STRATEGICALLY TARGETED AND
AFFORDABLE ROADWAY SOLUTIONS

STARS Route 17 (Carrollton Boulevard) Corridor Improvement Study

Isle of Wright, VIRGINIA

February, 2022

Route 17 (Carrollton Boulevard) Corridor Improvement Study

Between James River Bridge and Route 258

Isle of Wight, Virginia

Date:

February, 2022

Prepared for:

List of Acronyms

AADT – Annual Average Daily Traffic

CMF – Crash Modification Factor

CoSS+ – Corridor of Statewide Significance

FYA – Flashing yellow arrow

HCM – Highway Capacity Manual

LOS – Level of Service

MOE – Measure of Effectiveness

PDO – Property Damage Only

RCUT – Restricted crossing U-turn

RN – Regional Network

RNS – Roadway Network System

SPS – Statewide Planning System

STARS – Strategically Targeted and Affordable Roadway Solutions

SWG – Study Work Group

SYIP – Six Year Improvement Plan

TIA – Traffic Impact Assessment

TMC – Turning Movement Count

VDOT – Virginia Department of Transportation

VTrans – Virginia's Transportation Plan

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1. Introduction

1.1 Background and Study Initiation

The Virginia Department of Transportation Hampton District (VDOT), VDOT Transportation Mobility and Planning Division (TMPD) and the Isle of Wight County identified the need to evaluate the Carrollton Boulevard (U.S. Route 17) corridor in Isle of Wight County for study under the Strategically Targeted and Affordable Roadway Solutions (STARS) program. The STARS program uses a data-driven process to identify candidate projects with critical traffic and safety challenges. The study corridor experiences heavy congestion during peak hours especially during afternoon in the southbound direction. The STARS program seeks to develop comprehensive, innovative transportation solutions to relieve congestion bottlenecks and resolve safety issues. The goals of STARS studies include:

- Develop innovative, cost-effective solutions
- Evaluate potential solutions more thoroughly
- Identify potential project risks and costs
- Build stakeholder consensus
- Improve readiness for project implementation

This study is entitled as STARS Route 17 Corridor Improvement Study and will be referred to as the Study in this report. Also, Carrollton Boulevard will be referred as Route 17 throughout the report.

1.2 Purpose and Need

The purpose of this project was to evaluate existing operational and safety conditions and identify improvements that can be programmed into the Virginia Department of Transportation's (VDOT) Six-Year Improvement Program (SYIP). Route 17 is the primary north-south thoroughfare within the study area, providing connections to Brewers Neck Boulevard, the City of Suffolk, and the James River Bridge which provides direct access to/from the City of Newport News. Within the study area, it is a four lane divided road and classified as "Other Principal Arterial" by VDOT. This section of Route 17 carries about 29,000 vehicles/day. The study area is identified as part of the Arterial Preservation Network (Mobility Enhancement Segment). The Arterial Preservation Network includes segments of selected major highways that are part of the Corridors of Statewide Significance (CoSS) or are functionally classified as principal or other principal arterials. Route 17 is congested, especially during afternoon in the southbound direction. Traffic congestion is anticipated to increase within the study area with several planned and proposed developments along the corridor. The primary need for this study was to improve progression and operations on Route 17 where the congestion occurs. The 2021 Virginia's Transportation Plan (VTrans) needs identified for the Route 17 study corridor are listed below:

- Congestion Mitigation (CoSS & RN)
- Capacity Preservation (CoSS & RN)
- Transportation Demand Management (Non-Limited Access RN)
- Transit Access (RN)
- Bicycle Access (RN)
- Roadway capacity (UDA)
- Roadway operations (UDA)
- Transit frequency (UDA)
- Transit operations (UDA)
- Transit capacity (UDA)
- Street Grid (UDA)
- Bicycle Infrastructure (UDA)
- Pedestrian Infrastructure (UDA)
- Complete Streets (UDA)
- Safety features (UDA)
- On-street parking (UDA)
- Off-street parking (UDA)
- Intersection design (UDA)
- Signage/wayfinding(UDA)
- Traffic calming (UDA)
- Environment (UDA)
- Sidewalks (UDA)
- Safety Improvement (Segment & Intersection)
- Safety Improvement (CoSS Segment & CoSS Intersection)
- Pedestrian Safety Improvement

1.3 Study Work Group

A study work group (SWG) was formed for the Study to capture input from local stakeholders and to shape the development of improvement concepts. The SWG provided local and institutional knowledge of the corridor; reviewed study methodologies; provided input on key assumptions; and reviewed and approved proposed improvements created through the study process. The SWG included members representing the following organizations:

1. VDOT Hampton Roads District Office
2. Isle of Wight county, Virginia
3. Transportation Mobility and Planning Division, VDOT Central office

1.4 Study Area

The study area limits along Route 17 extended between Brewers Neck Boulevard (Route 258) and James River Bridge and totaled approximately 2.37 miles in length. The study area map is shown in ***Figure 1*** and includes the following corridor and intersections:

Corridor

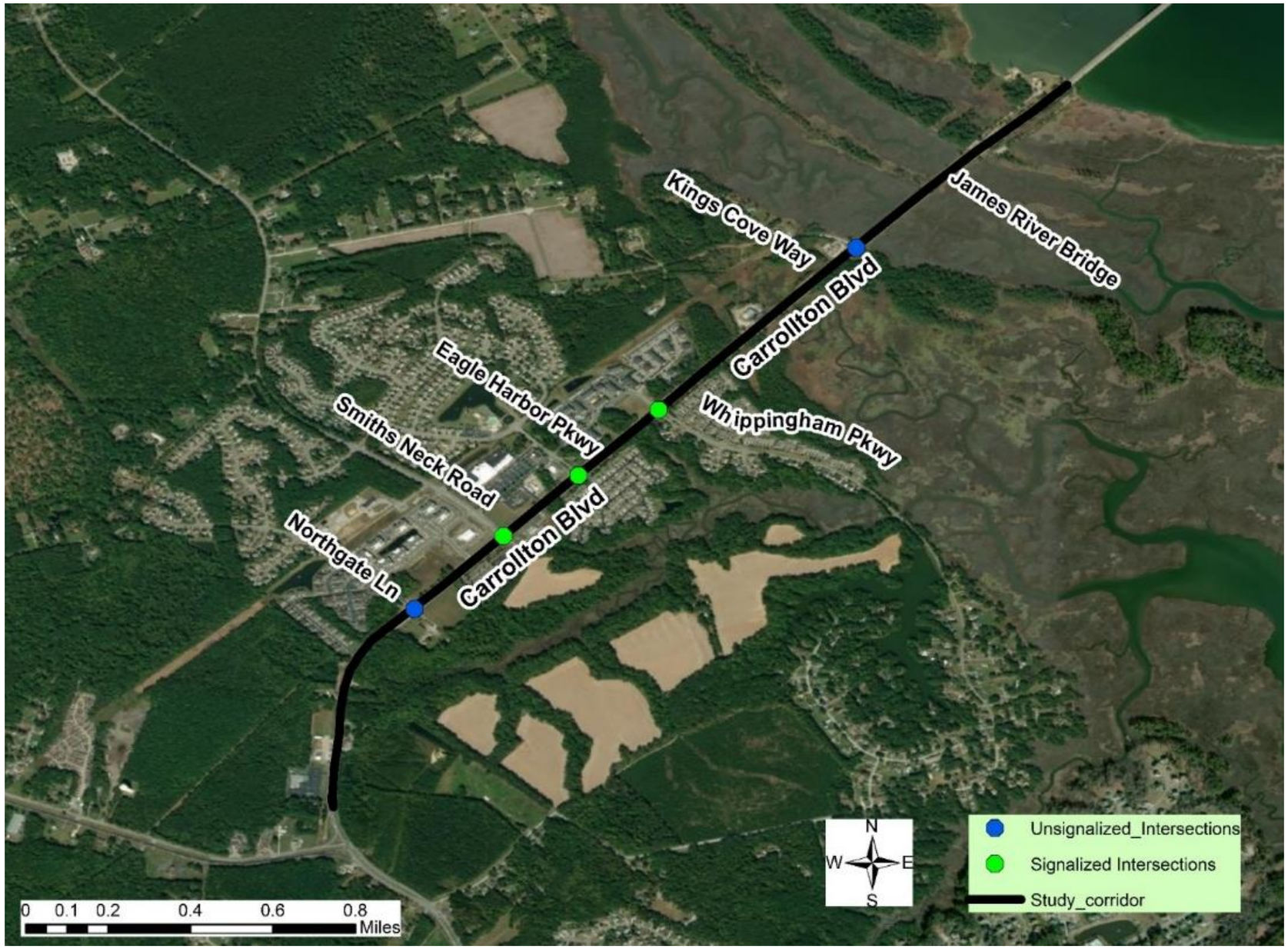
- Route 17*(Carrollton Blvd)* between Brewers Neck Boulevard (Route 258) and James River Bridge

Intersections

The following intersections are included in the study area:

- Route17/Northgate Lane (Unsignalized)
- Route 17/Smiths Neck Road (Signalized)
- Route 17/Eagle Harbor Parkway/Kings Cross (Signalized)
- Route 17/Harbor Point Lane/Whippingham Parkway (Signalized)
- Route17/ Kings Cove Way (Unsignalized)

Figure 1 Study Area



2. Data Collection and Inventory

2.1 Field Review

A field review of the study area was conducted during PM peak period on December 4th, 2019 to observe existing geometric conditions, traffic control devices, peak hour traffic conditions, and driver behavior. The following observations were made:

1. Maximum queues were observed in the field, starting from Smiths Neck Road and extending beyond bridge along Route 17 in the southbound direction.
2. Traffic signal at the intersection of Route 17 and Smiths Neck Road operates as protected only for left turn movements in the northbound direction. In the southbound direction, there is a Yield on flashing yellow arrow (FYA) sign for left turning traffic. However, during the field survey it was noted that it operates as protected only. It was later confirmed by the traffic engineering that the left turn operates as a protected-permissive left-turn (PPLT), FYA 24/ 7 with exception of 2:00pm to 6:00pm from Monday through Friday due to safety concerns.
3. Three to four feet wide shoulder is present along Route 17 northbound except it is missing at some places between Smiths Neck Road and Kings Cross road.
4. Three to four feet wide shoulder is present along Route 17 southbound in the vicinity of Ragged Island parking area and between Smiths Neck Road and Brewers Neck Boulevard.
5. Pedestrian accommodations were noted at the following locations within the study area:
    - Sidewalk present along the west side of Route 17 from Smiths Neck Road to Fiddler Lane. Additionally, a sidewalk is present along the south side of Smiths Neck Road from Route 17 to Chickahominy Loop.
    - A sidewalk present along the east side of Route 17 from the southern access to The Shoppes at Eagle Harbor to the right-in/right-out only access to serving the 7-Eleven entrance to the north.
    - A short segment of multi-use path located along west side of Route 17 at the frontage of Dunkin Donuts. A sidewalk is also present along the south side of Eagle Harbor Parkway between the intersection of Route 17 and Eagle Harbor Parkway and the intersection of Eagle Harbor Parkway and Marsh Landing.
    - Sidewalk along east side of Route 17 between the intersection of Route 17 and Eagle Harbor Parkway/ Kings Cross and the intersection of Route 17 and Whippingham Parkway/Harbor Point Lane. Additionally, at intersection of Route 17 and Whippingham Parkway/Harbor Point Lane, sidewalk is present along north side of Whippingham Parkway and on the south side of Eagle Harbor Parkway.

2.2 Existing Roadway Geometry

The existing roadway geometry in the study area was observed and documented during the field review. ***Figure 2*** on the next page summarizes the existing lane configuration of the roads within the study area. Posted speed limit on Route 17 is 55 mph with the exception of the corridor starting approximately 600 feet north of Harbor Point Lane until approximately 440 feet south of Smiths Neck Road which has posted speed limit of 45 mph.

Figure 2 Existing Roadway Geometry of the Study Area

2.3 Land Use

The existing (2020) land use map for Isle of Wight County is provided in ***Appendix B-1*** and was obtained from the Isle of Wight County Interactive GIS Map. This map shows that most parcels surrounding Route 17 within the study area are designated for mixed use development and urban residential use. At the northern end of the corridor, near James River Bridge, parcels are designated for Environment Conservation.

2.4 Traffic Volume Data

Turning movement counts (TMCs) were provided by VDOT Hampton District. The traffic volume counts were collected on May 29th, 2019 and recorded for 7 hours from 6:00 AM to 10:00 AM and 4:00 PM to 7:00 PM. Traffic counts were provided for the following intersections:

- Route17/Brewers Neck Boulevard (Signalized)Route17/Northgate Ln (Unsignalized)
- Route 17/Smiths Neck Road (Signalized)
- Route 17/Harbor Point Ln/Whippingham Pkwy (Signalized)
- Route17/ Kings Cove Way (Unsignalized)

It should be noted that intersection of Route 17 and Brewers Neck Boulevard is only included for traffic forecasting and peak hour determination purposes. No recommendations will be provided for this intersection. This intersection is being studied as a part of another ongoing study - US 17 Arterial Preservation Plan.

A comparable time period was used if data was not available during the same time period. Traffic counts for one the signalized intersection - Route 17/Eagle Harbor Pkwy/Kings Cross were not available. Hence, peak hour turning movements (TMCs) for this intersection were estimated using 2017 peak hour TMCs from Traffic Impact Analysis for The Pitt & Lippe (2019) report. In addition, 2017 existing conditions Synchro model, existing traffic signal timing data and traffic signal design plan details were provided by VDOT Hampton District.

2.5 Peak Hour Determination and Heavy Vehicle Percentages

A network-wide peak hour was developed for both the AM and PM peak periods. The AM and PM peak hours for the study area were determined by first reviewing the individual intersection and arterial peak hours. Traffic volumes during each hour were then compared to the traffic volumes during the peak hour at each location. The hours that captured the highest percentage of overall traffic in the network when compared to individual peaks were identified as the peak hours for the Study. The network-wide peak hours were determined to be 6:30 AM – 7:30 AM and 4:45 PM – 5:45 PM. The peak hour determination summary tables are provided in ***Appendix B-2*****.** Additionally**,** heavy vehicle percentages for each movement were calculated for all study intersections during the AM and PM peak hours based on raw traffic data.

2.6 Traffic Volume Balancing

Traffic volumes were hand balanced, where appropriate, throughout the study area in preparation for the existing conditions operations analyses. The following assumptions were used to balance traffic volumes:

- Raw traffic volumes should not be adjusted by more than 10 percent, if possible
- Peak hour traffic volumes were balanced between all study area intersections except at locations where imbalances existed due to the presence of significant roads or driveways.

The balanced 2019 AM and PM peak hour traffic volumes in the study area are shown in ***Figure 3*** and ***Figure 4.***

