Winooski Main Street Corridor Plan

Final Corridor Study

June 2014

CHITTENDEN COUNTY RPC
Communities Planning Together

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WINOOSKI MAIN STREET CORRIDOR PLAN

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1.0 INTRODUCTION

This report presents a summary of the process, findings, recommendations, and implementation plan for transportation improvements along the Main Street (US 2/7) corridor in Winooski from the Downtown Circulator north to the Colchester Town Line. This planning effort included the development of vision statement for the corridor, an identification of existing and future transportation issues, and development of short and medium term improvement options to address capacity and safety issues in the corridor.

The project was managed by the Chittenden County Regional Planning Commission (CCRPC) and was developed with assistance from a project Steering Committee comprised of representatives from the CCRPC, the Winooski Public Works Department, and the Winooski City Council.

Figure 1: Study Area

2.0 VISION & GOALS STATEMENT

The statement of vision and articulation of goals for the Main Street corridor serves as an important guidance for the development and screening of improvement options. The vision and goals statement was adapted from the vision for the corridor included in the Winooski Municipal Development Plan (2009).

2.1.1 Vision Statement

The Vision for the Main Street US2/7 Corridor in Winooski is a pedestrian-scale environment that consists of mixed use development with residences above commercial space, streets alive with street trees, flags, awnings, pocket parks and open spaces, with two lanes of traffic, on-street parking, and convenient pedestrian crossings. Buildings should be sited with a minimal front yard setback to create the desired objective of a pedestrian oriented urban edge and traditional "Main Street" character to create a pattern of growth that embodies the basic principles of Winooski's traditional downtown. The northern end of the corridor should serve as a proper gateway into Winooski with street trees, lighting, wayfinding signage, and public art.

2.1.2 Corridor Goals

- Roadway Capacity: Additional roadway capacity should be achieved through operational improvements at intersections. Reduced Levels of Service below LOS E are acceptable if the only solution is to expand the intersection footprint beyond the current curb lines.
- Pedestrian Accessibility: Pedestrian accessibility and safety should be maximized to the extent possible along the corridor. Continuous, accessible sidewalks should be maintained along both sides of the corridor. Actuated pedestrian signals should be provided across all approaches at signalized intersections. Safe, well-marked crosswalks should be provided at all unsignalized crossings.
- Streetscape: Within the public right-of-way, every attempt should be made to enhance the streetscape, with additional street trees and landscaping, pedestrian-scale lighting, benches, pocket parks, and other amenities consistent with a traditional “Main Street” character.
- Access Management: Existing curb cuts should be minimized to the extent possible by either closing access points to lots with multiple driveways, providing internal connections between lots, or providing access onto a side street. All new development along the corridor should be strongly encouraged to minimize new curb cuts, provide internal connectivity, and access onto side streets.
- Transit Accommodation: Every effort should be made to enhance the safety and accessibility of the seven designated transit stops along the corridor. Each stop should have proper signage, adequate bus pull-off area, an enclosed shelter or bench and adequate lighting.

3.0 EXISTING & FUTURE CONDITIONS ASSESSMENT

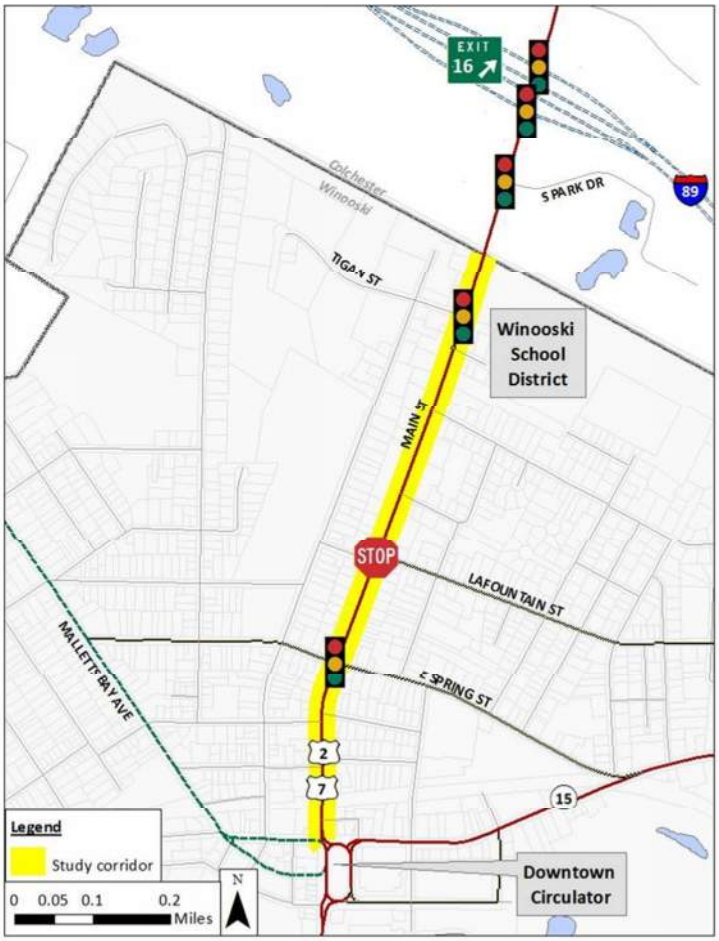
3.1 Project Study Area

The study corridor extends from the northern City limit, adjacent to I-89 Exit 16, south to West Allen Street at the downtown Circulator. In general, this study will assess conditions and develop short (less than 2 years) and medium term (less than 5 years) recommendations to address safety, mobility and connectivity issues in this corridor. The study will also develop improvement options for the following intersections:

- East / West Spring Street (signalized),
- La Fountain Street / Stevens Street (unsignalized),
- Tigan Street / Normand Street (signalized), and
- Winooski Educational Center's unsignalized entrance/exits.

In addition, three signals around the Exit 16 interchange (northbound off-ramp, southbound off-ramp, and South Park Drive) which is just north of the study area, are considered in this study (for signal coordination purposes) to ensure that recommendations made in this Corridor Plan are compatible and support the programmed improvements for the Exit 16 interchange.

Figure 2: Study Area



3.2 Corridor Context

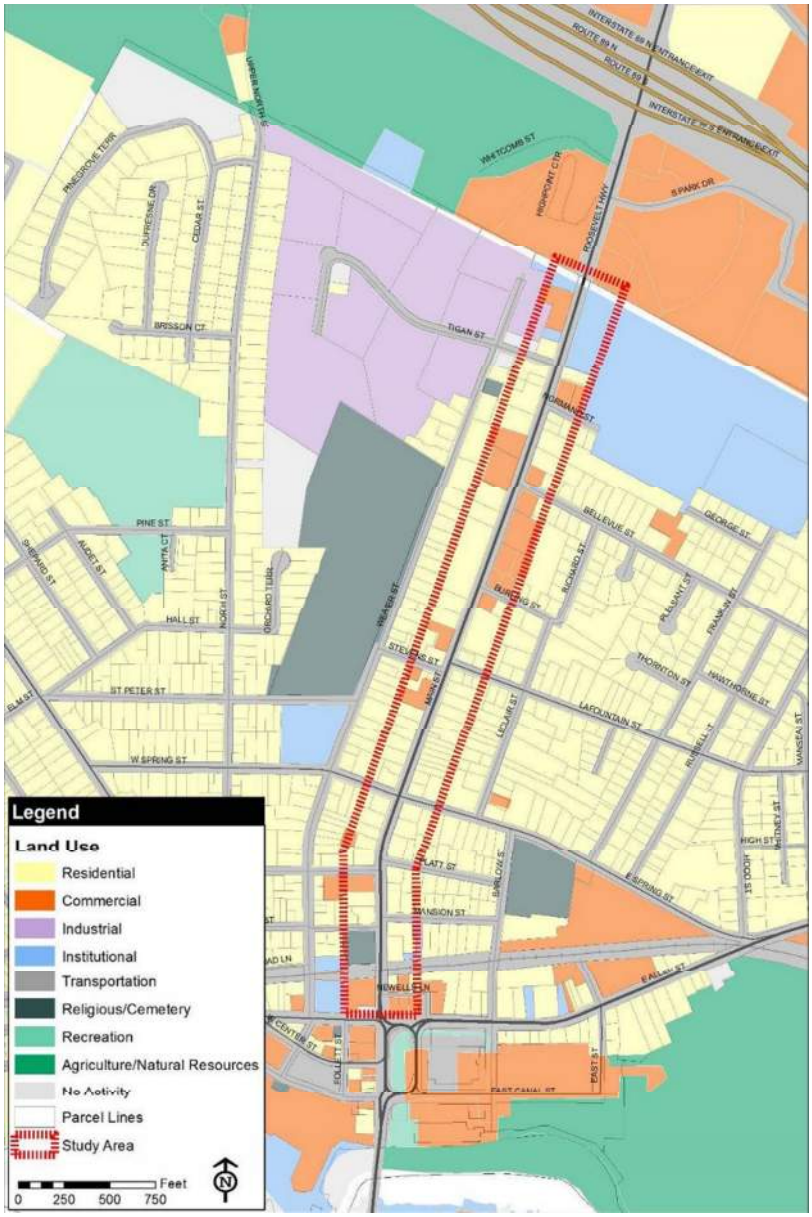
Within Winooski, the US 2/7 corridor (which begins immediately north of the Downtown Circulator) is generally a two lane principal arterial abutted by small businesses, civic buildings, and residences[1]. However, as the corridor heads north out of the Winooski downtown it's land use context changes to a more suburban, comercial-oriented uses, particularly adjacent to and north of Exit 16. The area around Exit 16 serves as a regional shopping area with a Costco and Shaw's and numerous other retail businesses. Mountain View Drive in Colchester and the Highland Industrial Park in Winooski provide office and industrial space for several regional businesses (Figure 3). The US 2/7 corridor provides access to both northbound and southbound I-89 at the Exit 16 interchange and acts as a gateway to the county's urban core, particularly for residents who live north of Winooski.

At the northern end of the study area is the Winooski School District, a single complex for grades Pre-K through 12. As of the school district's July 2012 newsletter, there were 398 students attending JFK Elementary (grades PreK-5), 156 attending Winooski Middle School (grades 6-8), and 250 attending Winooski High School (grades 9-12). Given the compactness of Winooski, it is foreseeable that a significant portion of students are currently walking/biking to school. The school property includes Hawthorne Field, with baseball and football fields, tennis and basketball courts, and a gymnasium with seating capacity for 1,100 people. The Winooski School District's 2012 Annual Report noted that it had recently completed sidewalk connections on Normand Street out to Main Street. Across from the School District is the Highland Industrial Park, which the Municipal Development Plan notes is "Winooski's greatest concentration of manufacturing." Figure 4 shows the current land uses along the study corridor.

Figure 3: Regional Context

[1] Winooski's 2009 Municipal Development Plan notes that the mean residential density of the city is approximately 8 units per acre.

Figure 4: Current Land Uses Along US 2/7



3.3 Demographics

According to the 2010 Census, Winooski's population is just under 7,000, ranking it among Vermont's twenty most populous towns/cities. Given that the land area of Winooski is approximately one square mile, it is also one of the most compact and dense towns in Vermont. The 2010 Census further indicates that Winooski is one of the most racially diverse cities in Vermont; the 2009 Municipal Development Plan (MDP) notes that the immigrant population of Winooski is increasing, with approximately 10% of the population being foreign born. The MDP also notes that the rest of Chittenden County tends to have attained a higher level of education than Winooski residents, and that Winooski residents tend to have lower incomes than the rest of the County; further: "in 1999 economic hardship remained a fact of life for many of Winooski's citizens. 993 People, or, 15.2% of the population, had incomes below the poverty level compared to 8.8% in Chittenden County." Winooski provides a large percentage of subsidized housing for Chittenden County for low and moderate-income families and seniors.

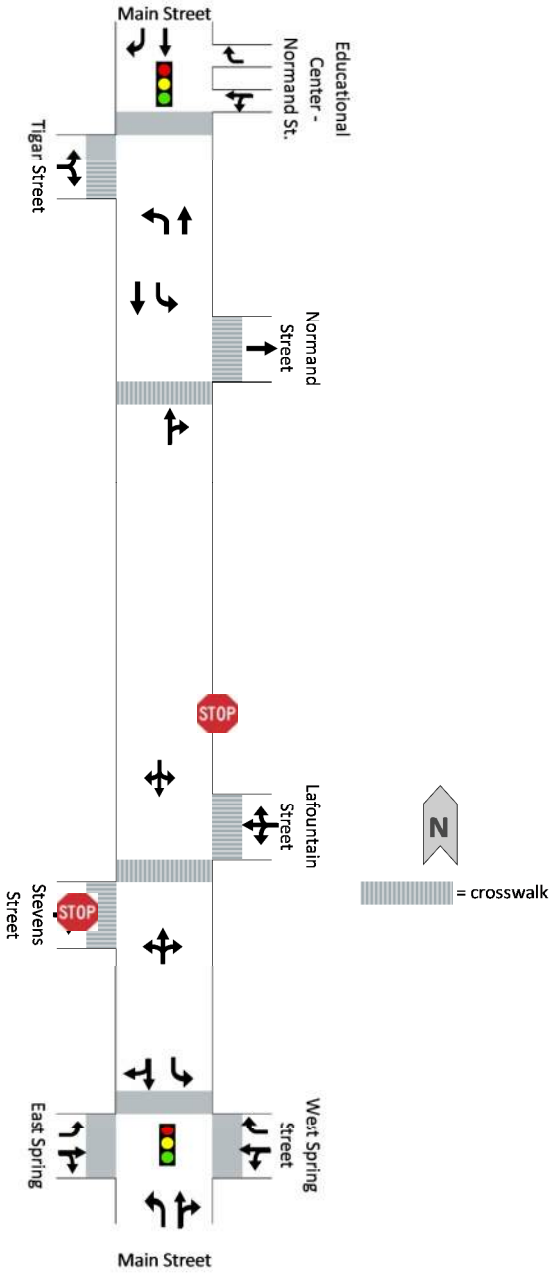
3.4 Intersection Control, Configuration and Operation

Figure 5 presents a schematic showing the intersection control type, lane configurations and crosswalk presence at each of the study intersections.

Current signal timings were collected from the signal cabinets on 24 August 2012 and the following observations were made regarding the current timings and operation of the signalized intersections:

- Main Street/Spring Street: This post and span-wire mounted signal is currently configured to run the same timing plan during both the morning and evening peak hours. There was no vehicle detection observed on either the eastnbound or westboad approaches and the minimum green time of 8 seconds often is not sufficient to process the westbound approach demand, particularly during the peak hours.
- Main Street/Tigan Street: This post and span-wire mounted signal is configured to service both Tigan Street and Norman Street, despite their offset approaches. The minor approaches are served by split phasing. While there are detectors installed on the Norman Street approach, there are no vehicle extension times associated with this approach in the timing plan (so the phase will only ever receive the minimum green time allocation).

Figure 5: Intersection configuration and control schematic



3.5 Functional Classification

The Federal Highway Administration's roadway functional classification system is organized as a hierarchy of facilities, based on the degree to which the roadway serves mobility for through traffic and access to adjacent land uses. Freeways and interstate highways, at the top of the hierarchy, are devoted exclusively to vehicle mobility with no direct access to adjacent land. Arterials and collectors provide both some level of mobility for through traffic and access to adjacent land uses. The primary purpose of local roads is to provide local access.

Figure 6 shows the functional classifications of the roadways in the study area. Main Street (US 2/7) is a *principal arterial*, the design relevance of which is described in Section 3.7. Main Street is one of three principal arterials in the area, along with VT 15 and US 2/7 in Burlington.

Any roadway that is classified as a major urban collector or above is part of the federal-aid highway system. As a principal arterial, Main Street is therefore part of the federal-aid highway system and is eligible for a variety of federal funding which is allocated through the CCRPC Transportation Improvement Program (TIP).

Figure 6: Roadway Functional Classification

3.6 Jurisdiction

Within the Winooski city limits, US 2/7 is a Class 1 Town Highway, which provides the City concurrent authority and jurisdiction with the state (VTrans) over this highway. The town highway classification system consists of classes 1 to 4 which are defined in the Vermont State Statutes. It is similar to the federal functional classification system in that a town highway class describes the role of a roadway in the overall highway network. As a Class 1 Town Highway, the state is responsible for scheduled surface maintenance or resurfacing as well as centerline pavement markings while the municipality is responsible for pot hole patching, crack filling, and striping of crosswalks and on-street parking lines.

More importantly, the mileage of class 1, 2 and 3 town highways is used to determine the amount of money a municipality will receive through an annual appropriation from the Town Highway State Aid Program approved by the Legislature each year. The funds are distributed quarterly with no application required and may be used for construction, improvements, and maintenance purposes, sidewalks and bike paths, or for the non-federal share of public transportation. The funds are distributed to various projects throughout the City and are incorporated into the annual municipal budget.

3.7 Existing Roadway Cross-Section

The function of the roadway should be reflected in its design, so VTrans has developed the *Vermont State Design Standards* to provide guidelines for design elements such as lane and shoulder widths for all classifications of roadways. The *State Design Standards* suggest lane widths of 10 to 12 feet for urban principal arterials (such as Main Street-US2/7), with appropriate offsets to the curb. However, the 10' widths are not recommended for areas with a high percent of truck traffic, so as a designated truck route, Main Street should have lane widths that are 11' to 12'. The *Design Standards* do not recommend specific shoulder widths, but note that appropriate widths

depend on the context of the area, vehicle speeds, whether bicycles are to be accommodated, drainage systems, and snow plow operations. For parking lanes, 8' is the minimum recommended width.

