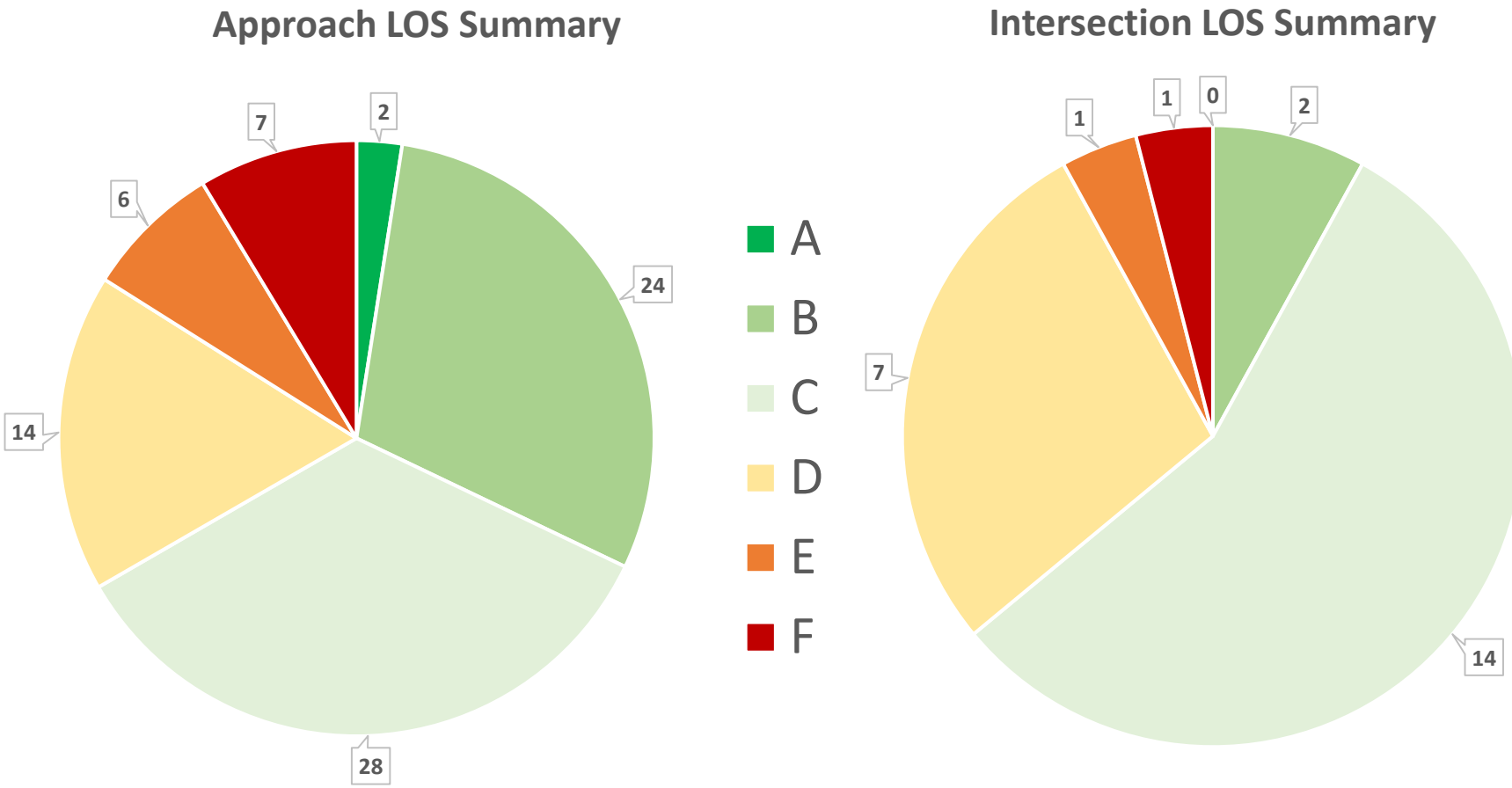
PM Peak Hour: 4:45PM-5:45PM

#	Intersection	Approach	Average Delay (sec/veh)	Approach LOS	Intersection Delay	Intersection LOS
1	K Street NW and 22nd Street NW	NB	29.2	C	32.8	C
		SB	-	-		
		EB Service Lane	10.2	B		
		WB Service Lane	34.2	C		
2	K Street NW and 21st Street NW	NB	-	-	43.7	D
		SB	59.6	E		
		EB	15.8	B		
		WB	44.7	D		
3	K Street NW and 20th Street NW	NB	37.3	D	20.0	C
		SB	-	-		
		EB	13.9	B		
		WB	12.0	B		
4	K Street NW and 19th Street NW	NB	-	-	25.2	C
		SB	33.7	C		
		EB	15.4	B		
		WB	14.7	B		
5	K Street NW and 18th Street NW	NB	28.6	C	21.0	C
		SB	-	-		
		EB	15.7	B		
		WB	18.9	B		
6	K Street NW and Connecticut Avenue	NB	21.5	C	45.7	D
		SB	97.6	F		
		EB	33.9	C		
		WB	11.8	B		
7	K Street NW and 17th Street NW (east)	NB	31.6	C	26.5	C
		SB	38.1	D		
		EB	17.8	B		
		WB	30.9	C		
8	K Street NW and 16th Street NW	NB	40.8	D	25.4	C
		SB	14.7	B		
		EB	35.2	D		
		WB	19.2	B		
9	K Street NW and 15th Street NW (west)	NB	28.5	C	45.5	D
		SB	93.4	F		
		EB	60.8	E		
		WB	30.2	C		
10	K Street NW and Vermont Avenue	NB	44.8	D	50.0	D
		SB	201.6	F		
		EB	34.1	C		
		WB	49.0	D		
11	K Street NW and 14th Street NW	NB	25.4	C	43.5	D
		SB	52.6	D		
		EB	38.1	D		
		WB	70.7	E		
12	K Street NW and 13th Street NW	NB	22.5	C	25.1	C
		SB	35.9	D		
		EB	18.2	B		
		WB	24.5	C		

#	Intersection	Approach	Average Delay (sec/veh)	Approach LOS	Intersection Delay	Intersection LOS
13	K Street NW and 12th Street NW	NB	55.4	E	32.8	C
		SB	-	-		
		EB	12.1	B		
		WB	18.2	B		
14	K Street NW and 11th Street NW	NB	28.7	C	20.9	C
		SB	30.4	C		
		EB	9.2	A		
		WB	11.5	B		
15	K Street NW and 10th Street NW	NB	-	-	21.4	C
		SB	26.9	C		
		EB	16.7	B		
		WB	18.3	B		
16	K Street NW and 9th Street NW	NB	-	-	13.5	B
		SB	5.0	A		
		EB	56.7	E		
		WB	-	-		
17	L Street NW and 21st Street NW	NB	-	-	31.8	C
		SB	32.4	C		
		EB	30.9	C		
		WB	-	-		
18	Pennsylvania Avenue NW and 21st Street NW	NB	-	-	92.3	F
		SB	16.7	B		
		EB	46.9	D		
		WB	183.4	F		
19	L Street NW and Connecticut Avenue	NB	20.5	C	45.0	D
		SB	104.9	F		
		EB	24.4	C		
		WB	-	-		
20	I Street NW and 17th Street NW (west)	NB	26.5	C	66.9	E
		SB	135.4	F		
		EB	-	-		
		WB	41.8	D		
21	L Street NW and 16th Street NW	NB	11.4	B	20.5	C
		SB	25.4	C		
		EB	21.7	C		
		WB	-	-		
22	I Street NW and 16th Street NW	NB	17.9	B	26.0	C
		SB	38.8	D		
		EB	-	-		
		WB	22.8	C		
23	L Street NW and 15th Street NW (west)	NB	16.4	B	18.9	B
		SB	70.0	E		
		EB	10.7	B		
		WB	-	-		
24	L Street NW and 14th Street NW	NB	12.7	B	20.5	C
		SB	23.2	C		
		EB	24.0	C		
		WB	-	-		
25	I Street NW and 14th Street NW	NB	21.3	C	45.4	D
		SB	80.5	F		
		EB	-	-		
		WB	39.0	D		