Figure 3. Existing 2019 AM Peak Hour Balanced Traffic Volumes

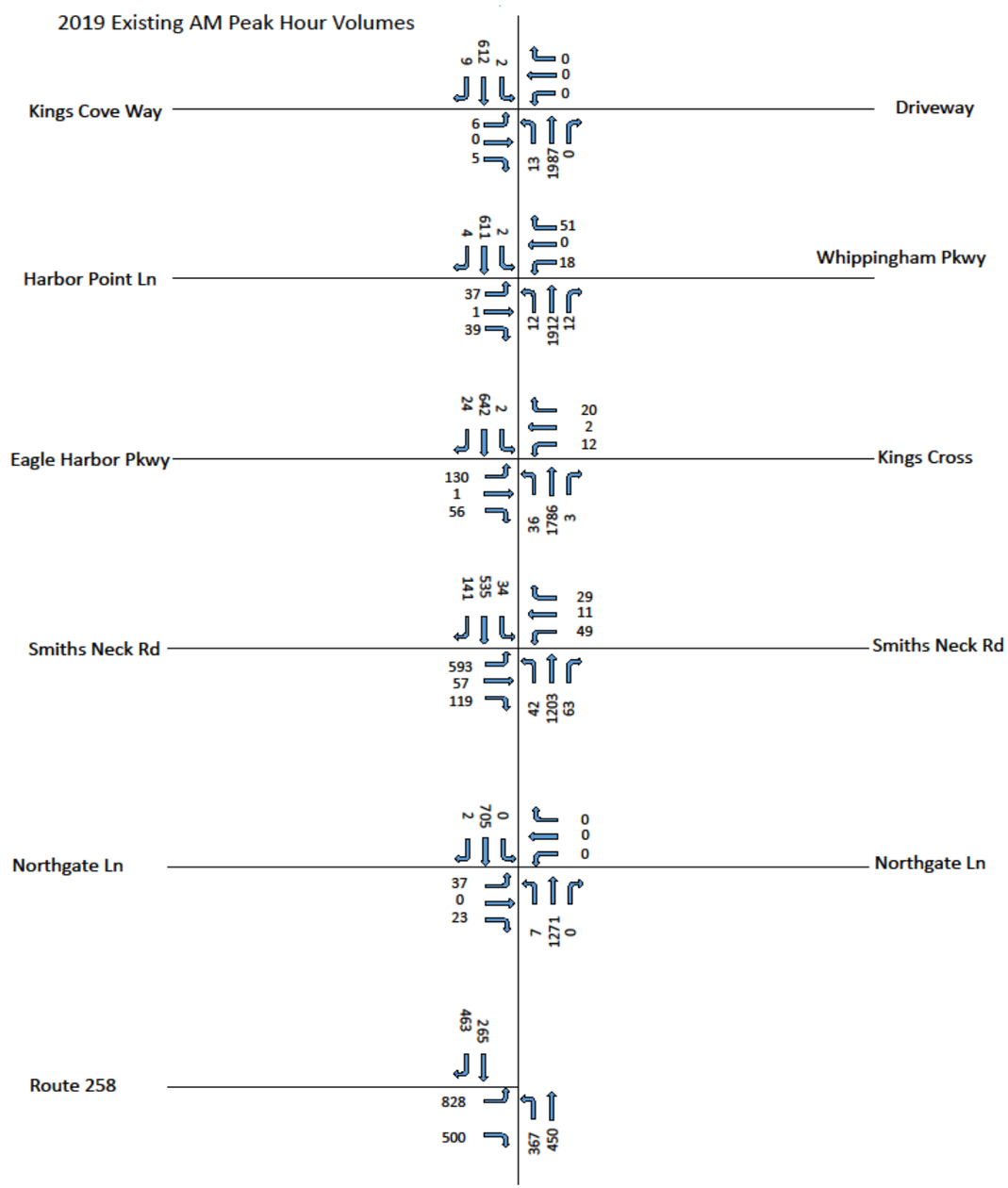
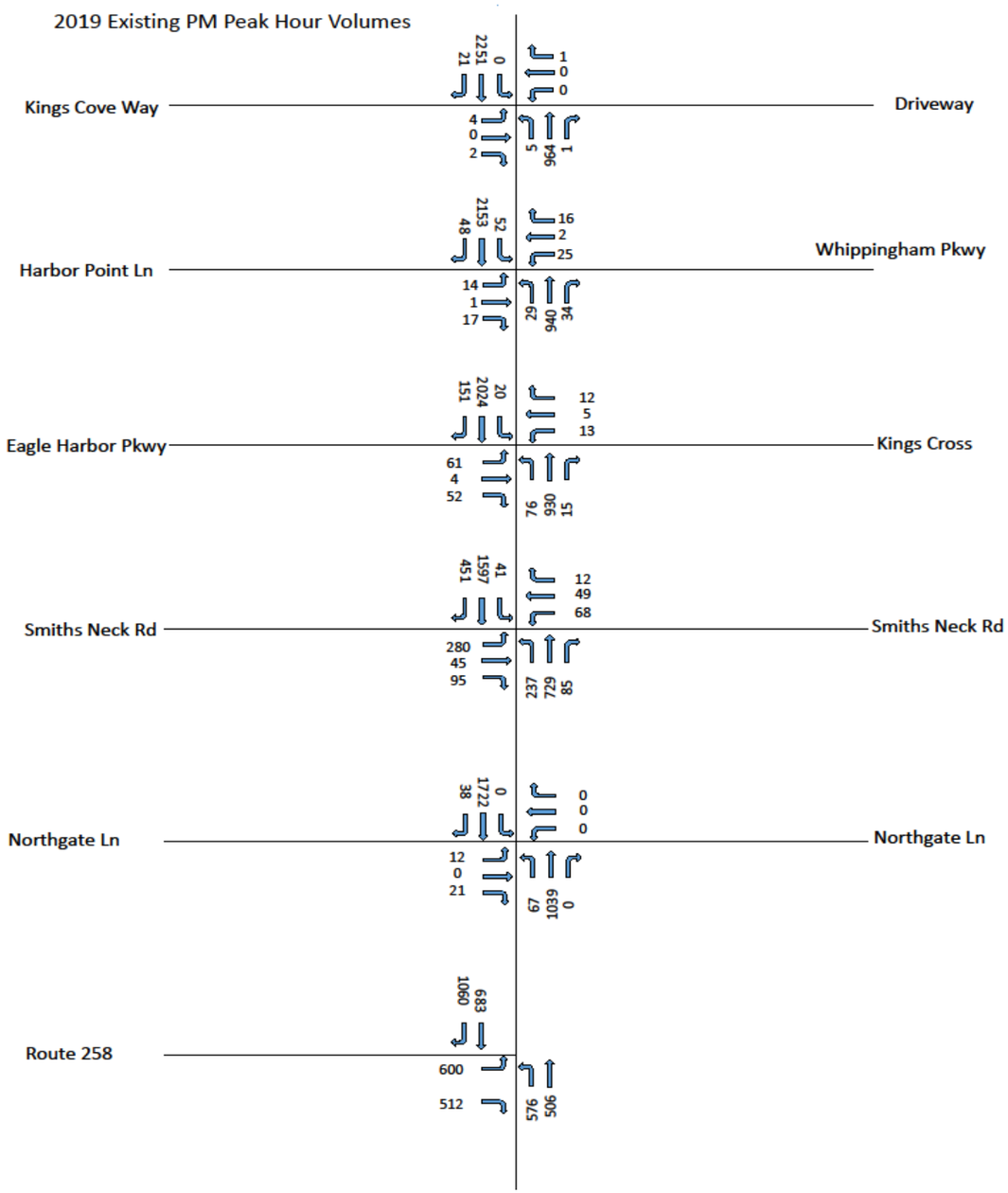


Figure 4. Existing 2019 PM Peak Hour Balanced Traffic Volumes



3. Safety Analysis

Crash data for the most recent five (5) years (January 1st, 2015 through December 31st, 2019) was obtained from VDOT Roadway Network System (RNS). Crash data was used to evaluate corridor safety and identify crash patterns. The following sections provide a summary of the crashes that occurred within the project study area during the five-year period.

3.1 Summary of Corridor Crashes

Crashes by Year and Severity

Over the five year period, 253 crashes has been reported within the study area. One fatal crash was reported during this 5-year study period. This fatality is pedestrian fatality which occurred at Route 17 and Harbor Point Lane intersection. In addition, there were 76 injury crashes and 176 crashes involving property damage only (PDO). A yearly summary of crashes by crash severity is shown in ***Table 1*****.**

Table 1 Study Area Crashes by Crash Severity

	Number of Crashes					
Year	**Fatality (K)**	**Incapacitating Injury (A)**	**No Injury (O)**	**Non-Incapacitating Injury (B)**	**Possible Injury (C)**	**Grand Total**
2015		1	27	6		34
2016		5	41	12		58
2017	1	6	39	15		61
2018		2	26	14	1	43
2019		5	43	8	1	57
Total	**1**	**19**	**176**	**55**	**2**	**253**

Crashes by Type

As shown in ***Table 2*****,** the majority of crashes that occurred were rear-end crashes (48 %), followed by angle crashes (17%) and fixed object –off road (8 %). This follows a typical pattern for roadways with signalized intersections, as the most common type of crash are rear-end.

Table 2 Study Area Crashes by Crash Type

	Crashes By Type					
Crash Type	**2015**	**2016**	**2017**	**2018**	**2019**	**Total**
Rear End	14	24	28	23	32	121
Deer	2	2	5		5	14
Ped			1			1
Backed Into			1			1
Other	2	6	5	1	2	16
Angle	7	8	13	7	9	44
Head On	1	2	1	3		7
Sideswipe - Same Direction	3	4	4	3	3	17
Sideswipe - Opposite Direction	1	2				3
Fixed Object in Road				2		2
Non-Collision		5	2	1		8
Fixed Object - Off Road	4	5	1	3	6	19
Total	**34**	**58**	**61**	**43**	**57**	**253**

Crashes by Roadway and Weather Conditions

Table 3 indicates the number of crashes by roadway surface condition. The majority (87%) of crashes occurred during dry roadway conditions. Wet conditions accounted for 11% of crashes.

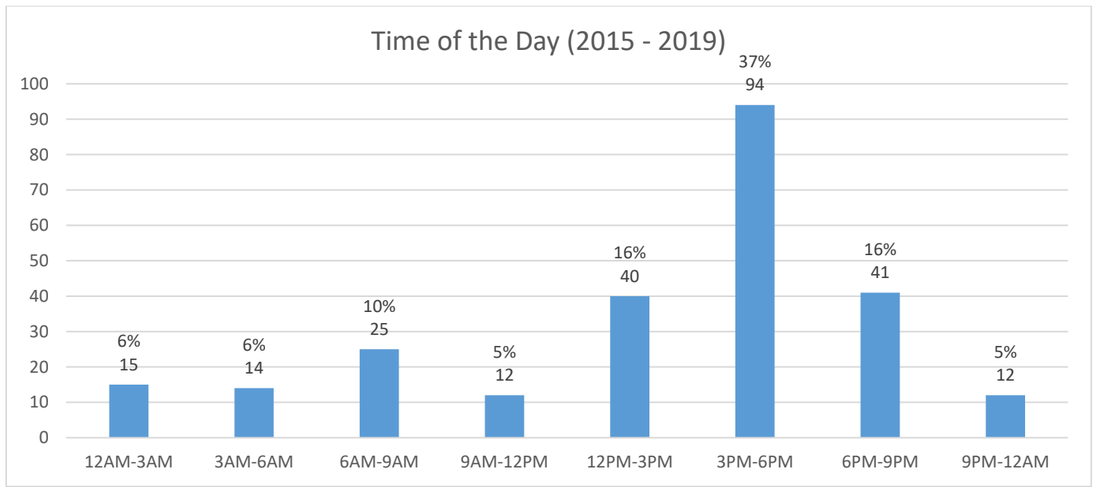
Table 3: Crashes by Roadway Surface condition

Surface Condition Type	Number of Crashes
Dry	220
Wet	29
Snowy	1
Icy	2
Other	1
Total	**253**

Crashes by Time of Day

Figure 5 displays the number of crashes that occurred by time of day, presented in 3-hour increments. The highest frequency of crashes occurred from 3PM-6PM (37%), from 6PM-9PM (16%), from 12PM-3PM (16%), from 6AM-9AM (10%).

Figure 5 Crashes by Time of the Day



3.2 Crash Analysis by Intersection

The study area crashes were assigned to intersections using intersection influence areas. For purpose of analysis, 250 ft. buffer was used as catchment area for intersection related crashes. However, the intersection influence areas were extended to the back of tapers for turn lanes on each approach to include intersection related crashes. ***Table 4*** shows number of crashes at intersection. Highest number of crashes occurred at signalized intersections such as Route 17 and Smiths Neck Road (38%), followed by Harbor Point Lane (25%) and Eagle Harbor Parkway (23%).

Table 4: Crashes by Intersections

Intersection	Number of Crashes
Route 17 at Eagle Harbor Parkway	35
Route 17 at Harbor Point Lane	39
Route 17 at Kings Cove Way	16
Route 17 at Northgate Lane	5
Route 17 at Smiths Neck Road	59
Total	154

Table 5 shows crashes by intersection by severity. As mentioned in previous section, one pedestrian fatality occurred at the intersection of Route 17 and Harbor Point Lane/Whippingham Parkway. Additionally, there is a funded SMARTSCALE 2018 application at the intersection of Route 17 and Eagle Harbor Pkwy. It includes installation of one crossing at Route 17 and one side street crossing parallel to Route 17 at Eagle Harbor Parkway. It will require the construction of a pedestrian refuge island in the median of Route 17, along with replacing the existing ADA curb ramps, adding crosswalk striping, and pedestrian signals with pedestrian pushbuttons. At the intersection of Route 17 and Smiths Neck Road, out 59 crashes, Incapacitating Injury (A) and Non-Incapacitating Injury (B) together, comprised of about 47 percent of crashes at this intersection.

Table 5: Crash Severity by Intersection

Crash Severity by Intersection	Number of Crashes
Route 17 at Eagle Harbor Pkwy	**35**
No Injury (O)	30
Non-Incapacitating Injury (B)	5
Route 17 at Harbor Point Lane	**39**
Fatality (K)	1
Incapacitating Injury (A)	1
No Injury (O)	26
Non-Incapacitating Injury (B)	9
Possible Injury (C)	2
Route 17 at Kings Cove Way	**16**
Incapacitating Injury (A)	1
No Injury (O)	12
Non-Incapacitating Injury (B)	3
Route 17 at Northgate Lane	**5**
No Injury (O)	4
Non-Incapacitating Injury (B)	1
Route 17 at Smiths Neck Road	**59**
Incapacitating Injury (A)	11
No Injury (O)	31
Non-Incapacitating Injury (B)	17
Total	**154**

Table 6 shows crash types at study intersections. Most of the rear-ended crashes occurred at Eagle Harbor Pkwy, Harbor Point Lane and Smiths Neck Road. Additionally, out of 39 angle crashes, 22 of these crashes occurred at the intersection of Route 17 and Smiths Neck Road.

Table 6: Crash Types at Study Intersections

Crash Type	Route 17 at Eagle Harbor Parkway	Route 17 at Harbor Point Lane	Route 17 at Kings Cove Way	Route 17 at Northgate Lane	Route 17 at Smiths Neck Road	Grand Total
Rear End	25	25	3	1	18	72
Deer	2	1			1	4
Pedestrian		1				1
Backed Into		1				1
Other	2		4		4	10
Angle	4	7	5	1	22	39
Head On		1			5	6
Sideswipe - Same Direction			1		5	6
Sideswipe - Opposite Direction			1		2	3
Fixed Object in Road		1				1
Non-Collision	1		1		1	3
9. Fixed Object - Off Road	1	2	1	3	1	8
Total	**35**	**39**	**16**	**5**	**59**	**154**

3.3 Average Crash Rate

The 2019 average crash rate for primary roads in Hampton district is 105.3 crashes per 100 million vehicle-miles traveled. This information was extracted from Tableau version of the Crash Summary Book[1] published by VDOT Traffic Engineering Division. The calculated crash rate of the study corridor is 202 crashes per 100 million vehicle-miles traveled. The formula used to calculate average crash rate is provided below:

$$R = \frac{C \times 100{,}000{,}000}{V \times 365 \times N \times L}$$

The variables in this equation are:

- R = Roadway crash rate for the road segment expressed as crashes per 100 million vehicle-miles of travel
- C = Total number of roadway departure crashes in the study period
- V = Traffic volumes using Average Annual Daily Traffic (AADT) volumes
- N = Number of years of data
- L = Length of the roadway segment in miles

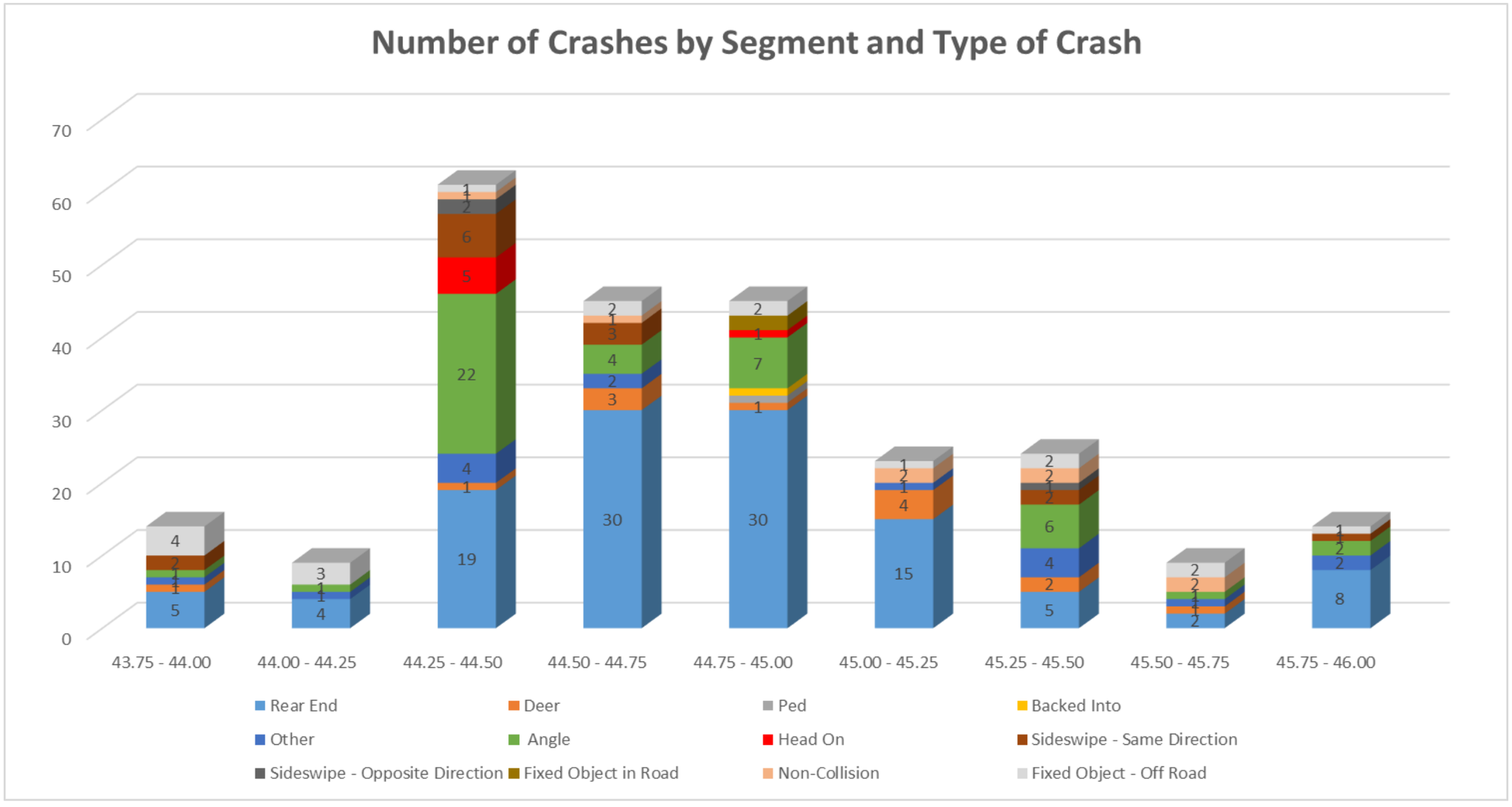
The average crash rate comparison indicates that the study corridor crash rate is much higher than similar roads in the Hampton Roads district.

[1] CRASH SUMMARY BOOK
https://public.tableau.com/app/profile/tien.simmons/viz/CRASHSUMMARYBOOK/TITLE_1)

3.4 Crash Analysis by Segment (0.25 miles)

For purpose of analysis, the study area was divided into 0.25 miles segments using mileposts in GIS. As shown in ***Figure 6,*** the highest number of crashes (61) were found from milepost (mp) 44.25 to 44.50, followed by 45 crashes each along 44.50 to 44.75 mp and 44.75 to 45.00 mp. These segments correspond to roadways along intersection of Route 17 at Smiths Neck Road, Eagle Harbor Pkwy and Whippingham Parkway.

Figure 6 Number of Crashes by Segment and Type of Crash



3.5 Access Spacing

An evaluation of the existing driveways and access points along the study area corridor was completed to assess compliance with VDOT Access Management Design Standards for Entrances and Intersections, which is included as Appendix F of the VDOT Roadway Design Manual. The assessment involved analysis of existing spacing of driveways and intersections and complies with VDOT minimum spacing standards for access points. ***Table 7*** provides a summary of the minimum spacing requirements for a design speed limit of 45 mph to 55 mph for a Principal Arterial. ***Table 8*** through ***Table 11*** show assessment of access point spacing within the study corridor.

