

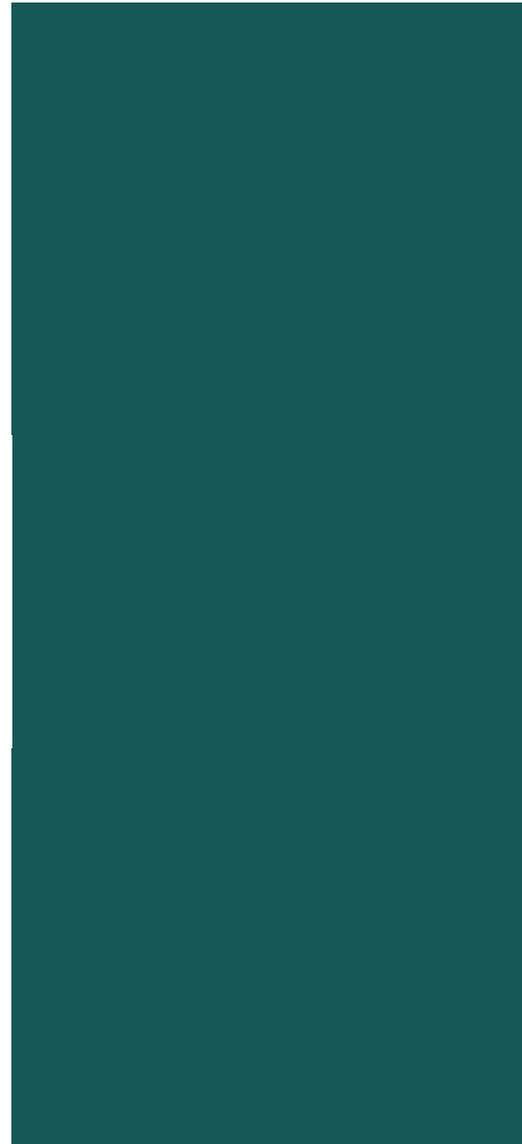


**North Moretown
Transportation Study:
US 2 - VT 100 East Intersection Area
Final Report**

Submitted to:
Central Vermont Regional
Planning Commission

Submitted by:
Resource Systems Group, Inc.

May 23, 2012



NORTH MORETOWN TRANSPORTATION STUDY

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1.0 INTRODUCTION

The intersection of US 2 – VT 100 (Figure 1) is directly to the south of Waterbury Village, lies within a Commercial Zoning District of Moretown, and is adjacent to a Village Zoning District in Duxbury. As such, the surrounding area has enough development potential to significantly impact this regionally important intersection.

This report presents a plan for improvements and provides a vision for the US 2 – VT 100 intersection in which all stakeholders can benefit. Under the guidance of a Study Committee comprised of VTrans and CVRPC staff, local representatives and stakeholders, the plan:

- Estimates future intersection performance under existing conditions and three alternative scenarios.
- Assesses the adequacy of the existing intersection geometry, particularly regarding pedestrians, bicycles, and transit.
- Conducts signal, turn lane, and four-way stop warrant analyses.
- Identifies intersection deficiencies through operational analysis, site visit observations, and a review of VTrans crash reports.
- Engages the public through a participation process to solicit input on issues and possible solutions.
- Develops conceptual alternatives to address existing and predicted deficiencies, to include resource impacts, permitting needs, cost estimates, and implementation timelines.
- Summarizes and compares alternatives to each other and to the existing condition in an Evaluation Matrix.

Several public meetings were conducted to solicit input on this project, including presentations to the Central Vermont Transportation Advisory Committee. All notes from these discussions are included in Appendix A: Meeting Notes.

Figure 1: Looking west at the US2 - VT100 intersection



2.0 PURPOSE AND NEED STATEMENT

The purpose and need statement was developed and revised by participants at the Local Concerns meeting.

2.1 Purpose

The purpose of the North Moretown Transportation Study is to provide a vision for the US 2 – VT 100 intersection and develop a plan for improvements which address existing and future performance and safety. Under the guidance of a Study Committee comprised of VTTrans and CVRPC staff, local representatives and stakeholders, the study:

1. Provides a thorough review of existing conditions and resources;
2. Develops specific, detailed and cost effective improvement alternatives;
3. Makes reasoned estimates of existing and future intersection performance; and
4. Makes recommendations that improve safety and operations which are context-appropriate and which take into account local plans and concerns.

2.2 Need

Improvements are needed because:

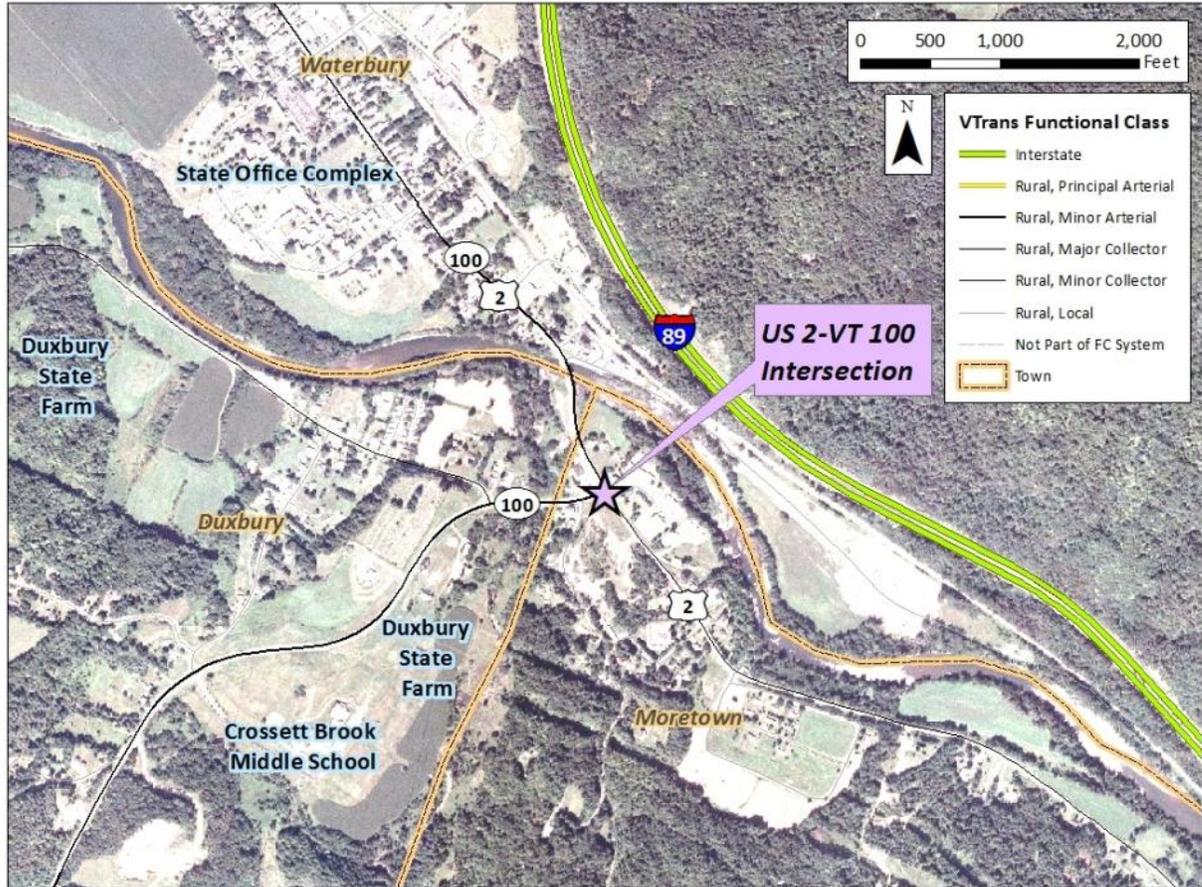
- There is a lack of bicycle and pedestrian facilities at the intersection, which particularly impacts schoolchildren in the area.
- New development is proposed nearby which will impact the intersection operations.
- Delay for the VT 100 approach is unacceptable at certain times of the day.
- The offset alignment of Commercial Drive and the Juniper's Fare Restaurant driveway creates conflicts and safety issues.



3.0 EXISTING PLANS, STUDIES AND ON-GOING PROJECTS

This section identifies relevant findings from related plans, studies, and contact with VTrans, towns, and Crossett Brook Middle School. A vicinity map is provided in Figure 2.

Figure 2: Vicinity map



3.1 Plans

Central Vermont Regional Transportation Plan (2008)

The Regional Transportation Plan notes that the US 2-VT 100 intersection is located within a regional growth area. The intersection is cited as a congestion problem area for both 2000 and 2020.

Duxbury Town Plan (2006)

The Duxbury Town Plan notes that there is concern over queuing at the US 2-VT 100 intersection and for pedestrian and bicyclist safety, particularly for Crossett Brook Middle School schoolchildren.

The Plan recommends that for VT 100 in general,

- Bicycle lanes be segregated from the highway as much as possible;



- Rumble strips be installed so as to discourage use of road shoulders as an excuse for increased driving speeds;
- On-site circulation of traffic be required for any business locating on Route 100, thus eliminating the need for large trucks to back into a business;
- Shared driveways be generally required;
- In the case of multi-home developments, rights-of-way be required, as needed, so that a single curb cut may serve a number of homes;
- Wherever possible, driveways make use of existing side roads rather than coming out directly onto Route 100;
- The Planning Commission, during site plan review of subdivision proposals, determines the maximum number of permissible curb cuts for that parcel and condition site plan approvals accordingly.

Moretown Town Plan (2008)

The Moretown Town Plan calls out US 2-VT 100 as one of three critical intersections in the Town (the other two being VT 100-VT 100B and Mountain Road-VT 100B). The Plan notes that three of the options that have been considered for improving the intersection are 1) left and right turn lanes; 2) signalization; or 3) roundabout.

The Plan recommends:

- developing/expanding the sidewalk network to connect the intersection to Crossett Brook Middle School following the 2002 Conceptual Alignment Analysis (discussed below);
- that sidewalks be included with any new development or redevelopment of the commercial/industrial sites surrounding the intersection;
- working with the Cross Vermont Trail Association to continue the trail through Moretown between Montpelier and Duxbury; and
- improving access management by following proper access management standards, including sharing driveways.

Waterbury Town Plan (2008)

The Waterbury Town Plan also recommends implementing the sidewalk connection for Crossett Brook Middle School and improving access management to improve safety and traffic circulation. Improving bicyclist safety by enhancing facilities (such as wider shoulders, where appropriate) is also suggested.

3.2 Projects

As applicable the volumes from these projects have been included in the Traffic Data Analysis in Section 6.3.

Waterbury State Office Complex

Due to the flooding from Tropical Storm Irene on August 29, 2011, 1,500 state employees were relocated from the Waterbury State Office Complex. The Waterbury Office Complex Feasibility Study¹ considered four

¹ Freeman French Freeman with Goody Clancy, March 9, 2012.



possible long-term options for the site: A return and full reuse of the Complex by the State which may include retaining all buildings or a combination of selected historic buildings and new construction.

- A mixed use site consisting of retail, office, and residential space, in which the State would reoccupy a portion of the complex along with other development.
- A new building at the site of the Department of Labor in Montpelier.
- A new building at an undeveloped site.

The state has decided to pursue the mixed use option. It has been decided that the Vermont State Hospital will not reopen at this site.

The traffic volumes used for the analysis in Section 6.3 were collected before the flooding of the Complex, so traffic from this site is included in the analysis.

Duxbury State Farm

The Duxbury State Farm property straddles VT 100 in Duxbury on the west side of US 2. The portion on the south side of VT 100 (adjacent to Crossett Brook Middle School) is proposed to be redeveloped in two phases:

Phase 1:

- Office space: 1,500 square feet
- Building supply and lumber store: 3,200 square feet

Phase 2, a compact mixed use development of 16 two-story buildings, each with a 3,000 square foot footprint:

- Residential: 33 apartment units (average size 1,000 square feet, all on second floors)
- Retail: 45,000 square feet (all on first floors)
- Office space: 15,000 square feet
- Restaurant: 3,000 square feet

For the US 2-VT 100 intersection, the 2011 *Duxbury State Farm Traffic Impact Review* concludes that although delay for the VT 100 approach is currently unacceptable (that is, without the project), making the intersection stop-controlled on all approaches (that is, a three-way stop) would distribute delay to all three approaches rather than over-burdening the VT 100 approach. A three-way stop would also improve the pedestrian environment at the intersection. Traffic from Phase 1 is concluded to have a negligible impact on the intersection.

Phase 1 project-generated volumes from the *Review* have been incorporated into the traffic analysis in Section 6.3 for the existing and future conditions, while Phase 2 traffic is only included in 2032.

Crossett Brook Middle School (CBMS)

The 2002 *Conceptual Alignment Analysis for the Crossett Brook Middle School* provides:

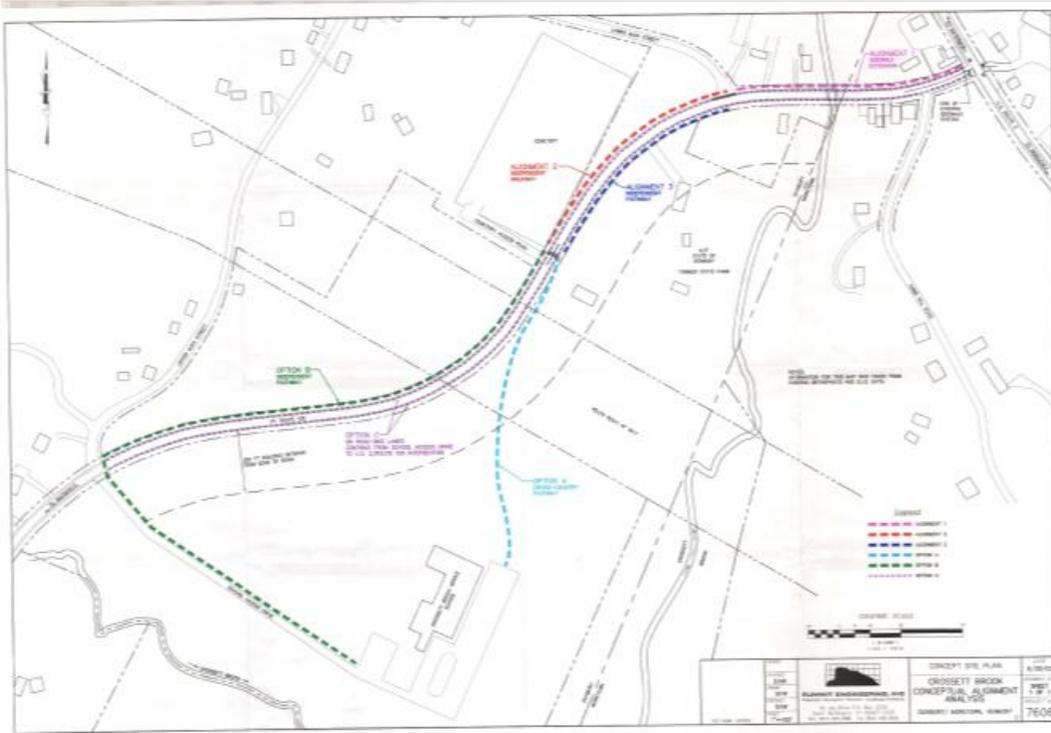
1. An improved route for pedestrians and bicyclists to travel from Waterbury Village to CBMS in Duxbury.
2. Dedicated on road bike lanes along VT 100 from the intersection with US 2 to CBMS, improving access and safety for bicyclists.
3. A traffic calming effect on vehicular through traffic along VT 100 by narrowing the appearance of the roadway, improving pedestrian access, and reinforcing the village character.



