Waterbury BO 1446(40)
Bridge #36
Scoping Study
Project Definition

Stowe Street over Thatcher Brook

6/24/21

Prepared for:

Vermont Agency of Transportation (VTrans)

Prepared by:

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Sign-off Sheet

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1.0 EXECUTIVE SUMMARY

This report summarizes a scoping study to evaluate alternatives for improving the intersections of Stowe Street / VT Route 100 (VT 100) and Stowe Street / Lincoln Street as well as Bridge 36 which carries Stowe Street over Thatcher Brook in the Town of Waterbury.

Traffic, Roadway and Pedestrian Accommodations:

Evaluation of the traffic, turning geometry and intersection site distances concluded the following:

- The addition of a northbound right turn lane to Stowe Street would reduce queuing lengths of the VT 100 / Stowe Street Intersection and improve the Level of Service (LOS). Analysis results indicate that while the VT 100 intersection operates at LOS B or C, the westbound Stowe Street approach operates at LOS E during the evening peak hour with queues of up to 10 vehicles, which pass beyond the Lincoln Street intersection. This queueing was also observed in the field.
- This right turn lane would also help accommodate turning geometry of the Link Bus that services the Park and Ride on Lincoln Street.
- A truck turning apron is proposed at the southwest corner of the bridge to accommodate the turning radius of the link bus making the right turn from Lincoln Street on to Stowe Street toward VT 100.

The Town has a long-term plan to include a sidewalk on the upstream (east) side of the bridge for connection with planned improvements to pedestrian facilities on the southern side of VT 100. Evaluation of the site constraints and geometry suggest a configuration that ties into the existing Stowe Street sidewalk with a crosswalk at the northern terminus of North Street and for this project will terminate at the planned future cross walk on VT 100.

Bridge Alternatives:

Several bridge alternatives were evaluated. Bridge replacement was considered more cost effective than rehabilitation or repair. A buried structure is a good fit for the complex roadway geometry at the site and is the most cost effective bridge alternative considered and is anticipated to have the lowest future maintenance costs.

Utility Relocations:

Overhead and underground utilities would need to be relocated; coordination should take place early in the design phase. Relocation of the existing Town sewer (if impacted by the project) would be eligible for federal and state funding participation. The Town's share would be either 5% or 10% depending on the chosen alternative.

Traffic Control:

The recommended method of traffic control is to close the bridge for 60 days and maintain traffic on an off-site detour. The detour for this project location would add approximately 0.2 miles to the through route and have an end-to-end distance of 1.8 miles.

Maintaining pedestrian traffic with an off-site detour is actually quite challenging. The limited access designation of the VT 100 overpass at the I-89 Exit 10 interchange precludes pedestrian use of that route as the off-site detour route for pedestrians due to safety concerns. The study did not identify a viable pedestrian route during the bridge closure. Not providing a pedestrian crossing during the bridge closure may be acceptable because:

- Current condition is not ADA accessible
- Existing sidewalk ends at northerly bridge terminus without pedestrian connection to VT 100
- A temporary pedestrian crossing would likely put more pedestrians in the construction work zone. Ushering pedestrians through the construction zone is dangerous and can attract onlookers, increasing their risk.

Another possibility that should be considered for providing connectivity is contracting with a shuttle service to ferry passengers from VT 100 to the Waterbury Village during construction.

2.0 INTRODUCTION

Stowe Street connects VT Route 100 to the north, with the Village of Waterbury to the south. The northern-most part of Stowe Street includes a signalized intersection with VT 100, and a STOP-controlled intersection with Lincoln Street, connected by a 175 ft. segment crossing Thatcher Brook via Bridge 36. Bridge 36 is a town-owned bridge located on Stowe Street approximately 110 ft. south of the junction with Vermont 100. The current bridge is in need of rehabilitation or replacement. The bridge is situated between two busy intersections and decisions regarding the proposed work on the bridge should consider the context of the adjacent intersections. The purpose of this project is to evaluate improvements in the area and define the scope and limits of work for a bridge repair, rehabilitation or replacement project.

3.0 BACKGROUND

A feasibility study for Waterbury Bridge 36 was undertaken in 2018 by Central Vermont Regional Planning Commission (CVRPC), in partnership with the Town of Waterbury, to document existing conditions, and identify opportunities for improvements at two intersections and the bridge between them, at the northern terminus of Stowe Street, in the Town of Waterbury, Vermont. Public input was received during a local concerns meeting held by the project team, as well as through a Local & Regional Input Questionnaire. Existing conditions were documented, including field observations and follow-up analyses, for traffic operations and safety, roadway geometry, and bridge condition inspection and assessment.

Improvements identified to consider include: pedestrian accommodations at the Stowe Street / VT 100 intersection; a dedicated right-turn lane for the Stowe Street approach to this intersection; geometric improvements for the STOP-controlled intersection of Lincoln Street / Stowe Street; and rehabilitation or replacement options for Bridge 36, the town-owned bridge carrying Stowe Street over Thatcher Brook, between the intersections with VT 100 and Lincoln Street.

One notable conclusion of the existing conditions study was that the wetlands or wetland buffers are not located within the anticipated project area. Class I wetlands were identified on the Vermont Agency of Natural Resources (VANR) map, however, Stantec's environmental scientist located and flagged the estimated wetland boundary, and the actual limits are not in the immediate vicinity of anticipated disturbance.

Background information, including existing physical and environmental conditions, were documented to understand the need for and potential impacts of improvements. Team members researched and reviewed available information, solicited input from the Town and project stakeholders, and completed a field review of the project area. Sources of information include site visits, inspection reports, route logs, an Operations Input Questionnaire, a Local & Regional Input Questionnaire, a Local Concerns Meeting, and previous studies, including the Colbyville Pedestrian/Bicycle Scoping Study.

3.1 PROJECT AREA

The project area is centered around Bridge 36, where Stowe Street passes over Thatcher Brook. The project area also includes the intersection of VT 100 / Stowe Street and Stowe Street / Lincoln Street, as shown in Figure 1.

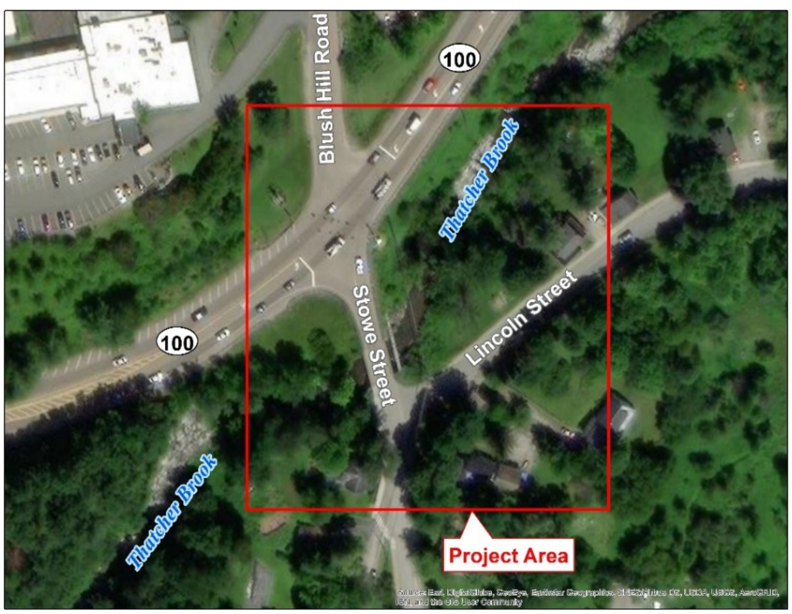

Figure 1 Project Location Plan

3.2 CLASSIFICATION

Roadway Classification (Stowe Street):	Local Town Road
Bridge Type:	Concrete T-Beam Bridge
Bridge Length:	42 feet
Existing Skew:	9 degrees (ahead right)
Year Built:	1928
Ownership:	Waterbury
Maintenance District:	District 5

3.3 ROADWAY DESCRIPTIONS

Existing conditions within the project area are shown in Figure 2 – Existing Conditions Layout. The existing bridge and roadway width is too narrow for the roadway classification, pedestrian and bicycle traffic, and traffic volumes. Commuter buses making turning movements onto Lincoln Street often utilize the bridge sidewalk or cross the centerline. Stowe Street continues south as a principally residential street to Main Street (US 2) in Waterbury Village. Lincoln Street is a two-lane roadway that provides access to a Park and Ride Lot, and to numerous intersecting residential streets. The area accessed by Lincoln Street has a second connection to VT100 via Perry Hill Road/Kneeland Flats Road/Guptil Road.

Stowe Street is a Class 2 Town Highway, two-lane variable width roadway, with 0- to1-foot shoulders along the 175-foot distance between the Lincoln Street and VT 100 intersections. There is a sidewalk on the west side of the bridge, which continues southerly along Stowe Street towards downtown Waterbury. The Stowe Street roadway width, which is 22 feet on Bridge 36, widens north of the bridge due to the corner radii at VT 100 and Stowe Street. There is continuous guardrail on both edges of the Stowe Street roadway, from VT 100 to the bridge, where the parapet is continuous across the bridge. Guardrail continues on both sides of Stowe Street from the bridge to Lincoln Street. The Stowe Street vertical profile rises by approximately 8 percent from Lincoln Street to VT 100. The pavement markings on Stowe Street between VT 100 and the bridge consist of a double yellow centerline, white edge lines, and a stop line on the approach to VT 100. The intersection of VT 100 and Stowe Street is traffic signal controlled. Lincoln Street, near Stowe Street, has approximately the same 22-foot width. As Lincoln Street slopes down to Stowe Street, there is approximately 75 feet of guardrail on the northerly side of the road, wrapping around the corner with Stowe Street to the bridge, protecting the slope down to Thatcher Brook. Pavement markings on Lincoln Street, near the intersection with Stowe Street, consist of a white edge line on the north side of the street connecting to the sidewalk curb. There are no pavement markings on Stowe Street at the intersection with Lincoln Street. Lincoln Street is STOP sign controlled on its approach to Stowe Street. The Stowe Street approaches are not controlled.

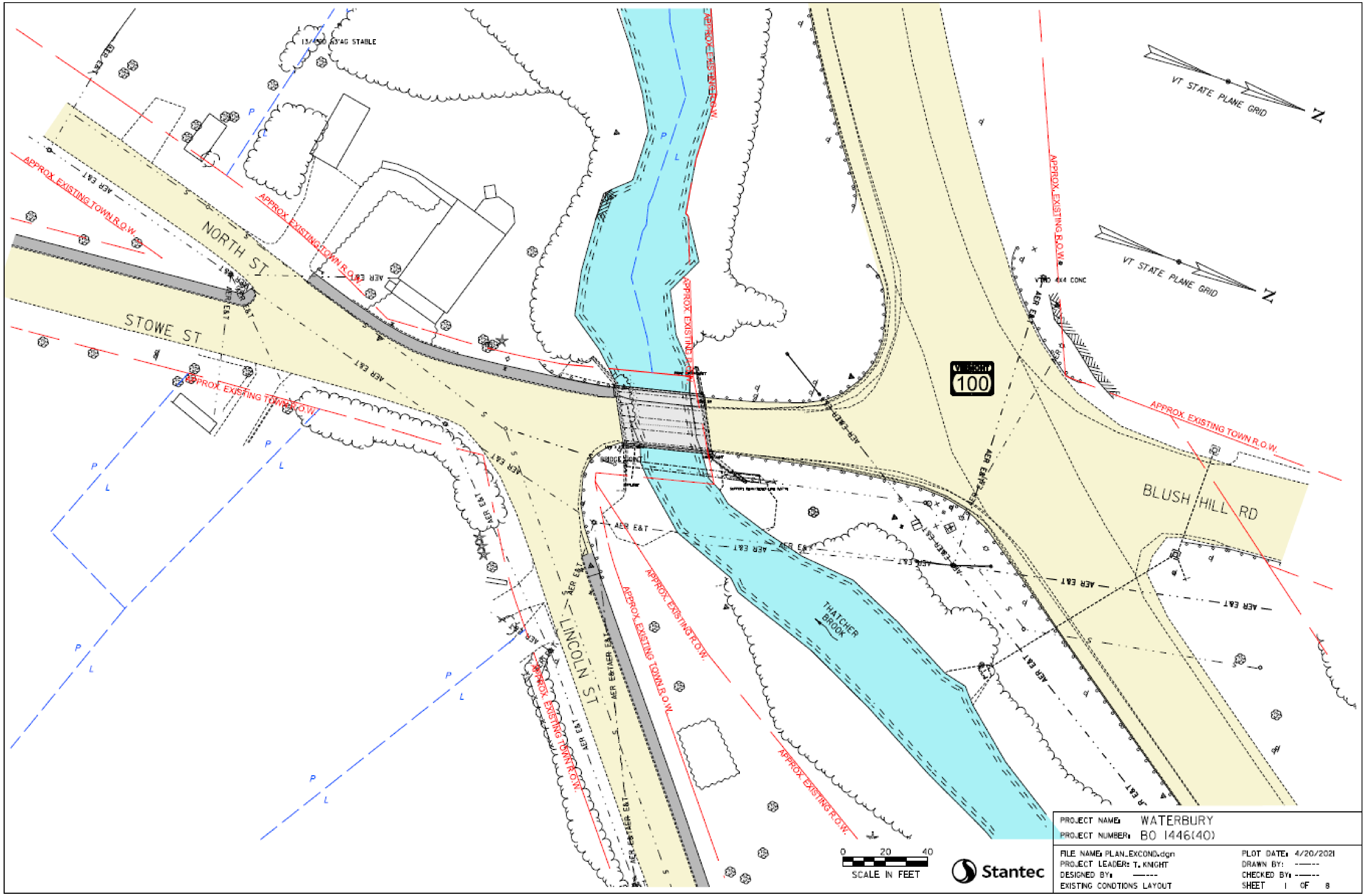

Figure 2 Existing Conditions

3.4 TRAFFIC

A traffic study of the project area was performed by Stantec in 2018 and updated in 2020. Traffic analyses completed by Stantec in 2018 (attached) were updated by Stantec for the intersections of Stowe Street at VT 100 and Lincoln Street at Stowe Street in Waterbury, Vermont, based on recent traffic data collected and adjusted for 2020, and a design year of 2045.

Turning movement counts (TMCs) were collected by the Vermont Agency of Transportation (VTrans) at VT 100/Stowe Street in July 2016. These volumes were adjusted to 2020 by Stantec using an annual growth factor of 1.02 per the VTrans Continuous Traffic Counter Report (The Redbook) based on 2016 traffic data. Stantec collected TMCs at Lincoln St/Stowe Street in November 2020. These volumes were adjusted to account for the reduced traffic volumes due to the COVID pandemic, using a factor of 1.2 per discussions with VTrans, to approximate pre-COVID traffic volumes. This 20% increase is based on a VTrans comparison of data collected by Automated Traffic Signal Performance Measures (ATSPMs) during Indigenous Peoples Day weekend in 2020 vs 2019. Volumes were balanced between both intersections, displayed in Figures 3 and 4.

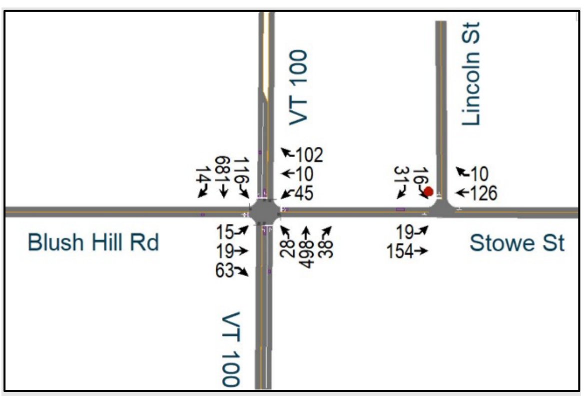

Figure 3 Existing 2020 AM

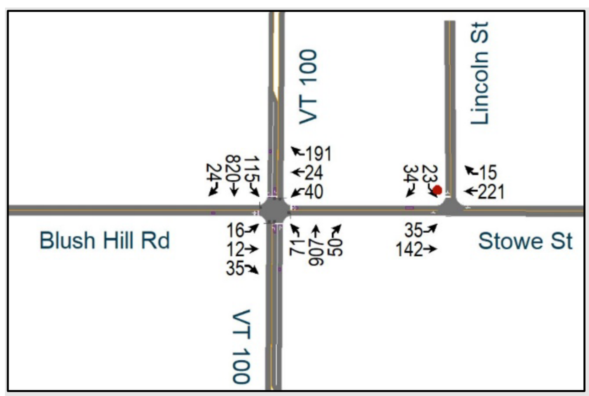

Figure 4 Existing 2020 PM

Operating level of service (LOS) is a term used to describe the quality of traffic flow on a roadway. It is an aggregate measure of travel delay, travel speed, congestion, driver discomfort, convenience, and safety based on a comparison of roadway capacity to travel demand. Operating levels of service are reported on a scale of A to F, with LOS A representing the best operating conditions (little or no delay to motorists) and LOS F representing the worst operating conditions (long delays and with traffic demands sometimes exceeding roadway capacity). Delay criteria are shown in Table 1 below.

Table 1 Signalized Intersection Level of Service Criteria

Level of Service	Average Delay per Vehicle (Seconds)
A	≤10.0
B	10.1 to 20.0
C	20.1 to 35.0
D	35.1 to 55.0
E	55.1 to 80.0
F	>80.0

The intersection peak hour operating levels of service were calculated following procedures described in the *2010 Highway Capacity Manual* and as applied by the Synchro software package. The Stowe Street and Lincoln Street intersection is close to VT 100 (175 feet) and queuing back from VT 100 queues past Lincoln Street during peak hours due to the operation of the traffic signal, as observed in person and shown in the capacity analysis results from Synchro software. The VT 100/Stowe Street traffic signal operates on an 88-second cycle during the morning peak hour and 96-second cycle during the evening peak hour as part of a coordinated traffic signal system on VT 100. Analysis of the existing conditions provides results as presented in Table 2. Analysis results indicate that while the VT 100 intersection operates at Level of Service B or C, the northbound Stowe Street approach operates at LOS E during the evening peak hour with queues of up to 10 vehicles which pass beyond the Lincoln Street intersection. The Lincoln Street unsignalized intersection is affected by those queues but otherwise would operate at LOS B.

Table 2 Existing (2020) Capacity Analysis Results

Peak Hour	Stowe Street at VT 100		Stowe Street WB Approach to VT 100			Lincoln Street at Stowe Street
	Overall LOS	Overall V/C	LOS	V/C	95Th Queue	LOS
AM	B	0.63	D	0.58	5 veh.	B
PM	C	0.89	E	0.90	10 veh.	B

LOS = Level of Service; V/C = volume to capacity ratio; 95th Queue = 95th percentile queue; RTL = Right Turn Lane

3.5 CRASH HISTORY

Stantec reviewed the crash history on Stowe Street at the Lincoln Street and VT 100 intersections. VTrans records were obtained for the 5-year period between 2012 and 2016. During this time there were no crashes reported at the Lincoln Street intersection. At the VT 100 intersection, a total of eight crashes were reported. Six were rear-end type crashes and four rear-end crashes occurred on the northbound VT 100 approach. One rear-end crash occurred on the Stowe Street approach to VT 100. None of the crashes resulted in personal injury. The crash rate is computed as 0.19 crashes per million vehicle miles. The statewide crash rate for local streets is 1.43 in rural areas and 2.62 in urban areas.

VTrans maintains a listing of High Crash Locations (HCL) within the state. A 0.3-mile highway segment or intersection must have at least 5 crashes over a 5-year period and the actual crash rate (number of crashes per million vehicles) must exceed a critical crash rate to be classified as an HCL. The critical crash rate is based on the average crash rate for similar highways in Vermont and is related to the functional class of a highway and whether it is located in an urban or rural area. The VTrans High Crash Report: Sections and Intersections 2012-2016 does not list this segment of Stowe Street or either intersection within the project area.

3.6 TURNING GEOMETRY

Figure 5 illustrates the turning geometry of the link commuter bus when making turns between Stowe Street and Lincoln Street. The current existing geometry of the intersection of Stowe Street and Lincoln Street results in commuter buses crossing over to the oncoming traffic lane on both streets for right turns onto Stowe Street. The existing geometry also results in commuter buses turning left onto Lincoln Street from Stowe Street driving up onto the bridge sidewalk and crossing over to the oncoming traffic lane on Lincoln Street.

Stantec developed a design with a wider (3-lane) configuration of Stowe Street north of the Lincoln Street intersection to better accommodate these turning movements. That roadway geometry is shown in Figure 5 superimposed over the existing conditions. Previous scoping efforts to identify an alternative location for the Park and Ride did not identify any viable options.

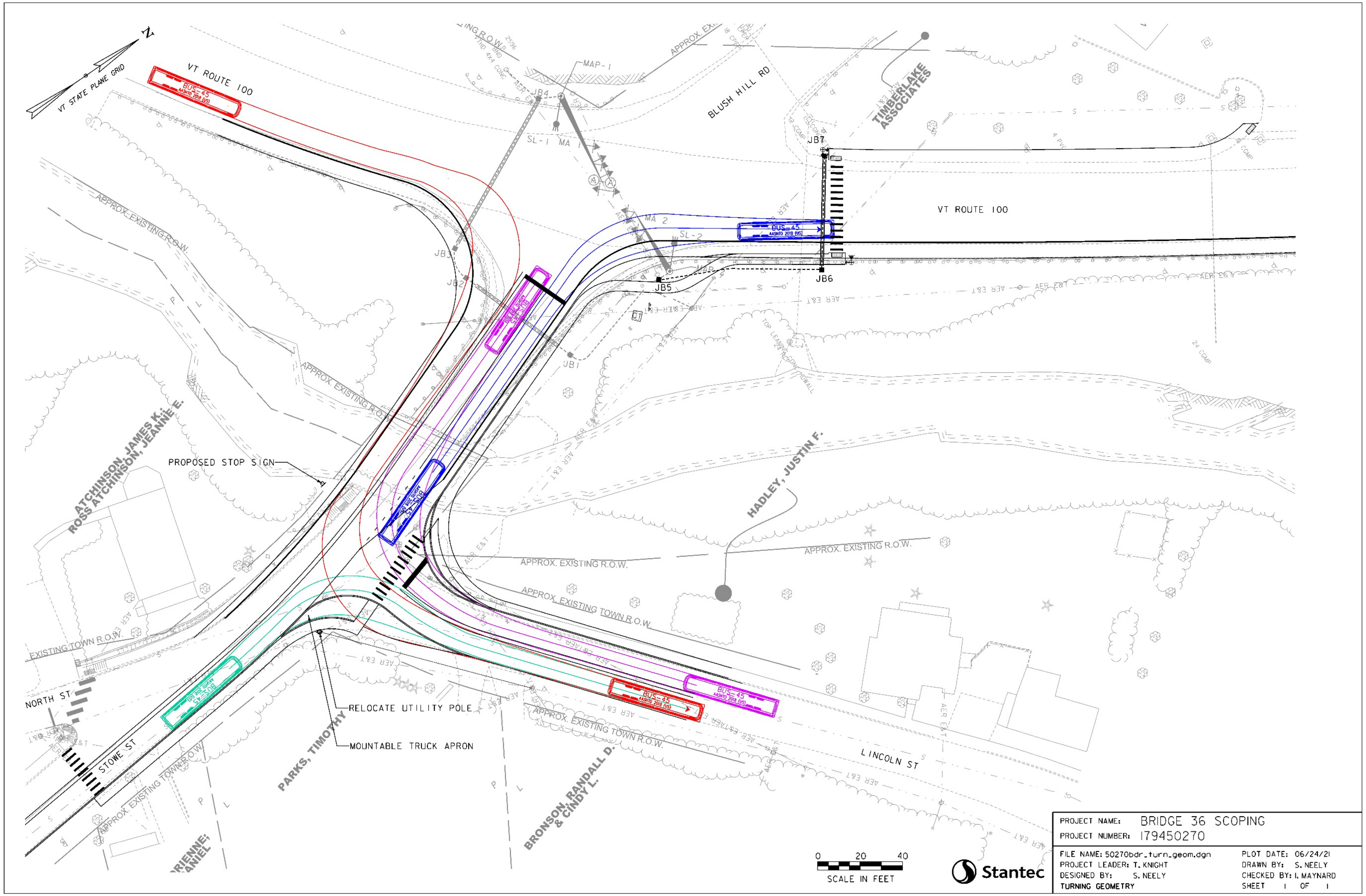

Figure 5 Link Bus Turning Geometry

3.7 SIGHT DISTANCE – LINCOLN STREET STOP CONDITION

Vehicles at the STOP sign, on the Lincoln Street approach to the STOP controlled intersection with Stowe Street, have terrain and vegetation obstructions within their sight triangle that prevent them from seeing vehicles approaching from the left. Figure 6 displays the AASHTO recommended sight lines for this movement, indicating 280 FT of visibility along the Stowe Street alignment, looking to the driver's left, for a vehicle at the STOP sign. Figure 7 displays actual sight lines, indicating only 70 FT of actual visibility along the Stowe Street alignment, looking to the driver's left, for a vehicle at the STOP sign, due to the terrain and vegetation obstructions shown. These obstructions are partially located outside of the road Right of Way, on the southeasterly corner of the intersection. This condition forces motorists to pull substantially forward past the STOP sign in order to see oncoming traffic from their left. This condition causes conflict when commuter buses are making a left-turn onto Lincoln Street from Stowe Street.

As part of the scoping process, Stantec developed an intersection configuration that improves the site distance and turning geometry for the Lincoln Street Stop Condition and that configuration is shown with the associated site triangles in Figure 8 that follows.

