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DRAFT – BROADVIEW ACCESS MANAGEMENT REVIEW

US 211/US17/29 BUS (BROADVIEW AVENUE), WARRENTON, VA

Date: May 31, 2018 Project #: 21905
To: Brandie Schaeffer, Town of Warrenton
From: Chris Tiesler, PE; Bradley Reynolds, PE; and Andy Butsick, PE

At the request of the Town of Warrenton, Kittelson & Associates, Inc. (KAI) performed a reevaluation and review of Broadview Avenue access management improvements along US 211/US 17/29 BUS (Broadview Avenue) from south of Frost Avenue to south of Winchester Street in Warrenton, Virginia. The purpose of this assessment is to aid in identifying potential transportation solutions that improve corridor safety, mobility, and multi-modal operations while maintaining business access, accommodating aesthetic enhancements, and supporting economic development. Kittelson reviewed project information, reports and Preliminary Field Inspection (PFI) plans provided by the Town of Warrenton and Virginia Department of Transportation (VDOT).

KAI reviewed the following information, reports, and PFI plans:

- Broadview Access Management Study, VDOT, February 2013
- ADA/Access Management/Traffic Assessment Report, VDOT, April 2015
- Intersection Traffic Analysis (Broadview Ave at Frost Ave / Waterloo St), VDOT, September 2015
- Smart Scale Technical Guide, August 2017
- Walkability Audit Report, September 2017
- Complete Streets Study, September 2017
- Broadview Avenue Presentation (Business Owner's Focus Group), VDOT, January 25th, 2018
- Traffic Sampling on Broadview Avenue Memorandum, Town of Warrenton, May 4th, 2018
- VDOT 30 Percent PFI Plans, VDOT, *Received April 4th, 2018*
- VDOT 30 Percent PFI Plans, VDOT, May 14th, 2018

KAI's reevaluation and review of Broadview Avenue access management improvements focused on the following four (4) components:

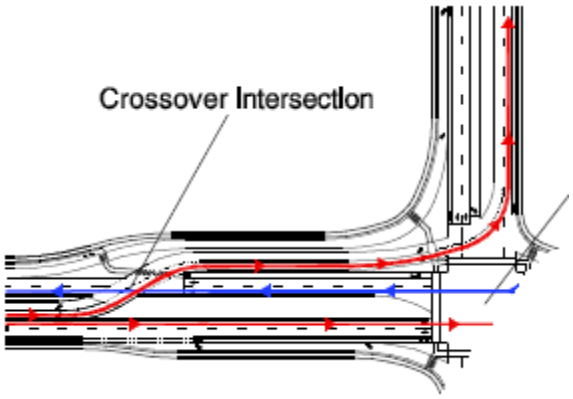
- Intersection Improvements at Broadview Ave and Frost Ave / Waterloo St
- Access Management Improvements
- Interparcel Connectivity
- Signal Warrant Review at Broadview Ave and Gold Cup Dr

1.0 INTERSECTION IMPROVEMENTS AT BROADVIEW AVE AND FROST AVE

Future traffic volumes and operations of the Broadview Avenue at Frost Avenue / Waterloo Street intersection were reevaluated to identify potential intersection improvements either not previously considered or analyzed in detail in the *Intersection Traffic Analysis (Broadview Ave at Frost Ave / Waterloo St), VDOT, September 2015* study. The VDOT Junction Screening Tool (vJuST) was utilized to screen alternative intersections to assess planning-level feasibility. Based on the initial screening using future 2040 weekday a.m., weekday p.m., and Saturday midday peak hour volumes and a review of the study area intersection, a partial displaced left-turn (DLT) intersection, also referred to as a continuous flow intersection (CFI) appeared to be a competitive improvement option from a congestion, pedestrian, and safety perspective. A DLT was previously screened out in the 2015 VDOT study.

A one-leg partial DLT intersection concept was developed to evaluate its operational feasibility, while considering its footprint, impacts to adjacent businesses, and cost. This concept relocates the Frost Avenue eastbound left-turn movements to the other side of the opposing Frost Avenue eastbound traffic flow and provides a southbound right-turn bypass lane. Crossing over the heavy eastbound left-turns allows this movement to proceed simultaneously with the through movements and eliminates the left-turn phase for this approach (or split phase), thereby reducing the number of existing signal phases. This configuration also reduces the number of conflict points from a conventional intersection, which can result in improved traffic operations and safety performance. The signal green time previously allocated for the left turns under existing conditions could be reallocated, including to accommodate pedestrian crossings.

- Partial DLT (Frost Avenue eastbound approach) – Provide signalized two-phase eastbound dual left-turns in advance of main intersection. Provide signalized dual southbound right-turns via bypass lane. Provide northbound dual left-turns. Restrict westbound left-turn or only allow permitted westbound left-turns. Realign Rappahannock Street as right-in/right-out to right-turn bypass lane. Accommodates pedestrian crossings with protected phasing.



In **Appendix A**, **Figure 1** illustrates the partial displaced left-turn intersection preliminary concept (illustration does not reflect analyzed geometry). **Figure 2** shows an example of a similar partial displaced left-turn intersection at Beechmont Avenue and Five Mile Road in Ohio.

Operational analysis of the future 2040 weekday a.m., weekday p.m., and Saturday midday peak hour volumes were developed for the study intersection in accordance with the Highway Capacity Manual (HCM) for signalized intersections using Synchro 9 and SimTraffic software. Overall, the DLT is projected to operate at LOS B in 2040 for the weekday a.m., weekday p.m., and Saturday peak hours

with minimal queues. Comparatively, the DLT provides greatly improved operations and reduced queues over the No-Build condition and the recommended Alternative 2 from the VDOT 2015 study.

Table 1 summarizes the HCM Level of Service (LOS). **Table 2** summarizes the resulting 95th percentile queues based Synchro analysis. **Table 3** provides a general list of DLT advantages and disadvantages for consideration in revaluation. **Appendix B** provides detailed Synchro analysis results and queuing results.

Table 1. 2040 Capacity Analysis Results

Intersection	Alternative	Weekday AM Peak Hour			Weekday PM Peak Hour			Saturday Midday Peak Hour		
		LOS	Delay (sec.)	v/c	LOS	Delay (sec.)	v/c	LOS	Delay (sec.)	v/c
Broadview Ave /Frost Ave/ Waterloo St/W Shirley Ave	No-Build	E	59.0	0.72	F	192.7	1.44	F	173.9	1.32
	VDOT Alternative 2[1]	D	44.8	0.68	E	55.7	0.83	E	69.9	0.91
	Partial DLT[2]	B	18.1	0.37	B	20.0	0.53	B	19.4	0.45
Frost Ave/EB DLT Crossover	Partial DLT[2]	B	16.1	0.37	B	14.5	0.67	B	12.8	0.56
Broadview Ave/EB DLT Crossover	Partial DLT[2]	A	7.8	0.47	A	9.9	0.85	A	9.9	0.88

[1]Includes dual-SBRT lanes and dual-NBLT lanes, as outlined in September 2015 study
[2]Includes partial displaced left-turn intersection with dual-SBRT lanes, dual-NBLT lanes, and restricted westbound left-turns

Table 2. 2040 Peak Hour 95th Percentile Queue Lengths

Alternative	Approach	Lane Group	Storage Available (ft)	95th Percentile Queue Length (ft)		
				AM	PM	SAT
VDOT Alternative 2	EB	L	-	496	539	808
		LT	-	481	483	755
		R	605	-	-	507
	WB	LT	290	164	355	216
		T	-	111	303	165
		R	225	64	88	111
	NB	L	500	197	504	212
		T	-	259	356	257
		R	-	226	348	234
	SB	L	250	174	202	265
		T	-	217	347	228
		R	400	-	355	206
Partial DLT	EB	L	350	102	222	275
		T	-	138	105	104
		R	605	44	8	45
	WB	T	-	41	125	60
		R	225	31	51	51
	NB	L	500	93	155	113
		TR	-	144	231	216
	SB[1]	L	250	337	332	361
		T	-	117	232	180
		R	-	-	-	-

[1]Cumulative SB queues between main intersection and adjacent DLT intersection

Table 3. Summary of DLT Advantages and Disadvantages*

Advantages	Disadvantages
Non-Motorized Users	
Bicycles and pedestrians can be accommodated at-grade	Pedestrians may require 2-stage crossings
Bicyclists have refuge (room for bicycle box) in making two-stage left turns	Some indirect movements may be necessary for pedestrians
	Longer pedestrian crossings
	Unique challenges for visually impaired pedestrians
Safety	
Fewer conflict points than interchanges (ramp terminals, exit/entrance ramps) and conventional intersections	Drivers may be less familiar with intersection
Lower delay and fewer stops on major street could reduce rear-end crash rates	Potential for wrong-way movements
	Issues with signal in flashing mode / going dark
Operations	
Increase in lane-by-lane capacity due to efficient 2-phase or 3-phase signal operation	Complex signal operations
Compatible with high-volume turning movements	Pedestrian crossing time and phasing may limit cycle length flexibility
More green time for major movements offers better progression when used as a corridor solution	Potential for additional user delay during off-peak periods
	No right-turn on red without bypass right-turn lane
Access Management	
Compatible with access-restricted corridors	May change ingress/egress patterns to corner businesses or development
	Medians and wide separators required
Cost and Right-of-Way Impact	
Smaller footprint than interchange	Required right of way likely larger than conventional intersection
Lower cost than interchange	More traffic signals, pavement, curbs and median/refuge islands