Intersection Delay and Estimated LOS

PM Peak Hour: 4:45PM-5:45PM



Approach LOS	A	B	C	D	E	F
	2	24	28	14	6	7

Intersection LOS	A	B	C	D	E	F
	0	2	14	7	1	1

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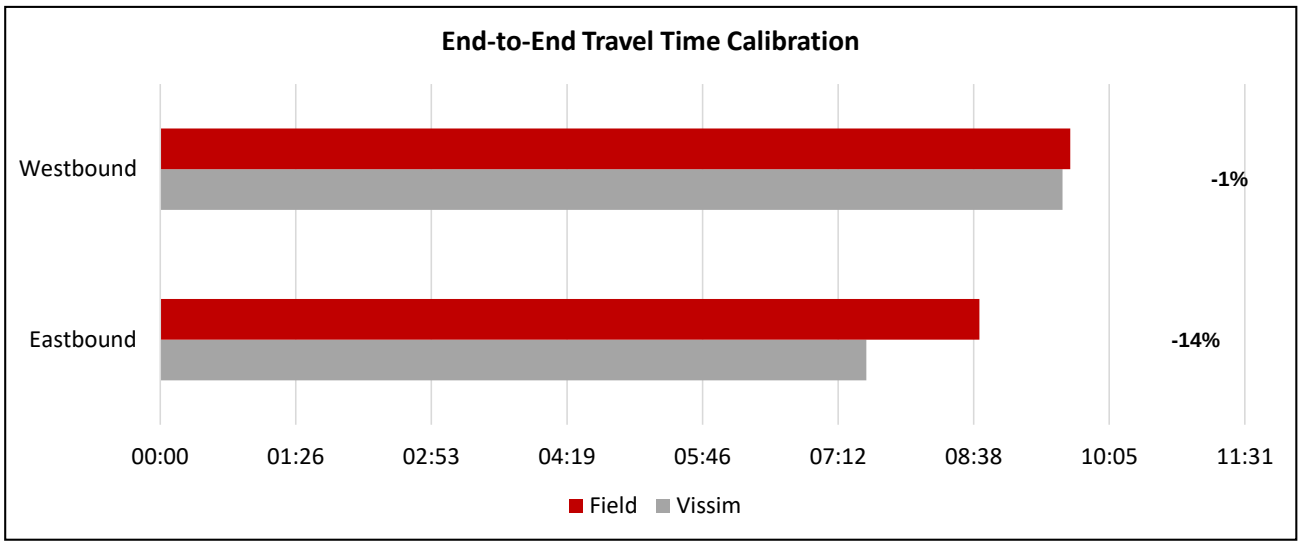
Travel Time | End-to-End Passenger Cars

PM Peak Period: 4:15PM-6:15PM

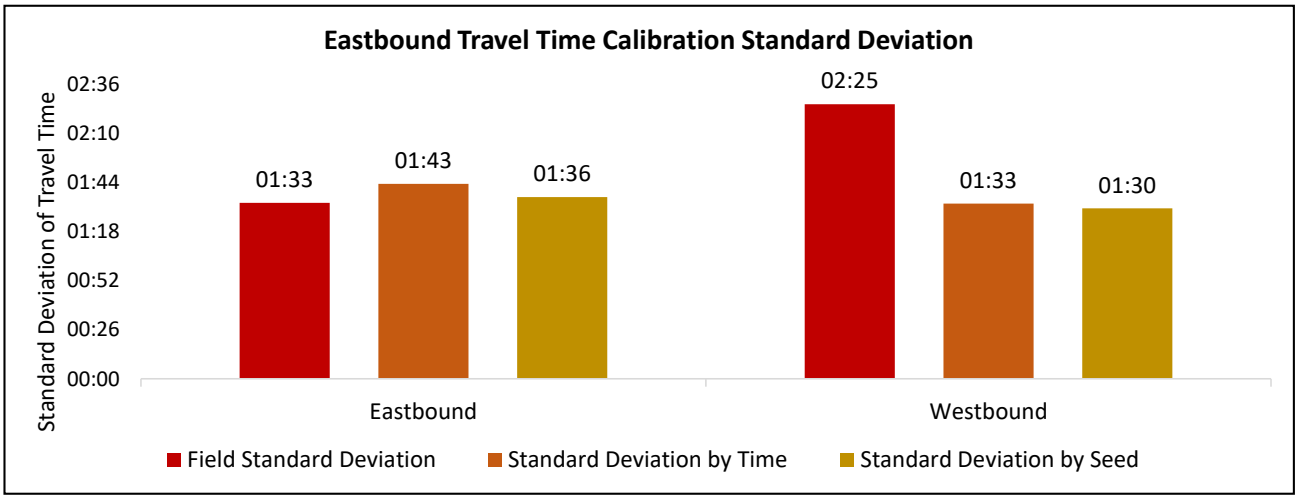
Travel Time Criteria	Number of Segments Passing	Percent	Target	Target Met
85% of Travel Time Segments Within ± 15% for observed travel times on K Street NW	2 of 2	100%	85%	Yes

Passenger Vehicle Travel Time Calibration					
Segment ID	Route	Field	Vissim	Difference	
		(MM:SS)	(MM:SS)	(MM:SS)	(%)
9	Eastbound	08:42	07:30	-01:12	-14%
10	Westbound	09:40	09:35	-00:05	-1%

**Results show the average from 10 simulation runs.*



Passenger Vehicle Travel Time Statistics					
Segment ID	Route	Field/Vissim Vehicle Count	Field Standard Deviation	Standard Deviation by Time	Standard Deviation by Seed
			(MM:SS)	(MM:SS)	(MM:SS)
9	Eastbound	12 / 102	01:33	01:43	01:36
10	Westbound	13 / 199	02:25	01:33	01:30



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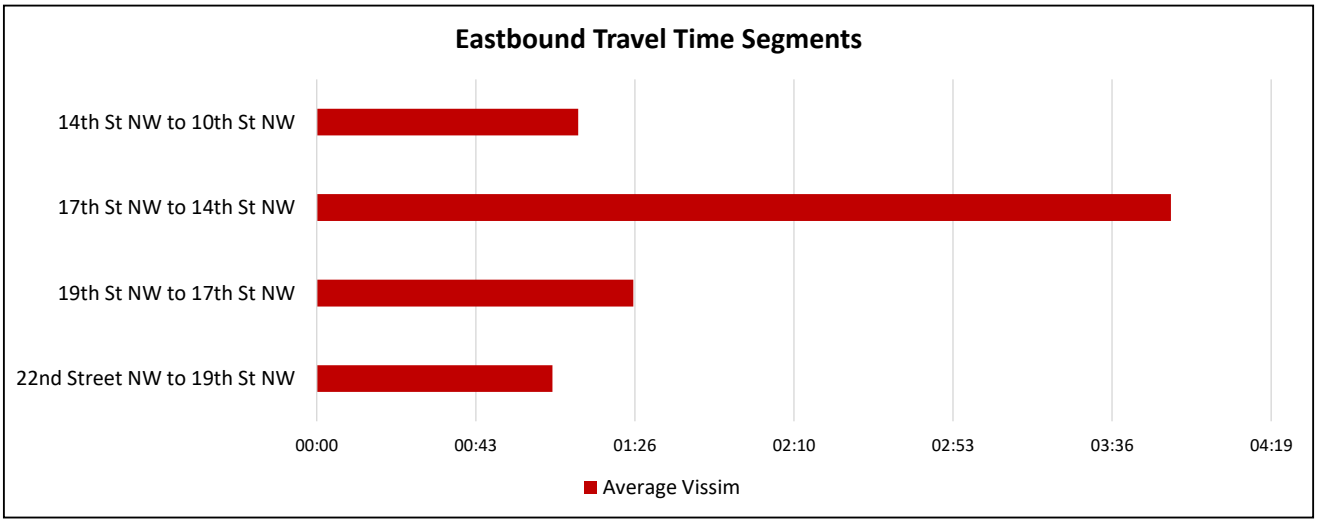
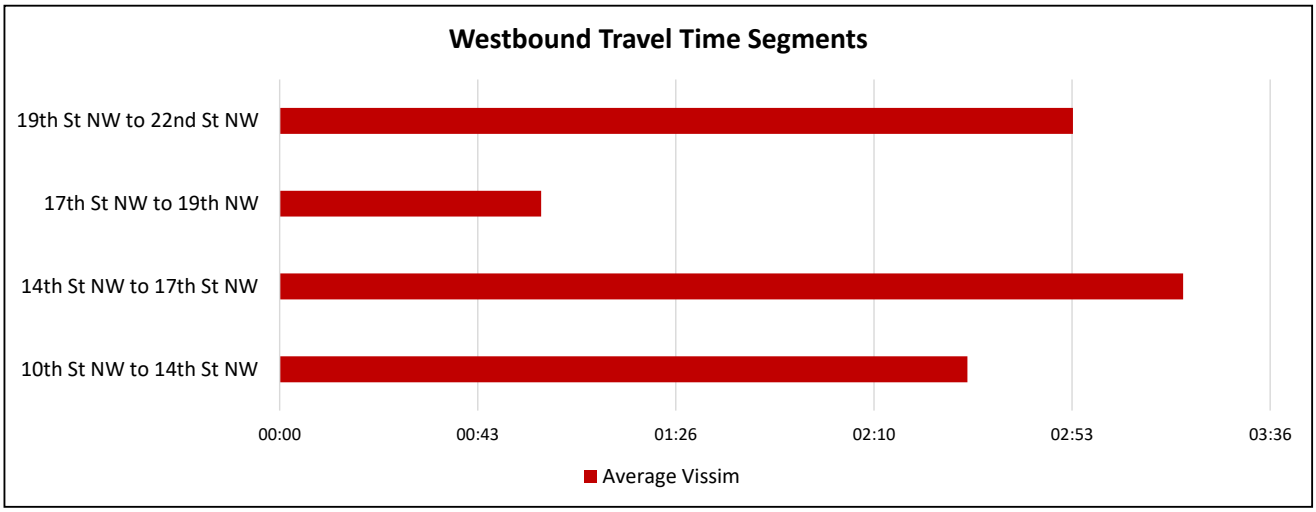
Travel Time | Segment-by-Segment Passenger Cars