Current roadway cross sections in the corridor are shown in Figure 7 through 10. Please note that the right-of-way width was estimated from GIS parcel data. There is curbing along the entire Main Street corridor as well as considerable variation in lane, shoulder and sidewalk widths, and presence of a greenstrip between the roadway and sidewalks. The sections shown below indicate a typical curb-to-curb width of between 45 and 47 feet.

Figure 7: Cross-sections in the northern half of the study area

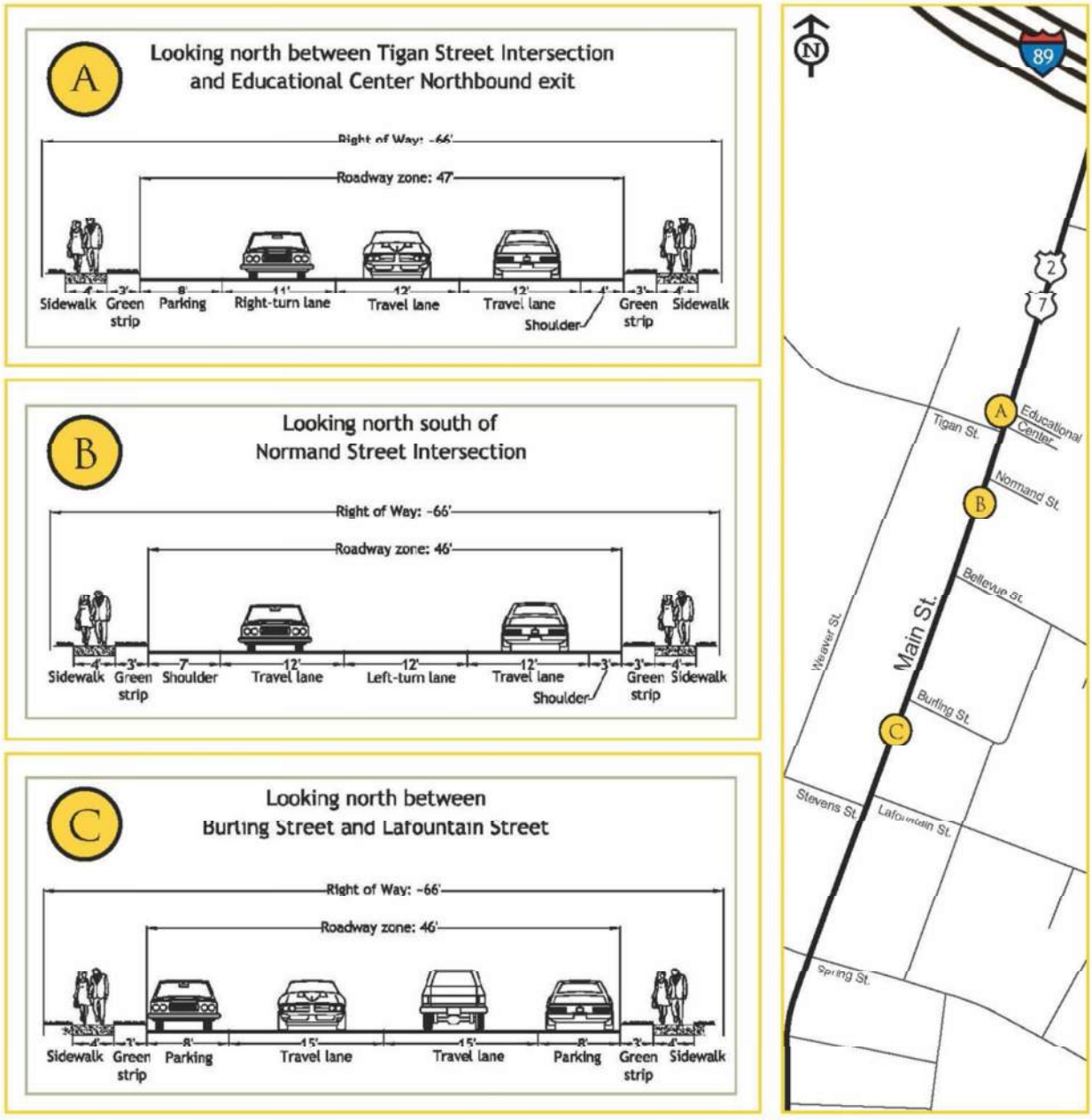


Figure 8: Cross-sections in the southern half of the study area

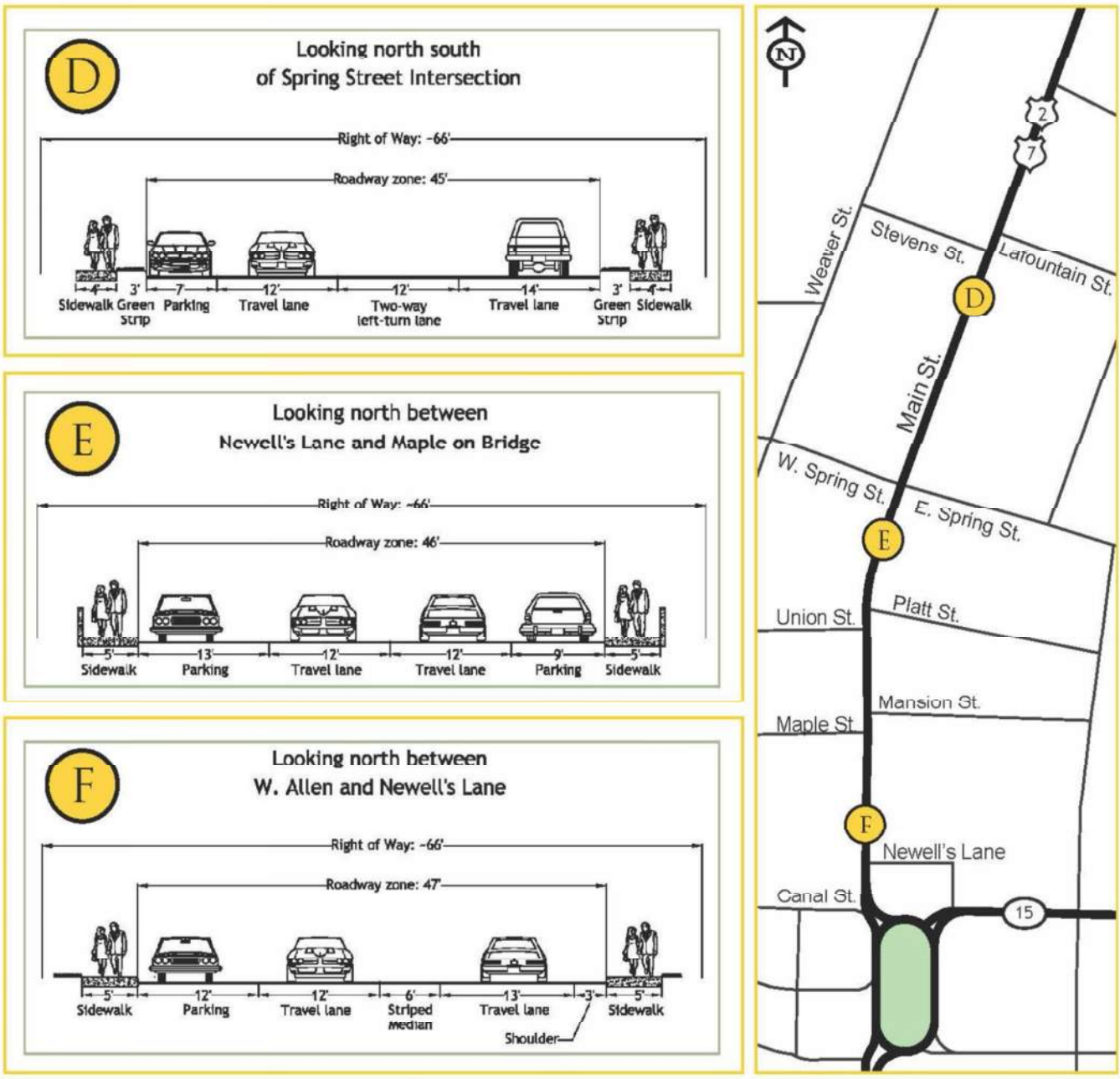
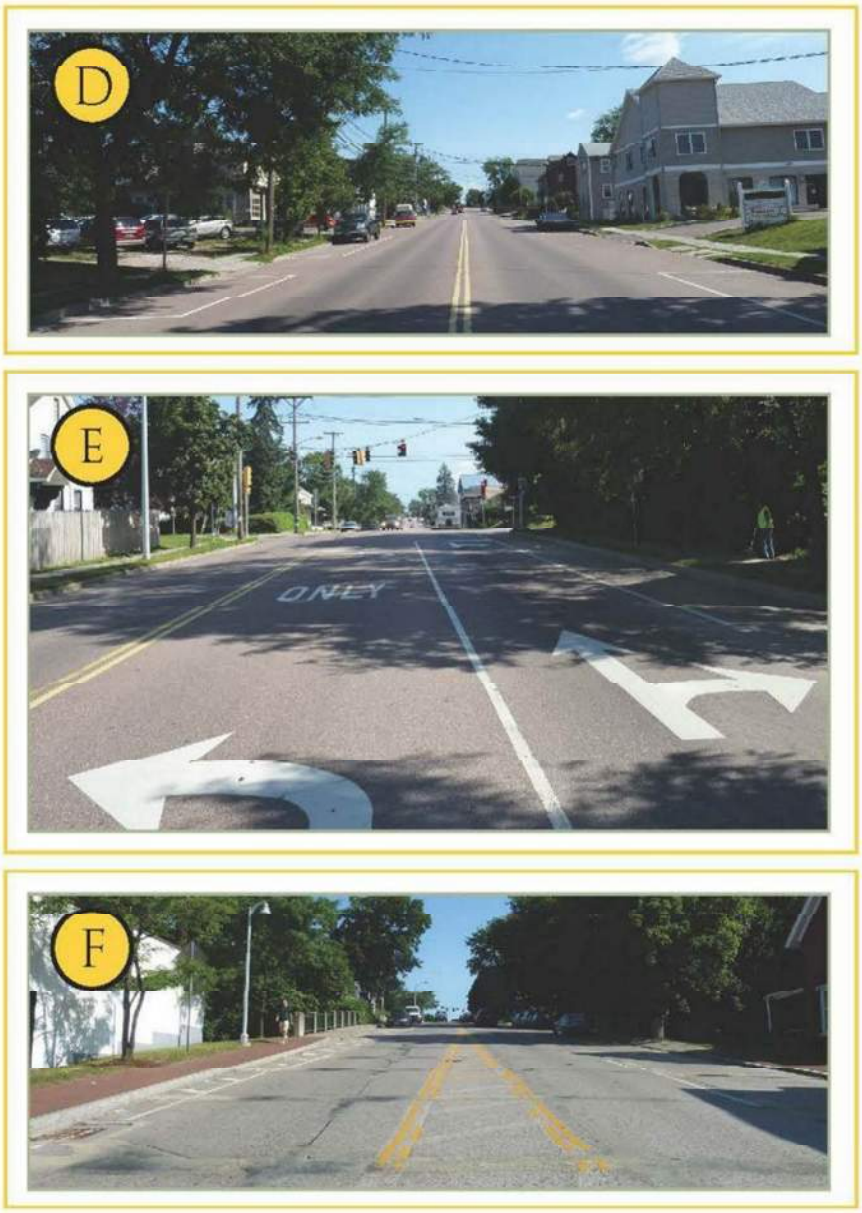


Figure 9: Cross-sections in the northern half of the study area (all sections are looking north)

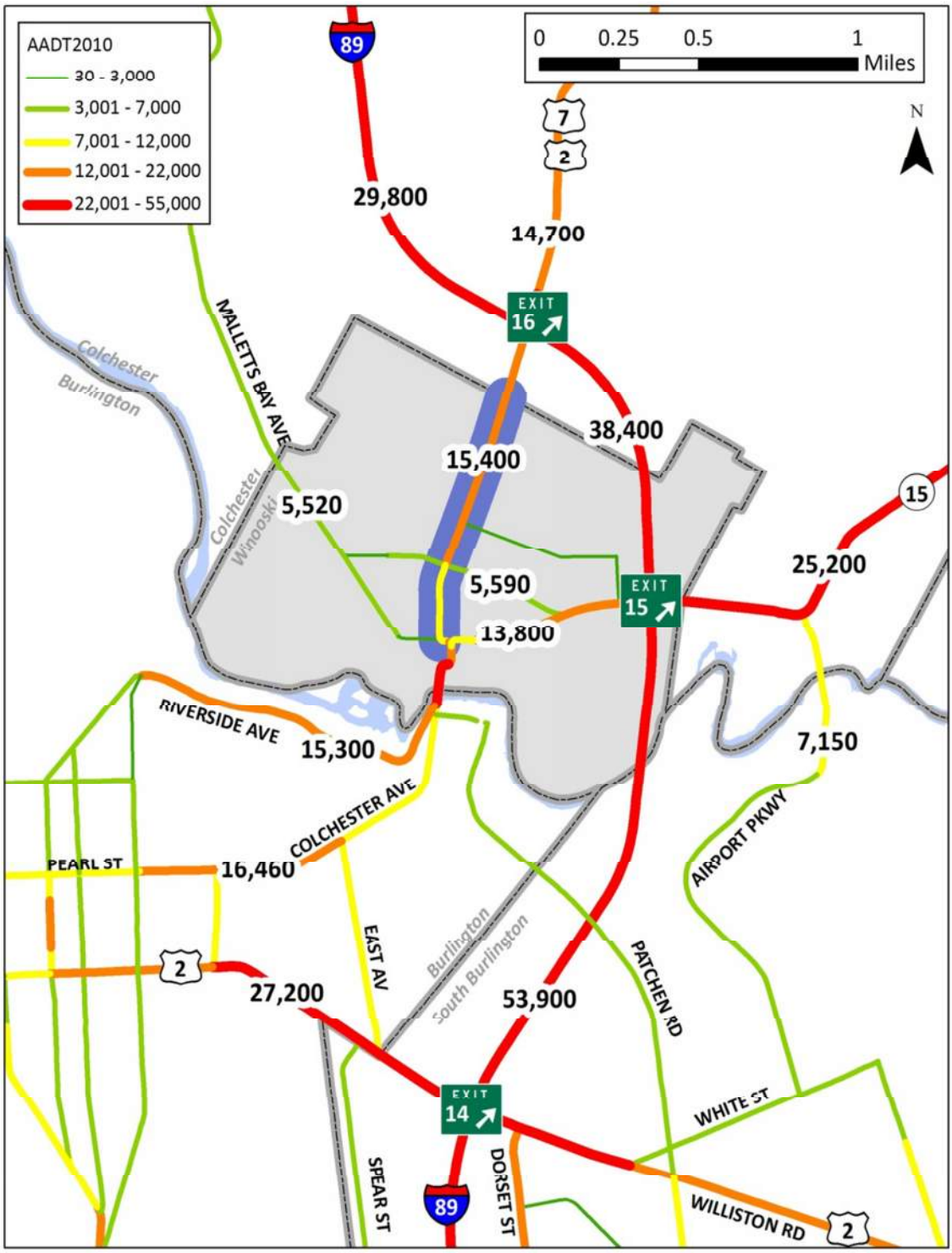
Figure 10: Cross-sections in the southern half of the study area (all sections are looking north)



3.8 Traffic Volumes

Figure 11 provides the 2010 average annual daily traffic (AADT) volumes along and adjacent to the project study area. The figure shows the prominent role that Main Street plays in the regional transportation network.

Figure 11: 2010 AADT (source: VTrans)



3.9 Traffic Congestion Analysis

Level-of-service (LOS) is a qualitative measure describing the operating conditions as perceived by motorists driving in a traffic stream. LOS is estimated using the procedures outlined in the *Highway Capacity Manual* (HCM). In addition to traffic volumes, key inputs include the number of lanes at each intersection and the traffic signal timing plans. The LOS results are based on the existing lane configurations and control types (signalized or unsignalized) at each study intersection.

The HCM defines six qualitative grades to describe the level of service at an intersection. LOS is based on the average control delay per vehicle. Figure 12 shows delays and characteristics for the various LOS grades for signalized and unsignalized intersections.

Figure 12. Level-of-Service Criteria for Signalized and Unsignalized Intersections

		Unsignalized	Signalized
LOS	Characteristics	Total Delay (sec)	Total Delay (sec)
A	Little or no delay	≤ 10.0	≤ 10.0
B	Short delays	10.1-15.0	10.1-20.0
C	Average delays	15.1-25.0	20.1-35.0
D	Long delays	25.1-35.0	35.1-55.0
E	Very long delays	35.1-50.0	55.1-80.0
F	Extreme delays	> 50.0	> 80.0

The delay thresholds for LOS at signalized and unsignalized intersections differ because of the driver's expectations of the operating efficiency for the respective traffic control conditions. According to HCM procedures, an overall LOS cannot be calculated for two-way stop-controlled intersections because not all movements experience delay. In signalized and all-way stop-controlled intersections, all movements experience delay and an overall LOS can be calculated.

Figure 13 shows the overall Level of Service (LOS), average vehicle delay (seconds), average and maximum queue lengths (feet), and volume to capacity ratio (v/c) for the study intersections under existing 2013 design hour volume (DHV)[2] conditions during the morning and evening peak hours. The signalized intersection congestion results are based on the signal timing plans currently running in the controllers.

[2] The DHV is the 30th highest hour of traffic for the year and is used as the design standard in Vermont.