*Exhibit 2-6, FHWA Displaced Left Turn Intersection Informational Guide, August 2014

2.0 ACCESS MANAGEMENT IMPROVEMENTS

The *ADA/Access Management/Traffic Assessment Report, VDOT, April 2015* provided access management recommendations and indicated the proposed improvements of installing a raised median with left-turn lanes at the median openings and intersections, capacity improvements at Frost Avenue / Waterloo Street, driveway and turning movement restrictions, and improving pedestrian and bicycle accommodations will effectively improve safety along the corridor. In general, the study recommended the following:

- Installation of medians – A total of 10 median breaks within the Broadview Avenue study corridor, the same number of median breaks proposed in the *Broadview Access Management Study, VDOT, February 2013.*
- Installation of left-turn lanes.
- Turning movement restrictions.
- Driveway access restrictions.
- Improved lighting.
- Improved pedestrian and bicycle facilities – Improved sidewalk, ADA facilities, and 5' bike lanes.
- Driveway consolidation (4 driveways consolidated).
- U-turn geometry to accommodate passenger cars.
- Restrict Broadview Avenue at Gold Cup Drive / Stuyvesant Street to left-in/right-in/right-out.
- Restrict Broadview Avenue at Old Broadview Avenue / Roebling Street to left-in/right-in/right-out.
- Install marked uncontrolled pedestrian crossing between Gold Cup Drive and Stuyvesant Street intersections.
- South of Frost Avenue, median break to access Wawa and Waterloo Station Shopping Center.

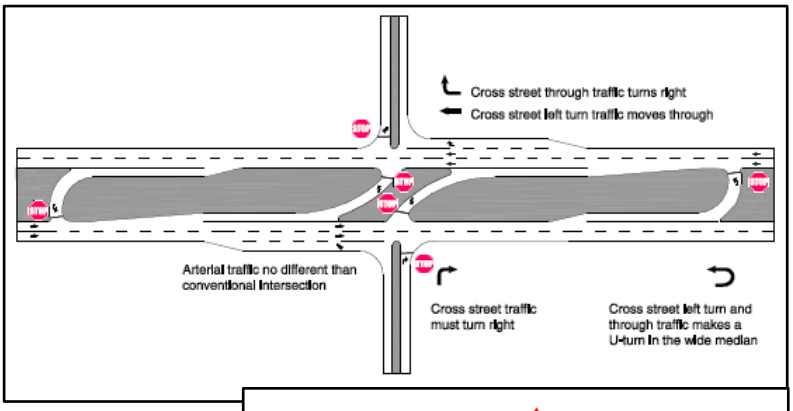
Since completion of the 2015 study, VDOT's most recent 30 Percent PFI Plan is dated May 14th, 2018. This plan is similar to the 2015 study but has the following general modifications:

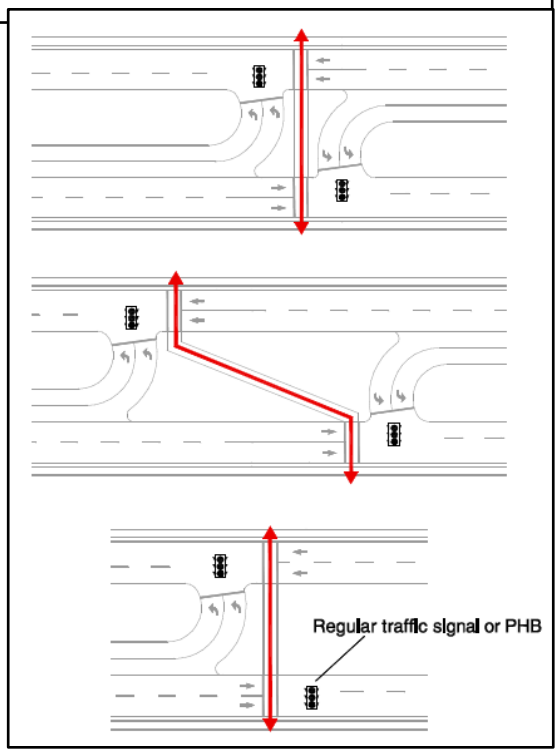
- A total of 9 median breaks from 10 (removal of the median break at Burger King and Frost Diner) with two median breaks no longer shown with back-to-back left-turns.
- Removed uncontrolled pedestrian crossing between Gold Cup Drive and Stuyvesant Street intersections.
- South of Frost Avenue, removed median break to access Wawa and Waterloo Station Shopping Center and extended median further south to Fox Den Antique Mall.
- Restricted all median breaks to directional left-in/right-in/right-out.

KAI has prepared a high-level conceptual access management plan that modifies VDOT's plan and further implements principles of Restricted Crossing U-Turn (RCUT) intersections along the Broadview Avenue corridor. This conceptual plan implements the following:

- Four (4) RCUT intersections at Church Street, Gold Cup Drive/Stuyvesant Street, Chappell Street, and Roebling Street. RCUT intersections provide directional left-turns and downstream u-turn movements.

- RCUT intersections can be operated under signalization or stop-control.
- RCUT intersections can accommodate mid-block pedestrian access with intersection signalization.
- Signalized RCUT intersections operate as two-phase intersections with bi-directional progression. Signalized corridor can be coordinated to progress traffic at desired speed limit in both directions.
- Potential additional impacts to ROW with u-turn bulb outs.
- Implement partial DLT intersections to improve traffic operations (see **Section 1.0**).
- South of Frost Avenue, evaluate access management options to either reduce median length or extend median to Hospital Drive and evaluate intersection for signalized u-turn.





Overall, the VDOT 30% PFI Plan design approach is an appropriate traffic engineering solution to improve safety, mobility, and operations but can be in conflict with local interests and business access. The Broadview corridor includes unique challenges such as a high-volume corridor, local versus thru trips, maintaining acceptable business access, right-of-way constraints, lack of interconnectivity, numerous driveway cuts, intersection spacing limitations, u-turn design vehicle accommodations, and pedestrian crossing accommodations.

In **Appendix A**, **Figure 3** schematically illustrates VDOT's 30% PFI Plan and provides general comments. **Figure 4** schematically illustrates the Conceptual Access Management Plan and provides comments. **Figures 5 and 6** show design vehicle checks for a Single Unit Truck and Passenger Vehicle, respectively.

3.0 INTERPARCEL CONNECTIVITY

Interparcel vehicular connections provide a number of benefits to drivers, businesses, and highway operations. Some of the benefits include allowing vehicles to access adjacent land uses without having to access the highway, maximizing the use of unsignalized intersections, and providing access to signalized intersections. The Broadview Avenue corridor, from south of Frost Avenue to south of Winchester Street, has poor overall interparcel connectivity with a majority of businesses not providing cross access. The following comments provide a general assessment of interparcel interconnectivity along the corridor, divided up into four segments:

- Southwest (West of Broadview Ave between Gold Cup Dr and Frost Ave)
    - Limited cross access, shared access, and on-site circulation
    - Key interparcel connection opportunities between Foster's Grille and Burger King, Burger King and Auto Plus Auto Parts, and Subway to Oak View National Bank to Sherwin-Williams.
    - Barriers for enhanced interconnectivity are between Warrenton Foreign Car and El Toro, Sherwin-Williams and Murphy's Motorsports, and Rappahannock St neighborhood.
- Southeast (East of Broadview Ave between Stuyvesant St and Waterloo St)
    - Limited cross access, shared access, and on-site circulation
    - Sullivan St and Church St provide additional access and roadway connectivity benefits for drivers, businesses, and highway operations.
    - Roadway connectivity, and interconnectivity, would be enhanced if Sullivan St connected to Stuyvesant St.
- Northwest (West of Broadview Ave between Roebling St and Gold Cup Dr)
    - Limited cross access, shared access, and on-site circulation
    - Norfolk Dr and residential neighborhood provides barrier to additional roadway connectivity.
- Northeast (East of Broadview Ave between Roebling St and Stuyvesant St)
    - Limited cross access, shared access, and on-site circulation
    - Jackson St, Stuyvesant St, Chappell St, and Roebling St provide additional access and roadway connectivity benefits for drivers, businesses, and highway operations. Benefit is limited due to residential units accessing Jackson St.

Overall, this corridor has many individual businesses with multiple driveway cuts and no or limited cross access. The existing limited roadway connectivity, high number of individual lots/driveways, and adjacent residential abutting to commercial development, make it very challenging to retrofit interparcel connectivity into the corridor without major redevelopment or access modifications. In **Appendix A**, Figure 7 illustrates interconnectivity opportunities and interconnectivity barriers for the southwest segment of the corridor.