Table 7 Access Management Design Standards

Functional Class	Design Speed	Minimum Spacing Standard (feet)			
		Type 1 (Spacing between Signalized Intersection and Signalized Intersection)	Type 2 (Spacing between Unsignalized Intersection/Full Median Crossover and Signalized Intersection/Unsignalized Intersection/Full Median Crossover)	Type 3 (Spacing between Full Access Entrance or Directional Median and Any Intersection, Full Access Entrance, or Median Crossover)	Type 4 (Spacing between Partial Access Entrance and Any Entrance, Intersection, or Median Crossover)
Principal Arterial	35 to 45 mph	1,320	1,050	565	305
	≥ 50 mph	2,640	1,320	750	495

Table 8 Access Spacing for Type 1 Access Points

Route 17 Segment	Distance (in ft.)	Compliance with VDOT Access Spacing Standards	Deficient length (in ft.)
Between Route 258 and Smiths Neck Road	4600	Compliant	N/A
Between Smiths Neck Road and Eagle Harbor Parkway	1068	Non-Compliant	252
Between Eagle Harbor Parkway and Whippingham Parkway	1172	Non-Compliant	148

Table 9 Access Spacing for Type 2 Access Points

Route 17 Segment	Distance (in ft.)	Compliance with VDOT Access Spacing Standards	Deficient length (in ft.)
Between Route 258 and Northgate Lane	3291	Compliant	N/A
Between Northgate Lane and Smiths Neck Road*	1307	Compliant	N/A
Between Kings Cove Way and Whippingham Parkway*	2892	Compliant	N/A
Between Kings Cove Way and median crossover at Ragged Island Parking Area	1720	Compliant	N/A

*Design Speed varies between 45 mph and 55 mph

Table 10 Access Spacing for Type 3 Access Points

Route 17 Segment	Distance (in ft.)	Compliance with VDOT Access Spacing Standards	Deficient length (in ft.)
Between Route 258 and Median Cross Over at Dashing Dogs/Ferguson's Automotive & Electrical Repair	1178	Compliant	N/A
Between median crossover at Dashing Dogs/Ferguson's Automotive & Electrical Repair and Northgate Lane	2103	Compliant	N/A
Between Whippingham Parkway and median crossover at Dock of the Bay*	1462	Compliant	N/A
Between median crossover at Dock of the Bay and Kings Cove Way	1427	Compliant	N/A

*Design Speed varies between 45mph and 55 mph

It should be noted that median crossover at Dashing Dogs/ Ferguson's Automotive & Electrical Repair is proposed to be a signalized intersection (Route 17 and Nike Park Ext. Road). In this case, access spacing between proposed Nike Park Ext. Road and Route 258 signal will not adhere to VDOT access spacing standards and would be deficient by 1470 ft. approximately.

Table 11 Access Spacing for Type 4 Access Points

Route 17 Segment	Distance (in ft.)	Compliance with VDOT Access Spacing Standards	Deficient length (in ft.)
Between entrance at Johns Brothers Security and median crossover at Dashing Dogs/Ferguson's Automotive & Electrical Repair	248	Non-Compliant	247
Between median crossover at Dashing Dogs/Ferguson's Automotive & Electrical Repair and entrance at 14114 Carrollton Blvd	725	Compliant	N/A
Between entrance at 14114 Carrollton Blvd and Northgate Lane	1396	Compliant	N/A
Between median crossover at Dashing Dogs/Ferguson's Automotive & Electrical Repair and James River Trail	1265	Compliant	N/A
Between James River Trail and Northgate Lane	823	Compliant	N/A
Between Northgate Lane and Fiddler Lane	856	Compliant	N/A
Between Fiddler Lane and Smiths Neck Road	456	Compliant	N/A
Between Northgate Lane and entrance to Virginia Barbeque/Bayview Physical Therapy	620	Compliant	N/A
Between entrance to Virginia Barbeque/Bayview Physical Therapy and Smiths Neck Road	672	Compliant	N/A
Between Smiths Neck Road and entrance at 7-Eleven	464	Compliant	N/A
Between entrance at 7-Eleven and Kings Cross Road	577	Compliant	N/A
Between Smiths Neck Road and entrance to Bank/Sonic Drive	555	Compliant	N/A
Between entrance to Bank/Sonic Drive and Eagle Harbor Parkway	510	Compliant	N/A

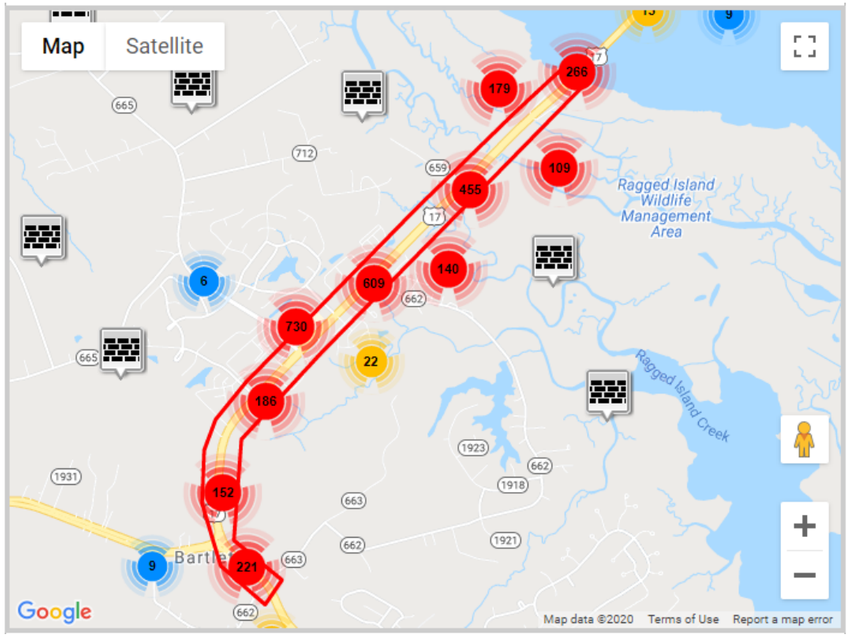
4. MetroQuest Public Involvement: Existing Conditions Survey Feedback

The Route 17 MetroQuest survey was launched to virtually collect public feedback on existing traffic and safety issues within the study corridor. The survey was live from 10th January, 2020 to 21st January, 2020 during which 1808 participants responded to the survey. Following is the summary of the public survey:

- Most respondents traveled the corridor 'Daily' followed by a 'A few times per week'
- 'Work' was the primary reason respondents traveled along the corridor followed by 'Shopping/Errands'
- Highest ranked mode of travel is 'Personal vehicle' followed by 'Truck/Commerical Vehicle'
- Congestion was noted as an issue in the 'weekday afternoons' followed by 'weekday evenings/nights' in southbound travel directions during these time periods
- 'Through travel' followed by 'difficulty making left turns' and 'Vehicle blocking entrances' were the top ranked accessibility issues
- 'Congestion' followed by 'sudden stops and rear-end' and 'aggressive or distracted behavior' were the top ranked safety issues
- 'Sidewalks / crosswalks' were the most requested multimodal facilities followed by 'shared used path '

Figure 7 shows the areas along the corridor where congestion, safety and other issues were identified by the participants.

Figure 7 Hotspots within the Study Area



5. Existing Conditions Analysis

Traffic operational analyses were conducted to evaluate the overall performance of the study corridor under existing (2019) AM and PM peak hour conditions. The intent of the existing conditions analyses was to provide a general understanding of the baseline traffic conditions as a starting point for developing future improvement strategies. Existing conditions were modeled using Synchro, Version 10 and SimTraffic, Version 10. Five simulations were conducted for both the AM and PM models using different random seeds.

5.1 Traffic Analysis Results

Three measures of effectiveness were selected to measure the quantitative performance of the study area intersections:

- Control delay by lane group, approach, and intersection – measured in seconds per vehicle [Synchro 10]
- Maximum queue length by lane group – measured in feet [SimTraffic 10]
- Travel time by direction – measured in seconds [SimTraffic 10]

Level of Service

Level of Service (LOS) was used to supplement control delay results from Synchro 10 based on the criteria outlined in the *Highway Capacity Manual (HCM) 2000*. LOS is a quality measure describing operating conditions and the driver's perception of those conditions. LOS A indicates a condition of little or no congestion whereas LOS F indicates a condition of severe congestion, unstable traffic flow, and stop-and-go conditions. ***Delay*** is reported from Synchro using HCM 2000 methodology ***Table 12*** summarizes the delay thresholds associated with each LOS category for signalized and unsignalized intersections. If intersection traffic volume exceeds capacity, LOS F is automatically reported.

Table 12.Signalized and Unsignalized Intersection LOS Criteria

LOS	Control Delay (sec/veh)	
	Signalized Intersections	Unsignalized Intersections
A	≤ 10	≤ 10
B	> 10 – 20	> 10 – 15
C	> 20 – 35	> 15 – 25
D	> 35 – 55	> 25 – 35
E	> 55 – 80	> 35 – 50
F	> 80	> 50

Control Delay and LOS Results

Table 13 summarized existing conditions LOS and control delay for study intersections by lane group, approach, and intersection at each study area intersection. The results show, Route 17 at Whippingham Parkway and Eagle Harbor Parkway are operating at an acceptable overall LOS B and intersection of Route 17 and Smiths Neck Road is operating at LOS D during the PM peak hour. In the AM peak hour, Route 17 at Whippingham Parkway and Eagle Harbor Parkway are operating at an acceptable overall LOS C and intersection of Route 17 and Smiths Neck Road is operating at LOS D.

Table 13. Existing (2019) LOS and Delay for signalized intersections

Intersection Name	Type of Control	Lane Group	Eastbound				Westbound				Northbound				Southbound				Overall	
			AM		PM		AM		PM		AM		PM		AM		PM		AM	PM
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS		
Route 17/Kings Cove Way	Two-Way Stop	Left	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**Delay**	**Delay**
		Through	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**	**-**
		Right	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**LOS**	**LOS**
		Approach	55.3	F	691.2	F	0.0	A	12.2	B	-	-	-	-	-	-	-	-	**-**	**-**
Route 17/ Harbor Point Lane/Whippingham Parkway	Signal	Left	-	-	-	-	-	-	-	-	8.1	A	99.7	F	16.5	B	4.4	A	**Delay**	**Delay**
		Through	54.1	D	97.1	F	53.7	D	98.4	F	31.6	C	2.0	A	8.9	A	15.3	B	**27.3**	**13.7**
		Right	50.8	D	93.8	F	52.2	D	92.8	F	6.6	A	5.2	A	7.0	A	4.9	A	**LOS**	**LOS**
		Approach	52.4	D	95.4	F	52.6	D	96.3	F	31.3	C	4.9	A	8.9	A	14.8	B	**C**	**B**
Route 17/Eagle Harbor Parkway/Kings Cross	Signal	Left	-	-	-	-	-	-	-	-	9.0	A	93.9	F	33.1	C	6.3	A	**Delay**	**Delay**
		Through	53.9	D	98.3	F	55.2	E	97.5	F	28.9	C	14.4	B	23.4	C	11.1	B	**29.0**	**17.1**
		Right	44.6	D	87.8	F	53.3	D	93.6	F	9.7	A	6.5	A	11.0	B	4.0	A	**LOS**	**LOS**
		Approach	51.1	D	93.6	F	54.1	D	95.9	F	28.4	C	20.2	C	22.9	C	10.5	B	**C**	**B**
Route 17/Smiths Neck Road	Signal	Left	64.9	E	114.4	F	56.3	E	101.8	F	54.9	D	117.5	F	55.1	E	92.9	F	**Delay**	**Delay**
		Through	61.6	E	112.0	F	51.9	D	94.2	F	35.3	D	17.0	B	37.9	D	36.5	D	47.1	**46.2**
		Right	34.7	C	78.2	E	-	-	-	-	18.7	B	13.4	B	122.0	F	22.3	C	**LOS**	**LOS**
		Approach	58.9	E	105.3	F	54.3	D	98.2	F	35.1	D	39.4	D	55.4	E	34.6	C	**D**	**D**
Route 17/Northgate Lane	Two-Way Stop	Left	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**Delay**	**Delay**
		Through	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**	**-**
		Right	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**LOS**	**LOS**
		Approach	35.2	E	226.7	F	0.0	A	0.0	A	-	-	-	-	-	-	-	-	**-**	**-**

NOTE: Lane configurations with a shared through lane shown as "through" lane group; with shared left-right lane shown as "left" lane group

Maximum Queue Length and Travel Time Results

Queue length, or the distance to which stopped vehicles accumulate in a lane at an intersection, is another performance measure of intersection operation. Lengthy queues may be indicative of intersection capacity or operational issues, such as absence of or insufficient dedicated turn lanes, inefficient signal timings or inappropriate phasing. A queuing analysis was completed for the study intersections during the peak hours. SimTraffic maximum queue lengths in feet were reported for each lane in ***Table 15***. Results indicate significant queueing in the southbound direction during PM peak hour at Route 17 and Smiths Neck Road intersection and the queue spills back to the next intersection which is Route 17 at Eagle Harbor Parkway. During the field trip, significant rolling queues were observed starting from Smiths Neck Road intersection and extending beyond the James River Bridge in the southbound direction during the PM peak hour. Additionally, at Route17 and Smiths Neck Road intersection, the northbound left and westbound left movement queues exceed storage length in the PM peak hour. At this intersection, northbound left and northbound right movement queues exceed their storage lengths during AM peak hour. At the intersection of Route 17 at Eagle Harbor Parkway, westbound right movement queues exceed the storage length during the peak hours. In addition to queuing analysis, travel times in both the directions are also reported to analyze mobility under existing conditions in ***Table 14.***

Table 14 Travel Time within Study Area in Existing (2019) Conditions

	Travel time (sec)	
Direction	**AM Peak Hour**	**PM Peak Hour**
Northbound	194.7	154.6
Southbound	172.8	245.3

Table 15 Existing (2019) Summary of Maximum Queues (in ft.)

Intersection Name	Type of Control	Lane Group	Eastbound			Westbound			Northbound			Southbound		
			Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)
Route 17/Kings Cove Way	Two-Way Stop	Left	-	56	43	-	-	18	264	21	23	317	14	-
		Through	-			-	-		-	-	-	-	2	-
		Right	-			-	-		-	-	-	-		-
Route 17/ Harbor Point Lane/Whippingham Parkway	Signal	Left	-	81	64	-	50	80	271	93	102	269	2	140
		Through	-			-			-	364	131	-	115	615
		Right	170	48	64	550	69	26	205	128	17	214	0	177
Route 17/Eagle Harbor Parkway/Kings Cross	Signal	Left	-	204	168	-	60	78	250	46	162	306	16	197
		Through	-			-			-	310	232	-	201	767
		Right	220	82	105	65	63	60	243	102	58	228	116	228
Route 17/Smiths Neck Road	Signal	Left	465	355	266	140	106	137	285	284	284	298	118	297
		Through*	-	386	304	-	88	180	-	484	451	-	230	954
		Right	-	85	167	-			238	238	117	344	85	344
Route 17/Northgate Lane	Two-Way Stop	Left	-	94	51	-	-	-	245	24	106	73	-	-
		Through	-			-	-	-	-	-	-	-	-	-
		Right	160	44	66	-	-	-	220	-	-	200	-	-

*This movement is shared left-through in the eastbound direction and shared through-right in the westbound direction.
'-'Storage Bay Length not provided or the movements do not exist.
Red text indicates queue lengths that exceed the available storage lengths or link distance.

6. Traffic Forecasting

6.1 Traffic Forecasting and Growth Rate Development

The following sources were reviewed to determine growth rates to apply to existing traffic volumes to forecast future volumes:

- Historic AADT Data published by VDOT
- Statewide Planning System (SPS) suggested growth rates
- Growth Rate from HRTPO MODEL
- Previous Studies and TIA's within the corridor

Additionally, annual growth rates were calculated using linear regression. This information was discussed and approved by the SWG. Based on the historic AADT data as shown in ***Table 17***, review of TMPD/SPS recommended growth forecasts, previous studies and an understanding of the potential for development in the study area, the SWG adopted the linear annual growth rate of 1.5% on Route 17 and Route 258; and 1% on side streets within the study corridor.