Figure 13: 2013 AM & PM Peak Hour LOS, Delay, Queue Length, and v/c

Study Intersections	Existing Conditions 2013 AM Peak Hour LOS	Delay	Avg. Q	Max. Q	v/c	2013 PM Peak Hour LOS	Delay	Avg. Q	Max. Q	v/c	Avail Space
Main St/Tigan St/School Exit											
Overall	**C**	**20**			**0.63**	**D**	**48**			**0.67**	
EB, Tigan St	C	33	96	236	-	E	61	210	344	-	260
WB, School Exit	C	30	68	145	-	C	35	26	76	-	190
NB, Main St	B	14	116	238	-	E	62	1614	1736	-	620
SB, Main St	B	19	271	586	-	C	30	900	1070	-	855
Main St/E Spring St/W Spring St											
Overall	**C**	**25**			**0.59**	**E**	**71**			**0.79**	
EB, W Spring St	D	36	160	349	-	C	30	102	248	-	330
WB, E Spring St	C	28	79	202	-	F	>100	649	1184	-	370
NB, Main St	B	19	120	250	-	C	21	254	687	-	290
SB, Main St	C	20	112	264	-	B	19	178	327	-	645
Main St/Stevens St/LaFountain St											
EB, Stevens St	E	44	29	69	0.28	F	95	89	334	0.42	340
WB, LaFountain St	C	23	51	135	0.33	F	>100	886	1427	0.96	385
NB, Main St	A	<1	7	94	0.01	A	<1	410	658	0.01	750
SB, Main St	A	1	22	141	0.05	A	3	121	375	0.10	470

LOS F

Average queue length is greater than available queuing space

Traffic volumes for future planning year (2033) were derived by applying a 5% growth to the 2013 volumes. This growth factor is consistent with recent growth assumptions used in CCRPC transportation studies in the Colchester Ave corridor in Burlington. A congestion analysis was performed for 2033 traffic conditions and the results are presented in Figure 14.

Figure 14: 2033 AM & PM Peak Hour LOS, Delay, Queue Length, and v/c

Study Intersections	No Build 2033 AM Peak Hour LOS	Delay	Avg. Q	Max. Q	v/c	2033 PM Peak Hour LOS	Delay	Avg. Q	Max. Q	v/c	Avail Space
Main St/Tigan St/School Exit											
Overall	**C**	**21**			**0.65**	**E**	**67**			**0.70**	
EB, Tigan St	C	34	106	229	-	E	62	207	387	-	260
WB, School Exit	C	30	68	142	-	D	36	29	92	-	190
NB, Main St	B	14	127	261	-	F	>100	1627	1736	-	620
SB, Main St	C	20	365	734	-	C	33	879	972	-	855
Main St/E Spring St/W Spring St											
Overall	**C**	**26**			**0.62**	**F**	**84**			**0.84**	
EB, W Spring St	D	37	166	329	-	C	30	105	246	-	330
WB, E Spring St	C	28	83	232	-	F	>100	594	977	-	370
NB, Main St	B	19	129	277	-	C	22	447	849	-	290
SB, Main St	C	21	132	275	-	C	20	172	381	-	645
Main St/Stevens St/LaFountain St											
EB, Stevens St	F	53	37	96	0.34	F	>100	93	247	0.59	340
WB, LaFountain St	D	26	57	171	0.39	F	>100	800	1137	1.26	385
NB, Main St	A	<1	8	107	0.01	A	<1	482	665	0.02	750
SB, Main St	A	1	30	193	0.05	A	3	93	342	0.11	470

LOS F

Average queue length is greater than available queuing space

Some observations based on the 2013 congestion analysis results:

- Main Street/Tigan Street: Under current conditions, the Main Street/Tigan Street experiences congested conditions and excessive queuing during the evening peak hour. The overall intersection operates at LOS D conditions during the evening peak hour, with both the eastbound and northbound approaches

operating at LOS E conditions, with queues projected to extend through upstream intersections on both the northbound and southbound approaches. As expected, conditions are projected to deteriorate in 2033, with the overall Level of Service projected to drop to LOS E during the evening peak hour in 2033 with the northbound Main Street approach operating at a LOS F.

- Main Street/Spring Street: This signalized intersection operates with moderate levels of delay during the morning peak hour and relatively high levels of delay during the evening peak hour, particularly on the East Spring Street approach. We observed in the field that there are no detectors installed on the East Spring Street approach causing the westbound approach to be served with only the minimum green time of 10 seconds, regardless of demand. This condition results in long queues backing up to, and sometimes beyond, Leclair Street. With the current alignment, the eastbound left-turn lane is aligned directly opposite the westbound left/through lane, which forces westbound through traffic to shift to the right when traversing the intersection. Limited visibility between eastbound left-turning traffic and westbound through traffic can occur when through traffic queues behind left-turning traffic on the westbound Spring Street approach. Overall LOS is projected to drop from LOS E to LOS F in 2033 without any signal timing or other operational changes at this intersection. See Appendix C for additional detail on this intersection.
- Main Street/Stevens Street/LaFountain Street: This stop-controlled intersection operates with relatively high levels of delay on the Stevens Street and LaFountain Street approaches. Of note, the eastbound Stevens Street approach is projected to drop from LOS E to LOS F during the morning peak hour and both minor approaches are projected to see even worse LOS F conditions during the evening peak hour. The volume-to-capacity ratio for the LaFountain Street approach is projected to increase from 0.96 in 2013 to 1.26 in 2033, representing significantly over-capacity conditions on this approach.

3.10 Signal Warrant Analysis

A signal warrant analysis is a set of tests that are run to determine whether a traffic signal would significantly improve operations, mobility, and safety at an intersection. There are a total of eight warrants identified in the *Manual of Uniform Traffic Control Devices*:

Eight-Hour Vehicular Traffic Warrant: when a large amount of intersecting traffic occurring over an 8-hour period is the principal reason for installing a traffic signal, or where excessive delays occur on minor approaches to an intersection.

Four-Hour Vehicular Traffic Warrant: when a large amount of intersecting traffic occurring over a 4-hour period is the principal reason for installing a traffic signal.

Peak Hour Warrant: when the minor-street traffic suffers unduly delay when entering or crossing the major-street during the average peak hour is the principal reason for installing a traffic signal.

Pedestrian Volume Warrant: when the traffic volumes on a major street are so heavy that pedestrians experience excessive delays.

School Crossing Warrant: when school children crossing a major street are the principal reason for installing a traffic signal.

Coordinated Signal System Warrant: when maintaining proper platooning of vehicles is the principal reason for installing a traffic signal.

Crash Experience Warrant: when the severity and frequency of accidents is the principal reason for installing a traffic signal.

Roadway Network Warrant: when the concentration and organization of traffic flow is the principal reason for installing a traffic signal.

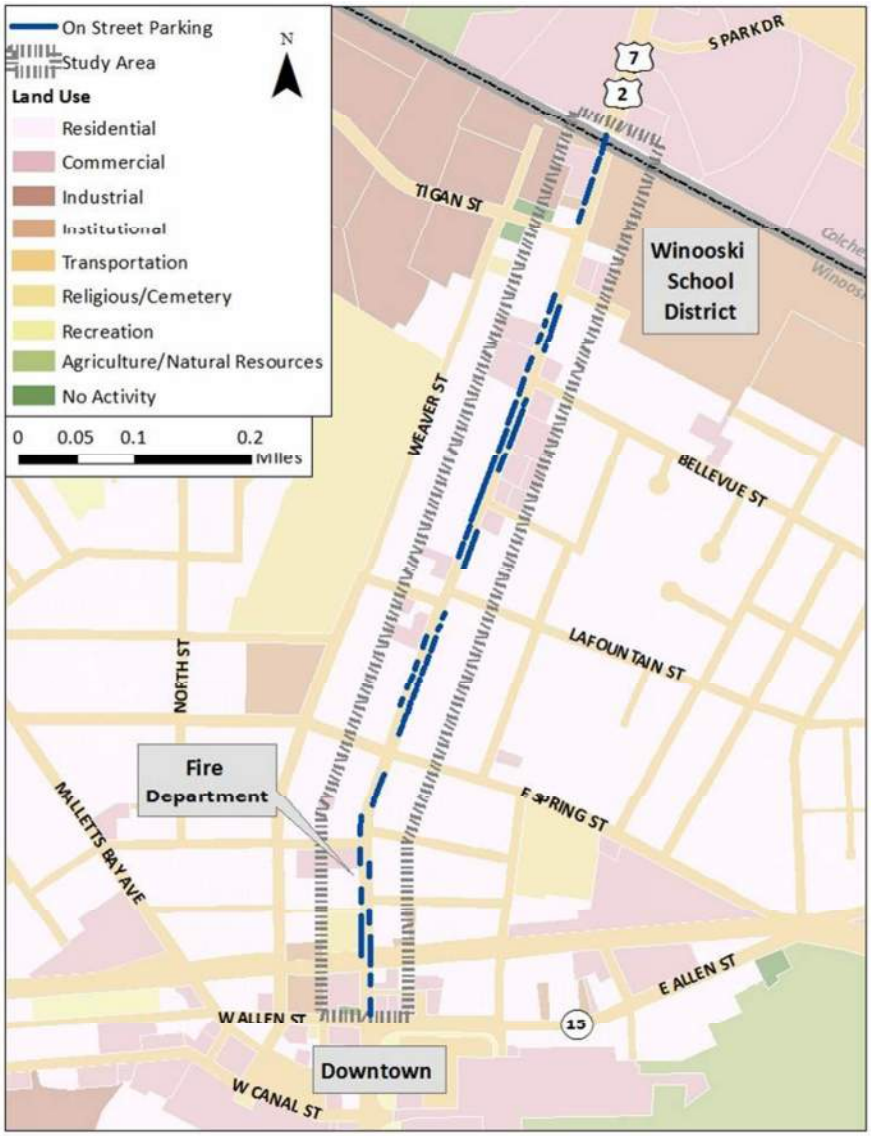
We conducted a signal warrant analysis at the Main Street/Stevens Street/LaFountain Street intersection using 12-hour turning movement count data collected in 2009 and adjusted to 2013 conditions. Based on these traffic volumes, only the peak hour volume warrant is met at this intersection. However, six of the eight hours are met

for the eight-hour warrant and three of the four hours are met for the four-hour warrant. Additionally, the section of Main Street through this intersection is classified as a High Crash Location section, so the crash experience warrant was analyzed. The intersection currently meets two of the three crash warrant thresholds – five or more crashes within a 12-month period and minimum approach volumes.

3.11 Parking

Figure 15 shows the locations of on-street parking in the study area. There are approximately 180 spaces along the corridor: 100 on the west side and 80 on the east side. For the most part, parking is unregulated (that is, no time limits, payment systems, or restrictions) with the exception of a few short-term (15-minute) loading/unloading zones.

Figure 15: On-Street Parking



3.12 Truck Traffic

This section of Main Street is a designated truck route within the City of Winooski. The latest VTrans Automatic Vehicle Classification Report notes that at the count station located on US 2/7 between Spring Street and Platt Street, the traffic flow was comprised of approximately 5.5% trucks (3.3% medium trucks, 2.2% heavy trucks). This average is somewhat lower than the statewide average on urban arterials of 6.4%. However, the percentage of heavy trucks on US 2/7 was slightly higher than the statewide urban arterial average of 1.7%.

3.13 Pedestrian and Bicycle Facilities

There are sidewalks on both sides of the street for the entire study area that vary in width as noted in Section 3.7. The sidewalks end at the northern limits of the study area at the Colchester town line but are expected to be extended through Exit 16 as part of the upcoming interchange reconstruction project.

Figure 16 summarizes the pedestrian crossing facilities at each intersection. Of note in this table is the lack of a pedestrian crosswalk across the northbound approach of the Main Street/Spring Street intersection as well as the relatively long distance between pedestrian crossings at Allen Street and Spring Street (1,200 feet) and between Norman Street and Stevens Street (1,500 feet), which create distict barriers to pedestrian crossings along the corridor.

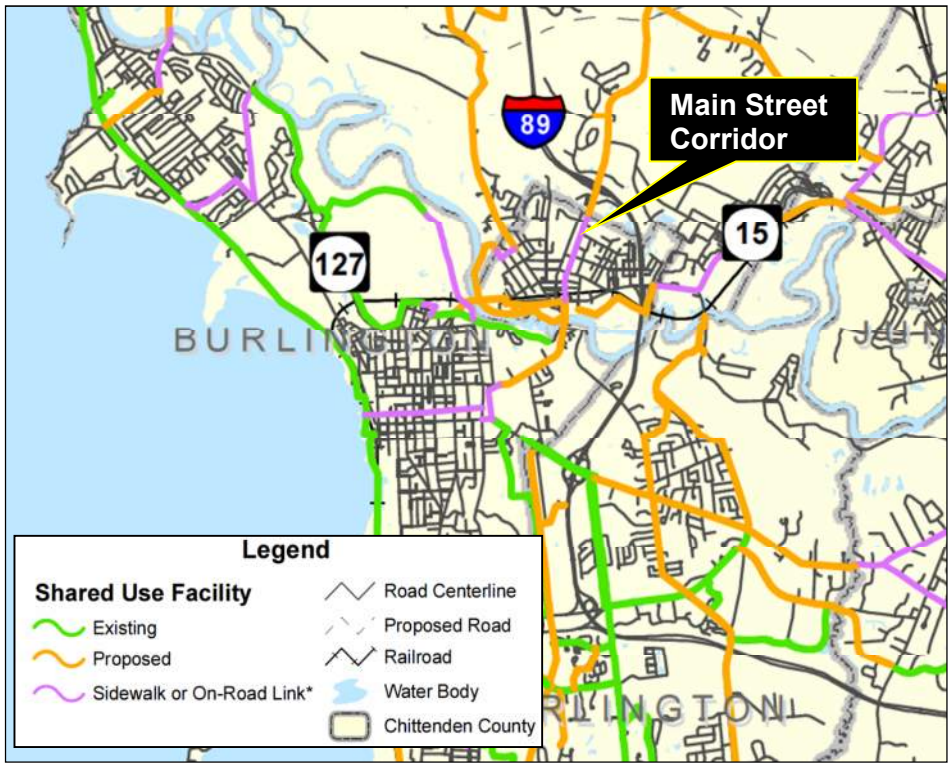
Figure 16: Pedestrian Crossings along the Corridor

	Main Street Intersection	**Pedestrian Facilities by Approach**			
		Eastbound	*Westbound*	*Northbound*	*Southbound*
1	*East/West Spring Street*	crosswalk, actuated ped signals w/ countdown timers	crosswalk, actuated ped signals w/ countdown timers	nothing	crosswalk, ped signals w/ countdown timers
2	*Lafountain Street/ Stevens Street*	crosswalk	crosswalk	crosswalk, ped signs	nothing
3	*Normand Street-Entrance*	crosswalk		crosswalk, ped signs	ped signs
4	*Tigan Street/ Educational Center/ Normand St. Exit*	crosswalk, actuated with ped signals with countdown timers	nothing	ped signs	crosswalk, actuated with ped signals with countdown timers

There are no formal bicycle facilities in the corridor. Figure 17 and Figure 18 show existing and recommended on-road bicycle and shared use facilities in the Chittenden region. According to the on-road facility map, this section of Main Street is not a designated bicycle corridor, however, the 2008 *CCRPC Regional Bicycle/Pedestrian Plan* suggests that it is commonly used for on-road bicycle travel. A shared use facility or on-road link is recommended along the corridor to close a gap in the regional bicycle network and provide a more direct route from downtown Burlington to points north.

Figure 17: Existing And Recommended On-Road Bicycle Facilities (Source: 2008 CCRPC Regional Bicycle/Pedestrian Plan Update)

Figure 18: Existing and Recommended Shared Use Bicycle Facilities (Source: 2008 CCRPC Regional Bicycle/Pedestrian Plan Update)



3.14 Transit

Winooski's downtown is served by CCTA's Route 9 Riverside/Winooski route, which connects various downtown locations with downtown Burlington. The Route 96 St. Albans LINK Express and the Route 56 Milton Commuter routes use the Main Street corridor to get between downtown Burlington and St. Albans and Milton. These overlapping routes along Main Street provide for expanded service for users wishing to travel from Main Street in Winooski to downtown Burlington.