PM Peak Period: 4:15PM-6:15PM

Passenger Vehicle Segment-by-Segment Travel Time Comparison					
Segment ID	Route	Vehicle Count	Average Vissim	Standard Deviation by Time[1]	Standard Deviation by Seed[2]
		(MM:SS)	(MM:SS)	(MM:SS)	(MM:SS)
1	22nd Street NW to 19th St NW	395	01:04	00:04	00:07
2	19th St NW to 17th St NW	710	01:26	00:39	00:40
3	17th St NW to 14th St NW	649	03:52	01:14	01:16
4	14th St NW to 10th St NW	706	01:11	00:03	00:08
Total	**Total Eastbound**	**2460**	**07:33**	**02:00**	**02:11**
5	10th St NW to 14th St NW	524	02:30	00:51	01:10
6	14th St NW to 17th St NW	703	03:17	00:23	00:29
7	17th St NW to 19th NW	1321	00:57	00:07	00:11
8	19th St NW to 22nd St NW	1283	02:53	00:22	00:35
Total	**Total Westbound**	**3831**	**09:37**	**01:43**	**02:25**

**Results show the average from 10 simulation runs.*





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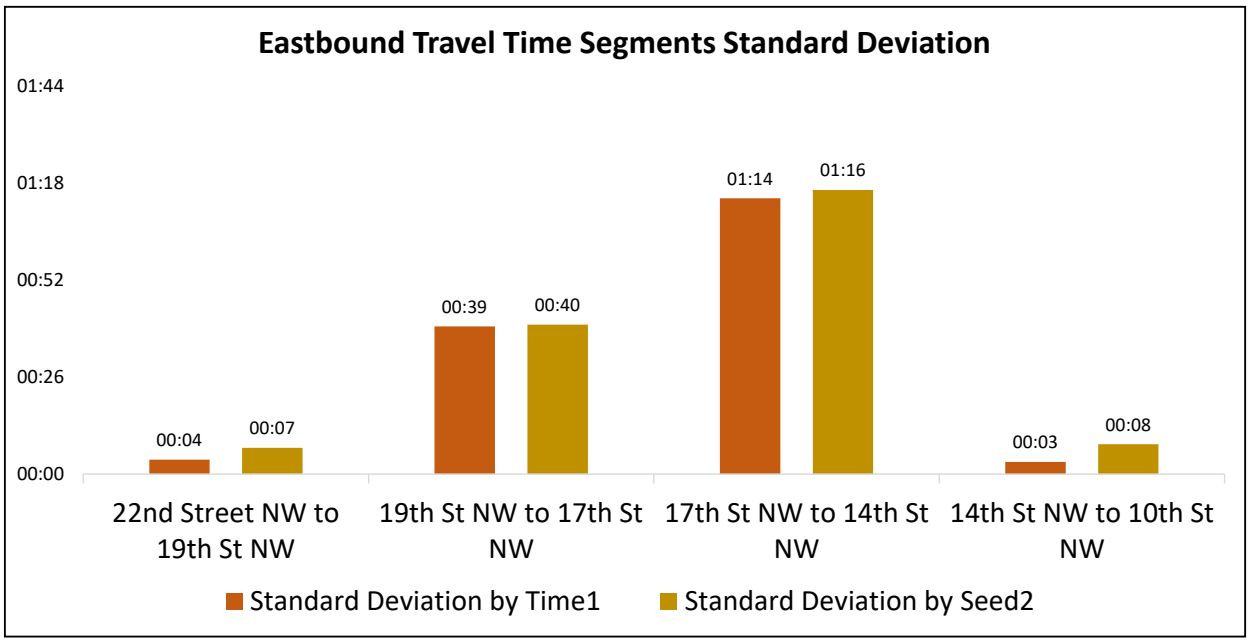
Travel Time | Segment-by-Segment Passenger Cars

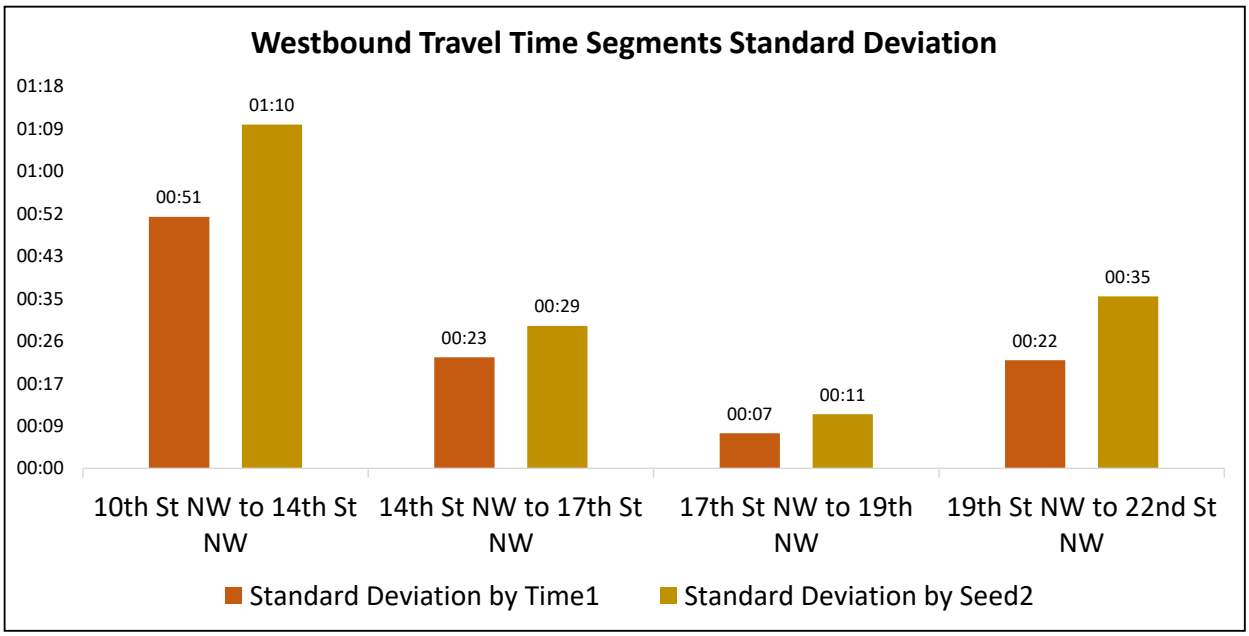
PM Peak Period: 4:15PM-6:15PM

**Travel time results collected throughout the 2-hour peak period at 15-minute intervals.*

[1]Standard deviation by time is standard deviation of the average travel time for all simulation runs in each 15-minute time segment, representing how the average travel time changes throughout the peak period.

[2]Standard deviation by seed is the average standard deviation of travel times for each 15-minute time segment in the peak period, representing the consistency of travel time throughout the peak period.





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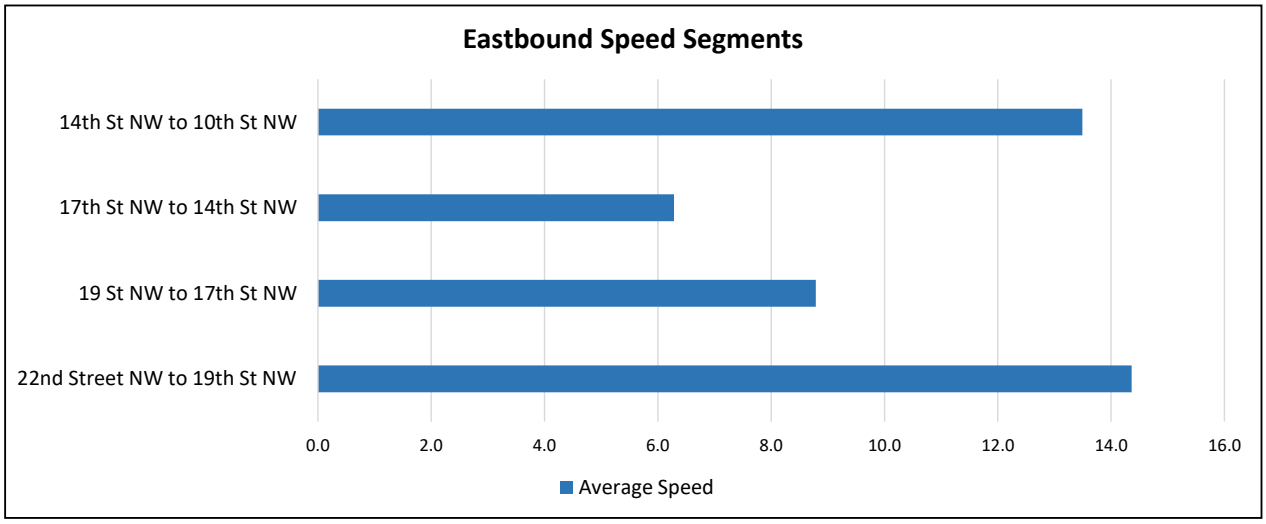
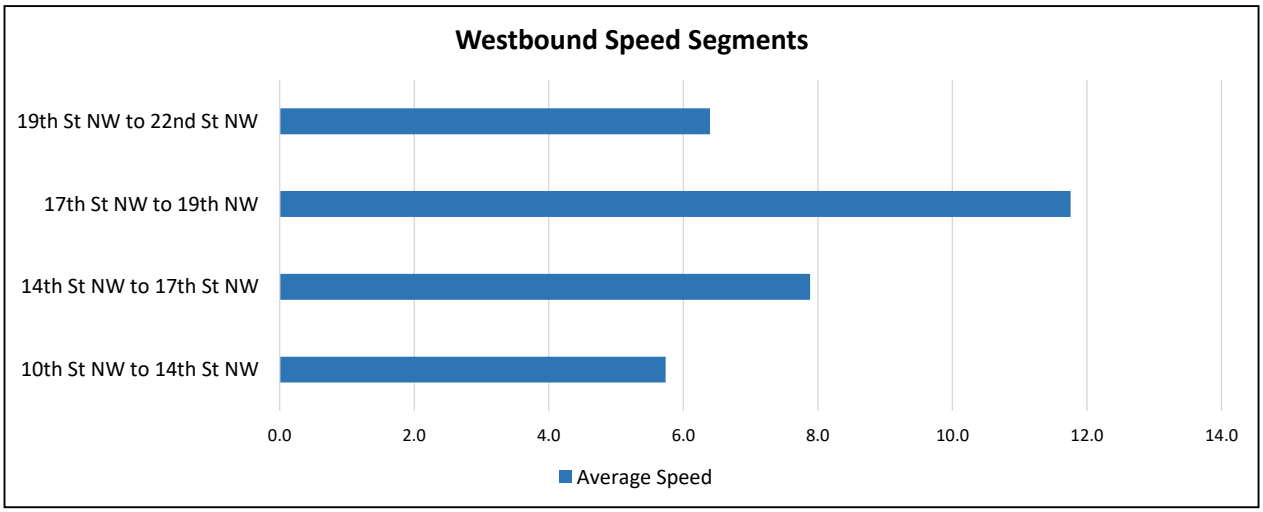
Speed | Segment-by-Segment Passenger Cars