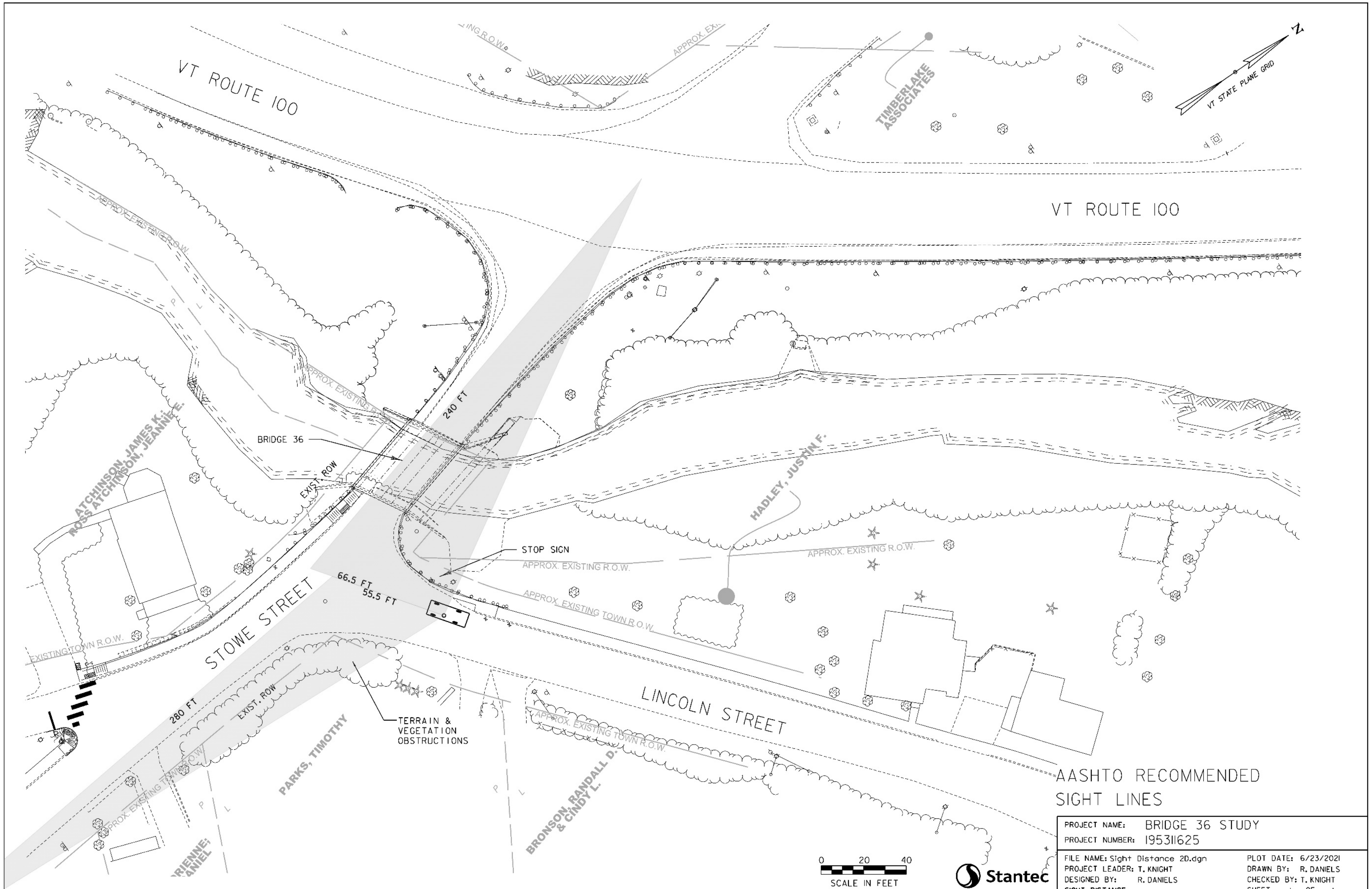

Figure 6 AASHTO Recommended Sight Lines, Existing Geometry

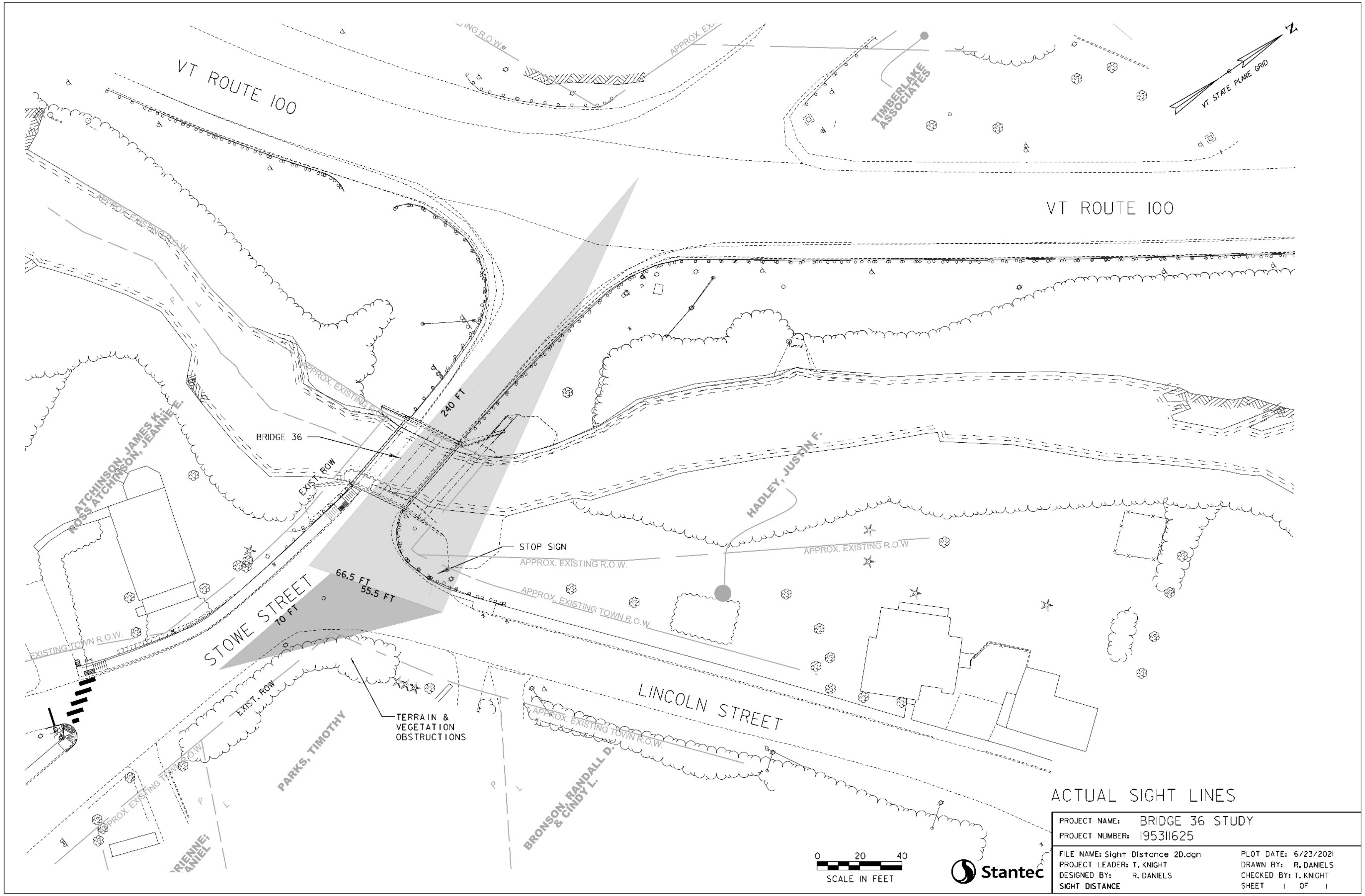

Figure 7 Actual Sight Lines with Existing Geometry

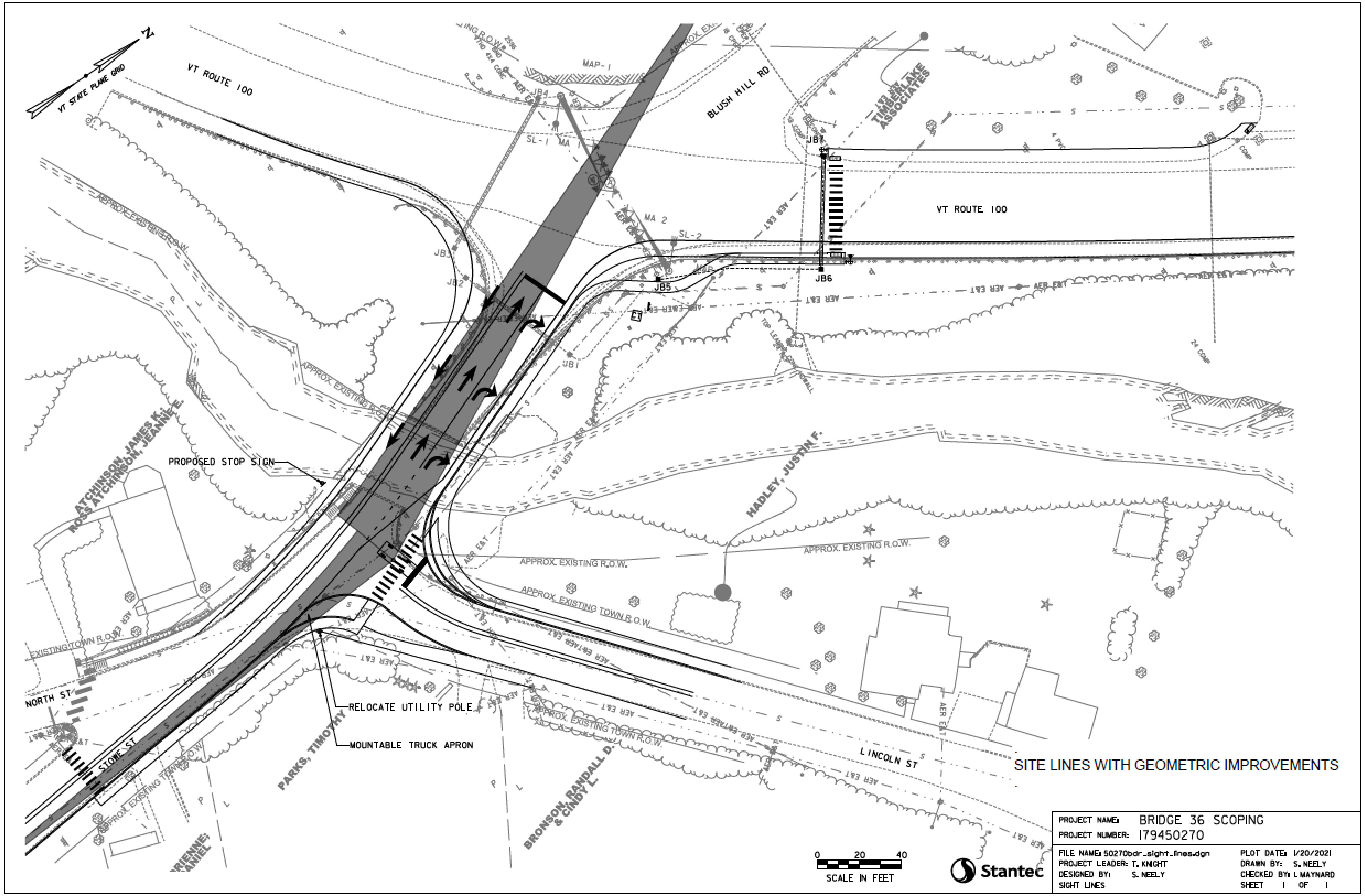

Figure 8 Sight Lines with Geometry Improvements

3.8 BRIDGE INSPECTION REPORT SUMMARY

VTrans conducts Bridge Safety inspections on a biennial basis to meet the National Bridge Inspection Standards (NBIS). As part of that process, VTrans rates the condition of various elements within the bridge using a numeric rating that corresponds to the condition of the element. Based on recent inspections, VTrans has opted to reduce the inspection frequency for the structure to annual. This change reflects the fact that this bridge is nearing the end of its service life and is likely to begin deteriorating more rapidly than it has in the past. The following is a summary of VTrans recent inspection history for Bridge 36:

When interpreting the inspection history, please note the following:

- NBIS defines the criteria for the numeric condition rating, but there is an accepted tolerance associated with the subjective nature of assigning a numeric value to the bridge element condition. In general, if a bridge were inspected by 2 different inspectors, you can expect that the numeric rating assigned to a given element would be within a numeric value of 1 of a numeric rating from another independent inspector. Thus, if one inspector were to rate the bridge as a "5 Fair", it would be acceptable for another independent inspector to rate that element as a "4 Poor", or perhaps a "6 Satisfactory", and still be within the accepted precision of the NBIS.

- Inspectors sometimes make anecdotal comments regarding the anticipated longevity of the structure and/or the need for repair or replacement of the structure at large. Engineers would take the inspector's comments under advisement when determining the need for repair or replacement of the structure, but these comments are understood to be somewhat subjective, as no inspector or engineer can predict the longevity of bridge elements with certainty. The anecdotal predictions are intended to highlight the degree of attention that is warranted for maintenance of the element.

Deck Rating:	*5 Fair*
Superstructure Rating:	*5 Fair*
Substructure Rating:	*5 Fair*
Channel Rating:	*6 Satisfactory*

Inspection History:

04/12/2018 - Special 12-month inspection of the concrete deck. The deck surface needs cold planning and repaving, as it is getting quite rough. The deck and sidewalk could use some patch repair work when the wearing surface is removed. The northwest wingwall is degrading with some heavy scaling and needs repair to prevent erosion of the approach fill material behind it. The deck is showing its age (90 years) in certain spots, but overall appears generally sound at this time. The deck rating will be raised back up to a 5, as fair for now. However, since the bridge is slowly degrading and extensive repairs are not advised, plans should be made to upgrade the bridge in its entirety in the next 10 to 20 years. ~ MJ/JS

9/6/2017 Deck has advanced to poor with heavy saturation bay 2, other areas along deck soffit also has saturation but not as severe. Failures along the deck is possible. Superstructure & substructure continues to deteriorate at steady pace. Abutment 1 upstream wing has very heavy scaling. Structure should be considered for full replacement. Structure will be moved to 12-month frequency inspection. MJK AC

09/09/15 Fair condition, structure continues to deteriorate along deck soffit, T beams and abutments. Structure should be considered for recon or replacement. MJK SP

09/06/13 Deck & T beams continue to deteriorate at a slow pace, approaches need to be shimmed. Structure should be considered for replacement in the next 10 +/- years. Recent repairs to fix undermining is a big improvement. MJK FE

05/05/11 Fair condition. Deck soffit has areas of saturation and t-beams are breaking down with cracking and spalling with exposed rebar. Structure should be replaced in near future. MJK & PH

05/08/09 - The bridge is in fair to satisfactory condition. - The deck and tee beams continue to deteriorate. Full depth holes could occur any time, any place in the deck; especially in bay 2. Abutment 2's approach guard rail needs repair. DCP

Stantec's bridge engineers conducted a site visit in August 2018 to verify the inspection findings in the current VTrans Bridge inspection report dated 4/12/2018. Stantec concurs with the findings of the inspection report, however, they noted that the Town of Waterbury has made repairs to the northeast wingwall and the adjacent corner of the north abutment since the April inspection.

3.9 HYDRAULICS

VTrans developed a preliminary hydraulics analysis with recommended span lengths and hydraulic capacities for proposed improvements. The existing structure does meet current standards of the VTrans Hydraulic Manual but does not meet state stream equilibrium standards for bankfull width. The report associated with this analysis recommends a minimum clear span of 45 feet for any new structure.

3.10 UTILITIES

The existing identified utilities consist of the following:

Municipal Utilities

- An existing sewer main runs from a sewer manhole (SMH) near the signal control cabinet at the southeast corner of the intersection of VT Route 100 and Stowe Street. The sewer then runs south paralleling Stowe Street about 10 feet from the shoulder on the upstream side before daylighting to parallel the bridge on a separate structure. The existing structures is in good condition. It appears that north of the bridge, the sewer main is encased in concrete for about a 15-foot length; this needs verification. The sewer main crosses Thatcher Brook and into a manhole before crossing Lincoln Street and continuing down the east side of Stowe Street.
- Traffic signal conduit runs under Stowe Street for the signal at the intersection of VT Route 100, Stowe Street and Blush Hill Road, approximately 60 feet south of the intersection. An electrical utility wire runs from the pull box on the east side of Stowe Street to the signal cabinet located south of the intersection.
- A storm sewer collects runoff from catch basins on each side of Blush Hill Road, just north of the intersection with VT 100, crosses VT 100, and discharges into Thatcher Brook upstream of the bridge. A storm sewer also collects runoff from a catch basin on the south side of Lincoln Street and a catch basin located approximately 100 feet east of the intersection of Lincoln Street and Stowe Streets before daylighting into Thatcher Brook, upstream of the bridge.
- An existing 12-inch water main is buried below Thatcher Brook, upstream of Bridge 36, and runs along Stowe Street and Lincoln Street. Water lines are located in the area of the intersection of Stowe Street and VT 100, with valve boxes.
- A fire hydrant is located approximately 50 feet south of the bridge and across from Lincoln Street.

Public Utilities (Overhead)

- Overhead utilities run along the east side of Stowe Street. Utility poles are located: southeasterly of the intersection of Route 100 and Stowe Street; a guy pole crossing Stowe Street northerly of the bridge; approximately 40 FT easterly of the northerly corner of the Lincoln Street and Stowe Street intersection; and on the southerly corner of the Lincoln Street and Stowe Street intersection.

The impact of the construction project to the sewer, water and overhead utility lines and poles will depend on the size and scope of the proposed bridge structure and will likely require relocation or temporary support. Coordination with the Municipality and public utility company will be necessary during design of any construction project. If replacement is pursued, carrying the existing sewer on the bridge should be considered.

3.11 RIGHT OF WAY

There are existing 3-rod (49.5 ft) (approximate) rights of way centered on both Stowe Street and Lincoln Street. The Right-of-Way boundary for Route 100 varies by location. Due to the large amount of Right-of-Way clearance on the north side of the bridge, no permanent or construction easements should be required. On the south side the bridge, Stowe Street Right-of-Way is within 12 feet of the bridge fascia and may require additional Right-of-Way acquisition. The existing Right-of-Way is plotted on the Existing Conditions Layout Sheet (Figure 2).

As discussed earlier regarding sight distance obstructions for the Lincoln Street STOP condition, there are existing terrain and vegetation obstructions on the southwesterly corner of the Stowe Street / Lincoln Street intersection. Those obstructions appear to be partially located outside of the Town Right-of-Way.

3.12 RESOURCES

The environmental resources present at this project are shown on the Existing Conditions Layout Sheet (Figure 2) and are as follows:

Biological

Wetlands/Watercourses

Wetlands or wetland buffers are not located within the project area. Class I wetlands were identified on Vermont Agency of Natural Resources (VANR) map; however, Stantec’s environmental scientist located and flagged the estimated wetland boundary. The boundary is located approximately 370 feet upstream of the project site, thus, the wetland and the wetland buffer are outside of the project limits. A figure depicting this location is included in the appendix of this report.

Impact below OHW/Fisheries/AOP

Thatcher Brook is the only regulated natural resource in the immediate project area and only impacts below ordinary high water (OHW) are regulated. Thatcher Brook is a tributary to the Winooski River. The current structure passes fish and other aquatic organisms. Thatcher Brook is not classified as Essential habitat or a Navigable Waterway. In-stream construction would be limited to between July 15 and October 1 under Section 404 Corp of Engineers Permit unless a Category 2 general permit is obtained.

Species / Habitats of Special Concern

The Northern Long Eared Bat is the only species with habitat of special concern. No other threatened or endangered species were identified within the project area.

Agricultural Soils / Floodplains

The project area is within a mapped flood hazard area located along the river. No agricultural soils have been identified within the project area.

Geotechnical

VTrans conducted a preliminary geotechnical investigation of Bridge 36 in 2019. This included review of as-built record plans, historical in-house boring logs, and hazardous site information held by the Vermont Agency of Natural Resources (ANR), published surficial and bedrock geological maps, and observations from a site visit.

Two borings were made at the intersection of VT 100 and Stowe Street in July 2017 for the Waterbury-Stowe STP 2945(1) project. Soils were shown to include varying amounts of gravelly sand and silt. Bedrock, classified as hard phyllite, was discovered at depths between 10.1 and 15.4 feet, which relate to elevations of 501.1 and 500.4 feet, respectively. Groundwater was discovered in both boring locations ranging between five and six feet below ground surface.

Recommendations from this investigation include conducting at least two borings at each abutment foundation to better assess subsurface conditions including soil properties, depth to and characteristics of bedrock, and groundwater conditions. Recommendations also include foundation options:

- Semi-integral abutments founded on spread footings on bedrock
- Concrete rigid frame supported on spread footings on bedrock

Hazardous Materials

According to the Vermont Agency of Natural Resources (VANR) Vermont Hazardous Sites List, there are numerous hazardous waste sites located near the project area. It is anticipated that none of these sites will be impacted. A list of hazardous sites in the project area can be found in the appendix.

Historic

The bridge is in the northern end of the Mill Village Historic District, with ordinary houses and a mill, dating back to the 19th century. Some of the houses and the mill remain in existence today, although converted into modern houses and a commercial space. The project area will not be impacting either the houses nor the mill.

Archaeological

The areas immediately around the bridge are steep and those along the VT 100 side have been impacted by widening of VT 100. The southwest and southeast quadrants are also very steep. Historic mapping does show some structures in the northwestern and northeastern quadrants which do not appear to exist any longer. VTrans conducted a site visit for this project in 2019 and no evidence of any structures were found. They may have been removed during roadway widening.

Stormwater

Bridge 36 is south and downhill of the intersection of Stowe Street and VT Route 100. The runoff from the road between the bridge and the intersection runs down and off the road under the transition barrier onto the substructure at the north end of the bridge. Due to the heavy rutting in the bridge surface, stormwater also ponds on the bridge deck and freezes in the winter.

4.0 COMMUNITY ENGAGEMENT

4.1 LOCAL CONCERNS MEETING AND QUESTIONNAIRE FINDINGS

Residents at the local concerns meeting held July 17th, 2018 expressed the following safety concerns regarding the Stowe Street intersection with Lincoln Street:

- Sight distance from the stop sign location on Lincoln Street is poor, and traffic needs to pull partially out onto Stowe Street in order to see oncoming vehicles.
- Vehicles often exceed the speed limit and residents are concerned that speeds are excessive in the residential area south of the Lincoln Street intersection.
- Due to the poor sight distance of traffic maneuvering from Lincoln Street, traffic is often not focusing on pedestrian traffic and pedestrians feel unsafe crossing the road.
- Residents noted the narrowness of the sidewalk, which is not ADA compliant, and minimal separation from traveling public is uncomfortable and feels unsafe.

Safety issues presented in the Operations Input Questionnaire

- Narrowness of the bridge and alignment causes vehicles to utilize the sidewalk to turn left onto Lincoln Street. Likewise, traffic turning right from Lincoln Street onto Stowe Street often crosses centerline to turn.
- When snow falls, plowing operation pushes snow onto the sidewalk. Current configuration of the railing does not allow snow to be pushed over bridge. Sidewalk plowing operation pushes some snow into roadway, causing bridge to retain more snow.
- Snow plows with wings are not able to drive over bridge without crossing centerline.

VTrans also indicates there have been discussions with the community about designating Stowe Street as the preferred bicycle route for an alternative to staying on VT 100 near the I-89 Exit 10 interchange.

5.0 PURPOSE AND NEED

The following ***Draft*** **Purpose and Need Statement** summarizes what the project is intending to accomplish and for what reasons.

Purpose: The purpose of the project is to provide a safe crossing of Thatcher Brook for the traveling public, including pedestrians and bicyclists and to address the current structural deficiencies and ongoing deterioration of the bridge.

Need: Recognizing the importance of this route in the transportation system for the Town of Waterbury and the surrounding communities, the following needs for the project have been identified:

- The existing concrete beams and deck are in fair to poor condition, with holes and heavy wheel rutting in the pavement.
- The concrete sidewalk is spalling, particularly in interface with roadway.
- The concrete sidewalk is not ADA compliant.
- The beams are cracked and spalled where previous repairs have failed to bond. There are large delaminated areas throughout the deck and beams, and large spalled areas with exposed rebar.
- The T-beams continue to deteriorate, spall, and crack due to corrosion of the reinforcement.
- The approach railing and bridge rail do not meet the current standard.
- The existing bridge width is inadequate to accommodate turning movements of the commuter bus that regularly uses the bridge to access the Park and Ride on Lincoln Street.
- The bridge is not wide enough to accommodate cyclists on the roadway shoulder.
- The adjacent intersection with Lincoln street has inadequate sight distance to the north.

6.0 DESIGN CONSIDERATIONS

6.1 BRIDGE DESIGN CRITERIA

The design standards for this bridge project are the Vermont State Design Standards, dated October 22, 1997. Minimum standards are based on an ADT of 3,330 (2043), a DHV of 475 and a design speed of 25 mph for a local town road.

Table 3 Bridge Design Criteria

Design Criteria	Source	Existing Condition	Minimum Standard	Comment
Approach Lane and Shoulder Widths	VSS Table 6.3	11'/0' (22')	11'/3' (28')	Substandard
Bridge Lane and Shoulder Widths	VSS Section 6.7	10'/0' (20') with 5' sidewalk	11'/2' (26')	Substandard
Clear Zone Distance	VSS Table 6.5	Bridge and guardrail located in clear zone	7' fill / 7' cut (1.5 behind curb)	Substandard
Banking	VSS Section 6.12	Normal Crown	8% (max)	No super elevation on low speed urban streets
Speed		25 mph (Posted)	25 mph (design)	
Horizontal Alignment	AASHTO Green Book Table 3-10b	R = ∞	R_{min} = 2370' @ NC	
Vertical Grade	VSS Table 6.6	-1.02% (max)	7% (max) for level terrain	
K Values for Vertical Curves	VSS Table 6.1	Ksag = 209	20' crest / 30' sag	
Stopping Sight Distance	VSS Table 6.1	TBD	150'	
Bicycle/Pedestrian Criteria	VSS Table 6.8	No shoulder	3' Shoulder	Substandard for Bicycles
Bridge Railing	Structures Design Manual Section 13	Concrete railing	TL-2	

Design Criteria	Source	Existing Condition	Minimum Standard	Comment
Hydraulics	VTrans Hydraulics Section	To be determined in later study	Pass Q_{50} storm event with 1.0' of	Substandard
Structural Capacity	SM, Ch. 3.4.1	Not Structurally Deficient, but current condition is deteriorating.	Design Live Load: HL- 93	

6.2 PEDESTRIAN AND RIGHT-TURN LANE ACCOMMODATION CONSIDERATION

Traffic analyses completed by Stantec in 2018 (included in appendix) were updated by Stantec. Analyses were updated to inform the design of the bridge replacement for Bridge 36, along with associated intersection improvements at Stowe Street/VT 100 and Stowe Street/Lincoln Street. Intersection improvements include pedestrian phasing accommodations for a future crossing of VT 100 on the southbound approach and the addition of a dedicated right-turn lane for the northbound Stowe Street approach to VT 100. Impacts to the coordinated traffic signal systems along VT 100 were not analyzed. Conditions analyzed include existing conditions and six scenarios for future conditions:

Stantec analyzed six alternatives for the VT 100 / Stowe Street intersection for the year 2045. These alternatives include:

- 2045 Baseline (No pedestrian accommodation and no right turn lane)
- 2045 Northbound Right-Turn Lane
- 2045 Concurrent Pedestrian Phase (Only pedestrian accommodation)
- 2045 Concurrent Pedestrian Phase and Northbound Right-Turn Lane
- 2045 Exclusive Pedestrian Phase (Only pedestrian accommodation)
- 2045 Exclusive Pedestrian Phase and Northbound Right-Turn Lane

Future traffic conditions for the year 2045 (25-year horizon) were determined by adjusting 2020 volumes to 2045 using a growth factor of 1.13, per the VTrans Continuous Traffic Counter Report (The Redbook), based on 2020 traffic data. Future 2045 volumes are displayed in Figures 9 and 10. No known specific land use development projects were identified.

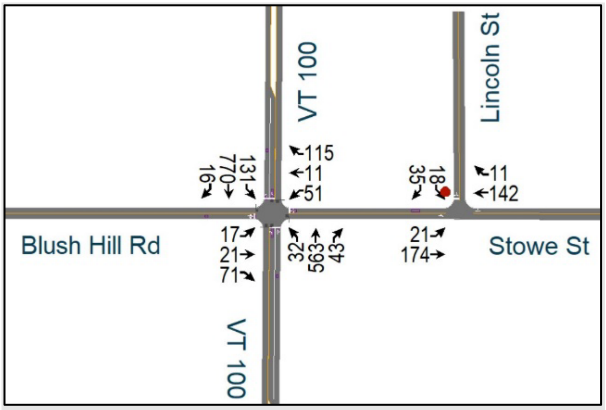

Figure 9 Future 2045 AM

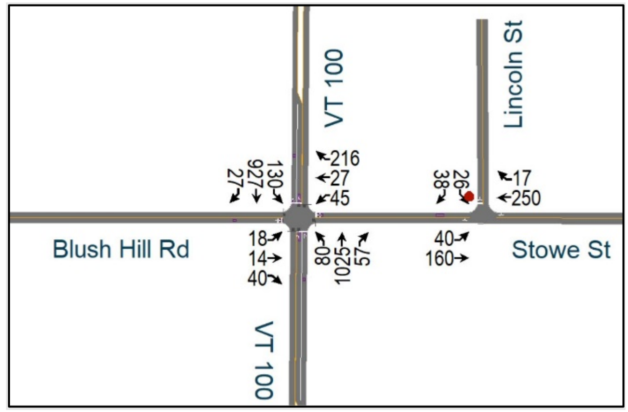

Figure 10 Future 2045 PM

Future conditions are expected to include pedestrian improvements to the VT 100/Stowe Street intersection. It is expected that VT 100 will be crossed just north of the intersection accommodated with pedestrian phasing, signal heads and pushbuttons. Both concurrent and exclusive pedestrian phasing were analyzed. In addition, a second approach lane on Stowe Street at VT 100 was analyzed. This lane would operate as a dedicated right-turn lane as it would be intended to accommodate 75 percent of the traffic on the Stowe Street approach. Existing phase splits were maintained from existing timing plans, while cycle lengths were adjusted for future conditions.

Future analyses of the year 2045, presented in Table 4, indicate overall operating conditions at the Stowe Street/VT 100 intersection in terms of level of service are expected to remain at LOS B during the morning peak hour for the baseline condition or with concurrent pedestrian phasing or exclusive pedestrian phasing with a dedicated northbound right-turn lane. During the evening peak hour, the intersection is expected to operate at an overall LOS D for the baseline condition or with concurrent pedestrian phasing. The concurrent pedestrian phase does result in more green time for the northbound approach and correspondingly a reduced v/c ratio for the northbound Stowe Street approach. Exclusive pedestrian phasing reduces the 2045 AM and PM LOS for the Stowe Street approach to F.

The benefit of a northbound right-turn lane for the Stowe Street approach was analyzed. The northbound approach experiences queuing today that extends beyond Lincoln Street during peak periods. Future traffic growth and the addition of the pedestrian phasing are expected to exacerbate this queuing. A right-turn lane that would extend over Bridge 36 would mitigate both the future growth and exclusive pedestrian phasing impacts on the northbound approach. The right-turn lane would also help accommodate the Link Bus turning onto and off Lincoln Street from Stowe Street for the Waterbury Park and Ride, maintaining a more compact approach for that intersection.

Motorists making a right turn onto VT 100 from Stowe Street may not currently expect pedestrians crossing at this location, due to the setting of the intersection along this portion of VT 100 and low pedestrian volumes. Combined with the large turning radius and corresponding higher turning speeds, this could be an issue for a concurrent pedestrian phase. With more complete pedestrian infrastructure at this intersection in the future, that may change, making a concurrent pedestrian phase more feasible. Signage to “Yield for Pedestrians” for motorists turning right onto VT 100 from Stowe Street may also help raise awareness of pedestrians by motorists making this movement.

Other approaches to the VT 100 / Stowe Street intersection were checked for impacts for each scenario. The eastbound approach is not expected to experience significant impacts for any of the scenarios. For the northbound and southbound approaches during the AM peak, LOS is expected to remain the same for all scenarios, while the v/c ratio is expected to remain close to the baseline or to improve. For the northbound and southbound approaches during the PM peak, LOS is expected to remain the same or improve for all scenarios; v/c ratio is expected to improve for all scenarios except for the exclusive pedestrian phase only scenario, which is expected to experience an increase in v/c ratio.

Future baseline 95th percentile queue lengths for the northbound and southbound approaches show potential impacts to the adjacent intersections along VT 100, particularly the I-89 northbound off ramp. The northbound approach is expected to experience an increase in 95th percentile queues, by about 16%, for the exclusive pedestrian phasing with right turn lane scenario during the PM peak hour, compared with the baseline. Capacity analysis worksheets are provided in the appendix.

Table 4 Future (2045) Capacity Analysis Results

Scenario	Time Period	Stowe Street at VT 100		Stowe Street WB Approach to VT 100			Lincoln St at Stowe Street
		Overall LOS	Overall V/C	LOS	V/C	95^{Th} Queue	LOS
Baseline	AM	B	0.73	E	0.74	7 veh.	B
	PM	D	1.03	F	1.07	12 veh.	B
RTL	AM	B	0.69	C	0.49	3 veh.	B
	PM	C	0.93	D	0.58	5 veh.	B
Concurrent Ped Phasing	AM	B	0.72	D	0.66	6 veh.	B
	PM	D	1.01	F	0.96	12 veh.	B
Concurrent Ped Phasing and RTL	AM	B	0.69	C	0.49	3 veh.	B
	PM	D	0.93	D	0.49	4 veh.	B
Exclusive Ped Phasing	AM	C	0.73	F	0.94	9 veh.	B
	PM	E	1.05	F	1.28	15 veh.	B
Exclusive Ped Phasing and RTL	AM	B	0.68	D	0.66	4 veh.	B
	PM	C	0.94	D	0.81	6 veh.	B

LOS = Level of Service; V/C = volume to capacity ratio; 95^{th} Queue = 95^{th} percentile queue; RTL = Right Turn Lane

7.0 TRAFFIC MAINTENANCE DURING CONSTRUCTION

The Vermont Agency of Transportation reviews each new project to determine suitability for the Accelerated Bridge Program, which focuses on faster delivery of construction plans, permitting, and Right-of-Way, as well as faster construction of projects in the field. One practice that will help in this endeavor is closing bridges for portions of the construction period, rather than providing temporary bridges. In addition to saving money, the intention is to minimize the closure period with faster construction techniques and incentives to contractors to complete projects sooner. The Agency considers the closure option on all projects where rapid reconstruction or rehabilitation is feasible. The use of prefabricated elements in new bridges will also expedite construction schedules. This can apply to decks, superstructures, and substructures. VTrans Accelerated Bridge Construction Program has demonstrated that accelerated construction often provides enhanced safety for the workers and the traveling public by removing traffic from the immediate vicinity of the construction work while maintaining project quality.