Figure 19: CCTA Transit Service in the Corridor

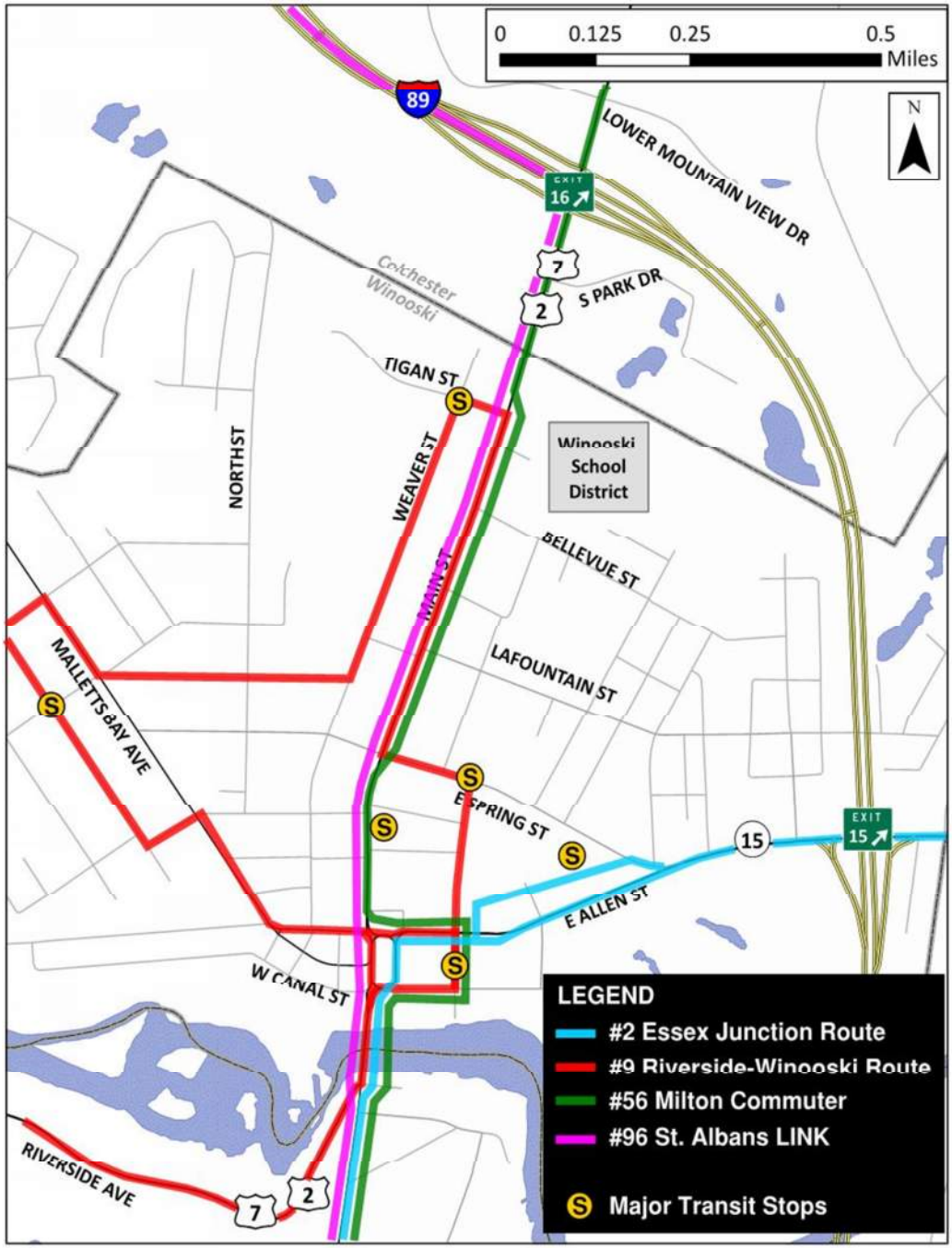


Table 1: Basic Characteristics of Transit in Corridor

Route	Origin	Destination	Fare (one-way)	Schedule	Frequency
#2 Essex Junction	Downtown Burlington	Essex Junction	$1.25	M-F 5:45 AM to 10:30 PM SAT 6:10 AM to 8:30 PM	M-F 15 minutes peak period, 30 minutes non-peak SAT 30 minutes peak period, 1 hour non-peak
#9 Riverside/ Winooski	Downtown Burlington	Winooski/ Tigan St.	$1.25	M-F 6:45 AM to 7:10 PM SAT 6:15AM to 7:00 PM	M-F 30 minutes peak period, 1 hour non-peak SAT 1 hour
#56 Milton Commuter	Downtown Burlington	Milton	$2.00	M-F 5:50 AM to 10:30 PM	1 hour peak period, varies during the day
#96 St. Albans LINK	Highgate	Downtown Burlington (via FAHC)	$4.00	M-F 6:30 AM to 7:20 PM	Varies

3.15 Safety Assessment

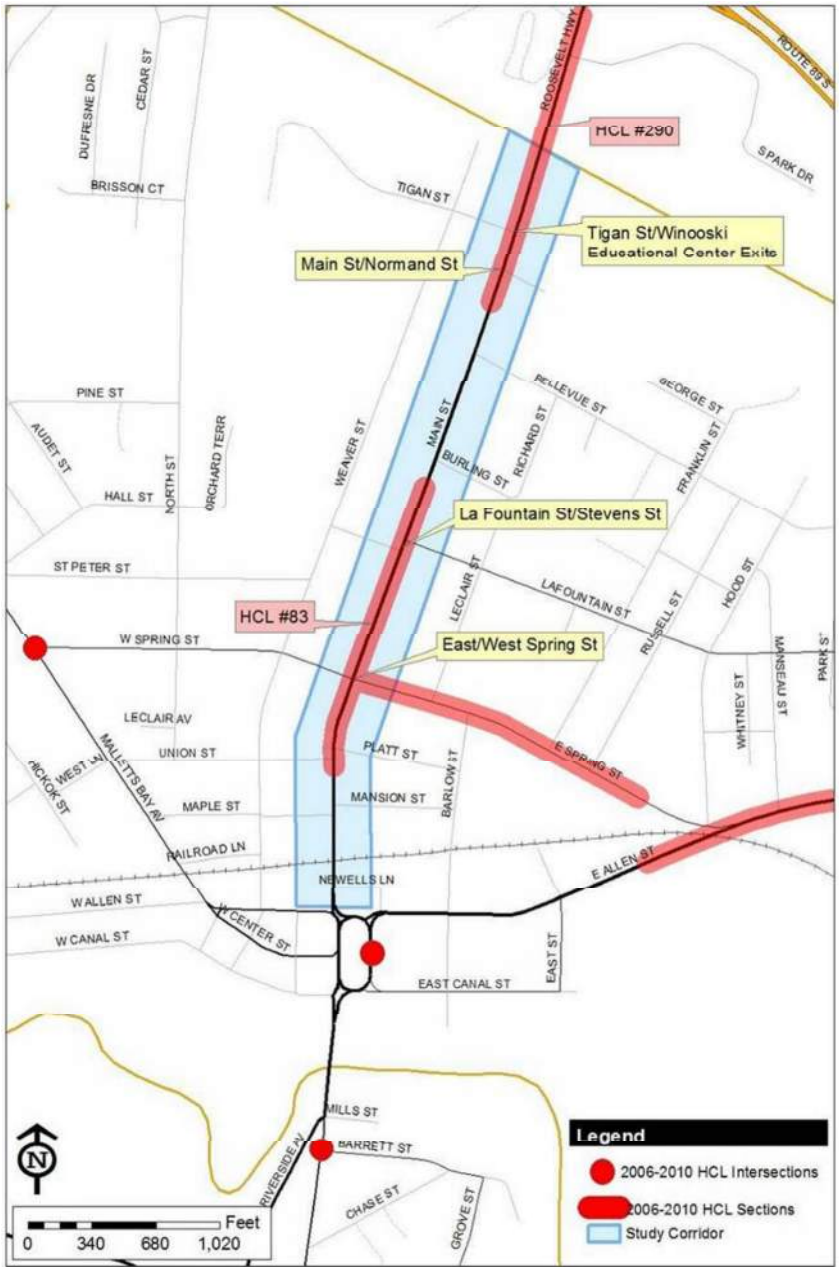
3.15.1 High Crash Locations

This section reviews VTrans crash data to identify patterns and summarize High Crash Locations (HCLs). A reportable crash is a collision with at least one of the following results: property damage exceeding $1,000, personal injury, and/or fatality.

A High Crash Location (HCL) is a section of roadway or an intersection where the number of crashes is significantly greater than the expected number of crashes for a similar type of facility (such as an arterial or local road) and areas (urban or rural). In order to be classified as a HCL, an intersection or road section (0.3 mile section) must meet the following two conditions: it must have at least 5 crashes over a 5-year period, and the Actual Crash Rate must exceed the Critical Crash Rate.

Based on the most current crash data available from VTrans (2006-2010), there are two sections in the study area that are HCLs, as shown in Figure 20. HCL section #83 includes sections of Main Street north and south of Spring Street along with most of East Spring Street. This HCL section, which has the 83rd highest Actual/Critical crash ratio in the state (2.04) has had 100 reported crashes between 2006 and 2010, with 0 fatalities, and 29 injuries. HCL section #290 covers US 2/7 from Normand Street north through Exit 16. This HCL section, which has the 290rd highest Actual/Critical crash ratio in the state (1.42) has had 89 reported crashes between 2006 and 2010, with 0 fatalities, and 25 injuries.

Figure 20: High Crash Locations (source: VTrans High Crash Location Report 2006-2010[3])



3.15.2 Sight Distances

Sight distances at intersections along the study area were measured in the field. Sight distances at the intersection with Stevens Street/LaFountain Street were found to be insufficient compared to the AASHTO recommended sight distances for the given circumstances due a small hill and shrub blocking the sight lines (Figure 21). The stopping sight distance on the Main Street southbound approach looking to LaFountain Street is also insufficient (137' measured vs. 155' required) due to the small hill. The intersection sight distance on Stevens Street is insufficient due to cars parked occasionally on private property blocking sight lines.

[3] This data is exempt from discover or admission under 23 USC 409.

Figure 21: Sight Distance Issues at LaFountain Street Intersection

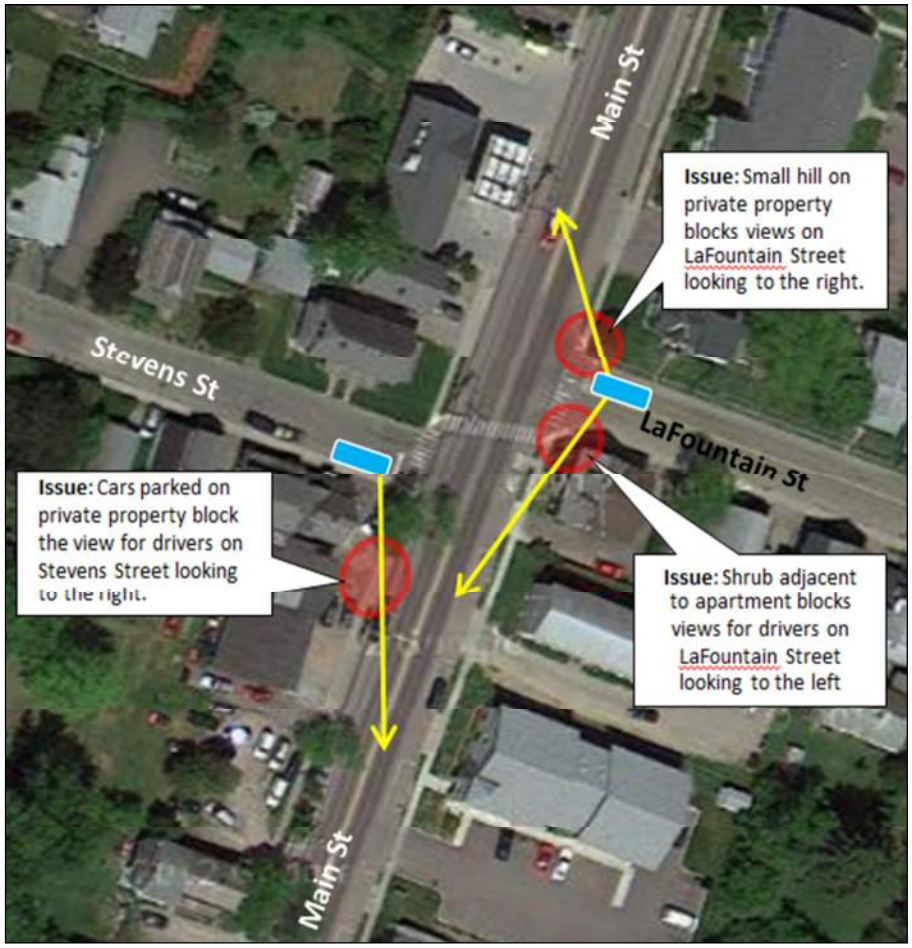


Figure 22 shows the view heading south on Main Street approaching LaFountain Street. The hill described above can be seen on the left side of the photo. Also notable in the picture is the car on LaFountain Street which is well beyond the stop bar, very likely due to limited sight lines along Main Street.

Figure 22: Southbound Main Street Approach to LaFountain Street

4.0 RECOMMENDATIONS

Short (less than 2 years) and medium term (less than 5 years) recommendations were developed for the Main Street corridor based on an assessment of existing and future conditions and through input from the Steering Committee and other corridor stakeholders. The recommendations were developed in response to identified issues and to further implement the vision that was identified for the corridor. The recommendations are shown graphically in Figure 23 and in tabular form, with costs and estimated timeline, in Figure 24. The recommendations are then presented in more detail in the remainder of this section.

Figure 23: Summary of Recommendations

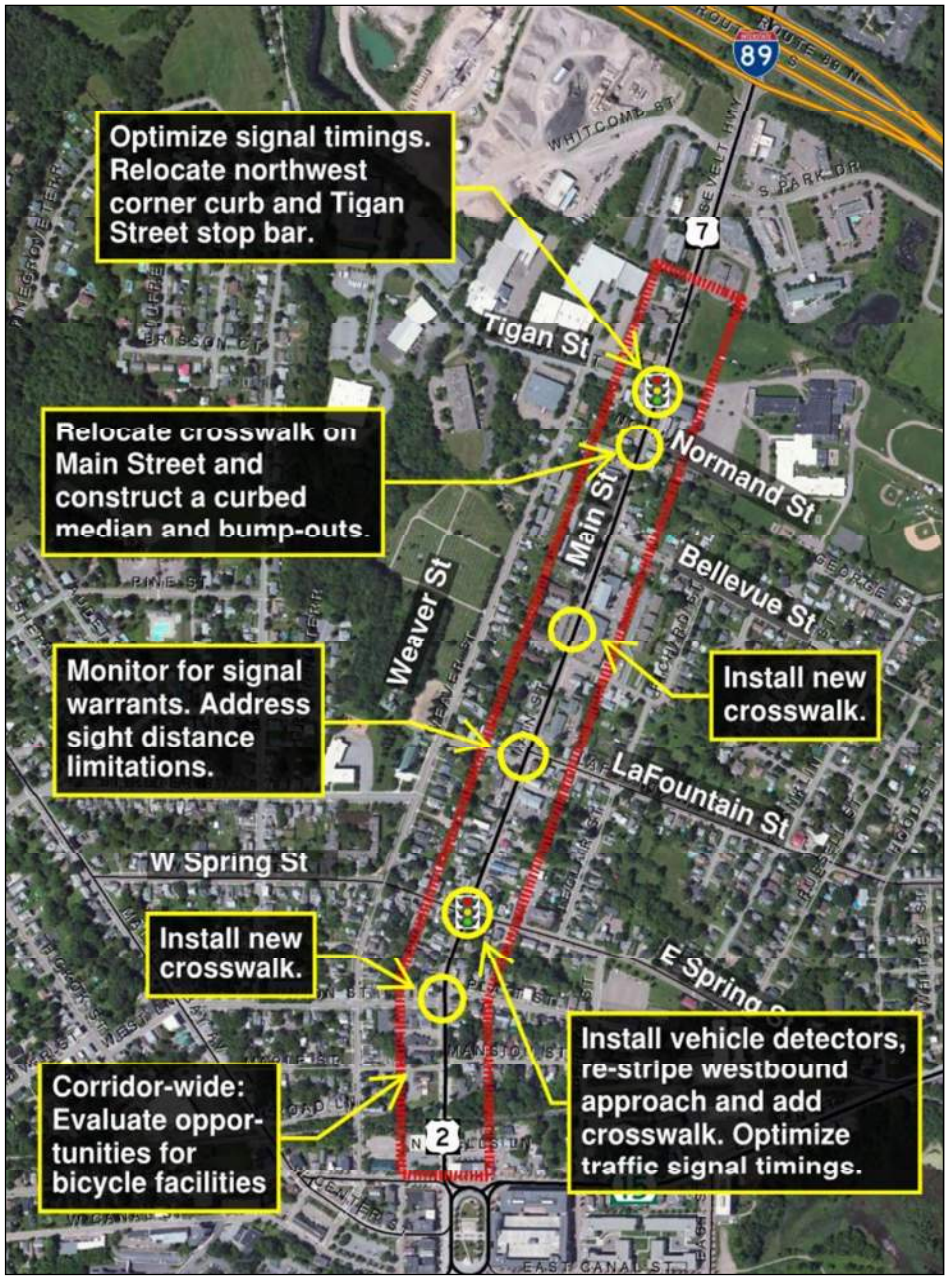


Figure 24: Summary of Recommendations

Recommendation	Cost Estimate	Timeline	Notes
Main Street / Spring Street Intersection			
Install video detectors on both Spring Street approaches and optimize AM, PM, and off-peak signal timing plan to process traffic more efficiently	$7,500 - $20,000	Short	*High end of cost estimate assumes installation of video detection for full intersection.*
Conduct an operational assessment once detection and re-striping are in place to observe performance and adjust signal timings as needed	$1,000	Short	
Restripe westbound Spring Street approach with dedicated left-turn lane and shared through/right lane and replace lane assignment sign on westbound approach	$1,500	Short	
Install a new crosswalk and pedestrian signals across the northbound Main Street intersection approach.	$10,000	Medium	
Main Street/Stevens Street/LaFountain Street Intersection			
Contact property owners on three corners to inquire about changes to improve sight distances at the intersection.	Negligible	Short	*May involve modifications on private property*
Continue to monitor traffic volumes and crashes to determine when a traffic signal will be warranted.	$200,000	Medium	*Cost for new signal. Highway Safety Improvement Program (HSIP) may be available for signal funding.*
Main Street /South Normand Street Intersection			
Construct a curbed median in the center of Main Street adjacent to crosswalk to provide a safe pedestrian refuge area and calm traffic speeds.	$20,000	Medium	
Main Street/Tigan Street Intersection			
Optimize AM, PM, and off-peak signal timing plan to process traffic more efficiently.	$1,500	Short	*Will be implemented as part of Exit 16 reconstruction project*
Relocate stop bar on southbound Main Street approach closer to intersection to improve overall efficiency.	$500	Short	
Relocate curbing on northwest corner to increase curb radius to better accommodate large truck turning movements. Relocate stop bar on Tigan Street closer to Main Street.	$15,000	Medium	
Corridor-Wide Recommendations			
Install new pedestrian crosswalk with pedestrian crossing signs and rectangular rapid flash beacons across Main Street at the Union/Platt Street intersection.	$12,000	Short	
Install new pedestrian crosswalk with pedestrian crossing signs and rectangular rapid flash beacons across Main Street at north of Burling Street.	$8,000	Short	
Evaluate potential reconfigurations of the Main Street cross-section to accommodate bicyclists as part of the upcoming Winooski Gateways project.	TBD	Planning & Scoping: Short-term Implementation: Medium-Long Term	

4.1 Main Street/Spring Street Intersection

RECOMMENDATIONS:

Install vehicle detectors (video/thermal camera units) on both Spring Street approaches and optimize AM, PM, and off-peak signal timing plan to process traffic more efficiently.