These selected growth rates were applied to the existing balanced 2019 traffic volumes to compute 2030 and 2045 background traffic volumes for future conditions analysis. Intersection Turning Movements were forecasted using FRATAR Technique. Future Background volumes were adjusted with Nike Park diversion trips and trip generations of approved developments volumes (See ***6.2 Traffic Assumptions: Land Development and TIA Considerations).***

Table 16 Previous Studies and TIA within corridor

Referenced Study/Data source	Route	Segment	Annual Growth Rate
The Pitt and Lippe TIA Report 2017	Route 17	Whole study corridor and side streets	1.5 percent exponential
Brewer's Neck Study 2014	Route 17	Whippingham Parkway/Harbor Point Ln to Brewer's Neck Boulevard	1.5 percent
	Route 17	Brewer's Neck Boulevard to Omera Drive/Ashby Way	1.25 percent
	Route 258	All	1 percent

Table 17 VDOT Historic Traffic Volumes (veh/day)

Year	Route 17 from Merritt Cove to Brewers Neck Boulevard	Route 17 from Brewers Neck Boulevard to Smiths Neck Road	Route 17 from Smiths Neck Road to James River Bridge	Route 17 from James River Bridge to Newport News CL	Route 258 from Bartlett Cir to Carrollton Boulevard	Smiths Neck Road from Carrollton Boulevard to Reynolds Drive North
1997	18,516	22,631	22,631	22,631	22,631	-
1998	19,000	22,873	22,873	36,698	23,000	-
1999	12,186	22,918	22,918	36,770	20,612	-
2000	12,301	23,134	23,134	37,117	20,882	-
2001	12,931	24,321	24,321	25,180	21,206	-
2002	11,939	25,166	25,166	26,055	22,764	-
2003	12,454	26,251	26,251	27,178	23,201	-
2004	13,009	27,421	27,421	29,337	23,538	-
2005	14,982	27,833	27,833	29,778	25,225	10,407
2006	14,985	27,838	27,838	29,783	25,316	10,444
2007	15,197	28,233	28,233	28,978	26,161	10,793
2008	14,078	27,612	27,612	28,341	22,140	10,864
2009	14,197	27,845	27,845	28,580	22,709	11,143
2010	14,634	27,516	27,516	27,201	23,646	11,603
2011	14,720	27,823	27,823	27,504	24,708	10,674
2012	14,965	28,609	28,609	28,107	24,161	10,438
2013	15,210	28,464	28,464	27,801	24,297	10,497
2014	14,878	28,149	28,149	27,909	24,247	11,310
2015	15,281	28,912	28,912	28,016	24,729	11,535
2016	15,334	29,012	29,012	29,026	25,624	11,952
2017	15,670	28,907	28,907	28,921	24,319	11,171
2018	15,770	29,091	29,091	29,105	24,367	11,193
SPS Growth Rate	0.255	1.029	1.029	0.50	0.002	1.023
TMPD suggested Growth Rate from SPS	0.61	1.80	1.80	0.83	1.21	1.04

Table 18 Calculated Line Regression Growth Rate

Route	SEGMENT_FROM	SEGMENT_TO	Regression Growth Per Year	Forecast Year	Forecast Volume	R^2	2018 Growth rate	Forecast Year	Forecast Volume
Route 17	Merritt Cove	Brewers Neck Boulevard	-1182	2030	33812	0.01917	-7.49367	2045	16085
Route 17	Brewers Neck Boulevard	Smiths Neck Road	310	2030	33812	0.80743	1.06457	2045	38457
Route 17	Smiths Neck Road	James River Bridge	310	2030	33812	0.80743	1.06457	2045	38457
Route 17	James River Bridge	Newport News Cl	-139	2030	25955	0.06511	-0.47898	2045	23864
Brewers Neck Boulevard	Bartlett Cir	Carrollton Boulevard	146	2030	26890	0.38964	0.59766	2045	29074
Smiths Neck Road	Carrollton Boulevard	Reynolds Drive North	67	2030	12247	0.32859	0.60132	2045	13256

6.2 Traffic Assumptions: Land Development and TIA Considerations

The following assumptions were made during the traffic forecasting process:

- With the development of Nike Park Extension Road, 40 percent of the background traffic from Smiths Neck Road is diverted to the intersection of Route 17/ Nike Park Extension. This assumption is adopted from the Pitt and Lippe TIA report.
- Trip generation, distribution and assignments of approved developments were kept same as in The Pitt & Lippe TIA Report. For intersections which do not have this information, traffic volumes were adjusted and balanced based on intersections- upstream or downstream.
- Development traffic of the following approved developments was added to background traffic to arrive at the final traffic forecast:
    - Benns Grant
    - St. Luke's Village
    - Riverside Medical Center
    - Red Oaks
    - Norsworthy
    - Eagle Harbor Tract 8
    - The Crossings
    - Archers Meade
    - Bridge Point Commons
    - Carrollton Manor
    - The Pitte & Lippe

The forecasted 2030 and 2045 volumes are presented in *Figure 8* through ***Figure 11***. Detailed future traffic volume development worksheets are provided in ***Appendix C***.

Figure 8 Future 2030 AM Peak Hour Traffic Volumes

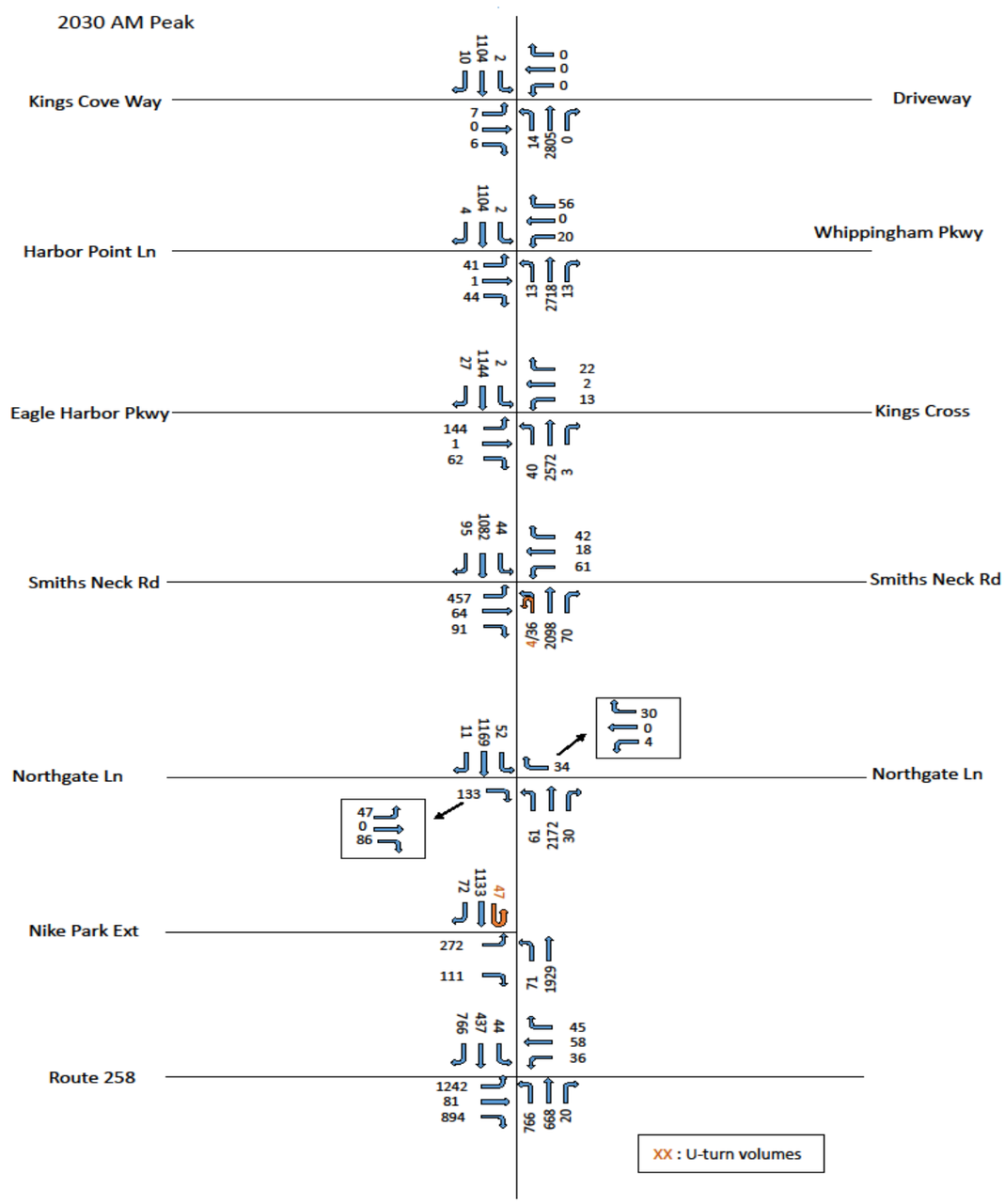


Figure 9 Future 2030 PM Peak Hour Traffic Volumes

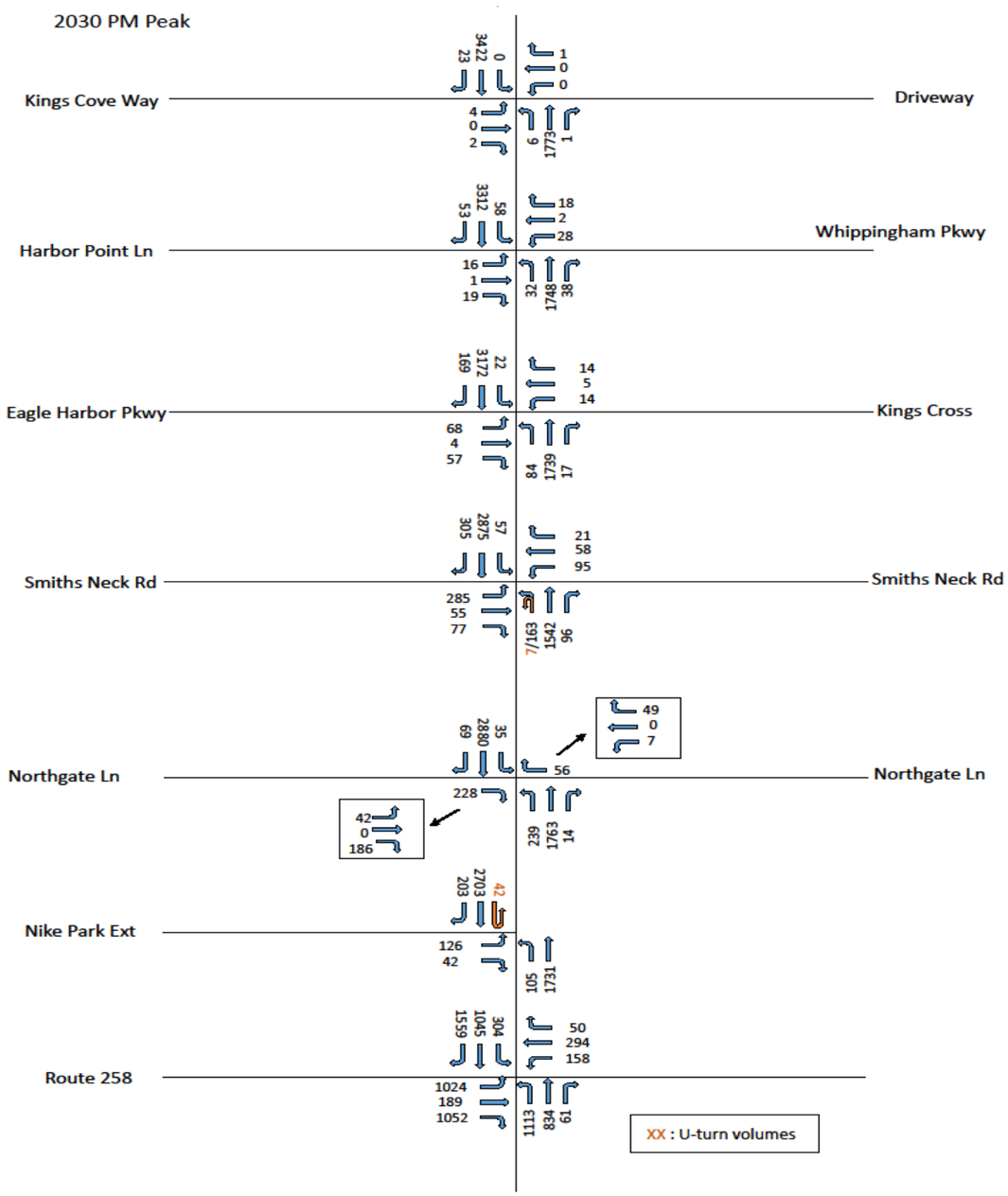


Figure 10 Future 2045 AM Peak Hour Traffic Volumes

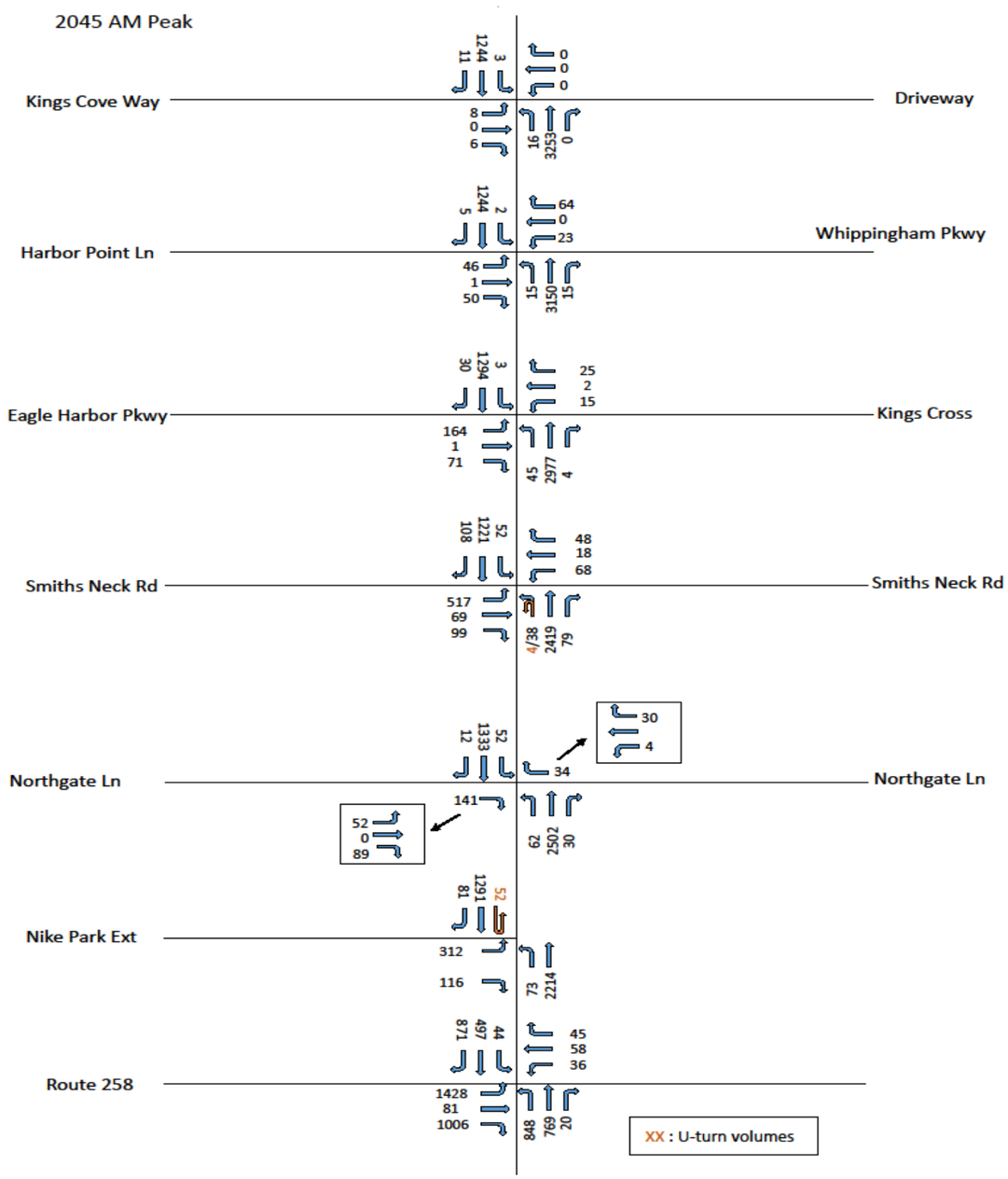
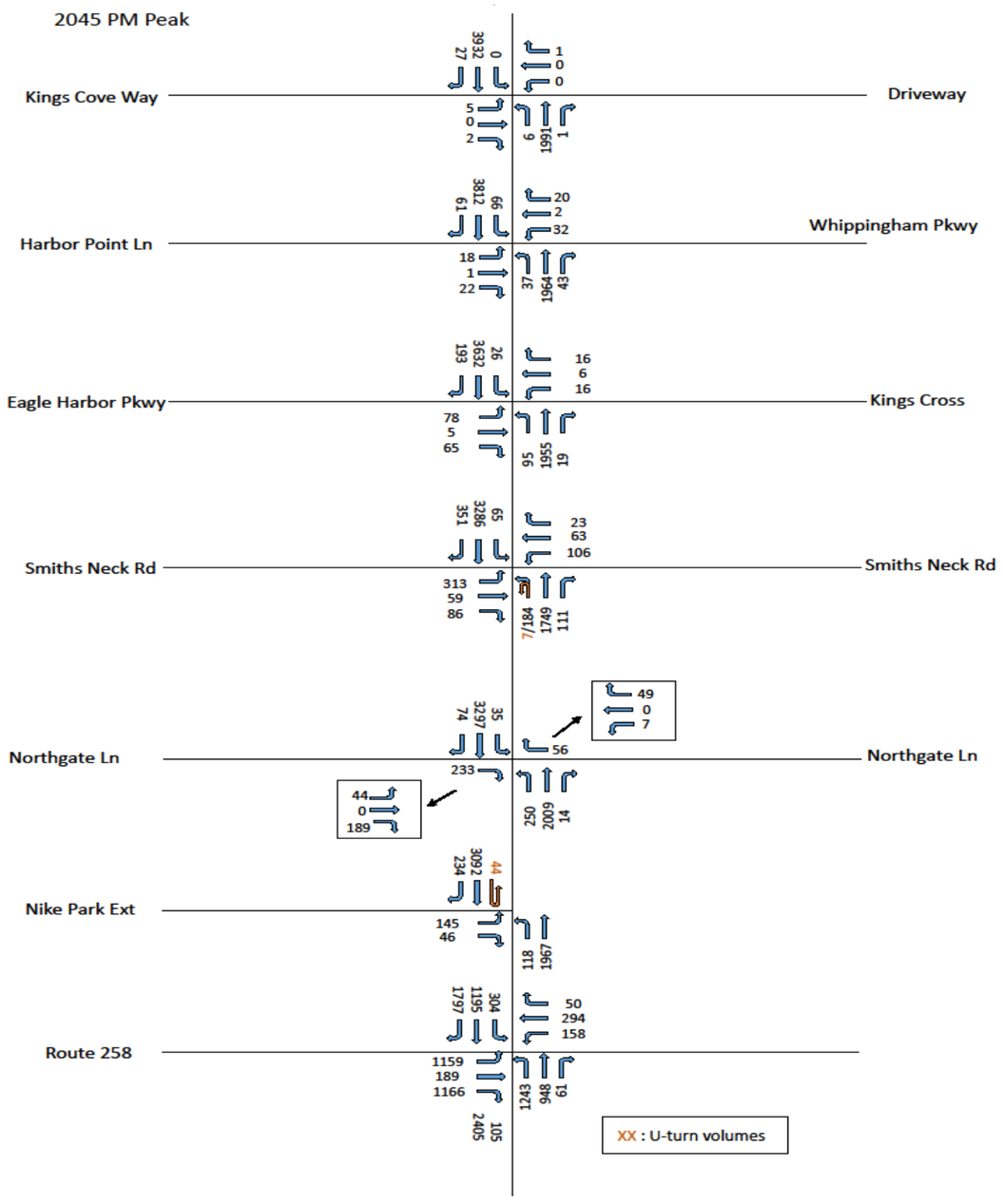


Figure 11 Future 2045 PM Peak Hour Traffic Volumes



7. No-Build Conditions Analysis

Traffic operational analyses were conducted to evaluate the overall performance of the study corridor under No-Build (2030 and 2045) AM and PM peak hour conditions. The intent of the No-Build conditions analyses was to provide a general understanding of the baseline future traffic conditions as a starting point for developing future improvement strategies. No-Build conditions were modeled using Synchro, Version 10 and SimTraffic, Version 10.