PM Peak Period: 4:15PM-6:15PM

Passenger Vehicle Segment-by-Segment Average Speed Comparison			
Segment ID	Route	Vehicle Count	Average Speed
			MPH
1	22nd Street NW to 19th St NW	395	14.4
2	19 St NW to 17th St NW	710	8.8
3	17th St NW to 14th St NW	649	6.3
4	14th St NW to 10th St NW	706	13.5
Average Eastbound		**2460**	**10.7**
5	10th St NW to 14th St NW	524	5.7
6	14th St NW to 17th St NW	703	7.9
7	17th St NW to 19th NW	1321	11.8
8	19th St NW to 22nd St NW	1283	6.4
Average Westbound		**3831**	**7.9**

**Results show the average from 10 simulation runs.*





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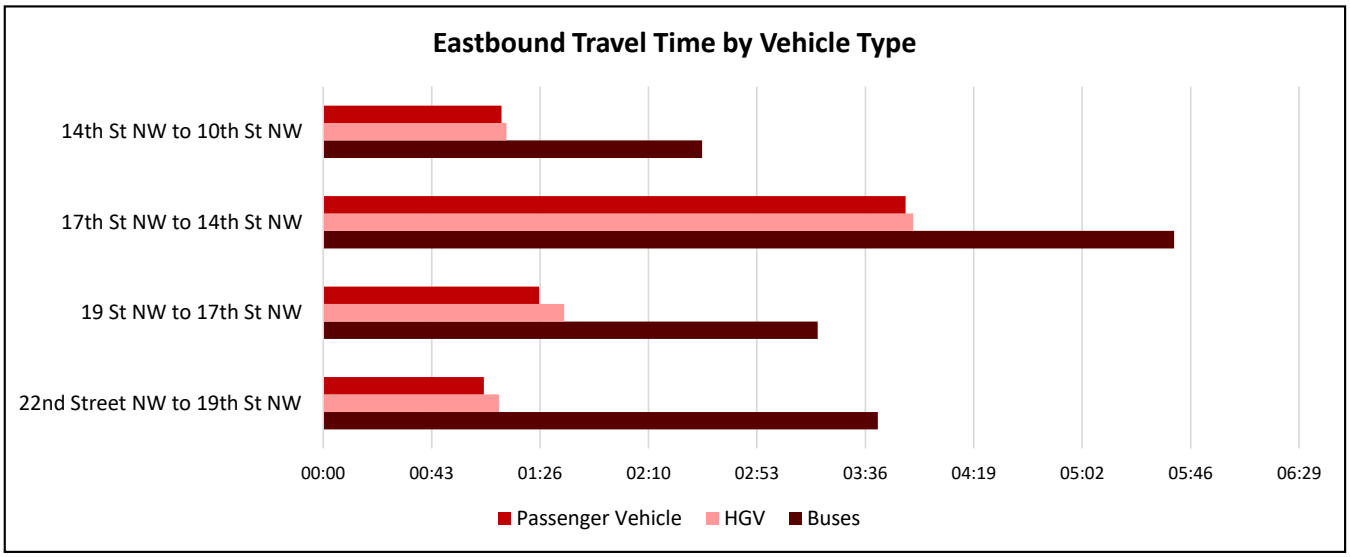
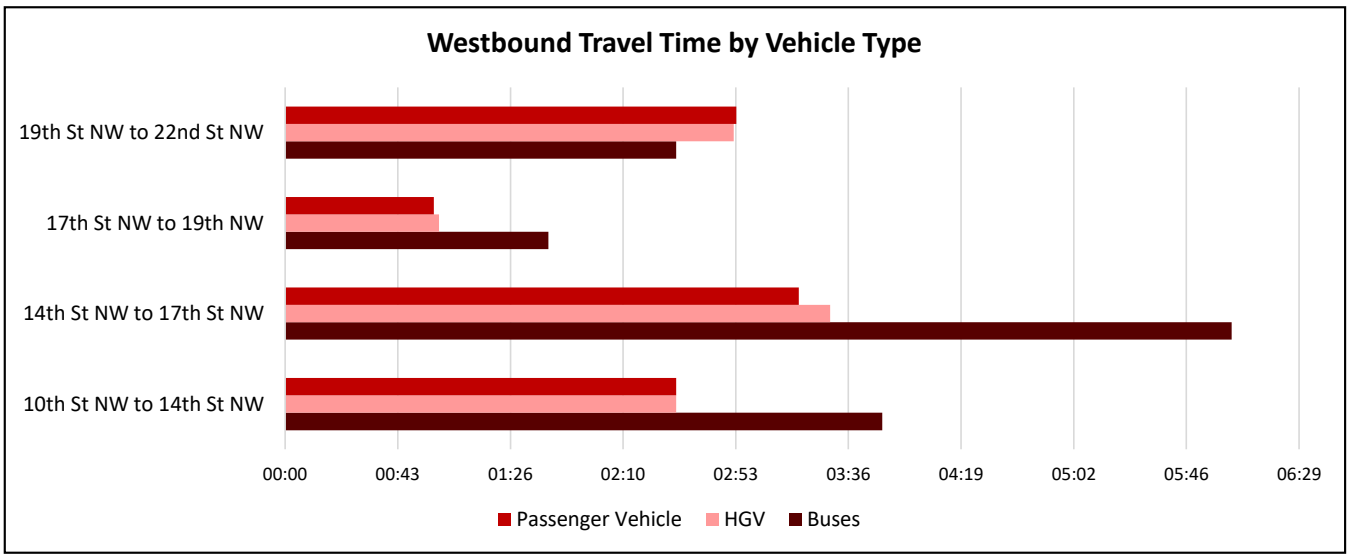
Travel Time | Comparison by Vehicle Type

PM Peak Period: 4:15PM-6:15PM

Travel Time by Vehicle Type				
Segment ID	Route	Passenger Vehicle (MM:SS)	HGV (MM:SS)	Buses (MM:SS)
1	22nd Street NW to 19th St NW	01:04	01:10	03:41
2	19 St NW to 17th St NW	01:26	01:36	03:17
3	17th St NW to 14th St NW	03:52	03:55	05:39
4	14th St NW to 10th St NW	01:11	01:13	02:31
Total	**Total Eastbound**	**07:33**	**07:54**	**15:08**
5	10th St NW to 14th St NW	02:30	02:30	03:49
6	14th St NW to 17th St NW	03:17	03:29	06:03
7	17th St NW to 19th NW	00:57	00:59	01:41
8	19th St NW to 22nd St NW	02:53	02:52	02:30
Total	**Total Westbound**	**09:37**	**09:50**	**14:03**