Restripe the westbound Spring Street approach to have a dedicated left-turn lane and a shared through/right lane and replace the lane assignment sign on the westbound approach to reflect the change.

Install a new crosswalk and pedestrian signals across the northbound Main Street intersection approach.

Conduct an operational assessment once the above items are in place to observe performance and adjust the signal timings as needed.

This intersection currently experiences high levels of delay during the PM peak hour due in large part to the lack of vehicle detectors on the Spring Street approaches. Additionally, the eastbound left-turn lane is aligned directly opposite the westbound left/through lane, which forces westbound through traffic to shift to the right when traveling through the intersection. Limited visibility between eastbound left-turning traffic and westbound through traffic can occur when through traffic queues behind left-turning traffic on the westbound Spring Street approach. This conflict could be avoided by reconfiguring the westbound geometry to include a dedicated left-turn lane and a shared through/right lane. To address the identified issues, the following alternatives were evaluated and the traffic performance results are presented in Figure 26:

- **Alternative 1**: Existing Conditions
- **Alternative 2**: Add vehicle detection and optimize signal timings (no change in lane striping)
- **Alternative 3**: Reconfigure striping on the westbound approach to have a dedicated left-turn lane and a shared through/right lane; add vehicle detection and optimize signal timings
- **Alternative 4**: Reconfigure striping on the westbound approach to have a dedicated left-turn lane and a shared through/right lane; implement Protected/Permitted phasing

Figure 25: Main Street/Spring Street Intersection - 2013 Traffic Performance

	ALTERNATIVE 1			ALTERNATIVE 2			ALTERNATIVE 3			ALTERNATIVE 4		
WB Approach Geometry:	Existing Geometry			Existing Geometry			Restripe WB approach to have a dedicated left-turn lane and a shared through/right lane			Restripe WB approach to have a dedicated left-turn lane and a shared through/right lane		
Signal Timing	Existing Timings			Detect & Optimize			Detect & Optimize			Detect & Prot/Perm		
	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c
AM Peak Hour												
Overall	C	32	0.73	C	22	0.70	C	23	0.66	C	30	0.68
EB, from West Spring St	E	63	-	C	23	-	C	27	-	C	25	-
WB, from East Spring St	C	31	-	C	20	-	C	24	-	D	36	-
NB, along Main St	B	18	-	C	22	-	C	22	-	C	32	-
SB, along Main St	B	20	-	C	22	-	B	19	-	C	30	-
PM Peak Hour												
Overall	F	88	0.94	C	30	0.83	C	33	0.82	D	43	0.81
EB, from West Spring St	C	31	-	C	24	-	C	27	-	D	36	-
WB, from East Spring St	F	>100	-	C	31	-	D	40	-	E	56	-
NB, along Main St	C	34	-	D	36	-	C	33	-	D	43	-
SB, along Main St	C	22	-	C	26	-	C	29	-	D	36	-

Figure 26 (continued): Main Street/Spring Street Intersection - 2013 Traffic Performance

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
AM Peak Hour				
EB	8	5	5	6
WB	3	3	4	7
NB	6	7	6	7
SB	6	8	9	9
Sum of all Queues	**23**	**23**	**25**	**28**
PM Peak Hour				
EB	4	4	5	5
WB	50	16	16	20
NB	16	17	16	22
SB	10	11	12	16
Sum of all Queues	**80**	**48**	**49**	**63**

Results presented in Figure 25 indicate that Alternatives 2 and 3 perform the best in terms of vehicle delay, and queuing. Adding detection and optimizing timings (i.e. Alternative 2) is expected to significantly reduce delays and queues regardless of the westbound lane configuration. However, the reconfiguration of the westbound lane geometry plus vehicle detection (Alternative 3) has the advantage of improving both overall operations and eliminating the potentially unsafe westbound through lane offset.

In addition to the traffic operational and striping improvements, we also recommend the installation of a crosswalk and pedestrian signal heads along the northbound Main Street intersection approach. There are existing sidewalks, curb ramps, and detectable warning strips as well as signal poles for mounting the pedestrian signals on both the southeast and southwest corners of the intersection to accommodate the new crosswalk.

A detailed operational assessment of this intersection can be found in Appendix C.

4.2 Main Street/Stevens Street/LaFountain Street Intersection

RECOMMENDATIONS:

Continue to monitor traffic volumes and crashes to determine when a traffic signal will be warranted.

Begin to identify and allocate funds for future traffic signal.

Contact property owners on three corners to inquire about changes to improve sight distances at the intersection.

Although a signal was not found to be warranted at this intersection under current conditons, six of the eight hours are met for the eight-hour warrant and three of the four hours are met for the four-hour warrant. Additionally, two of the three crash experience warrant thresholds were met. We conducted a sensitivity analysis and found that a 2% increase in background volumes would meet all four hours of the four-hour warrant and that a 5% increase in background volumes would meet all eight hours of the eight-hour warrant. We therefore recommend that the City continue to monitor traffic volumes and crashes to determine if and when a signal is warranted here. We also recommend that the City begin to identify and set aside funds for a new signal installation.

To address the sight distance limitations identified at this intersection, we recommend implementing the following measures:

- Contacting the property owner at the northeast corner of the Main Street/LaFountain intersection to discuss opportunities for regrading the slope in their front yard to improve sight lines from LaFountain Street to the north.
- Contacting the property owner at the southeast corner of the Main Street/LaFountain intersection to discuss opportunities for triming the bushes in front of their apartment building to improve sight lines from LaFountain Street to the south.
- Contacting the property owner at the southwest corner of the Main Street/Stevens Street intersection to discuss opportunities for relocating parking in the northeast corner of their lot to improve sight lines from Stevens Street to the south.

It should be noted that with the installation of a traffic signal, sight distance limitations are no longer as important, as the signal takes care of allocating right-of-way within the intersection.

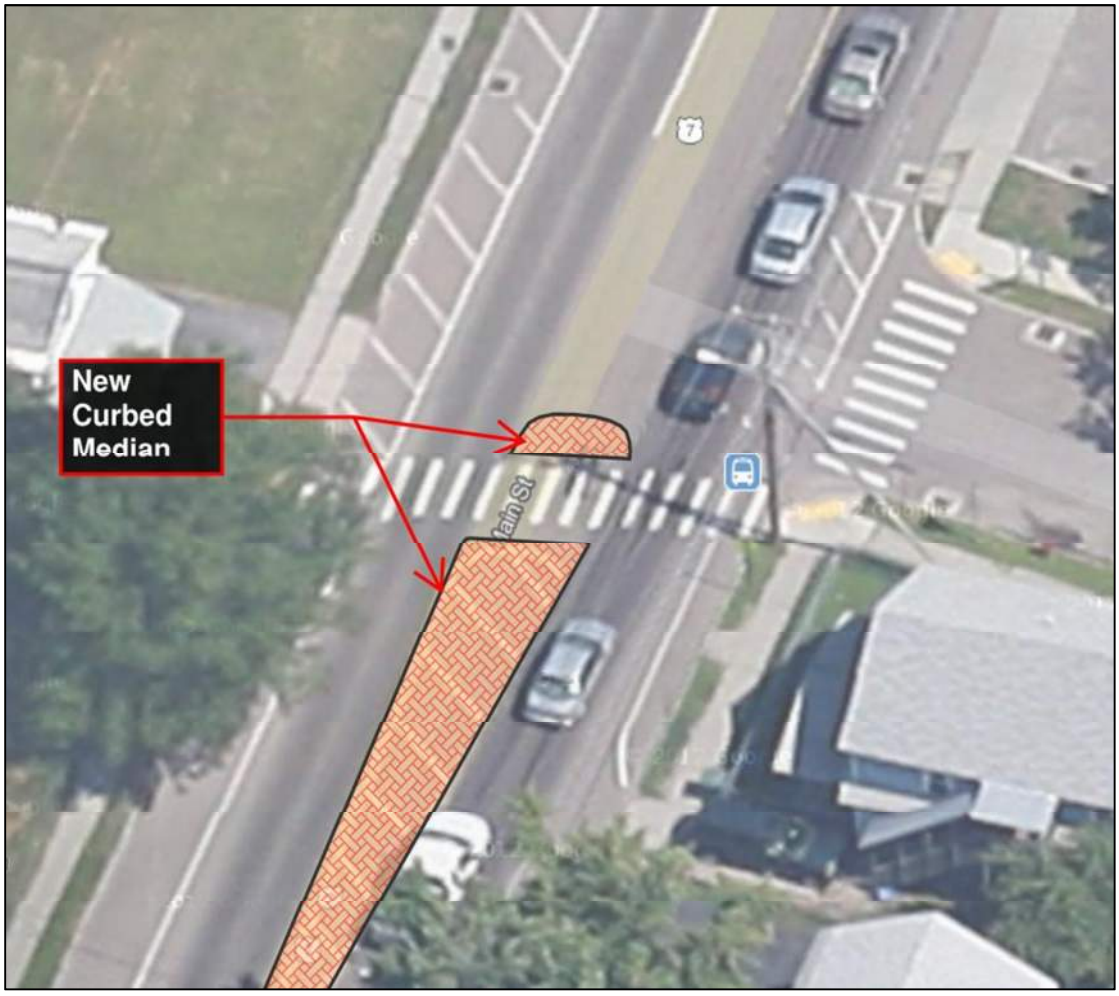
4.3 Main Street /South Normand Street Intersection

RECOMMENDATIONS:

Construct a curbed median in the center of Main Street adjacent to crosswalk to provide a safe pedestrian refuge area.

The pedestrian crosswalk across Main Street just south of Normand Street serves as a key crossing point for students who live on the west side of Main Street to get to school. Given the importance of this crosswalk for students, the proximity to the schools, and the relatively high traffic volumes on Main Street, we recommend constructing a curbed median adjacent to the relocated crosswalk. As shown below in Figure 27, the raised median would provide a pedestrian refuge in the center of Main Street and help to slow traffic speeds through the intersection.

Figure 27: Pedestrian Crossing Improvements at Main Street/Normand Street Intersection



4.4 Main Street/Tigan Street Intersection

RECOMMENDATIONS:

Optimize AM, PM, and off-peak signal timing plan to process traffic more efficiently – part of Exit 16 Project.

Relocate the curbing on the northwest corner of the intersection to increase the curb radius to better accommodate large truck turning movements. Relocate the stop bar on Tigan Street closer to Main Street.

Relocate the stop bar on the southbound Main Street approach closer to the intersection to improve overall efficiency.

To address peak hour congestion at this intersection, we evaluated changing the signal from the current split phasing to concurrent phasing for the eastbound and westbound approaches. Our analysis found that traffic operated more efficiently with the current split phasing primarily due to the increased turning conflicts created by the offset east and west approaches. We then examined potential improvements to the existing signal timing plan and found that optimizing the signal timings could reduce the average evening peak hour intersection delay from 48 seconds (LOS D) down to 20 seconds (LOS B). The existing and optimized (proposed) timing and phasing plans are shown in Figures 27 and 28, respectively. The optimized plan reduces the cycle length from 148 seconds to 110 seconds, provides a smaller percentage of the green time to the school exit approach, and increases the exclusive pedestrian phase to provide adequate crossing time for users of all abilities.

Figure 28: Existing PM Peak Signal Phasing and Splits (Cycle Length = 148 seconds)

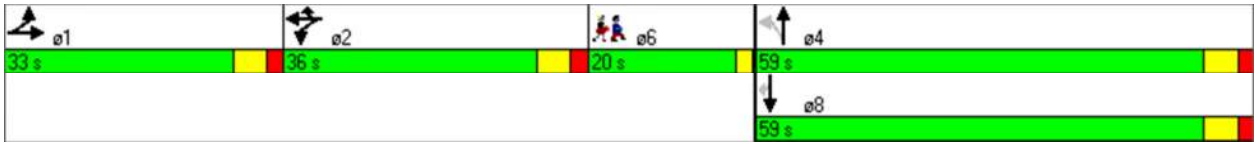
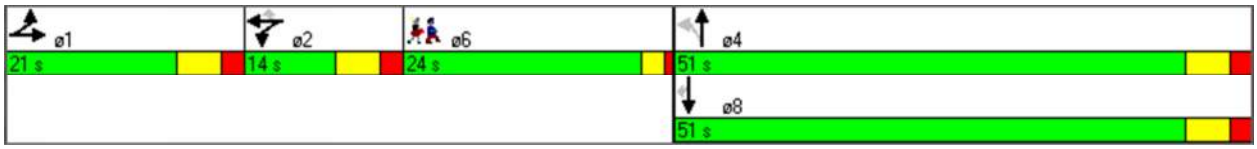


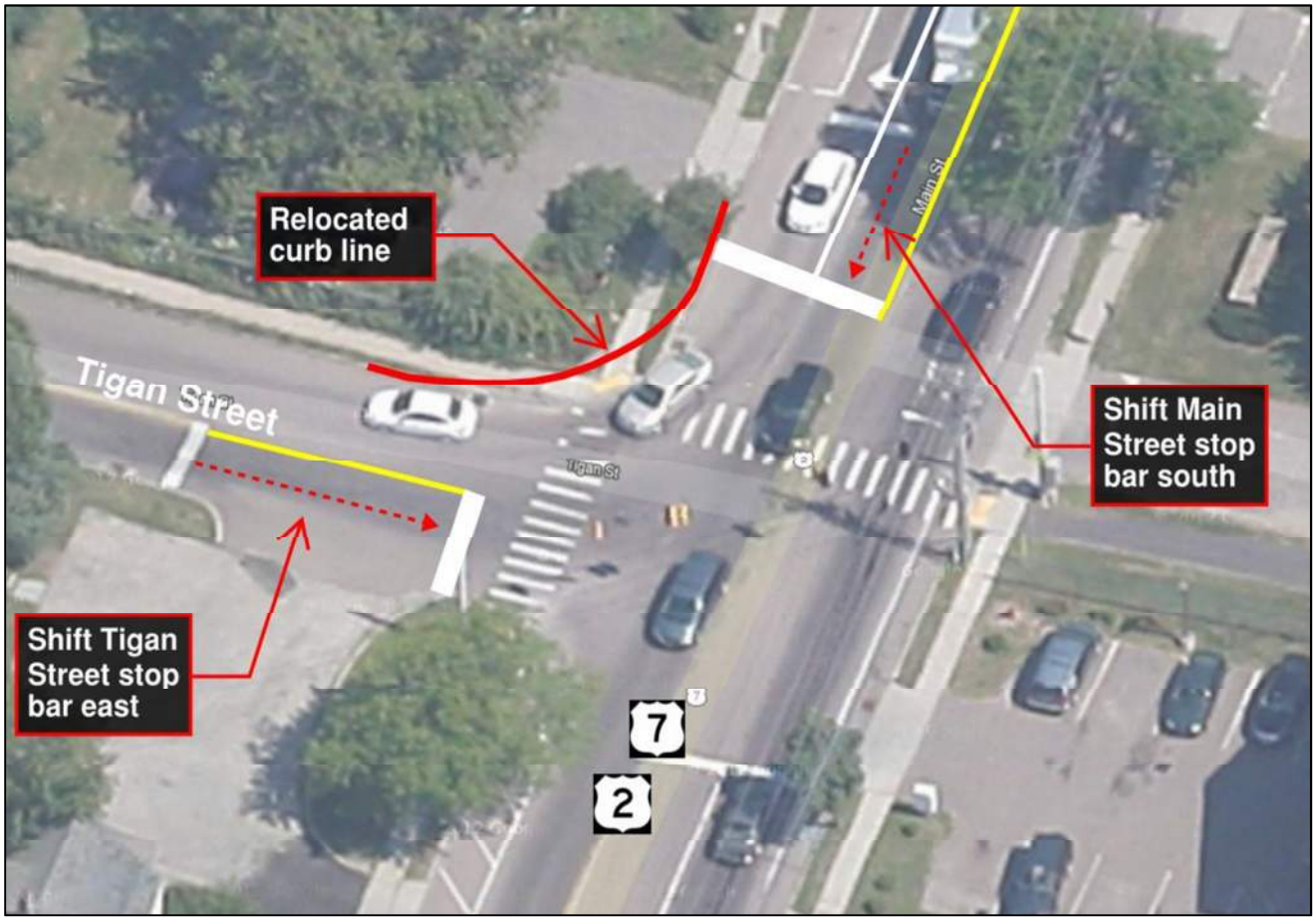
Figure 29: Optimized PM Peak Signal Phasing and Splits (Cycle Length = 110 seconds)



In addition to the signal timing improvements identified above, we also noted that the stop bars on both Main Street and Tigan Street are set relatively far from the intersection. The stop bar placement on Tigan Street is likely due to the relatively small curb radius on the northwest corner of the intersection (to accommodate large truck movements) as well as the presence of the private driveway access on the south side of Tigan Street. These large stop bar setbacks increase the amount of time that vehicles need to get into and through the intersection, and reduces the overall efficiency of the intersection operation.

Given the land uses along Tigan Street and the relatively high number of large trucks using Tigan Street, we recommend increasing the curb radius on the northwest corner of the intersection to better accommodate large truck turning movements and shifting the stop bar on Tigan Street closer to Main Street (see Figure 30).