7.1 Background Improvements

The following improvements have been or are projected to be completed before 2030 and were included in the 2030 and 2045 No-Build Synchro models:

- A new signalized intersection of Nike Park Extension at Route 17 located between Brewers Neck Boulevard and Northgate Lane. Nike Park Extension will include dual lefts and an exclusive right-turn lane.
- Pedestrian Accommodations at Route 17/Eagle Harbor Parkway as part of the Smart scale application 4971 in Round 3 (FY2020) -This project includes one crossing of Route 17 and one side street crossing parallel to Route 17 at Eagle Harbor Parkway. It requires the construction of a pedestrian refuge island in the median of Route 17, along with replacing the existing ADA curb ramps, adding crosswalk striping, and pedestrian signals with pedestrian pushbuttons. This project was recently completed in December 2020 and included pedestrian push buttons at each corner of Eagle Harbor (1 on the right and 2 on the left) and Kings Cross (1 on the left and 2 on the right) for pedestrians to cross Rte. 17. There is a pedestrian push button (1) in the median of Route 17 also so traffic will not be backed up waiting for the pedestrian to cross the entire Rte. 17 at one time. This area has a refuge island for pedestrians.

The following proffers as described in the Pitt and Lippe TIA Report were also included in the 2030 and 2045 No-Build Synchro models:

<u>Route 17 at Smiths Neck Road</u>

Intersection improvements consist of the following improvements:

- Improve/extend the existing exclusive northbound left-turn lane to consist of 400 feet of storage and a 100-foot taper
- Improve/extend the existing exclusive southbound left-turn lane to consist of 400 feet of storage and a 100-foot taper
- Lane configuration for westbound approach of Smiths Neck Road includes the exclusive left-turn lane, through lane and exclusive right-turn lane.
- Lane configuration change for the eastbound approach of Smiths Neck Road to include dual exclusive left-turn lanes and a shared through/right turn lane.

<u>Route 17 at Northgate Lane</u>

Intersection improvements consist of the following improvements:

- Improve/extend the existing exclusive northbound right-turn lane to consist of 200 feet of storage and a 200-foot taper.
- Improve/extend the existing exclusive southbound left-turn lane to consist of 200 feet of storage and a 200-foot taper.
- Unsignalized Restricted crossing U-turn (RCUT) at the intersection of Route 17 and Northgate Lane.

7.2 Intersection Operations: Future 2030 and 2045 No-Build Conditions

Operational analysis was performed at each of the study intersections for the future 2030 & 2045 No-Build Conditions scenario. ***Table 19*** and ***Table 20*** summarize AM and PM peak hour delay and LOS for each movement for the study intersections along the Route 17 corridor. Synchro output sheets are provided in ***Appendix D***.

The results in ***Table 19*** show that, under Future 2030 No Build conditions in the AM peak period, Route 17 at Whippingham Parkway and Eagle Harbor Parkway are expected to operate at overall LOS F and Route 17 at Smiths Neck Road at LOS E. Additionally, Nike Park Ext and Route 17 intersection is shown to operate at LOS C. In the PM peak period, all signalized intersections are expected to operate at LOS F except the Nike Park Ext and Route 17 intersection which operates at LOS D.

Furthermore, the traffic conditions are anticipated to get worse as shown in ***Table 20***, under the Future 2045 No Build conditions during PM peak hour, all the signalized intersections are expected to operate at severely congested LOS F. In the AM peak hour, all the signalized intersections are expected to operate at LOS F except intersection of Route 17 and Nike Park which operates at LOS D.

In addition of LOS and Delay, queuing results from SimTraffic are summarized in ***Table 21*** and ***Table 22.*** Significant queues are expected in the southbound direction during PM peak hour conditions starting from Smiths Neck Road intersection and extending towards the James River Bridge in future years 2030 and 2045. Additionally, during AM peak hour, queuing is observed in the northbound direction starting from intersection of Route 17 at Nike Park Extension to Eagle Harbor Parkway. In addition to queues in the northbound direction, eastbound queuing is also observed in the AM peak hour at the intersection of Route 17 and Smiths Neck Road during the future years 2030 and 2045.

During 2030 and 2045, in the PM peak hour, northbound left movement and northbound right movement queues at the intersection of Route 17 at Smiths Neck Road intersection are exceeding their storage lengths. Additionally, Route 17 at Northgate Lane and Nike Park Extension has northbound left turn movement queues that exceed their storage lengths during PM peak hour. Furthermore, at the intersection of Route 17 and Eagle Harbor Parkway, westbound right movement queues are expected to exceed their storage lengths during AM and PM peak hours.

Table 19 Future 2030 No-Build Delay and LOS (veh/sec)

Intersection Name	Type of Control	Lane Group	Eastbound				Westbound				Northbound				Southbound				Overall	
			AM		PM		AM		PM		AM		PM		AM		PM		AM	PM
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS		
Route 17/Kings Cove Way	Two-Way Stop	Left		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**Delay**	**Delay**
		Through		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**	**-**
		Right		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**LOS**	**LOS**
		Approach	498.7	F	Err	F	0.0	A	19.0	C	-	-	-	-	-	-	-	-	**-**	**-**
Route 17/ Harbor Point Lane/Whippingham Parkway	Signal	Left		-	-	-		-	-	-	7.1	A	113.7	F	28.6	C	12.7	B	**Delay**	**Delay**
		Through	54.0	D	97.6	F	53.8	D	98.7	F	118.6	F	4.7	A	11.5	B	132.3	F	85.6	86.3
		Right	51.2	D	93.7	F	52.1	D	92.6	F	6.7	A	5.7	A	7.1	A	5.0	A	**LOS**	**LOS**
		Approach	52.6	D	95.6	F	52.6	D	96.4	F	117.5	F	6.6	A	11.5	B	128.3	F	**F**	**F**
Route 17/Eagle Harbor Parkway/Kings Cross	Signal	Left		-	-	-			-	-	11.9	B	126.9	F	27.3	C	14.5	B	**Delay**	**Delay**
		Through	55.7	E	97.3	F	56.8	E	97.6	F	168.6	F	4.7	A	19.7	B	167.2	F	116.5	105.5
		Right	45.0	D	86.7	F	54.7	D	93.5	F	10.0	A	6.8	A	11.8	B	7.1	A	**LOS**	**LOS**
		Approach	52.5	D	92.6	F	55.6	E	95.8	F	166.0	F	10.3	B	19.6	B	158.2	F	**F**	**F**
Route 17/Smiths Neck Road	Signal	Left	231.1	F	96.9	F	91.1	F	116.2	F	68.4	E	99.8	F	27.7	C	80.2	F	**Delay**	**Delay**
		Through	61.9	E	99.2	F	53.8	D	97.3	F	81.0	F	24.3	C	16.9	B	273.1	F	76.2	161.1
		Right		-	-	-	52.3	D	88.6	F	10.2	B	25.0	C	6.1	A	7.7	A	**LOS**	**LOS**
		Approach	188.1	F	97.6	F	71.9	E	106.6	F	78.5	E	31.4	C	16.4	B	244.6	F	E	**F**
Route 17/Northgate Lane	Two-Way Stop	Left		-	-	-		-	-	-	-	-	-	-	-	-	-	-	**Delay**	**Delay**
		Through		-	-	-		-	-	-	-	-	-	-	-	-	-	-	**-**	**-**
		Right		-	-	-		-	-	-	-	-	-	-	-	-	-	-	**LOS**	**LOS**
		Approach	17.2	C	658.1	F	27.9	D	22.2	C	-	-	-	-	-	-	-	-	**-**	**-**
Route 17/Nike Park Ext.	Signal	Left	106.1	F	95.8	F	-	-	-	-	122.9	F	141.5	F	113.5	F	100.5	F	**Delay**	**Delay**
		Through		-	-	-	-	-	-	-	15.5	B	9.5	A	9.8	A	52.8	D	25.7	39.2
		Right	81.6	F	87.6	F	-	-	-	-	-	-	-	-	6.3	A	0.0	A	**LOS**	**LOS**
		Approach	99.0	F	93.8	F	-	-	**-**	-	19.3	B	17.0	B	13.5	B	49.8	D	**C**	**D**

NOTE: Lane configurations with a shared through lane shown as "through" lane group; with shared left-right lane shown as "left" lane group.

Table 20 Future 2045 No-Build Delay and LOS (veh/sec)

Intersection Name	Type of Control	Lane Group	Eastbound				Westbound				Northbound				Southbound				Overall	
			AM		PM		AM		PM		AM		PM		AM		PM		AM	PM
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS		
Route 17/Kings Cove Way	Two-Way Stop	Left	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**Delay**	**Delay**
		Through	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**	**-**
		Right	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**LOS**	**LOS**
		Approach	1463.4	F	Err	F	0.0	A	21.7	C	-	-	-	-	-	-	-	-	**-**	**-**
Route 17/ Harbor Point Lane/Whippingham Parkway	Signal	Left	-	-	-	-	-	-	-	-	8.1	A	94.1	F	28.4	C	24.6	C	**Delay**	**Delay**
		Through	54.2	D	97.7	F	53.8	D	98.8	F	208.8	F	4.7	A	12.9	B	219.5	F	148.1	141.6
		Right	50.4	D	93.6	F	52.0	D	92.2	F	6.9	A	6.1	A	7.3	A	5.3	A	**LOS**	**LOS**
		Approach	52.2	D	95.5	F	52.5	D	96.3	F	206.9	F	6.4	A	12.9	B	212.8	F	**F**	**F**
Route 17/Eagle Harbor Parkway/Kings Cross	Signal	Left	-	-	-	-	-	-	-	-	15.0	B	123.6	F	27.3	C	21.8	C	**Delay**	**Delay**
		Through	56.1	E	100.0	F	57.0	E	98.0	F	275.3	F	6.4	A	23.4	C	267.1	F	186.9	166.1
		Right	43.9	D	85.9	F	54.6	D	93.3	F	10.6	B	7.5	A	12.6	B	7.6	A	**LOS**	**LOS**
		Approach	52.4	D	93.8	F	55.6	E	96.0	F	271.1	F	11.8	B	23.1	C	252.4	F	**F**	**F**
Route 17/Smiths Neck Road	Signal	Left	307.7	F	98.7	F	114.7	F	124.1	F	72.3	E	99.2	F	28.4	C	80.6	F	**Delay**	**Delay**
		Through	69.9	E	101.3	F	53.8	D	98.7	F	153.7	F	33.2	C	18.5	B	398.1	F	122.9	228.6
		Right	-	-	-	-	52.3	D	88.2	F	10.3	B	31.5	C	6.1	A	8.0	A	**LOS**	**LOS**
		Approach	249.3	F	99.5	F	84.1	F	111.5	F	147.9	F	39.2	D	17.9	B	355.5	F	**F**	**F**
Route 17/Northgate Lane	Two-Way Stop	Left	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**Delay**	**Delay**
		Through	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**	**-**
		Right	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**LOS**	**LOS**
		Approach	20.4	C	Err	F	37.2	E	27.3	D	-	-	-	-	-	-	-	-	**-**	**-**
Route 17/Nike Park Ext.	Signal	Left	226.0		97.1	F	-	-	-	-	127.9	F	197.5	F	104.7	F	100.6	F	**Delay**	**Delay**
		Through	-	-	-	-	-	-	-	-	19.2	B	12.2	B	9.0	A	124.6	A	36.2	80.6
		Right	85.5	F	86.8	F	-	-	-	-	-	-	-		5.3	A	0.0	A	**LOS**	**LOS**
		Approach	187.9	F	94.6	F	-	-	-	-	22.6	C	22.6	C	12.3	B	115.7	F	**D**	**F**

NOTE: Lane configurations with a shared through lane shown as "through" lane group; with shared left-right lane shown as "left" lane group.

Table 21 2030 No-Build Summary of Maximum Queues (in ft.)

Intersection Name	Type of Control	Lane Group	Eastbound			Westbound			Northbound			Southbound		
			Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)
Route 17/Kings Cove Way	Two-Way Stop	Left	-	72	118	-	-	18	264	34	43	317	6	-
		Through	-			-	-		-	-	-	-	-	1508
		Right	-			-	-		-	-	-	-	-	
Route 17/ Harbor Point Lane/Whippingham Parkway	Signal	Left	-	94	63	-	53	93	271	186	70	269	14	268
		Through	-			-			-	923	144	-	205	2850
		Right	170	117	58	550	80	28	205	135	28	214	3	214
Route 17/Eagle Harbor Parkway/Kings Cross	Signal	Left	-	210	158	-	68	69	250	248	157	306	18	250
		Through	-			-			-	986	208	-	380	1132
		Right	220	118	135	65	62	65	243	49	18	228	149	228
Route 17/Smiths Neck Road	Signal	Left	465	1150	280	212	120	163	450	499	446	450	86	449
		Through	-	1146	253	-	89	247	-	1268	530	-	345	997
		Right	-			150	81	112	238	238	238	344	111	344
Route 17/Northgate Lane	Two-Way Stop	Left	-	-	-	-	-	-	245	245	245	300	193	62
		Through	-	-	-	-	-	-	-	1982	891	-	88	10
		Right	-	123	372	-	214	126	300	300	-	-	-	-
Route 17/Nike Park Ext.	Signal	Left	-	492	165	-	-	-	105	129	129	65	64	64
		Through	-	-	-	-	-	-	-	982	898	-	376	669
		Right	-	99	76	-	-	-	-	-	-	300	249	300

'--'Storage Bay Length not provided or the movements do not exist.
Red text indicates queue lengths that exceed the available storage lengths or link distance.

Table 22 2045 No-Build Summary of Maximum Queues (in ft.)

Intersection Name	Type of Control	Lane Group	Eastbound			Westbound			Northbound			Southbound		
			Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)
Route 17/Kings Cove Way	Two-Way Stop	Left		125	162	-	-	6	264	18	32	317	16	-
		Through				-	-		-	540	-	-	-	1516
		Right				-	-		-		-	-	-	
Route 17/ Harbor Point Lane/Whippingham Parkway	Signal	Left	-	142	72	-	61	96	271	96	67	269	10	268
		Through	-			-			-	848	186	-	248	2846
		Right	170	81	70	550	109	44	205	92	34	214	4	214
Route 17/Eagle Harbor Parkway/Kings Cross	Signal	Left	-	231	186	-	87	102	250	249	198	306	31	305
		Through	-			-			-	997	245	-	462	1133
		Right	220	166	153	65	63	67	243	100	11	228	228	228
Route 17/Smiths Neck Road	Signal	Left	465	1147	303	212	127	164	450	500	499	450	106	449
		Through	-	1146	266	-	114	297	-	1266	683	-	383	993
		Right	-			150	104	128	238	238	238	344	222	344
Route 17/Northgate Lane	Two-Way Stop	Left	-	-	-	-	-	-	245	245	245	300	105	77
		Through	-	-	-	-	-	-	-	2000	683	-	-	-
		Right	-	130	514	-	289	165	300	300	-	200	-	5
Route 17/Nike Park Ext.	Signal	Left	-	1482	184	-	-		105	130	129	65	64	63
		Through	-	-	-	-	-		-	1138	1134	-	371	664
		Right	-	772	99	-	-		-	-	-	300	296	300

'--' Storage Bay Length not provided or the movements do not exist.
Red text indicates queue lengths that exceed the available storage lengths or link distance.

8. Concept Development and Screening

Improvement concepts were developed to address operational deficiencies, especially congestion in the southbound direction during afternoons along the study corridor as identified in the existing and no-build analyses, as well as observed during field review. Improvement project concepts were vetted through internal meetings, shared with the SWG at a concept development meeting. This section illustrates all the alternatives (1-5) that were presented during SWG meeting:

8.1 Alternative 1

This alternative recommends the following improvements (See ***Figure 12***)

1. Provide an exclusive right-turn lane in the eastbound direction and an additional left-turn lane in the northbound direction at the intersection of Route 17 and Smiths Neck Road.
2. Connect right-turn lane between Smiths Neck Road and Eagle Harbor Parkway along Route 17 in the southbound direction.
3. Restripe side street approaches at the intersection of Route 17/ Eagle Harbor Parkway/Kings Cross and Route 17/ Harbor Point Lane/Whippingham Pkwy to eliminate split phase on the side streets. Recommended configuration is an exclusive left-turn and shared through/right-turn lane on the side street approaches.
4. Optimize signal timing after implementing the recommended improvements.

8.2 Alternative 2

This alternatives includes the following improvements (See ***Figure 13***):

1. Provide an exclusive right-turn lane in the eastbound direction and an additional left-turn lane in the northbound direction at the intersection of Route 17 and Smiths Neck Road.
2. Provide an additional left-turn lane in southbound direction at the intersection of Route 17 and Smiths Neck Road.
3. Connect right-turn lane between Smiths Neck Road and Eagle Harbor Parkway along Route 17 in the southbound direction.
4. Convert intersection of Route 17/Eagle Harbor Parkway/Kings Cross into Restricted Crossing U-Turn (RCUT) intersection design. This innovative intersection only allows right out from the side street. Through and left turning traffic from side streets is rerouted through U-turn at downstream intersections.
5. Convert intersection of Route 17/Whippingham Parkway/Harbor Point Lane intersection to a Thru-Cut intersection. This design restricts through movement from the side street. Through traffic from Harbor Point Lane is rerouted to Eagle Harbor Parkway intersection through U-turn and followed by right-turn onto Whippingham Parkway. Through traffic from Whippingham Parkway makes a left turn, followed by U-turn at Eagle Harbor Parkway and then turns left onto Harbor Point Lane.
6. Optimize signal timing after implementing the recommended improvements.

8.3 Alternative 3 (builds on improvements from Alternative 2)

This alternative includes the following improvements (See **Figure 14**):

1. Include all the improvements from Alternative 2.
2. Construct a through lane in the southbound direction from Kings Cove Way to Route 258.
3. Optimize signal timing after implementing the recommended improvements.

8.4 Alternative 4

This alternative includes the following improvements (See ***Figure 15***):

1. Add a through lane in the southbound direction from Kings Cove Way to Route 258 along Route 17.
2. Restripe side street approaches at the intersection of Route 17 at Eagle Harbor Parkway/Kings Cross and Route 17 at Harbor Point Lane/Whippingham Pkwy to eliminate split phase on the side street. Recommended configuration is exclusive left-turn and shared through/right-turn lane on the side street approaches.
3. Connect right turn lane between Smiths Neck Road and Eagle Harbor Parkway along Route 17 in the southbound direction.
4. Optimize signal timing after implementing the recommended improvements.