**Results show the average from 10 simulation runs.*





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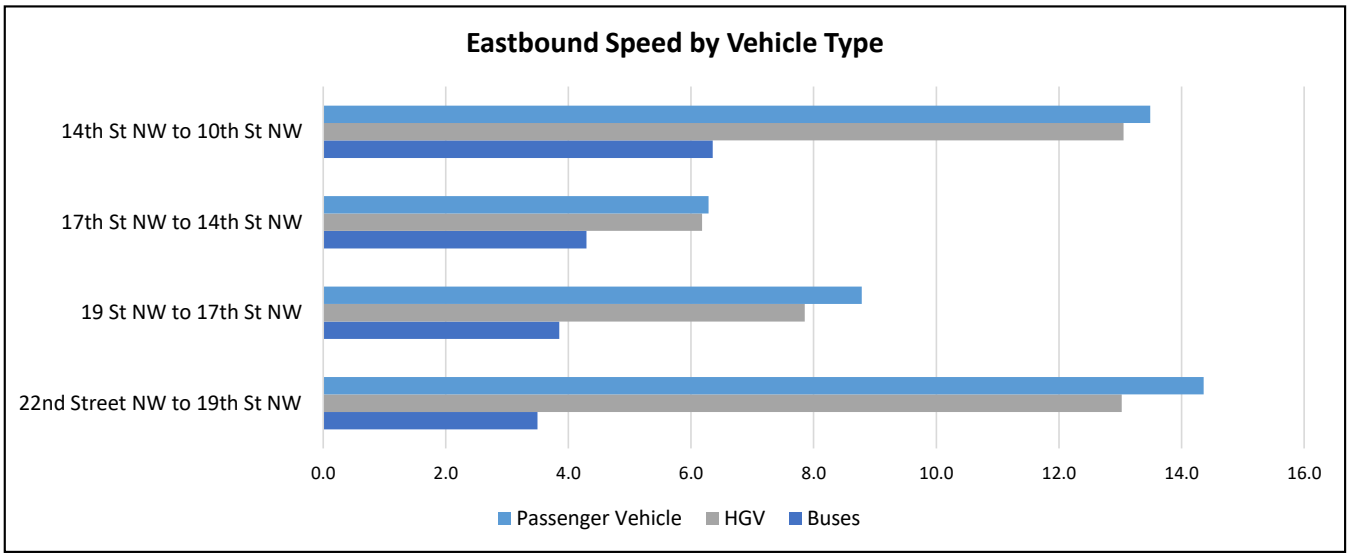
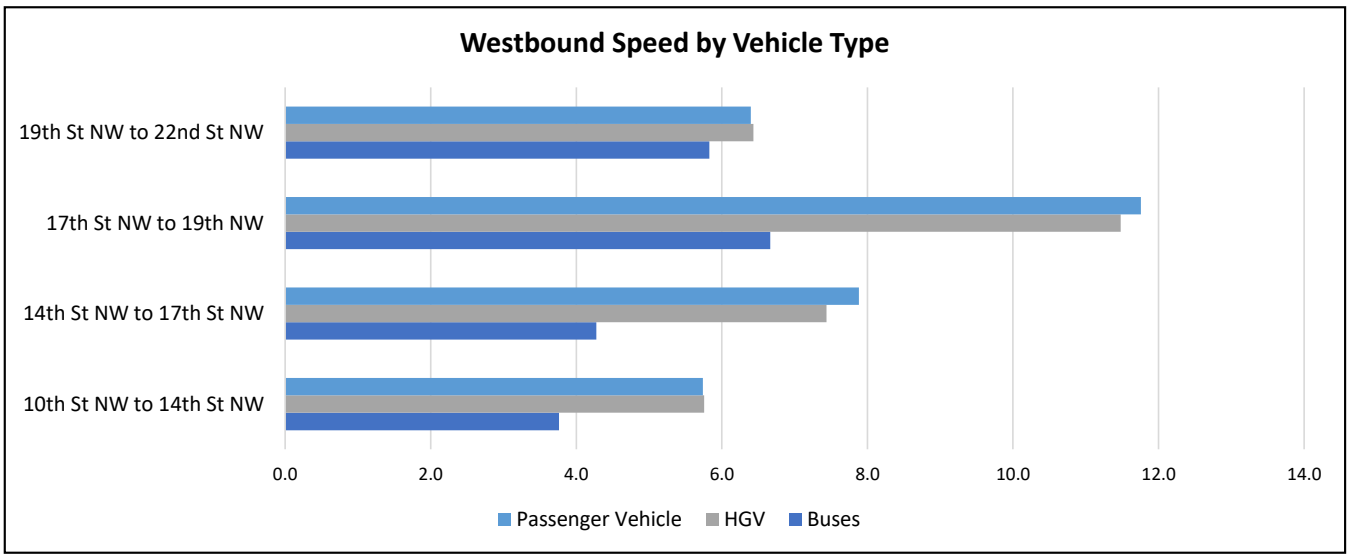
Speed | Comparison by Vehicle Type

PM Peak Period: 4:15PM-6:15PM

Speed by Vehicle Type				
Segment ID	Route	Passenger Vehicle (MM:SS)	HGV (MM:SS)	Buses (MM:SS)
1	22nd Street NW to 19th St NW	14.4	13.0	3.5
2	19 St NW to 17th St NW	8.8	7.9	3.9
3	17th St NW to 14th St NW	6.3	6.2	4.3
4	14th St NW to 10th St NW	13.5	13.1	6.4
Average Eastbound		**10.7**	**10.0**	**4.5**
5	10th St NW to 14th St NW	5.7	5.8	3.8
6	14th St NW to 17th St NW	7.9	7.4	4.3
7	17th St NW to 19th NW	11.8	11.5	6.7
8	19th St NW to 22nd St NW	6.4	6.4	5.8
Average Westbound		**7.9**	**7.8**	**5.1**

**Results show the average from 10 simulation runs.*





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Travel Time | Comparison by Vehicle Type

PM Peak Period: 4:15PM-6:15PM

Number of Vehicles Represented in Travel Time/Speed by Vehicle Type				
Segment ID	Route	Passenger Vehicle	HGV	Buses
		Vehicle Count	Vehicle Count	Vehicle Count
1	22nd Street NW to 19th St NW	395	19	41
2	19 St NW to 17th St NW	710	38	82
3	17th St NW to 14th St NW	649	38	82
4	14th St NW to 10th St NW	706	41	75
Total	**Total Eastbound**	**2460**	**136**	**280**
5	10th St NW to 14th St NW	524	28	12
6	14th St NW to 17th St NW	703	38	37
7	17th St NW to 19th NW	1321	66	49
8	19th St NW to 22nd St NW	1283	67	4
Total	**Total Westbound**	**3831**	**199**	**102**

**Total number of vehicles counted in Travel Time runs through the 2-hour peak period.*

GEH of Vehicular Throughput

PM Peak Hour: 4:45PM-5:45PM

GEH Criteria	Value	Percent	Target	Target Met
Total Network Volume with GEH < 4	GEH: 2.6	N/A	4	Yes
Total Network Volume %Difference from Balanced Counts	N/A	-1.4%	5%	Yes
85% of individual links below GEH < 5	103 of 103	100%	85%	Yes

Total K Street NW Volume	Sum of balanced counts	Sum of all link flows	Percent Difference	GEH
	36,918	36,411	-1.4%	2.6

** Bus volume during peak period added to "Sum of balanced counts"*

Intersection Approaches	Number of Approaches	Number of Segments with GEH < 5	Number of Segments with GEH >5	Percent Compliance
	103	103	0	100%

The GEH statistic is computed using the following formua:

E = Vissim estimated throughput
V = balanced field count:

$$GEH = \sqrt{\frac{(E-V)^2}{(E+V)/2}}$$

Sample Size Determination Tool, Version 2.0

VDOT Virginia Department of Transportation

Step 1: Input number of MOEs (max is 12). Clear out old data.

Step 2: Select type of MOEs

Step 3: Insert simulation results from four random seeds for selected MOEs

User Inputs

Constants

Outputs

Sample Size (N) = Number of Model Runs
Sample Mean (Xs) = (1/N) (X1 + X2 + X3 … + XN)
Sample Standard Deviation (Ss) = √[(Σ(X-Xs)2)/(N-1)]
Sampling Error = t (Ss/√N)
Confidence Level = Xs ± t (Ss/√N)
% of Sample Mean (E) = % Tolerance * Xs Sample Size Needed = [(t)2 * (Ss)2] / (E)2

The "t" statistic is the hypothsized number of standard deviations away from the mean corresponding to the required confidence level and sample size in a t-distribution.

Inputs

Confidence Interval:	95%
Tolerance Error:	10%
Number of MOEs:	10

Output

Number of Required Runs: **10**

*Minimum number of required runs = 10

Location (optional)	EB K Street	WB K Street	EB (17th/18th)	WB (17th/18th)	EB (13th/14th)	WB (13th/14th)	EB (17th/18th)	WB (17th/18th)	EB (13th/14th)	WB (13th/14th)
Runs (Seeds)	***Travel Time***	***Travel Time***	***Volume***	***Volume***	***Volume***	***Volume***	***Speed***	***Speed***	***Speed***	***Speed***
1	327	446	1690	1869	1536	1317	19.3	18.5	24.2	18.8
2	317	459	1619	1882	1482	1365	18.2	19.8	24.4	20.8
3	314	467	1553	1912	1502	1361	17.8	20.3	24.6	20.3
4	292	450	1576	1854	1387	1399	17.6	20.3	24.4	23.2

**Results from four random seeds*

Statistics

X_s	=	312.4	455.4	1609.5	1879.3	1476.8	1360.5	18.2	19.7	24.4	20.8
S_s	=	15.0	9.2	60.2	24.6	63.9	33.6	0.8	0.8	0.2	1.8
E	=	31.2	45.5	161.0	187.9	147.7	136.1	1.8	2.0	2.4	2.1
t	=	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18
Sampling Error	=	23.82	14.58	95.85	39.22	101.60	53.53	1.23	1.34	0.27	2.88
95% Interval Lower	=	288.5	440.8	1513.7	1840.0	1375.1	1307.0	17.0	18.4	24.1	17.9
95% Interval Upper	=	336.2	470.0	1705.3	1918.5	1578.4	1414.0	19.4	21.1	24.7	23.7
% of Sample Mean	=	7.63%	3.20%	5.96%	2.09%	6.88%	3.93%	6.72%	6.77%	1.12%	13.85%
Sample Size Needed	=	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**8**