Figure 30: Recommended Geometric Changes at the Main Street/Tigan Street Intersection



4.5 Corridor-Wide Recommendations

RECOMMENDATIONS:

Install new pedestrian crosswalk with pedestrian crossing signs and rectangular rapid flash beacons across Main Street at the Union/Platt Street intersection.

Install new pedestrian crosswalk with pedestrian crossing signs and rectangular rapid flash beacons across Main Street, north of Burling Street.

Evaluate potential reconfigurations of the Main Street cross-section to accommodate bicyclists as part of the upcoming Winooski Gateways project.

4.5.1 Additional Mid-Block Crosswalks

As was noted earlier in this report, there are relatively long distances between pedestrian crossings at Allen Street and Spring Street (1,200 feet) and between Norman Street and Stevens Street (1,500 feet), which create distict barriers to pedestrian crossings along the corridor.

Given existing pedestrian desire lines, surrounding land uses, and available sight distances, we recommend installation of two new crosswalks across Main Street at the Union/Platt Street intersection (Figure 31) and north of Burling Street (Figure 32). At the Burling Street crosswalk location, three of the on-street parking spaces on the west side of Main Street would need to be removed to accommodate the crosswalk and provide adequate sight lines. New curb ramps with tactile warning panels would need to be installed at either end of the crosswalk. To provide additional safety for the pedestrians at these crossings, we recommend the installation of rectangular rapid flash beacons and push buttons along the with the pedestrian crossings signs. These supplemental signs flash immediately when activated by a pedestrian and have been shown to significantly increase awareness of pedestrians at mid-block crossing locations. The City has greater flexibility in siting new crosswalks since Main Street is a Class 1 Town highway, rather than being entirely under the State's jurisdiction and a determination by the City Council is all that is needed to install the crossings.

Figure 31: Proposed Crosswalk at Union/Platt Street

Figure 32: Proposed Crosswalk North of Burling Street

4.5.2 Accommodate Bicyclists along the Corridor

During the development of this study, the desire for safer bicycle accommodations along the corridor was noted. The *CCRPC Regional Bicycle/Pedestrian Plan* recommends a shared-use facility or on-street bicycle lanes along Main Street to close a gap in the regional bicycle network and provide a more direct route from downtown Burlington to points north.

A safe and accessible bicycle facility in the City in the north-south direction could be accommodated in a number of ways:

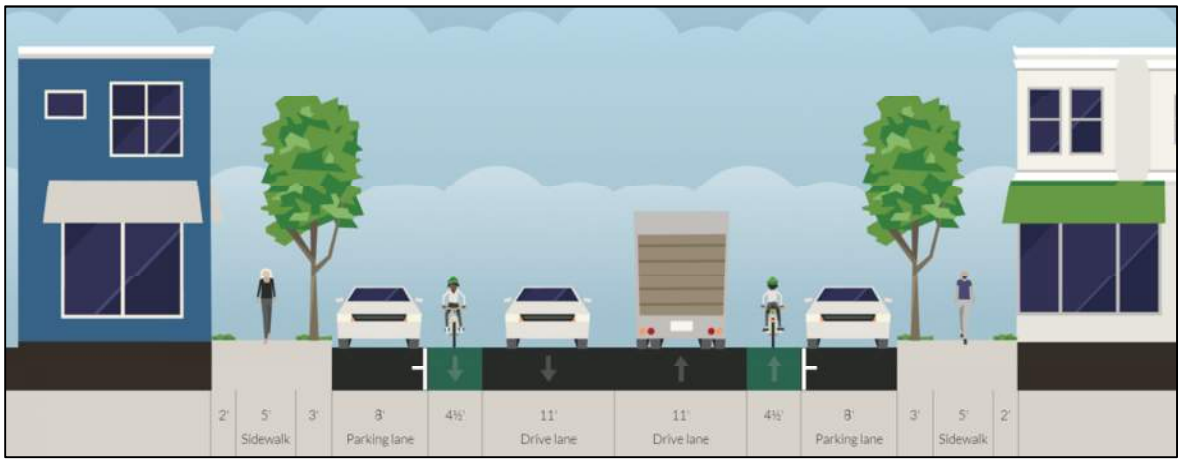
- Striped and signed bicycle lane along Main Street
- Separated cycle-track along Main Street
- Designated bicycle route along Weaver Street from Tigan Street to Allen Street

Each of the alternatives above provide for a dedicated bicycle facility, but each option has potential benefits and challenges. The first two options, which accommodate bicyclists on Main Street, provide the most direct option but would likely require some reduction in on-street parking and potential changes to the existing curbline. Designating a route along Weaver Street would provide a facility on a street with lower traffic volumes but may not be used by commuting cyclists due to its longer length.

The Main Street right-of-way appears to be 66 feet (4 rods wide) with a curb-to-curb width that varies from approximately 45-feet to 47-feet. Travel lanes vary from 12-feet up to 15-feet in width and parking lanes range from 7 feet up to 13 feet in certain places. Several different cross-section alternatives were evaluated (see Appendix B for full evaluation) to better "normalize" the Main Street cross-section and provide accommodations for cyclists.

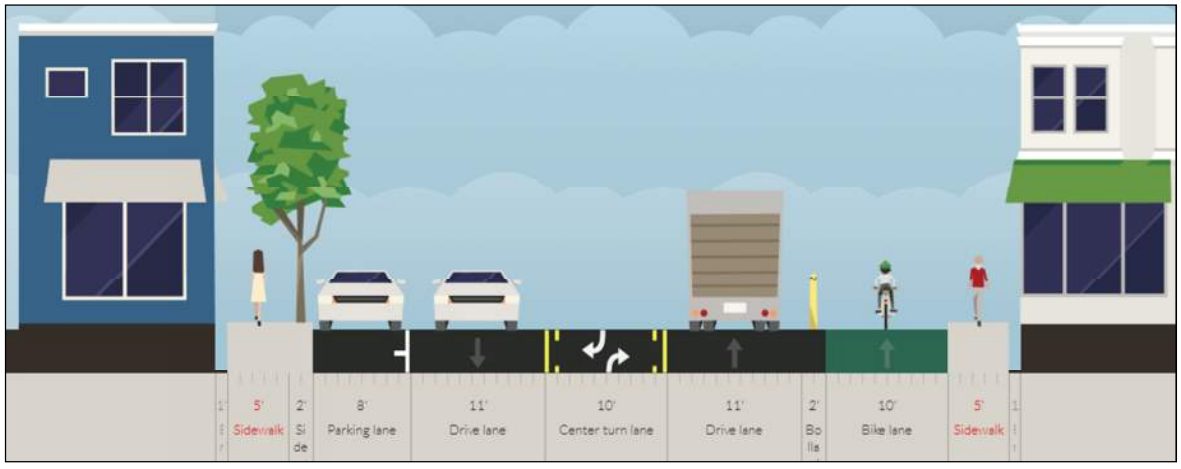
Two potential cross-section alternatives are shown below. The first cross-section (Figure 33) incorporates four and a half foot striped bicycle lanes on Main Street. This cross-section is 46 feet wide from curb-to-curb and would likely fit into Main Street without any modifications to the existing curblines. At key intersections (e.g. Spring Street), the on-street parking would need to be removed to accommodate a turning lane. More scoping study would need to be conducted to determine how much parking would be lost to accommodate necessary turn lane storage.

Figure 33. Cross-Section Alternative 1 – Striped Bicycle Lanes – 46' Curb-to-Curb (image courtesy: Streetmix)



The second alternative (Figure 34) incorporates a full ten foot separated cycle track into the Main Street cross-section. From a cyclist's perspective, this alternative provides a fully-protected, dedicated space that is removed from potential conflicts with traffic along Main Street. To accommodate this cross-section, parking along one-side of Main Street would need to be removed. With the center turn lane incorporated, this cross-section is 52 feet wide from curb-to-curb. This would require moving the curb line along one side of Main Street back approximately six feet, which would result in much higher costs to implement than the first alternative.

Figure 34. Cross-Section Alternative 2 – Separated Cycle Track – 52' Curb-to-Curb (image courtesy: Streetmix)



We recommend that the potential cross-section alternatives be evaluated further during the upcoming Winooski Gateways study, to ensure that the desired street cross-section (and any potential parking or property impacts) be evaluated in tandem with the urban landscape vision of the corridor.

APPENDIX A: SUMMARY OF PREVIOUS PLANS

This section reviews aspects of relevant plans and studies to ensure consistency with the Main Street Corridor Plan.

LOCAL PLANS AND STUDIES

Winooski is currently updating its Zoning Ordinance. Below, the Municipal Development Plan, Exit 16 Scoping Study, and Winooski Downtown Circulation Study are reviewed.

Winooski Municipal Development Plan (2009)

The compactness of Winooski lends itself to walkability and other benefits of high density, mixed use patterns. However, the City's role as a gateway to the region's urban core is often at odds with this.

Through the MDP, the City lays out its plan to develop guidelines for streetscape improvements and traffic calming measures, as well as a multimodal transportation hub for the region. The MDP presents a vision to improve the US 7/2/Main Street corridor, noting that "Although the High School has replaced the junkyard, which greeted visitors on this route in the early 1960's, upper Main Street remains, at best, an ordinary gateway to the City" (Figure 35). The MDP notes that upper Main Street is zoned for commercial use and is therefore the City's least residential artery. There is significant potential for roadside commercial development given the corridor's proximity to Exit 16. The MDP discourages strip development, and considers expanding the boundaries of the designated downtown to include Main Street.

Figure 35: Gateway to Winooski at the Colchester Town Line, at the Northern End of the Study Area

Aspects of the MDP's vision of upper Main Street/US 2/7 are:

- A pedestrian-scale environment that consists of mixed use development with residences above commercial space, streets alive with street trees, flags, awnings, vest pocket parks and open spaces.
- Two lanes of traffic, on-street parking, and convenient pedestrian crossings.
- Traditional 2 to 3 story buildings close to the sidewalk in a defined edge to contain the street corridor.
- Siting of new buildings with a minimal front yard setback to create the desired objective of a pedestrian oriented urban edge and traditional "Main Street" character; hedges, fences and buildings set back a maximum of 10 feet from the front property line to create a pattern of growth that embodies the basic principles of Winooski's traditional downtown.
- Intersection improvements to maximize pedestrian convenience and safety including pedestrian crossings with pavement treatment.
- Landscaped buffering between non-residential and residential uses and provision of additional street trees.
- Creation of planting beds, lawns, and courtyards on the south side of each site to create useable open space.
- Gateways into the City at the Colchester line to celebrate arrival and strengthen Winooski's heritage.

Enhance gateways with street trees, lighting, wayfinding signage, and public art. Currently, the appearance of the gateways to Winooski and of the major arteries through the City requires improvement. In some instances, Winooski's major thoroughfares lack aesthetic integrity and appear more like large metropolitan truck-routes than streets in a small New England community.

Through participation in Regional, State and Federal transportation programs, Winooski will ensure that traffic calming measures and transportation enhancement improvements are installed on the state highways which pass through the community. Winooski must work hard to insure that its local interests are not lost in the effort to move as many vehicles through the City as quickly as possible. Routes 15, 2 and 7 and the bridge over the Winooski River shoulder much of northern Chittenden County's commuting burden…. With City and regional needs in competition, installation of traffic calming and transportation enhancement improvements are necessary to allow the commuter routes and Winooski's traditional development fabric to co-exist.

Widening of arterial and local streets and elimination of on-street parking is strongly discouraged. Increased pavement width and traveled lanes drastically alter the physical characteristics of neighborhoods and adjoining properties by reducing separation between vehicles and existing land uses. Such enlargements lower the quality of life for area residents and business people by increasing noise, dirt, and vibration, eliminating on-street parking, and reducing landscape buffers. On Main Street -Routes 2 and 7- additional or wider lanes will impair pedestrian crossing, contribute to increased speed and illegal traffic maneuvers -such as passing on the right- and exacerbate the dividing effect which the roadway causes between the east and west sides of the city.

Currently, all trucks over 24,000 pounds must acquire an annual permit to operate within Winooski. The City will routinely enforce its truck route and weight ordinances and will re-evaluate provisions as necessary.

To offset management and maintenance burdens related to higher traffic volumes and inordinate wear and tear caused by heavy vehicles, the City will continue to seek impact fees from those generating new traffic through Act 250 and other regulatory processes. Heavy users and contractors will be charged for damage and undue wear and tear caused to City streets.

City shall enforce maximum curb cut widths, and discourage multiple curb cuts in development and redevelopment projects.

Wide or numerous curb cuts create a situation where it is hazardous for pedestrians to cross, allow for unsafe entry or backing into traveled lanes, and encourage drivers to enter or exit sites at high speeds. Appropriate site

circulation management, with curb cuts minimized in number and widths, no wider than needed, reduce traffic interference and the possible number of collision points with traffic flow. Additionally, site circulation schemes, which wisely manage curb cuts, provide additional on-site parking and reduced paving for driveway aprons and allows for additional greenspace in the public rights of way.

In the interest of pedestrian and motorist safety, corner curbs on streets intersecting with arteries including Main Street, East and West Allen Streets and Malletts Bay Avenue shall be restored as a component of street reconstruction projects or redevelopment efforts.

In areas near schools, parks or public services, sidewalks should be installed or reconstructed. In some sections of the city, streets do not inter-connect and pedestrian traffic is possible only by crossing public or private property. Two such short cuts across public property which should be recognized as important exist between North and Main Streets through Highland Industrial Park, and between Main and George Streets through the Winooski School property. These, and other pedestrian ways, are acknowledged as links in Winooski's transportation chain and should be improved, expanded, and preserved to the extent possible.

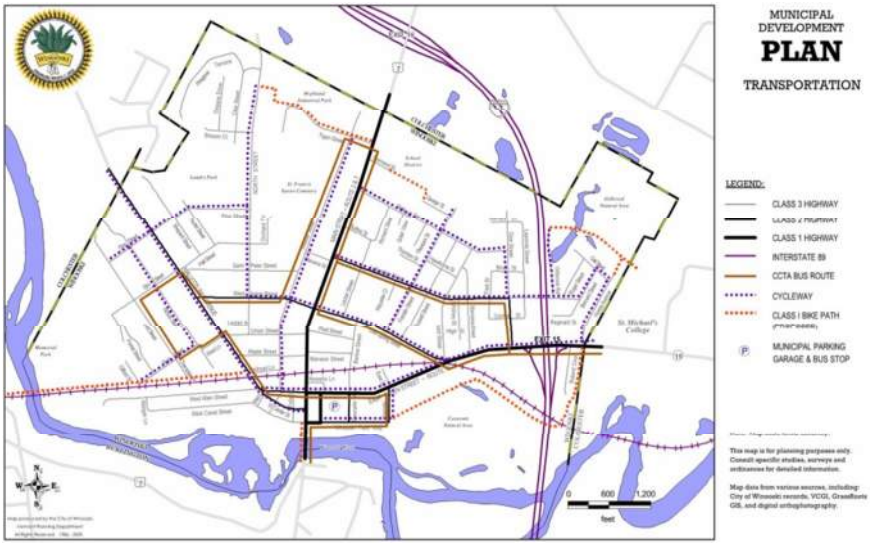
The City of Winooski shall study, seek funding for and put in place improved pedestrian crossings along major highways which traverse the community. Commuter arterials in Winooski must be crossed by pedestrians traveling to school, work and services. It is the policy of the City of Winooski to improve pedestrian crossings and shorten distance of pedestrian crossings through reduction of the number of lanes and reduced lane widths; such improvements have been put in place in the downtown area. High traffic volumes on Main and East Allen Streets continue to present particular challenges to pedestrian crossing.

There are three types of bikeways which can be implemented:

- Class I (Bike Path): a paved path separate from the street which is for the exclusive use of non-motorized vehicles.
- Class II (Bike Lane): a separately marked lane on a street which is designated for use by bicycles by signs, pavement markings and physical barriers.
- Class III (Bike Route): a facility designated by signs only, such as a city street, where bicycles and vehicles share the pavement.

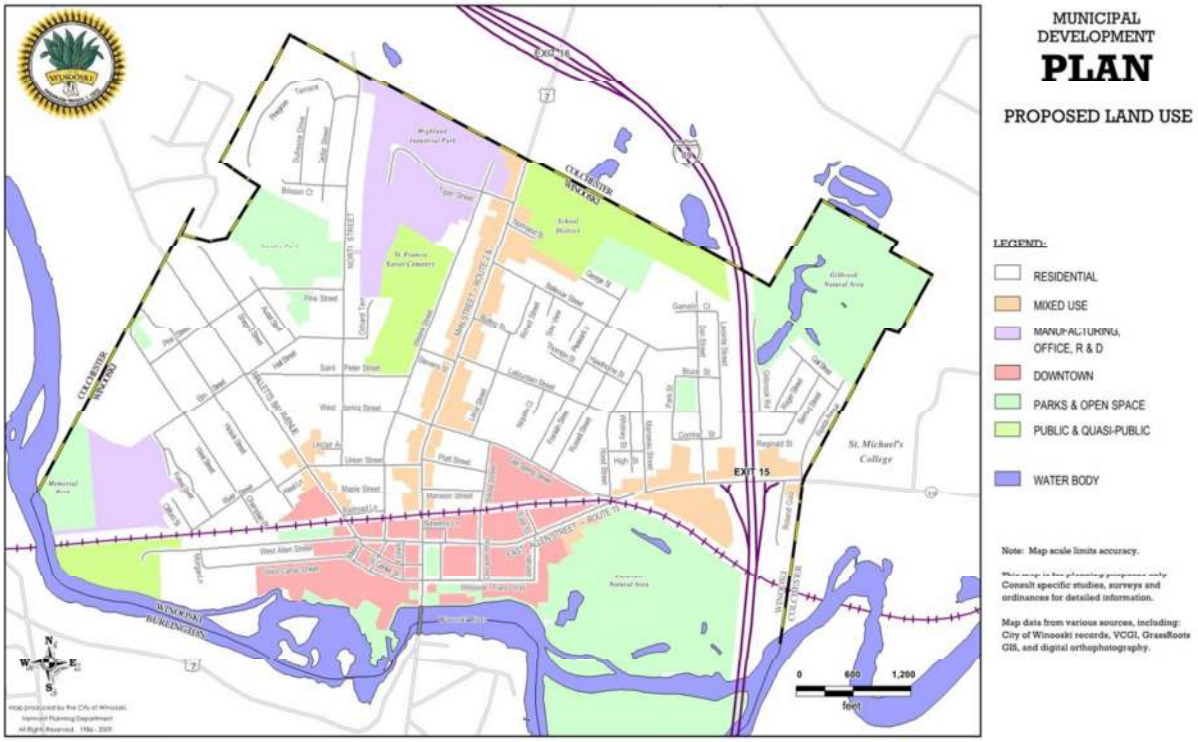
Winooski's 18.25 miles of paved streets are proposed to continue to carry the bulk of bicycle traffic. It is expected that the City's street reconstruction program will improve road surfaces and enhance bicycling conditions. Class III designation is proposed for Weaver, North and Lafountain Streets, Hickok Street plus Malletts Bay Avenue, and their connecting streets. These facilities will be promoted over Route 2 & 7 (Main Street) and Route 15 (East Allen Street); corridors which have relatively high automobile volumes.