7.1 OPERATION 1: OFF-SITE DETOUR WITH PEDESTRIAN SHUTTLE

This option would close the bridge on Stowe Street and depending on the limits of work, may also limit access to Lincoln Street. Traffic would be rerouted to an off-site detour. Since the bridge is located on a Class 2 Town Highway, it would be the responsibility of the Town of Waterbury to choose the preferred detour route, and to sign it according to the MUTCD Manual.

The anticipated detour route is: Stowe Street ➔ VT Route 100 ➔ US 2 (west) ➔ Union Street ➔ back to Stowe Street. This route has an end-to-end distance of 1.4 miles. Stantec collected traffic counts and did a preliminary evaluation of the US 2 to Union Street turning movement with traffic re-routed through this detour route. There is a possibility that the additional volume turning left from US 2 onto Union Street may cause a queue that impedes movement through the VT100/US 2 roundabout. Therefore, routing traffic from Stowe Street ➔ VT Route 100 ➔ US 2 (west) and ➔ back to the southern terminus of Stowe Street with adjustments to the timing of the Stowe Street/US 2 signal timing may be required.

Pedestrian Accommodations

The limited access designation of the VT 100 overpass at the I-89 Exit 10 interchange precludes pedestrian use of that route as an off-site detour route for pedestrians due to safety concerns. The study considered other possible pedestrian detours, but no viable pedestrian routes of reasonable length were identified for use during the bridge closure. Another possibility is contracting with a shuttle service to ferry passengers from VT 100 to the Waterbury Village during construction.

Current bus routes may also help maintain access. The Green Mountain Transit (GMT) #86 Montpelier Link Express, typically operates between Burlington and Montpelier. The Montpelier Link Express stops at the Waterbury Park and Ride on Lincoln Street; South Main Street at People’s United Bank and opposite Park Row; and the Waterbury State Complex. On a typical day, the Montpelier Link Express stops at the Waterbury Park & Ride at 4:45 pm and at the Waterbury State Complex at 4:55pm. Relocating the Park & Ride and commuter bus stop temporarily from the existing location on Lincoln Street to the nearby Shaw’s parking lot on VT 100 is an option that would maintain service without a significant impact on the commuter bus schedule.

Considerations that will require community input during the alternatives phase include:

- Providing an alternate temporary location for the Waterbury Park and Ride at Shaw's
- Maintaining pedestrian access at the site during construction
- Access to Lincoln Street
- Emergency services response time to Lincoln Street
- School bus access to Thatcher Brook Elementary School
- School pedestrian access to Thatcher Brook Elementary School

Advantages: This option would eliminate the need for phasing construction and a temporary bridge, which would significantly decrease cost and time of construction. This option reduces the time and cost of the project both at the development stage and construction. The Town of Waterbury would reduce their local share by 50% for choosing to close the bridge during construction per ACT 153.

Disadvantages: Traffic flow would not be maintained through the project site during construction. Maintaining pedestrian mobility through the project area will be difficult. Further alternatives would need to be considered for Park and Ride users, pedestrian traffic and school bus traffic.

7.2 OPERATION 2: PHASED CONSTRUCTION

Phased construction is the maintenance of traffic on the existing bridge while building the proposed structure one lane at a time. This allows keeping the road open during construction, while having minimal impacts to adjacent property owners and environmental resources. Given the narrow width of the existing structure, and limited length for queuing traffic on the VT 100 side of the bridge, phased construction is not preferred at this site due to safety and functional concerns.

7.3 OPERATION 3: TEMPORARY BRIDGE

The existing roadway geometry accompanied with the proximity of the VT Route 100 intersection, make constructing a temporary alignment sufficient for transit traffic and larger vehicles very tight. Permanent or temporary Right-of-Way would need to be acquired and utilities and existing signals relocated. The location of a temporary bridge further upstream of the existing would result in having Stowe Street offset from the current intersection resulting in complication with queuing traffic and traffic flow through both VT 100 intersections (Blush Hill and a temporary Stowe Street Intersection).

Significant additional costs would be incurred to use a temporary bridge, including the cost of the bridge itself, installation and removal, restoration of the disturbed area, and the time and money associated with the temporary Right-of-Way. If used, a two-way temporary bridge would be appropriate based on the daily traffic volumes. Including a temporary bridge to accommodate pedestrians, may be a viable option.

7.4 OPERATION 4: TEMPORARY PEDESTRIAN BRIDGE

Adding a temporary pedestrian facility is a feasible option. It could be placed along the alignment of the existing sewer line, which may need to be supported during construction anyway.

It should be noted that the Town of Waterbury would not be able to reduce their local share by 50% for choosing to close the bridge during construction. Including a temporary pedestrian bridge also negates the option for a reduced local share under ACT 153.

7.5 OPERATION 5: NO PEDESTRIAN ACCOMMODATIONS

There may be justification for not including pedestrian access during a bridge closure:

- Current condition is not ADA accessible
- Existing sidewalk ends at northerly bridge terminus with no pedestrian connection to VT 100
- A temporary pedestrian crossing would likely put more pedestrians in the construction work zone. Ushering pedestrians through the construction zone is dangerous and can attract onlookers, increasing their risk.

8.0 ALTERNATIVES DISCUSSION

8.1 ROADWAY IMPROVEMENTS AND PEDESTRIAN CONNECTIONS TO EXISTING AND PROPOSED SIDEWALKS.

As discussed above, Stantec developed a design for roadway and intersection improvements that would improve intersection turning geometry, sight distance and improve the level of service at the intersections. This plan includes a right-turn lane. Figures in this report currently show 12 foot lanes and 3 foot shoulders. The Town has the option to utilize 4 foot shoulders and 11 foot lanes or 3 foot shoulders with 12 foot lanes.

The Town has committed to providing pedestrian improvements in this area with the Waterbury STP BP17(11) grant. The high cost of sidewalk relocation on Bridge 36 has delayed the pedestrian project until a point when that work will be included as part of a larger bridge project. The Town would prefer having the sidewalk on the upstream side of the bridge to tie in with planned pedestrian improvements on the south side of VT 100 east of the VT 100 intersection. Moving the sidewalk to the upstream fascia raises questions about how to tie into the existing sidewalk network on the west side of Stowe Street south of the bridge. Stantec developed a potential sidewalk configuration that continues the sidewalk on the east side of Stowe Street until reaching the northern terminus of North Street, where it would be connected with a cross-walk to the existing sidewalk on the west side of Stowe Street.

This configuration is depicted in Figure 11 which is referred to as a common feature plan, intended to summarize proposed roadway improvements for all “build” alternatives being considered.

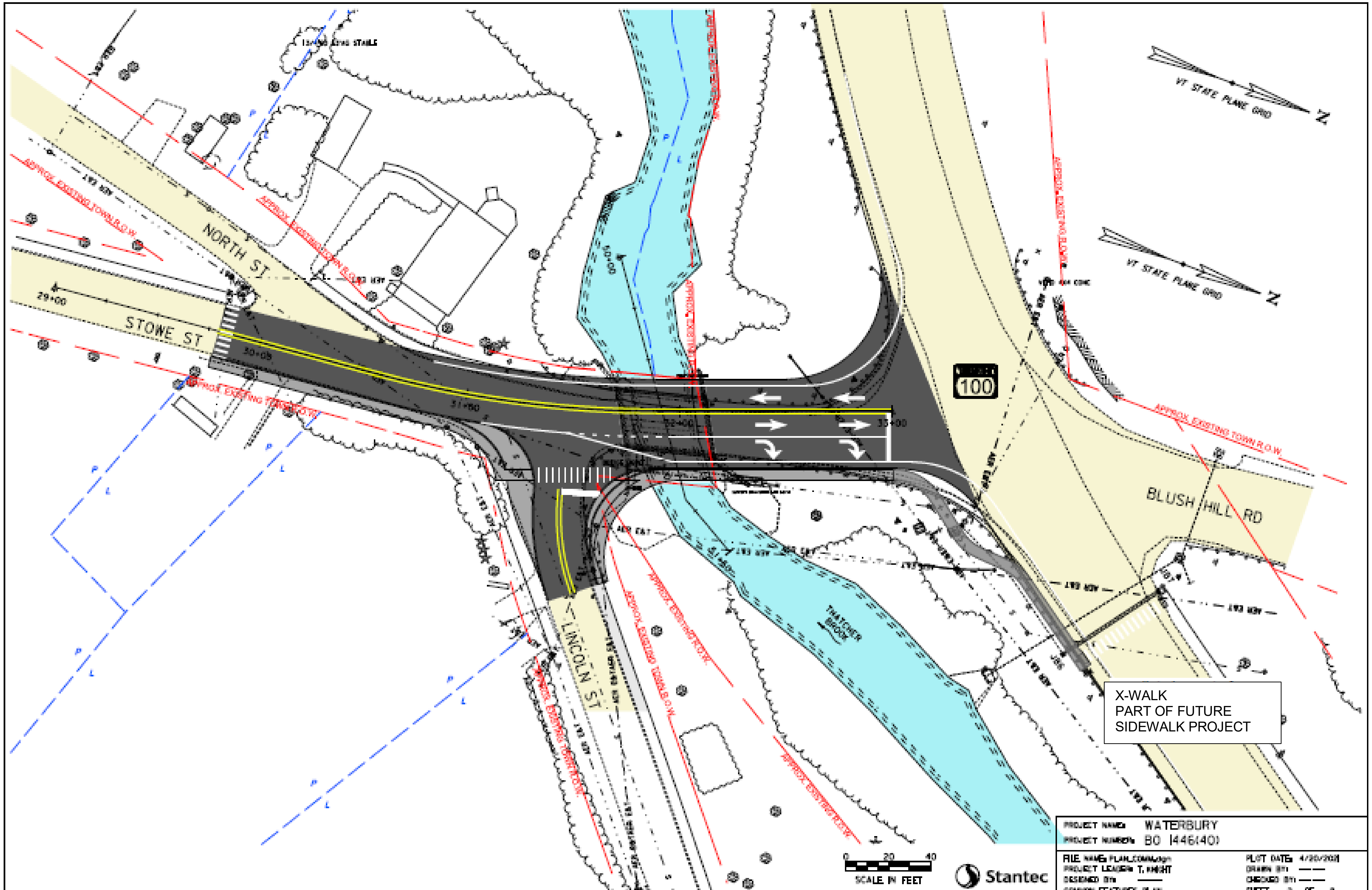

Figure 11 Common Features to all Build Alternatives Considered

8.2 NO ACTION

Bridge 36 is a 1928 Concrete T-Beam structure. During the 2018 NBIS inspection, the 90-year old structure was rated to be in fair condition. While the structure is not in danger of an imminent collapse, it would need to be replaced in the near future. If no action is taken, then the structure would likely need to be taken out of service. This alternative is not recommended.

8.3 ALTERNATIVE 1: SUPERSTRUCTURE AND SUBSTRUCTURE REPAIRS

In order to keep Bridge 36 in service, superstructure repairs would likely be needed within the next 5-10 years. The concrete on the T-beams have begun spalling and delaminating in multiple areas. The deck exhibits signs of unsound concrete and saturation. In 2017, the deck was rated as poor but was changed to fair in 2018 after it was sounded.

The proposed superstructure repairs would consist of removing deteriorated concrete from the deck and patching these areas with new concrete and galvanic anodes. In addition, any exposed reinforcing steel and delamination on the concrete T-Beams would need to be repaired using an overhead patching material. The costs of patching the superstructure are not significant; however, a considerable amount of the project costs would be because of traffic control, containment of debris, and contractor mobilization. Due to the age, current condition of the structure, and its exposure to moisture, any repairs would result in limited improvements to the service life. This combined with the project costs does not make repairing the superstructure a cost-effective option. The goal of these repairs would be to extend the service life of the structure if replacement is not a viable option. This alternative is not recommended.

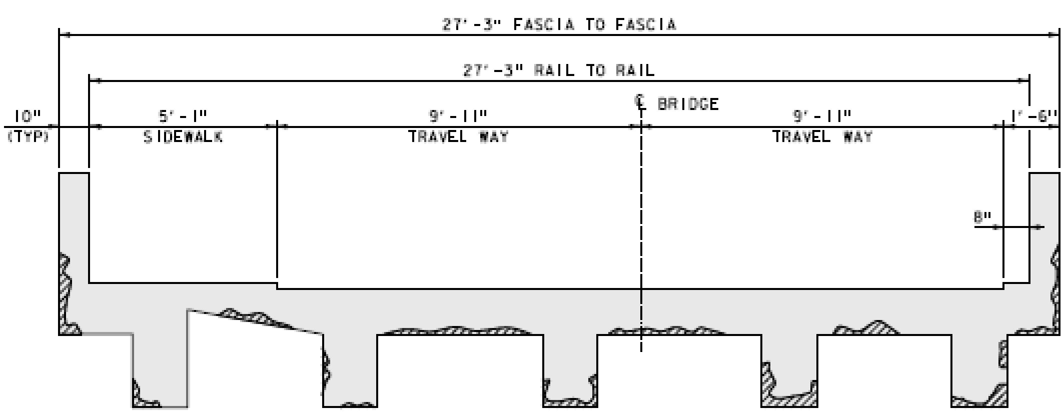

Figure 12 Alternative 1 - Typical Bridge Section

Advantages: This alternative would temporarily extend the service life of the structure with a minimal construction cost and would have less impacts to traffic and the adjacent properties and resources.

Disadvantages: The existing structure does not meet ANR Bank Full Width, however it still meets VTrans Hydraulics Standard. While this alternative does marginally increase the service life, it is not significant and results in a high annualized cost.

Maintenance of Traffic: This alternative may be constructed under phasing or short-term lane closures. A temporary bridge and off-site detour are also possible but not recommended.

8.4 ALTERNATIVE 2: SUPERSTRUCTURE REPLACEMENT WITH WIDENED SUBSTRUCTURE

This alternative would involve removing the existing superstructure and backwall in its entirety, as well as removing upstream and downstream portions of the existing substructure. The substructure would be widened to accommodate a wider superstructure and the new alignment and roadway configuration. The bridge superstructure would be replaced with a conventional steel beam and concrete deck superstructure.

As noted earlier, the existing structure meets VTrans Hydraulics Standards but does not meet the Agency of Natural Resources Bank Full Width criteria. Since the existing substructure is likely founded on bedrock, scour would not be an issue with the proposed structure and the hydraulics can be considered satisfactory despite not meeting bank full width.

In order to reconstruct the existing abutment to accommodate the new superstructure, the existing wingwalls would need to be removed along with a portion of the abutment that lies within the bridge seat. The new portions of the substructure would be constructed on spread footings and their length would be extended significantly in order to support the widened structure and roadway configuration. Overall, the existing substructure was noted to be in fair condition with most of the deterioration occurring on the wing walls, which would be removed. However, it is unlikely that the service life of the existing portions of the substructure would line up with that of the superstructure due to its age and current condition. This makes this option less practical from a cost standpoint and, overall, is not recommended.

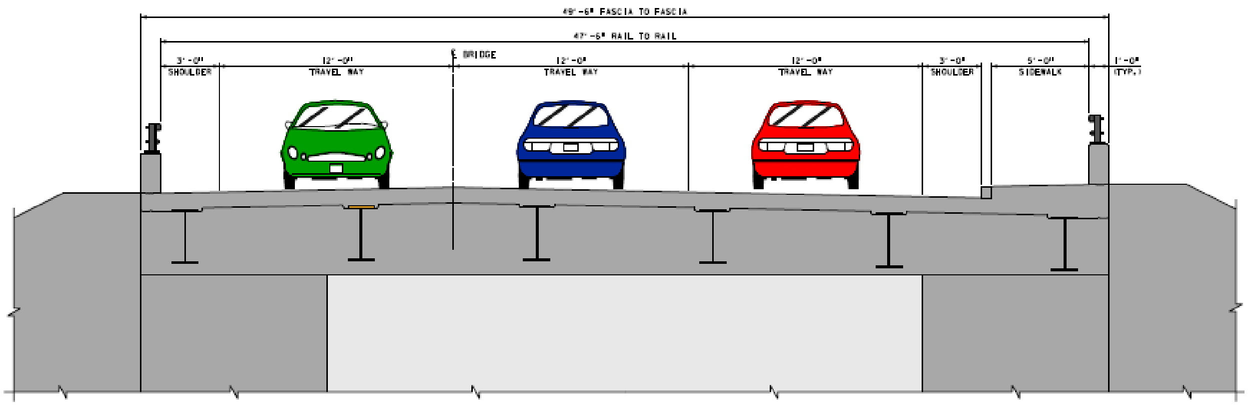

Figure 13 Alternative 2 - Typical Bridge Section

Advantages: This alternative would extend the service life of the structure and address the structural issues of the existing bridge. Roadway and intersection improvements are compatible with this approach. It also has a lower up-front construction cost than both full bridge replacement options.

Disadvantages: The existing structure does not meet ANR Bank Full Width. While this alternative does increase the service life, the new superstructure would have a design life that exceeds that of the substructure resulting in higher annualized costs than the two full replacement options.

Maintenance of Traffic: It is recommended that this option is constructed with traffic maintained on either a temporary bridge or an off-site detour with the off-site detour being the preferred option.

8.5 ALTERNATIVE 3: BRIDGE REPLACEMENT – BURIED STRUCTURE

This alternative would involve the removal of the existing structure in its entirety and replacing it with a buried concrete structure. The new structure would have a 100-year design life. The proposed structure would have a minimum hydraulic width of 50'-0" with a 15'-4" rise measured from the bottom of the streambed. The proposed structure would meet the ANR Bank Full Width criteria of a minimum clear span of 45'-0". The proposed structure length would be approximately 72'-0" to accommodate the widened roadway, new alignment, and channel skew.

Buried structures have significant maintenance advantages over conventionally constructed. Due to the soil above the concrete surfaces, they are less exposed to chlorides and other elements that accelerate the deterioration of bridges. Buried structures also lack any expansion joint further reducing the maintenance involved by removing a high-maintenance element of bridges. Because of the advantages of maintaining the structure over its design life and its low annualized cost, this is the preferred alternative.

Structure Type: For the purposes of this scoping study a CONSPAN precast arch was investigated as the preferred structure type. These structures have been commonly used in Vermont with success. However, other structure types can be feasibly used at this site. For example, a composite arch bridge system may be a viable option that should be considered later in design.

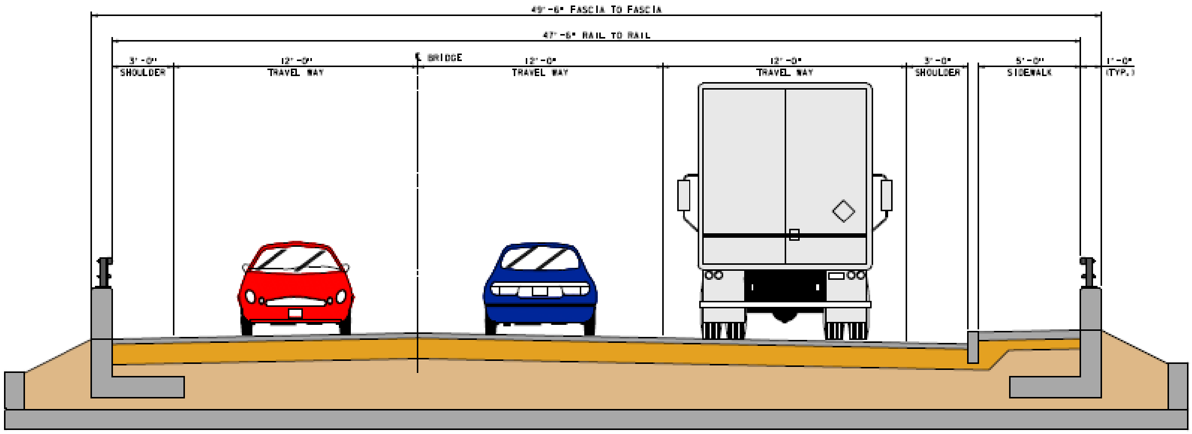

Figure 14 Alternative 3 - Typical Bridge Section

Advantages: This alternative has the longest service life and the lowest annualized costs of the proposed alternatives. Buried structures also have minimal exposure to chlorides and have less long-term maintenance associated with them. Since the structure is mostly precast concrete, it has a shorter construction duration than a conventional bridge replacement, minimizing the impacts to vehicular and pedestrian traffic. The new bridge can also be constructed with the new roadway configuration, creating a safer and more efficient intersection.

Disadvantages: This alternative has a higher up-front construction cost and would impact the adjacent properties.

Maintenance of Traffic: It is recommended that this option is constructed with traffic maintained on either a temporary bridge or an off-site detour with the off-site detour being the preferred option.

8.6 ALTERNATIVE 4: BRIDGE REPLACEMENT – STEEL BEAM SUPERSTRUCTURE

This alternative would replace the existing Concrete T-Beam structure with a Steel Beam Superstructure on a new foundation. In order to meet bank full width, the new structure should have a minimum clear span of 45'-0". A skew of 15 degrees is recommended to match the stream alignment. For the purposes of this scoping study, a 65'-0" long span was considered. Beyond the structure's hydraulics, the longer span has several advantages. Setting the abutments back from the channel reduces the need for dewatering by utilizing the existing abutments. The increased length also reduces the overall wingwall length and provides a better fit to the existing channel. These cost savings negate the increased costs from a longer bridge length.

Superstructure Type: A conventional steel structure with a cast-in-place concrete deck is the recommended option for this alternative. Due to the high curvature of the deck fascia, this would make precast concrete a costly and impractical alternative. Prefabricated Bridge Units would also be difficult to use as the deck ends would likely require a splayed girder. The uneven weight distribution from the splayed girder would complicate the erection and details of the PBU's. Since this project would either use a short off-site detour or a temporary bridge, there is little advantage to accelerating the construction of the project.

Substructure Type: Bedrock appears to be visible near the streambed and it is likely that shallow bedrock is located at the project site. Borings should be taken to determine the depth of bedrock. Both reinforced concrete abutments and integral abutments may be feasible substructure options. If dewatering is necessary for the construction of the spread footings, consideration should be given to pre-drilling for integral abutment piles to reduce construction costs.

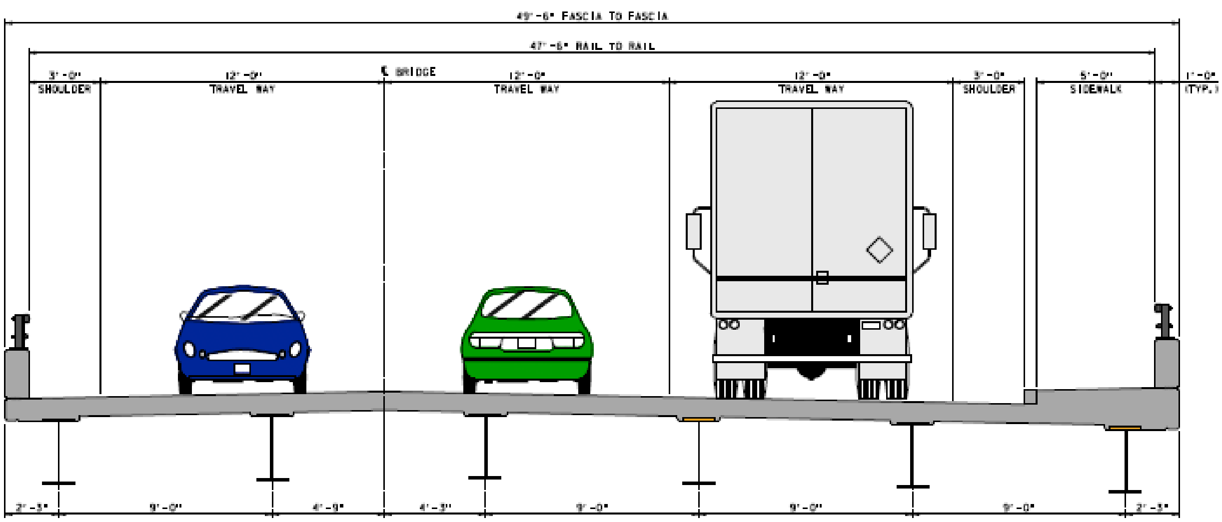

Figure 15 Alternative 4 - Typical Bridge Section

Advantages: This alternative has a 100-year design life with low annualized costs. The new bridge can also be constructed with the new roadway configuration, creating a safer and more efficient intersection.

Disadvantages: This alternative has a higher up-front construction cost and higher life cycle costs due to maintenance than the Bridge Replacement – Buried Structure Alternative. Construction activities would impact the adjacent properties.

Maintenance of Traffic: It is recommended that this option is constructed with traffic maintained on either a temporary bridge or an off-site detour with the off-site detour being the preferred option.

8.7 ALTERNATIVES EVALUATION MATRIX

Waterbury BO 1446(40)		Do Nothing	Alt 1a	Alt 2a Offsite Detour	Alt 2b Temporary Bridge[4]	Alt 3a Offsite Detour	Alt 3b Temporary Bridge[4]	Alt 4a Offsite Detour	Alt 4b Temporary Bridge[4]
			Superstructure Rehabilitation	Superstructure Replacement, Widened Existing Substructure		Bridge Replacement - Buried Structure		Bridge Replacement - Steel Beam Superstructure	
			Phased Construction	Offsite Detour	Temporary Bridge	Offsite Detour	Temporary Bridge	Offsite Detour	Temporary Bridge
COST[1]	Bridge Cost	$0	$250,000	$1,200,000	$1,200,000	$1,600,000	$1,600,000	$1,800,000	$1,800,000
	Removal of Structure	$0	$0	$50,000	$50,000	$150,000	$150,000	$150,000	$150,000
	Roadway	$0	$0	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000
	Maintenance of Traffic	$0	$120,000	$75,000	$350,000	$75,000	$350,000	$75,000	$350,000
	Construction Costs	$0	$370,000	$1,825,000	$2,100,000	$2,325,000	$2,600,000	$2,525,000	$2,800,000
	Construction Engineering & Contingencies	$0	$70,000	$370,000	$420,000	$470,000	$520,000	$510,000	$560,000
	Total Construction Costs	$0	$440,000	$2,195,000	$2,520,000	$2,795,000	$3,120,000	$3,035,000	$3,360,000
	Preliminary Engineering[2]	$0	$90,000	$435,000	$500,000	$560,000	$620,000	$610,000	$670,000
	Right of Way	$0	$0	$20,000	$30,000	$20,000	$30,000	$20,000	$30,000
	Total Project Costs	$0	$530,000	$2,650,000	$3,050,000	$3,375,000	$3,770,000	$3,665,000	$4,060,000
	Annualized Costs	$0	$35,333	$53,000	$61,000	$45,000	$50,267	$48,867	$54,133
TOWN SHARE			$26,500	$66,250	$152,500	$168,750	$377,000	$183,250	$406,000
TOWN %			5%	2.5%	5%	5%	10%	5%	10%
SCHEDULING	Project Development Duration[3]		4 years	4 years	4 years	4 years	4 years	4 years	4 years
	Construction Duration		2 Months	6 Months	9 Months	6 Months	9 Months	6 Months	9 Months
	Closure Duration (If Applicable)		N/A	3 Months	N/A	3 Months	N/A	3 Months	N/A
Engineering	Typical Section - Roadway (feet)	21'	21'	42'	42'	42'	42'	42'	42'
	Typical Section - Bridge (feet)	21'	21'	42'	42'	42'	42'	42'	42'
	Geometric Design Criteria		No improvement	Meets Standards	Meets Standards	Meets Standards	Meets Standards	Meets Standards	Meets Standards
	Traffic Safety	No Change	No Change	Improved	Improved	Improved	Improved	Improved	Improved
	Alignment Change	No Change	No Change	Yes	Yes	Yes	Yes	Yes	Yes
	Bicycle Access	No	No	Yes	Yes	Yes	Yes	Yes	Yes
	Pedestrian Access	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Hydraulics	Substandard	Substandard	Meets Standards	Meets Standards	Meets Standards	Meets Standards	Meets Standards	Meets Standards
	Utilities	No Change	No Change	Relocation of Aerial and Buried	Relocation of Aerial and Buried	Relocation of Aerial and Buried	Relocation of Aerial and Buried	Relocation of Aerial and Buried	Relocation of Aerial and Buried
Other	ROW Acquisition	No Change	No Change	Yes	Yes	Yes	Yes	Yes	Yes
	Road Closure	N/A	No	Yes	No	Yes	No	Yes	No
	Design Life	<10 Years	15	50	50	75	75	75	75

[1] Costs are estimates only, used for comparison purposes.
[2] Preliminary Engineering costs are estimated starting from the end of the Project Definition Phase.
[3] Project Development Durations are starting from the end of the Project Definition Phase.
[4] A vehicular Temporary Bridge is assumed. A Pedestrian Temporary Bridge may be substituted for a slightly reduced cost (-$100,000).

9.0 CONCLUSIONS AND RECOMMENDATIONS

All build alternatives include similar roadway improvements including 3 lanes on the bridge and a sidewalk on the upstream side of the bridge extending from a cross walk at the top of North Street to the proposed future cross walk on VT100 North. The Town has the option to utilize 4 foot shoulders and 11 foot lanes on Stowe Street or to use 3 foot shoulders with 12 foot lanes.