Kimley»Horn

Intersection Queue Lengths

PM Peak Hour: 4:45PM-5:45PM

Intersection		Approach	Storage (ft)	Max Queue Observed (ft)	Vissim Average Queue (ft)	Vissim Max Queue (ft)	Vissim Max Queue			Vissim Average Queue			Is Max Observed Queue between Average and Max Vissim Queue?
							Queue Difference	% Queue Difference (ft)	% Queue Difference wrt Storage Space[1]	Queue Difference	% Queue Difference (ft)	% Queue Difference wrt Storage Space[1]	
1	K Street NW and 22nd Street NW												
2	K Street NW and 21st Street NW	EB	490	343	14	133	-210	-61%	-43%	-329	-96%	-67%	False
		WB	410	246	157	480	234	95%	57%	-89	-36%	-22%	True
		SB	--	--	221	452	--	--	--	--	--	--	--
3	K Street NW and 20th Street NW	EB	410	164	71	329	165	101%	40%	-93	-57%	-23%	True
		WB	320	320	33	218	-102	-32%	-32%	-287	-90%	-90%	False
4	K Street NW and 19th Street NW	EB	320	192	83	336	144	75%	45%	-109	-57%	-34%	True
		WB	410	410	45	281	-129	-31%	-31%	-365	-89%	-89%	False
5	K Street NW and 18th Street NW	EB	410	123	52	263	140	114%	34%	-71	-58%	-17%	True
		WB	520	520	83	315	-205	-39%	-39%	-437	-84%	-84%	False
6	K Street NW and Connecticut Avenue	EB	520	520	124	462	-58	-11%	-11%	-396	-76%	-76%	False
		WB	145	124	48	254	130	105%	89%	-76	-62%	-53%	True
		NB	310	155	64	279	124	80%	40%	-91	-59%	-29%	True
		SB	315	284	221	455	171	60%	54%	-63	-22%	-20%	True
7	K Street NW and 17th Street NW (east)	EB	145	102	80	306	204	200%	141%	-22	-21%	-15%	True
		WB	460	368	86	384	16	4%	3%	-282	-77%	-61%	True
		NB	315	158	17	110	-48	-30%	-15%	-141	-90%	-45%	False
		SB	--	--	45	190	--	--	--	--	--	--	--
8	K Street NW and 16th Street NW	EB	460	276	90	507	231	84%	50%	-186	-67%	-40%	True
		WB	450	225	41	192	-33	-14%	-7%	-184	-82%	-41%	False
		NB	300	270	45	203	-67	-25%	-22%	-225	-83%	-75%	False
		SB	305	305	28	223	-82	-27%	-27%	-277	-91%	-91%	False
9	K Street NW and 15th Street NW (west)	EB	450	450	229	564	114	25%	25%	-221	-49%	-49%	True
		WB	160	160	144	348	188	118%	118%	-16	-10%	-10%	True
		SB	330	165	113	365	200	121%	61%	-52	-31%	-16%	True
10	K Street NW and Vermont Avenue	EB	160	160	107	294	134	84%	84%	-53	-33%	-33%	True
		WB	360	324	161	488	164	50%	45%	-163	-50%	-45%	True
		NB	295	148	32	217	69	46%	23%	-116	-78%	-39%	True
		SB	--	--	178	391	--	--	--	--	--	--	--
11	K Street NW and 14th Street NW	EB	360	360	120	380	20	6%	6%	-240	-67%	-67%	True
		WB	530	265	178	504	239	90%	45%	-87	-33%	-16%	True
		NB	300	300	44	229	-71	-24%	-24%	-256	-85%	-85%	False
		SB	315	221	100	330	109	49%	34%	-121	-55%	-38%	True
12	K Street NW and 13th Street NW	EB	530	265	71	299	34	13%	6%	-194	-73%	-37%	True
		WB	330	198	68	276	78	39%	24%	-130	-66%	-39%	True
		SB	315	221	68	250	29	13%	9%	-153	-69%	-49%	True
13	K Street NW and 12th Street NW	EB	330	99	29	326	227	229%	69%	-70	-70%	-21%	True
		WB	200	200	29	221	21	10%	10%	-171	-85%	-85%	True
14	K Street NW and 11th Street NW	EB	200	200	18	199	-1	-1%	-1%	-182	-91%	-91%	False
		WB	190	95	54	183	88	93%	46%	-41	-43%	-22%	True
		NB	--	--	50	264	--	--	--	--	--	--	--
		SB	--	--	40	219	--	--	--	--	--	--	--
15	K Street NW and 10th Street NW	EB	190	190	32	217	27	14%	14%	-158	-83%	-83%	True
		WB	480	96	9	102	6	6%	1%	-87	-91%	-18%	True
		SB	270	243	42	212	-31	-13%	-11%	-201	-83%	-74%	False
16	K Street NW and 9th Street NW	EB	480	144	74	324	180	125%	37%	-70	-49%	-15%	True

[1] *Percent difference with respect to storage space*

Kimley»Horn

Intersection Queue Lengths - Service Lanes

PM Peak Hour: 4:45PM-5:45PM

Intersection		Approach	Storage (ft)	Max Queue Observed (ft)	Vissim Average Queue (ft)	Vissim Max Queue (ft)	Vissim Max Queue			Vissim Average Queue			Is Max Observed Queue between Average and Max Vissim Queue?
							Queue Difference	% Queue Difference (ft)	% Queue Difference wrt Storage Space[1]	Queue Difference	% Queue Difference (ft)	% Queue Difference wrt Storage Space[1]	
1	K Street NW and 22nd Street NW	EB	40	16	7	146	130	814%	326%	-9	-55%	-22%	True
		WB	530	265	46	165	-100	-38%	-19%	-219	-83%	-41%	False
2	K Street NW and 21st Street NW	EB	490	294	56	339	45	15%	9%	-238	-81%	-49%	True
		WB	410	123	16	162	39	32%	10%	-107	-87%	-26%	True
3	K Street NW and 20th Street NW	EB	410	123	8	119	-4	-4%	-1%	-115	-94%	-28%	False
		WB	320	320	9	146	-174	-54%	-54%	-311	-97%	-97%	False
4	K Street NW and 19th Street NW	EB	320	128	58	272	144	112%	45%	-70	-54%	-22%	True
		WB	410	123	6	104	-20	-16%	-5%	-117	-95%	-28%	False
5	K Street NW and 18th Street NW	EB	410	41	3	52	11	26%	3%	-38	-94%	-9%	True
		WB	520	156	5	95	-61	-39%	-12%	-151	-97%	-29%	False
6	K Street NW and Connecticut Avenue	EB	520	520	130	408	-112	-22%	-22%	-390	-75%	-75%	False
		WB	145	145	89	281	136	94%	94%	-56	-38%	-38%	True
7	K Street NW and 17th Street NW (east)	WB	460	368	25	217	-151	-41%	-33%	-343	-93%	-75%	False
8	K Street NW and 16th Street NW	EB	460	23	1	43	20	87%	4%	-22	-97%	-5%	True
		WB	450	180	21	179	-1	-1%	0%	-159	-88%	-35%	False
9	K Street NW and 15th Street NW (west)	EB	450	45	0	33	-12	-26%	-3%	-45	-99%	-10%	False
		WB	160	160	20	185	25	16%	16%	-140	-87%	-87%	True
10	K Street NW and Vermont Avenue	WB	360	144	12	131	-13	-9%	-3%	-132	-92%	-37%	False
11	K Street NW and 14th Street NW	EB	360	180	19	181	1	1%	0%	-161	-90%	-45%	True
		WB	530	106	26	185	79	74%	15%	-80	-75%	-15%	True
12	K Street NW and 13th Street NW	WB	330	33	16	188	155	469%	47%	-17	-51%	-5%	True
13	K Street NW and 12th Street NW	EB	330	0	0	14	14	--	4%	0	--	0%	False