Figure 36: Municipal Development Plan - Transportation Network



In addition to the vision for the Upper Main Street corridor, the MDP encourages a mix of uses which will strengthen the Winooski tax base, which is frequently in contrast with the rest of Chittenden County's prosperity. In particular, the City is trying to broaden the range of its housing options, and increase the commercial component of its tax base, which has to compete with suburban areas. A major theme of the MDP is to protect and improve Winooski's historic neighborhoods.

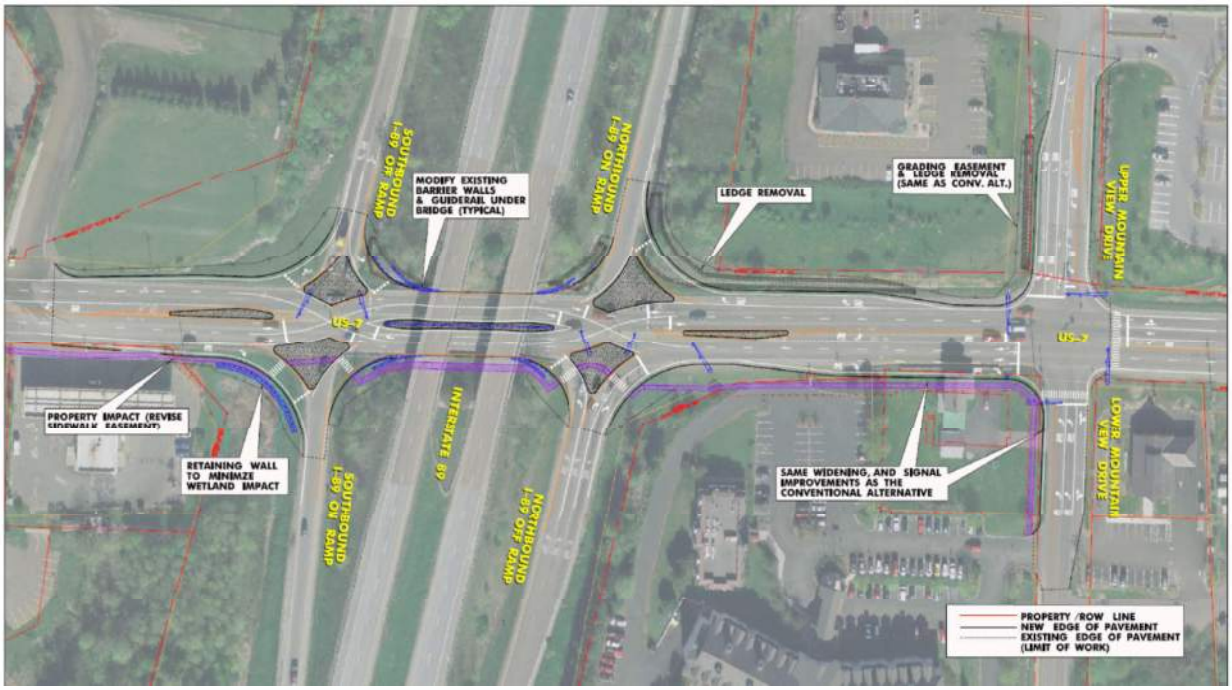
Figure 37: Municipal Development Plan - Proposed Land Use



Exit 16 Scoping Study (2011)

This Scoping Study reviewed several alternatives for the Exit 16 area (Interchange and US 2/7 corridor from the South Park to the Rathe Road intersection) and recommends the Double Crossover Diamond (DCD) as the preferred alternative because it increases traffic capacity, reduces congestion, and improves safety. The DCD is expected to address excessive congestion which causes traffic on the northbound I-89 off-ramp to back up on to the interstate. The Scoping Study examined alternatives with the purpose of increasing the development potential and economic opportunities in the area. VTrans is currently designing the DCD and anticipates beginning construction in 2015. VTrans also has a bicycle and pedestrian improvement project programmed in the area to include sidewalks, pedestrian signals, crosswalks, and streetscaping extending north from the Colchester/Winooski town line.

Figure 38: Exit 16 - Preferred Alternative: Double Crossover Diamond Interchange



Winooski Downtown Circulation Study (2012)

This study was initiated to address pedestrian safety issues and vehicle crashes within the Winooski Circulator as well as congestion and queuing on the Main Street (US 2/7), East Allen Street (VT 15), and West Allen Street approaches to the Circulator. The study recommends eliminating the existing pedestrian signals at the center of the Circulator, adding a pedestrian signal at the southwest corner and improving signage and markings to clarify which lane drivers choose. To address congestion, the study proposed several alternatives that required changes to traffic cirulation patterns. The City Council endorsed the pedestrian signal reccomendations but required further study of the traffic circulation alternatives.

REGIONAL PLANS

Chittenden County ECOS Plan (2013)

The 2013 ECOS Plan combines the Regional Plan, the Metropolitan Plan (MTP), and the Comprehensive Economic Development Strategy (CEDS) into one integrated plan for Chittenden County. The Chittenden County Regional

Planning Commission (CCRPC) is required to develop a long range Metropolitan Transportation Plan (MTP) every five years in order to provide short- and long-range strategies that address transportation needs, which leads to the development of an integrated, inter-modal transportation system that facilities the efficient movement of people and goods.

The Main Street/US 2/7 corridor is part of the "Northern Corridor" identified by the ECOS plan, which serves north/south travel needs connecting the Regional Core area to Colchester, Milton, and Franklin and Grand Isle counties. Public transportation is limited in this corridor, although Milton has recently become a CCTA member which will provide additional commuter services linking through the study area into the Regional Core. Pedestrian and bicyclist accommodations are also improving in this corridor, although there are areas with narrow road shoulders.

The ECOS Plan recommends the following projects and strategies for improving the travel conditions and addressing future growth needs in and around the study area:

- Roadway system management improvements at Main Street (US 7) from West Allen Street to City Line (Winooski), US 2/US 7 at Blakely/Severance Road (Colchester), Blakely Road/Laker Ln intersection (Colchester), US 2A/US 7/Creek Rd/Bay Rd Intersection (Colchester), and the Winooski Circulator (Winooski).
- New facility or major roadway upgrade at Exit 16
- On-road bike facility on Colchester Ave

CCRPC Regional Bicycle-Pedestrian Plan Update (2008)

The Regional Bicycle/Pedestrian Plan comprises the bicycle and pedestrian portion of the MTP. The plan presents a vision and goals for the bicycle and pedestrian network in the county, an overview of existing conditions, recommendations, and an implementation plan. Among the goals of the plan are closing existing gaps in the system, improving bike/ped connectivity, and developing a seamless multimodal transportation network. Main Street is identified as a route that is "commonly used for on-road bicycle travel, but may not have adequate shoulder or be signed for bicycle travel."

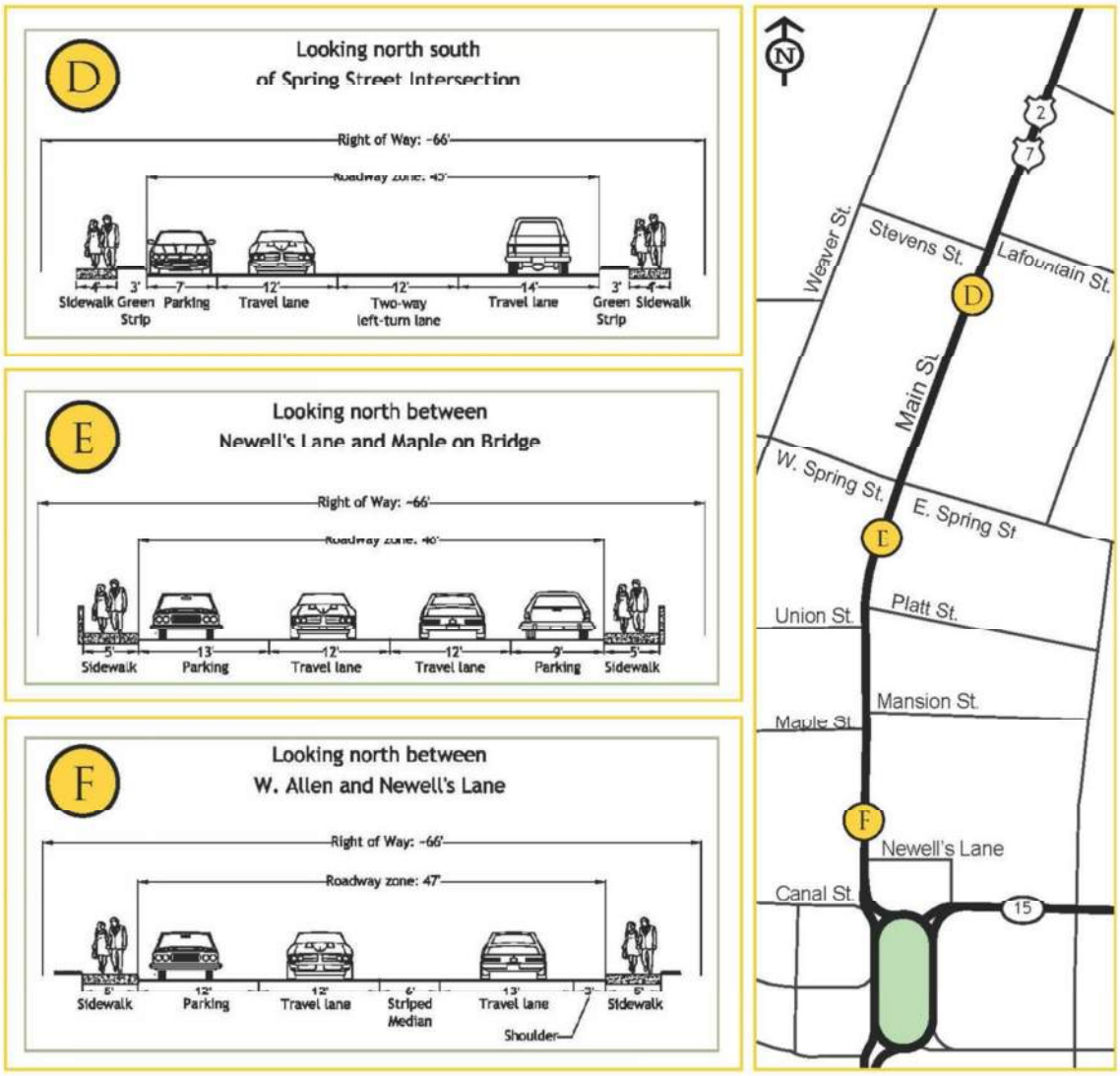
CCRPC Park and Ride Plan (2011)

The Chittenden County Park and Ride Plan provides a comprehensive approach to assessing and satisfying the need for new and improved park and ride facilities in the County. The MTP recommendation for a Park & Ride at Exit 16 is carried through in this plan, and is the number 3 priority in the list of intercept facilities (after the Exit 14 facility and the South End Transit Center). Conceptually, the Exit 16 facility is estimated to have 800 spaces and be served by transit. The Plan recommends identifying an interim location for a park and ride lot and conducting a scoping study to identify specific locations for a permanent intercept facility in the Exit 16 area.

APPENDIX B: LONG-TERM CROSS-SECTION "NORMALIZATION"

The existing Main Street corridor cross sections vary considerably, which results in unnecessary through lane shifts and variable lane widths as one proceeds along the corridor. As shown below in Figure 39, the typical curb-to-curb width of Main Street varies from approximately 45-feet to 47-feet. Travel lanes vary from 12-feet up to 15-feet in width and parking lanes range from 7 feet up to 13 feet in certain places.

Figure 39: Select Main Street Cross-Sections

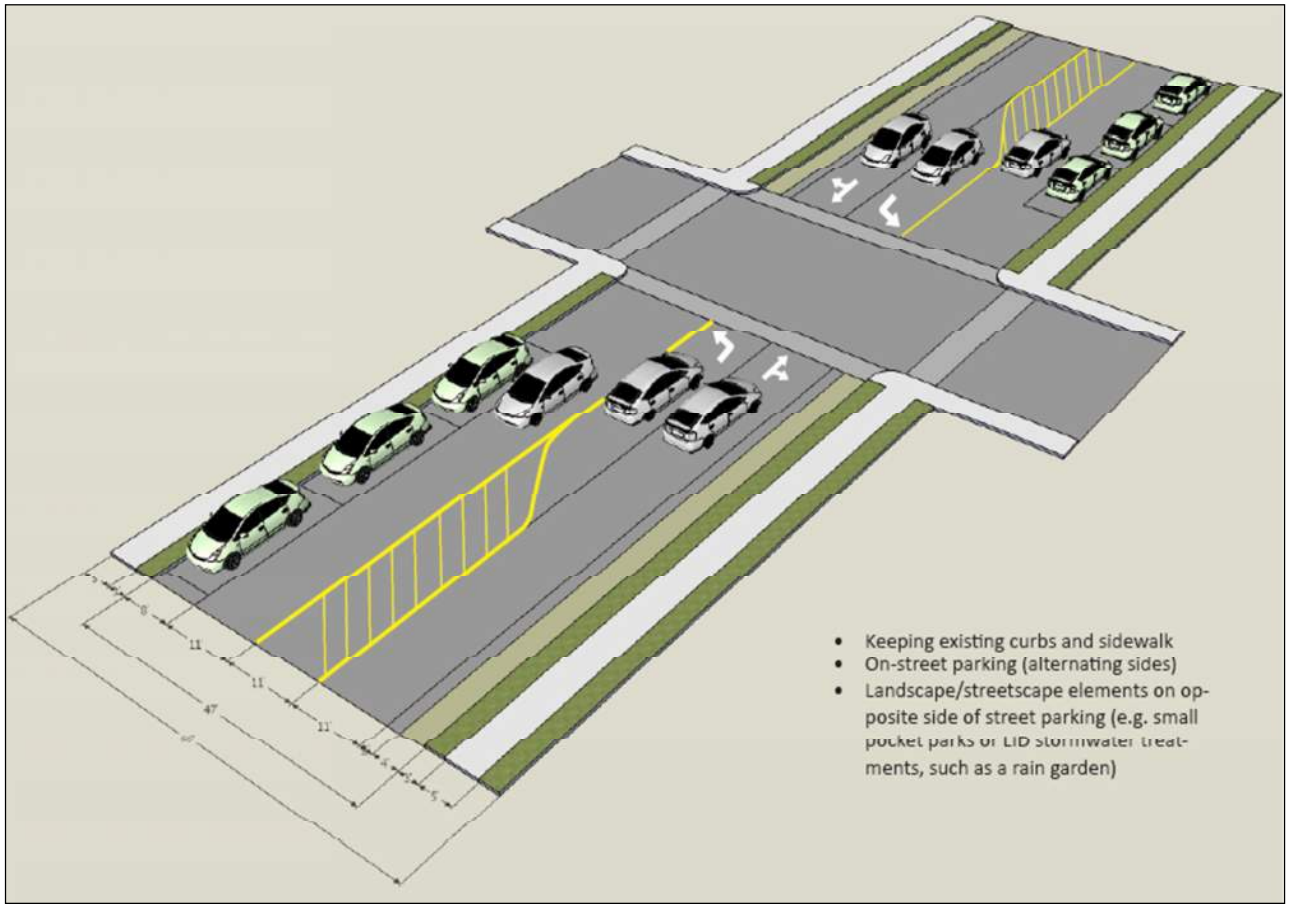


In an effort to better "normalize" the street cross sections and improve safety and the streetscape environment throughout the corridor, we have developed three cross-section alternatives which are described in detail below. Each of these alternatives involves the re-purposing of half of the on-street parking spaces to create additional opportunities for streetscaping and enhanced bicycle accessibility along the corridor.

Alternative 1: Existing Curbs with On-street Parking & Streetscaping

Within the existing curb limits, this scenario provides and 8-foot on-street parking lane on alternating sides of the street, one 11-foot travel lane in each direction and an 11-foot central median, which provides room for exclusive turn lanes where needed. At locations where an exclusive turn lane is not needed, the central median could be curbed and landscaped. This alternative also provides the opportunity to narrow the street by up to 4 feet to provide additional landscaping features, stormwater treatment opportunities (e.g. bioswale), or widened sidewalk on one side of the street.