8.5 Alternative 5

This alternatives includes the following improvements (See ***Figure 16***):

1. Add a through lane in the southbound direction from Kings Cove Way to Route 258 along Route 17.
2. Provide an exclusive right-turn lane in the eastbound direction and an additional left-turn lane in the northbound direction at the intersection of Route 17 and Smiths Neck Road.
3. Provide an additional left-turn lane in southbound direction at the intersection of Route 17 and Smiths Neck Road.
4. Convert Route 17 at Eagle Harbor Parkway intersection into Restricted Crossing U-Turn (RCUT) intersection design. This innovative intersection only allows right out from the side street. Through and left turning traffic from side streets is rerouted through U-turn at downstream intersections.
5. Restripe side street approaches at the intersection of Route 17/ Harbor Point Lane/Whippingham Parkway to eliminate split phase on the side streets. Recommended configuration is an exclusive left-turn and shared through/right-turn lane on the side street approaches.
6. Connect right turn lane between Smiths Neck Road and Eagle Harbor Parkway along Route 17 in southbound direction.
7. Optimize signal timing after implementing the recommended improvements.

8.6 Additional Recommendations

The following recommendations were included in all the alternatives:

1. Install a traffic signal at intersection of Route 17 and Northgate lane if MUTCD warrants and VDOT access spacing criteria is met. A Signal justification report (SJR) needs to be prepared to justify this signal. Please note the scope of this study does not include SJR which can be performed under a separate task.
2. Extend the following turn lanes:

<u>Rt. 17/Nike Park Ext.</u>

Improve/extend the exclusive northbound left-turn lane and southbound left-turn lane to consist of 200-foot storage and 200-foot taper

Rt. 17/Northgate Lane.
Improve/extend the existing exclusive northbound left-turn lane to consist of 400-foot storage and 200-foot taper.

8.7. Bike and Pedestrian Recommendations

At present, there are no VDOT bike/pedestrian current or future projects, but the County does require a multi-use trail with applicable site and subdivision plans, so there may be some instances where it is installed in spot locations. Hence, further study needs to be done to assess suitable locations for bike and pedestrian accommodations.

8.8. Concept Screening

Based on the preliminary operational analyses, feasibility and feedback from the SWG, Alternatives 1, 2 and 4 advanced to Build Conditions Analysis. These alternatives were also presented to the public for their feedback through a virtual public survey using MetroQuest platform. The virtual public survey results are discussed in the ***Section 10*** of the report. More detailed analysis, design and cost estimates were developed for these selected improvement projects.

Table 23 Concept Screening

Improvements	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Lane configuration change at Whippingham Parkway/Harbor Point Ln.	X			X	X
Lane configuration change at Eagle Harbor Parkway/Kings Cross	X			X	
Exclusive right-turn lane in the eastbound direction and an additional northbound left-turn lane at the intersection of Route 17 and Smiths Neck Road	X	X	X		X
Add an additional southbound left-turn lane at Route 17 and Smiths Neck Road intersection		X	X		X
Connect right-turn lane between Smiths Neck Road and Eagle Harbor Parkway along Route 17 in the southbound direction	X	X	X	X	X
RCUT at Route 17/Eagle Harbor Parkway/ Kings Cross		X	X		X
Through Cut at Route 17/Whippingham Parkway/Harbor Point Lane		X	X		
Construct a through lane in the southbound direction from Kings Cove Way to Route 258			X	X	X
Increase in storage lengths – Route 17 at Northgate Lane and Nike Park Extension	X	X	X	X	X
Install a traffic Signal at intersection of Route 17 at Northgate Lane	X	X	X	X	X
Advanced to Future Build Analysis	**Yes**	**Yes**	**No**	**Yes**	**No**

Figure 12 Alternative 1 Improvements Exhibit

Figure 13 Alternative 2 Improvements Exhibit

Figure 14 Alternative 3 Improvements Exhibit

Figure 15 Alternative 4 Improvements Exhibit

Figure 16 Alternative 5 Improvements Exhibit

9. Future Build 2030 and 2045 Analysis

Traffic operational and safety analyses were conducted to evaluate the overall performance of the study corridor under build (2030 & 2045) AM and PM peak hour conditions. The intent of the build conditions analysis was to evaluate the effectiveness of the selected improvement alternatives and understand how these improvements projects work in conjunction with one another to mitigate congestion and safety issues. Traffic operations analysis was performed using Synchro and SimTraffic 10.

9.1 Traffic Operations Analysis Assumptions

The no-build conditions Synchro models were used as a basis to develop the build models for the AM and PM peak hour conditions. Roadway geometry and traffic signal timing adjustments were made to reflect the improvement strategies set forth in the preferred build alternatives. The models were updated with the re-routed future traffic volumes to account for changing traffic patterns primarily due to the access management improvements in the build alternatives. At intersections with directional median openings or restricted movements, left-turn and through vehicles were re-routed to turn left at the nearest intersection if feasible (see ***Table 24***). Autoturn analysis was conducted to determine the feasibility and construction of loons if required. Detailed graphics from Autoturn analysis are provided in ***Appendix E-1***.

Table 24 Vehicle Rerouting Method and related Geometric Improvements

Intersection	Restricted movement	Re-routing Method	Geometric Improvements
Route 17 at Eagle Harbor Parkway (RCUT)/Kings Cross	WBL	Turn right and U-turn at the intersection of Route 17 and Whippingham Parkway	Construction of loon in the SW corner of intersection of Route 17/Whippingham Parkway/Harbor Point Lane
	WBT	Turn right and U-turn at the intersection of Route 17 and Whippingham Parkway and then turn right on Eagle Harbor Parkway	Construction of loon in the SW corner of intersection of Route 17/Whippingham Parkway/Harbor Point Lane
	EBL	Turn right and U-turn at the intersection of Route 17 and Smiths Neck Road	Construction of loon in the NE corner of intersection of Route 17 and Smiths Neck Road
	EBT	Turn right and U-turn at the intersection of Route 17 and Smiths Neck Road and then turn right on Kings Cross Road	Construction of loon in the NE corner of intersection of Route 17 and Smiths Neck Road
Route 17 at Whippingham Parkway/Harbor Point Lane	WBT	Turn left onto Route 17, make U-turn at Eagle Harbor Parkway and then turn left onto Harbor Point Lane	-
	EBT	Turn right and U-turn at intersection of Route 17 and Eagle Harbor Parkway and then turn right on Whippingham Parkway	-

Rerouting of traffic was performed for Alternative 2 which includes proposed RCUT and Thru-CUT improvements. For Alternatives 1 and 4, future 2030 & 2045 no-build volumes were used. The projected (2030 & 2045) AM and PM peak hour traffic volumes for the Build conditions of Alternative 2 are shown in ***Figure 17*** through ***Figure 20***.

Figure 17 Future 2030 AM Peak Hour Volumes - Alternative 2

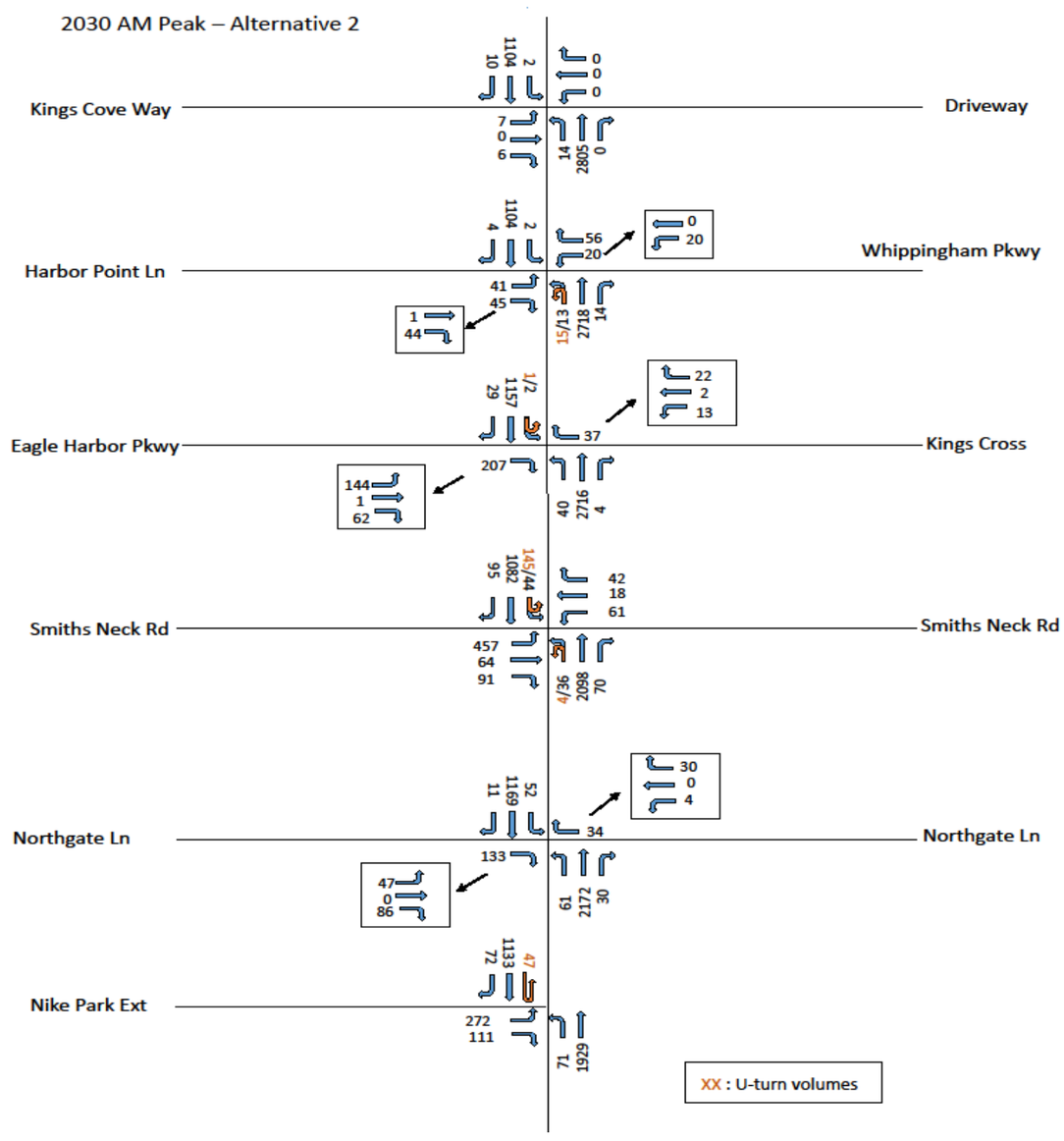


Figure 18 Future 2030 PM Peak Hour Volumes - Alternative 2

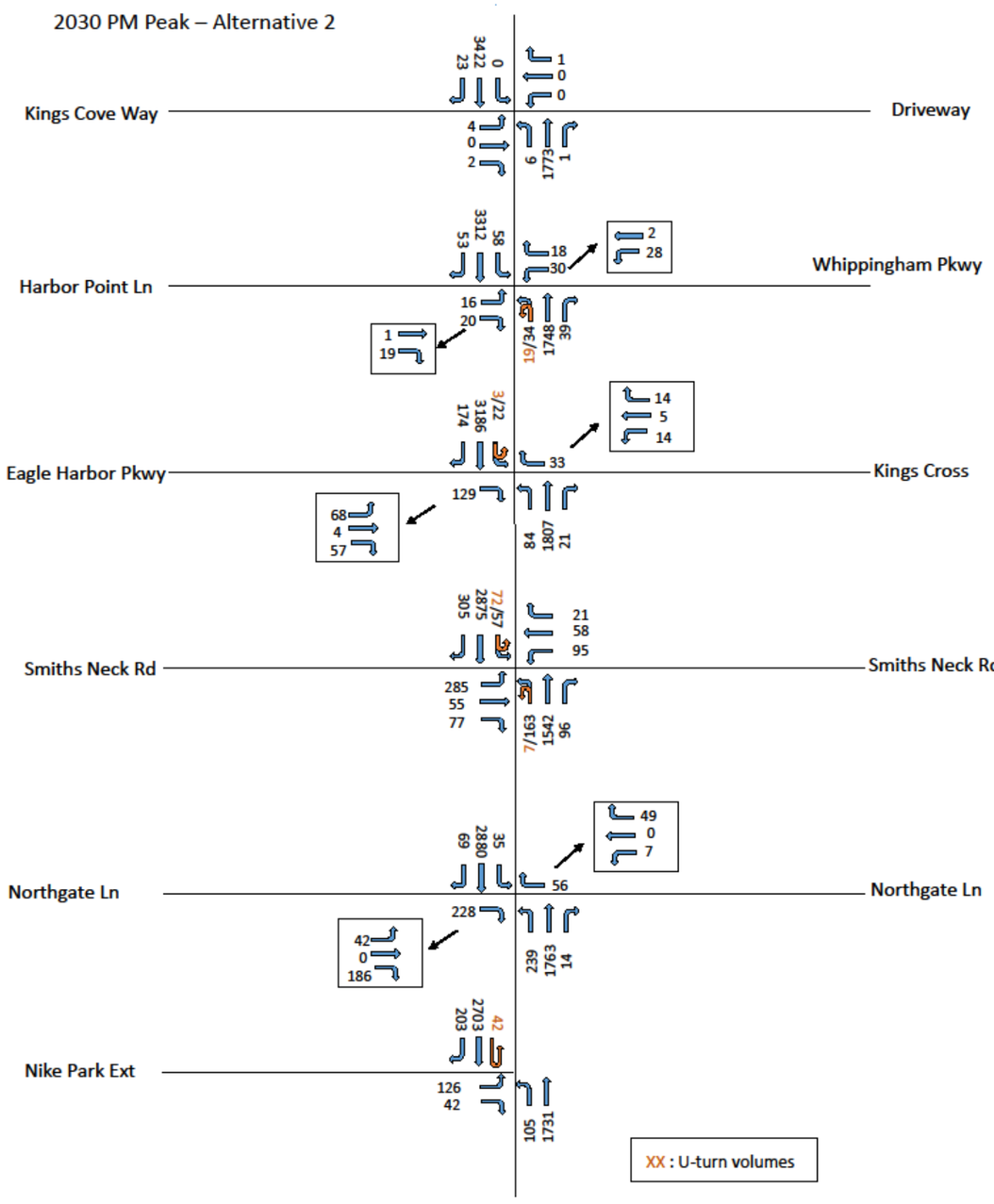


Figure 19 Future 2045 AM Peak Hour Volumes - Alternative 2

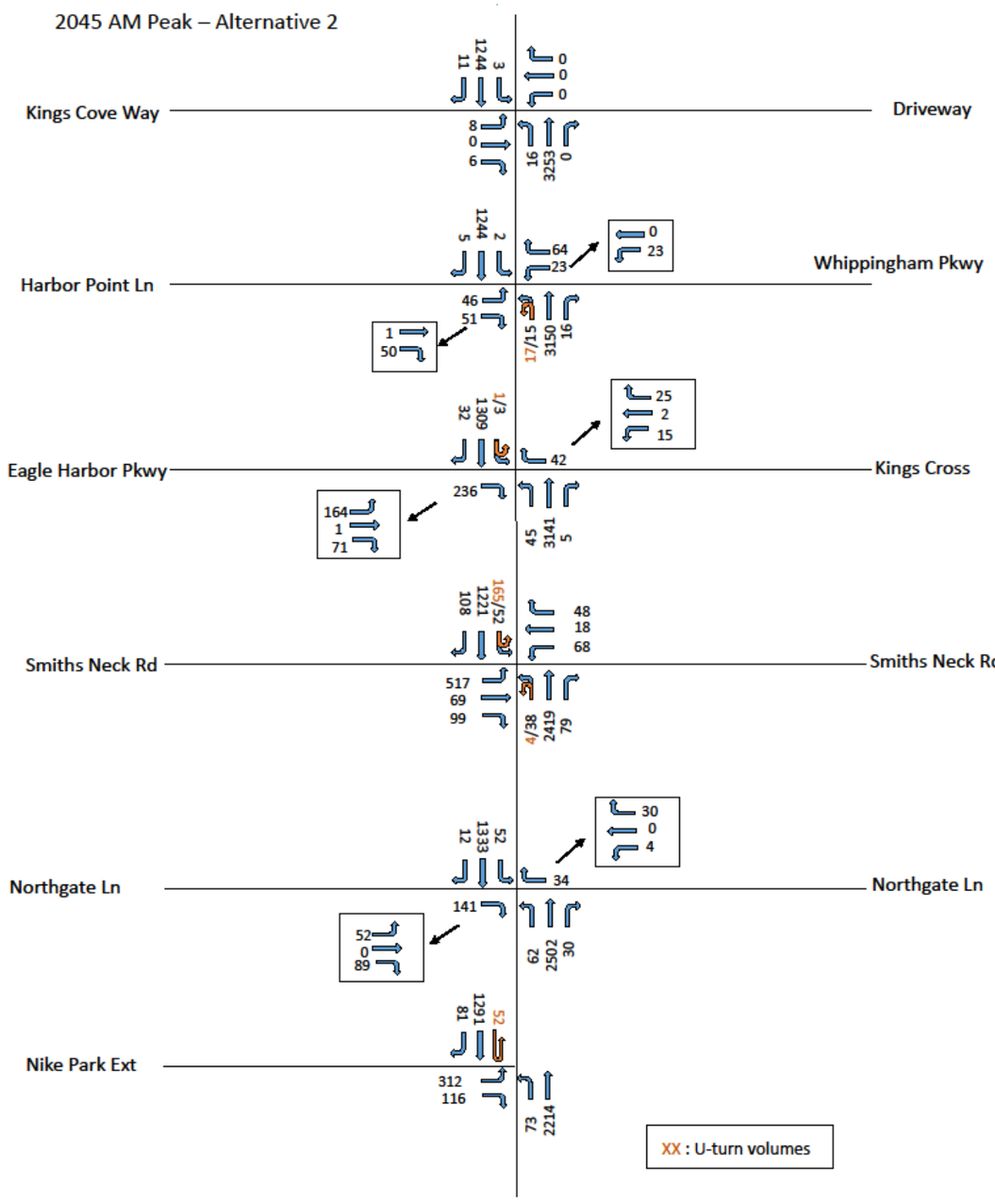
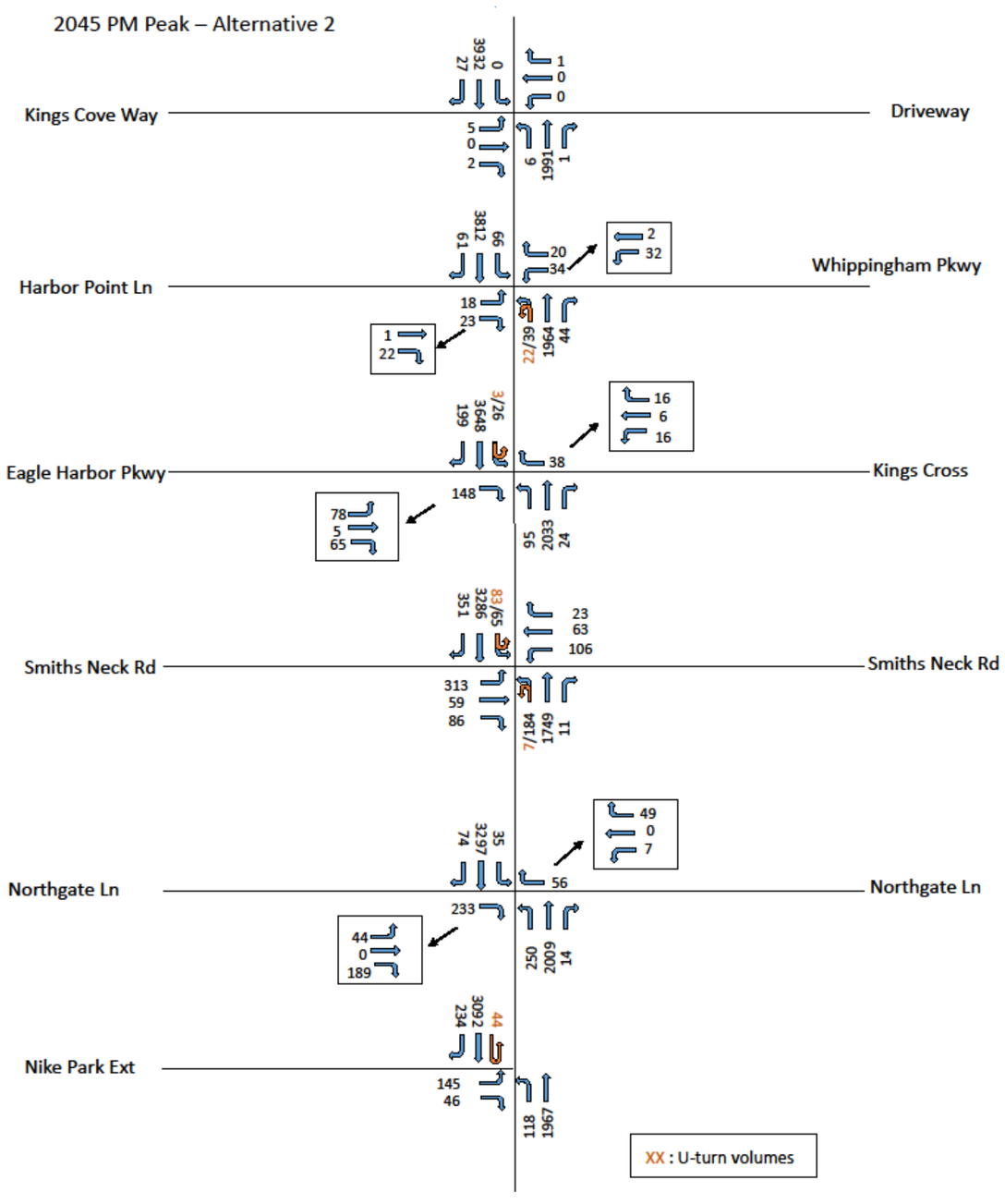