[1] *Percent difference with respect to storage space*

Kimley»Horn

Network Gridlock Check

Inputs

Confidence Interval:	95%
Tolerance Error:	10%

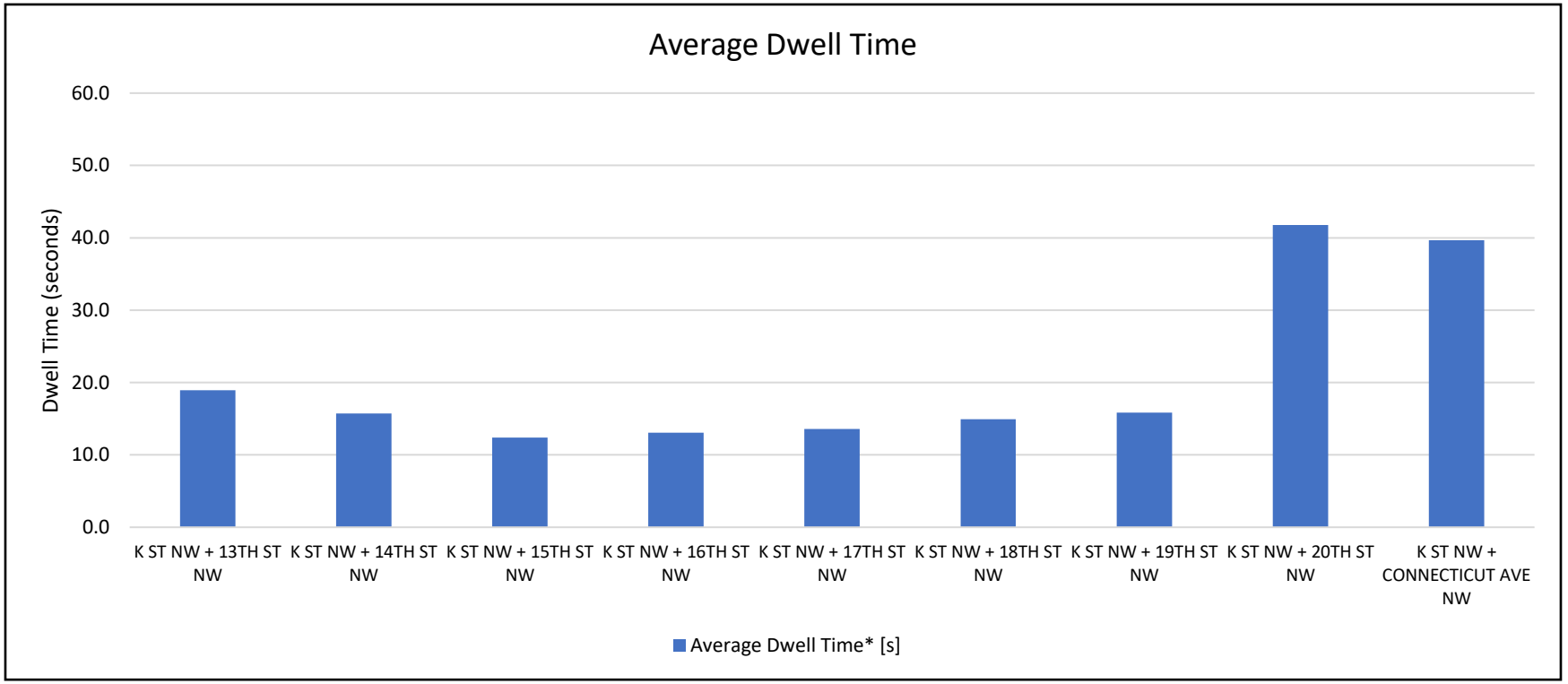
Runs (Seeds)	*Ave Delay PVs*	*Latend Demand*	*Ave Speed PVs*	*Ave Delay Stop PVs*	*Total Delay PVs*	*PVs Active @ End of Simulation*	*Total PVs Arrived*
1	92.87	136	8.5	67.7	4.1	1024	43164
2	86.40	127	8.9	62.6	3.8	999	43037
3	90.82	115	8.7	66.0	4.0	997	43011
4	91.42	88	8.6	67.2	4.0	1190	42973
5	88.00	210	8.8	64.1	3.9	1166	42793
6	81.91	37	9.2	58.9	3.6	994	43294
7	87.92	120	8.8	63.5	3.9	914	43153
8	77.14	33	9.6	55.6	3.4	876	43202
9	91.02	154	8.7	66.3	4.0	955	43245
10	98.15	68	8.2	72.4	4.4	1088	43402

Statistics

X_s	=	88.6	108.8	8.8	64.4	3.9	1020.3	43127.4
S_s	=	5.9	54.3	0.4	4.7	0.3	101.5	177.0
E	=	8.9	10.9	0.9	6.4	0.4	102.0	4312.7
t	=	3.18	3.18	3.18	3.18	3.18	3.18	3.18
Sampling Error	=	9.34	86.37	0.61	7.54	0.42	161.49	281.63
95% Interval Lower	=	79.2	22.4	8.2	56.9	3.5	858.8	42845.8
95% Interval Upper	=	97.9	195.2	9.4	72.0	4.3	1181.8	43409.0
% of Sample Mean	=	10.54%	79.39%	6.93%	11.70%	10.82%	15.83%	0.65%

Attachment C: WMATA Bus Dwell Times

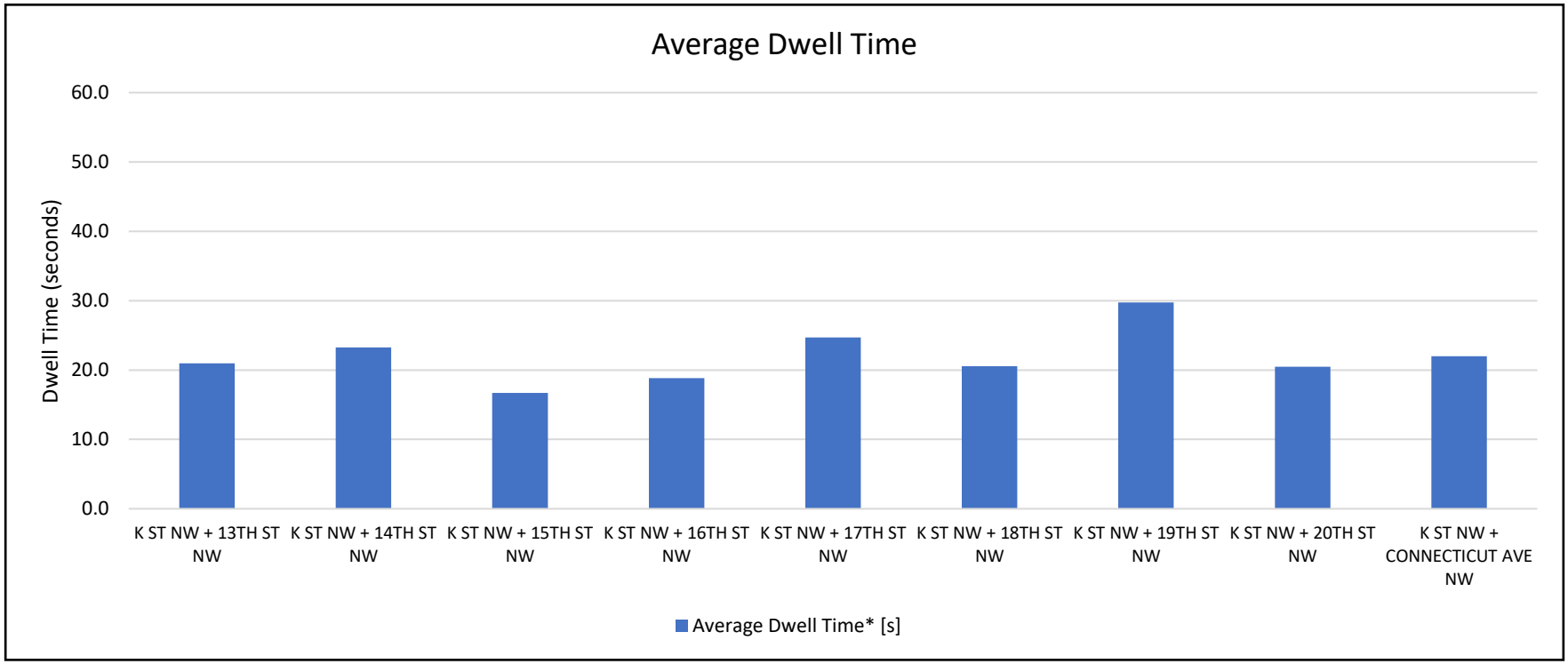
WMATA Dwell Time | AM, Eastbound				
Stop Locations	**Average Dwell Time* [s]**	**Stdev Dwell Time [s]**	**95th Percentile Dwell Time [s]**	**Sample Size**
K ST NW + 13TH ST NW	18.9	23.4	60.8	546
K ST NW + 14TH ST NW	15.7	15.6	52.7	284
K ST NW + 15TH ST NW	12.4	19.7	38.6	213
K ST NW + 16TH ST NW	13.1	12.9	40.0	200
K ST NW + 17TH ST NW	13.6	12.1	40.1	418
K ST NW + 18TH ST NW	14.9	21.4	36.2	260
K ST NW + 19TH ST NW	15.8	17.2	50.1	119
K ST NW + 20TH ST NW	41.8	105.6	202.6	55
K ST NW + CONNECTICUT AVE NW	39.7	36.4	89.0	233
Average	**20.7**	**29.4**	**67.8**	**259**