The preferred alternative selected by the study was a combination of the magenta, red, and turquoise alignments shown in Figure 3, which extend the sidewalk from the US 2-VT 100 intersection along the north side of VT 100, cross VT 100 at the Cemetery Access Road/crest of the hill, and travel cross-country to connect directly to the school. Section 7.2 recommends building the sidewalk and provides updated cost estimates.

Duxbury, Waterbury, and Moretown support this plan.

Figure 3: Alternative alignments for the Crossett Brook Middle School sidewalk



Family Dollar

The 2011 Traffic Impact Report for the proposed 8,000 square foot Family Dollar discount store on Commercial Drive on the east side of the US 2-VT 100 intersection concludes that the project is not expected to impact the LOS of the intersection.

Project-generated volumes have been incorporated into the traffic analysis in Section 6.3.

Green Mountain Performing Arts and Central Vermont Gymnastics Academy

The Central Vermont Gymnastics Academy opened in summer 2011 and Green Mountain Performing Arts is scheduled to open on January 16, 2012. Traffic associated with these studios is accounted for in Section 6.3.

Green Mountain Coffee Roasters Demerit Place Extension

GMCR proposed to construct an internal circulation road to connect Demerit Place to Pilgrim Park Road in Waterbury. This is an internal project that is expected to change circulation patterns at the US 2/VT100-



Demeritt Place intersection, but not volumes nor circulation patterns at the US 2-VT 100 intersection. The 2010 Traffic Impact Study for the Extension notes that:

Per GMCR, all truck traffic currently accesses I-89 from the north via Exit 10. It is anticipated that this same traffic pattern will remain, however the trucks traveling to/from the south on I-89 could be asked to use I-89 Exit 9 at Middlesex at some point in the future. Should this occur, traffic operations would not be altered significantly given the low hourly truck volumes.

3.3 State and Town Input

State agencies and towns were contacted for their input and insight into specific issues which should be addressed by the study. This section summarizes the input. In addition, representatives attended a project initiation meeting in December 2011. Notes from the Kick-Off Meeting are included in Appendix A.

VTrans Planning and Program Development Divisions

- No issues

VTrans Traffic Research

- Include signal and roundabout in alternatives
- Include crash analysis

VTrans Highway Research

- No issues

VTrans Right-of-Way Unit

- No issues

VTrans Utilities Unit

- No issues

State Historic Preservation Office

- No issues

Town of Duxbury

- A Family Dollar store has been proposed on Commercial Drive; the project is under appeal.
- The double access into the Commercial Drive development is problematic. Particularly for vehicles entering the site from VT 100: first they turn right onto southbound US 2 and then make a left turn into the site.
- Make intersection more bike/ped friendly; preserve the network of bike trails, extend sidewalks.

Town of Moretown

- Consider a roundabout in the alternatives.
- The double access at Juniper's Fare Restaurant seems excessive.

Town of Waterbury

- Improve pedestrian access; implement the CBMS bike/ped path project.



- Consider a roundabout in the alternatives; might require additional right-of-way, but may be possible if shifted to southeast.

Crossett Brook Middle School

- Include bicycle and pedestrian improvements for safety, such as the CBMS bike/ped path project.
- There is no sidewalk on the north side of US 2 between Commercial Drive and Waterbury Village; this is an obstacle for schoolchildren who participate in activities at the Central Vermont Gymnastics Academy and live in Waterbury Village.
- School buses turn left onto US 2 from VT 100 and drop off students on the same side of the road as the Central Vermont Gymnastics Academy so that they do not have to cross US 2.

4.0 EXISTING CONDITIONS

This section describes the roadway characteristics, bicycle and pedestrian facilities, safety records, available right-of-way data, and utilities in the study area.

4.1 Land Use Context

The US 2 corridor serves as the front door to Moretown, Waterbury, and Duxbury, depending on the traveler’s direction. Bordered by the floodplains of the Winooski River, it is identified as a gateway opportunity in the Moretown Town Plan, which would provide a sense of arrival and help calm traffic, and improve safety.

The area surrounding the intersection is zoned Commercial; to the west on the Duxbury side, it is zoned Village. Commercial uses are located on all corners of the intersection including Hannon Home Center on the southwest corner of the intersection, a retail center on the east side of US 2 in the Commercial Drive site, and Snowfire Auto on the northwest corner of the intersection. Residential properties border both sides of VT 100 west of Cobb Hill Road.

The purpose of this district according to the Moretown Town Plan is to allow for commercial use in a manner that is compatible with residential uses and the town’s rural character. The land uses surrounding the intersection are transitioning and growing and several commercial properties are expanding. These uses are consistent with much of the recent development in this area, characterized by automobile orientation, poor access management, single-story, pre-fabricated metal buildings, and limited landscaping or screening. More integrated site planning could help to address some of these issues, such as developing shared driveways and improving pedestrian connectivity.

Ideally, this area could become a compact center occupied by an attractive mix of commercial and residential uses. This would require Moretown to adopt appropriate regulatory standards regarding site design, architecture and access management, and a master plan coordinating facility improvements in the area. The

What is a Gateway?

A gateway is a physical or geometric landmark that indicates a change in environment from a high speed road to a lower speed residential or commercial district. Gateways may be a combination of street narrowing, medians, signs, roundabouts, or other identifiable features. Gateways should send a clear message to motorists that they have reached a specific place and must reduce speeds for a different driving environment. In addition, a gateway creates a unique image for an area and a sense of place.



town may also want to pursue the Town Plan’s recommendation to designate North Moretown a regional “village growth center”.

Transportation and land use issues along the corridor and intersection of US 2 and VT 100 are:

- The offset intersection created by Commercial Drive not being directly across from VT 100.
- The U-shaped access to Juniper’s Fare and Commercial Drive.
- The overall lack of trees and landscaping to visually unify the area, and provide shade and a buffer between vehicles and pedestrians.
- The presence of small grass areas that are difficult to maintain and don’t serve an aesthetic or functional purpose (Figure 4).
- The dominance of surface parking areas and vacant lots (for example, parking could be located behind buildings instead of in front).
- An imbalance of narrow sidewalks and overly wide roadways, encouraging high speeds, allowing fast-moving traffic to visually dominate the area, and creating a place that lacks “human scale.”
- Much of the recent development in this area is characterized by poorly integrated site planning, automobile orientation, single-story pre-fabricated metal buildings, and limited landscaping or screening.

Figure 4: Small grass areas



4.2 Roadway

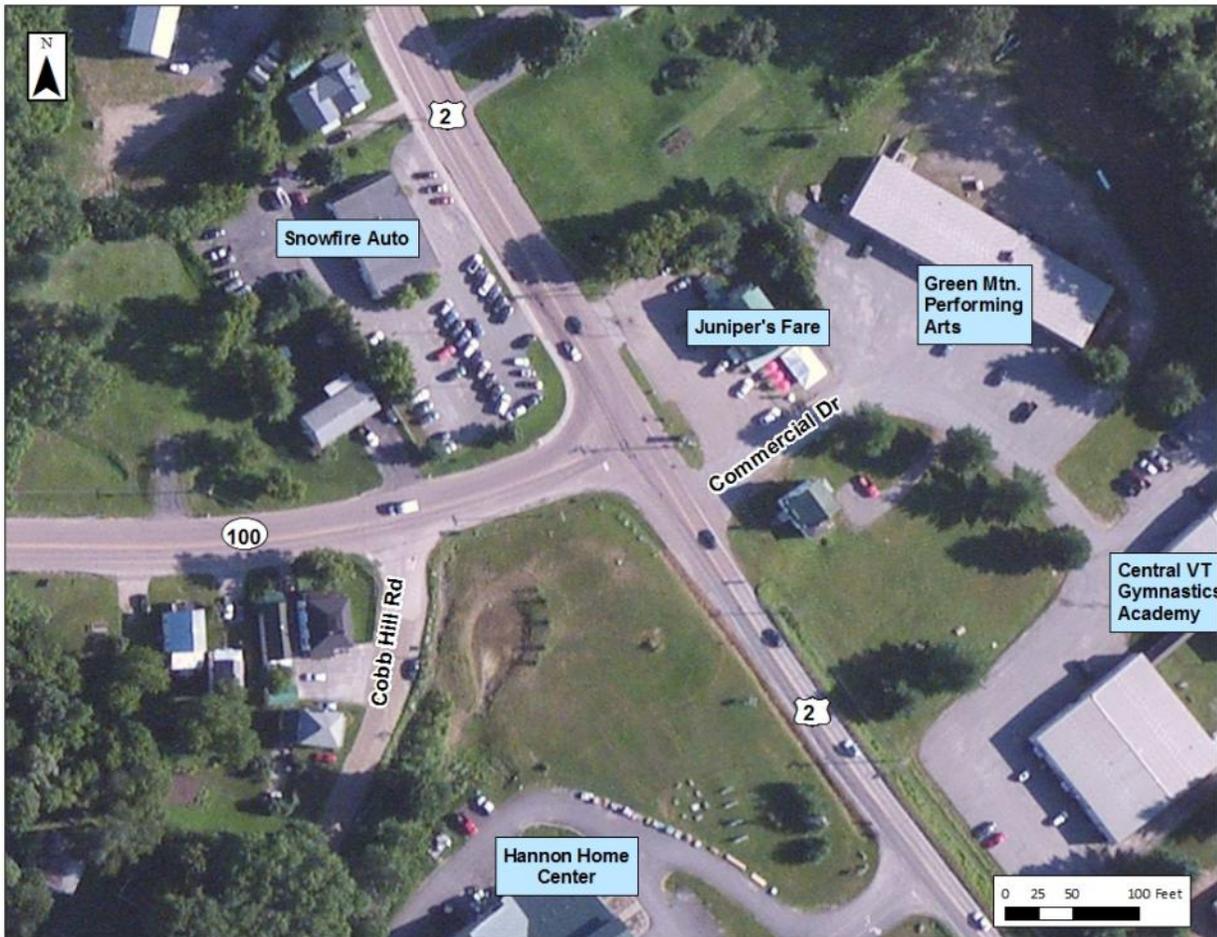
Classifications and Design Standards

An aerial photo of the study area is shown in Figure 5. US 2 is a US highway and VT 100 is a state highway, owned and maintained by the State of Vermont. South of the intersection, US 2 is classified as a rural major collector, while north of the intersection it is a rural minor arterial, as is VT 100. The function of a minor arterial is to provide mobility for through traffic as well as access, primarily through connecting streets, to adjacent land uses. A major collector collects traffic from adjacent properties and distributes them on the road network.

Cobb Hill Road is approximately 180’ west of the intersection. Commercial Drive and a secondary access to Juniper’s Fare are on the east side of US 2, offset from the VT 100 approach. Snowfire Auto has two curb cuts on US 2 north of the intersection, the closest one of which is approximately 80’ from the intersection.



Figure 5: Study area



As shown in Figure 6, the intersection is stop-controlled on the VT 100 approach while US 2 runs free. There are no turn lanes on US 2, but VT 100 has left and right turn lanes. Commercial Drive is offset to the west of the intersection and is stop-controlled. There is also a driveway for Juniper's Fare Restaurant to the east of the intersection. Figure 6 also shows the potential conflict points stemming from the many turning movements along this segment.

Figure 6: Intersection geometry

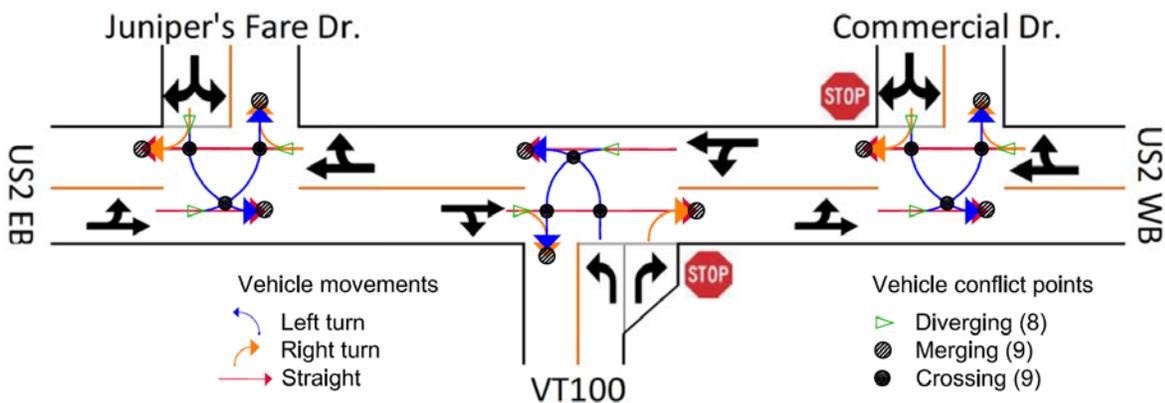
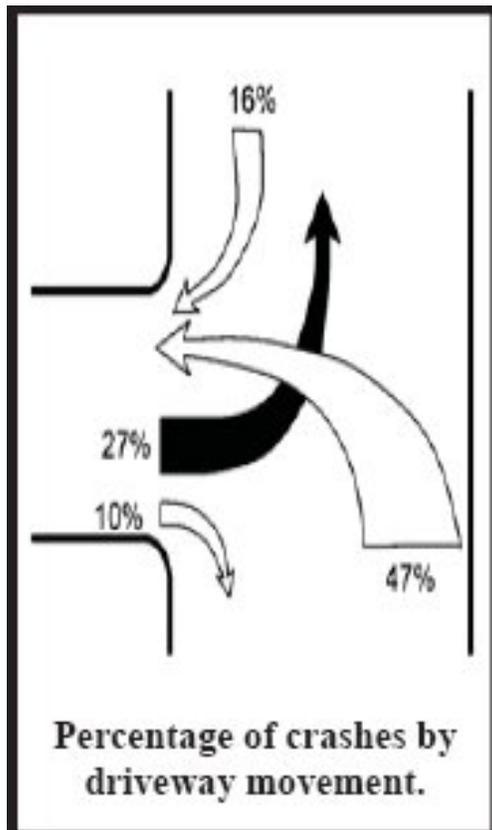


Figure 7: Percentage of crashes by driveway movement¹



The more driveways there are, the more turns there are on to and off of the roadway and the greater the potential for conflicts. Figure 7 shows that left-turns into and out of a driveway comprise the majority of conflicts. This issue is compounded at the US 2-VT 100 intersection because of the offset intersection: that is, vehicles that turn right out of VT 100 and then left into Commercial Drive are making two separate turns. However, if Commercial Drive were located directly across from VT 100 (which would require the relocation of a utility pole), vehicles could go straight across the intersection and the turning movements would be consolidated.