4.0 SIGNAL WARRANT REVIEW AT BROADVIEW AVE AND GOLD CUP DR

In the *Intersection Traffic Analysis (Broadview Ave at Frost Ave / Waterloo St), VDOT, September 2015*, signal warrant analyses were performed at the following five unsignalized intersections in accordance to the 2011 Virginia Manual on Uniform Traffic Control Devices (VaMUTCD):

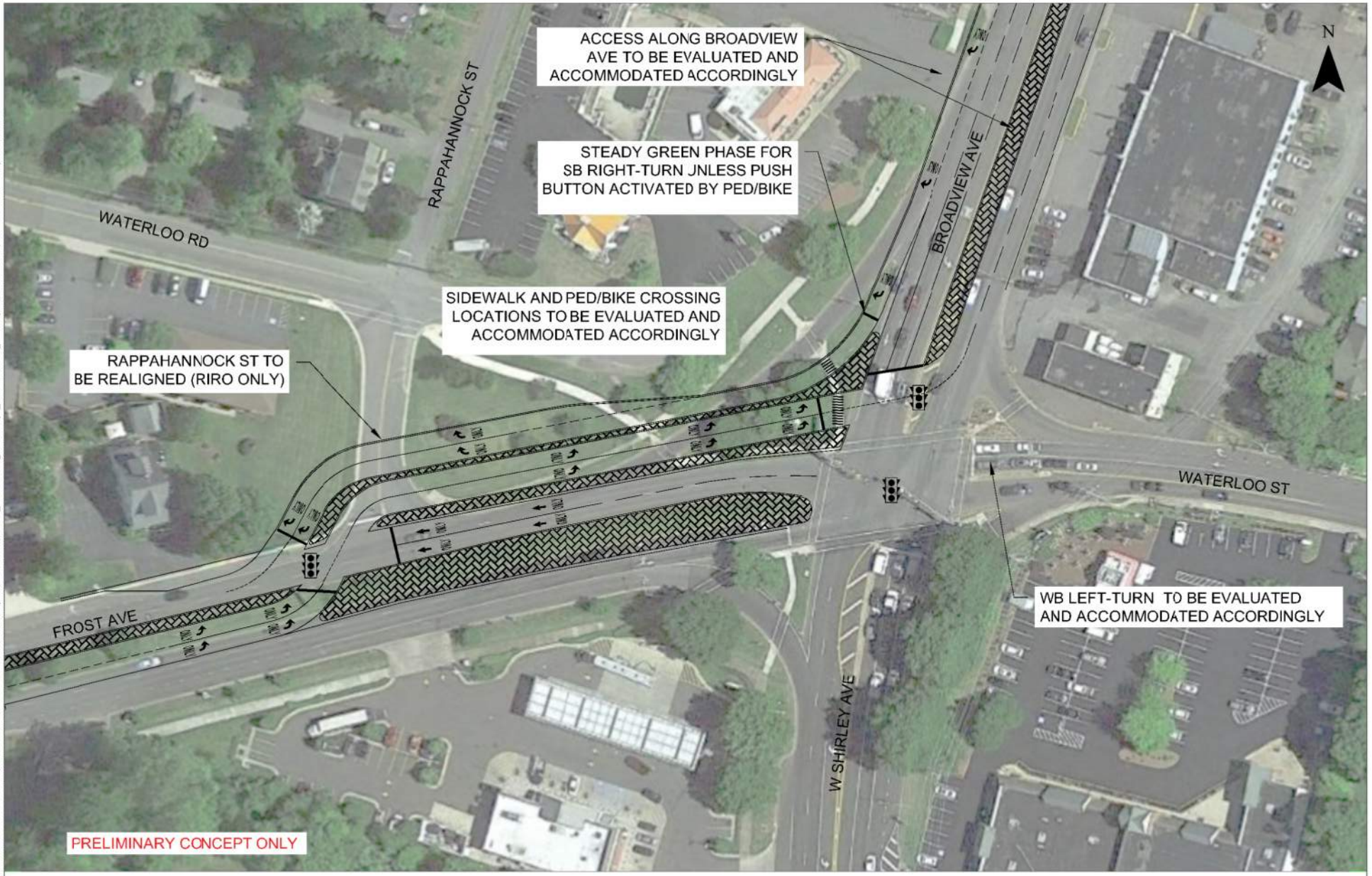
- Broadview Ave at Church St
- Broadview Ave at Gold Cup Dr
- Broadview Ave at Stuyvesant St
- Broadview Ave at Chappell St
- Broadview Ave at Roebling St / Old Broadview Ave

The Broadview Ave at Roebling St / Old Broadview Ave intersection was the only location that met one signal warrant (eight-hour vehicle volume). However, this location would not meet any signal warrants if right turns were separated from the shared through and left-turn movements or the minor streets were restricted to right-turns only.

While a traffic signal may not be warranted at Gold Cup Drive or other individual intersection locations, there may be additional benefits of considering traffic signals at select locations along the Broadview Avenue corridor:

- Traffic progression – The traffic sampling memo dated May 4, 2018 indicate average travel speeds on Broadview Avenue were generally 40 mph and that four of six 85% speeds were higher than 45 mph. While traffic signals are not installed to control speed, two or more adjacent traffic signals can be coordinated as a system to progress traffic at a posted or desired speed. For these types of signal systems, it is counterproductive to exceed the speed limit.
- Traffic gaps – Traffic signals create gaps in traffic that allow for downstream minor street turning movements or major street left-turns or U-turns. With a projected AADT of approximately 40,000 in 2040, gaps in traffic will be increasingly difficult to find and navigate safely.
- Traffic weaving – In an access management scenario, traffic signals create gaps in traffic that should allow for safer and more efficient cross weaving maneuvers.
- U-turns – In an access management scenario, traffic signals may be necessary to safely accommodate the U-turn of a design vehicle.
- RCUT alternative – Two-phase ‘half’ signals along an RCUT corridor can operate efficiently and in relative close proximity while providing corridor mobility, safety, progression, and multimodal accommodations.
- Pedestrians and bicycles crossings – Traffic signals can have the added benefit of providing protected pedestrian and bicycle crossings at full movement, directional left-turn, or U-turn intersections.

Appendix A
Figures



SCALE

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Conceptual Partial Displaced Left-Turn
Broadview Ave/Frost Ave/Waterloo St/W Shirley Ave
Warrenton, VA

Figure 1

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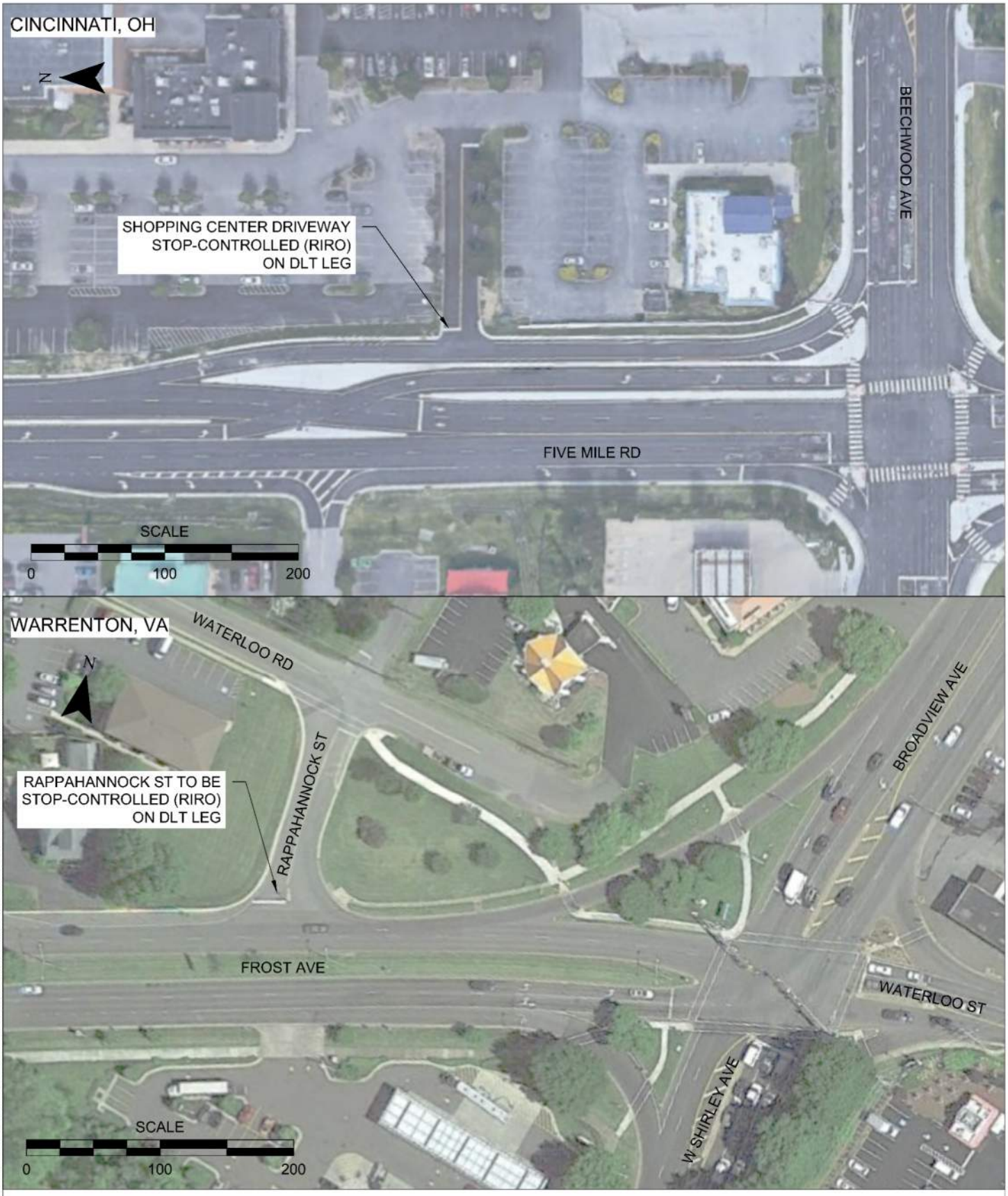

Existing DLT with Restricted Access (Cincinnatti, OH)
Relative to Existing Study Intersection (Warrenton, VA)

Figure
2

Channelized median island shown as pavement markings. Consider raised median to physically restrict to LI/RI/RO.