Based on the alternatives evaluation, Stantec and VTrans recommend Alternative 3a which is a full bridge replacement with a buried structure utilizing an offsite detour to maintain traffic during construction. Alternative 3a utilizes accelerated construction to minimize the duration of the offsite detour with a target duration of 60 days.

Recommended Scope

- Full Bridge Replacement with Buried Structure:
- Traffic Maintained on an Offsite Detour with shuttle Option for PedestrianTraffic
- 60 day proposed closure, detour signed by Town
- 3 Lanes on Bridge 12'/3' (or 11'/4') typical with a 5-foot wide sidewalk on the upstream fascia
- Span length of approximately 50'
- Substructure on ledge
- Historic railing
- 75-year design life
- Right of Way Needed
- Minor Aerial Utility Relocation

Municipal Utility Relocation appendices

APPENDIX A

Local and Regional Input Questionnaire

Town of Waterbury, Stowe St. Bridge – Existing Conditions Study - Community Considerations

1. *Are there any scheduled public events in the community that will generate increased traffic (e.g. vehicular, bicycles and/or pedestrians), or may be difficult to stage if the bridge is closed during construction? Examples include bike races, festivals, parades, cultural events, farmers market, concerts, etc. that could be impacted? If yes, please provide date, location and event organizers' contact info.*

   Currently the events that generate the heaviest traffic are the Stowe Lacrosse Tournament that was on July 14-15 and July 21-22. This impacts traffic that is primarily traveling north on Route 100 / Waterbury-Stowe Rd. from Exit 10 but the traffic also backs up into Waterbury village. The other heavy traffic weekend is the Antique Car Show that will be on August 10, 11 and 12 at Farr's Field on Route 2, west of Waterbury village. This event will impact congestion in the I-89 Exit 10 interchange area.

2. *Is there a "slow season" or period of time from May through October where traffic is less?*

   There is not very much of a "slow season" for the vicinity of I-89 Exit 10. The spring months, once the ski areas close, are somewhat "slow". The period in September from Labor Day to the start of foliage season may be "slow" as well.

3. *Please describe the location of emergency responders (fire, police, ambulance) and emergency response routes.*

   The Waterbury Fire Stations are located at 43 S. Main St. in Waterbury village and 158 Maple St. in Waterbury Center. The State Police serve Waterbury from their barracks in Middlesex. The Waterbury Ambulance Service is located at 1727 Guptil Rd. in Waterbury Center. Stowe St. is not a common route for these emergency services unless there is a call for response to a site on or directly off Stowe St.

4. *Are there businesses (including agricultural operations) that would be adversely impacted either by a detour or due to work zone proximity?*

   The Grist Mill is located at 92 Stowe St. and houses three businesses including the Hen of the Wood Restaurant. The restaurant is a popular destination eating establishment that requires reservations well in advance and is easily accessed from the south end of Stowe St. It is unlikely that a detour would adversely impact the restaurant or the other businesses in the building that include an upholstery shop and ceramic studio / gallery. The businesses in the most southerly block of Stowe St. are typically accessed from Main St. or other nearby side streets and should not be adversely impacted by a detour either.

5. *Are there important public buildings (town hall, community center, senior center, library) or community facilities (recreational fields, town green, etc.) close to the project?*

   The Waterbury Area Senior Center is located in the first block of Stowe St. off Main St. and would not be adversely impacted.

6. *What other municipal operations could be adversely affected by a road/bridge closure or detour?*

   The Water, Wastewater, and Highway Departments all use Stowe St. frequently but could still serve the Stowe St. and Perry Hill Rd. areas adequately with detours. Winter plow routes in the area would have to be altered with some small additional time required.

7. *Are there any town highways that might be adversely impacted by traffic bypassing the construction on another local road?*

   There would be some impact to Perry Hill Rd. since it would be one of the detour routes. A significant portion of Perry Hill Rd. is gravel surfaced so additional grading may be needed during the time of the closure of Stowe St. at the bridge.

8. *Is there a local business association, chamber of commerce or other downtown group that we should be working with?*

   Revitalizing Waterbury, Inc. is very involved in our transportation projects and assisting the businesses that may be negatively impacted during the construction periods for these projects.

<u>Schools</u>

1. *Where are the schools in your community and what are their schedules?*

   The Thatcher Brook Primary School is located at 47 Stowe St. The regular school schedule starts at about 7:45 a.m. and ends at about 2:30 p.m. Closure of Stowe St. at the bridge would impact the bus routes that access the school since many of the buses come and go from the school on Stowe St. to serve the most populous areas of Waterbury. Most of these buses could detour the bridge without a serious impact to their service and schedules.

2. *Is this project on the specific routes that students use to walk to and from school?*

   Most of the students that walk or bike to school live to the south and east of the bridge and would not be seriously impacted by a bridge closure.

3. *Are there recreational fields associated with the schools (other than at the school)?*

   The Town has recreation fields at Dascomb Rowe Field located at 32 N. Main St. and Anderson Field, that includes our Municipal Pool and Recreation Building, located at 25-29 Butler St. off N. Main St. These facilities would not be seriously impacted by a bridge closure.

Pedestrians and Bicyclists

1. *What is the current level of bicycle and pedestrian use on the bridge?*

   There is a moderate amount of pedestrian and bicycle use of the bridge. Since the village sidewalk currently ends on the north side of the bridge, that limits the amount of pedestrian use of the bridge but people still walk up and down Route 100 / Waterbury-Stowe Rd. and Blush Hill Rd. and use the bridge to access Waterbury village.

2. *Are the current lane and shoulder widths adequate for pedestrian and bicycle use?*

   No - the lane and shoulder widths are too narrow for bicycle use and the existing sidewalk on the bridge is in poor condition and is inadequate as well.

3. *Does the community feel there is a need for a sidewalk on the bridge?*

   We definitely need a sidewalk on at least one side of the bridge to tie into the pedestrian facilities for the intersection with Route 100 / Waterbury-Stowe Rd. and its vicinity that are currently in design and will be constructed.

4. *Is pedestrian and bicycle traffic heavy enough that it should be accommodated during construction?*

   There are different opinions about this issue as expressed at the Local Concerns meeting on July 17th. It is unlikely that pedestrian and bicycle traffic is currently heavy enough that it needs to be accommodated with the significant additional cost during construction, especially if the bridge is closed and replaced under the accelerated bridge program. If however, the existing bridge can be used while a new bridge is under construction and pedestrians and bicyclists can be accommodated with a minor amount of additional cost, then those accommodations should be considered.

5. *Does the Town have plans to construct either pedestrian or bicycle facilities leading up to the bridge? Please provide a planning document demonstrating this (scoping study, master plan, corridor study, town plan).*

   The Broadreach Planning & Design, Colbyville Pedestrian/Bicycle Scoping Study and the current VTrans Bike/Ped grant funded design and construction project includes pedestrian and bicycle facilities leading from the bridge through the intersection of Route 100 / Waterbury-Stowe Rd.

and Stowe St. / Blush Hill Rd. A recent VTrans Enhancement Grant funded project constructed sidewalk on Stowe St. from the Thatcher Brook Primary School to the bridge.

6. *In the vicinity of the bridge, is there a land use pattern, existing generators of pedestrian and/or bicycle traffic, or zoning that will support development that is likely to lead to significant levels of walking and bicycling?*

   There is a 26-lot single-family house planned unit development that is off Perry Hill Rd. nearby the bridge that is approximately ½ constructed that is already a generator of additional pedestrian and bike traffic. Also the 60-unit Blush Hill Meadows apartment complex that is across Route 100 / Waterbury-Stowe Rd. from the Shaw's supermarket in Colbyville is a potential generator of both pedestrian and bicycle traffic. Both the nearby Best Western Inn and Fairfield Inn in Colbyville generate a significant amount of pedestrian traffic that includes guests that walk down Stowe St. to downtown Waterbury. Other similar projects could occur in the vicinity of the bridge, especially under revisions / amendments to the current zoning and subdivision regulations that are being considered.

Communications

1. *Please identify any local communication channels that are available for us to use in communicating with the local population. Include weekly or daily newspapers, blogs, radio, public access TV, Front Porch Forum, etc. Also include any unconventional means such as local low-power FM.*

   The following communication channels should be utilized: The Waterbury Record weekly newspaper, WDEV radio, ORCA Media public access TV in Montpelier, Waterbury / Duxbury Front Porch Forum, and the Town of Waterbury website.

Design Considerations

1. *Are there any concerns with the alignment of the existing bridge? For example, if the bridge is located on a curve, has this created any problems that we should be aware of?*

   The alignment of the bridge in relationship to the nearby intersection with Route 100 / Waterbury-Stowe Rd. is skewed which is not ideal, especially for the Link Express bus and school buses which go over the bridge frequently.

2. *Are there any concerns with the width of the existing bridge?*

   The existing bridge has a total roadway width of approximately 20' which is very inadequate, especially for buses.

3. *Are there any special aesthetic considerations we should be aware of?*

   The bridge is a gateway into Waterbury village and aesthetics are very important for the gateways to our villages. There is also a need for traffic calming in this location, especially for vehicles coming off Route 100 / Waterbury-Stowe Rd. and Blush Hill Rd., going south and downhill on Stowe St. There are many families with young children living in this area who walk and bike through the neighborhood. Vehicles need to be encouraged / required to slow down, especially for safety reasons. Lighting on the bridge and the nearby intersections, including the Stowe St. / Lincoln St. intersection should be taken into consideration in conjunction with replacing / rehabilitating the bridge.

4. *Does the location have a history of flooding? If yes, please explain.*

   Thatcher Brook, that flows under the bridge, is prone to flooding. This is more of an issue with potential undermining of and damage to the wing walls and abutments for the bridge than the superstructure and roadway which are well above the 100-year floodplain.

5. *Are there any known Hazardous Material Sites near the project site?*

   There are none that we are aware of.

6. *Are there any known historic, archeological and/or other environmental resource issues near the project site?*

   The bridge is a gateway to the Mill Village Historic District that is south of the bridge along Stowe St. There are numerous old mill sites with remnants of the old dams in the Mill Village area and Colbyville to the north. There is one existing grist mill in Mill Village that has been restored for other uses including the Hen of the Wood restaurant. There are no known archeological or historic sites in the immediate vicinity of the bridge. Our understanding is that there are no mapped wetlands in the immediate vicinity of the bridge as well.

7. *Are there any other comments that are important for us to consider?*

   None at the current time.

<u>Land Use & Zoning</u> (to be filled out by the municipality or RPC).

1. *Please provide a copy of your existing and future land use map or zoning map, if applicable.*

   The Future Land Use Map from the Municipal Plan, and the Zoning Map for Waterbury village from the Zoning Regulations are attached.

2. *Is there any existing, pending or planned development proposal that would impact future transportation patterns near the bridge? If so please explain.*

   There are no major new developments proposed or permitted in the vicinity of the bridge other than the build-out of the 26-lot single-family house planned unit development that is off Perry Hill Rd. and the 60-unit Blush Hill Meadows apartment complex that are described above.

3. *Is there any planned expansion of public transit service in the project area? If not known please contact your Regional Public Transit Provider.*

   We are not aware of any proposed expansions of the public transit service in the project area. The existing Park & Ride lot off Lincoln St. already serves as a hub for the Green Mountain Transit Link Express, Morrisville Commuter, and Waterbury Commuter buses.

APPENDIX B

Operations Input Questionnaire

Bridge Scoping Project – To Be Determined
Operations Input Questionnaire

The Structures Section has begun the scoping process for Stowe Street Bridge over Thatcher Brook Bridge 36. This is a Concrete T-Beam bridge constructed in the 1920's. The Structure Inspection, Inventory, and Appraisal Sheet (attached) rates the deck as 5 (Fair), the superstructure as 5 (Fair), and the substructure as 5 (Fair). We are interested in hearing your thoughts regarding the items listed below. Leave it blank if you don't wish to comment on a particular item.

1. Your thoughts on the general condition of this bridge and the general maintenance effort required to keep it in service.

   As VTRANS Bridge Inspection reports state the bridge continues to deteriorate and replacement needs to happen in the next 10 years. VTRANS has increased inspection to annual. In the past 10 years the Town has done three repair projects and prior to that the concrete tee beams were patched. The patching has started to significantly spall exposing rebar. The Town feels it is better to quickly plan for a new bridge rather than to continue to spend monies on short-term repairs.

2. Any comments on the geometry of the bridge (curve, sag, banking, sight distance)?

   Bridge is too narrow for especially large vehicles crossing the bridge in either direction due to the existing alignment. Alignment makes turning off Lincoln Street onto the bridge difficult for any size vehicle. Sidewalk on the bridge is too narrow.

3. Do you feel the posted speed limit is appropriate?
   Yes

4. Is the width adequate for snow plowing?

   Per Randy Guyette, Asst. Highway Foreman, who has plowed the Village for many years the existing bridge width is not adequate for plowing. When his plow truck is carrying the wing he crosses over into the other lane so he ends up sometimes waiting for traffic to move through the bridge. Even without the wing his plow creeps up on the existing sidewalk.

5. Are the joints salvageable or would you recommend replacement?

   There are no visible expansion joints but whatever is there needs to be replaced along with the rest of the entire existing bridge.

6. Are the railings constantly in need of repair or replacement? What type of railing works best for your district?

   Existing bridge railings are concrete and have not required repair. The Town is open to all options for new railing types on a new bridge.

7. Are you aware of any unpermitted driveways within the likely project limits? We frequently encounter driveways that prevent us from meeting railing standards and then discover them to be illegal.

   No

8. Are you aware of abutting property owners that are likely to need special attention during the planning and construction phases? These could be people with disabilities, elderly, or simply folks who feel they have been unfairly treated in the past.

   Property owner directly across from the bridge on Stowe Street has complained about GMTA buses going up on his lawn as well as large vehicles. Need to keep him in the loop during planning phase.

9. Do you find that extra effort is required to keep the slopes and river banks around the bridge in a stable condition? Is there frequent flood damage that demands repair?

   No. The bridge has experienced minor erosion to top of footings when flow rises above the top of footings. Not judge serious enough at this time. Bridge did experience undercutting of easterly footing and the Town had Austin Construction drive sheeting adjacent to the footing to minimize future undercutting of the footing.

10. Does this bridge seem to pick up an unusual amount of debris from the waterway?
    No

11. Do you think a closure with off-site detour and accelerated construction would be appropriate? What should we consider for a detour route, assuming that we use State route for State projects and any route for Town projects?

    This may be the best and fastest option because there is little room for a temporary bridge adjacent to the existing bridge. Detour route will utilize Stowe Street as the main detour. While much longer in road length access to Perry Hill and side roads off Perry Hill can come off Guptil Road/Kneeland Flats Roads

12. Please describe any larger projects that you have completed that may not be reflected on the attached Appraisal sheet, such as deck patches, paving patches, railing replacement with new type, steel coating, etc.

    The Town has in chronologic order patched the concrete tee beams, rehabbed the upstream ends of both wing walls to better support a critical gravity sewer that crosses Thatcher Brook, drove sheeting on the downstream east side to minimize under cutting of the bridge footing and most recently repaired the west upstream wing wall.

13. If there is a sidewalk on this bridge, how effective are the Town's efforts to keep it snow and ice free?

    A recent sidewalk project brought a new sidewalk up to the bridge sidewalk. This project did bring the sidewalk plow to the bridge sidewalk more often allowing for more frequent sidewalk plowing. However road plowing across the bridge dumps snow onto the sidewalk and with the solid concrete railing snow cannot be pushed through the concrete railing and off the bridge sidewalk.

14. Are there any drainage issues that we should address on this project?

    The existing grade between the bridge and VT 100 results in runoff coming down to the bridge which has resulted in wing wall deterioration. The runoff also deposits sediment onto the bridge.

15. Are you aware of any complaints that the public has about issues that we can address on this project?

    GMTA has complained about the narrowness and alignment issues which requires their large buses to cross over into the other lane or even up on the sidewalk when crossing the bridge. Public complains about the condition of the sidewalk, closeness to the road, narrowness of the sidewalk and that the sidewalk ends on the west end of the bridge.

16. Anything else?

APPENDIX C

Contaminated Site List

Waterbury Contaminated Site List

Site#	Site Name	Site Address	Site Town	Site County	Priority	Discovery Date	Closure Date	Primary Consultant
20134435	Best Western Waterbury	45 Blush Hill Rd.	Waterbury		LOW	06-12-2013		Wheeler Environmental Services
890359	Billings Mobil	Route 100	Waterbury	Washington	SMAC	01-01-1989	10-22-2012	GES
992666	Waterbury Mobil	758 Waterbury Stowe Rd	Waterbury	Washington	SMAC	09-17-1998	08-10-2001	Groundwater and Environmental Services
972296	Ben And Jerrys Homemade Inc	Route 100	Waterbury	Washington	SMAC	09-01-1997	01-30-2004	Sprague Geoscience
20184788	14 South Main Street	14 South Main Street	Waterbury		LOW	05-10-2018		Ross Environmental Assoc. Inc.
992722	A G Anderson	Railroad St	Waterbury	Washington	SMAC	11-29-1999	11-16-2005	EIV Technical Services
20114145	Bourne's Energy Waterbury Bulk Plant	1983 Waterbury Stowe Rd.	Waterbury		LOW	08-05-2010		Weston & Sampson
20063556	Burt Residence	39 High St	Waterbury	Washington	SMAC	06-26-2006	06-13-2008	Ross Environmental Assoc. Inc.
982502	Caforia Market	Route 100	Waterbury	Washington	LOW	09-28-1998		Vermont HydroGeo LLC
972214	Champlain Farms	1 Main St	Waterbury	Washington	MED	06-27-1997		Aquaterra
921288	D S B Soils	Main St	Waterbury	Washington	NFAP		09-28-1993	N/A
992586	Eagle Oil	Batchelder St	Waterbury	Washington	SMAC	01-05-1999	03-04-1999	Heindel & Noyes
900521	Eagle Oil Co	n/a	Waterbury	Washington	NFAP			N/A
900618	Estroffs Store	Rt 100	Waterbury	Washington	SMAC		08-01-1998	N/A
20022958	Flanders Residence	21 Elm St	Waterbury	Washington	SMAC	11-02-2001	02-19-2003	Heindel & Noyes
20053431	former Coffin/Farnham Property	944 Waterbury-Stowe Rd, Rt 100	Waterbury	Washington	SMAC	09-01-2005	06-28-2007	Environmental Compliance Services Inc
20164673	Former Emery's Store	3627 VT Route 100 (Waterbury-S	Waterbury				01-04-2018	Environmental Compliance Services Inc
20043226	former Keil Property	2032 U S Rt 2	Waterbury	Washington	SMAC	05-14-2004	04-04-2005	Ross Environmental Assoc. Inc.
20144520	GMP Winooski Street Substation	Winooski Street	Waterbury		LOW	08-26-2014		Green Mountain Power Corporation
20144474	Larkin Building	3 South Main St	Waterbury		SMAC	10-23-2013	05-07-2014	Environmental Compliance Services Inc
20053408	Luce Residence	94 Lake View Terrace	Waterbury	Washington	SMAC	07-12-2005	12-21-2005	Ross Environmental Assoc. Inc.
20114231	Northfield Savings Bank	29 South Main St	Waterbury		MED	08-29-2011		Wheeler Environmental Services
20144536	O'Kane Residence	1566 Shaw Mansion Rd	Waterbury		SMAC	09-25-2014	08-03-2015	Environmental Compliance Services Inc
890440	Park Street Well	Park Street	Waterbury	Washington	NFAP	03-01-1989	10-21-1994	Heindel & Noyes
20124285	Ray's Autobody, Inc.	327 US Route 2	Waterbury		LOW	03-12-2012		ATC Group Services LLC
951834	S T Paving	Coffee Lane	Waterbury	Washington	SMAC	04-10-1995	01-22-2001	Hoffer Associates
20053448	Sanders Residence	225 Stuart Lane	Waterbury	Washington	SMAC	10-27-2005	08-10-2007	Wheeler Environmental Services
911158	Smiths Store	Route 100	Waterbury	Washington	LOW	11-21-1991		Sites Management Section - DEC
911184	Snow Valley Sunoco	Route 100	Waterbury	Washington	SMAC	01-01-1992	12-03-2010	DB Environmental
20043253	Thatcher Brook Inn	1017 Waterbury-Stowe Rd	Waterbury	Washington	SMAC	07-22-2004	12-04-2006	EIV Technical Services
20023022	Valley Rent-All	53 N Main St	Waterbury	Washington	SMAC	04-10-2002	06-18-2010	Griffin International Inc
20033131	Vermont Clay Studio	Rt 100N	Waterbury	Washington	SMAC	08-01-2003	04-05-2004	EIV Technical Services
870109	Village Garage	Rt 2, Main St	Waterbury	Washington	SMAC	06-06-1987	06-19-2009	N/A
870155	Walter Pavitt	n/a	Waterbury	Washington	NFAP			N/A
890405	Waterbury B.P.	145 South Main St	Waterbury	Washington	NFAP		12-01-1993	Hoffer Associates
982499	Waterbury Citgo	49 S Main St	Waterbury	Washington	SMAC	08-24-1998	09-23-2002	Griffin International Inc
20144508	Waterbury Community Garden	28 North Main Street	Waterbury		SMAC	07-30-2014	02-23-2016	KAS Inc
20083796	Waterbury Crossroads Citgo	52 N Main St	Waterbury	Washington	SMAC	05-23-2008	05-08-2012	KAS Inc
962068	Waterbury Elementary School	47 Stowe St	Waterbury	Washington	SMAC	09-01-1996	04-01-1997	Griffin International Inc
992710	Waterbury Municipal Dump	Old Dump Rd	Waterbury	Washington	SMAC	11-15-1999	06-20-2008	Heindel & Noyes
870069	Waterbury School	n/a	Waterbury	Washington	NFAP			N/A
911057	Waterbury Town Garage	Guptil Rd	Waterbury	Washington	LOW	01-01-1991		LE Environmental
20012888	WDEV Radio Station	Blush Hill Rd	Waterbury	Washington	SMAC	07-19-2001	07-31-2001	Environmental Products and Services Inc
20144543	Wtby State Office Complex Berm Material	103 South Main Street	Waterbury		LOW			Ross Environmental Assoc. Inc.

APPENDIX D

Structures Inspection Report

STRUCTURE INSPECTION, INVENTORY and APPRAISAL SHEET

Vermont Agency of Transportation ~ Structures Section ~ Bridge Management and Inspection Unit

Inspection Report for : WATERBURY VILLAGE **Bridge No.:** 00036 **District:** 5
Located on: C2002 **over** THATCHER BROOK **approximately** 0.02 MI TO JCT W VT100 **Owner:** TOWN-OWNED

CONDITION

Deck Rating: 5 FAIR
Superstructure Rating: 5 FAIR
Substructure Rating: 5 FAIR
Channel Rating: 6 SATISFACTORY
Culvert Rating: N NOT APPLICABLE
Federal Str. Number: 101218003612181
Federal Sufficiency Rating: 41.8
Deficiency Status of Structure: SD

AGE and SERVICE

Year Built: 1928 **Year Reconstructed:** 0000
Service On: 5 HIGHWAY-PEDESTRIAN
Service Under: 5 WATERWAY
Lanes On the Structure: 02
Lanes Under the Structure: 00
Bypass, Detour Length (miles): 02
ADT: 002830 **% Truck ADT:** 02
Year of ADT: 2007

GEOMETRIC DATA

Length of Maximum Span (ft): 0042
Structure Length (ft): 000044
Lt Curb/Sidewalk Width (ft): 5
Rt Curb/Sidewalk Width (ft): 0.7
Bridge Rdwy Width Curb-to-Curb (ft): 25.3
Deck Width Out-to-Out (ft): 27
Appr. Roadway Width (ft): 027
Skew: 05
Bridge Median: 0 NO MEDIAN
Min Vertical Clr Over (ft): 99 FT 99 IN
Feature Under: FEATURE NOT A HIGHWAY OR RAILROAD
Min Vertical Underclr (ft): 00 FT 00 IN

STRUCTURE TYPE and MATERIALS

Bridge Type: CONCRETE T-BEAM
Number of Approach Spans: 0000 **Number of Main Spans:** 001
Kind of Material and/or Design: 1 CONCRETE
Deck Structure Type: 1 CONCRETE CIP
Type of Wearing Surface: 6 BITUMINOUS
Type of Membrane: 0 NONE
Deck Protection: 0 NONE

APPRAISAL *AS COMPARED TO FEDERAL STANDARDS

Bridge Railings: 0 DOES NOT MEET CURRENT STANDARD
Transitions: 0 DOES NOT MEET CURRENT STANDARD
Approach Guardrail: 1 MEETS CURRENT STANDARD
Approach Guardrail Ends: 1 MEETS CURRENT STANDARD
Structural Evaluation: 4 MEETS MINIMUM TOLERABLE CRITERIA
Deck Geometry: 2 INTOLERABLE REPLACEMENT NEEDED
Underclearances Vertical and Horizontal: N NOT APPLICABLE
Waterway Adequacy: 6 OCCASIONAL OVERTOPPING OF ROADWAY WITH INSIGNIFICANT TRAFFIC DELAYS
Approach Roadway Alignment: 8 EQUAL TO DESIRABLE CRITERIA
Scour Critical Bridges: 8 STABLE FOR SCOUR

DESIGN VEHICLE, RATING and POSTING

Load Rating Method (Inv): 1 LOAD FACTOR(LF)
Posting Status: A OPEN, NO RESTRICTION
Bridge Posting: 5 NO POSTING REQUIRED
Load Posting: 10 NO LOAD POSTING SIGNS ARE NEEDED
Posted Vehicle: POSTING NOT REQUIRED
Posted Weight (tons):
Design Load: 0 OTHER OR UNKNOWN

INSPECTION

Insp. Date: 042018 **Insp. Freq. (months):** 24 **X-Ref. Route:**
X-Ref. BrNum:

INSPECTION SUMMARY and NEEDS

04/12/2018 - Special 12 month inspection of the concrete deck. The deck surface needs cold planing and repaving, as it is getting quite rough. The deck and sidewalk could use some patch repair work when the wearing surface is removed. The northwest wingwall is degrading with some heavy scaling and needs repair to prevent erosion of the approach fill material behind it. The deck is showing its age (90 years) in certain spots, but overall appears generally sound at this time. The deck rating will be raised back up to a 5, as fair for now. However, since the bridge is slowly degrading and extensive repairs are not advised, plans should be made to upgrade the bridge in its entirety in the next 10 to 20 years. ~ MJ/JS

9/6/2017 Deck has advanced to poor with heavy saturation bay 2, other areas along deck soffit also has saturation but not as severe. Failures along the deck is possible. Superstructure & substructure continues to deteriorate at steady pace. Abutment 1 upstream wing has very heavy scaling. Structure should be considered for full replacement. Structure will be moved to 12 month frequency inspection. MJK AC

09/09/15 Fair condition, structure continues to deteriorate along deck soffit, T beams and abutments. Structure should be considered for recon or replacement. MJK SP

09/06/13 Deck & T beams continue to deteriorate at a slow pace, approaches need to be shimmed. Structure should be considered for replacement in the next 10 +/- years. Recent repairs to fix undermining is a big improvement. MJK FE

05/05/11 Fair condition. Deck soffit has areas of saturation and t-beams are breaking down with cracking and spalling with exposed rebar. Structure should be replaced in near future. MJK & PH

05/08/09 - The bridge is in fair to satisfactory condition. - The deck and tee beams continue to deteriorate. Full depth holes could occur any time, any place in the deck; especially in bay 2. Abutment 2's approach guard rail needs repair. DCP


09/06/2017


09/06/2017


09/06/2017


09/06/2017


09/06/2017


09/06/2017


09/06/2017


09/06/2017


PARK -
RIDE
09/06/2017


09/06/2017


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09/06/2017


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09/06/2017


09/06/2017

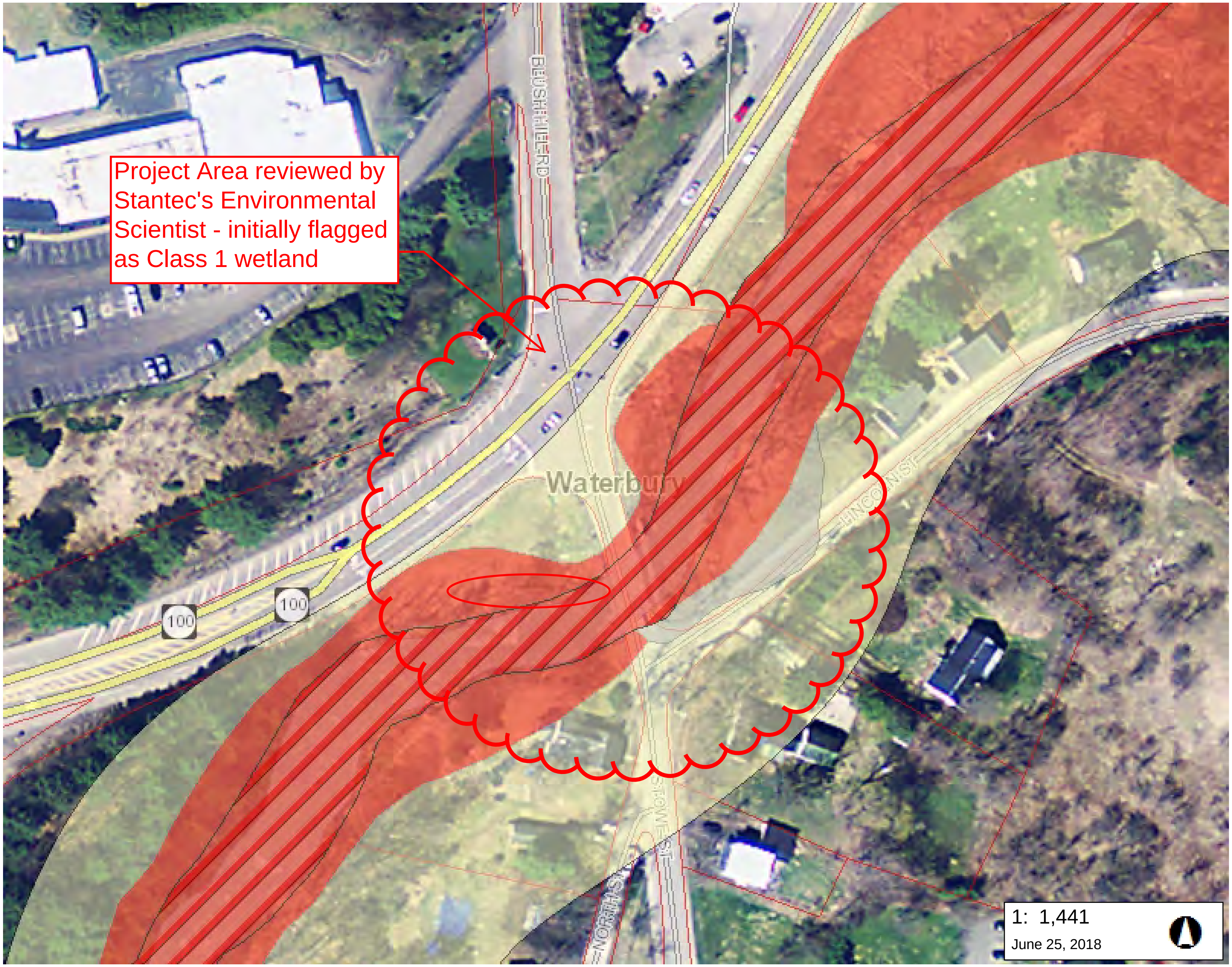
APPENDIX E

ANR Map

Waterbury **Stowe Street Bridge** ANR Map

Vermont Agency of Natural Resources

vermont.gov



LEGEND

Wetland - VSWI
- Class 1 Wetland
- Class 2 Wetland
- Buffer

Wetlands Advisory Layer

DFIRM Floodways

Flood Hazard Areas (Only FEN
- AE (1-percent annual chance flood
- A (1-percent annual chance floodpl
- AO (1-percent annual chance zone feet)
- 0.2-percent annual chance flood ha

River Corridors (Jan 2, 2015)
- .5 - 2 sqmi.
- .25-.5 sqmi.