Similarly, the Juniper's Fare driveway to the north/west of VT 100 is redundant given the Commercial Drive access point, and creates additional conflicts. Proper access management (that is, controlling driveways/points at which vehicles access the roadway) would suggest minimizing the number of driveways and therefore closing this access point. This would improve safety for vehicles, bicycles and pedestrians, and improve traffic flow by reducing the number of turns on to and off of the roadway.

The posted speed limit on US 2 approaching the intersection is 40 mph and on VT 100 is 35 mph.

The cross-sections in Figure 8 refer to the locations shown on the map in Figure 9. For rural minor arterials (VT 100 (cross section A-A) and US 2 north of the intersection (cross section B-B)), the *VT State Design Standards* suggest 11' travel lanes and 5' shoulders for the relative speed limits and traffic volumes. For rural major collectors (US 2 south of the intersection (cross section C-C)), 11' travel lanes and 3' shoulders are indicated.² Figure 8 shows that the existing cross-sections for the minor arterials tend to be wider than the *Standards* suggest.

¹ FHWA Office of Operations: Safe Access is Good for Business: http://ops.fhwa.dot.gov/publications/amprimer/access_mgmt_primer.htm.

² According to the *Standards*, both the 5' and 3' shoulders will accommodate bicycles for these applications.



Figure 8: Existing roadway cross sections

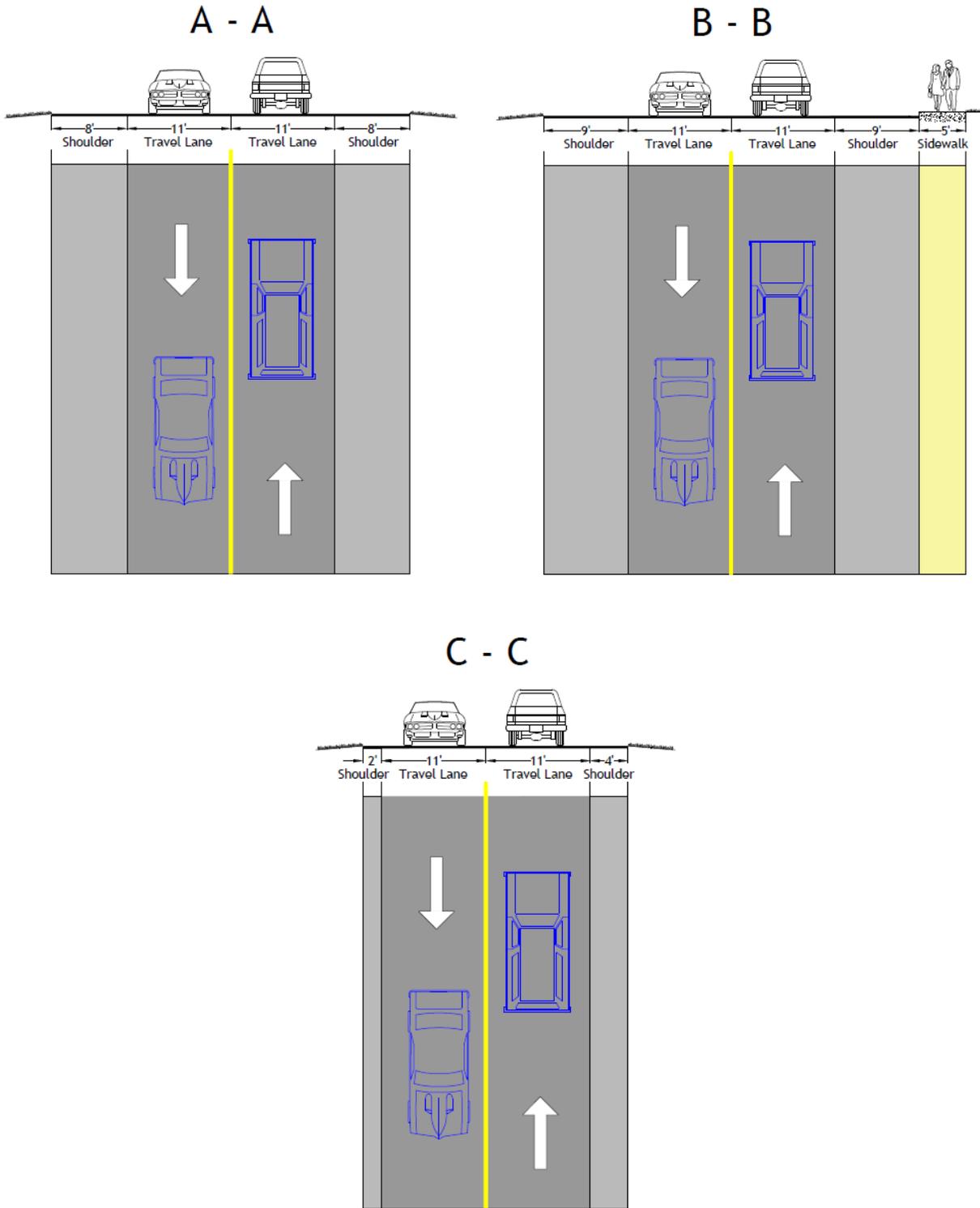
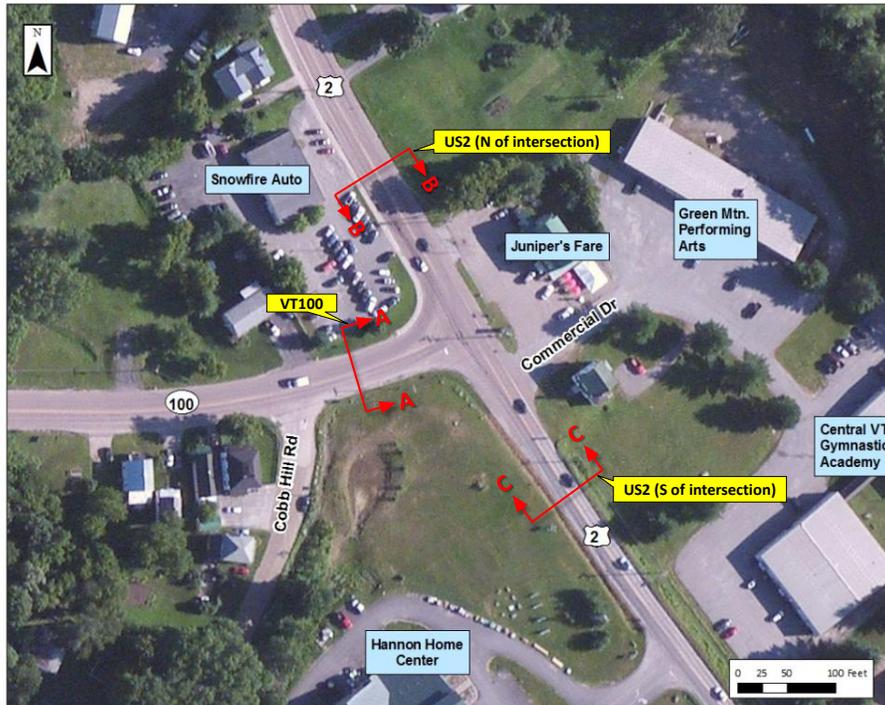


Figure 9: Cross section reference map



Roadway Sufficiency Ratings

A highway sufficiency rating evaluates a roadway's structural condition, safety, and service. The 2008 Highway Sufficiency Rating Report from VTrans' Highway Research Division rates US 2 within the study area 79.6 out of 100, and VT 100 at 88.7. According to the report, a rating of 60-80 is considered fair, and a rating of 80-100 is deemed in good condition. Of the entire State Highway System, 24.1% of the roadway miles are in good condition, while 35.4% are in fair condition.

Trucks and Buses

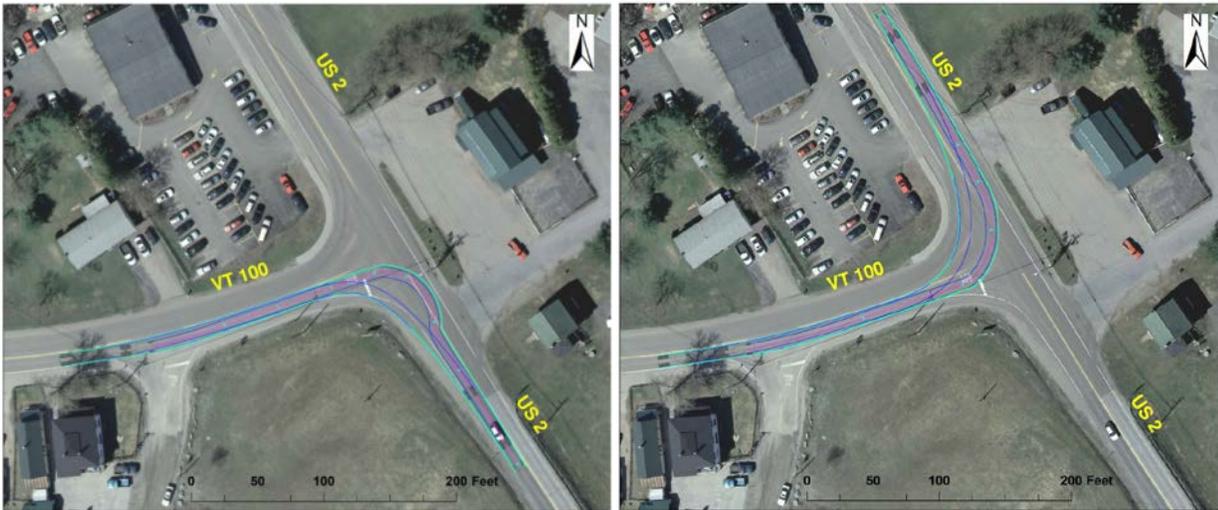
Green Mountain Transit Agency's (GMTA) Waterbury Commuter (Route #83) provides service along this section of US 2 between Waterbury and Montpelier, although the nearest signed stops are in Waterbury. The service operates Monday through Friday, with three morning trips and three afternoon trips. School buses for nearby schools pass through the intersection as well.

As for freight movements, the GMCR Demeritt Place Extension Traffic Impact Study indicates that most trucks leave the plant and access the interstate at the Waterbury interchange and therefore do not travel through the US 2-VT 100 intersection. Large vehicle volumes recorded in the VTrans turning movement counts used in Section 6.3.1 indicate that 2% of the intersection traffic is comprised of large vehicles.

The turning template of a WB-67 truck (interstate semitrailer with a 52' trailer) was applied to a scaled aerial photo of the intersection to determine any existing constraints to large vehicle movements. The result is that while the truck can maneuver through a left or right turn from VT 100 on to US 2 or make a left-turn from westbound US 2 on to VT 100, it consumes either the shoulder or part of the opposing travel lane to do so. (see Figure 10.) Moreover, trucks making a right-turn from eastbound US 2 on to VT 100 travel on the sidewalk, which could be dangerous for pedestrians. This movement is verified by tire tracks observed at the site (see Figure 12 in Section 4.3 below).

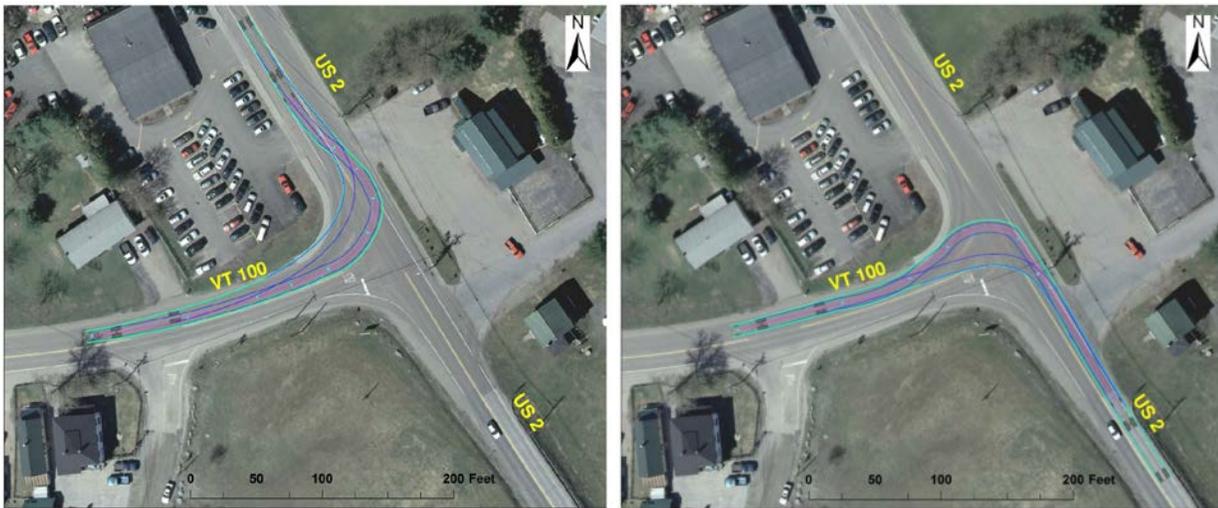


Figure 10: WB-67 turning maneuvers



Right turn from VT 100

Left turn from VT 100



Right turn from US 2

Left turn from US 2

4.3 Bicycle and Pedestrian Facilities

Bicycle and pedestrian facilities within the study area are shown in Figure 11. The Cross Vermont Trail, a multiuse trail which traverses Vermont from east to west, includes this section of US 2. There is a 5' wide sidewalk north of the intersection on the west side of US 2 that ends as shown in Figure 12. As noted above, large trucks end up riding on the sidewalk when making the right-turn from eastbound US 2 onto VT 100. There are no marked crosswalks or bicycle/pedestrian related signs.