Corridor Plan Comments

-Four-lane median-divided facility with 11′ lanes, 5′ bike lanes, raised median, and restricted full-movement access along entire corridor.

-No provisions for mid-block pedestrian crossings.

-Design does not accomodate u-turns for single unit vehicles or larger.

-For all channelized median breaks, consider extending median island nose to physicallly restrict potential illegal maneuvers.

Consider providing northbound U-turn to accommodate Church St

Consider slightly shifting northbound U-turn further north opposite Church St or south opposite existing driveway.

Proposed intersection improvements. Consider additional alternative intersection improvements.

EQUESTRIAN RD
CHASE ST
NORFOLK DR
ROEBLING ST
WINCHESTER ST
BROADVIEW AVE
CHAPPELL ST
JACKSON ST
FORBES CT
STUYVESANT ST
PIEDMONT ST
BLUE RIDGE ST
RAPPAHANNOCK ST
CHURCH ST
MOSER RD
BRENDA CT
WATERLOO RD
FROST AVE
WEST SHIRLEY AVE
WATERLOO ST
HOSPITAL DR

Legend

- Raised Median
- Existing Raised Median
- Existing Signalized Intersection
- Existing UnSignalized Intersection
- U-Turn
- Left-In / Right-In / Right-Out
- Funeral Home Mountable Island

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VDOT 30% PFI Plan (5/14/18) Schematic

Figure **3**

Corridor Concept Comments

-Concept incorporates Restricted Crossing U-Turn intersection principles to the Broadview Avenue corridor.

-Concept modifies access breaks and U-turns from the PFI plan.

-RCUT intersections can be operated under signal control or stop-control. Signals would operate as two-phase, with northbound and southbound signals operating independently. Signal timings and progression can govern desired arterial speeds. Signalized movements provide opportunities to incorporate mid-block pedestrian crossings.

-Intersection spacing, existing driveways, and right-of-way constraints may limit ability to fully apply RCUT principles along Broadview Avenue corridor.

Consider one-leg Displaced Left Turn alternative intersection treatment.

Evaluate access management design alternatives, such as extending median, providing southbound U-turn, and evaluating Hospital Dr. for signalization.

EQUESTRIAN RD
ROEBLING ST
WINCHESTER ST
NORFOLK DR
BROADVIEW AVE
CHAPPELL ST
JACKSON ST
FORBES CT
STUYVESANT ST
PIEDMONT ST
BLUE RIDGE ST
RAPPAHANNOCK ST
CHURCH ST
MOSER RD
BRENDA CT
WATERLOO RD
FROST AVE
WEST SHIRLEY AVE
WATERLOO ST
HOSPITAL DR

Legend

- Raised Median
- Existing Raised Median
- Existing Signalized Intersection
- Existing UnSignalized Intersection
- U-Turn
- Left-In / Right-In / Right-Out
- Pedestrian Mid-Block Crossing
- Funeral Home Mountable Island

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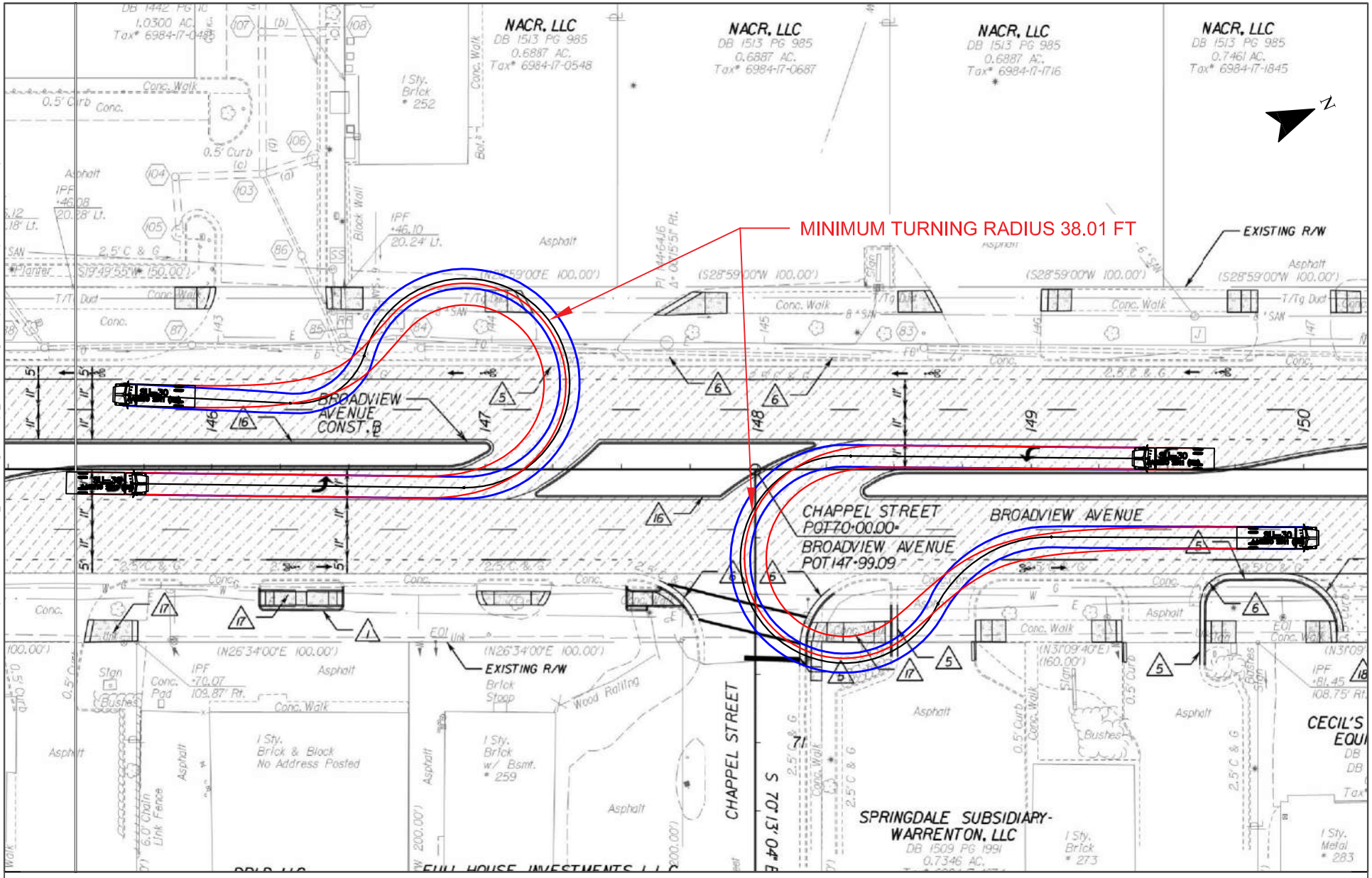
Conceptual Access Management Plan Schematic

Figure **4**



Single Unit Truck (SU-30) U-Turn Movement
VDOT Proposed Plan and Profile (05/14/19)
Warrenton, VA