Rare Threatened Endangered
- Threatened or Endangered
- Rare

Significant Natural Community

Uncommon Species and Other
- Animal
- Plant
- Natural Community

Roads
- Interstate
- Principal Arterial
- Minor Arterial
- Major Collector

NOTES

Map created using ANR's Natural Resources Atlas

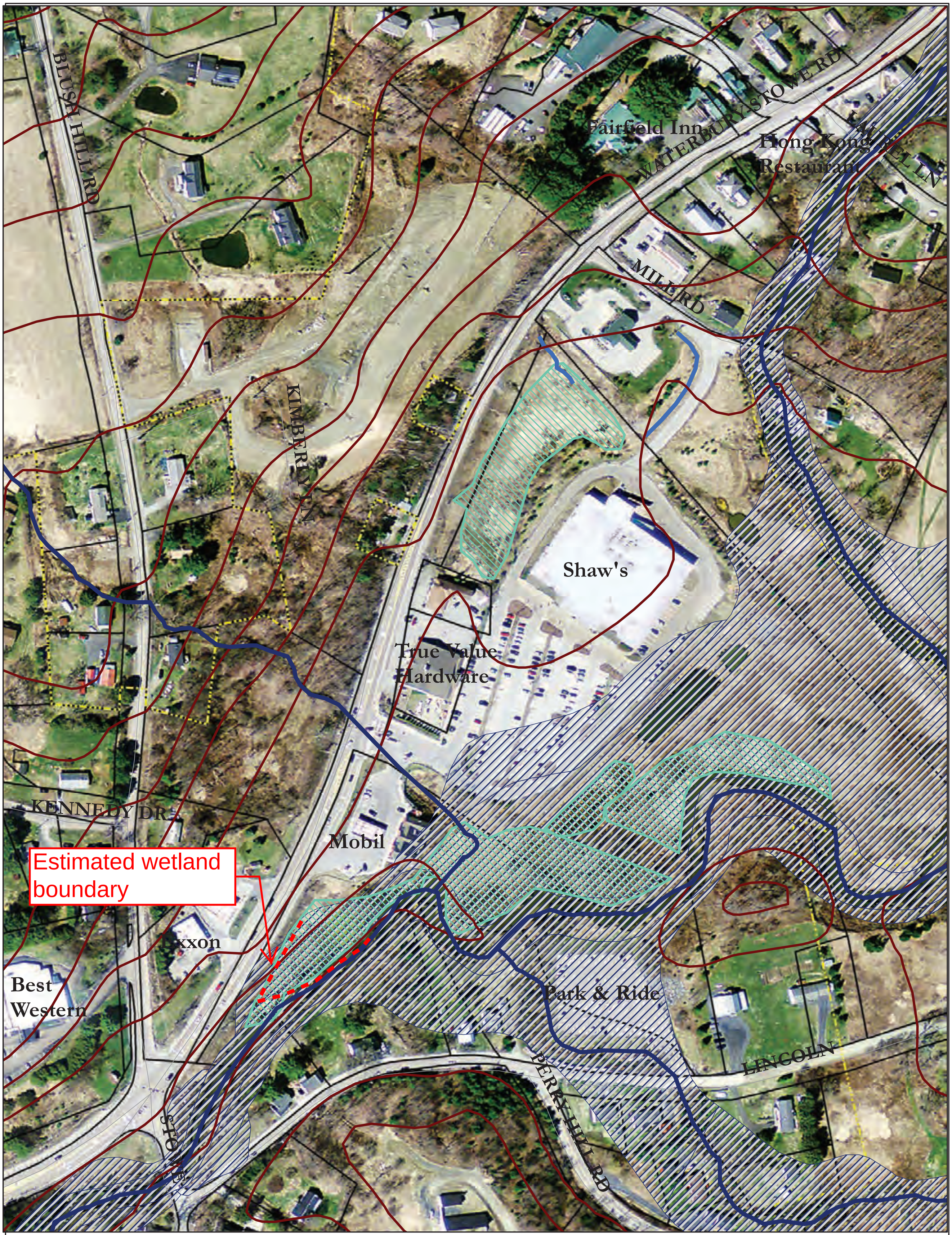
73.0 0 36.00 73.0 Meters

WGS_1984_Web_Mercator_Auxiliary_Sphere 1" = 120 Ft. 1cm = 14 Meters

THIS MAP IS NOT TO BE USED FOR NAVIGATION

APPENDIX F

Wetland Boundary Figure



Colbyville Pedestrian/Bicycle Scoping Study

Waterbury, Vermont

Existing Conditions: Natural

Legend

Watercourse	Wetland
Twenty Ft Contours	Flood Hazard
Drainage Way	Parcel Line
	Village Boundary

BROADREACH Planning & Design

Lamoureux & Dickinson

Heritage Landscapes

UVM CAP

200 100 0 200 Feet

June 2, 2017

Figure 3

Knight, Tom

From: Knight, Tom
Sent: Friday, August 3, 2018 8:38 AM
To: Daniels, RuthAnne
Subject: FW: Waterbury Stowe Street Bridge - site recon
Attachments: Fig 3 from Colbyville_Report_edited.pdf; Waterbury Stowe St Bridge ANR Map.pdf

---

From: Harris, Polly
Sent: Tuesday, July 17, 2018 4:08 PM
To: Knight, Tom <tom.knight@stantec.com>
Subject: Waterbury Stowe Street Bridge - site recon

Tom - I visited the Waterbury Stowe Street Bridge project site on June 27, 2018 to verify the location of wetlands upstream of the project area. These wetlands are not mapped on the ANR database but were mapped as part of the Broadreach/Colbyville project. Based on my site visit, the wetlands mapped on Figure 3 in that report are a bit over-generous – the actual wetlands do not extend downstream (toward the bridge) as far as shown on the sketch. However, even as mapped, the bridge is located outside of the 50-foot buffer to these wetlands. Attached is a revised Figure 3 showing my estimate of the wetland boundary.

With respect to other natural resources, there is a mapped floodplain located along the river. No RTE species have been identified in the project area, but all of Vermont is considered habitat for the Threatened Northern Long-eared bat.

Let me know if you have further questions.

Polly Harris
Environmental Project Manager
Stantec
55 Green Mountain Drive South Burlington VT 05403-7824
Phone: (802) 497-6407
Polly.Harris@stantec.com

APPENDIX G

Traffic Analysis

Stantec

Memo

To:	Tom Knight South Burlington, VT	From:	Sean Neely South Burlington, VT
File:	179450270	Date:	February 5, 2021

Reference: Waterbury Stowe St Bridge 36 – Updated Traffic Analysis

Traffic analyses completed by Stantec in 2018 (attached) were updated by Stantec for the intersections of Stowe Street at VT 100 and Lincoln Street at Stowe Street in Waterbury, Vermont, based on recent traffic data collected and adjusted for 2020, and a design year of 2045. Analyses were updated to inform the design of a bridge replacement for Bridge 36, located on Stowe St between VT 100 and Lincoln St, along with associated intersection improvements at Stowe St/VT 100 and Stowe St/Lincoln St. Intersection improvements include pedestrian phasing accommodations for a future crossing of VT 100 on the southbound approach and the addition of a dedicated right-turn lane for the westbound Stowe Street approach to VT 100. Impacts to the coordinated traffic signal systems along VT 100 were not analyzed. Conditions analyzed include existing conditions and five scenarios for future conditions:

- 2020 Existing Conditions
- 2045 Baseline (No pedestrian accommodation and no right turn lane)
- 2045 Westbound Right Turn Lane
- 2045 Concurrent Pedestrian Phase (Only pedestrian accommodation)
- 2045 Concurrent Pedestrian Phase and Westbound Right Turn Lane
- 2045 Exclusive Pedestrian Phase (Only pedestrian accommodation)
- 2045 Exclusive Pedestrian Phase and Westbound Right Turn Lane

Existing Conditions

Turning movement counts (TMCs) were collected by the Vermont Agency of Transportation (VTrans) at VT 100/Stowe Street in July 2016. These volumes were adjusted to 2020 by Stantec using an annual growth factor of 1.02 per the VTrans Continuous Traffic Counter Report (The Redbook) based on 2016 traffic data. Stantec collected TMCs at Lincoln St/Stowe Street in November 2020. These volumes were adjusted to account for the reduced traffic volumes due to the COVID pandemic, using a factor of 1.2 per discussions with VTrans, to approximate pre-COVID traffic volumes. This 20% increase is based on a VTrans comparison of data collected by Automated Traffic Signal Performance Measures (ATSPMs) during Indigenous Peoples Day weekend in 2020 vs 2019. Volumes were balanced between both intersections.

The Stowe Street and Lincoln Street intersection is close to VT 100 (175 feet) and queuing back from VT 100 queues past Lincoln Street during peak hours due to the operation of the traffic signal, as observed in person and shown in the capacity analysis results from Synchro software. The VT 100/Stowe Street traffic signal operates on an 88-second cycle during the morning peak hour and 96-second cycle during the evening peak hour as part of a coordinated traffic signal system on VT 100. Analysis of the existing conditions provides results as presented in Table 1. Analysis results indicate that while the VT 100 intersection operates at Level of Service B or C, the westbound Stowe Street approach operates at LOS E during the evening peak hour with queues of up to 10 vehicles which pass beyond the Lincoln Street intersection. The Lincoln Street unsignalized intersection is affected by those queues but otherwise would operate at LOS B.

Table 1 Existing (2020) Capacity Analysis Results

Time Period	Stowe Street at VT 100		Stowe Street WB Approach to VT 100			Lincoln St at Stowe Street
	Overall LOS	Overall V/C	LOS	V/C	95^{Th} Queue	LOS
AM	B	0.63	D	0.58	5 veh.	B
PM	C	0.89	E	0.90	10 veh.	B

LOS = Level of Service; V/C = volume to capacity ratio; 95^{th} Queue = 95^{th} percentile queue; RTL = Right Turn Lane

Future Conditions

Future traffic conditions for the year 2045 (25-year horizon) were determined by adjusting 2020 volumes to 2045 using a growth factor of 1.13, per the VTrans Continuous Traffic Counter Report (The Redbook), based on 2020 traffic data. No known specific land use development projects were identified.

Future conditions are expected to include pedestrian improvements to the VT 100/Stowe Street intersection. It is expected that VT 100 will be crossed just north of the intersection accommodated with pedestrian phasing, signal heads and pushbuttons. Both concurrent and exclusive pedestrian phasing were analyzed. In addition, a second approach lane on Stowe Street at VT 100 was analyzed. This lane would operate as a dedicated right turn lane as it would be intended to accommodate 75 percent of the traffic on the Stowe Street approach. Existing phase splits were maintained from existing timing plans, while cycle lengths were adjusted for future conditions.

Future analyses of the year 2045, presented in Table 2, indicate overall operating conditions at the Stowe Street/VT 100 intersection in terms of level of service are expected to remain at LOS B during the morning peak hour for the baseline condition or with concurrent pedestrian phasing or exclusive pedestrian phasing with a dedicated westbound right turn lane. During the evening peak hour, the intersection is expected to operate at an overall LOS D for the baseline condition or with concurrent pedestrian phasing. The concurrent pedestrian phase does result in more green time for the westbound approach and correspondingly a reduced v/c ratio for the westbound Stowe Street approach. Exclusive pedestrian phasing reduces the 2045 AM and PM LOS for the Stowe Street approach to F.

The benefit of a westbound right turn lane for the Stowe Street approach was analyzed. The westbound approach experiences queuing today that extends beyond Lincoln Street during peak periods. Future traffic growth and the addition of the pedestrian phasing are expected to exacerbate this queuing. A right turn lane that would extend over Bridge 36 would mitigate both the future growth and exclusive pedestrian phasing impacts on the westbound approach. The right turn lane would also help accommodate the Link Bus turning onto and off Lincoln Street from Stowe Street for the Waterbury Park and Ride, maintaining a more compact approach for that intersection.

Motorists making a right turn onto VT 100 from Stowe Street may not expect pedestrians crossing at this location, due to the setting of the intersection along this portion of VT 100 and low pedestrian volumes. Combined with the large turning radius and corresponding higher turning speeds, this may be an issue for a concurrent pedestrian phase. An exclusive pedestrian phase is better suited here.

Other approaches to the VT 100 / Stowe Street intersection were checked for impacts for each scenario. The eastbound approach is not expected to experience significant impacts for any of the scenarios. For the northbound and southbound approaches during the AM peak, LOS is expected to remain the same for all scenarios, while the v/c ratio is expected to remain close to the baseline or to improve. For the northbound and southbound approaches during the PM peak, LOS is expected to remain the same or improve for all scenarios; v/c ratio is expected to improve for all scenarios except for the exclusive pedestrian phase only scenario, which is expected to experience an increase in v/c ratio.

Future baseline 95th percentile queue lengths for the northbound and southbound approaches show potential impacts to the adjacent intersections along VT 100, particularly the I-89 northbound off ramp. The northbound approach is expected to experience an increase in 95th percentile queues, by about 16%, for the exclusive pedestrian phasing with right turn lane scenario during the PM peak hour, compared with the baseline. Capacity analysis worksheets are provided in the appendix.

Table 2 Future (2045) Capacity Analysis Results

Scenario	Time Period	Stowe Street at VT 100		Stowe Street WB Approach to VT 100			Lincoln St at Stowe Street
		Overall LOS	Overall V/C	LOS	V/C	95Th Queue	LOS
Baseline	AM	B	0.73	E	0.74	7 veh.	B
	PM	D	1.03	F	1.07	12 veh.	B
RTL	AM	B	0.69	C	0.49	3 veh.	B
	PM	C	0.93	D	0.58	5 veh.	B
Concurrent Ped Phasing	AM	B	0.72	D	0.66	6 veh.	B
	PM	D	1.01	F	0.96	12 veh.	B
Concurrent Ped Phasing and RTL	AM	B	0.69	C	0.49	3 veh.	B
	PM	D	0.93	D	0.49	4 veh.	B
Exclusive Ped Phasing	AM	C	0.73	F	0.94	9 veh.	B
	PM	E	1.05	F	1.28	15 veh.	B
Exclusive Ped Phasing and RTL	AM	B	0.68	D	0.66	4 veh.	B
	PM	C	0.94	D	0.81	6 veh.	B

LOS = Level of Service; V/C = volume to capacity ratio; 95th Queue = 95th percentile queue; RTL = Right Turn Lane

Reference: Waterbury Stowe St Bridge 36 – Updated Traffic Analysis DRAFT

Stantec Consulting Services Inc.

Sean Neely
Transportation Designer

Phone: 802 864 0223
Sean.Neely@stantec.com

Attachment: VT 100/Stowe St Traffic Signal Layout and Timings; 2016 VTrans TMCs; 2020 Stantec TMCs; Synchro volume networks and reports; 2018 Traffic Memo

c. C.C

APPENDIX

TRAFFIC CONTROL SIGNAL SYSTEM, INTERSECTION (VT ROUTE 100 @ BLUSH HILL ROAD)
SEE LIST OF MAJOR EQUIPMENT, ON SHEET 182

REMOVAL OF EXISTING TRAFFIC CONTROL SIGNAL SYSTEM (VT ROUTE 100 @ BLUSH HILL ROAD)
STA. 35+50

CONSTRUCT MAST ARM POLES
STA. 34+96, 34' LT (MAP-1)
STA. 35+58, 40' RT (MAP-2)

CONSTRUCT CONTROLLER CABINET (GROUND MOUNTED)
STA. 35+50, RT

WIRED CONDUIT (2") (SCH 80 PVC)
SEE CONDUIT SCHEDULE, ON SHEET 182

ELECTRICAL CONDUIT (2") (SCH 80 PVC)
SEE CONDUIT SCHEDULE, ON SHEET 182

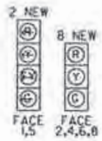
SPECIAL PROVISION (JUNCTION BOX, HEAVY DUTY)
STA. 34+62, 47' RT (JB3)
STA. 34+70, 59' RT (JB2)
STA. 34+85, 31' LT (JB4)
STA. 35+20, 85' RT (JB1)

BRACKET ARM
STA. 34+96, LT (SL-1) 12'
STA. 35+47, RT (SL-2) 12'

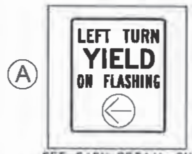
LUMINAIRE
STA. 34+96, LT (SL-1)
STA. 35+47, RT (SL-2)

SPECIAL PROVISION (HORIZONTAL DIRECTIONAL DRILLING) (12" CASING PIPE)
STA. 34+63, RT TO 34+85, LT (77')
STA. 34+75, RT TO 35+15, RT (45')

SIGNAL FACE ARRANGEMENT

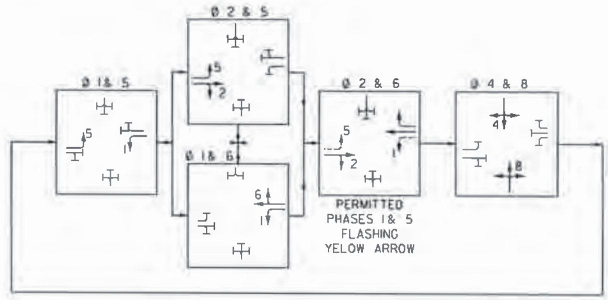


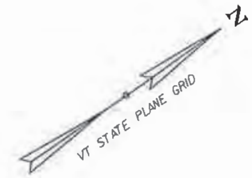
NOTE: ALL NEW 12" LED LENSES WITH 5" LOUVERED BACKPLATES, 2" RETROREFLECTIVE BORDERS AND VISORS

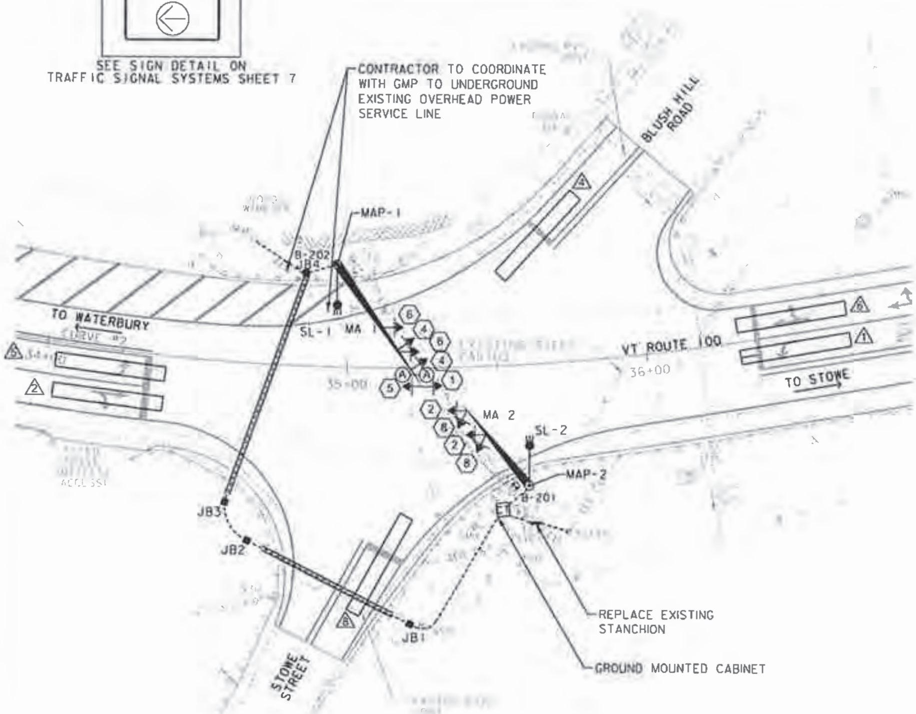


SEE SIGN DETAIL ON TRAFFIC SIGNAL SYSTEMS SHEET 7

PHASING DIAGRAM







VT ROUTE 100 / BLUSH HILL ROAD / STOWE STREET INTERSECTION

EXISTING	NEW	DESCRIPTION
		UTILITY POLE
		LUMINAIRE
		LIGHT POLE
		STRAIN POLE/CANTILEVER POLE
		CONTROLLER CABINET
		JUNCTION BOX
		PEDESTRIAN SIGNAL HEAD
		SIGNAL HEAD WITH LOUVERED PLATE
		CONDUIT (SIGNAL)
		VEHICLE DETECTION AREA
		PEDESTAL POST/LIGHTING POLE
		CANTILEVER
		SLEEVE
		PREEMPT OPTICAL DETECTOR
		PREEMPTION STROBE
		PEDESTRIAN PUSHBUTTON ASSEMBLY
		POWER DROP STANCHION
		L.E.D REGULATORY SIGN

NOTES:

1. FOR A LIST OF MAJOR EQUIPMENT AND CONDUIT SCHEDULE, SEE SHEET 182.
2. UNDERGROUND UTILITIES ARE APPROXIMATE AND SHALL BE VERIFIED BY THE CONTRACTOR.
3. EXISTING INTERCONNECT, DETECTION, ADAPTIVE TRAFFIC CONTROL (ATC), AND INTERNET CONNECTION SHALL BE MAINTAINED OR SALVAGED AND REUSED. PAYMENT SHALL BE UNDER CONTRACT ITEM 678.15 TRAFFIC CONTROL SIGNAL SYSTEM, INTERSECTION (VT ROUTE 100 @ BLUSH HILL ROAD)
4. EXISTING GRIDSMART 360 DEGREE CAMERA AND ASSOCIATED EQUIPMENT SHALL BE REMOVED AND SALVAGED TO VTRANS TRAFFIC SIGNAL MAINTENANCE. PAID UNDER ITEM 678.45 REMOVAL OF EXISTING TRAFFIC CONTROL SIGNAL SYSTEM (VT ROUTE 100 @ BLUSH HILL ROAD)
5. MOUNT AXIS 06044-E PTZ DOME NETWORK CAMERA (OR APPROVED EQUAL) ON 15' EXTENSION POLE FOR OBSERVATIONAL PURPOSES. PAID UNDER 678.15 TRAFFIC CONTROL SIGNAL SYSTEM, INTERSECTION (VT ROUTE 100 @ BLUSH HILL ROAD).

0 20 40
SCALE IN FEET

Stantec

PROJECT NAME: WATERBURY-STOWE
PROJECT NUMBER: STP 2945(1)

FILE NAME: z11b342signal.dgn	PLOT DATE: 9/1/2017
PROJECT LEADER: G. EDWARDS	DRAWN BY: C. WAITE
DESIGNED BY: T. LUTHER	CHECKED BY: D. DEBAIE
TRAFFIC SIGNAL SYSTEMS SHEET 1	SHEET 181 OF 376

VT ROUTE 100 / BLUSH HILL ROAD / STOWE STREET INTERSECTION

LIST OF MAJOR EQUIPMENT

EQUIPMENT ITEMS - 678.15 TRAFFIC CONTROL SIGNAL SYSTEM, INTERSECTION (VT ROUTE 100 @ BLUSH HILL ROAD)	QUANTITY	REMARKS
STEEL MAST ARM SIGNAL POLE (FLAT BLACK)	2	
STEEL MAST ARM (FLAT BLACK)	2	MA-1= 50', MA-2 = 35'
POWER STANCHION WITH DISCONNECTS	1	
TRAFFIC SIGNAL CONTROLLER (NEMA TS2)	1	ECONOLITE COBALT
NEW 12-INCH LED SIGNAL HEADS (ONE-WAY 3-SECTION, VISORS, DISCONNECT HANGERS, 5 INCH LOUVERED BACKPLATES WITH 2 INCH RETRO-REFLECTIVE BORDER AND MOUNTING HARDWARE (FLAT BLACK)	8	
NEW 12-INCH LED SIGNAL HEADS (ONE-WAY 4-SECTION, VISORS, DISCONNECT HANGERS, 5 INCH LOUVERED BACKPLATES WITH 2 INCH RETRO-REFLECTIVE BORDER AND MOUNTING HARDWARE (FLAT BLACK)	2	
SIGNAL HEAD BRACKETS AND ANCILLARY EQUIPMENT	10	
NEMA P44 BASE-MOUNTED CONTROLLER CABINET WITH 15-INCH EXTENDED BASE ON A CONCRETE FOUNDATION	1	PAINTED FLAT BLACK WITH ANCILLARY EQUIPMENT, FACING AWAY FROM TRAFFIC
ELECTRICAL WIRING	560'	SEE SUMMARY THIS SHEET
MALFUNCTION MONITORING UNIT (MMU)	1	ECONOLITE MMU2-16LEIP
BIU	1	ECONOLITE BIU-64
DETECTOR BRACKET FOR MAST ARM OR POLE	6	
STOP BAR DETECTOR ASSEMBLY	4	WAVETRONIX SMARTSENSOR MATRIX
ADVANCED DETECTOR ASSEMBLY	2	WAVETRONIX SMARTSENSOR ADVANCE
DETECTION PROCESSOR (CARDS)	2	WAVETRONIX CLICK 650
DETECTION CABINET RACK	2	
360 DEGREE OBSERVATIONAL CAMERA W/ 15' EXTENSION ARM	1	360 DEGREE NETWORK CAMERA
CONTROLLER IDENTIFICATION PLAQUE	1	SEE TRAFFIC SIGNAL SYSTEM NOTES

CONDUIT SCHEDULE

	WIRED CONDUIT		ELECTRICAL CONDUIT		DESCRIPTION
	2"	4"	2"	4"	
POWER TO STANCHION	40'				SERVICE
STANCHION TO CONTROLLER	20'				POWER
CONTROLLER TO JB1			55'		FUTURE USE
CONTROLLER TO JB1	70'				SIGNAL / LIGHTING
CONTROLLER TO JB1	70'				DETECTION
CONTROLLER TO MAP-2	70'				DETECTION
JB1 TO JB2			70'		FUTURE USE
JB1 TO JB2	70'				SIGNAL / LIGHTING
JB1 TO JB2	70'				DETECTION
JB2 TO JB3			20'		FUTURE USE
JB2 TO JB3	20'				SIGNAL / LIGHTING
JB2 TO JB3	20'				DETECTION
JB3 TO JB4			90'		FUTURE USE
JB3 TO JB4			90'		FUTURE USE
JB3 TO JB4	90'				SIGNAL / LIGHTING
JB3 TO JB4	90'				DETECTION
JB4 TO MAP-1			20'		FUTURE USE
JB4 TO MAP-1	20'				SIGNAL / LIGHTING
JB4 TO MAP-1	20'				DETECTION
SUBTOTAL	670'		345'		
ROUNDING	10'		5'		
TOTAL	680'		350'		

CONTROLLER TIMING CHART

PHASE	1	2	3	4	5	6	7	8	9
IN USE	X	X		X	X	X		X	
TRAFFIC MOVEMENT	┌	—		|	┘	—		|	
MIN. GREEN	5	8		8	5	8		8	
MAX 1 - GREEN (OFF)	6	64		13	6	64		13	
MAX 2 - GREEN (AM)	6	53		10	6	53		10	
MAX 3 - GREEN (PM)	6	59		12	6	59		12	
YELLOW CLEARANCE	4.1	4.1		4.1	4.1	4.1		4.1	
ALL RED CLEARANCE	2	2		2	2	2		2	
VEHICLE EXTENSION	3	3		3	3	3		3	
DELAY GREEN	0	0		0	0	0		0	
WALK									
PEDESTRIAN CLEAR									
RECALL MODE (SOFT)		X				X			

SCHEDULE PLAN

SCHEDULE NO.	DAY PLAN	DAYS	DATES
1	1	MON, TUE, WED, THU, FRI	1-31
1	2	SAT, SUN	1-31

COORDINATION PLAN

				SPLIT PHASES/SPLIT TIMES								
PATTERN	COS	CYCLE	OFFSET	1	2	3	4	5	6	7	8	9
1	111	102	80	12	70	0	20	12	70	0	20	0
2	211	88	80	12	59	0	17	12	59	0	17	0
3	311	96	79	12	65	0	19	12	65	0	19	0

DAY PLAN

PLAN NO.	EVENT	ACTION PLAN	START TIME
1	1	254	12:00 AM
1	2	2	6:00 AM
1	3	1	9:00 AM
1	4	3	2:00 PM
1	5	1	7:00 PM
1	6	254	10:00 PM
2	1	254	12:00 AM
2	2	1	6:00 AM
2	3	3	9:00 AM
2	4	254	10:00 PM