Figure 11: Bicycle and pedestrian facilities

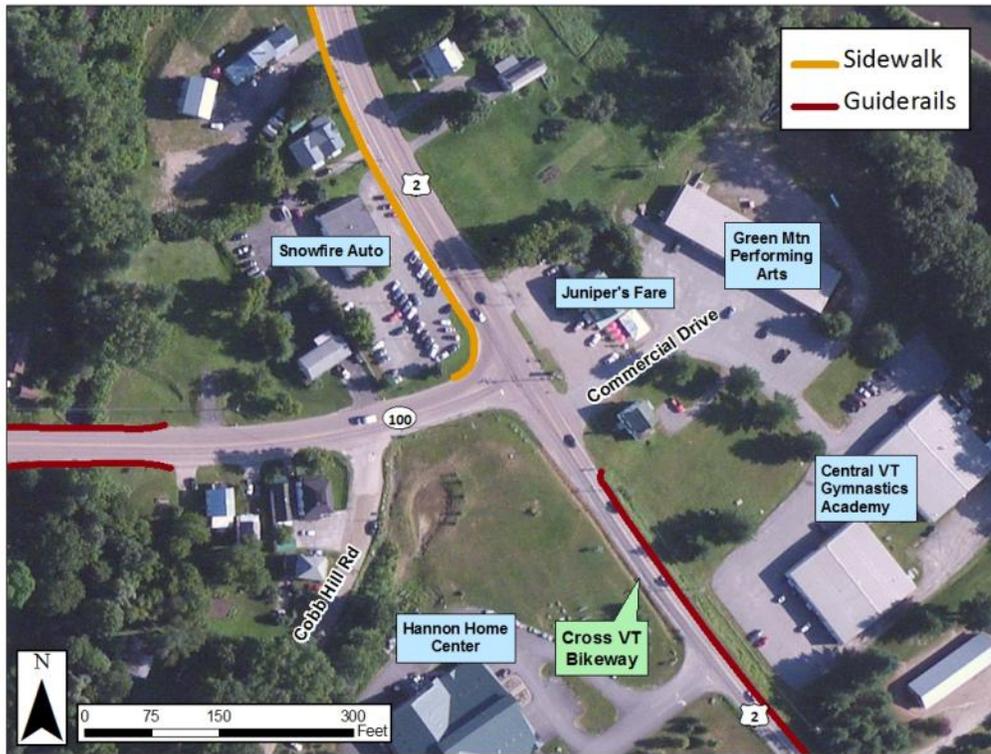


Figure 12: End of sidewalk on northwest corner of US 2-VT 100 (note tire tracks on sidewalk and in mud)



Despite the lack of pedestrian warning signs or facilities, there was considerable pedestrian activity observed involving school children during the Project Kick-Off Meeting at Juniper's Fare on the afternoon of December 6, 2011. Students disembark from school buses on VT 100 and US 2 and walk across US 2 to participate in activities at the Central Vermont Gymnastics Academy adjacent to Juniper's Fare in the Commercial Drive complex. Although the school bus lights and signs force traffic to stop so that the children can cross, there are no permanent fixtures in place to warn drivers of pedestrian activity, particularly school children.

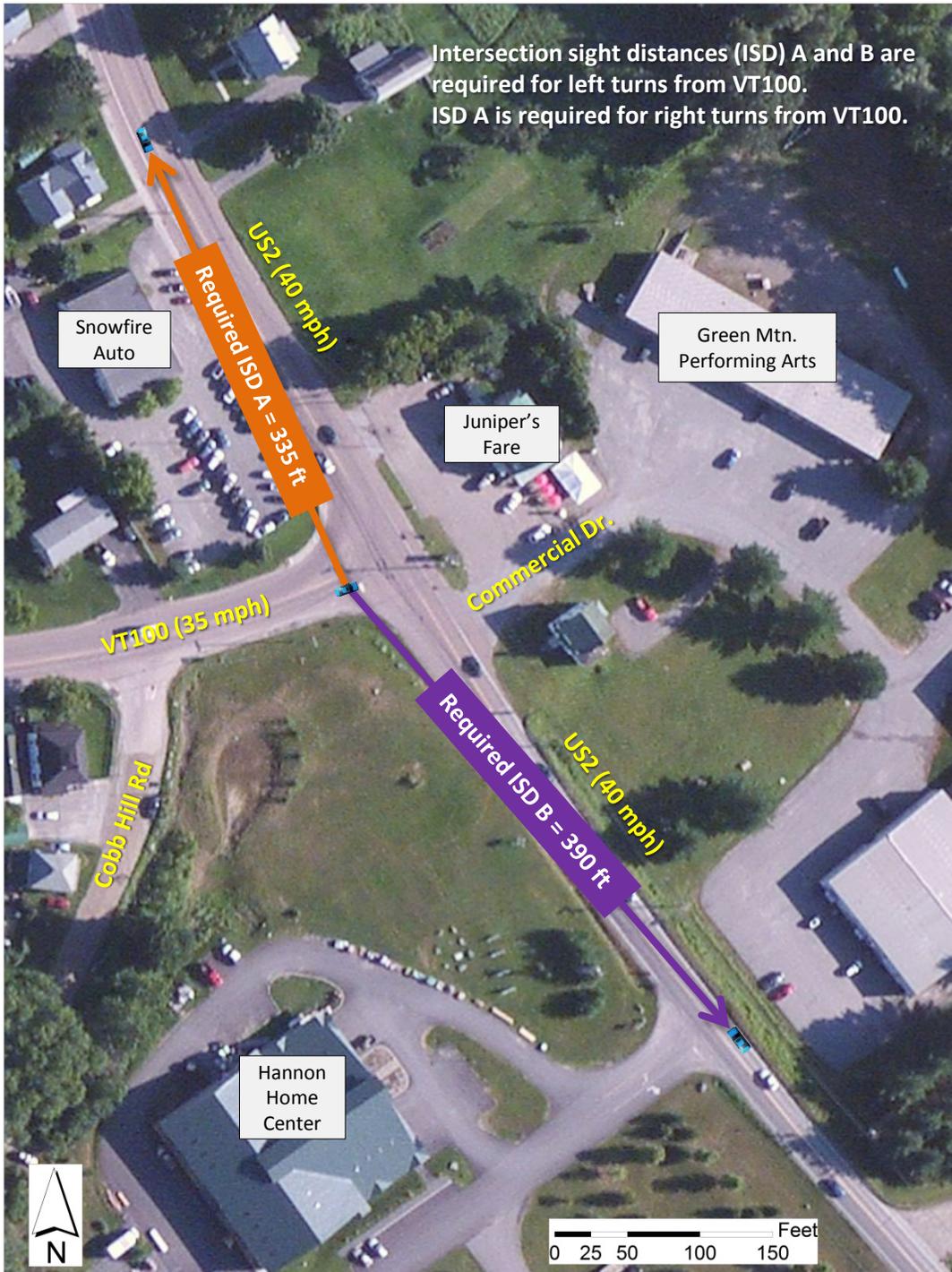
4.4 Safety

Sight Distances

The posted speed limit on US 2 approaching the intersection is 40 mph and on VT 100 is 35 mph. Given these speed limits, AASHTO recommends the intersection sight distances shown in Figure 13. The sight distances measured in the field exceed these distances.



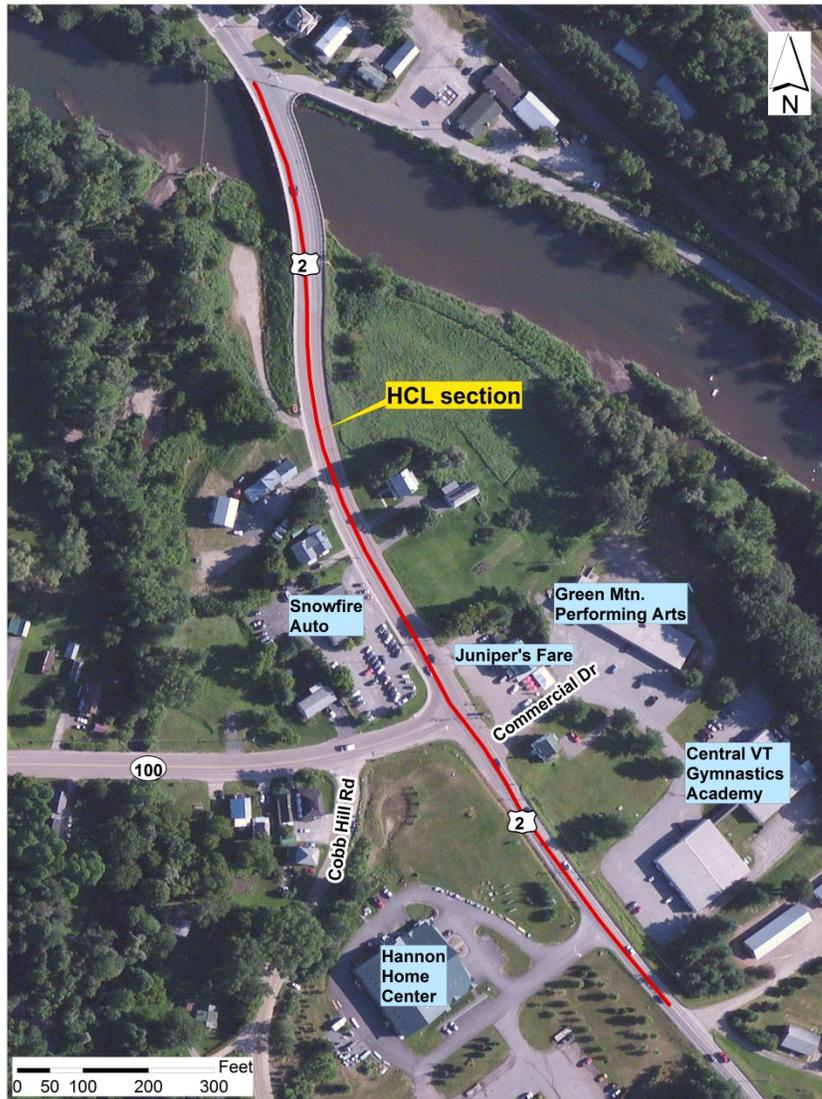
Figure 13: Sight distances



High Crash Locations

The most recent VTrans High Crash Location (HCL) Report (based on 2006-2010 data) lists US2 in the vicinity of the intersection as an HCL section (MM 0.192-4.905) which ranks 417 among 659 HCLs in VT (Figure 14).

Figure 14: HCL Section in the Study Area

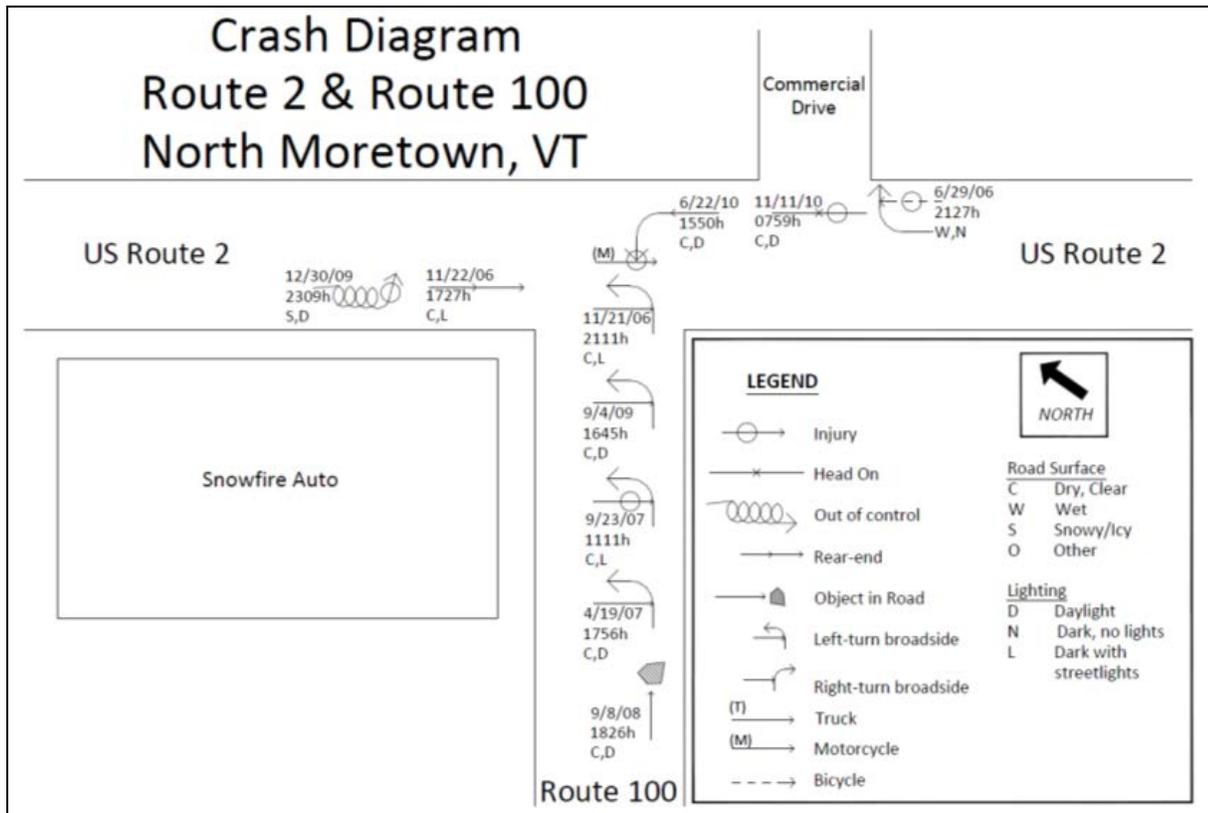


Crash History

The VTrans Highway Research Division was contacted to review crash reports at the intersection for the most recent five years of data. A summary of the findings is shown in Figure 15 and suggests a crash pattern of left-turns from VT 100 being broadsided by eastbound through traffic on US 2. This may be due to the poor level of service for VT 100, causing drivers to accept a smaller (and less safe) gap in traffic before making the turn.



Figure 15: Crash diagram summarizing the findings of the 2006-2010 crash report review¹



4.5 Right of Way and Survey Availability

Top Notch Properties owns land northeast of the intersection and has submitted proposals for projects on this site. Their site engineer, Charles Grenier Consulting Engineers, was contacted to see if the survey data on which the designs are based includes the intersection. The firm responded that they have AutoCad plans (which are compatible with MicroStation) of most of the intersection and could probably supplement any missing information relatively affordably.

The VTrans Right-of-Way Division has provided right-of-way information which was used during alternatives development in Section 6.0.