Figure
5

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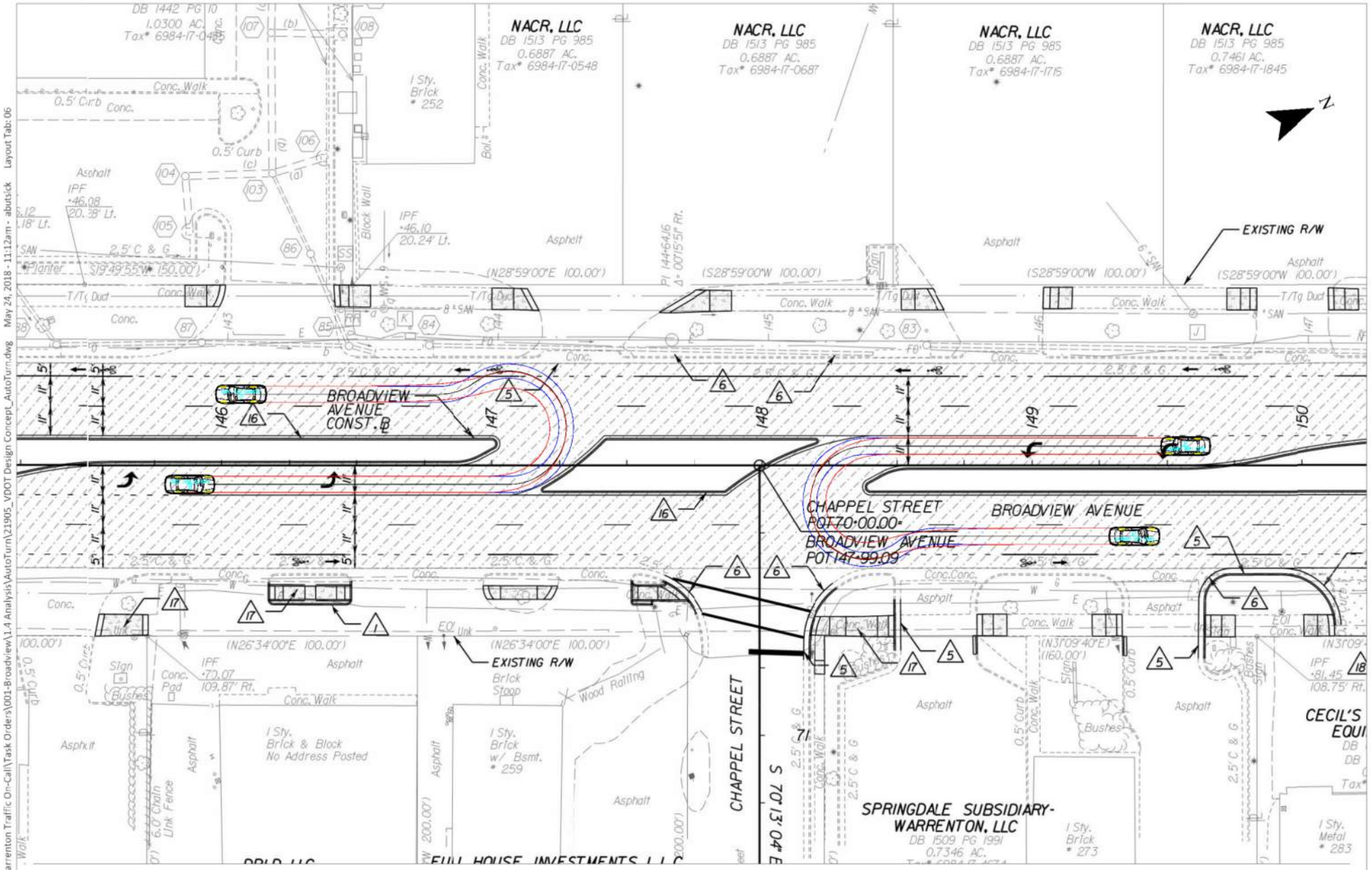
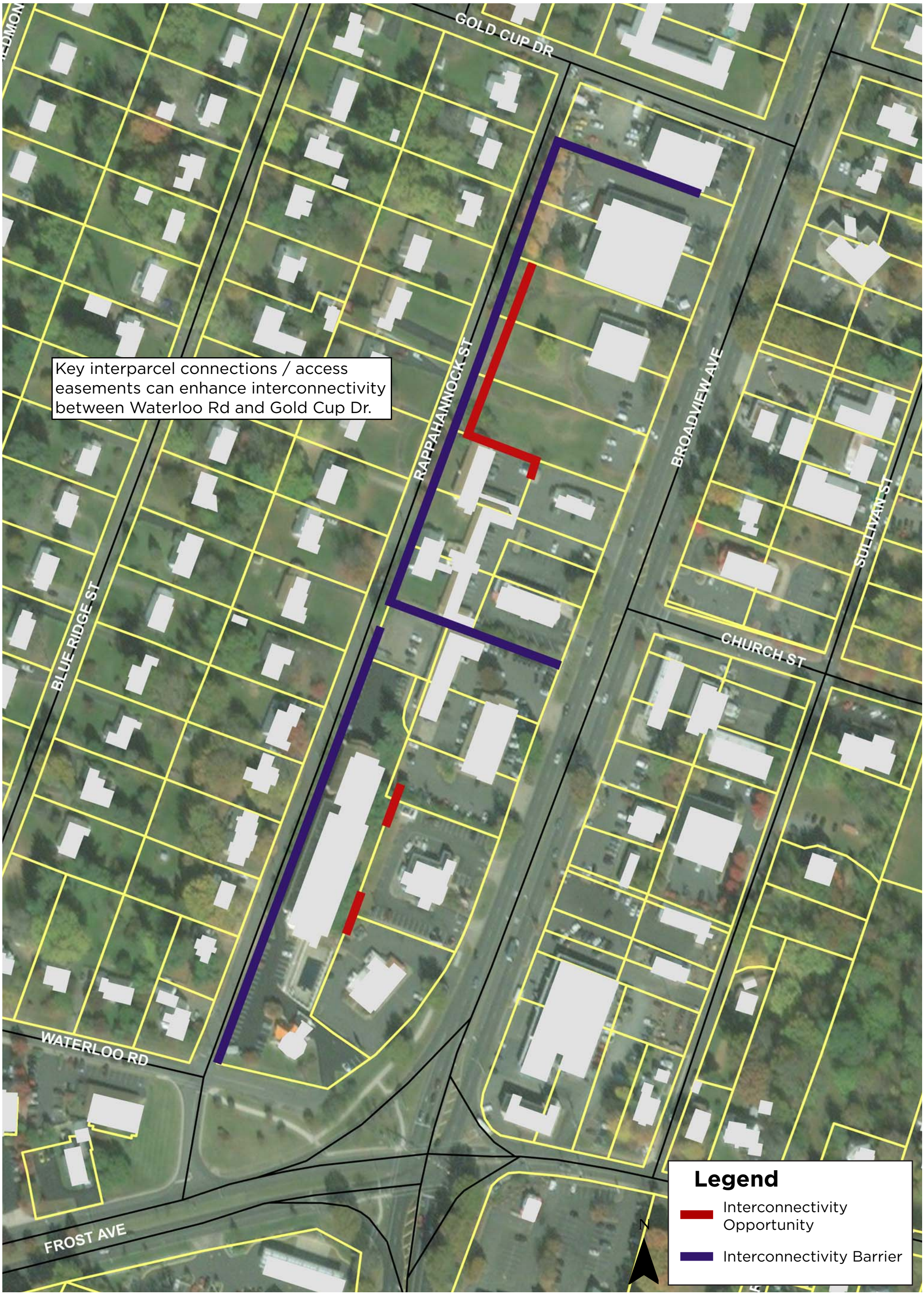


Passenger Vehicle (P) U-Turn Movement
VDOT Proposed Plan and Profile (05/14/19)
Warrenton, VA

Figure
6



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Interparcel Connectivity Review

Figure **7**

Appendix B
Capacity Analysis Results

VDOT Junction Screening Tool

VDOT Junction Screening Tool

Results Worksheet

General Information	
Project Title:	Broadview Cooridor Evaluation
EW Facility:	Frost Ave/Waterloo St
NS Facility:	Broadview Ave/W Shirely Ave
Date:	May 8, 2018

Volumes (veh/hr)	U-Turn / Left	Through	Right
Eastbound	714	177	180
Westbound	30	99	86
Northbound	174	352	27
Southbound	82	338	367

General Instructions: All intersection and interchange configurations have a default assumption of one exclusive lane per movement. No results shall be interpreted until the user has verified the lane configurations on each worksheet.

Intersection Results

Type	Dir	Maximum V/C	Accommodation Compared to Conventional	Weighted Total Conflict Points	Notes
		Congestion	Pedestrian	Safety	
Conventional	-	0.62		48	
Partial Displaced Left Turn	-	0.46	-	44	
Partial Median U-Turn	-	0.79	+	28	
Restricted Crossing U-Turn	-	0.74		20	
Roundabout	-	1.01		8	

Information

Congestion	The maximum v/c ratio represents the worst v/c of all zones that make up an intersection.
Pedestrian	Compares the potential of each design to accommodate pedestrians based on safety, wayfinding, and delay. Potential is qualitatively defined as better (+), similar (blank cell), or worse (-) than a conventional intersection or traditional diamond interchange.
Safety	Weighted Total = (2 x Crossing Conflicts) + Merging Conflicts + Diverging Conflicts

VDOT Junction Screening Tool

Results Worksheet

General Information	
Project Title:	Broadview Cooridor Evaluation
EW Facility:	Frost Ave/Waterloo St
NS Facility:	Broadview Ave/W Shirely Ave
Date:	May 8, 2018

Volumes (veh/hr)	U-Turn / Left	Through	Right
Eastbound	548	117	76
Westbound	68	310	121
Northbound	337	585	19
Southbound	75	601	950

General Instructions: All intersection and interchange configurations have a default assumption of one exclusive lane per movement. No results shall be interpreted until the user has verified the lane configurations on each worksheet.