ELECTRICAL WIRING

	LENGTH	DESCRIPTION
MAP-1 TO MA-1	48'	DETECTION
MAP-1 TO MA-1	48'	SIGNAL HEAD
MAP-1 TO MA-1	48'	SIGNAL HEAD
MAP-1 TO MA-1	48'	SIGNAL HEAD
MAP-1 TO MA-1	48'	SIGNAL HEAD
MAP-1 TO MA-1	48'	SIGNAL HEAD
MAP-1 TO LUMINAIRE	45'	STREET LIGHTING
MAP-2 TO MA-2	36'	DETECTION
MAP-2 TO MA-2	36'	SIGNAL HEAD
MAP-2 TO MA-2	36'	SIGNAL HEAD
MAP-2 TO MA-2	36'	SIGNAL HEAD
MAP-2 TO MA-2	36'	SIGNAL HEAD
MAP-2 TO LUMINAIRE	42'	STREET LIGHTING
SUBTOTAL	555'	
ROUNDING	5'	
TOTAL	560'	(SEE NOTES BELOW)

NOTES:

1. TOTAL QUANTITY OF ELECTRICAL WIRING SHOWN IS APPROXIMATED FOR BIDDING PURPOSES. THE ACTUAL AMOUNT OF ELECTRICAL WIRING MAY VARY DUE TO FIELD CONDITIONS.
2. ELECTRICAL WIRING SHALL BE PAID UNDER ITEM 678.15 TRAFFIC CONTROL SIGNAL SYSTEM, INTERSECTION (VT ROUTE 100 @ BLUSH HILL ROAD)

ACTION PLAN

PLAN NO.	PATTERN	FLASH	REFERENCE
1	1	NO	MAX 1
2	2	NO	MAX 2
3	3	NO	MAX 3
4	254-FREE	NO	MAX 1

WEEKDAY PEAKS

	HOURS		
MAX 2 - AM PEAK	6:00 AM	TO	9:00 AM
MAX 1 - OFF PEAK	9:00 AM	TO	2:00 PM
	7:00 PM	TO	10:00 PM
MAX 3 - PM PEAK	2:00 PM	TO	7:00 PM
FLASH	10:00 PM	TO	6:00 AM

Stantec

PROJECT NAME: WATERBURY-STOWE
PROJECT NUMBER: STP 2945(1)

FILE NAME: z11b342signal.dgn
PROJECT LEADER: G. EDWARDS
DESIGNED BY: T. LUTHER
TRAFFIC SIGNAL SYSTEMS SHEET 2

PLOT DATE: 9/1/2017
DRAWN BY: C. WAITE
CHECKED BY: D. DEBAIE
SHEET 182 OF 376

APPENDIX

Stantec

Peak Hour Data for Intersection

Int ID: 31218805
Community: WATERBURY
Road 1: VT-100
Road 2: STOWE ST
Corridor: Test
Road 3: VT-100
Road 4: BLUSH HILL RD

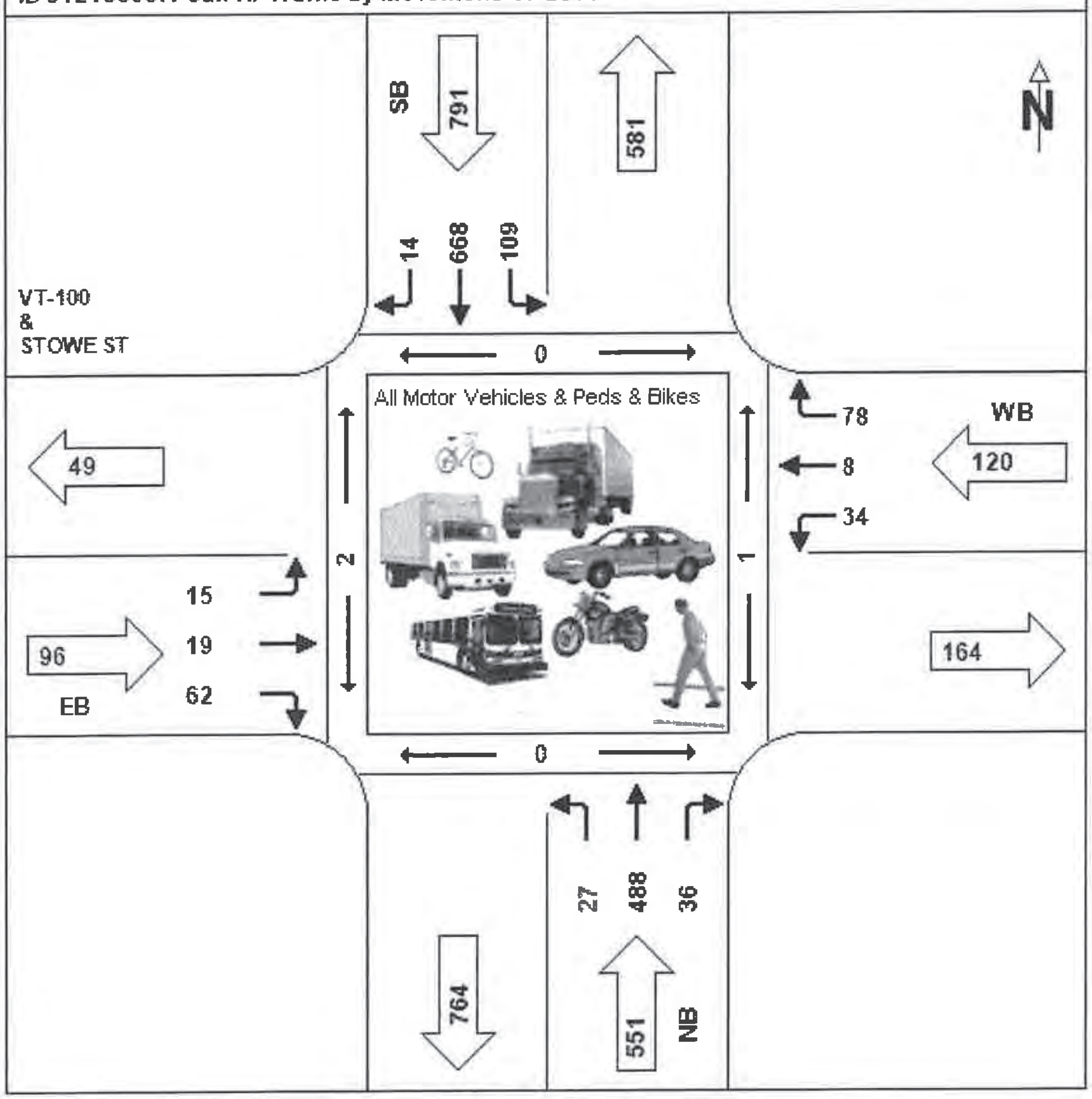
|<< < > >>| 1-7 of 7

AM Peak Hour
08/17/2016

	NB					EB					SB					WB					
Start Time	Left	Thru	Right	Ped	App Total	Left	Thru	Right	Ped	App Total	Left	Thru	Right	Ped	App Total	Left	Thru	Right	Ped	App Total	Int Total
7:45 AM	7	118	8	0	133	4	5	24	0	33	25	173	2	0	200	9	2	19	0	30	396
8:00 AM	10	134	14	1	158	5	4	16	0	25	31	174	6	0	211	11	0	20	0	31	425
8:15 AM	4	115	7	0	126	5	6	8	0	19	28	151	1	2	180	7	1	23	0	31	356
8:30 AM	6	121	7	0	134	1	4	14	0	19	25	170	5	0	200	7	5	16	0	28	381
Total	27	488	36	1	551	15	19	62	0	96	109	668	14	2	791	34	8	78	0	120	1558
PHF	0.68	0.91	0.64		0.87	0.75	0.79	0.65		0.73	0.88	0.96	0.58		0.94	0.77	0.40	0.85		0.97	
HV %	7	9	3		8.5	0	0	2		1.0	1	4	7		3.9	6	0	5		5.0	

☑ Cars ☑ Trucks ☑ Pedestrians ☑ Bikes

ID 31218805: Peak Hr Traffic by Movemen8/17/2016 — 7:45 AM to 8:45 AM



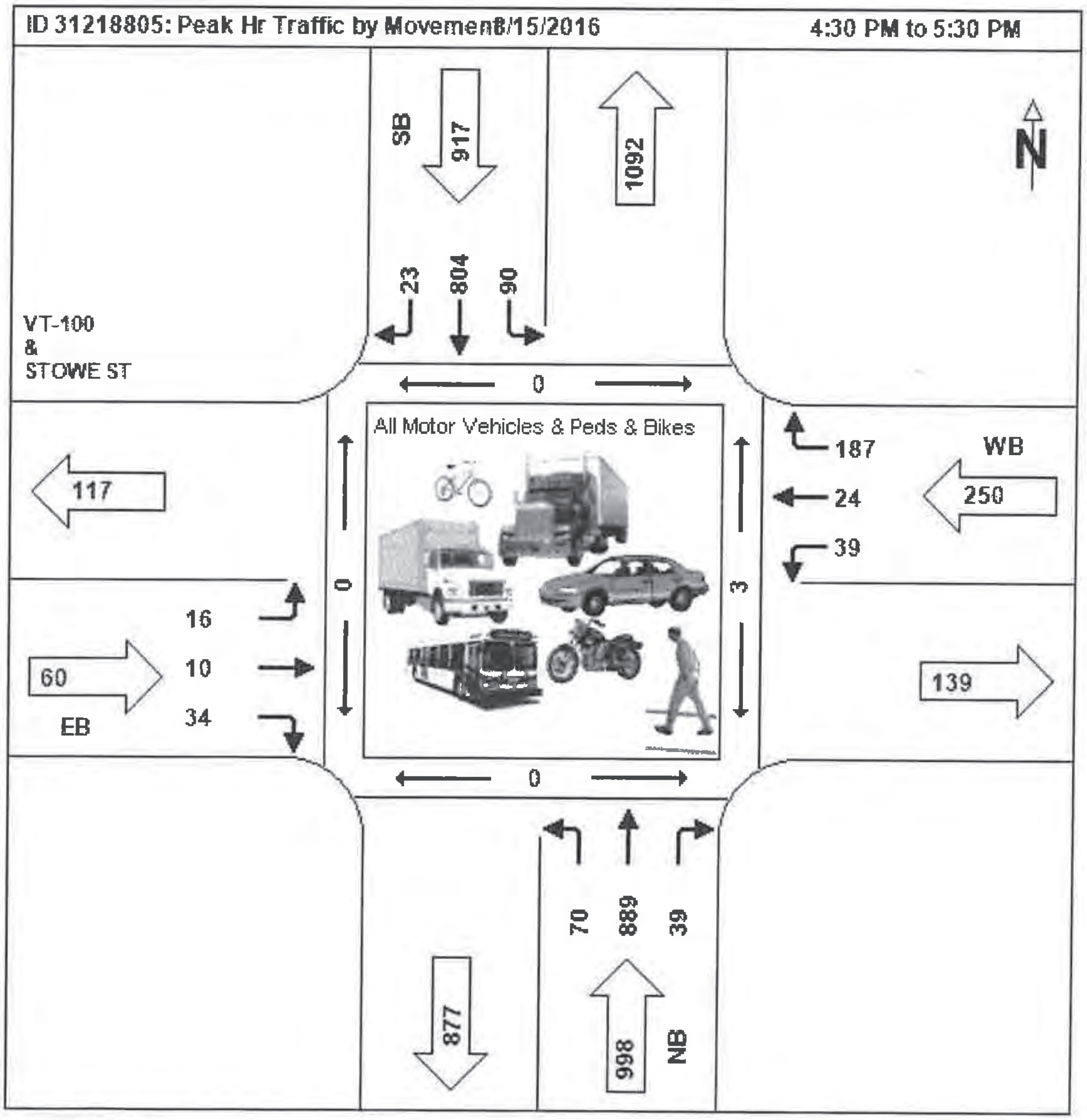
Designed by: Checked by:

Stantec

PM Peak Hour
08/15/2016

Start Time	NB Left	NB Thru	NB Right	NB Ped	NB App Total	EB Left	EB Thru	EB Right	EB Ped	EB App Total	SB Left	SB Thru	SB Right	SB Ped	SB App Total	WB Left	WB Thru	WB Right	WB Ped	WB App Total	Int Total
4:30 PM	12	221	8	0	241	4	1	8	0	13	16	185	5	0	206	8	4	47	0	59	519
4:45 PM	20	211	7	0	238	4	2	12	0	18	23	195	7	0	225	10	10	69	0	89	570
5:00 PM	20	223	11	1	254	4	3	9	0	16	25	207	6	0	238	11	7	47	0	65	573
5:15 PM	18	234	13	2	265	4	4	5	0	13	26	217	5	0	248	10	3	24	0	37	563
Total	70	889	39	3	998	16	10	34	0	60	90	804	23	0	917	39	24	187	0	250	2225
PHF	0.88	0.95	0.75		0.94	1.00	0.63	0.71		0.83	0.87	0.93	0.82		0.92	0.89	0.60	0.68		0.70	
HV %	3	3	8			0	0	3			1	3	0			8	0	0			

☑ Cars ☑ Trucks ☑ Pedestrians ☑ Bikes



Designed by: Checked by:

Stantec

Date: 11/11/2020
Location: Waterbury, VT

A.M. Peak Hour (Midnight to Noon)

	Time	Stowe St SB Left	Stowe St SB Thru	Stowe St SB Right	Lincoln St WB Left	Lincoln St WB Thru	Lincoln St WB Right	Stowe St NB Left	Stowe St NB Thru	Stowe St NB Right	EB Left	EB Thru	EB Right			
	7:30 - 7:45	5	32	0	0	0	9	0	24	1	0	0	0	71	MAX	
	7:45 - 8:00	5	42	0	6	0	7	0	26	2	0	0	0	88		88
	8:00 - 8:15	2	30	0	3	0	6	0	30	4	0	0	0	75		
	8:15 - 8:30	4	24	0	4	0	4	0	25	1	0	0	0	62		
A.M. PEAK	**7:30 - 8:30**	**16**	**128**	**0**	**13**	**0**	**26**	**0**	**105**	**8**	**0**	**0**	**0**			

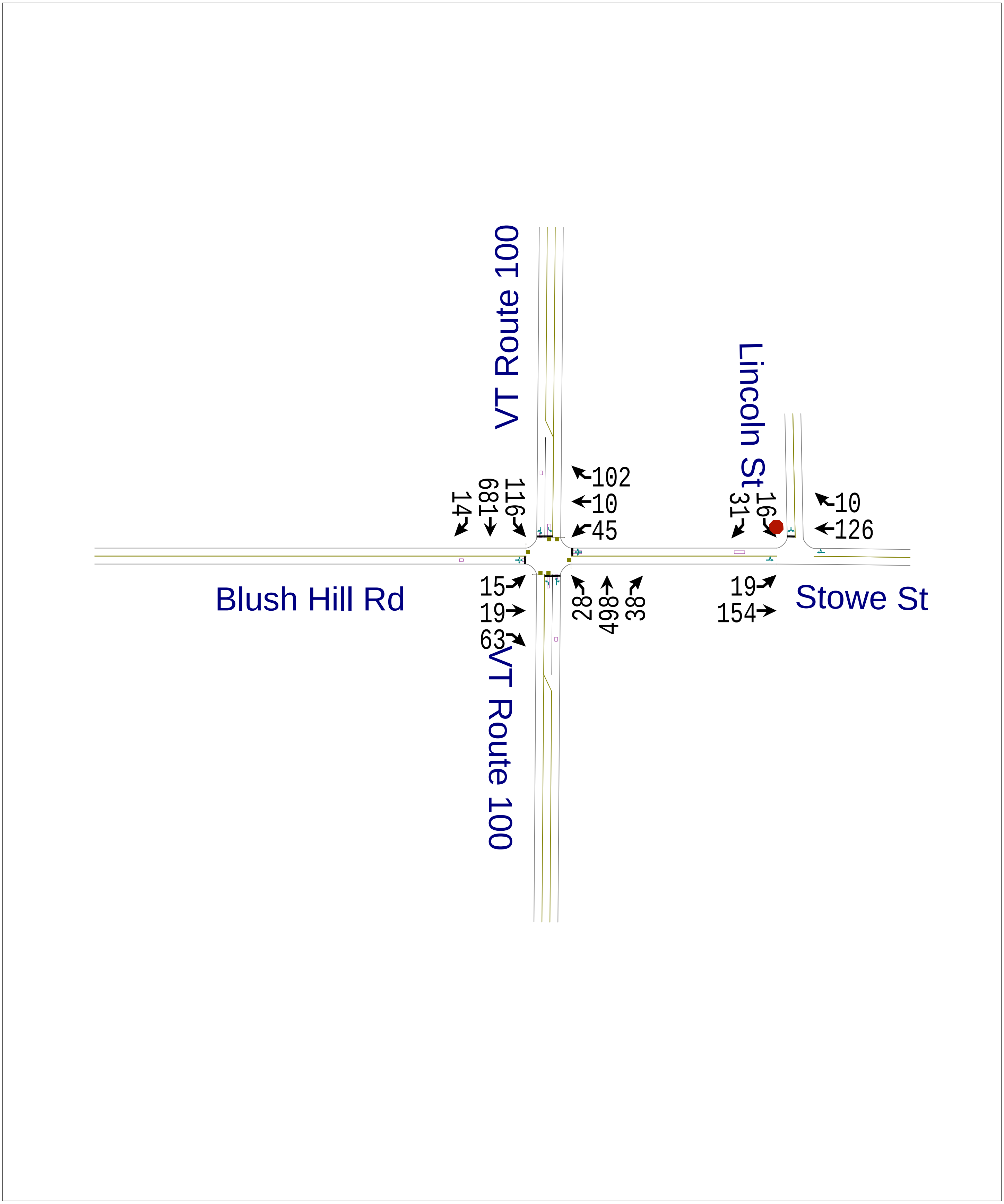
Peak Hour Factor: 0.841

P.M. Peak Hour (Noon to Midnight)

	Time	Stowe St SB Left	Stowe St SB Thru	Stowe St SB Right	Lincoln St WB Left	Lincoln St WB Thru	Lincoln St WB Right	Stowe St NB Left	Stowe St NB Thru	Stowe St NB Right	EB Left	EB Thru	EB Right			
	16:15 - 16:30	5	30	0	5	0	4	0	44	6	0	0	0	94	MAX	
	16:30 - 16:45	9	28	0	4	0	9	0	45	4	0	0	0	99		99
	16:45 - 17:00	9	20	0	7	0	5	0	43	1	0	0	0	85		
	17:00 - 17:15	6	40	0	3	0	8	0	34	4	0	0	0	95		
P.M. PEAK	**16:15 - 17:15**	**29**	**118**	**0**	**19**	**0**	**26**	**0**	**166**	**15**	**0**	**0**	**0**			

Peak Hour Factor: 0.942

Map - Bridge 36 Stowe Street Waterbury
Volumes 01/12/2021



Queues
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	105	161	30	582	123	739
v/c Ratio	0.48	0.73	0.07	0.56	0.24	0.60
Control Delay	23.5	38.6	3.4	12.4	4.3	10.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.5	38.6	3.4	12.4	4.3	10.8
Queue Length 50th (ft)	19	38	3	171	15	141
Queue Length 95th (ft)	67	#127	9	264	28	377
Internal Link Dist (ft)	602	95		470		414
Turn Bay Length (ft)			340		200	
Base Capacity (vph)	232	232	428	1032	512	1235
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.45	0.69	0.07	0.56	0.24	0.60

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	15	19	63	45	10	102	28	498	38	116	681	14
Future Volume (vph)	15	19	63	45	10	102	28	498	38	116	681	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	11	11	11	11	11	11	11	11	11	11
Grade (%)		-10%			8%			0%			0%	
Total Lost time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.91			0.91		1.00	0.99		1.00	1.00	
Flt Protected		0.99			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1729			1510		1601	1667		1678	1761	
Flt Permitted		0.86			0.88		0.31	1.00		0.34	1.00	
Satd. Flow (perm)		1496			1341		516	1667		600	1761	
Peak-hour factor, PHF	0.92	0.92	0.92	0.97	0.97	0.97	0.92	0.92	0.92	0.94	0.94	0.94
Adj. Flow (vph)	16	21	68	46	10	105	30	541	41	123	724	15
RTOR Reduction (vph)	0	61	0	0	79	0	0	3	0	0	1	0
Lane Group Flow (vph)	0	44	0	0	82	0	30	579	0	123	738	0
Heavy Vehicles (%)	1%	1%	1%	5%	5%	5%	9%	9%	9%	4%	4%	4%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		9.2			9.2		56.1	53.7		63.5	57.4	
Effective Green, g (s)		9.2			9.2		56.1	53.7		63.5	57.4	
Actuated g/C Ratio		0.11			0.11		0.64	0.62		0.73	0.66	
Clearance Time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		158			141		362	1028		513	1161	
v/s Ratio Prot							0.00	0.35		c0.02	c0.42	
v/s Ratio Perm		0.03			c0.06		0.05			0.16		
v/c Ratio		0.28			0.58		0.08	0.56		0.24	0.64	
Uniform Delay, d1		35.8			37.1		6.3	9.8		4.7	8.7	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.0			6.0		0.1	2.2		0.2	2.7	
Delay (s)		36.8			43.1		6.4	12.0		4.9	11.3	
Level of Service		D			D		A	B		A	B	
Approach Delay (s)		36.8			43.1			11.7			10.4	
Approach LOS		D			D			B			B	

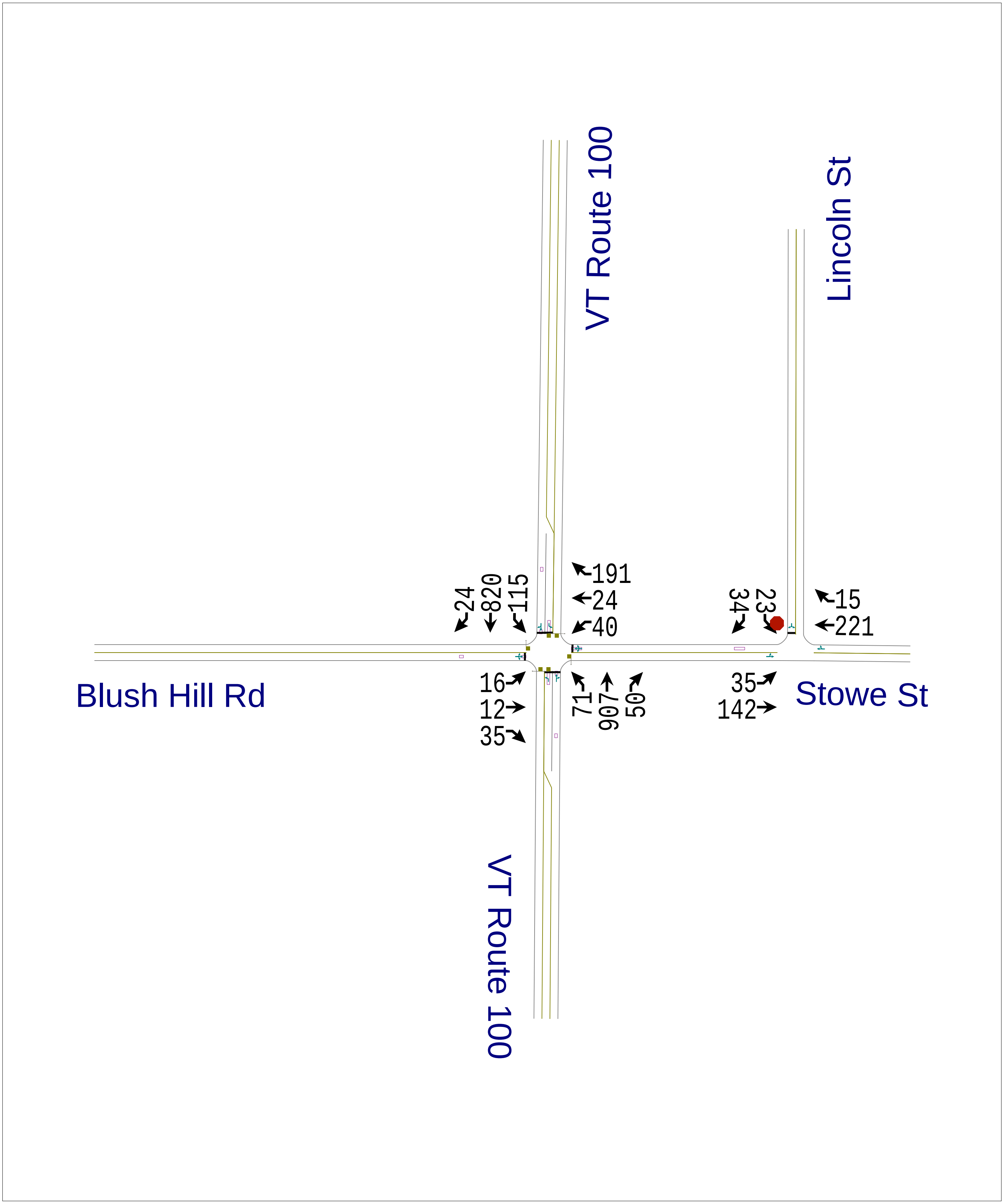
Intersection Summary			
HCM 2000 Control Delay	15.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	87.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	71.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	19	154	126	10	16	31
Future Volume (Veh/h)	19	154	126	10	16	31
Sign Control		Free	Free		Stop	
Grade		5%	-5%		0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	21	171	140	11	18	34
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)		175				
pX, platoon unblocked					0.98	
vC, conflicting volume	151				358	146
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	151				340	146
tC, single (s)	4.1				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.4
p0 queue free %	99				97	96
cM capacity (veh/h)	1412				616	889

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	192	151	52
Volume Left	21	0	18
Volume Right	0	11	34
cSH	1412	1700	771
Volume to Capacity	0.01	0.09	0.07
Queue Length 95th (ft)	1	0	5
Control Delay (s)	0.9	0.0	10.0
Lane LOS	A		B
Approach Delay (s)	0.9	0.0	10.0
Approach LOS			B

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	29.7%	ICU Level of Service	A
Analysis Period (min)	15		

Map - Bridge 36 Stowe Street Waterbury
Volumes 01/12/2021



Queues
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	68	277	76	1018	125	917
v/c Ratio	0.40	0.93	0.26	0.92	0.59	0.79
Control Delay	28.3	61.2	5.7	31.0	21.4	19.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.3	61.2	5.7	31.0	21.4	19.9
Queue Length 50th (ft)	17	89	10	497	17	394
Queue Length 95th (ft)	59	#244	20	#832	#68	604
Internal Link Dist (ft)	602	95		470		690
Turn Bay Length (ft)			340		200	
Base Capacity (vph)	171	301	294	1106	211	1154
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.40	0.92	0.26	0.92	0.59	0.79

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	16	12	35	40	24	191	71	907	50	115	820	24
Future Volume (vph)	16	12	35	40	24	191	71	907	50	115	820	24
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	11	11	11	11	11	11	11	11	11	11
Grade (%)		-10%			8%			0%			0%	
Total Lost time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.92			0.90		1.00	0.99		1.00	1.00	
Flt Protected		0.99			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1744			1557		1694	1769		1694	1776	
Flt Permitted		0.62			0.94		0.17	1.00		0.09	1.00	
Satd. Flow (perm)		1093			1477		300	1769		164	1776	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Adj. Flow (vph)	17	13	38	43	26	208	76	965	53	125	891	26
RTOR Reduction (vph)	0	33	0	0	115	0	0	2	0	0	1	0
Lane Group Flow (vph)	0	35	0	0	162	0	76	1016	0	125	916	0
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	3%	3%	3%	3%	3%	3%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		11.7			11.7		64.1	59.3		66.5	60.5	
Effective Green, g (s)		11.7			11.7		64.1	59.3		66.5	60.5	
Actuated g/C Ratio		0.12			0.12		0.67	0.62		0.70	0.64	
Clearance Time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		134			181		272	1104		211	1131	
v/s Ratio Prot							0.01	c0.57		c0.04	0.52	
v/s Ratio Perm		0.03			c0.11		0.17			0.38		
v/c Ratio		0.26			0.90		0.28	0.92		0.59	0.81	
Uniform Delay, d1		37.7			41.0		10.2	15.8		16.6	12.9	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.0			38.6		0.6	13.7		4.4	6.3	
Delay (s)		38.8			79.7		10.8	29.4		21.0	19.2	
Level of Service		D			E		B	C		C	B	
Approach Delay (s)		38.8			79.7			28.1			19.5	
Approach LOS		D			E			C			B	

Intersection Summary			
HCM 2000 Control Delay	30.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	90.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
6: Stowe St & Lincoln St