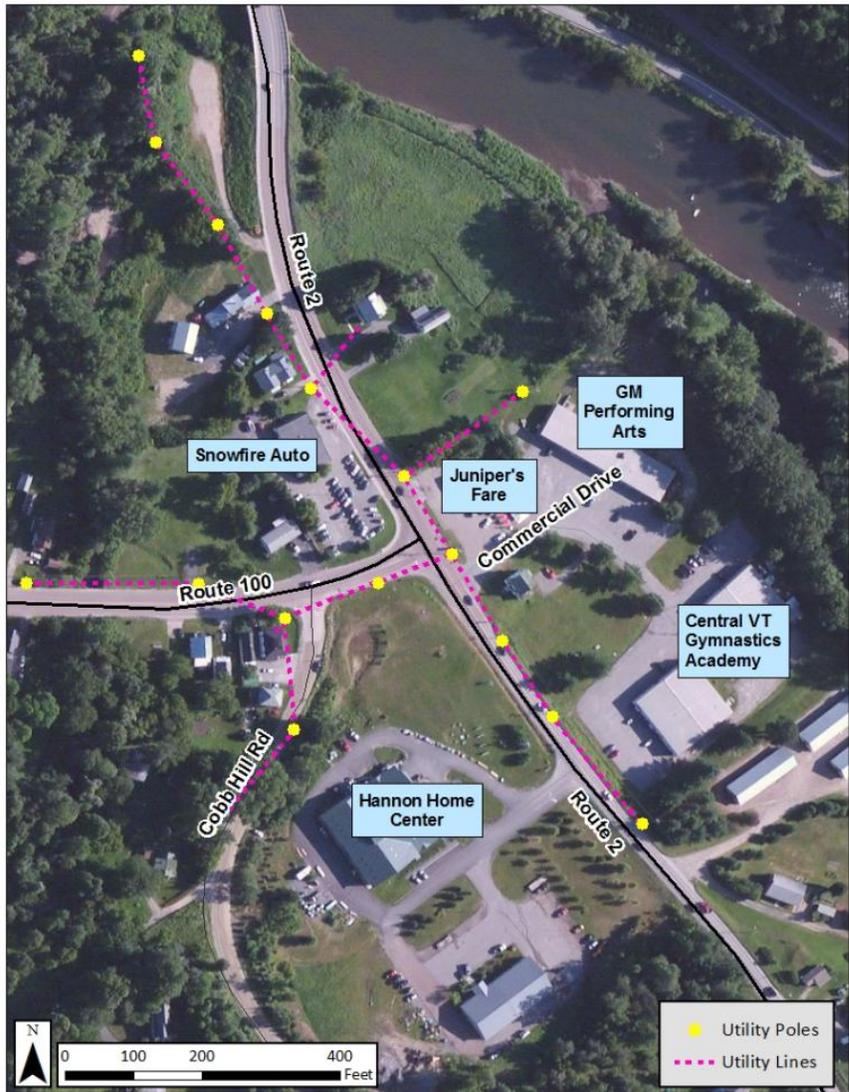
¹ Per VTrans, these data are exempt from discovery or admission under 23 U.S.C. 409.



4.6 Drainage and Utilities

Figure 16: Overhead utilities

Roadway drainage appears to be sheet flow into adjacent ditches; no catch basins were observed. Overhead utilities and poles are shown in Figure 16. There is a cobra-head street light affixed to a utility pole in front of Juniper's Fare and one adjacent to Snowfire Auto. Approximately 800' north of the intersection, US 2 crosses the Winooski River. There is a smaller bridge on VT 100 about 500' west of the intersection. The VTrans Utilities Division was contacted for any known issues, but they are not aware of any existing problems at the intersection.



4.7 Existing Conditions Summary

The following existing issues should be addressed by the proposed intersection improvements:

- Lack of pedestrian facilities.
- There is support for improving bicycle and pedestrian facilities at the intersection, and for implementing the CBMS bike/ped path.
- Local town plans encourage management of access, such as sharing driveways.
- Pattern of broadside crashes in which left-turns from VT 100 are hit by eastbound through traffic on US 2.



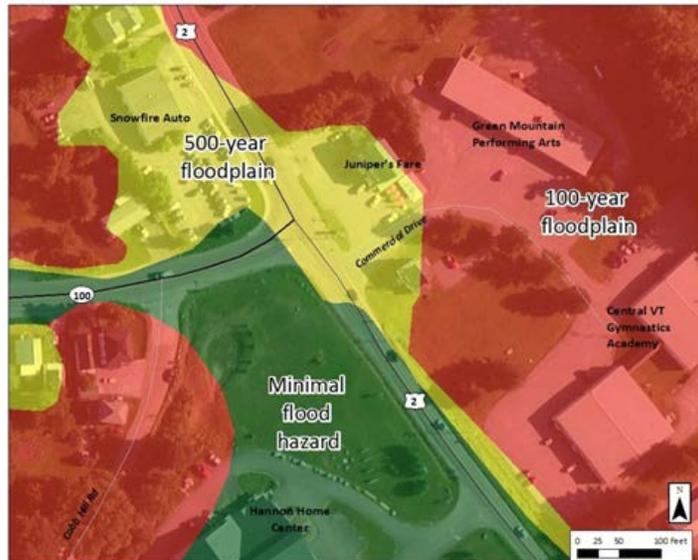
5.0 ENVIRONMENTAL AND CULTURAL RESOURCES

The study area was examined for potential environmental, natural, and cultural resource impacts based on site assessments and existing GIS resource data. This preliminary resource assessment should be revisited during design.

Flood Zones

2009 preliminary flood zones are shown in Figure 17. The base floodplain is shown in red and depicts the extent of the 100-year flood, or the flood which has a 1% chance of being equaled or exceeded in any given year. The yellow area depicts the extents of the 500-year flood which has a 0.2% chance of occurring in any given year. As shown, the intersection is within the 500-year floodplain.

Figure 17: 2009 Preliminary flood zones



Wetlands

Based on the Vermont Significant Wetlands Inventory, there is one significant wetland between the Commercial Drive site and the Winooski River (Figure 18).

Historic and Archeological Resources

The State Historic Preservation Office was contacted for input to the study and any potential issues to include, but has not had any comment. Final plans will need to be reviewed by the State Historic Preservation Officer to determine whether any potentially sensitive historic properties are impacted.

Hazardous Waste Sites

Based on the Vermont Agency of Natural Resource's Environmental Interest Locator, there is one hazardous waste generator on the Snowfire Auto property. There is no

Figure 18: Wetlands near study area



indication of additional hazardous waste sites or underground storage tanks.

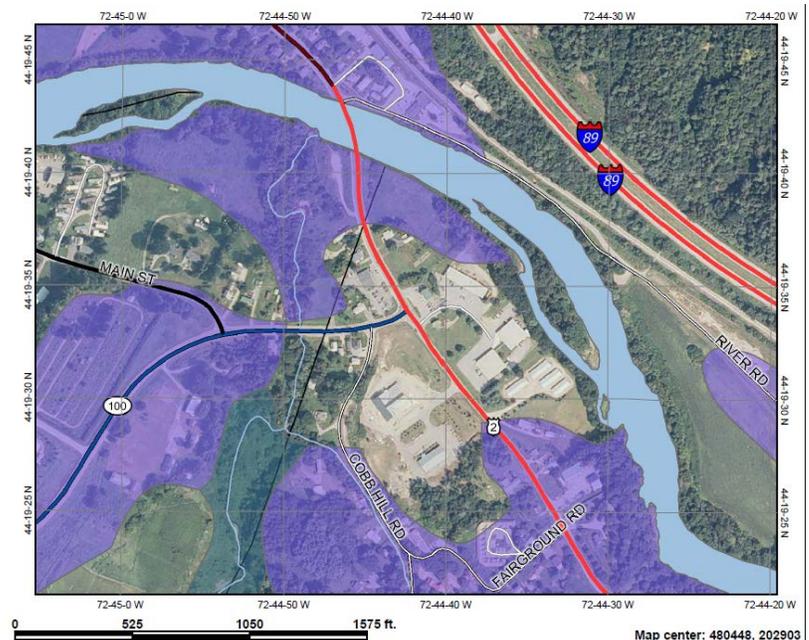
Prime Agricultural Soils

The closest Prime Agricultural Soils to the intersection (as surveyed by the Natural Resource Conservation Service) are approximately 300' west of the intersection (shown in purple in Figure 19). In addition, the area surrounding the intersection is pre-disturbed land and reversion to agricultural uses is unlikely.

Rare, Threatened or Endangered Species and Significant Communities

Based on the Vermont Agency of Natural Resource's Environmental Interest Locator there are no significant communities, rare, threatened or endangered species, nor deer wintering areas.

Figure 19: Prime agricultural soils



6.0 ALTERNATIVES

Three alternative concepts for improving the intersection to address the identified needs are discussed in this section.

6.1 Base Improvements

As the three alternatives evolved, a list of basic improvements develop which should be pursued regardless of which alternative is selected. These include:

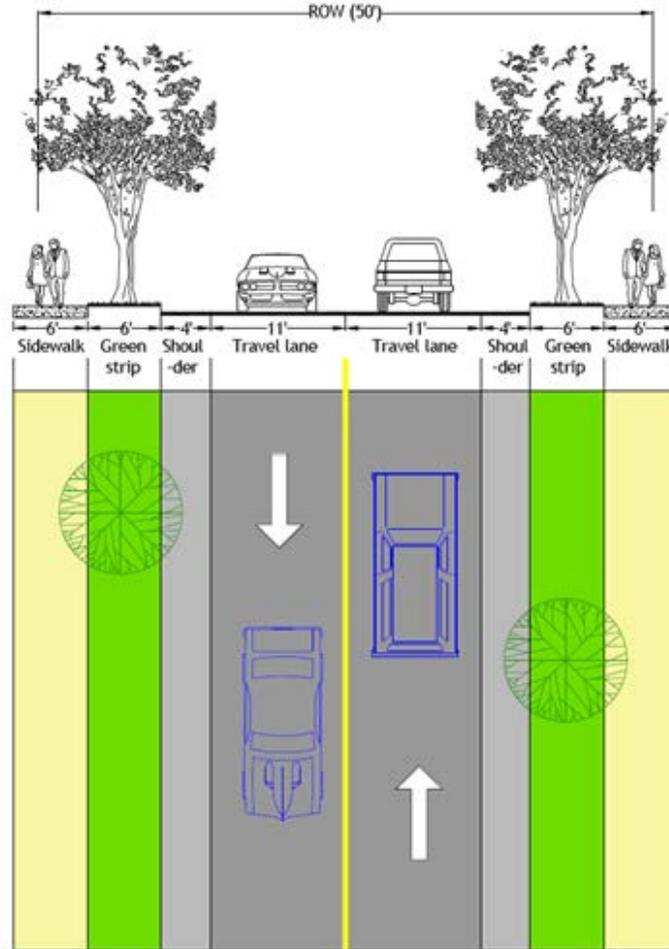
- Enhancing the intersection as a gateway to create a sense of place and calm traffic (which will also improve safety and conditions for bicycles and pedestrians).
- Constructing the proposed Crossett Brook Middle School path between the school and the intersection.
- Realigning Commercial Drive so that it is directly across from VT 100 (to reduce vehicle conflicts).
- Adding crosswalks on the VT 100 and eastbound US 2 approaches.
- Formalizing the right-turn lane on VT 100.
- Adding a sidewalk on the east side of US 2 north from Juniper's Fare. (Eventually, the sidewalk would extend over the bridge, which appears to be wide enough to accommodate 5' sidewalks on each side, two 11' travel lanes, and two 4' shoulders/bike lanes. However, any changes beyond re-striping will require engineering to determine whether the bridge can support a new sidewalk.)



- Adding a sidewalk on the south side of VT 100 to connect the intersection to Cobb Hill Road. (This sidewalk would extend to the end of the pavement on Cobb Hill Road.)
- Planting trees and other landscaping to enhance the area, make it more pedestrian-friendly, and calm traffic.
- Closing the northern Juniper's Fare access to reduce vehicle turning movements and improve safety.

Figure 20: Proposed cross-section

Given these improvements, a typical section for the roadways approaching the intersection (not including turn lanes) is shown in Figure 20.



6.2 Alternative Concepts

A four-way stop was originally considered as a preliminary alternative, but was discarded after discussions with VTrans because:

- US 2 is rarely stop-controlled in Vermont, so putting a stop-sign on US 2 is likely to be unexpected for drivers and may lead to an unsafe situation.
- The intersection does not meet MUTCD warrants for a four-way stop. (See Appendix B: Four-Way Stop Warrant Analysis.)
- It did not perform well in terms of traffic delay and queuing when modeled under various scenarios (further described in the AM and PM peak hour LOS and queuing results).

Therefore, this alternative was replaced with one that included a traffic signal and turn lanes, as described below.

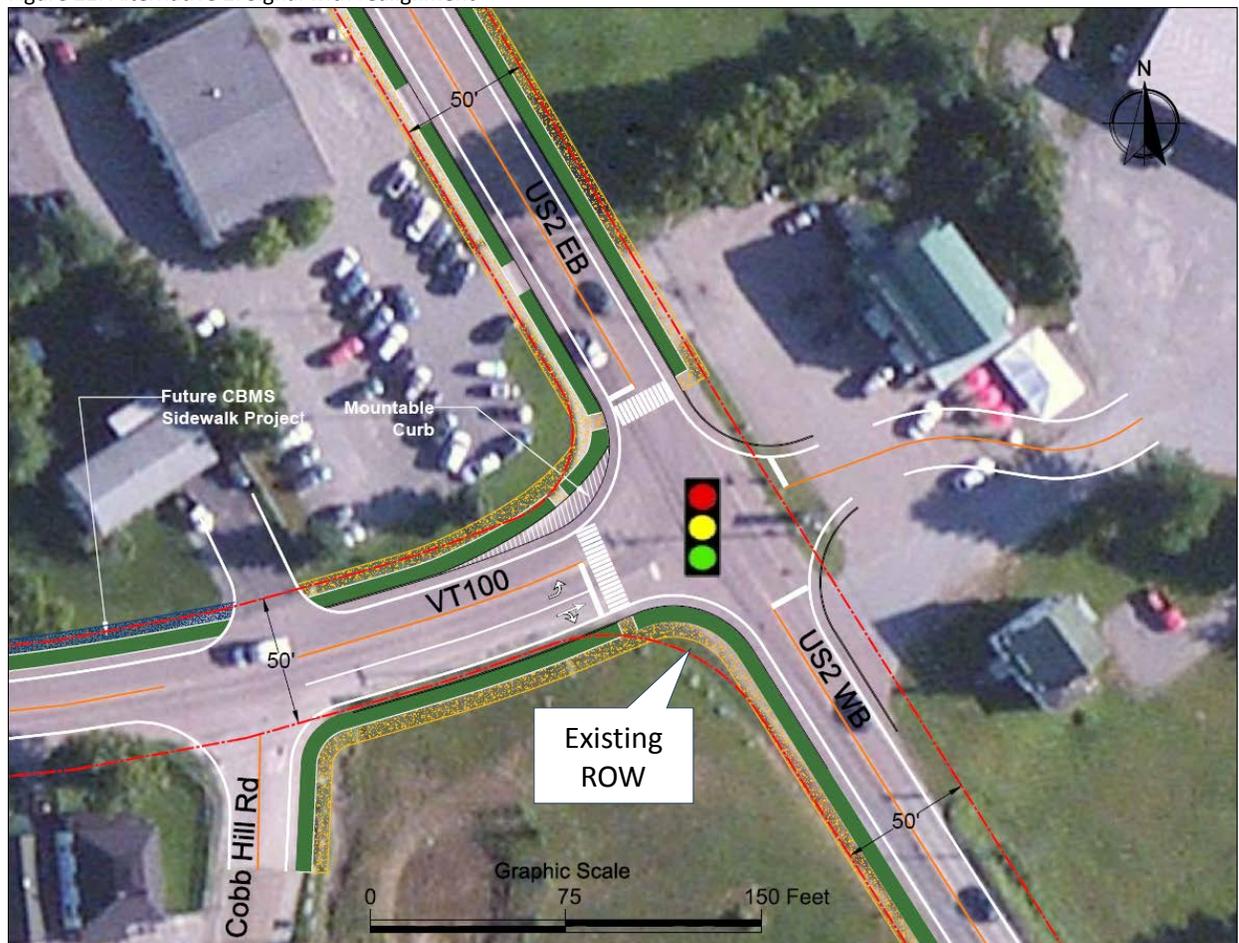


6.2.1 Signal

Alternative 1 involves installing a traffic signal and realigning Commercial Drive, as shown in Figure 21. Also shown are the base improvements of new crosswalks, sidewalks, and a greenstrip/landscape buffer, which would require additional right-of-way width. The realignment of Commercial Drive impacts the outdoor seating area on the south side of Juniper's Fare. The northwest corner of the intersection (where tire marks were observed on the sidewalk) was redesigned to distance pedestrians from vehicle traffic, and with tighter radius and mountable curb to discourage high-speed turns while accommodating large trucks (WB-67).