Figure 20 Future 2045 PM Peak Hour Volumes - Alternative 2



9.2 Traffic Analysis Results

The build conditions traffic analysis results are summarized in the following section of the report. The same methodologies used to analyze the existing and no-build conditions were also used to analyze the build conditions. Refer to ***Table 12*** for the delay thresholds associated with each LOS category for signalized and unsignalized intersections.

LOS and Delay Results

Capacity analysis results which includes delay and LOS results by lane group, approach, and intersection at each study for all the alternatives are summarized in ***Appendix E-2***. The corresponding Synchro output sheets are included in ***Appendix E-3*****.**

As shown in ***Table 25*** and ***Table 26***, Capacity results indicate that during 2030 and 2045 AM and PM peak hour conditions, all three alternatives are expected to operate at better LOS and/or show reduction in Control delay as compared to No-build conditions. During 2030 and 2045 AM peak hour conditions, Alternative 1 and 4 show similar delay reductions except during 2045 AM peak hour conditions where Alternative 1 show slightly better delay reduction than Alternative 4 at the intersection of Route 17 at Whippingham Parkway. Under Alternative 1 and 4, all the intersections operate at LOS E or better.

During 2030 & 2045 PM peak hour, Alternative 1 and 2 show similar LOS and Delay reduction results. Alternative 4 which includes widening option, shows the highest reduction in delay for all the intersections. Additionally, all the intersections operate at LOS B or better with the exception of Route 17 at Smiths Neck Road which operate at LOS E during 2045 PM Peak hour conditions. In the no-build conditions, all the intersections are expected to operate at LOS F in the year 2045.

Table 25 2030 LOS and Control Delay Comparison - Alternatives Vs No-Build

Intersection	2030 AM Peak hour								2030 PM Peak hour							
	No-Build		Alternative 1		Alternative 2		Alternative 4		No-Build		Alternative 1		Alternative 2		Alternative 4	
	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)
Route 17/ Harbor Point Lane/Whippingham Parkway	F	85.6	A	8.8	A	8.9	A	8.5	F	86.3	D	51.8	D	52.0	A	8.0
Route 17/Eagle Harbor Parkway/Kings Cross	F	116.5	B	19.7	B	15.1	B	19.6	F	105.5	E	74.2	E	72.1	B	13.1
Route 17/Smiths Neck Road	E	76.2	D	46.4	E	65.7	D	46.7	F	161.1	F	83.0	F	85.0	D	37.8
Route 17/Northgate Lane*	-	-	B	12.7	B	12.3	B	12.2	-		E	73.9	E	68.5	B	14.8
Route 17/Nike Park Ext.	C	25.7	C	23.8	C	25.1	C	25.8	D	39.2	C	31.8	D	35.6	B	12.0

Intersection of Route 17 and Northgate Lane is unsginalized during No-build conditions and signalized during build conditions.

Table 26 2045 LOS and Control Delay Comparison - Alternatives Vs No-Build

Intersection	2045 AM Peak hour								2045 PM Peak hour							
	No-Build		Alternative 1		Alternative 2		Alternative 4		No-Build		Alternative 1		Alternative 2		Alternative 4	
	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)
Route 17/ Harbor Point Lane/Whippingham Parkway	F	148.1	C	34.1	C	34.5	D	43.0	F	141.6	F	98.8	F	99.2	B	11.1
Route 17/Eagle Harbor Parkway/Kings Cross	F	186.9	E	58.3	E	70.8	E	58.4	F	166.1	F	125.3	F	124.9	B	20.0
Route 17/Smiths Neck Road	F	122.9	E	72.1	F	98.3	E	73.1	F	228.6	F	128.5	F	129.3	E	60.1
Route 17/Northgate Lane	-	-	B	14.9	B	15.3	B	13.1	-	-	F	115.8	F	110.5	B	17.6
Route 17/Nike Park Ext.	D	36.2	C	28.7	C	30.2	C	29.7	F	80.6	E	71.6	E	75.9	B	13.3

Intersection of Route 17 and Northgate Lane is unsginalized during No-build conditions and signalized during build conditions.

Queuing Results

Queuing analysis was completed for the study intersections during the AM and PM peak hours for 2030 & 2045 Build conditions. *SimTraffic* Maximum Queue Lengths in feet were reported for each lane. ***Table 27*** through ***Table 32*** summarizes the maximum queue lengths during the 2030 and 2045 AM and PM peak hours. Improvements were developed with the focus to reduce congestion in the southbound direction during PM peak hours. It is observed that:

- Under Alternative 1, during 2030 and 2045 PM peak hour conditions, queueing is observed in the southbound direction at the intersection of Route 17 at Kings Cove Way, Harbor Point Lane and Eagle Harbor Parkway. Additionally, southbound right-turn movements at intersections of Route 17 at Nike Park Ext. and Northgate Lane exceeds storage lengths.
- Under Alternative 2, during 2030 and 2045 PM peak hour conditions, southbound queuing is observed at the intersections of Route 17 at Kings Cove Way, Whippingham Parkway, Eagle Harbor and Smiths Neck Road. Additionally, at the intersection of Route 17 at Nike Park Ext. and Northgate Lane, southbound right-turn movements exceed storage lengths. Southbound left-turn movements exceed storage length at intersection of Route 17 and Northgate Lane during 2045 PM peak hour conditions.
- Alternative 4 is not expected to have queues along Route 17 in the southbound direction that spill back to upstream intersection during 2030 & 2045 PM peak hour conditions with the exception of southbound left-turn movements that exceed storage length. This alternative significantly reduces queues in the southbound direction during PM peak hour conditions as compared to the no-build conditions.
- Under all three alternatives, queueing is observed in the northbound direction at the intersections of Route 17 at Nike Park Extension, Northgate Lane and Smiths Neck Road during 2045 AM peak hour conditions.
- Under all three alternatives, queuing is observed at the intersection of Route 17 and Smiths Neck Road in the eastbound direction during 2045 AM and PM peak hour conditions.

Table 27 2030 Build Alternative 1 Summary of Maximum Queues (in ft.)

Intersection Name	Type of Control	Lane Group	Eastbound			Westbound			Northbound			Southbound		
			Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)
Route 17/Kings Cove Way	Two-Way Stop	Left	-	143	182	-	-	18	264	21	115	317	18	-
		Through	-			-	-		-	-	45	-	-	1493
		Right	-			-	-		-	-	-	-	-	
Route 17/ Harbor Point Lane/Whippingham Parkway	Signal	Left	-	139	73	-	86	93	271	51	82	269	18	268
		Through	-	79	74	-	133	43	-	254	194	-	140	2802
		Right	170			550			205	22	29	214	3	214
Route 17/Eagle Harbor Parkway/Kings Cross	Signal	Left	-	347	172	-	48	64	250	134	192	306	21	203
		Through	-	79	154	-	84	61	-	666	277	-	282	1127
		Right	220			65			243	-	28	228	114	228
Route 17/Smiths Neck Road	Signal	Left	465	525	656	212	128	176	450	60	307	450	158	392
		Through	-	131	324		136	279	-	968	291	-	395	838
		Right	-	105	328	150	115	107	238	238	200	344	31	53
Route 17/Northgate Lane	Signal	Left	-	-	-	-	-	-	500	216	499	300	140	266
		Through	-	-	-	-	-	-	-	382	1268	-	166	695
		Right	-	114	512	-	92	80	300	29	23	200	26	200
Route 17/Nike Park Ext.	Signal	Left	-	264	173	-	-	-	300	299	272	300	182	94
		Through	-	-	-	-	-	-	-	543	367	-	352	864
		Right	-	100	100	-	-	-	-	-	-	300	160	300

'-'Storage Bay Length not provided or the movements do not exist.
Red text indicates queue lengths that exceed the available storage lengths or link distance.

Table 28 2045 Build Alternative 1 Summary of Maximum Queues (in ft.)

Intersection Name	Type of Control	Lane Group	Eastbound			Westbound			Northbound			Southbound		
			Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)
Route 17/Kings Cove Way	Two-Way Stop	Left	-	321	173	-	-	12	264	17	92	317	18	-
		Through	-			-	-		-	548	-	-	-	1499
		Right	-			-	-		-	-	-	-		
Route 17/ Harbor Point Lane/Whippingham Parkway	Signal	Left	-	150	64	-	57	101	271	111	85	269	24	268
		Through	-	78	97	-	156	55	-	358	224	-	130	2814
		Right	170			550			205	17	28	214	9	214
Route 17/Eagle Harbor Parkway/Kings Cross	Signal	Left	-	450	178	-	61	69	250	249	212	306	25	305
		Through	-	170	142	-	69	65	-	665	302	-	219	1126
		Right	220			65			243	105	66	228	68	228
Route 17/Smiths Neck Road	Signal	Left	465	1084	465	212	135	177	450	499	318	450	240	387
		Through	-	945	1149		131	465	-	1253	343	-	345	832
		Right	-	548	753	150	128	150	238	238	200	344	34	59
Route 17/Northgate Lane	Signal	Left	-	-	-	-	-	-	500	500	500	300	140	177
		Through	-	-	-	-	-	-	-	1974	1867	-	219	828
		Right	-	144	576	-	79	104	300	300	19	200	29	200
Route 17/Nike Park Ext.	Signal	Left	-	347	210	-	-	-	300	300	300	300	143	151
		Through	-	-	-	-	-	-	-	1124	1077	-	278	757
		Right	-	108	115	-	-	-	-	-	-	300	94	298

'-'Storage Bay Length not provided or the movements do not exist.
Red text indicates queue lengths that exceed the available storage lengths or link distance.

Table 29 2030 Build Alternative 2 Summary of Maximum Queues (in ft.)

Intersection Name	Type of Control	Lane Group	Eastbound			Westbound			Northbound			Southbound		
			Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)
Route 17/Kings Cove Way	Two-Way Stop	Left	-	169	128	-	-	23	264	30	68	317	11	
		Through	-			-	-		-	-	-	-	-	1492
		Right	-			-	-		-	-	-	-	-	
Route 17/ Harbor Point Lane/Whippingham Parkway	Signal	Left	-	158	90	-	72	131	271	56	122	269	13	268
		Through	-	-	-	-	-	-	-	186	206	-	135	2822
		Right	170	55	76	550	140	31	205	17	28	214	4	214
Route 17/Eagle Harbor Parkway/Kings Cross	Signal	Left	-	-	-	-	-	-	250	90	189	306	28	253
		Through	-	-	-	-	-	-	-	524	208	-	190	1108
		Right	220	250	248	65	97	82	243	14	16	228	30	228
Route 17/Smiths Neck Road	Signal	Left	465	642	777	212	120	173	450	499	386	500	403	449
		Through	-	134	326		112	376	-	1244	430	-	649	992
		Right	-	84	164	150	109	128	238	238	162	344	36	261
Route 17/Northgate Lane	Signal	Left	-	-	-	-	-	-	500	325	500	300	132	215
		Through	-	-	-	-	-	-	-	1009	1168	-	177	740
		Right	-	139	387	-	95	110	300	244	71	200	63	200
Route 17/Nike Park Ext.	Signal	Left	-	304	178	-	-	-	300	299	287	300	256	193
		Through	-	-	-	-	-	-	-	645	490	-	393	838
		Right	-	100	98	-	-	-	-	-		300	192	300

'--' Storage Bay Length not provided or the movements do not exist.
Red text indicates queue lengths that exceed the available storage lengths or link distance.

Table 30 2045 Build Alternative 2 Summary of Maximum Queues (in ft.)

Intersection Name	Type of Control	Lane Group	Eastbound			Westbound			Northbound			Southbound		
			Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)
Route 17/Kings Cove Way	Two-Way Stop	Left	-	208	183	-	-	12	264	27	90	317	23	-
		Through	-			-	-		-	-	-	-	-	1505
		Right	-			-	-		-	-	-	-	-	-
Route 17/ Harbor Point Lane/Whippingham Parkway	Signal	Left	-	172	98	-	72	243	271	61	116	269	29	268
		Through	-	-	-	-	-	-	-	411	228	-	123	2842
		Right	170	62	93	550	150	39	205	12	30	214	3	214
Route 17/Eagle Harbor Parkway/Kings Cross	Signal	Left	-	-	-	-	-	-	250	214	187	306	82	208
		Through	-	-	-	-	-	-	-	578	293	-	647	1107
		Right	220	453	254	65	126	73	243	22	40	228	142	228
Route 17/Smiths Neck Road	Signal	Left	465	1140	1026	212	140	177	450	499	340	500	503	448
		Through	-	1140	752		132	473	-	1246	455	-	920	945
		Right	-	1128	549	150	119	150	238	238	163	344	432	247
Route 17/Northgate Lane	Signal	Left	-	-	-	-	-	-	500	500	500	300	155	299
		Through	-	-	-	-	-	-	-	1983	1995	-	222	770
		Right	-	122	382	-	108	118	300	300	67	200	56	200
Route 17/Nike Park Ext.	Signal	Left	-	316	277	-	-	-	300	300	300	300	167	235
		Through	-	-	-	-	-	-	-	1140	1039	-	275	911
		Right	-	120	124	-	-	-	-	-	-	300	88	300

'--' Storage Bay Length not provided or the movements do not exist.
Red text indicates queue lengths that exceed the available storage lengths or link distance.

Table 31 2030 Build Alternative 4 Summary of Maximum Queues (in ft.)

Intersection Name	Type of Control	Lane Group	Eastbound			Westbound			Northbound			Southbound		
			Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)
Route 17/Kings Cove Way	Two-Way Stop	Left	-	159	139	-	-	18	264	13	118	317	14	-
		Through	-			-	-		-	-	-	-	-	1562
		Right	-			-	-		-	-	-	-	-	
Route 17/ Harbor Point Lane/Whippingham Parkway	Signal	Left	-	137	64	-	81	81	271	55	102	269	9	79
		Through	-	91	90	-	112	47	-	333	171	-	88	240
		Right	170			550			205	12	22	214	9	102
Route 17/Eagle Harbor Parkway/Kings Cross	Signal	Left	-	361	191	-	51	56	250	170	207	306	25	49
		Through	-	165	104	-	86	54	-	654	333	-	161	358
		Right	220			65			243	8	114	228	31	227
Route 17/Smiths Neck Road	Signal	Left	465	480	376	212	141	202	450	499	467	450	114	324
		Through	-	266	412		122	299	-	1141	618	-	278	706
		Right	-			150	104	150	238	238	238	344	49	93
Route 17/Northgate Lane	Signal	Left	-	-	-	-	-	-	500	198	441	300	120	67
		Through	-	-	-	-	-	-	-	503	376	-	244	382
		Right	-	100	350	-	93	88	300	69	11	200	34	64
Route 17/Nike Park Ext.	Signal	Left	-	274	140	-	-	-	300	299	277	300	139	170
		Through	-	-	-	-	-	-	-	597	366	-	267	285
		Right	-	98	86	-	-	-	-	-	-	300	96	113

'-'Storage Bay Length not provided or the movements do not exist.
Red text indicates queue lengths that exceed the available storage lengths or link distance.