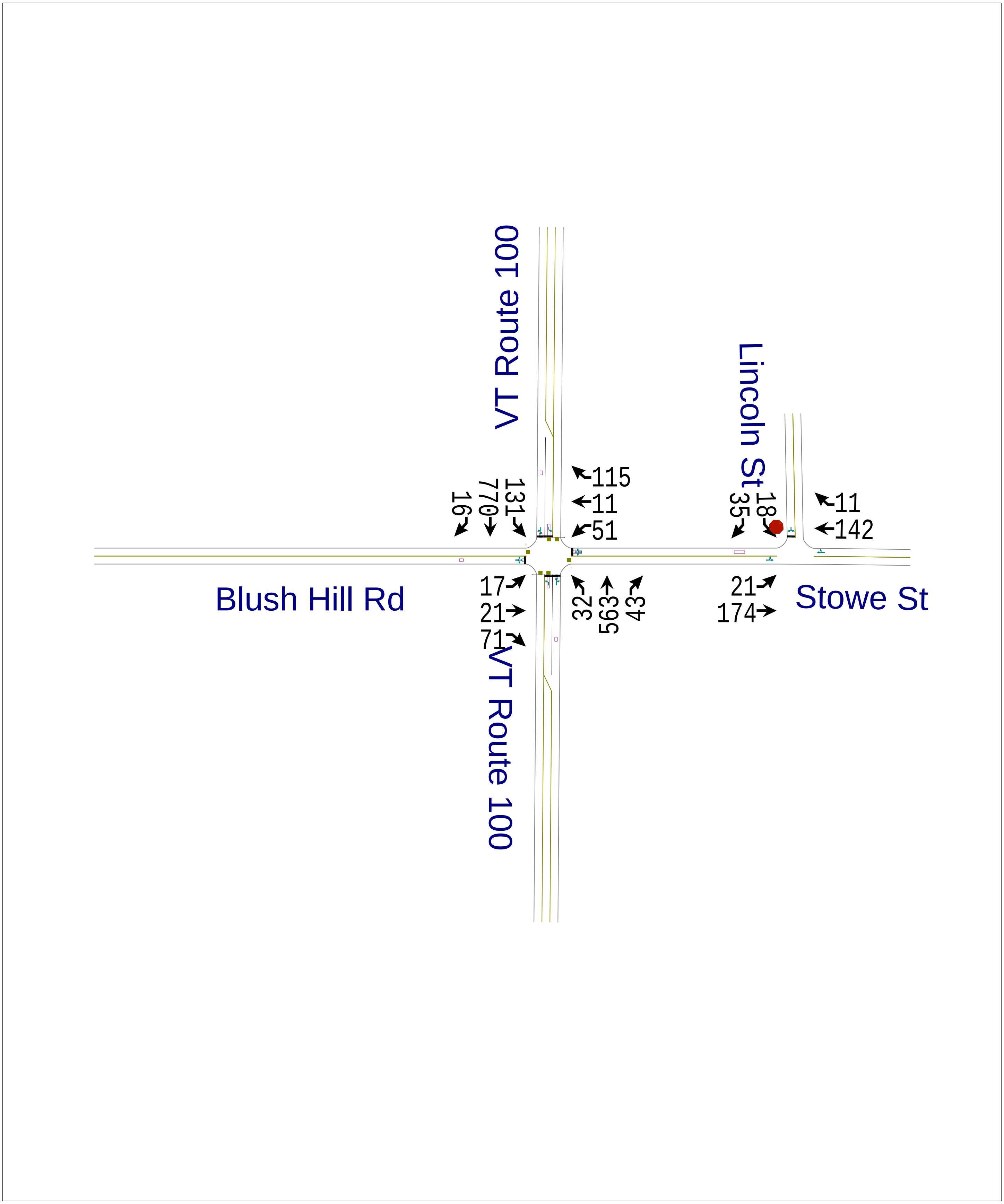
02/05/2021

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	35	142	221	15	23	34
Future Volume (Veh/h)	35	142	221	15	23	34
Sign Control		Free	Free		Stop	
Grade		5%	-5%		0%	
Peak Hour Factor	0.90	0.90	0.91	0.91	0.90	0.90
Hourly flow rate (vph)	39	158	243	16	26	38
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)		175				
pX, platoon unblocked					0.98	
vC, conflicting volume	259				487	251
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	259				466	251
tC, single (s)	4.2				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.3				3.6	3.4
p0 queue free %	97				95	95
cM capacity (veh/h)	1266				515	762

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	197	259	64
Volume Left	39	0	26
Volume Right	0	16	38
cSH	1266	1700	637
Volume to Capacity	0.03	0.15	0.10
Queue Length 95th (ft)	2	0	8
Control Delay (s)	1.8	0.0	11.3
Lane LOS	A		B
Approach Delay (s)	1.8	0.0	11.3
Approach LOS			B

Intersection Summary			
Average Delay	2.1		
Intersection Capacity Utilization	35.3%	ICU Level of Service	A
Analysis Period (min)	15		

Map - Bridge 36 Stowe Street Waterbury
Volumes 01/12/2021



Queues
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	118	183	34	659	139	836
v/c Ratio	0.52	0.83	0.10	0.64	0.31	0.71
Control Delay	24.0	51.2	3.7	14.3	5.1	15.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.0	51.2	3.7	14.3	5.1	15.0
Queue Length 50th (ft)	21	51	4	209	17	308
Queue Length 95th (ft)	73	#163	10	324	31	480
Internal Link Dist (ft)	602	95		470		414
Turn Bay Length (ft)			340		200	
Base Capacity (vph)	234	226	347	1026	452	1179
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.50	0.81	0.10	0.64	0.31	0.71

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	15	19	63	45	10	102	28	498	38	116	681	14
Future Volume (vph)	15	19	63	45	10	102	28	498	38	116	681	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	11	11	11	11	11	11	11	11	11	11
Grade (%)		-10%			8%			0%			0%	
Total Lost time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.91			0.91		1.00	0.99		1.00	1.00	
Flt Protected		0.99			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1728			1510		1601	1667		1678	1761	
Flt Permitted		0.83			0.85		0.23	1.00		0.30	1.00	
Satd. Flow (perm)		1448			1301		385	1667		525	1761	
Peak-hour factor, PHF	0.92	0.92	0.92	0.97	0.97	0.97	0.92	0.92	0.92	0.94	0.94	0.94
Growth Factor (vph)	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%
Adj. Flow (vph)	18	23	77	52	12	119	34	612	47	139	819	17
RTOR Reduction (vph)	0	69	0	0	77	0	0	3	0	0	1	0
Lane Group Flow (vph)	0	49	0	0	106	0	34	656	0	139	835	0
Heavy Vehicles (%)	1%	1%	1%	5%	5%	5%	9%	9%	9%	4%	4%	4%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		9.6			9.6		57.0	53.4		61.8	55.8	
Effective Green, g (s)		9.6			9.6		57.0	53.4		61.8	55.8	
Actuated g/C Ratio		0.11			0.11		0.66	0.61		0.71	0.64	
Clearance Time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		159			143		302	1023		452	1129	
v/s Ratio Prot							0.00	0.39		c0.02	c0.47	
v/s Ratio Perm		0.03			c0.08		0.07			0.20		
v/c Ratio		0.31			0.74		0.11	0.64		0.31	0.74	
Uniform Delay, d1		35.7			37.5		7.4	10.7		5.8	10.6	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.1			17.9		0.2	3.1		0.4	4.4	
Delay (s)		36.8			55.4		7.6	13.8		6.1	15.0	
Level of Service		D			E		A	B		A	B	
Approach Delay (s)		36.8			55.4			13.5			13.8	
Approach LOS		D			E			B			B	

Intersection Summary			
HCM 2000 Control Delay	18.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	87.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	77.8%	ICU Level of Service	D
Analysis Period (min)	15		

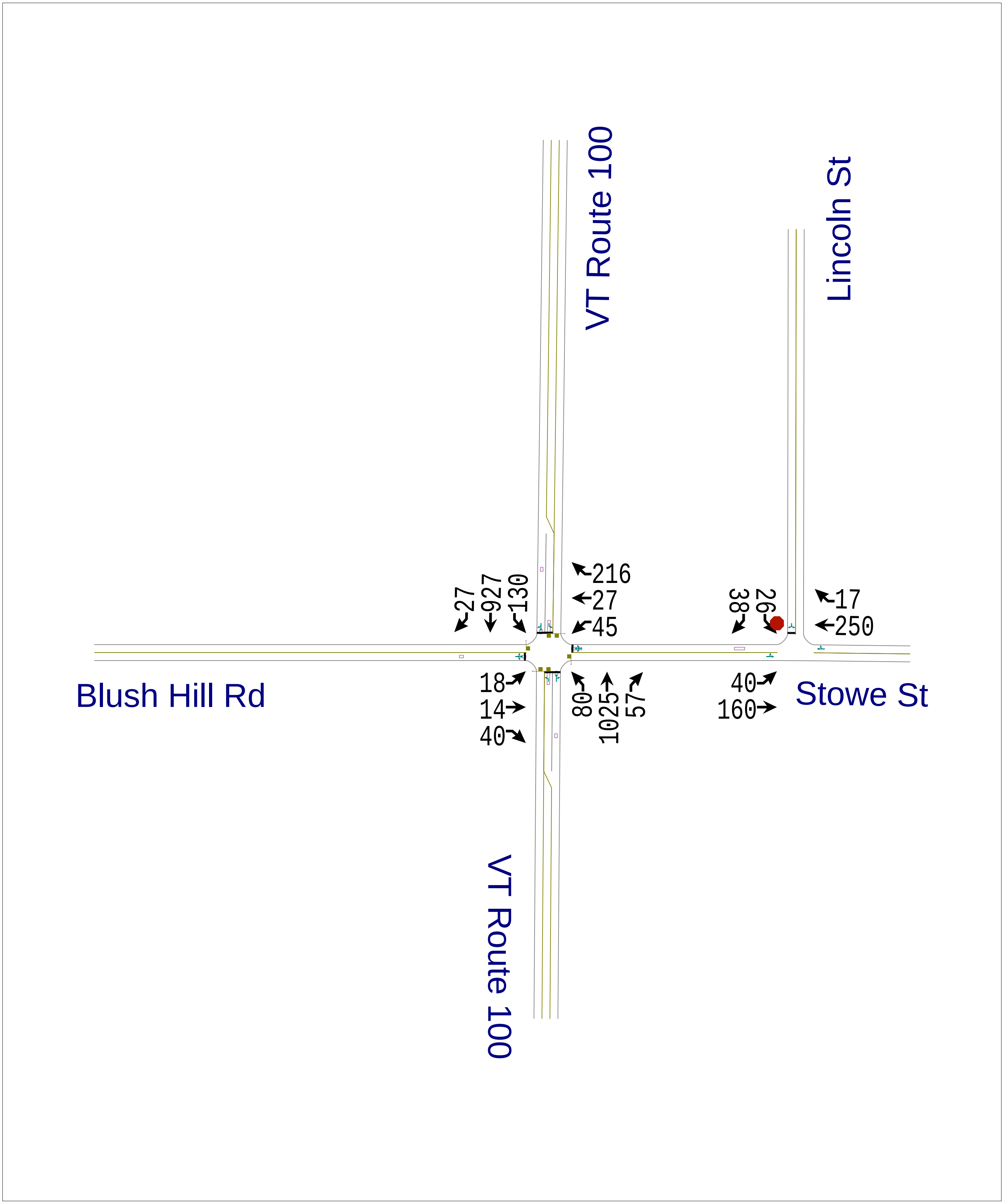
c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	19	154	126	10	16	31
Future Volume (Veh/h)	19	154	126	10	16	31
Sign Control		Free	Free		Stop	
Grade		5%	-5%		0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	24	193	158	13	20	39
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)		175				
pX, platoon unblocked					0.98	
vC, conflicting volume	171				406	164
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	171				380	164
tC, single (s)	4.1				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.4
p0 queue free %	98				97	96
cM capacity (veh/h)	1388				579	867

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	217	171	59
Volume Left	24	0	20
Volume Right	0	13	39
cSH	1388	1700	742
Volume to Capacity	0.02	0.10	0.08
Queue Length 95th (ft)	1	0	6
Control Delay (s)	1.0	0.0	10.3
Lane LOS	A		B
Approach Delay (s)	1.0	0.0	10.3
Approach LOS			B

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	31.9%	ICU Level of Service	A
Analysis Period (min)	15		

Map - Bridge 36 Stowe Street Waterbury
Volumes 01/12/2021



Queues
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	78	313	85	1150	141	1036
v/c Ratio	0.46	1.04	0.40	1.05	0.78	0.90
Control Delay	29.8	88.2	10.5	59.7	46.6	28.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.8	88.2	10.5	59.7	46.6	28.3
Queue Length 50th (ft)	19	~130	11	~758	36	517
Queue Length 95th (ft)	65	#298	25	#1009	#136	#855
Internal Link Dist (ft)	602	95		470		690
Turn Bay Length (ft)			340		200	
Base Capacity (vph)	170	301	211	1100	181	1149
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.46	1.04	0.40	1.05	0.78	0.90

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	16	12	35	40	24	191	71	907	50	115	820	24
Future Volume (vph)	16	12	35	40	24	191	71	907	50	115	820	24
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	11	11	11	11	11	11	11	11	11	11
Grade (%)		-10%			8%			0%			0%	
Total Lost time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.93			0.90		1.00	0.99		1.00	1.00	
Flt Protected		0.99			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1745			1557		1694	1769		1694	1776	
Flt Permitted		0.60			0.94		0.09	1.00		0.07	1.00	
Satd. Flow (perm)		1056			1477		167	1769		118	1776	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Growth Factor (vph)	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%
Adj. Flow (vph)	20	15	43	49	29	235	85	1090	60	141	1007	29
RTOR Reduction (vph)	0	38	0	0	114	0	0	2	0	0	1	0
Lane Group Flow (vph)	0	40	0	0	199	0	85	1148	0	141	1035	0
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	3%	3%	3%	3%	3%	3%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		12.0			12.0		63.8	59.0		66.2	60.2	
Effective Green, g (s)		12.0			12.0		63.8	59.0		66.2	60.2	
Actuated g/C Ratio		0.13			0.13		0.67	0.62		0.70	0.63	
Clearance Time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		133			186		189	1098		181	1125	
v/s Ratio Prot							0.02	c0.65		c0.05	0.58	
v/s Ratio Perm		0.04			c0.13		0.28			0.49		
v/c Ratio		0.30			1.07		0.45	1.05		0.78	0.92	
Uniform Delay, d1		37.7			41.5		15.5	18.0		26.0	15.3	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.3			85.0		1.7	39.8		18.8	13.4	
Delay (s)		39.0			126.5		17.2	57.8		44.8	28.7	
Level of Service		D			F		B	E		D	C	
Approach Delay (s)		39.0			126.5			55.0			30.6	
Approach LOS		D			F			D			C	

Intersection Summary			
HCM 2000 Control Delay	52.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	99.8%	ICU Level of Service	F
Analysis Period (min)	15		

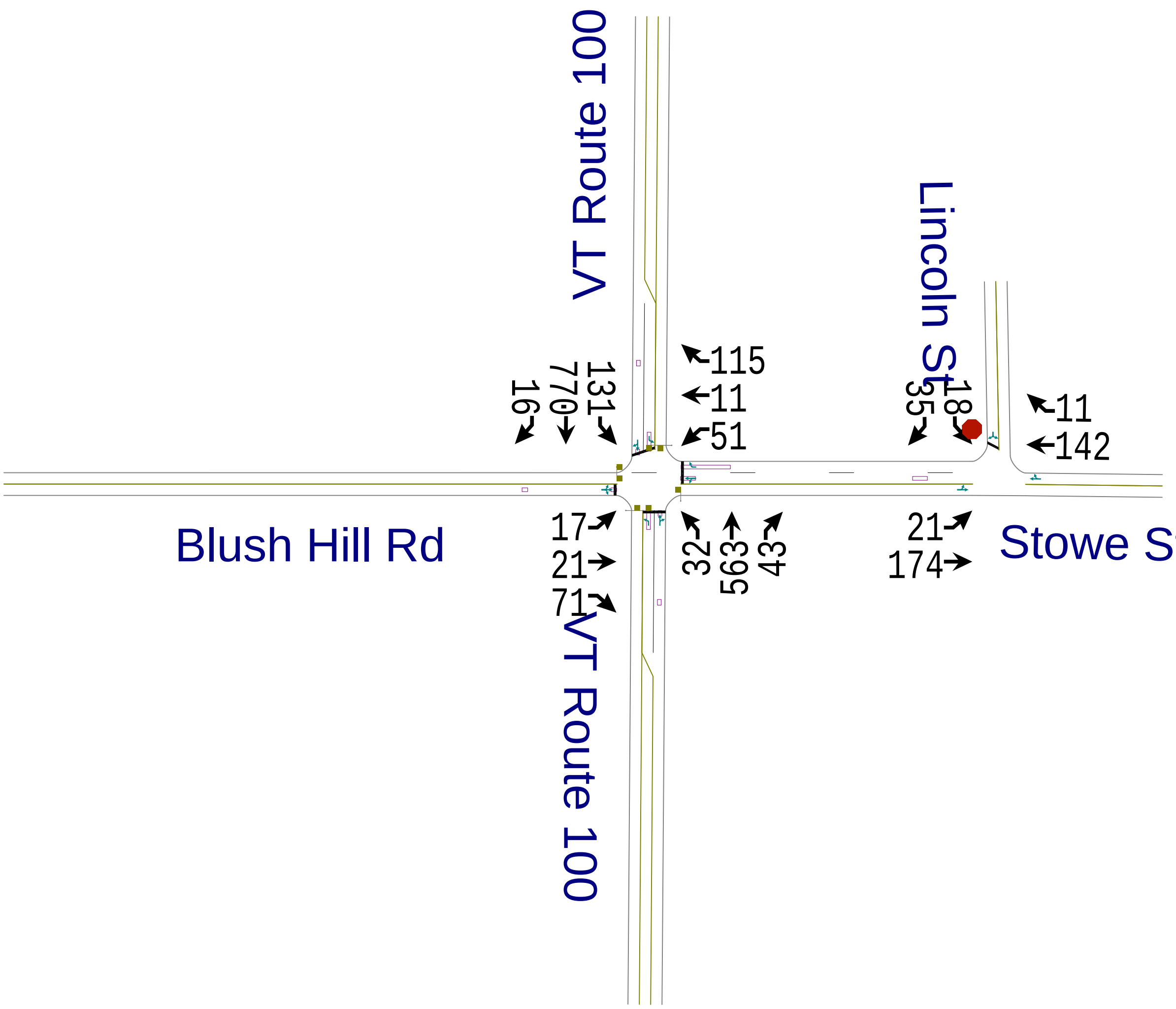
c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
6: Stowe St & Lincoln St 02/05/2021

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	35	142	221	15	23	34
Future Volume (Veh/h)	35	142	221	15	23	34
Sign Control		Free	Free		Stop	
Grade		5%	-5%		0%	
Peak Hour Factor	0.90	0.90	0.91	0.91	0.90	0.90
Hourly flow rate (vph)	44	178	274	19	29	43
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)		175				
pX, platoon unblocked					0.97	
vC, conflicting volume	293				550	284
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	293				525	284
tC, single (s)	4.2				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.3				3.6	3.4
p0 queue free %	96				94	94
cM capacity (veh/h)	1230				471	730

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	222	293	72
Volume Left	44	0	29
Volume Right	0	19	43
cSH	1230	1700	598
Volume to Capacity	0.04	0.17	0.12
Queue Length 95th (ft)	3	0	10
Control Delay (s)	1.9	0.0	11.8
Lane LOS	A		B
Approach Delay (s)	1.9	0.0	11.8
Approach LOS			B

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	38.6%	ICU Level of Service	A
Analysis Period (min)	15		


VT Route 100
Lincoln St
Blush Hill Rd
Stowe St
VT Route 100
115
11
51
16
770
131
35
18
11
142
17
21
71
32
563
43
21
174

Queues
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	118	64	119	34	659	139	836
v/c Ratio	0.46	0.49	0.26	0.10	0.64	0.31	0.71
Control Delay	21.3	49.9	6.5	4.2	15.2	5.3	15.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	21.3	49.9	6.5	4.2	15.2	5.3	15.7
Queue Length 50th (ft)	22	35	0	4	222	17	310
Queue Length 95th (ft)	70	74	39	12	355	36	525
Internal Link Dist (ft)	602	95			470		414
Turn Bay Length (ft)			150	340		200	
Base Capacity (vph)	300	164	464	346	1022	454	1183
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.39	0.39	0.26	0.10	0.64	0.31	0.71

Intersection Summary

HCM Signalized Intersection Capacity Analysis
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	15	19	63	45	10	102	28	498	38	116	681	14
Future Volume (vph)	15	19	63	45	10	102	28	498	38	116	681	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	11	12	12	12	11	11	11	11	11	11
Grade (%)		-10%			8%			0%			0%	
Total Lost time (s)		6.0			6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Frt		0.91			1.00	0.85	1.00	0.99		1.00	1.00	
Flt Protected		0.99			0.96	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1728			1669	1477	1601	1667		1678	1761	
Flt Permitted		0.93			0.66	1.00	0.23	1.00		0.29	1.00	
Satd. Flow (perm)		1625			1138	1477	392	1667		516	1761	
Peak-hour factor, PHF	0.92	0.92	0.92	0.97	0.97	0.97	0.92	0.92	0.92	0.94	0.94	0.94
Growth Factor (vph)	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%
Adj. Flow (vph)	18	23	77	52	12	119	34	612	47	139	819	17
RTOR Reduction (vph)	0	68	0	0	0	97	0	3	0	0	1	0
Lane Group Flow (vph)	0	50	0	0	64	22	34	656	0	139	835	0
Heavy Vehicles (%)	1%	1%	1%	5%	5%	5%	9%	9%	9%	4%	4%	4%
Turn Type	Perm	NA		Perm	NA	pm+ov	pm+pt	NA		pm+pt	NA	
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		10.3			10.3	16.9	58.7	55.1		64.7	58.1	
Effective Green, g (s)		10.3			10.3	16.9	58.7	55.1		64.7	58.1	
Actuated g/C Ratio		0.11			0.11	0.19	0.65	0.61		0.72	0.65	
Clearance Time (s)		6.0			6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		185			130	375	304	1020		456	1136	
v/s Ratio Prot						0.00	0.00	0.39		c0.02	c0.47	
v/s Ratio Perm		0.03			c0.06	0.01	0.07			0.20		
v/c Ratio		0.27			0.49	0.06	0.11	0.64		0.30	0.74	
Uniform Delay, d1		36.4			37.4	30.0	7.6	11.2		5.9	10.8	
Progression Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.8			2.9	0.1	0.2	3.1		0.4	4.2	
Delay (s)		37.2			40.3	30.1	7.8	14.3		6.3	15.0	
Level of Service		D			D	C	A	B		A	B	
Approach Delay (s)		37.2			33.7			14.0			13.8	
Approach LOS		D			C			B			B	

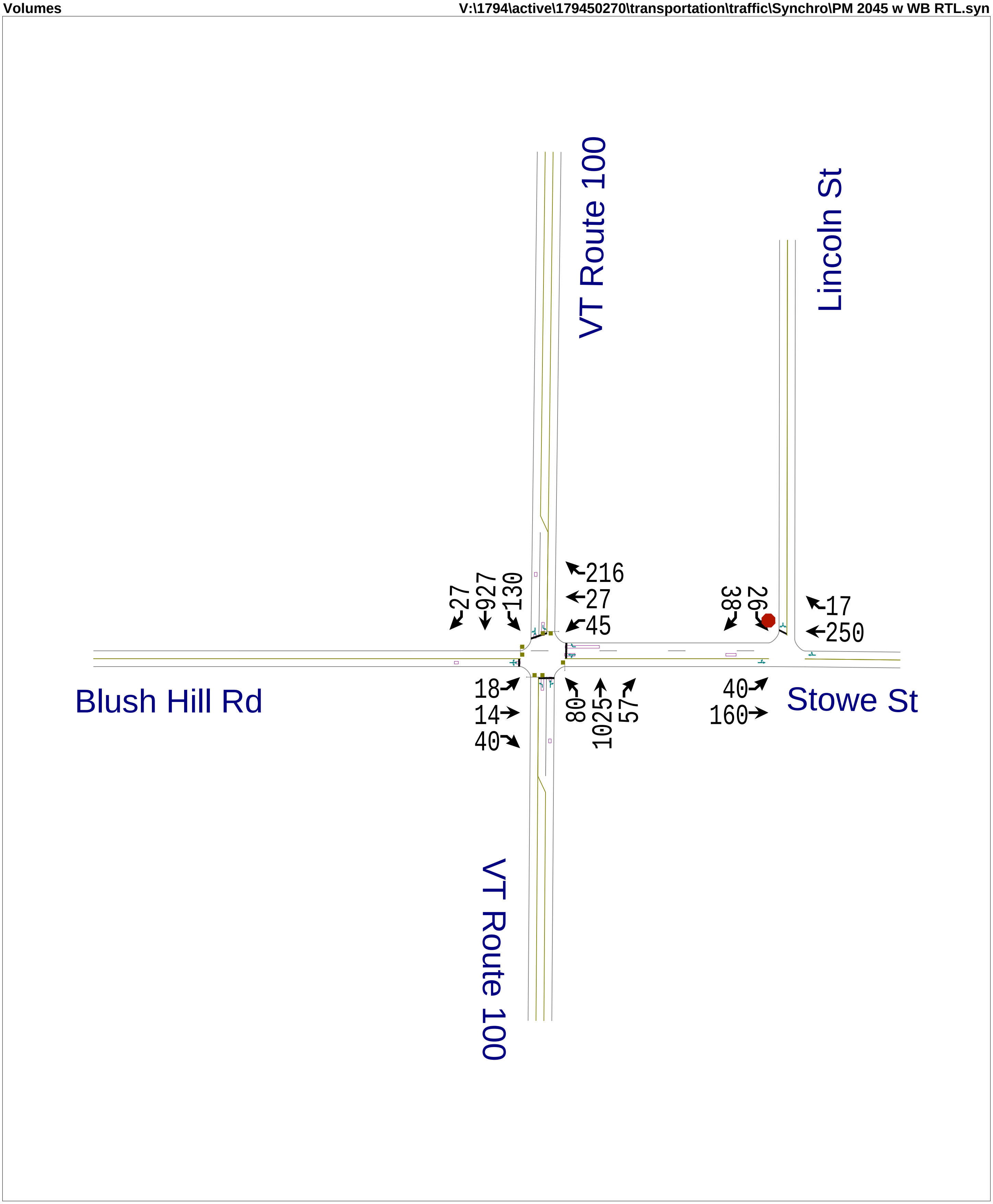
Intersection Summary			
HCM 2000 Control Delay	17.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	73.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	19	154	126	10	16	31
Future Volume (Veh/h)	19	154	126	10	16	31
Sign Control		Free	Free		Stop	
Grade		5%	-5%		0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	24	193	158	13	20	39
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)		175				
pX, platoon unblocked					0.98	
vC, conflicting volume	171				406	164
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	171				380	164
tC, single (s)	4.1				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.4
p0 queue free %	98				97	96
cM capacity (veh/h)	1388				579	867

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	217	171	59
Volume Left	24	0	20
Volume Right	0	13	39
cSH	1388	1700	742
Volume to Capacity	0.02	0.10	0.08
Queue Length 95th (ft)	1	0	6
Control Delay (s)	1.0	0.0	10.3
Lane LOS	A		B
Approach Delay (s)	1.0	0.0	10.3
Approach LOS			B

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	31.9%	ICU Level of Service	A
Analysis Period (min)	15		


VT Route 100
Lincoln St
216
27
45
27
927
130
38
26
17
250
Blush Hill Rd
18
14
40
80
1025
57
40
160
Stowe St
VT Route 100

Queues
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	78	78	235	85	1150	141	1036
v/c Ratio	0.38	0.49	0.57	0.33	0.98	0.72	0.83
Control Delay	26.0	50.3	22.5	6.9	41.3	39.6	21.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.0	50.3	22.5	6.9	41.3	39.6	21.7
Queue Length 50th (ft)	20	45	63	10	~758	36	498
Queue Length 95th (ft)	61	89	137	22	#1009	#141	#855
Internal Link Dist (ft)	602	95			470		690
Turn Bay Length (ft)			150	340		200	
Base Capacity (vph)	235	188	410	259	1171	197	1255
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.33	0.41	0.57	0.33	0.98	0.72	0.83

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	16	12	35	40	24	191	71	907	50	115	820	24
Future Volume (vph)	16	12	35	40	24	191	71	907	50	115	820	24
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	11	12	12	12	11	11	11	11	11	11
Grade (%)		-10%			8%			0%			0%	
Total Lost time (s)		6.0			6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Frt		0.93			1.00	0.85	1.00	0.99		1.00	1.00	
Flt Protected		0.99			0.97	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1745			1751	1535	1694	1769		1694	1776	
Flt Permitted		0.89			0.83	1.00	0.13	1.00		0.06	1.00	
Satd. Flow (perm)		1568			1492	1535	226	1769		112	1776	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Growth Factor (vph)	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%
Adj. Flow (vph)	20	15	43	49	29	235	85	1090	60	141	1007	29
RTOR Reduction (vph)	0	39	0	0	0	90	0	2	0	0	1	0
Lane Group Flow (vph)	0	39	0	0	78	145	85	1148	0	141	1035	0
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	3%	3%	3%	3%	3%	3%
Turn Type	Perm	NA		Perm	NA	pm+ov	pm+pt	NA		pm+pt	NA	
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		8.6			8.6	15.4	66.5	61.6		70.3	63.5	
Effective Green, g (s)		8.6			8.6	15.4	66.5	61.6		70.3	63.5	
Actuated g/C Ratio		0.09			0.09	0.16	0.70	0.65		0.74	0.67	
Clearance Time (s)		6.0			6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		141			135	345	233	1147		196	1187	
v/s Ratio Prot						c0.03	0.02	c0.65		c0.05	0.58	
v/s Ratio Perm		0.02			0.05	0.06	0.24			0.48		
v/c Ratio		0.28			0.58	0.42	0.36	1.00		0.72	0.87	
Uniform Delay, d1		40.3			41.5	35.8	12.1	16.7		26.2	12.5	
Progression Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.1			5.9	0.8	1.0	26.8		11.9	8.9	
Delay (s)		41.4			47.3	36.6	13.1	43.5		38.1	21.5	
Level of Service		D			D	D	B	D		D	C	
Approach Delay (s)		41.4			39.3			41.4			23.5	
Approach LOS		D			D			D			C	

Intersection Summary			
HCM 2000 Control Delay	33.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	92.4%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