Based on 2006 VTrans data adjusted to 2012 and including the traffic from proposed developments, only one (the Four Hour Vehicle Volume Warrant) of the eight signal warrants was met in the analysis (see Appendix C: Signal Warrant Analysis).

Figure 21: Alternative 1: Signal with realignment

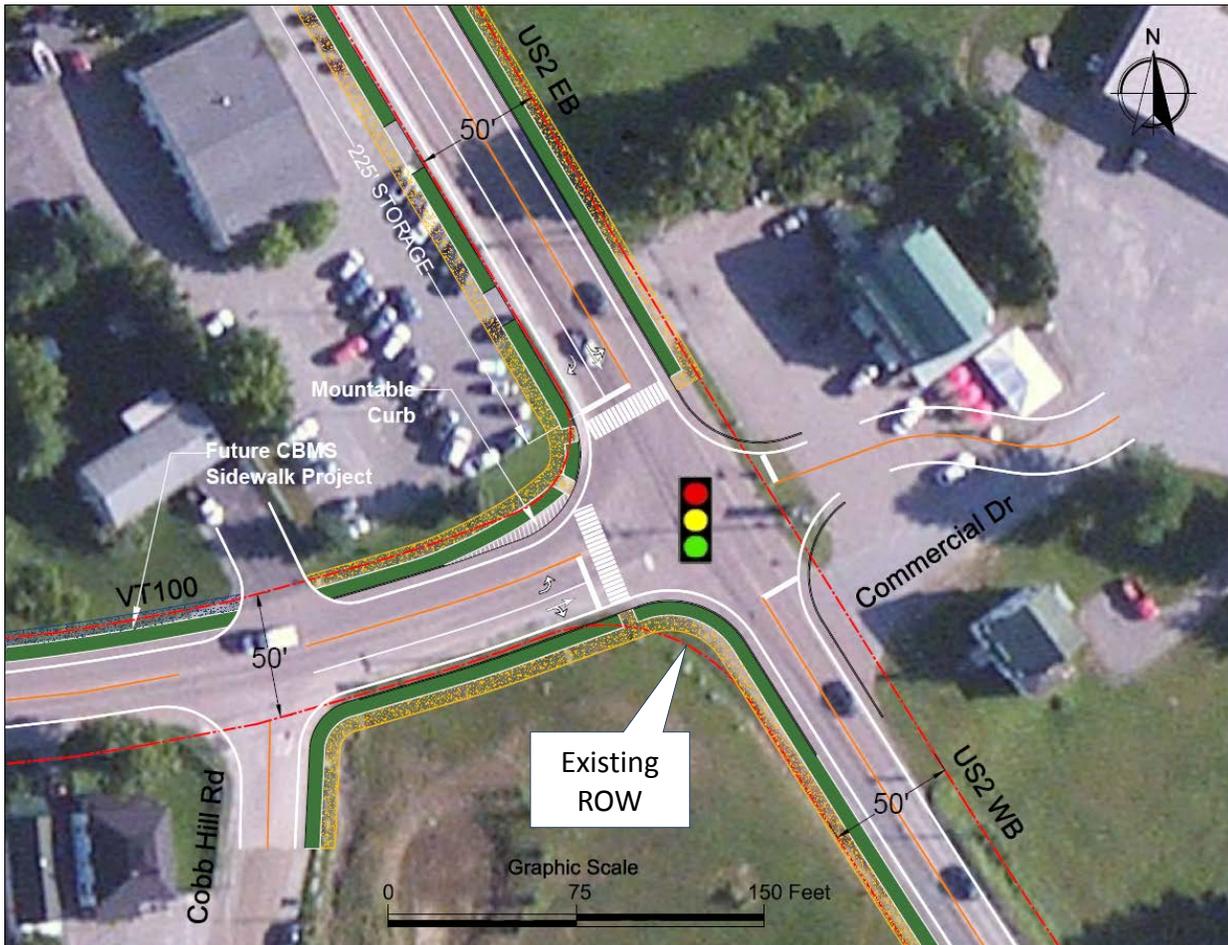


6.2.2 Signal with turn lane

Alternative 2 builds upon Alternative 1 by adding a right-turn lane on eastbound US 2, as shown in Figure 22. The turn lane warrant (Appendix D: Turn Lane Guidelines for Signalized Intersection) for a right-turn lane from eastbound US 2 onto VT 100 is met under existing conditions during the PM peak hour.¹

This alternative consumes slightly more right-of-way than Alternative 1 on the US 2 eastbound approach. One of the disadvantages of this alternative is that the additional lane extends the crossing distance for and exposure of pedestrians.

Figure 22: Alternative 2: Signal with turn lane



¹ Although the warrant analysis was met for left-turn lane for the US 2 westbound approach as well, the guidelines in NCHRP 457 "Evaluating Intersection Improvements" suggests that it is not needed since the left turn volume is less than the threshold of 100 veh/h (pp.40).

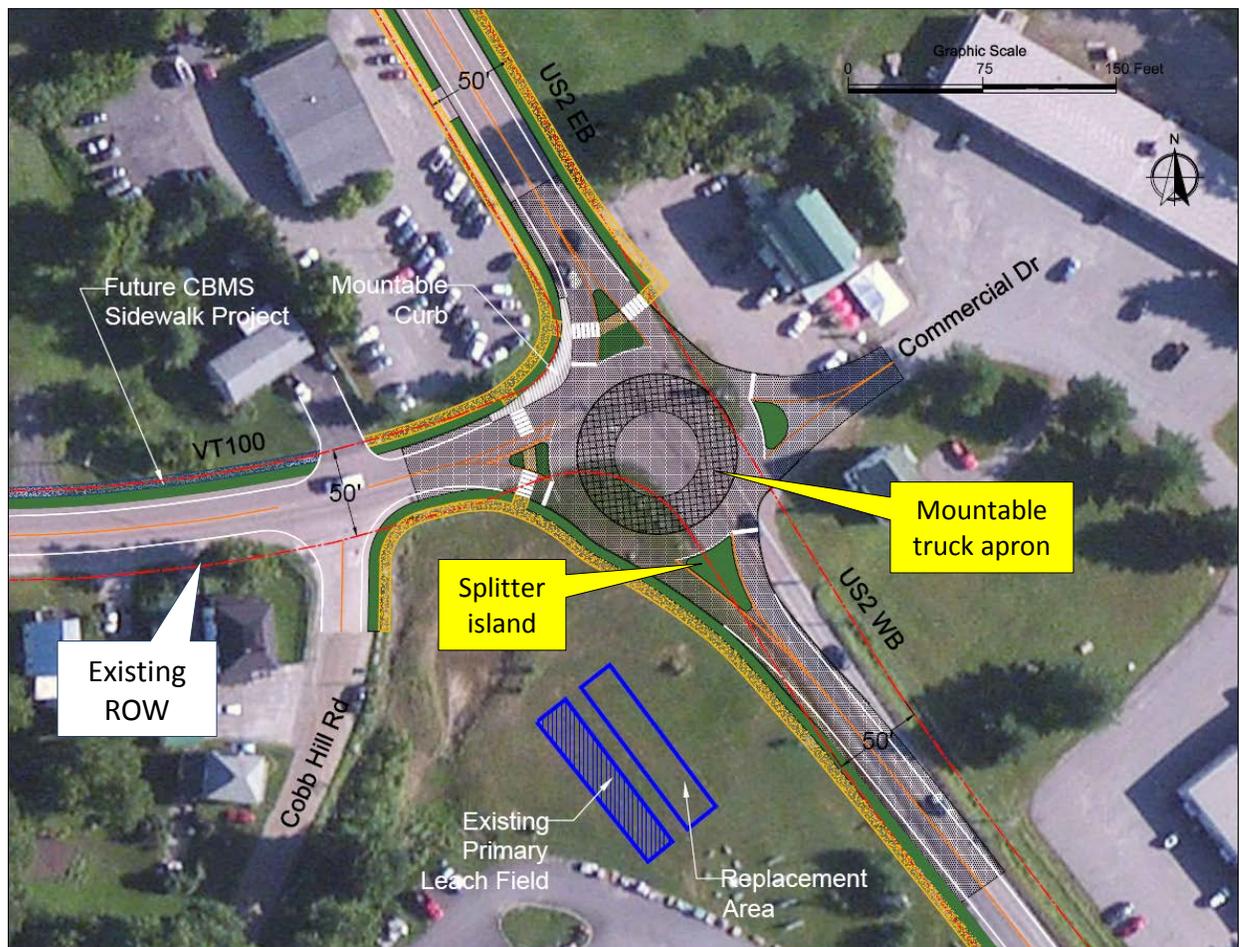


6.2.3 Roundabout

The roundabout alternative is shown in Figure 23. The major concern with this alternative is the amount of right-of-way needed. Given the existing land uses and traffic patterns, the inner circle was centered slightly towards the southwest corner of the intersection, resulting in the biggest property impact occurring to Hannon Home Center. The Home Center's site plans were checked to determine whether the roundabout would impact the property's current leach fields, but it does not. Hannon is, however, planning for new leach fields which would be located closer to the intersection corner, increasing the potential for interference from the roundabout. It has been suggested that Waterbury Village extend its sewer system south of the river to serve the properties adjacent to the intersection; therefore, leach fields would not be needed and would not present an obstacle to the roundabout.

This alternative does not require that Commercial Drive be realigned, since it eliminates conflicting vehicle movements. As noted in the base improvements, the northern access to Juniper's Fare would be closed. Truck and bicycle/pedestrian accommodations are included in this conceptual design. The roundabout alternative has the added benefits of being the safest of the three alternatives and providing an effective gateway for the area. (Additional information is provided in Appendix E: Roundabout Benefits)

Figure 23: Alternative 3: Roundabout



6.3 Performance

The major unknown during the majority of this study was the future of the State Office Complex in Waterbury. The decision has been made to reuse the site with a mix of state offices and residential and commercial uses. VTrans has collected 12-hour turning movement counts every two years since 2002, which reflect the traffic generated from the 1,500 State Office Complex employees, and this is anticipated to be similar to the future reuse.

6.3.1 Traffic Volumes

Bridge construction during the 2010 VTrans count created temporary traffic detours and patterns which do not typically exist. Therefore, VTrans' 12-hour turning movement count from June 2006 was used for this analysis. Based on this count, the AM peak hour is 7:15 AM-8:15 AM, while the PM peak hour is 4:30 PM-5:30 PM. Both AM and PM peak hours are analyzed.

The peak hour traffic volumes are adjusted to represent the design hour volume (DHV)¹ in the 2017 base year using two adjustment factors:

1. Design hour adjustment factors are based on VTrans short term counter S6W349, located on US 2 in Waterbury between Demeritt Place and River Road.² The count revealed a higher peak hour volume than the DHV prescribed by the VTrans Methodology (that is, the calculated DHV adjustment factor was less than one). To be conservative, the volumes are analyzed without being adjusted to the lower DHV.
2. An annual adjustment factor, which represents general background traffic growth, is based on estimated growth in the area. According to the *VTrans Continuous Traffic Counter Grouping Study and Regression Analysis*, the annual adjustment factor to 2012 for a rural area is 1.01.

Other development volumes (ODVs) represent trips generated by developments in the study area which are not accounted for in the VTrans counts. Trips generated by ODVs are typically included in the base scenario because we assume they are present on the road network in the analysis years. We have included Hannon Home Center (built after the 2006 counts), Duxbury State Farm (Phase 1), and the Family Dollar discount store. (Phase 2 of Duxbury State Farm is included in an alternate future scenario as discussed below.)

A traffic impact study was not available for Green Mountain Performing Arts which opened behind Juniper's Fare Restaurant on January 16, 2012; the class schedule indicates that in each of the two studios, one class ends and one class begins between 4:30 and 5:30. Assuming 20 students per class, this would result in 40 students getting picked up and 40 students getting dropped off between 4:30 and 5:30. To be conservative, we assume 2 vehicle trips for each student (one entering, one exiting). Since the earliest class starts at 9:30, no trips are expected in the AM peak hour.

RSG conducted a spot count of the entering and exiting volumes at Commercial Drive during the peak hour on Monday, January 9, 2012 to develop an understanding of the impact of the Central Vermont Gymnastics Academy development. PM peak hour volumes associated with the Academy are included in this count. No trips associated with this development are expected in the AM peak hour.

¹ The DHV is the 30th highest hour of traffic for the year and is used as the design standard in Vermont.

² Typically, continuous traffic counters, which collect data year round, are used in calculating the design hour adjustment factors. It was determined that there were no appropriate continuous traffic counters, so VTrans short term counters were used instead, as prescribed in the *VTrans Traffic Impact Study Guidelines*.



Figure 24 shows the 2017 AM and PM volumes used for this base year analysis; these volumes represent the 2006 VTrans turning movement count adjusted to 2017 with ODVs. Figure 25 and Figure 26 show the 2022, 2032, and 2032a (2032 with Duxbury State Farm Phase 2) AM and PM volumes for the future conditions.