Table 32 2045 Build Alternative 4 Summary of Maximum Queues (in ft.)

Intersection Name	Type of Control	Lane Group	Eastbound			Westbound			Northbound			Southbound		
			Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)	Storage Bay Distance	AM Queue (ft.)	PM Queue (ft.)
Route 17/Kings Cove Way	Two-Way Stop	Left	-	339	239	-	-	6	264	22	133	317	28	-
		Through	-			-	-		-	-	-	-	-	444
		Right	-			-	-		-	-	-	-	-	
Route 17/ Harbor Point Lane/Whippingham Parkway	Signal	Left	-	150	81	-	69	82	271	77	106	269	19	86
		Through	-	79	64	-	157	50	-	817	132	-	83	242
		Right	170			550			205	131	16	214	3	58
Route 17/Eagle Harbor Parkway/Kings Cross	Signal	Left	-	449	193	-	57	82	250	249	204	306	23	56
		Through	-	118	162	-	81	63	-	605	334	-	163	372
		Right	220			65			243	10	27	228	37	228
Route 17/Smiths Neck Road	Signal	Left	465	1155	452	212	161	206	450	499	500	450	236	188
		Through	-	970	752		245	484	-	1260	928	-	186	586
		Right	-			150	136	150	238	238	238	344	34	80
Route 17/Northgate Lane	Signal	Left	-	-	-	-	-	-	500	500	492	300	103	82
		Through	-	-	-	-	-	-	-	1966	934	-	172	978
		Right	-	108	378	-	93	144	300	300	12	200	21	107
Route 17/Nike Park Ext.	Signal	Left	-	431	184	-	-	-	300	300	299	300	146	120
		Through	-	-	-	-	-	-	-	1123	479	-	207	533
		Right	-	92	107	-	-	-	-	-	-	300	88	251

'-'Storage Bay Length not provided or the movements do not exist.
Red text indicates queue lengths that exceed the available storage lengths or link distance.

Travel Time Analysis Results

Travel time analyses were conducted using SimTraffic to analyze mobility throughout the study corridor under Existing, No-Build, and Build conditions. The analyses evaluated how well the Study recommendations addressed the need to improve progression and operations on Route 17. The travel time was recorded for each analysis period and summarized in ***Table 33***. Under all three alternatives, southbound direction of travel was projected to experience a decrease in travel time in PM peak hour compared to No-Build conditions. Alternative 4 shows the highest reduction in southbound travel time for Route 17 in 2045 PM peak hour conditions. Additionally, under all three alternatives, northbound direction of travel is projected to experience reduction in travel time during AM peak hour conditions. During 2045 AM peak hour, Alternative 4 shows highest travel time reduction in the northbound direction.

Table 33 Travel Time Comparison: No-Build Vs Build Conditions

		Projected Travel Time (in seconds)			
Analysis Period	**Direction**	**No-Build**	**Alternative 1**	**Alternative 2**	**Alternative 4**
2030 AM	NB Route 17	535	256	296	266
	SB Route 17	199	185	188	190
2030 PM	NB Route 17	212	195	210	190
	SB Route 17	1685	888	880	479
2045 AM	NB Route 17	945	494	634	477
	SB Route 17	208	181	214	180
2045 PM	NB Route 17	338	334	344	221
	SB Route 17	2400	1375	1369	899

9.3 Safety Analysis

Crash modification factors (CMFs) were used to determine the potential safety benefits of the recommended improvements. CMFs were chosen from the approved list of CMFs used for the VDOT SMART SCALE safety scoring process and Clearing house. The best applicable CMF was applied to crashes in the influence area of each intersection. The applicable CMFs and potential safety benefits of the recommended improvements are documented in ***Table 34***.

Table 34 Crash Reduction Analysis of Proposed Improvements

Intersection	Improvement	Crash Type	Crash Severity	CMF	Reduction in Crashes (within 5 years)	Reference
Route 17 at Smiths Neck Road	Addition of EBR turn lane	All	K, A, B, C	0.91	2.52	CMF ID: 288
Route 17 at Smiths Neck Road	Addition of NBL turn lane and SBL turn lane	All	All	0.76	14.16	CMF ID: 263
Route 17 at Smiths Neck Road	Connect two right turn lanes between Smiths Neck and Eagle Harbor Pkwy	All	All	0.85	4.8	FHWA Desktop Reference
Route 17 at Northgate Drive.	Install a traffic signal at Northgate Drive	All	All	0.95	0.25	CMF ID: 322
Route 17 at Northgate Drive.	Extend northbound left-turn lane	All	K, A, B, C	0.85	0.15	FHWA Desktop Reference
Route 17 at Smiths Neck Road	Addition of NBL turn lane and SBL turn lane	All	All	0.76	14.16	CMF ID: 263
Route 17 at Eagle Harbor Parkway/Kings Cross	Convert Route 17 at Eagle Harbor Parkway/Kings Cross into signalized RCUT	All	K, A, B, C	0.78	1.1	CMF ID: 9985
Corridor Wide	Add a through lane in the SB direction from Kings Cove Way to Route 258	All	All	0.85	24.15	CMF ID: 7924

10. Virtual Public Survey Results

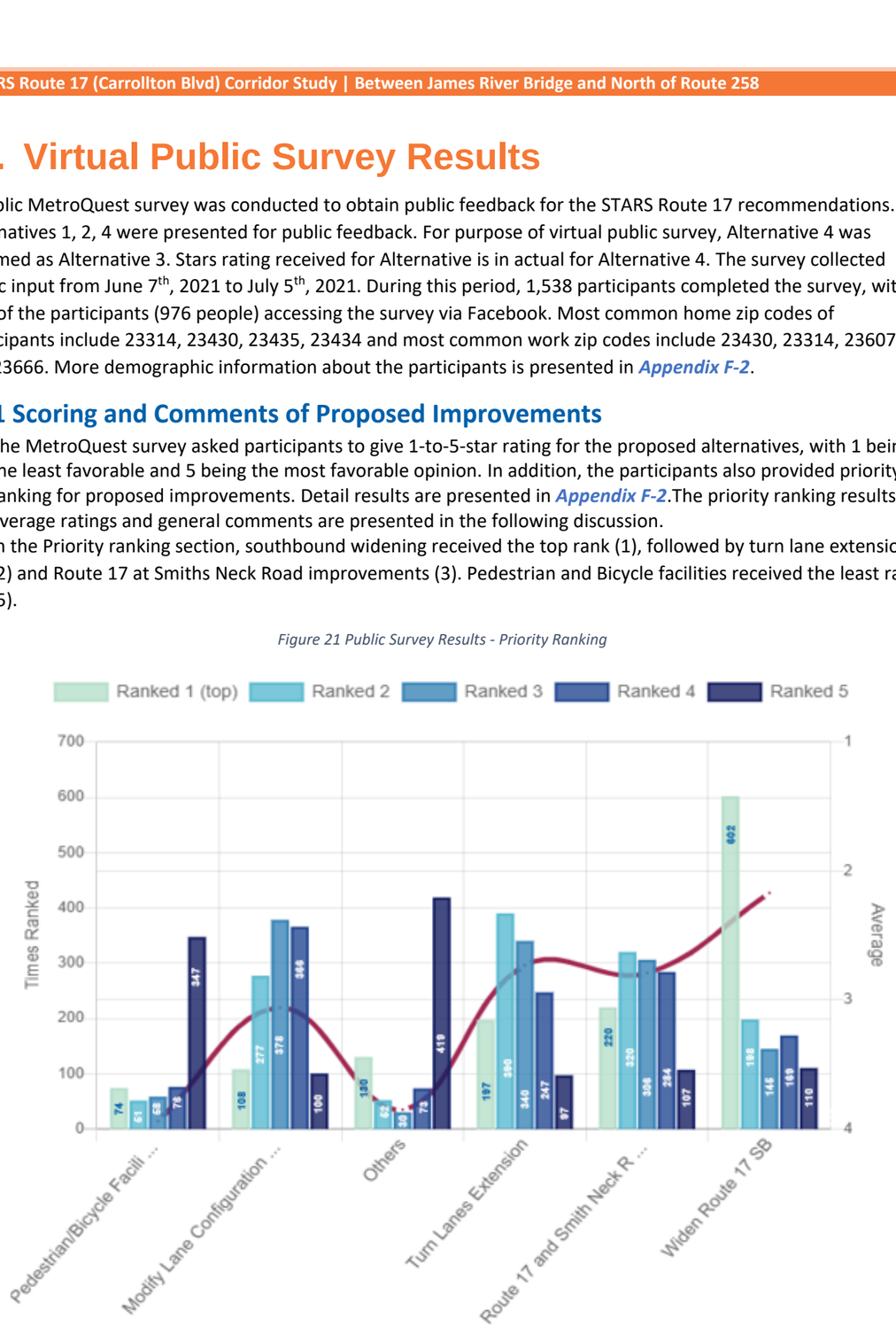
A public MetroQuest survey was conducted to obtain public feedback for the STARS Route 17 recommendations. Alternatives 1, 2, 4 were presented for public feedback. For purpose of virtual public survey, Alternative 4 was renamed as Alternative 3. Stars rating received for Alternative is in actual for Alternative 4. The survey collected public input from June 7th, 2021 to July 5th, 2021. During this period, 1,538 participants completed the survey, with 63% of the participants (976 people) accessing the survey via Facebook. Most common home zip codes of participants include 23314, 23430, 23435, 23434 and most common work zip codes include 23430, 23314, 23607, and 23666. More demographic information about the participants is presented in ***Appendix F-2***.

10.1 Scoring and Comments of Proposed Improvements

The MetroQuest survey asked participants to give 1-to-5-star rating for the proposed alternatives, with 1 being the least favorable and 5 being the most favorable opinion. In addition, the participants also provided priority ranking for proposed improvements. Detail results are presented in ***Appendix F-2***.The priority ranking results, average ratings and general comments are presented in the following discussion.

In the Priority ranking section, southbound widening received the top rank (1), followed by turn lane extensions (2) and Route 17 at Smiths Neck Road improvements (3). Pedestrian and Bicycle facilities received the least rank (5).

Figure 21 Public Survey Results - Priority Ranking

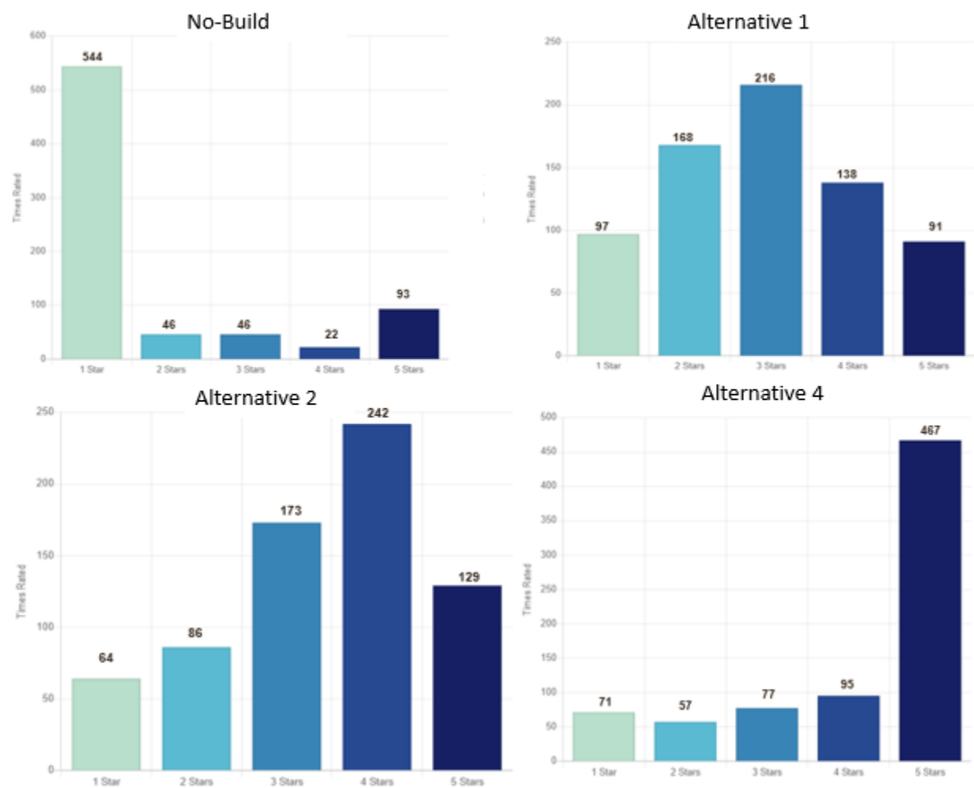


In the average ratings section, three alternatives along with no-build scenario were presented in the survey to solicit public feedback based on the County's decision. The ratings of these three alternatives is discussed below:

The No-Build conditions received 1 star rating 72% of the times it was rated. This scenario had 13 comments which indicated something needs to be done to improve traffic conditions in the area, especially with all the proposed development coming in the near future.

Alternative 1 received 3 stars rating 30% of the times it was rated. There were 9 comments on this option. Some of the comments described it as a great option and like the idea of turn lane extensions. However, there was a concern about increasing the travel time in the northbound direction during PM peak hour conditions and the addition of new traffic lights within the study corridor. Alternative 2 received 4 stars rating 35% of the times it was rated. There were 8 comments on this option which indicated these are good improvements at a more feasible cost. Alternative 4 received 5 stars rating 61% of the times it was rated. The average stars rating of these alternatives is shown below. It should be noted that the five stars rating is better than 1 star rating.

Figure 22 Public Survey Results - Stars Rating



11. Conceptual Design & Cost Estimates

Conceptual designs and planning-level cost estimates were developed for each of the three selected alternatives and discussed below:

11.1 Conceptual Design

Conceptual designs were developed in MicroStation OpenRoads for improvement projects along the Route 17 corridor in accordance with the following applicable guidelines:

- A Policy on Geometric Design of Highways and Streets (AASHTO 2011)
- VDOT Road Design Manual (Issued January 2005, Revised July 2016)
- VDOT Road and Bridge Standards (VDOT 2016, latest revisions)
- Manual on Uniform Traffic Control Devices (MUTCD 2009)
- 2011 Virginia Supplement to the MUTCD
- Design Manual for the Henrico County Department of Public Works

Design criteria and guidance from these documents were applied to roadways within the project limits based on functional classification and roadway design speeds, in concurrence with the VDOT Road Design Manual. All single-lane left-turn movements and U-turns were designed to accommodate the turning radius for a WB-67 vehicle (loons provided where appropriate). All dual-lane left-turn movements were designed to accommodate two concurrent turning vehicles – a SU-40 in the inside lane and a WB-67 in the outside lane. All pedestrian refuges will need to be designed at a minimum of six feet wide; however, the existing median widths at several locations are narrower than six feet. The minimum width for the pedestrian refuge can be obtained by narrowing lane widths by up to one foot. Design to this level of detail was not included in the conceptual design drawings. Curb Ramps (Std. CG-12) are shown at each side street, but were not included across each public/private entrance.

11.2 Planning-Level Cost Estimates

A refined planning-level cost estimate, in 2021 dollars, was developed for all selected improvement projects. A variable percentage preliminary engineering (PE) cost was included, ranging from 16 to 20 percent of construction costs, including contingency. For projects with anticipated right-of-way and/or utility impacts, right-of-way and utility relocation costs were estimated on a project-by-project basis based on the size and complexity of the project, as well as the existing right-of-way limits. Construction (CN) costs were estimated using a combination of design software quantity take-offs, the Transportation and Mobility Planning Division Statewide Planning Level Cost Estimate Spreadsheet, and recent bid costs. In addition, the construction cost included an additional 40 percent contingency of the base roadway construction cost, 20 percent for construction engineering and inspection (CEI), and a 5 percent incentive. ***Table 35*** summarizes the preliminary engineering (PE); right-of-way and utility relocation (RW); construction (CN); and total planning level cost estimates for each improvement project. A more detailed breakdown of the planning level cost estimates is provided in ***Appendix E-5***.

Table 35 Planning-Level Cost Estimates

Improvement	Cost Estimate (2021 dollars)			
	PE	RW	CN	Total
Alternative 1	$ 900,000	$ 922,000	$ 4,300,000	$ 6,100,000
Alternative 2	$ 1,200,000	$ 1,500,000	$ 5,900,000	$ 8,500,000
Alternative 4	$ 2,100,000	$ 5,000,000	$ 13,200,000	$ 20,200,000

12. Project Advancement

This Study should be used as a planning tool to achieve the next steps of planning, programming, designing, and constructing the identified safety and operational improvements in the study corridor. The alternatives identified in the study and the public survey results were presented to the Board of Supervisors on December 9th, 2021 to bring them up to date with the study efforts. With thorough and expansive public involvement efforts of the study, the options put forth demonstrate broad support for Alternative 4, which includes widening of Route 17 in the southbound direction. Based on operational analysis, Alternative 4 is expected to have huge operational benefits in terms of mitigating congestion on Route 17 in the southbound direction during PM peak period. Additionally, intersection of Route 17 and Smiths Neck Road improvements significantly improve traffic operations at this intersection and is also the immediate need. Hence, it is recommended that along with Alternative 4, the improvements at the intersection of Route 17 and Smiths Neck Road should be considered for further development and engineering.

12.1 Prioritize Projects and Apply for Funding

Improvement projects should be prioritized on a local and regional level. Prior to submitting funding applications, applicant must have one of the following:

1. Inclusion of proven consistency with the Constrained Long-Range Transportation Plan (CLRP)
2. Resolution of support from governing body

The following funding sources should be considered for improvement projects identified in this study:

- **Revenue Sharing** – a program that provides a dollar for dollar state match to local funds for transportation projects. Projects eligible for Revenue Sharing funds include construction, reconstruction, improvement, and maintenance projects.
- **Highway Safety Improvement Program (HSIP)** – a program that provides funding for improvements that correct or improve safety on a section of roadway or intersection with a high incidence of crashes.
- **SMART SCALE** – a program that allocates funding from the construction District Grants Program (DGP) and High-Priority Projects Program (HPPP) to transportation projects. SMART SCALE uses a scoring process that evaluates, scores, and ranks project applications based on six measures: congestion mitigation, economic development, accessibility, safety, environmental quality, and land use. All proposed projects included in this study are eligible for SMART SCALE funding.