Intersection Results

Congestion | Pedestrian | Safety | Notes

Type	Dir	Maximum V/C	Accommodation Compared to Conventional	Weighted Total Conflict Points	
Conventional	-	0.81		48	
Partial Displaced Left Turn	-	0.91	-	44	
Partial Median U-Turn	-	0.81	+	28	
Restricted Crossing U-Turn	-	1.21		20	
Roundabout	-	1.06		8	

Information

Congestion	The maximum v/c ratio represents the worst v/c of all zones that make up an intersection.
Pedestrian	Compares the potential of each design to accommodate pedestrians based on safety, wayfinding, and delay. Potential is qualitatively defined as better (+), similar (blank cell), or worse (-) than a conventional intersection or traditional diamond interchange.
Safety	Weighted Total = (2 x Crossing Conflicts) + Merging Conflicts + Diverging Conflicts

VDOT Junction Screening Tool

Results Worksheet

General Information	
Project Title:	Broadview Cooridor Evaluation
EW Facility:	Frost Ave/Waterloo St
NS Facility:	Broadview Ave/W Shirely Ave
Date:	May 8, 2018

Volumes (veh/hr)	U-Turn / Left	Through	Right
Eastbound	675	117	159
Westbound	41	140	161
Northbound	222	531	17
Southbound	137	528	983

General Instructions: All intersection and interchange configurations have a default assumption of one exclusive lane per movement. No results shall be interpreted until the user has verified the lane configurations on each worksheet.

Intersection Results

Type	Dir	Maximum V/C	Accommodation Compared to Conventional	Weighted Total Conflict Points	Notes
		Congestion	Pedestrian	Safety	
Conventional	-	0.68		48	
Partial Displaced Left Turn	-	0.84	-	44	
Partial Median U-Turn	-	0.86	+	28	
Restricted Crossing U-Turn	-	1.19		20	
Roundabout	-	1.12		8	

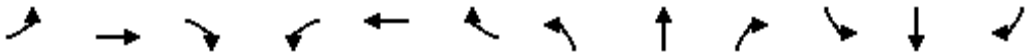
Information

Congestion	The maximum v/c ratio represents the worst v/c of all zones that make up an intersection.
Pedestrian	Compares the potential of each design to accommodate pedestrians based on safety, wayfinding, and delay. Potential is qualitatively defined as better (+), similar (blank cell), or worse (-) than a conventional intersection or traditional diamond interchange.
Safety	Weighted Total = (2 x Crossing Conflicts) + Merging Conflicts + Diverging Conflicts

Synchro

Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	212	216	119	139	207	454	130	441
v/c Ratio	0.22	0.24	0.07	0.16	0.57	0.56	0.58	0.48
Control Delay	16.0	3.4	14.8	3.2	44.7	32.4	21.4	4.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.1
Total Delay	16.0	3.4	14.8	3.2	44.7	32.4	23.8	4.2
Queue Length 50th (ft)	65	0	17	0	58	120	52	4
Queue Length 95th (ft)	138	44	41	31	93	144	126	6
Internal Link Dist (ft)	547		899			763		85
Turn Bay Length (ft)				225	400			
Base Capacity (vph)	943	911	1771	870	387	1163	262	1331
Starvation Cap Reductn	0	0	0	0	0	0	56	115
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.22	0.24	0.07	0.16	0.53	0.39	0.63	0.36

Intersection Summary



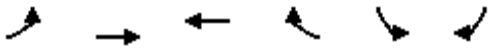
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	212	216	0	119	139	207	422	32	130	441	0
Future Volume (vph)	0	212	216	0	119	139	207	422	32	130	441	0
Ideal Flow (vphpl)	1950	1950	1950	1950	1950	1950	1950	1950	1950	1950	1950	1950
Total Lost time (s)		4.0	4.0		4.5	4.5	4.5	6.0		4.5	5.0	
Lane Util. Factor		1.00	1.00		0.95	1.00	0.97	0.95		1.00	0.95	
Frt		1.00	0.85		1.00	0.85	1.00	0.99		1.00	1.00	
Flt Protected		1.00	1.00		1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1912	1625		3632	1625	3523	3594		1816	3632	
Flt Permitted		1.00	1.00		1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1912	1625		3632	1625	3523	3594		1816	3632	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	212	216	0	119	139	207	422	32	130	441	0
RTOR Reduction (vph)	0	0	109	0	0	71	0	7	0	0	0	0
Lane Group Flow (vph)	0	212	107	0	119	68	207	447	0	130	441	0
Turn Type		NA	Perm		NA	Perm	Prot	NA		Prot	NA	
Protected Phases		1			2		3	8		7	4	
Permitted Phases			1			2						
Actuated Green, G (s)		44.4	44.4		43.9	43.9	9.4	20.0		11.1	22.7	
Effective Green, g (s)		44.4	44.4		43.9	43.9	9.4	20.0		11.1	22.7	
Actuated g/C Ratio		0.49	0.49		0.49	0.49	0.10	0.22		0.12	0.25	
Clearance Time (s)		4.0	4.0		4.5	4.5	4.5	6.0		4.5	5.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		943	801		1771	792	367	798		223	916	
v/s Ratio Prot		c0.11			0.03		0.06	c0.12		c0.07	0.12	
v/s Ratio Perm			0.07			0.04						
v/c Ratio		0.22	0.13		0.07	0.09	0.56	0.56		0.58	0.48	
Uniform Delay, d1		13.0	12.4		12.2	12.3	38.4	31.1		37.3	28.6	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00		0.30	0.09	
Incremental Delay, d2		0.1	0.1		0.1	0.2	2.0	0.9		3.7	0.4	
Delay (s)		13.1	12.4		12.3	12.5	40.3	32.0		14.8	2.9	
Level of Service		B	B		B	B	D	C		B	A	
Approach Delay (s)		12.8			12.4			34.6			5.6	
Approach LOS		B			B			C			A	

Intersection Summary			
HCM 2000 Control Delay	18.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.37		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	42.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBT	SBR
Lane Group Flow (vph)	855	428	326	440
v/c Ratio	0.70	0.12	0.17	0.34
Control Delay	28.2	0.1	2.3	1.6
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	28.2	0.1	2.3	1.6
Queue Length 50th (ft)	213	0	22	0
Queue Length 95th (ft)	237	0	37	18
Internal Link Dist (ft)		1207	547	
Turn Bay Length (ft)	250			
Base Capacity (vph)	2035	3632	1971	1859
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.42	0.12	0.17	0.24

Intersection Summary



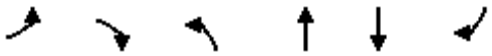
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	855	428	326	0	0	440
Future Volume (vph)	855	428	326	0	0	440
Ideal Flow (vphpl)	1950	1950	1950	1950	1950	1950
Total Lost time (s)	5.0	4.0	5.0			5.0
Lane Util. Factor	0.97	0.95	0.95			0.88
Frt	1.00	1.00	1.00			0.85
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3523	3632	3632			2860
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3523	3632	3632			2860
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	855	428	326	0	0	440
RTOR Reduction (vph)	0	0	0	0	0	288
Lane Group Flow (vph)	855	428	326	0	0	152
Turn Type	Prot	NA	NA			Over
Protected Phases	1	Free	2			1
Permitted Phases						
Actuated Green, G (s)	31.1	90.0	48.9			31.1
Effective Green, g (s)	31.1	90.0	48.9			31.1
Actuated g/C Ratio	0.35	1.00	0.54			0.35
Clearance Time (s)	5.0		5.0			5.0
Vehicle Extension (s)	3.0		3.0			3.0
Lane Grp Cap (vph)	1217	3632	1973			988
v/s Ratio Prot	c0.24	0.12	c0.09			0.05
v/s Ratio Perm						
v/c Ratio	0.70	0.12	0.17			0.15
Uniform Delay, d1	25.5	0.0	10.3			20.4
Progression Factor	1.00	1.00	0.18			1.00
Incremental Delay, d2	1.9	0.1	0.2			0.1
Delay (s)	27.3	0.1	2.1			20.4
Level of Service	C	A	A			C
Approach Delay (s)		18.2	2.1		20.4	
Approach LOS		B	A		C	

Intersection Summary			
HCM 2000 Control Delay	16.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.37		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	40.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	NBT	SBT	SBR
Lane Group Flow (vph)	855	561	571	440
v/c Ratio	0.50	0.20	0.43	0.27
Control Delay	2.4	0.8	28.3	0.4
Queue Delay	0.0	0.1	0.0	0.0
Total Delay	2.4	1.0	28.3	0.4
Queue Length 50th (ft)	0	9	101	0
Queue Length 95th (ft)	102	8	111	0
Internal Link Dist (ft)	417	85	659	
Turn Bay Length (ft)				200
Base Capacity (vph)	1718	3203	1913	1625
Starvation Cap Reductn	0	1613	0	0
Spillback Cap Reductn	0	0	124	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.50	0.35	0.32	0.27