Figure 24: 2017 AM & PM volumes

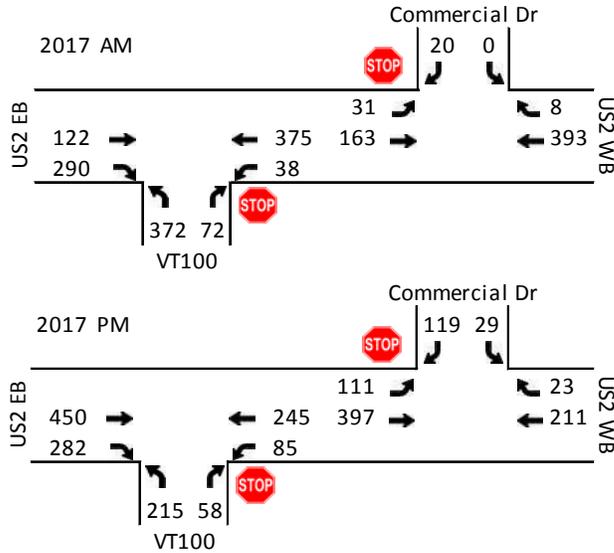


Figure 25: 2022, 2032, and 2032a AM volumes

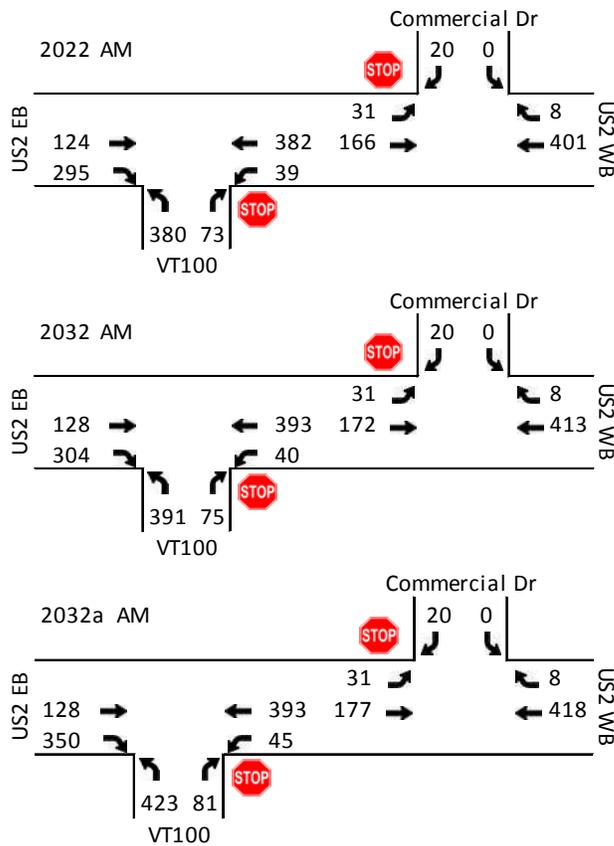
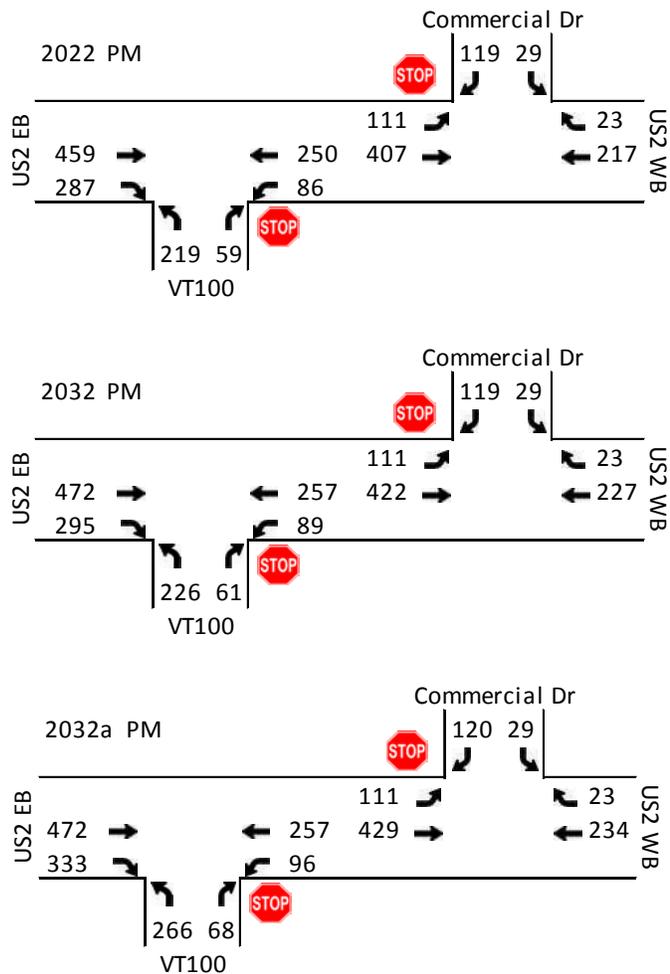


Figure 26: 2022, 2032, and 2032a PM volumes



6.3.2 Congestion Analysis

Level-of-Service Definition

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 2010 *Highway Capacity Manual*. In addition to traffic volumes, key inputs include the number of lanes at each intersection and the traffic signal timing plans. LOS results are based on the existing lane configurations and control types (signalized or unsignalized) at each study intersection.

The 2010 *Highway Capacity Manual* (HCM) defines six qualitative grades to describe the LOS at an intersection. LOS is based on the average control delay per vehicle. Table 1 shows the various LOS grades and descriptions for signalized and unsignalized intersections.



Table 1: Level-of-Service Criteria for Signalized and Unsignalized Intersections

LOS	Characteristics	Unsignalized	Signalized
		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.

The VTrans policy on level of service is:

- Overall LOS C should be maintained for state-maintained highways and other streets accessing the state’s facilities
- Reduced LOS may be acceptable on a case-by-case basis when considering, at minimum, current and future traffic volumes, delays, volume to capacity ratios, crash rates, and negative impacts as a result of improvement necessary to achieve LOS C.
- LOS D should be maintained for side roads with volumes exceeding 100 vehicles/hour for a single lane approach (150 vehicles/hour for a two-lane approach) at two-way stop-controlled intersections.

Level-of-Service Results (2017, 2022, and 2032)

The HCM reports from Synchro (v8), a traffic analysis software package from Trafficware, were used to assess congestion at the study intersections. Table 2 and Table 3 present the LOS results during the weekday AM and PM peak hours. The volume-to-capacity ratio (v/c) is also shown, indicating the ratio of the hourly traffic flow rate to the capacity of the given lane group to process vehicles. A ratio of 1.0 (or higher) indicates the facility is at (or over) capacity for the study period.

The No Build scenario shows conditions if no changes were made, and basically reflects two separate intersections (US 2-VT 100 and US 2-Commercial Drive). The “2032a” scenario is the 2032 scenario with traffic from Phase 2 of the Duxbury State Farm project added in.

As shown in the tables, in 2017 the northbound VT 100 approach operates at LOS F in both AM and PM peak hours and the AM peak hour traffic volumes are close to the capacity. US2 eastbound and westbound approaches operate at LOS A during both AM and PM peak hours. The Commercial Drive access is acceptable.

The signal (Alternative 1) improves performance, but during the PM peak hour queuing is still excessive on the eastbound US 2 approach and VT 100 continues to have the longest delays, even reaching LOS E in the 2032a scenario with Duxbury State Farm Phase 2 traffic.

The signal with the US 2 right-turn lane (Alternative 2) further improves performance, but there are still long queues on some approaches in nearly all the scenarios.

The roundabout (Alternative 3) slightly improves performance compared to Alternative 2.



Table 2: AM peak hour LOS and queuing results

	AM															
	2017				2022				2032				2032a			
	LOS	Delay (s)	Q. Length (# vehs)	v/c	LOS	Delay (s)	Q. Length (# vehs)	v/c	LOS	Delay (s)	Q. Length (#)	v/c	LOS	Delay (s)	Q. Length (#)	v/c
No Build																
EB Thru/RT, US2	A	0	0	0	A	0	0	0.00	A	0	0	0.00	A	0	0	0.00
WB LT/Thru, US2	A	8	1	0.03	A	8	1	0.03	A	8	1	0.04	A	8	1	0.04
NB LT, VT100	F	74	>10	0.98	F	85	>10	>1	F	>100	>10	>1	F	>100	>10	>1
NB RT, VT100	B	10	1	0.09	B	10	1	0.10	B	10	1	0.10	B	11	1	0.06
US2/Commercial Dr.																
EB LT/Thru, US2	A	1	-	-	A	1	-	-	A	1	-	-	A	1	-	-
WB Thru/RT, US2	A	0	-	-	A	0	-	-	A	0	-	-	A	0	-	-
SB LT/RT, Commercial Dr.	B	11	-	-	B	11	-	-	B	11	-	-	B	11	-	-
Four-way Stop Control																
Overall	D	26	-	-	D	29	-	-	D	33	-	-	-	-	-	-
EB LT/Thru/RT, US2	C	23	7	0.69	C	25	8	0.71	D	28	9	0.75	-	-	-	-
WB LT/Thru/RT, US2	D	25	8	0.72	D	28	9	0.74	D	31	>10	0.77	-	-	-	-
NB LT, VT100	E	35	>10	0.78	E	39	13	0.80	E	46	>10	0.83	-	-	-	-
NB Thru/RT, VT100	B	10	1	0.13	B	10	1	0.13	B	10	1	0.14	-	-	-	-
SB LT/Thru/RT, Commercial Dr	B	11	1	0.04	B	11	1	0.04	B	11	1	0.04	-	-	-	-
Signal																
Overall	B	12	-	-	B	12	-	-	B	13	-	-	B	15	-	-
EB LT/Thru/RT, US2	B	12	5	0.56	B	12	5	0.58	B	13	5	0.59	B	16	7	0.66
*WB LT/Thru/RT, US2	B	11	10	0.66	B	11	10	0.68	B	12	10	0.70	B	13	>10	0.74
*NB LT, VT100	B	13	10	0.76	B	13	10	0.77	B	14	>10	0.78	B	16	>10	0.80
NB Thru/RT, VT100	A	9	1	0.12	A	9	1	0.12	A	9	1	0.12	B	10	2	0.12
SB LT/Thru/RT, Commercial Dr	A	9	1	0.03	A	9	1	0.03	A	9	1	0.03	A	10	1	0.03
Signal w/Turn Lane																
Overall	B	11	-	-	B	11	-	-	B	12	-	-	B	13	-	-
EB LT/Thru, US2	A	9	3	0.22	A	9	3	0.22	A	9	3	0.23	B	10	7	0.24
EB RT, US2	B	11	3	0.41	B	12	3	0.41	B	12	3	0.42	B	14	7	0.47
*WB LT/Thru/RT, US2	B	12	10	0.66	B	12	>10	0.68	B	12	>10	0.70	B	13	>10	0.73
*NB LT, VT100	B	12	10	0.73	B	12	10	0.74	B	13	>10	0.75	B	13	>10	0.77
NB Thru/RT, VT100	A	9	1	0.11	A	9	1	0.12	A	9	1	0.12	A	9	2	0.12
SB LT/Thru/RT, Commercial Dr	A	8	1	0.03	A	8	1	0.03	A	8	1	0.03	A	9	1	0.03
Roundabout																
Overall	A	9	-	-	A	9	-	-	A	10	-	-	B	10	-	-
EB LT/Thru/RT, US2	A	6	3	0.34	A	6	3	0.34	A	6	3	0.35	A	7	4	0.39
WB LT/Thru/RT, US2	B	14	5	0.55	B	14	5	0.57	B	15	6	0.59	B	16	6	0.62
NB LT/Thru/RT, VT100	A	8	3	0.41	A	8	3	0.42	A	8	4	0.43	A	9	4	0.47
SB LT/Thru/RT, Commercial Dr	A	7	1	0.04	A	7	1	0.04	A	8	1	0.04	A	8	1	0.04

2032a is the 2032 scenario with traffic generated by Phase 2 of the Duxbury State Farm project.



Table 3: PM peak hour LOS and queuing results

	PM															
	2017				2022				2032				2032a			
	LOS	Delay (s)	Q. Length (# vehs)	v/c	LOS	Delay (s)	Q. Length (# vehs)	v/c	LOS	Delay (s)	Q. Length (# vehs)	v/c	LOS	Delay (s)	Q. Length (# vehs)	v/c
No Build																
EB Thru/RT, US2	A	0	0	0.00	A	0	0	0.00	A	0	0	0.00	A	0	0	0.00
WB LT/Thru, US2	A	10	1	0.10	A	10	1	0.10	A	10	1	0.10	A	10	1	0.12
NB LT, VT100	F	76	8	0.89	F	86	9	0.93	F	>100	10	>1	F	>100	>10	>1
NB RT, VT100	B	13	1	0.11	B	13	1	0.12	B	13	1	0.12	B	14	1	0.14
US2/Commercial Dr.																
EB LT/Thru, US2	A	2	-	-	A	2	-	-	A	2	-	-	A	2	-	-
WB Thru/RT, US2	A	0	-	-	A	0	-	-	A	0	-	-	A	0	-	-
SB LT/RT, Commercial Dr.	B	13	-	-	B	13	-	-	B	14	-	-	B	13	-	-
Four-way Stop Control																
Overall	F	66	-	-	F	66	-	-	F	67	-	-	-	-	-	-
EB LT/Thru/RT, US2	F	>100	>10	>1	F	>100	>10	>1	F	>100	>10	>1	-	-	-	-
WB LT/Thru/RT, US2	B	15	3	0.43	C	15	3	0.45	C	16	3	0.47	-	-	-	-
NB LT, VT100	C	18	3	0.47	C	18	3	0.48	C	19	3	0.50	-	-	-	-
NB Thru/RT, VT100	B	10	1	0.11	B	11	1	0.11	B	11	1	0.12	-	-	-	-
SB LT/Thru/RT, Commercial Dr.	B	13	2	0.29	B	13	2	0.29	B	13	2	0.29	-	-	-	-
Signal																
Overall	C	20	-	-	C	21	-	-	C	23	-	-	D	36	-	-
EB LT/Thru/RT, US2	C	23	>10	0.83	C	24	>10	0.84	C	27	>10	0.86	D	38	>10	0.91
*WB LT/Thru/RT, US2	A	8	4	0.3	A	8	4	0.31	A	8	4	0.33	A	8	4	0.34
*NB LT, VT100	C	27	8	0.67	C	28	8	0.68	C	30	8	0.70	E	73	10	0.80
NB Thru/RT, VT100	B	17	2	0.14	B	17	2	0.14	B	18	2	0.15	B	18	2	0.16
SB LT/Thru/RT, Commercial Dr.	B	18	8	0.34	B	19	3	0.33	B	19	3	0.33	B	19	3	0.33
Signal w/Turn Lane																
Overall	B	11	-	-	B	11	-	-	B	12	-	-	B	15	-	-
EB LT/Thru, US2	B	11	>10	0.53	B	11	>10	0.54	B	8	>10	0.67	B	14	10	0.68
EB RT, US2	A	9	2	0.3	A	9	2	0.30	A	9	2	0.35	B	11	2	0.39
*WB LT/Thru/RT, US2	A	9	4	0.28	A	9	4	0.29	A	9	4	0.36	B	12	5	0.39
*NB LT, VT100	B	15	7	0.62	B	16	7	0.63	B	17	7	0.68	C	27	10	0.76
NB Thru/RT, VT100	B	11	2	0.12	B	11	2	0.12	B	11	2	0.13	B	13	2	0.13
SB LT/Thru/RT, Commercial Dr.	B	11	3	0.29	B	12	3	0.29	B	12	3	0.29	B	13	3	0.28
Roundabout																
Overall	A	10	-	-	B	10	-	-	B	11	-	-	B	12	-	-
EB LT/Thru/RT, US2	B	11	6	0.62	B	11	7	0.63	B	12	7	0.65	B	13	8	0.69
WB LT/Thru/RT, US2	A	8	2	0.29	A	8	2	0.30	A	8	2	0.31	A	9	3	0.34
NB LT/Thru/RT, VT100	B	10	3	0.38	B	10	3	0.39	B	11	3	0.41	B	13	4	0.49
SB LT/Thru/RT, Commercial Dr.	A	7	1	0.19	A	7	2	0.19	A	7	2	0.20	A	7	2	0.21

2032a is the 2032 scenario with traffic generated by Phase 2 of the Duxbury State Farm project.