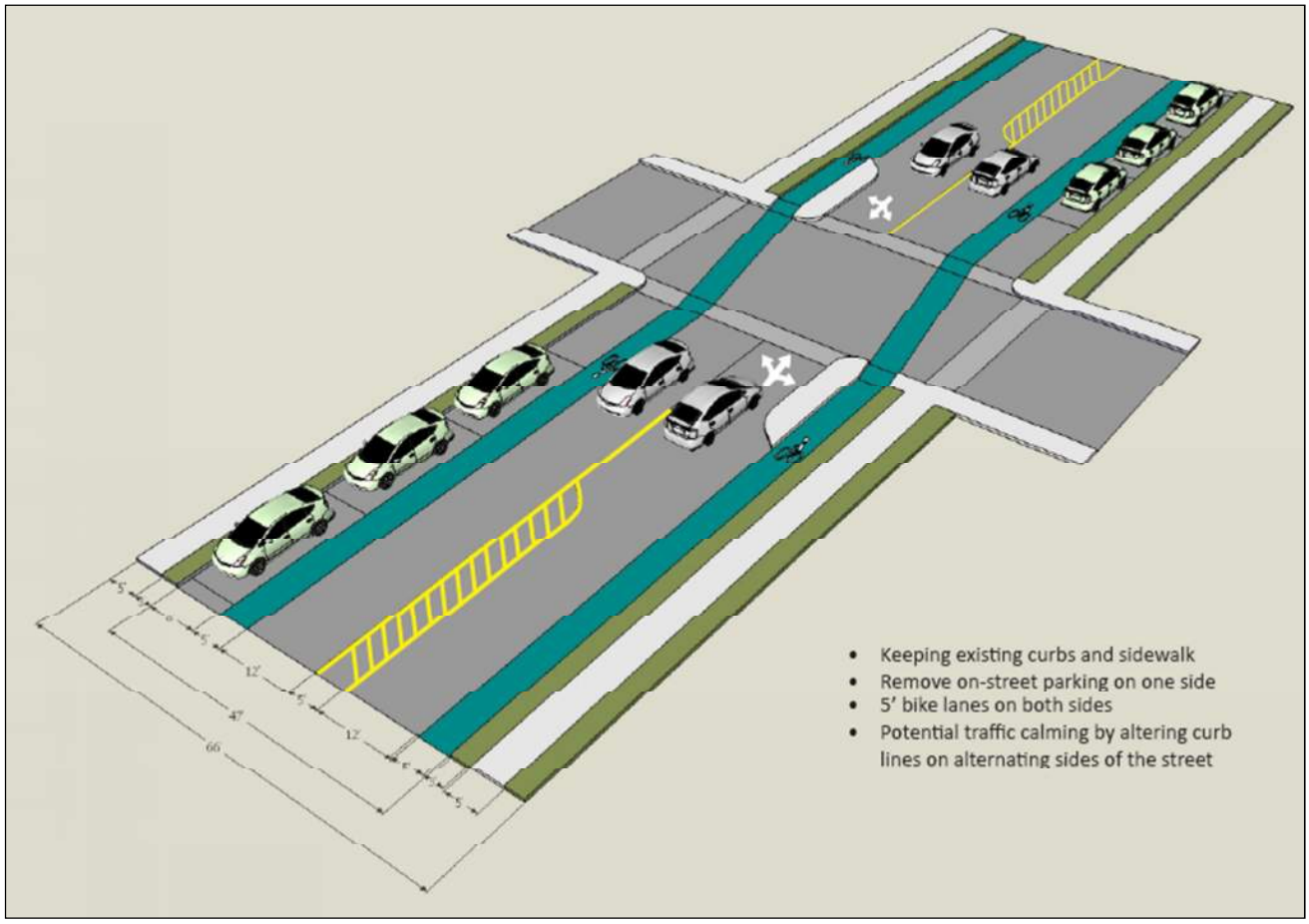
Figure 40: Cross-Section Alternative 1 - Existing Curbs with On-street Parking and Landscape Elements



Alternative 2: Existing Curbs with Bike Lanes & Alternating Parking

Similar to Alternative 1, this alternative also maintains one 8 foot on-street parking lane on alternating sides of the street, one 12 foot travel lane in each direction and a 5 foot central median. This scenario adds in a 5 foot dedicated bicycle lane on both sides of the street to enhance safety and accessibility along Main Street for bicyclists. At intersections, raised bump-outs could be provided (as shown below) to calm traffic speeds and shorten the pedestrian crossing distances. Alternatively, the bump-outs could be flush with the pavement (e.g. stamped asphalt) or left out entirely, to provide room to pass left-turning vehicles. At locations with heavy left-turn movements, such as Spring Street, the on-street parking lane would end in advance of the intersection to provide space for exclusive left-turn lanes.

Figure 41. Cross-Section Alternative 2 - Existing Curbs with Bike Lanes and Alternating On-street Parking



Alternative 3: Relocated East Curb with Cycle Track & Median

This alternative removes the on-street parking entirely from the east side of Main Street to create the opportunity for a 10-foot protected bicycle lane or cycle track along one side of the street. This alternative maintains a single 8-foot parking lane along the west side of Main Street, one 12-foot travel lane in each direction, and a 6-foot central median that could be curbed and landscaped. As with Alternative 2, at intersections where exclusive left-turn lanes are needed, the parking lane and median could be removed to provide room for the turn lanes. The cross-section shown, which includes a curb-delineated cycle track would require a relocation of the eastern curb to narrow the street width to 40-feet. Alternatively, the existing east curb line could be maintained and the cycle track could be offset by a 3-foot striped buffer, as shown in Figure 43. To accommodate this option, the travel lanes would be reduced to 11-feet and the center median would be narrowed to 4-feet.

Figure 42. Cross-Section Alternative 3 - Relocated Eastern Curb with Cycle Track, On-Street Parking, and Central Median

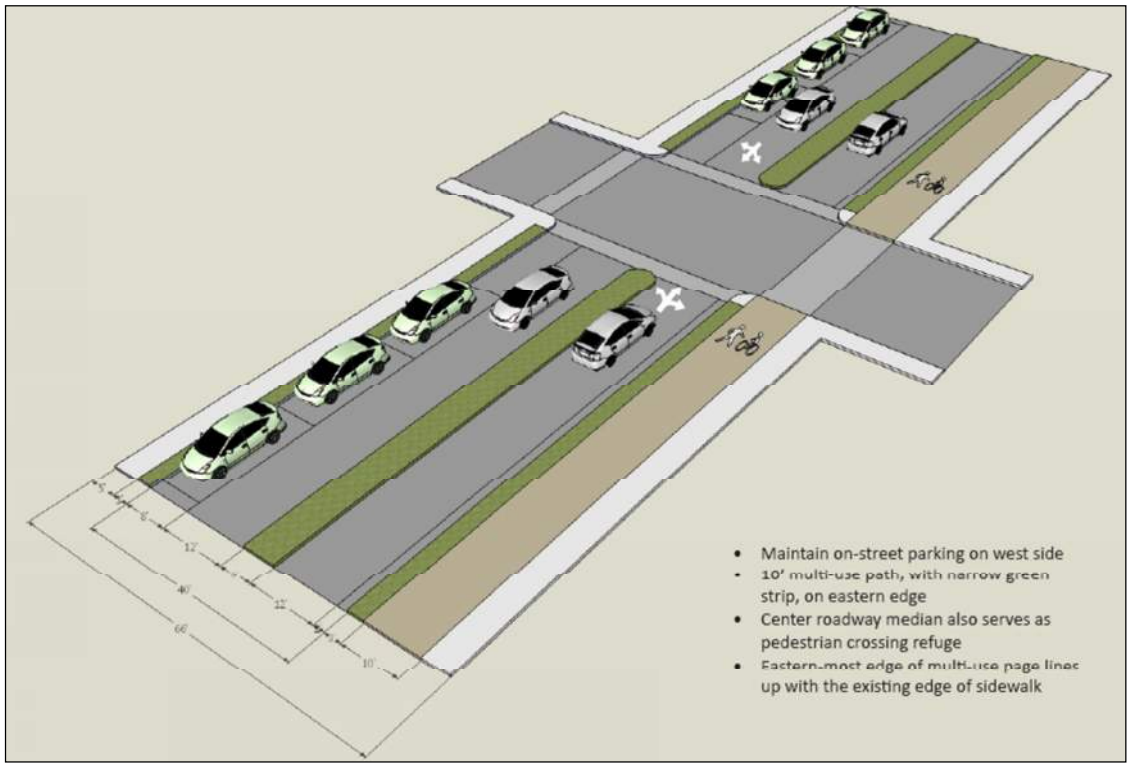
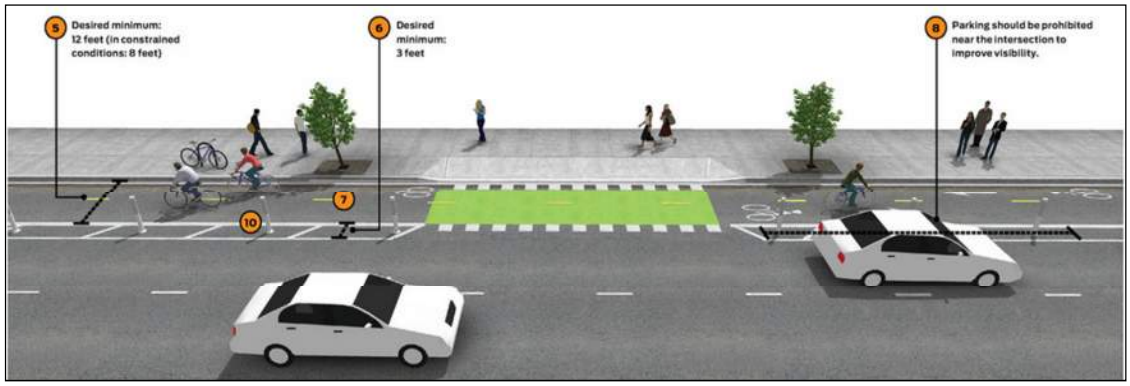


Figure 43: Non Curb Delineated Cycle Track (Image courtesy NACTO)



APPENDIX C: MAIN STREET/SPRING STREET INTERSECTION ASSESSMENT

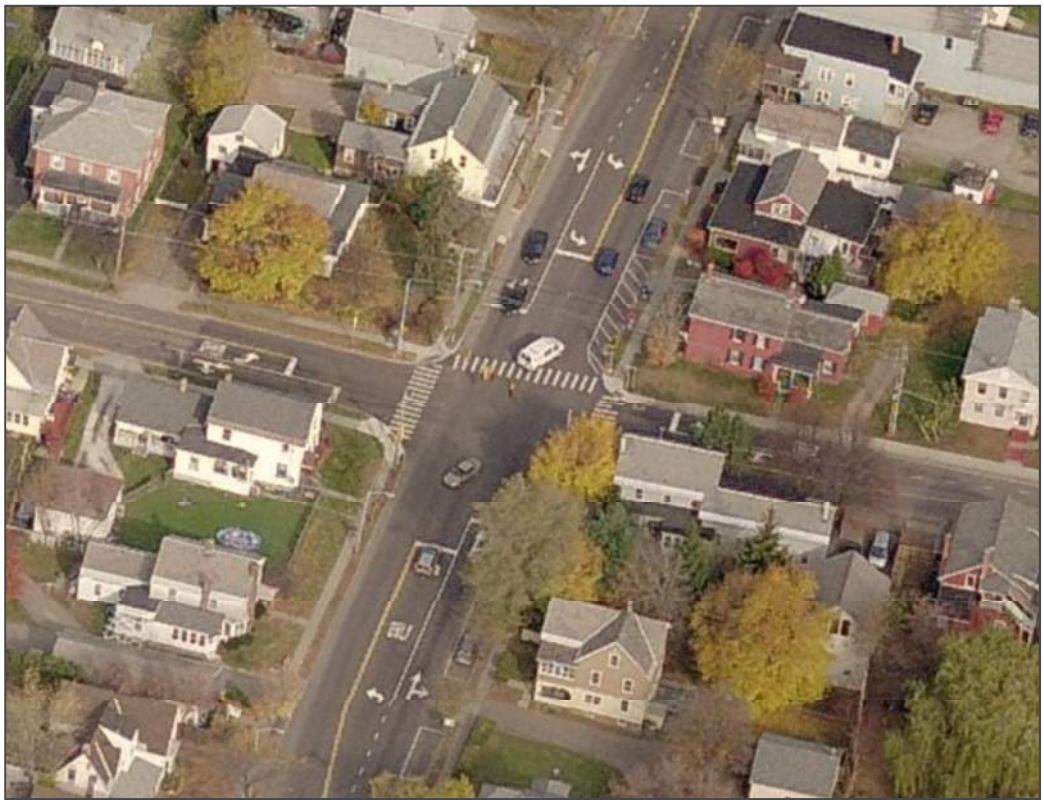
To supplement the Winooski Main Street Corridor Study, RSG has conducted a detailed assessment of traffic operations at the Main Street/Spring Street intersection to identify a package of potential short-term improvements.

Existing Conditions

The Main Street/Spring Street intersection currently operates with the following configuration:

- Northbound Main Street: Left-Turn lane (±100' storage) and a shared Through/Right lane
- Southbound Main Street: Left-Turn lane (±80' storage) and a shared Through/Right lane
- Eastbound Spring Street: Left-Turn lane and a shared Through/Right lane (±130' storage)
- Westbound Spring Street: Shared Left/Through lane (±60' storage) and a Right-Turn lane

Figure 44: Aerial View of Intersection (Main Street Runs North/South)



With the current alignment, the eastbound left-turn lane is aligned directly opposite the westbound left/through lane, which forces westbound through traffic to shift to the right when traversing the intersection. Limited visibility between eastbound left-turning traffic and westbound through traffic can occur when through traffic queues behind left-turning traffic on the westbound Spring Street approach. This conflict could be avoided by reconfiguring the westbound geometry to include a dedicated left-turn lane and a shared through/right lane.

Figure 45: View Looking East from West Spring Street

The intersection currently does not have vehicle detection on the eastbound and westbound Spring Street approaches so the maximum green time of 10 seconds is called every cycle, regardless of demand. This fixed, and relatively short, green time leads to occasionally long queues on the Spring Street approaches during the peak hours.

Alternatives Analysis

To identify the appropriate set of short-term improvements for consideration at the Main & Spring Street intersection, we evaluated traffic operations under the following scenarios:

- **Alternative 1**: Existing Conditions
- **Alternative 2**: Add vehicle detection and optimize signal timings (no change in lane striping)
- **Alternative 3**: Reconfigure striping on the westbound approach to have a dedicated left-turn lane and a shared through/right lane; add vehicle detection and optimize signal timings
- **Alternative 4**: Reconfigure striping on the westbound approach to have a dedicated left-turn lane and a shared through/right lane; implement Protected/Permitted phasing

As shown in the tables below, Alternatives 2 and 3 perform the best in terms of vehicle delay, and queuing. Adding detection and optimizing timings (i.e. Alternative 2) is expected to significantly reduce delays and queues regardless of the westbound lane configuration. However, the reconfiguration of the westbound lane geometry plus vehicle detection (Alternative 3) has the advantage of improving both overall operations and eliminating the potentially unsafe westbound through lane offset.

Figure 46: Delay and Level-of-Service Results

	ALTERNATIVE 1			ALTERNATIVE 2			ALTERNATIVE 3			ALTERNATIVE 4		
WB Approach Geometry:	Existing Geometry			Existing Geometry			Restripe WB approach to have a dedicated left-turn lane and a shared through/right lane			Restripe WB approach to have a dedicated left-turn lane and a shared through/right lane		
Signal Timing	Existing Timings			Detect & Optimize			Detect & Optimize			Detect & Prot/Perm		
	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c
AM Peak Hour												
Overall	C	32	0.73	C	22	0.70	C	23	0.66	C	30	0.68
EB, from West Spring St	E	63	-	C	23	-	C	27	-	C	25	-
WB, from East Spring St	C	31	-	C	20	-	C	24	-	D	36	-
NB, along Main St	B	18	-	C	22	-	C	22	-	C	32	-
SB, along Main St	B	20	-	C	22	-	B	19	-	C	30	-
PM Peak Hour												
Overall	F	88	0.94	C	30	0.83	C	33	0.82	D	43	0.81
EB, from West Spring St	C	31	-	C	24	-	C	27	-	D	36	-
WB, from East Spring St	F	>100	-	C	31	-	D	40	-	E	56	-
NB, along Main St	C	34	-	D	36	-	C	33	-	D	43	-
SB, along Main St	C	22	-	C	26	-	C	29	-	D	36	-

Figure 47: Queue Results (# of Vehicles)

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
AM Peak Hour				
EB	8	5	5	6
WB	3	3	4	7
NB	6	7	6	7
SB	6	8	9	9
Sum of all Queues	**23**	**23**	**25**	**28**
PM Peak Hour				
EB	4	4	5	5
WB	50	16	16	20
NB	16	17	16	22
SB	10	11	12	16
Sum of all Queues	**80**	**48**	**49**	**63**

Recommendations

Based on our investigation of the Main Street & Spring Street intersection, we would recommend that the City proceed with the following action plan:

1. Add signal detection (video/thermal camera units) for all approaches and re-time traffic signal to increase split for Spring Street approaches (Cost: $7,500-$20,000)
2. Restripe the westbound Spring Street approach to have a dedicated left-turn lane and a shared through/right lane and replace the lane assignment sign on the westbound approach to reflect the change. (Cost: $500 – 2,000)
3. Conduct an operational assessment once the above items are in place to observe performance and adjust the signal timings as needed. (Cost $500 - $1,500)