Intersection Summary



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	855	0	0	561	571	440
Future Volume (vph)	855	0	0	561	571	440
Ideal Flow (vphpl)	1950	1950	1950	1950	1950	1950
Total Lost time (s)	4.5			4.0	5.0	4.0
Lane Util. Factor	0.97			0.95	0.91	1.00
Frt	1.00			1.00	1.00	0.85
Flt Protected	0.95			1.00	1.00	1.00
Satd. Flow (prot)	3523			3632	5219	1625
Flt Permitted	0.95			1.00	1.00	1.00
Satd. Flow (perm)	3523			3632	5219	1625
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	855	0	0	561	571	440
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	855	0	0	561	571	440
Turn Type	Prot			NA	NA	Free
Protected Phases	2!			1 8!	4	
Permitted Phases						Free
Actuated Green, G (s)	43.9			68.4	22.7	90.0
Effective Green, g (s)	43.9			68.4	22.7	90.0
Actuated g/C Ratio	0.49			0.76	0.25	1.00
Clearance Time (s)	4.5				5.0	
Vehicle Extension (s)	3.0				3.0	
Lane Grp Cap (vph)	1718			2760	1316	1625
v/s Ratio Prot	c0.24			0.15	c0.11	
v/s Ratio Perm						c0.27
v/c Ratio	0.50			0.20	0.43	0.27
Uniform Delay, d1	15.6			3.1	28.3	0.0
Progression Factor	0.09			0.25	1.00	1.00
Incremental Delay, d2	1.0			0.0	0.2	0.4
Delay (s)	2.3			0.8	28.5	0.4
Level of Service	A			A	C	A
Approach Delay (s)	2.3			0.8	16.3	
Approach LOS	A			A	B	

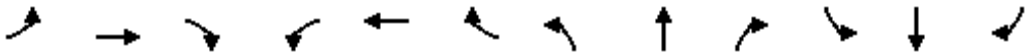
Intersection Summary			
HCM 2000 Control Delay	7.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	46.0%	ICU Level of Service	A
Analysis Period (min)	15		

! Phase conflict between lane groups.

c Critical Lane Group

Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	140	91	372	227	404	733	146	803
v/c Ratio	0.21	0.14	0.30	0.32	0.69	0.63	0.49	0.66
Control Delay	23.2	1.2	23.9	4.8	41.4	27.8	15.1	5.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.0
Total Delay	23.2	1.2	23.9	4.8	41.4	27.8	18.9	5.7
Queue Length 50th (ft)	59	0	86	0	111	174	75	24
Queue Length 95th (ft)	105	8	125	51	155	231	135	35
Internal Link Dist (ft)	547		899			763		85
Turn Bay Length (ft)				225	400			
Base Capacity (vph)	668	667	1230	700	685	1286	313	1270
Starvation Cap Reductn	0	0	0	0	0	0	100	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.21	0.14	0.30	0.32	0.59	0.57	0.69	0.63

Intersection Summary



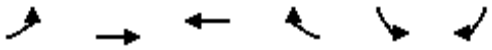
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	140	91	0	372	227	404	701	32	146	803	0
Future Volume (vph)	0	140	91	0	372	227	404	701	32	146	803	0
Ideal Flow (vphpl)	1950	1950	1950	1950	1950	1950	1950	1950	1950	1950	1950	1950
Total Lost time (s)		4.0	4.0		5.0	5.0	4.5	6.0		4.5	5.0	
Lane Util. Factor		1.00	1.00		0.95	1.00	0.97	0.95		1.00	0.95	
Frt		1.00	0.85		1.00	0.85	1.00	0.99		1.00	1.00	
Flt Protected		1.00	1.00		1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1912	1625		3632	1625	3523	3609		1816	3632	
Flt Permitted		1.00	1.00		1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1912	1625		3632	1625	3523	3609		1816	3632	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	140	91	0	372	227	404	701	32	146	803	0
RTOR Reduction (vph)	0	0	59	0	0	150	0	4	0	0	0	0
Lane Group Flow (vph)	0	140	32	0	372	77	404	729	0	146	803	0
Turn Type		NA	Perm		NA	Perm	Prot	NA		Prot	NA	
Protected Phases		1			2		3	8		7	4	
Permitted Phases			1			2						
Actuated Green, G (s)		31.5	31.5		30.5	30.5	15.1	29.1		14.9	29.9	
Effective Green, g (s)		31.5	31.5		30.5	30.5	15.1	29.1		14.9	29.9	
Actuated g/C Ratio		0.35	0.35		0.34	0.34	0.17	0.32		0.17	0.33	
Clearance Time (s)		4.0	4.0		5.0	5.0	4.5	6.0		4.5	5.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		669	568		1230	550	591	1166		300	1206	
v/s Ratio Prot		0.07			c0.10		0.11	c0.20		0.08	c0.22	
v/s Ratio Perm			0.02			0.05						
v/c Ratio		0.21	0.06		0.30	0.14	0.68	0.63		0.49	0.67	
Uniform Delay, d1		20.5	19.4		21.9	20.6	35.2	25.8		34.1	25.8	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00		0.30	0.12	
Incremental Delay, d2		0.2	0.0		0.6	0.5	3.3	1.1		1.1	1.2	
Delay (s)		20.7	19.4		22.5	21.2	38.5	26.9		11.2	4.4	
Level of Service		C	B		C	C	D	C		B	A	
Approach Delay (s)		20.2			22.0			31.0			5.4	
Approach LOS		C			C			C			A	

Intersection Summary			
HCM 2000 Control Delay	20.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	15.5
Intersection Capacity Utilization	55.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBT	SBR
Lane Group Flow (vph)	657	231	776	1139
v/c Ratio	0.39	0.06	0.52	0.80
Control Delay	15.0	0.0	8.1	20.9
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	15.0	0.0	8.1	20.9
Queue Length 50th (ft)	113	0	104	266
Queue Length 95th (ft)	136	0	145	320
Internal Link Dist (ft)		1207	547	
Turn Bay Length (ft)	250			
Base Capacity (vph)	1918	3632	1479	1599
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.34	0.06	0.52	0.71

Intersection Summary



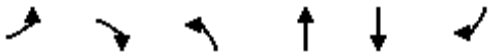
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	657	231	776	0	0	1139
Future Volume (vph)	657	231	776	0	0	1139
Ideal Flow (vphpl)	1950	1950	1950	1950	1950	1950
Total Lost time (s)	5.0	4.0	5.0			5.0
Lane Util. Factor	0.97	0.95	0.95			0.88
Frt	1.00	1.00	1.00			0.85
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3523	3632	3632			2860
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3523	3632	3632			2860
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	657	231	776	0	0	1139
RTOR Reduction (vph)	0	0	0	0	0	49
Lane Group Flow (vph)	657	231	776	0	0	1090
Turn Type	Prot	NA	NA			Over
Protected Phases	1	Free	2			1
Permitted Phases						
Actuated Green, G (s)	43.3	90.0	36.7			43.3
Effective Green, g (s)	43.3	90.0	36.7			43.3
Actuated g/C Ratio	0.48	1.00	0.41			0.48
Clearance Time (s)	5.0		5.0			5.0
Vehicle Extension (s)	3.0		3.0			3.0
Lane Grp Cap (vph)	1694	3632	1481			1375
v/s Ratio Prot	0.19	0.06	c0.21			c0.38
v/s Ratio Perm						
v/c Ratio	0.39	0.06	0.52			0.79
Uniform Delay, d1	14.9	0.0	20.1			19.6
Progression Factor	1.00	1.00	0.32			1.00
Incremental Delay, d2	0.1	0.0	1.2			2.3
Delay (s)	15.0	0.0	7.6			21.9
Level of Service	B	A	A			C
Approach Delay (s)		11.1	7.6		21.9	
Approach LOS		B	A		C	

Intersection Summary			
HCM 2000 Control Delay	14.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	68.1%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	NBT	SBT	SBR
Lane Group Flow (vph)	657	928	949	1139
v/c Ratio	0.55	0.35	0.55	0.70
Control Delay	14.1	1.2	25.6	2.5
Queue Delay	0.0	0.2	0.1	0.0
Total Delay	14.1	1.4	25.7	2.5
Queue Length 50th (ft)	164	18	150	0
Queue Length 95th (ft)	222	15	197	0
Internal Link Dist (ft)	417	85	659	
Turn Bay Length (ft)				200
Base Capacity (vph)	1193	2804	1825	1625
Starvation Cap Reductn	0	892	0	0
Spillback Cap Reductn	0	0	140	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.55	0.49	0.56	0.70

Intersection Summary



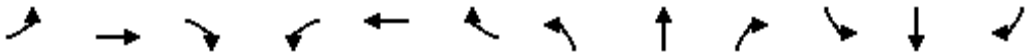
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	657	0	0	928	949	1139
Future Volume (vph)	657	0	0	928	949	1139
Ideal Flow (vphpl)	1950	1950	1950	1950	1950	1950
Total Lost time (s)	5.0			4.0	5.0	4.0
Lane Util. Factor	0.97			0.95	0.91	1.00
Frt	1.00			1.00	1.00	0.85
Flt Protected	0.95			1.00	1.00	1.00
Satd. Flow (prot)	3523			3632	5219	1625
Flt Permitted	0.95			1.00	1.00	1.00
Satd. Flow (perm)	3523			3632	5219	1625
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	657	0	0	928	949	1139
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	657	0	0	928	949	1139
Turn Type	Prot			NA	NA	Free
Protected Phases	2!			1 8!	4	
Permitted Phases						Free
Actuated Green, G (s)	30.5			64.6	29.9	90.0
Effective Green, g (s)	30.5			64.6	29.9	90.0
Actuated g/C Ratio	0.34			0.72	0.33	1.00
Clearance Time (s)	5.0				5.0	
Vehicle Extension (s)	3.0				3.0	
Lane Grp Cap (vph)	1193			2606	1733	1625
v/s Ratio Prot	0.19			0.26	0.18	
v/s Ratio Perm						c0.70
v/c Ratio	0.55			0.36	0.55	0.70
Uniform Delay, d1	24.2			4.8	24.5	0.0
Progression Factor	0.48			0.22	1.00	1.00
Incremental Delay, d2	1.8			0.1	0.4	2.5
Delay (s)	13.4			1.1	24.9	2.5
Level of Service	B			A	C	A
Approach Delay (s)	13.4			1.1	12.7	
Approach LOS	B			A	B	