6.4 Evaluation Matrix

The three alternatives are compared in the Evaluation Matrix in Figure 27. This matrix summarizes each alternative’s impacts, permit needs and cost estimates (details are provided in Appendix F: Cost Estimates). Each alternative is estimated to cost almost \$1 million.

The numerous safety benefits of roundabouts are discussed in Appendix E: Roundabout Benefits. Alternative 2 has a “potential” hazardous material impact because of its encroachment on the SnowFire site, which was identified as a hazardous waste generator; but as the impact would be on the edge of the property, this is not likely to be an issue (but would still need to be confirmed).

All three alternatives have significant property impacts: both signal alternatives involve the realignment of Commercial Drive and would require the relocation of Juniper’s Fare’s outdoor seating. The roundabout’s impact is focused on the Hannon Home Center parcel, but does not interfere with the site’s leach fields.



The roundabout best addresses traffic performance; vehicle, bicycle, and pedestrian safety; and community character and the potential to create a gateway.

Figure 27: Evaluation matrix

	Alternative 1: Signal	Alternative 2: Signal with Turn Lane	Alternative 3: Roundabout	
COST (order of magnitude)	Preliminary Cost Estimate (final design, construction, inspection, contingency)	\$990,000	\$1,050,000	\$1,170,000
	Annual Maintenance Costs	\$49,500	\$52,500	\$58,500
ENGINEERING	Traffic Safety	Improved	Improved	Significantly improved
	Level of Service/Congestion	Improved	Significantly improved	Significantly improved
	Roadway Alignment Change	Commercial Drive realigned	Commercial Drive realigned	Minor US 2 realignment
	Bicycle/Pedestrian Access	Improved	Improved	Improved
	Hydraulic Performance	Improved	Improved	Improved
IMPACTS	Agricultural Lands	No	No	No
	Archaeological	No	No	No
	Hazardous Materials	No	Potential	No
	Historic Structures/Sites	No	No	No
	Floodplain	No change	No change	No change
	Fish and Wildlife	No	No	No
	Rare, Threatened & Endangered Species	No	No	No
	Public Lands	No	No	No
	Noise	No	No	No
	Right-of-Way/Property	Significant (Juniper's Fare)	Significant (Juniper's Fare)	Significant (Hannon Home Center)
Utility	Utility pole relocation	Utility pole relocation	Utility pole relocation	
Wetlands	No	No	No	
LOCAL & REGIONAL ISSUES	Community Character	Improved	Improved	Significantly improved
	Conformance to Regional Transportation Plan	Yes	Yes	Yes
	Economic Impacts	Improved	Improved	Improved
	Local Concerns	Improved	Improved	Significantly improved
	Satisfies Purpose & Need	Yes	Yes	Yes
PERMITS	Act 250	No	No	No
	401 Water Quality	No	No	No
	404 Corps of Engineers Permit	No	No	No
	Stream Alteration	No	No	No
	Conditional Use Determination	Potential	Potential	Potential
	Storm Water Discharge	Potential	Potential	Potential
	Shoreland Encroachment	No	No	No
	Endangered & Threatened Species	No	No	No
	State Historic Preservation Office Clearance	No	No	No
Categorical Exclusion	Potential	Potential	Potential	



7.0 RECOMMENDATIONS

The study recommendations focus on the intersection’s role as a gateway to Moretown, Waterbury, and Duxbury; improving pedestrian safety and walkability; improving intersection performance and safety for vehicle traffic; and the selected alternative of a roundabout, which satisfies each of these areas most effectively.

An important part of implementing the recommendations is determining the appropriate contribution that related developments should make to the improvements given their project’s impacts to the intersection. Currently, the development which triggers the permit thresholds ends up paying for transportation infrastructure improvements to accommodate growth, even though projects before it have incrementally increased traffic volumes as well. In other words, later projects end up paying to mitigate predecessors’ impacts as well as their own. In response, a fair share cost method could be used to assess transportation impacts, which would be based on the amount of traffic that a project generates regardless of when the project is proposed or the current level of traffic at an intersection or on a roadway. This way, district environmental commissions and VTrans can ensure that all development proposals contribute a fair share towards transportation projects that will be necessary to accommodate growth.

It is likely that this method would be based on daily traffic counts, but for the sake of illustration, Table 4 shows that in 2032, approximately 6% of the AM and PM peak hour intersection volumes (combined) would be related to Phase 2 of the Duxbury State Farm project.

Table 4: Portion of total intersection volume attributed to related developments in 2032

	Contribution to 2032 AM and PM peak hour traffic, combined
Hannon Home Center	2.0%
Family Dollar	1.3%
Commercial Drive businesses*	5.8%
Duxbury State Farm Phase 1	0.5%
Duxbury State Farm Phase 2	5.8%
SnowFire	To Be Determined
Crossett Brook Middle School	To Be Determined
Green Mountain Coffee Roasters	To Be Determined
State Office Complex	To Be Determined
* This estimate is based on Juniper's Fare and Green Mountain Performing Arts, and does not take into account other business within the Commercial Drive development.	

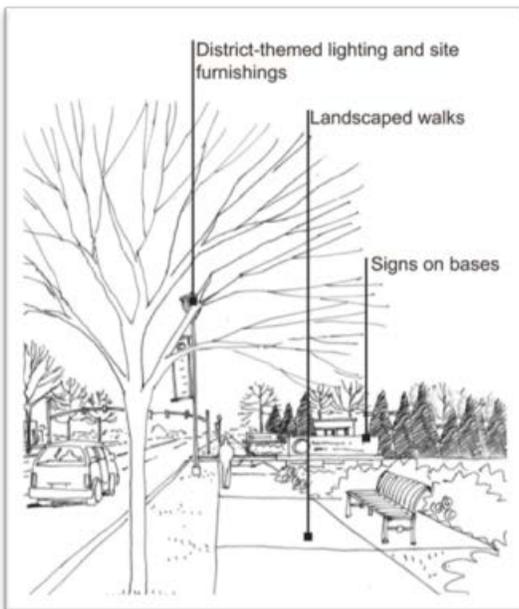


7.1 Gateway

Recreating the intersection as a gateway to Moretown, Waterbury, and Duxbury will serve many functions: it will improve safety by shifting the driver's perspective from the regional context of US 2 to the village setting of the Juniper's Fare/SnowFire/Hannon Home Center area and slowing vehicle speeds. It will also enhance the character of the area as an economically viable, walkable, mixed use community. Even minor improvements like adding a town welcome sign (Figure 28) can play up the intersection's role as a gateway.

More extensive improvements include adding streetscape elements such as curbing and benches, and planting trees and other landscaping to make the area more pedestrian-friendly and calm traffic (Figure 29). Street lighting at the intersection would enhance pedestrian safety and help create a unique identity and consistent image for the intersection. Light levels need to be bright enough to address concerns over safety and visibility but not so bright that the light is overwhelming and uncomfortable for the community. Lighting must be adequate for the roadway while also providing sufficient pedestrian visibility. "Dark sky" light fixtures should be used to limit light pollution.

Figure 29: Example of streetscape elements that improve the pedestrian environment and identify the area as a gateway



streetscape;

- two - three story buildings designed to include varied roof forms and traditional building materials;
- integrated sidewalk network and a pedestrian scale of building development.

Figure 28: Gateway sign



Regulatory tools can also support the intersection's role as a gateway. As suggested by the Moretown Town Plan, the area could be designated as a growth center to encourage a mix of compatible commercial, residential and industrial uses, providing such uses reflect high quality site design characterized by the features such as:

- parking located to the side and rear of buildings;
- shared parking and driveway access wherever possible;
- buildings located close to roads, with entrances and facades oriented toward the road, to create a defined

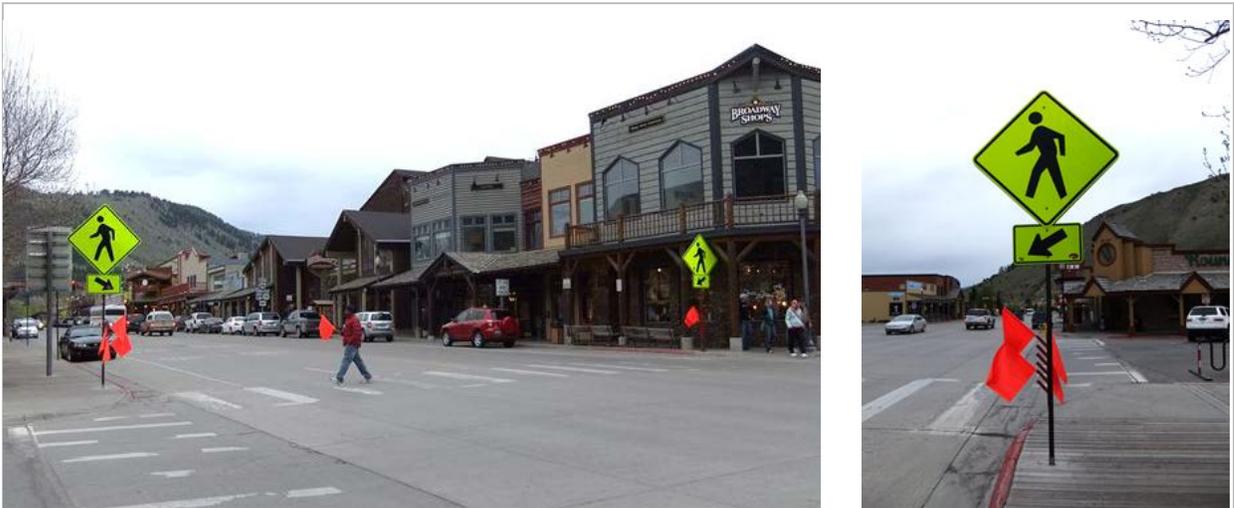


Furthermore, cooperation will be needed to fairly assign responsibility for impacts. The State is currently working on a method to determine fair shares for development impacts.

7.2 Pedestrian Improvements

- Construct the proposed Crossett Brook Middle School path between the school and the intersection.
- Add warning signs to notify drivers of pedestrians.
- Add crosswalks on the VT 100 and eastbound US 2 approaches.
- Add a sidewalk on the east side of US 2 north from Juniper's Fare. (Eventually, the sidewalk would extend over the bridge, which appears to be wide enough to accommodate 5' sidewalks on each side, two 11' travel lanes, and two 4' shoulders/bike lanes. However, any changes beyond re-striping will require engineering to determine whether the bridge can support a new sidewalk.)
- Add a sidewalk on the south side of VT 100 to connect the intersection to Cobb Hill Road. (This sidewalk would extend to the end of the pavement on Cobb Hill Road.)
- Add crosswalk safety enhancements such as rectangular rapid flashing beacons (RRFBs), in-pavement lights, flags (Figure 30), and other design elements as VTrans deems appropriate.

Figure 30: Flags used at crosswalk to alert drivers to pedestrians and increase visibility (example from Jackson, WY)



VTrans provides criteria for the installation of crosswalk on uncontrolled approaches to an intersection (that is, the current condition on US 2); as summarized in Table 5 below, the eastbound/southbound US 2 approach satisfies these criteria, although pedestrian counts may be needed.



Table 5: VTrans criteria for installation of a crosswalk at an uncontrolled approach of an unsignalized intersection¹

Criteria	US 2 Existing Condition
Speedlimit is 40mph or less.	Speed limit on US 2 is 40 mph.
Pedestrian crossing volumes are at least 20 people during AM and PM peak hours (can be less if large percentage of pedestrian population includes young, elderly or disabled pedestrians).	Pedestrian counts and data need to be collected.
Annual Average Daily Traffic (AADT) > 3000 vehicles per day.	2010 AADT for US 2 north of VT 100 = 7,000 2010 AADT for US 2 south of VT 100 = 3,700; 2010 AADT VT 100 = 4,100
There is a sidewalk or adequate shoulder on both sides of road.	There is a sidewalk on the northwest corner of the intersection and proposed on all other corners; also, the pedestrian destination is the Commercial Drive development on the east side of the intersection.
There is not another crosswalk across the same road within 200'.	No crosswalks.
There is adequate sight distance.	The measured sight distances in Section 4.4 confirm that there is adequate sight distance.

Waterbury in Motion, a multi-town bike-ped committee, is considering applying for grants to build a path connecting to Crossett Brook Middle School. The path project is considered in three sections, following the 2002 *Conceptual Alignment Analysis for the Crossett Brook Middle School*, which is provided on the next page for reference.

1. For the section of VT 100 between US 2 and Lower Main Street, there would be a sidewalk on one side (which side is still to be determined) of VT 100.
2. For the section of VT 100 from Lower Main Street to the cemetery access road, there would either be a 5' walkway on the north side (Alignment 2 on the following page) or a 8-10' path on the south side (Alignment 3).
3. The final segment would be a 8-10' paved path through the fields between VT 100 and CBMC (Option A).

In addition, bike lane markings and signage to the school entrance are recommended. Comparing the existing 38' pavement width on the VT 100 approach to the US 2 intersection (8' shoulders and 11' travel lanes) and the Vermont Design Standards for a rural minor arterial (5' shoulders and 11' travel lanes) as discussed in Section 4.2, there is adequate room to fit a 5' sidewalk without impacting adjacent properties.

The CVRPC updated the cost estimates from the 2002 CBMS path study to 2011 (see Appendix G) and found that the recommended alternative (Alignments 1 & 2 and Option A) would now cost approximately \$450,000. Pursuing a similar option on the south side of VT 100 would cost approximately \$600,000.

¹ VTrans Guideline for the Installation of Crosswalk Markings and Pedestrian Signing at Marked and Unmarked Crossings, 2004; page 17.



7.3 Traffic Improvements

- To reduce vehicle conflicts, realign Commercial Drive so that it is directly across from VT 100.
- Close the northern Juniper's Fare access to reduce conflicts and improve safety.
- Formalize the right-turn lane on VT 100.

7.4 Selected Alternative

This study aims to provide a vision for the US 2 – VT 100 intersection and improve performance and safety. In particular, the study addresses:

- The lack of bicycle and pedestrian facilities at the intersection, which particularly impacts schoolchildren in the area.
- Intersection performance, especially for the VT 100 approach.
- The offset alignment of Commercial Drive and the Juniper's Fare Restaurant driveway, which creates conflicts and safety issues.

Each of the three alternatives achieves this purpose, but the roundabout does so most effectively. The roundabout best addresses traffic performance; vehicle, bicycle, and pedestrian safety; and community character and the potential to create a gateway.

8.0 NEXT STEPS

- Request Waterbury Village to consider extending the sewer line south of the river to serve the properties adjacent to the intersection.
- Explore the potential for acquiring the needed right-of-way for a roundabout from Hannon Home Center.
- Work with developers to determine their fair share of responsibility for addressing project impacts to the intersection.
- Work with VTrans to move the roundabout alternative forward.
- In the interim, add pedestrian facilities such as pavement markings/crosswalk, signs, and other safety improvements. Look into reducing speed limits.