**Average of recorded dwell times for stops greater than 5 seconds with more than 0 passengers boarding or alighting.*

Kimley»Horn

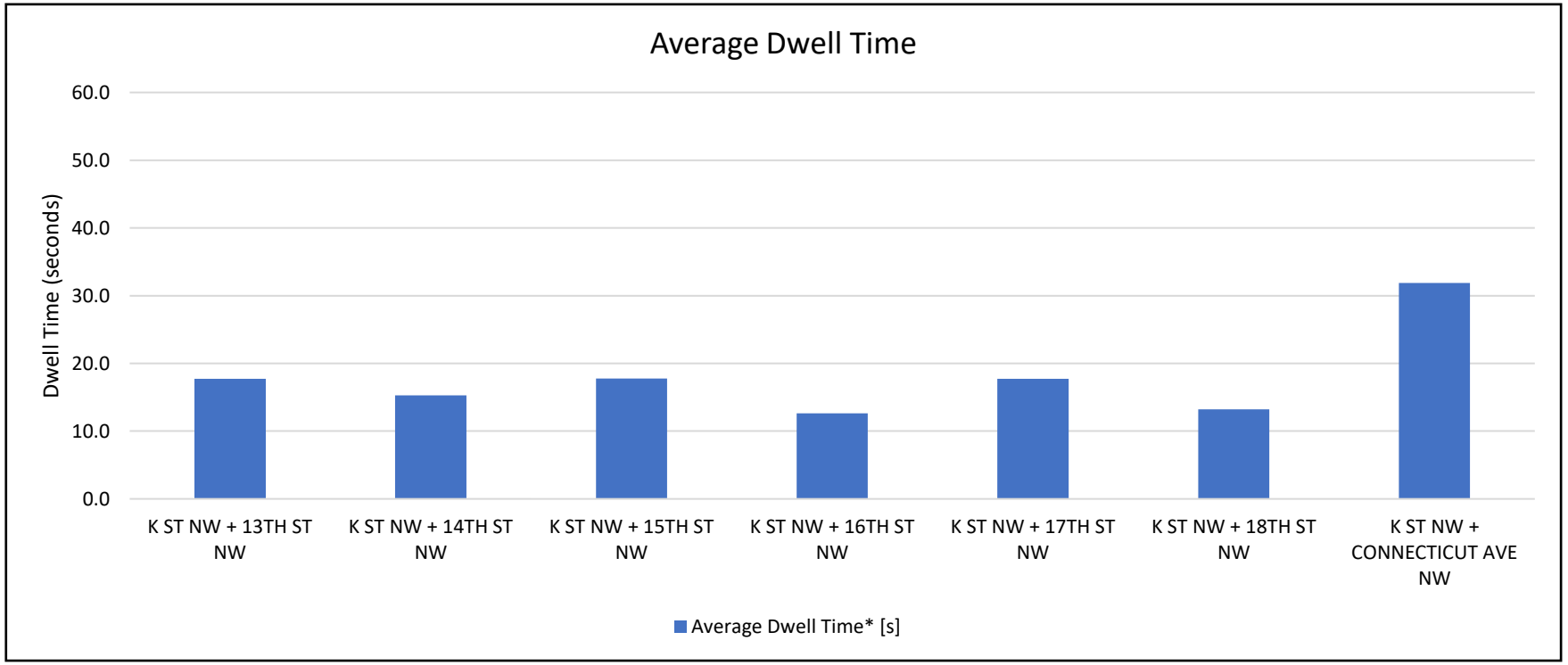
WMATA Dwell Time | PM, Eastbound				
Stop Locations	**Average Dwell Time* [s]**	**Stdev Dwell Time [s]**	**95th Percentile Dwell Time [s]**	**Sample Size**
K ST NW + 13TH ST NW	21.0	25.3	252.0	576
K ST NW + 14TH ST NW	23.3	22.9	182.0	414
K ST NW + 15TH ST NW	16.7	23.2	175.0	123
K ST NW + 16TH ST NW	18.9	22.2	199.0	242
K ST NW + 17TH ST NW	24.7	23.3	158.0	482
K ST NW + 18TH ST NW	20.6	33.2	255.0	147
K ST NW + 19TH ST NW	29.7	53.2	433.0	107
K ST NW + 20TH ST NW	20.5	36.7	381.0	98
K ST NW + CONNECTICUT AVE NW	22.0	20.8	103.0	88
Average	**21.9**	**29.0**	**237.6**	**253**



**Average of recorded dwell times for stops greater than 5 seconds with more than 0 passengers boarding or alighting.*

Kimley»Horn

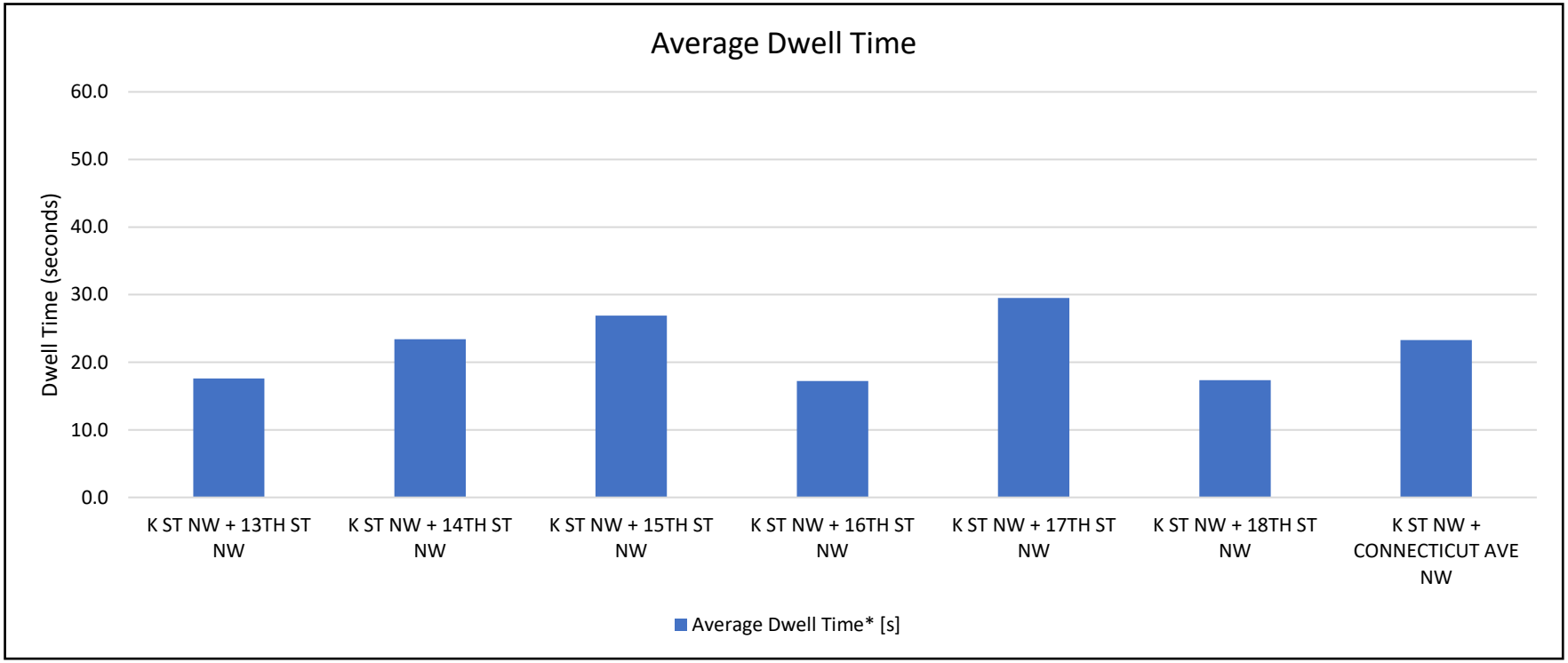
WMATA Dwell Time | AM, Westbound				
Stop Locations	**Average Dwell Time* [s]**	**Stdev Dwell Time [s]**	**95th Percentile Dwell Time [s]**	**Sample Size**
K ST NW + 13TH ST NW	17.7	18.7	215.0	574
K ST NW + 14TH ST NW	15.3	13.9	112.0	281
K ST NW + 15TH ST NW	17.8	33.3	242.0	121
K ST NW + 16TH ST NW	12.6	11.6	88.0	190
K ST NW + 17TH ST NW	17.7	19.7	101.0	46
K ST NW + 18TH ST NW	13.2	16.1	168.0	251
K ST NW + 19TH ST NW	--	--	--	--
K ST NW + 20TH ST NW	--	--	--	--
K ST NW + CONNECTICUT AVE NW	31.9	31.4	403.0	396
Average	**17.4**	**19.6**	**175.4**	**240**



**Average of recorded dwell times for stops greater than 5 seconds with more than 0 passengers boarding or alighting.*

Kimley»Horn

WMATA Dwell Time | PM, Westbound				
Stop Locations	**Average Dwell Time* [s]**	**Stdev Dwell Time [s]**	**95th Percentile Dwell Time [s]**	**Sample Size**
K ST NW + 13TH ST NW	17.6	23.2	252.0	397
K ST NW + 14TH ST NW	23.4	26.9	187.0	355
K ST NW + 15TH ST NW	26.9	52.5	324.0	176
K ST NW + 16TH ST NW	17.2	21.9	238.0	257
K ST NW + 17TH ST NW	29.5	25.6	158.0	167
K ST NW + 18TH ST NW	17.4	16.2	119.0	260
K ST NW + 19TH ST NW	--	--	--	--
K ST NW + 20TH ST NW	--	--	--	--
K ST NW + CONNECTICUT AVE NW	23.3	18.4	103.0	381
Average	**22.1**	**30.1**	**217.3**	**254**



**Average of recorded dwell times for stops greater than 5 seconds with more than 0 passengers boarding or alighting.*

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