Intersection Summary			
HCM 2000 Control Delay	9.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	15.5
Intersection Capacity Utilization	50.8%	ICU Level of Service	A
Analysis Period (min)	15		

! Phase conflict between lane groups.
c Critical Lane Group

Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	140	189	168	242	265	657	220	682
v/c Ratio	0.19	0.26	0.13	0.32	0.61	0.62	0.73	0.54
Control Delay	21.7	4.5	21.0	4.5	43.7	29.7	26.3	3.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0
Total Delay	21.7	4.5	21.0	4.5	43.7	29.7	29.8	3.8
Queue Length 50th (ft)	56	0	34	0	73	161	118	7
Queue Length 95th (ft)	104	45	60	51	113	216	191	10
Internal Link Dist (ft)	547		899			763		85
Turn Bay Length (ft)				225	400			
Base Capacity (vph)	725	733	1337	751	469	1167	353	1432
Starvation Cap Reductn	0	0	0	0	0	0	67	7
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.19	0.26	0.13	0.32	0.57	0.56	0.77	0.48

Intersection Summary



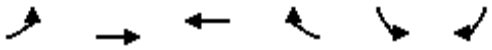
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	140	189	0	168	242	265	637	20	220	682	0
Future Volume (vph)	0	140	189	0	168	242	265	637	20	220	682	0
Ideal Flow (vphpl)	1950	1950	1950	1950	1950	1950	1950	1950	1950	1950	1950	1950
Total Lost time (s)		4.0	4.0		5.0	5.0	4.5	6.0		4.5	5.0	
Lane Util. Factor		1.00	1.00		0.95	1.00	0.97	0.95		1.00	0.95	
Frt		1.00	0.85		1.00	0.85	1.00	1.00		1.00	1.00	
Flt Protected		1.00	1.00		1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1912	1625		3632	1625	3523	3616		1816	3632	
Flt Permitted		1.00	1.00		1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1912	1625		3632	1625	3523	3616		1816	3632	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	140	189	0	168	242	265	637	20	220	682	0
RTOR Reduction (vph)	0	0	117	0	0	153	0	3	0	0	0	0
Lane Group Flow (vph)	0	140	72	0	168	89	265	654	0	220	682	0
Turn Type		NA	Perm		NA	Perm	Prot	NA		Prot	NA	
Protected Phases		1			2		3	8		7	4	
Permitted Phases			1			2						
Actuated Green, G (s)		34.1	34.1		33.1	33.1	11.1	26.3		15.1	31.3	
Effective Green, g (s)		34.1	34.1		33.1	33.1	11.1	26.3		15.1	31.3	
Actuated g/C Ratio		0.38	0.38		0.37	0.37	0.12	0.29		0.17	0.35	
Clearance Time (s)		4.0	4.0		5.0	5.0	4.5	6.0		4.5	5.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		724	615		1335	597	434	1056		304	1263	
v/s Ratio Prot		c0.07			0.05		0.08	c0.18		c0.12	0.19	
v/s Ratio Perm			0.04			0.05						
v/c Ratio		0.19	0.12		0.13	0.15	0.61	0.62		0.72	0.54	
Uniform Delay, d1		18.7	18.2		18.9	19.0	37.4	27.5		35.5	23.6	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00		0.37	0.10	
Incremental Delay, d2		0.1	0.1		0.2	0.5	2.5	1.1		7.6	0.4	
Delay (s)		18.9	18.2		19.1	19.6	39.9	28.6		20.8	2.7	
Level of Service		B	B		B	B	D	C		C	A	
Approach Delay (s)		18.5			19.4			31.9			7.1	
Approach LOS		B			B			C			A	

Intersection Summary			
HCM 2000 Control Delay	19.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	15.5
Intersection Capacity Utilization	48.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBT	SBR
Lane Group Flow (vph)	804	329	433	1178
v/c Ratio	0.44	0.09	0.32	0.75
Control Delay	13.9	0.0	6.3	15.4
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	13.9	0.0	6.3	15.4
Queue Length 50th (ft)	136	0	44	232
Queue Length 95th (ft)	136	0	68	239
Internal Link Dist (ft)		1207	547	
Turn Bay Length (ft)	250			
Base Capacity (vph)	2231	3632	1356	1886
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.36	0.09	0.32	0.62

Intersection Summary



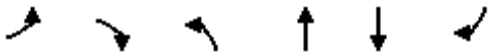
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	804	329	433	0	0	1178
Future Volume (vph)	804	329	433	0	0	1178
Ideal Flow (vphpl)	1950	1950	1950	1950	1950	1950
Total Lost time (s)	5.0	4.0	5.0			5.0
Lane Util. Factor	0.97	0.95	0.95			0.88
Frt	1.00	1.00	1.00			0.85
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3523	3632	3632			2860
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3523	3632	3632			2860
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	804	329	433	0	0	1178
RTOR Reduction (vph)	0	0	0	0	0	99
Lane Group Flow (vph)	804	329	433	0	0	1079
Turn Type	Prot	NA	NA			Over
Protected Phases	1	Free	2			1
Permitted Phases						
Actuated Green, G (s)	46.4	90.0	33.6			46.4
Effective Green, g (s)	46.4	90.0	33.6			46.4
Actuated g/C Ratio	0.52	1.00	0.37			0.52
Clearance Time (s)	5.0		5.0			5.0
Vehicle Extension (s)	3.0		3.0			3.0
Lane Grp Cap (vph)	1816	3632	1355			1474
v/s Ratio Prot	0.23	0.09	c0.12			c0.38
v/s Ratio Perm						
v/c Ratio	0.44	0.09	0.32			0.73
Uniform Delay, d1	13.7	0.0	20.1			17.0
Progression Factor	1.00	1.00	0.26			1.00
Incremental Delay, d2	0.2	0.0	0.6			1.3
Delay (s)	13.9	0.0	5.8			18.3
Level of Service	B	A	A			B
Approach Delay (s)		9.8	5.8		18.3	
Approach LOS		A	A		B	

Intersection Summary			
HCM 2000 Control Delay	12.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	60.1%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	NBT	SBT	SBR
Lane Group Flow (vph)	804	879	902	1178
v/c Ratio	0.62	0.33	0.50	0.72
Control Delay	15.4	1.4	23.7	2.9
Queue Delay	0.0	0.2	0.1	0.0
Total Delay	15.4	1.6	23.8	2.9
Queue Length 50th (ft)	201	20	139	0
Queue Length 95th (ft)	275	17	170	0
Internal Link Dist (ft)	417	85	659	
Turn Bay Length (ft)				200
Base Capacity (vph)	1298	2790	2058	1625
Starvation Cap Reductn	0	945	0	0
Spillback Cap Reductn	0	0	267	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.62	0.48	0.50	0.72

Intersection Summary



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	804	0	0	879	902	1178
Future Volume (vph)	804	0	0	879	902	1178
Ideal Flow (vphpl)	1950	1950	1950	1950	1950	1950
Total Lost time (s)	5.0			4.0	5.0	4.0
Lane Util. Factor	0.97			0.95	0.91	1.00
Frt	1.00			1.00	1.00	0.85
Flt Protected	0.95			1.00	1.00	1.00
Satd. Flow (prot)	3523			3632	5219	1625
Flt Permitted	0.95			1.00	1.00	1.00
Satd. Flow (perm)	3523			3632	5219	1625
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	804	0	0	879	902	1178
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	804	0	0	879	902	1178
Turn Type	Prot			NA	NA	Free
Protected Phases	2!			1 8!	4	
Permitted Phases						Free
Actuated Green, G (s)	33.1			64.4	31.3	90.0
Effective Green, g (s)	33.1			64.4	31.3	90.0
Actuated g/C Ratio	0.37			0.72	0.35	1.00
Clearance Time (s)	5.0				5.0	
Vehicle Extension (s)	3.0				3.0	
Lane Grp Cap (vph)	1295			2598	1815	1625
v/s Ratio Prot	0.23			0.24	0.17	
v/s Ratio Perm						c0.72
v/c Ratio	0.62			0.34	0.50	0.72
Uniform Delay, d1	23.3			4.8	23.1	0.0
Progression Factor	0.53			0.25	1.00	1.00
Incremental Delay, d2	2.1			0.1	0.2	2.9
Delay (s)	14.6			1.3	23.4	2.9
Level of Service	B			A	C	A
Approach Delay (s)	14.6			1.3	11.7	
Approach LOS	B			A	B	

Intersection Summary			
HCM 2000 Control Delay	9.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	15.5
Intersection Capacity Utilization	53.5%	ICU Level of Service	A
Analysis Period (min)	15		

! Phase conflict between lane groups.

c Critical Lane Group