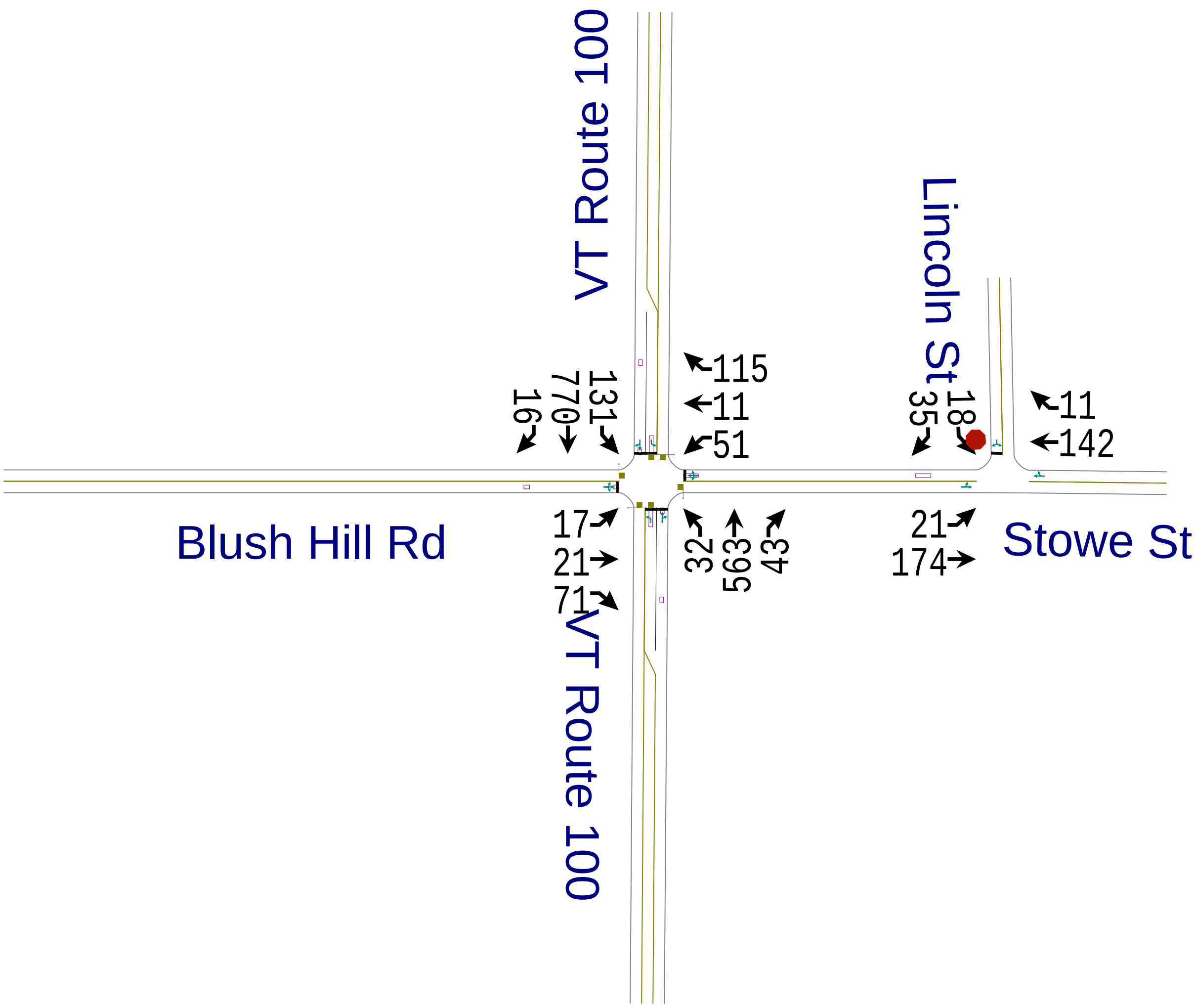
HCM Unsignalized Intersection Capacity Analysis
6: Stowe St & Lincoln St

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	35	142	221	15	23	34
Future Volume (Veh/h)	35	142	221	15	23	34
Sign Control		Free	Free		Stop	
Grade		5%	-5%		0%	
Peak Hour Factor	0.90	0.90	0.91	0.91	0.90	0.90
Hourly flow rate (vph)	44	178	274	19	29	43
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)		175				
pX, platoon unblocked					0.98	
vC, conflicting volume	293				550	284
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	293				528	284
tC, single (s)	4.2				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.3				3.6	3.4
p0 queue free %	96				94	94
cM capacity (veh/h)	1230				470	730

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	222	293	72
Volume Left	44	0	29
Volume Right	0	19	43
cSH	1230	1700	597
Volume to Capacity	0.04	0.17	0.12
Queue Length 95th (ft)	3	0	10
Control Delay (s)	1.9	0.0	11.9
Lane LOS	A		B
Approach Delay (s)	1.9	0.0	11.9
Approach LOS			B

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	38.6%	ICU Level of Service	A
Analysis Period (min)	15		

Map - Bridge 36 Stowe Street Waterbury
Volumes 01/12/2021



Queues
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	118	183	34	659	139	836
v/c Ratio	0.48	0.77	0.10	0.65	0.31	0.71
Control Delay	22.0	42.2	4.2	15.2	5.5	16.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	22.0	42.2	4.2	15.2	5.5	16.1
Queue Length 50th (ft)	21	51	4	224	19	331
Queue Length 95th (ft)	72	#149	11	346	34	510
Internal Link Dist (ft)	602	95		470		414
Turn Bay Length (ft)			340		200	
Base Capacity (vph)	265	256	338	1016	444	1170
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.45	0.71	0.10	0.65	0.31	0.71

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	15	19	63	45	10	102	28	498	38	116	681	14
Future Volume (vph)	15	19	63	45	10	102	28	498	38	116	681	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	11	12	12	12	11	11	11	11	11	11
Grade (%)		-10%			8%			0%			0%	
Total Lost time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.91			0.91		1.00	0.99		1.00	1.00	
Flt Protected		0.99			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1728			1562		1601	1667		1678	1761	
Flt Permitted		0.85			0.85		0.23	1.00		0.29	1.00	
Satd. Flow (perm)		1479			1346		380	1667		516	1761	
Peak-hour factor, PHF	0.92	0.92	0.92	0.97	0.97	0.97	0.92	0.92	0.92	0.94	0.94	0.94
Growth Factor (vph)	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%
Adj. Flow (vph)	18	23	77	52	12	119	34	612	47	139	819	17
RTOR Reduction (vph)	0	68	0	0	77	0	0	3	0	0	1	0
Lane Group Flow (vph)	0	50	0	0	106	0	34	656	0	139	835	0
Heavy Vehicles (%)	1%	1%	1%	5%	5%	5%	9%	9%	9%	4%	4%	4%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		10.7			10.7		57.7	54.1		62.9	56.7	
Effective Green, g (s)		10.7			10.7		57.7	54.1		62.9	56.7	
Actuated g/C Ratio		0.12			0.12		0.65	0.61		0.71	0.64	
Clearance Time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		177			161		295	1013		445	1121	
v/s Ratio Prot							0.00	0.39		c0.02	c0.47	
v/s Ratio Perm		0.03			c0.08		0.07			0.20		
v/c Ratio		0.28			0.66		0.12	0.65		0.31	0.75	
Uniform Delay, d1		35.7			37.4		7.9	11.3		6.1	11.2	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.9			9.8		0.2	3.2		0.4	4.5	
Delay (s)		36.5			47.2		8.0	14.5		6.5	15.7	
Level of Service		D			D		A	B		A	B	
Approach Delay (s)		36.5			47.2			14.2			14.4	
Approach LOS		D			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	18.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	89.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	77.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

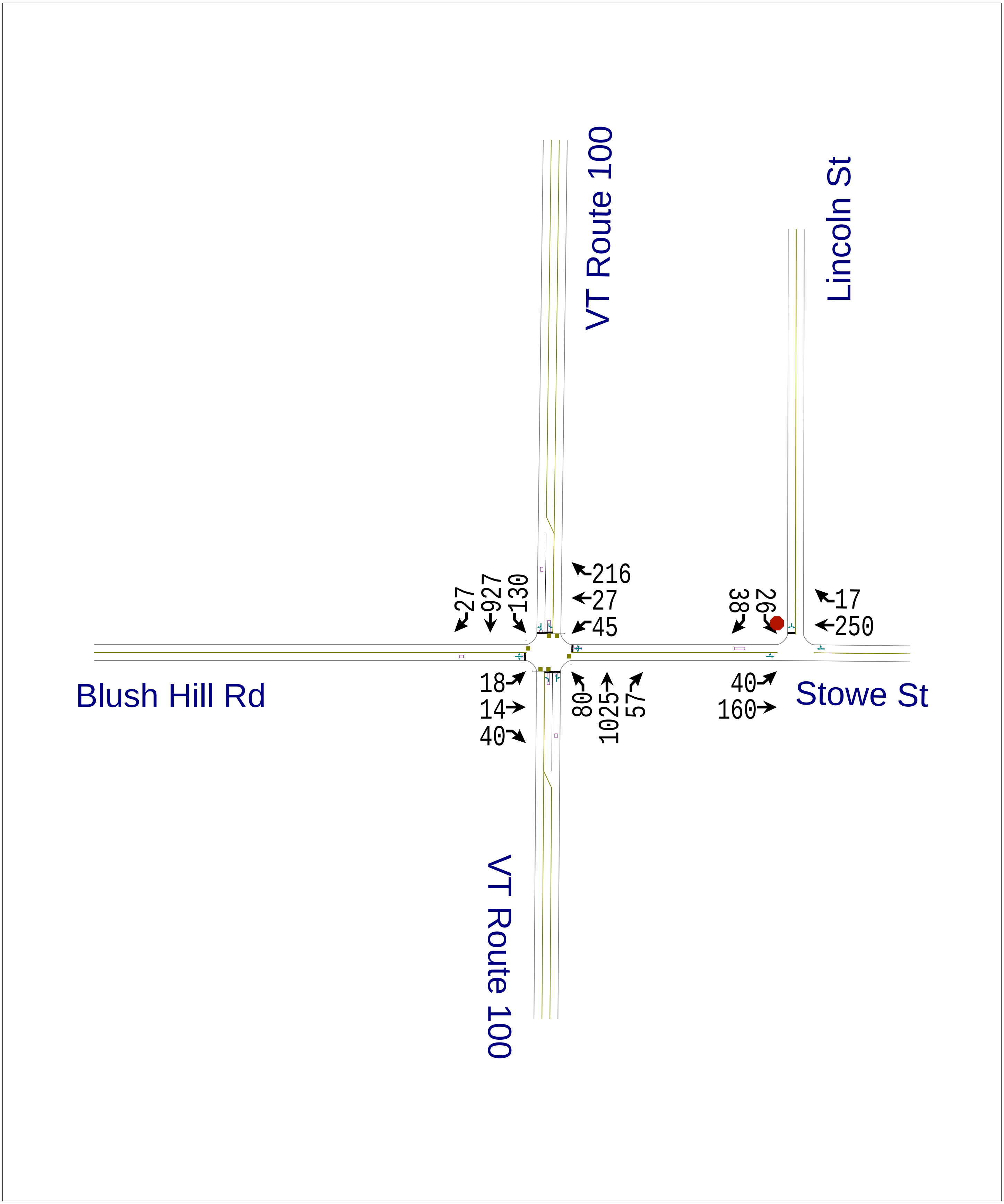
HCM Unsignalized Intersection Capacity Analysis
6: Stowe St & Lincoln St

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	19	154	126	10	16	31
Future Volume (Veh/h)	19	154	126	10	16	31
Sign Control		Free	Free		Stop	
Grade		5%	-5%		0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	24	193	158	13	20	39
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)		175				
pX, platoon unblocked					0.98	
vC, conflicting volume	171				406	164
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	171				379	164
tC, single (s)	4.1				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.4
p0 queue free %	98				97	96
cM capacity (veh/h)	1388				579	867

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	217	171	59
Volume Left	24	0	20
Volume Right	0	13	39
cSH	1388	1700	742
Volume to Capacity	0.02	0.10	0.08
Queue Length 95th (ft)	1	0	6
Control Delay (s)	1.0	0.0	10.3
Lane LOS	A		B
Approach Delay (s)	1.0	0.0	10.3
Approach LOS			B

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	31.9%	ICU Level of Service	A
Analysis Period (min)	15		

Map - Bridge 36 Stowe Street Waterbury
Volumes 01/12/2021



Queues
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	78	313	85	1150	141	1036
v/c Ratio	0.42	0.97	0.44	1.03	0.91	0.89
Control Delay	28.0	70.8	11.5	55.2	73.3	27.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.0	70.8	11.5	55.2	73.3	27.6
Queue Length 50th (ft)	20	124	12	~789	42	534
Queue Length 95th (ft)	66	#299	24	#1044	#160	#881
Internal Link Dist (ft)	602	95		470		690
Turn Bay Length (ft)			150		150	
Base Capacity (vph)	187	322	194	1116	155	1158
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.42	0.97	0.44	1.03	0.91	0.89

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	16	12	35	40	24	191	71	907	50	115	820	24
Future Volume (vph)	16	12	35	40	24	191	71	907	50	115	820	24
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	11	12	12	12	11	11	11	11	11	11
Grade (%)		-10%			8%			0%			0%	
Total Lost time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.93			0.90		1.00	0.99		1.00	1.00	
Flt Protected		0.99			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1745			1610		1694	1769		1694	1776	
Flt Permitted		0.61			0.94		0.10	1.00		0.06	1.00	
Satd. Flow (perm)		1076			1525		175	1769		111	1776	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Growth Factor (vph)	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%
Adj. Flow (vph)	20	15	43	49	29	235	85	1090	60	141	1007	29
RTOR Reduction (vph)	0	37	0	0	108	0	0	2	0	0	1	0
Lane Group Flow (vph)	0	41	0	0	205	0	85	1148	0	141	1035	0
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	3%	3%	3%	3%	3%	3%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		14.0			14.0		67.0	63.0		69.0	64.0	
Effective Green, g (s)		14.0			14.0		67.0	63.0		69.0	64.0	
Actuated g/C Ratio		0.14			0.14		0.67	0.63		0.69	0.64	
Clearance Time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		150			213		178	1114		155	1136	
v/s Ratio Prot							0.02	c0.65		c0.05	0.58	
v/s Ratio Perm		0.04			c0.13		0.30			0.58		
v/c Ratio		0.27			0.96		0.48	1.03		0.91	0.91	
Uniform Delay, d1		38.5			42.7		16.2	18.5		29.3	15.5	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.0			50.3		2.0	35.1		46.1	12.4	
Delay (s)		39.4			93.0		18.2	53.6		75.4	27.9	
Level of Service		D			F		B	D		E	C	
Approach Delay (s)		39.4			93.0			51.2			33.6	
Approach LOS		D			F			D			C	

Intersection Summary			
HCM 2000 Control Delay	48.2	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	99.8%	ICU Level of Service	F
Analysis Period (min)	15		

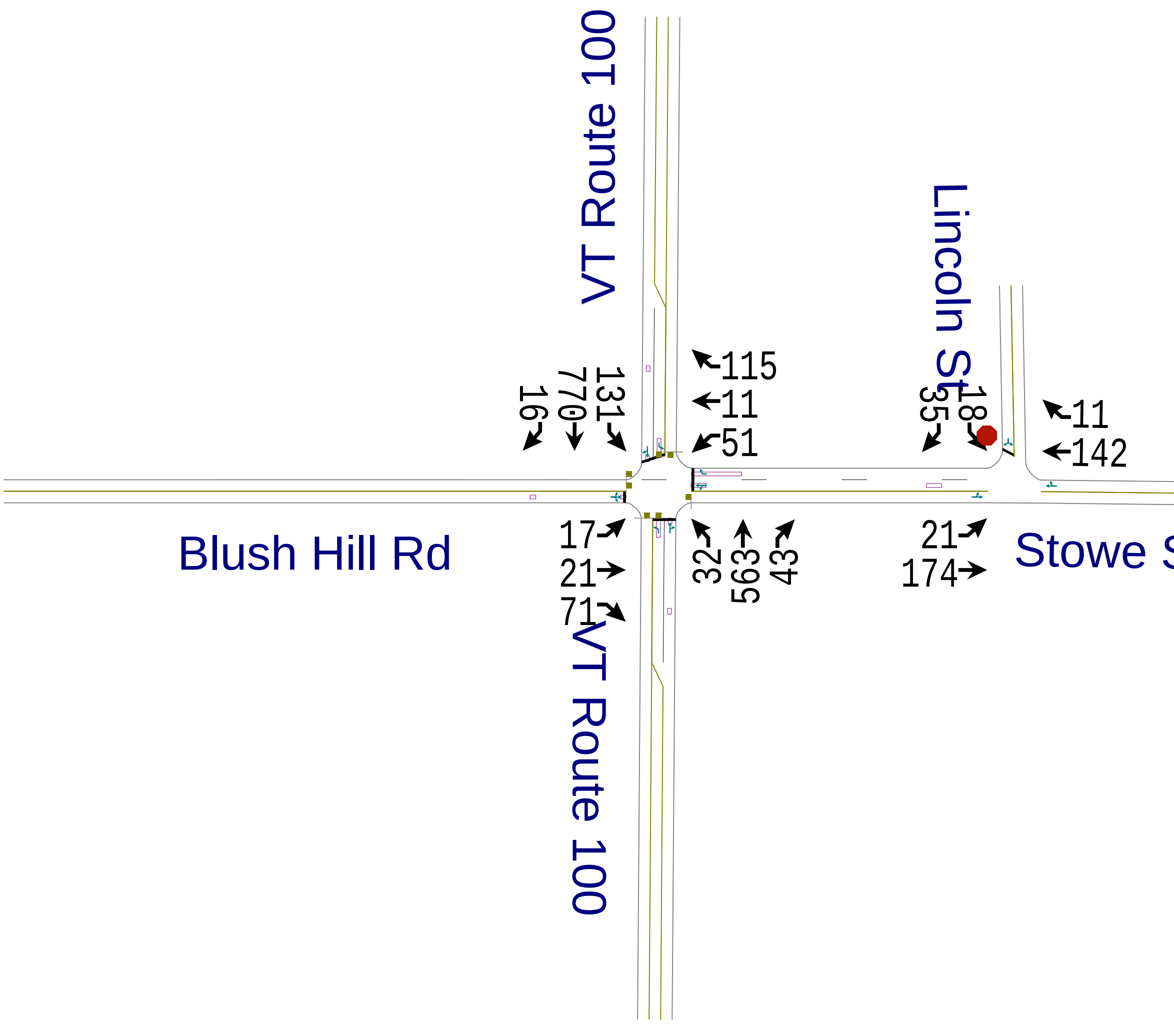
c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
6: Stowe St & Lincoln St

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	35	142	221	15	23	34
Future Volume (Veh/h)	35	142	221	15	23	34
Sign Control		Free	Free		Stop	
Grade		5%	-5%		0%	
Peak Hour Factor	0.90	0.90	0.91	0.91	0.90	0.90
Hourly flow rate (vph)	44	178	274	19	29	43
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)		175				
pX, platoon unblocked					0.97	
vC, conflicting volume	293				550	284
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	293				525	284
tC, single (s)	4.2				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.3				3.6	3.4
p0 queue free %	96				94	94
cM capacity (veh/h)	1230				471	730

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	222	293	72
Volume Left	44	0	29
Volume Right	0	19	43
cSH	1230	1700	598
Volume to Capacity	0.04	0.17	0.12
Queue Length 95th (ft)	3	0	10
Control Delay (s)	1.9	0.0	11.8
Lane LOS	A		B
Approach Delay (s)	1.9	0.0	11.8
Approach LOS			B

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	38.6%	ICU Level of Service	A
Analysis Period (min)	15		


VT Route 100
Lincoln St
115
11
51
16
770
131
35
18
11
142
Blush Hill Rd
17
21
71
32
563
43
21
174
Stowe St
VT Route 100

Queues
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	118	64	119	34	659	139	836
v/c Ratio	0.46	0.49	0.26	0.10	0.64	0.31	0.71
Control Delay	21.3	49.9	6.5	4.2	15.2	5.3	15.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	21.3	49.9	6.5	4.2	15.2	5.3	15.7
Queue Length 50th (ft)	22	35	0	4	222	17	310
Queue Length 95th (ft)	70	74	39	12	355	36	525
Internal Link Dist (ft)	602	95			470		414
Turn Bay Length (ft)			150	340		200	
Base Capacity (vph)	300	164	464	346	1022	454	1183
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.39	0.39	0.26	0.10	0.64	0.31	0.71

Intersection Summary

HCM Signalized Intersection Capacity Analysis
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	15	19	63	45	10	102	28	498	38	116	681	14
Future Volume (vph)	15	19	63	45	10	102	28	498	38	116	681	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	11	12	12	12	11	11	11	11	11	11
Grade (%)		-10%			8%			0%			0%	
Total Lost time (s)		6.0			6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Frt		0.91			1.00	0.85	1.00	0.99		1.00	1.00	
Flt Protected		0.99			0.96	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1728			1669	1477	1601	1667		1678	1761	
Flt Permitted		0.93			0.66	1.00	0.23	1.00		0.29	1.00	
Satd. Flow (perm)		1625			1138	1477	392	1667		516	1761	
Peak-hour factor, PHF	0.92	0.92	0.92	0.97	0.97	0.97	0.92	0.92	0.92	0.94	0.94	0.94
Growth Factor (vph)	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%
Adj. Flow (vph)	18	23	77	52	12	119	34	612	47	139	819	17
RTOR Reduction (vph)	0	68	0	0	0	97	0	3	0	0	1	0
Lane Group Flow (vph)	0	50	0	0	64	22	34	656	0	139	835	0
Heavy Vehicles (%)	1%	1%	1%	5%	5%	5%	9%	9%	9%	4%	4%	4%
Turn Type	Perm	NA		Perm	NA	pm+ov	pm+pt	NA		pm+pt	NA	
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		10.3			10.3	16.9	58.7	55.1		64.7	58.1	
Effective Green, g (s)		10.3			10.3	16.9	58.7	55.1		64.7	58.1	
Actuated g/C Ratio		0.11			0.11	0.19	0.65	0.61		0.72	0.65	
Clearance Time (s)		6.0			6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		185			130	375	304	1020		456	1136	
v/s Ratio Prot						0.00	0.00	0.39		c0.02	c0.47	
v/s Ratio Perm		0.03			c0.06	0.01	0.07			0.20		
v/c Ratio		0.27			0.49	0.06	0.11	0.64		0.30	0.74	
Uniform Delay, d1		36.4			37.4	30.0	7.6	11.2		5.9	10.8	
Progression Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.8			2.9	0.1	0.2	3.1		0.4	4.2	
Delay (s)		37.2			40.3	30.1	7.8	14.3		6.3	15.0	
Level of Service		D			D	C	A	B		A	B	
Approach Delay (s)		37.2			33.7			14.0			13.8	
Approach LOS		D			C			B			B	

Intersection Summary			
HCM 2000 Control Delay	17.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	73.7%	ICU Level of Service	D
Analysis Period (min)	15		

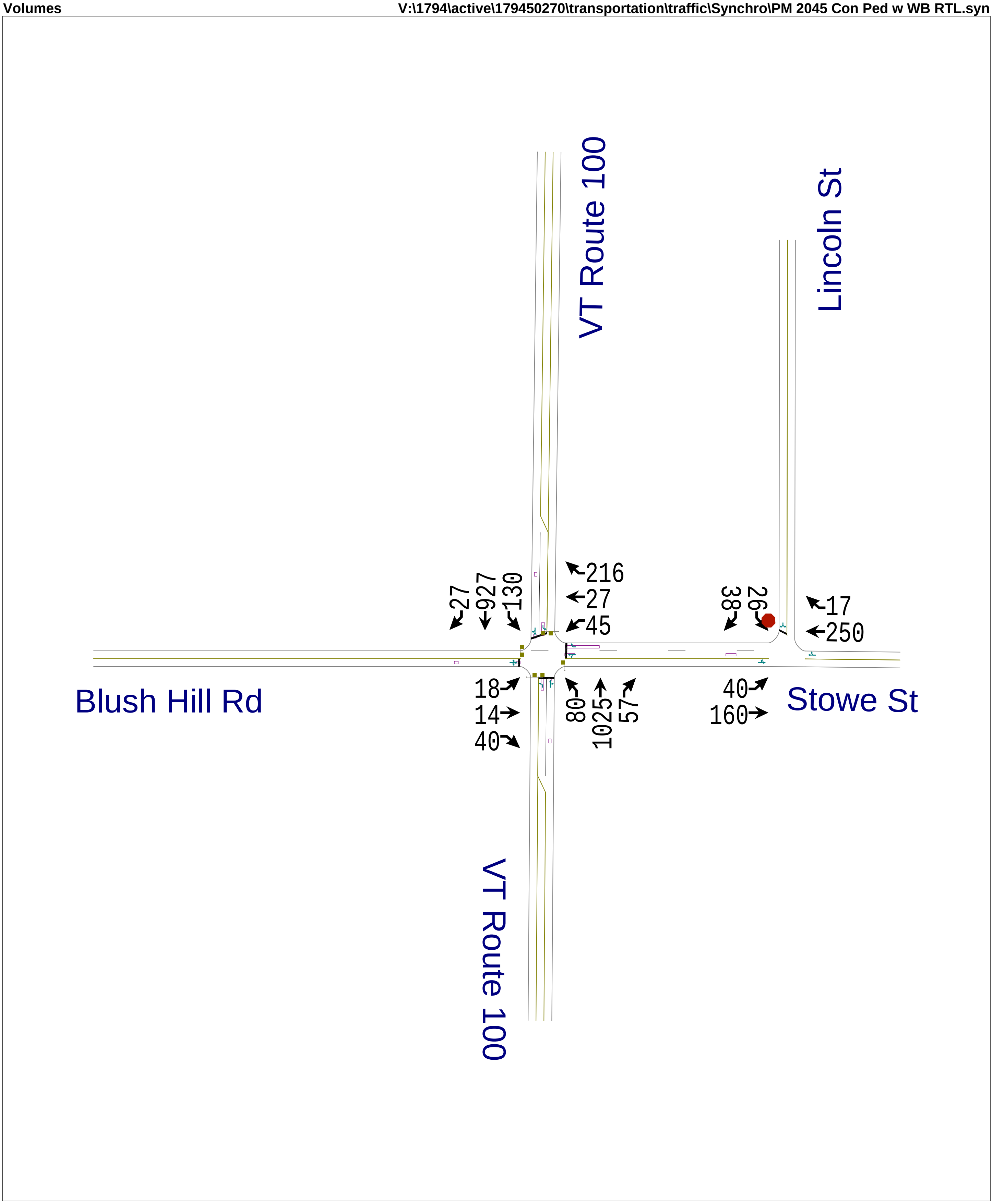
c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
6: Stowe St & Lincoln St

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	19	154	126	10	16	31
Future Volume (Veh/h)	19	154	126	10	16	31
Sign Control		Free	Free		Stop	
Grade		5%	-5%		0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	24	193	158	13	20	39
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)		175				
pX, platoon unblocked					0.98	
vC, conflicting volume	171				406	164
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	171				380	164
tC, single (s)	4.1				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.4
p0 queue free %	98				97	96
cM capacity (veh/h)	1388				579	867

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	217	171	59
Volume Left	24	0	20
Volume Right	0	13	39
cSH	1388	1700	742
Volume to Capacity	0.02	0.10	0.08
Queue Length 95th (ft)	1	0	6
Control Delay (s)	1.0	0.0	10.3
Lane LOS	A		B
Approach Delay (s)	1.0	0.0	10.3
Approach LOS			B

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	31.9%	ICU Level of Service	A
Analysis Period (min)	15		


VT Route 100
Lincoln St
27
927
130
216
27
45
38
26
17
250
Blush Hill Rd
18
14
40
80
1025
57
40
160
Stowe St
VT Route 100

Queues
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	78	78	235	85	1150	141	1036
v/c Ratio	0.38	0.49	0.69	0.36	1.03	0.71	0.88
Control Delay	26.0	50.5	20.6	8.0	54.2	38.7	25.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.0	50.5	20.6	8.0	54.2	38.7	25.3
Queue Length 50th (ft)	20	45	21	10	~758	34	498
Queue Length 95th (ft)	61	89	95	22	#1009	#138	#855
Internal Link Dist (ft)	602	95			470		690
Turn Bay Length (ft)				340		200	
Base Capacity (vph)	235	187	366	235	1118	198	1180
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.33	0.42	0.64	0.36	1.03	0.71	0.88

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	16	12	35	40	24	191	71	907	50	115	820	24
Future Volume (vph)	16	12	35	40	24	191	71	907	50	115	820	24
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	11	12	12	12	11	11	11	11	11	11
Grade (%)		-10%			8%			0%			0%	
Total Lost time (s)		6.0			6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Frt		0.93			1.00	0.85	1.00	0.99		1.00	1.00	
Flt Protected		0.99			0.97	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1745			1751	1535	1694	1769		1694	1776	
Flt Permitted		0.89			0.82	1.00	0.11	1.00		0.06	1.00	
Satd. Flow (perm)		1568			1481	1535	199	1769		115	1776	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Growth Factor (vph)	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%
Adj. Flow (vph)	20	15	43	49	29	235	85	1090	60	141	1007	29
RTOR Reduction (vph)	0	38	0	0	0	177	0	2	0	0	1	0
Lane Group Flow (vph)	0	40	0	0	78	58	85	1148	0	141	1035	0
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	3%	3%	3%	3%	3%	3%
Turn Type	Perm	NA		Perm	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		10.2			10.2	10.2	64.8	59.9		68.8	61.9	
Effective Green, g (s)		10.2			10.2	10.2	64.8	59.9		68.8	61.9	
Actuated g/C Ratio		0.11			0.11	0.11	0.68	0.63		0.72	0.65	
Clearance Time (s)		6.0			6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		168			159	164	212	1115		197	1157	
v/s Ratio Prot							0.02	c0.65		c0.05	0.58	
v/s Ratio Perm		0.03			c0.05	0.04	0.25			0.46		
v/c Ratio		0.24			0.49	0.36	0.40	1.03		0.72	0.89	
Uniform Delay, d1		38.8			40.0	39.3	13.6	17.6		26.5	13.8	
Progression Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.7			2.4	1.3	1.2	34.8		11.7	10.8	
Delay (s)		39.6			42.3	40.7	14.9	52.3		38.2	24.6	
Level of Service		D			D	D	B	D		D	C	
Approach Delay (s)		39.6			41.1			49.7			26.2	
Approach LOS		D			D			D			C	

Intersection Summary			
HCM 2000 Control Delay	38.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	92.4%	ICU Level of Service	F
Analysis Period (min)	15		

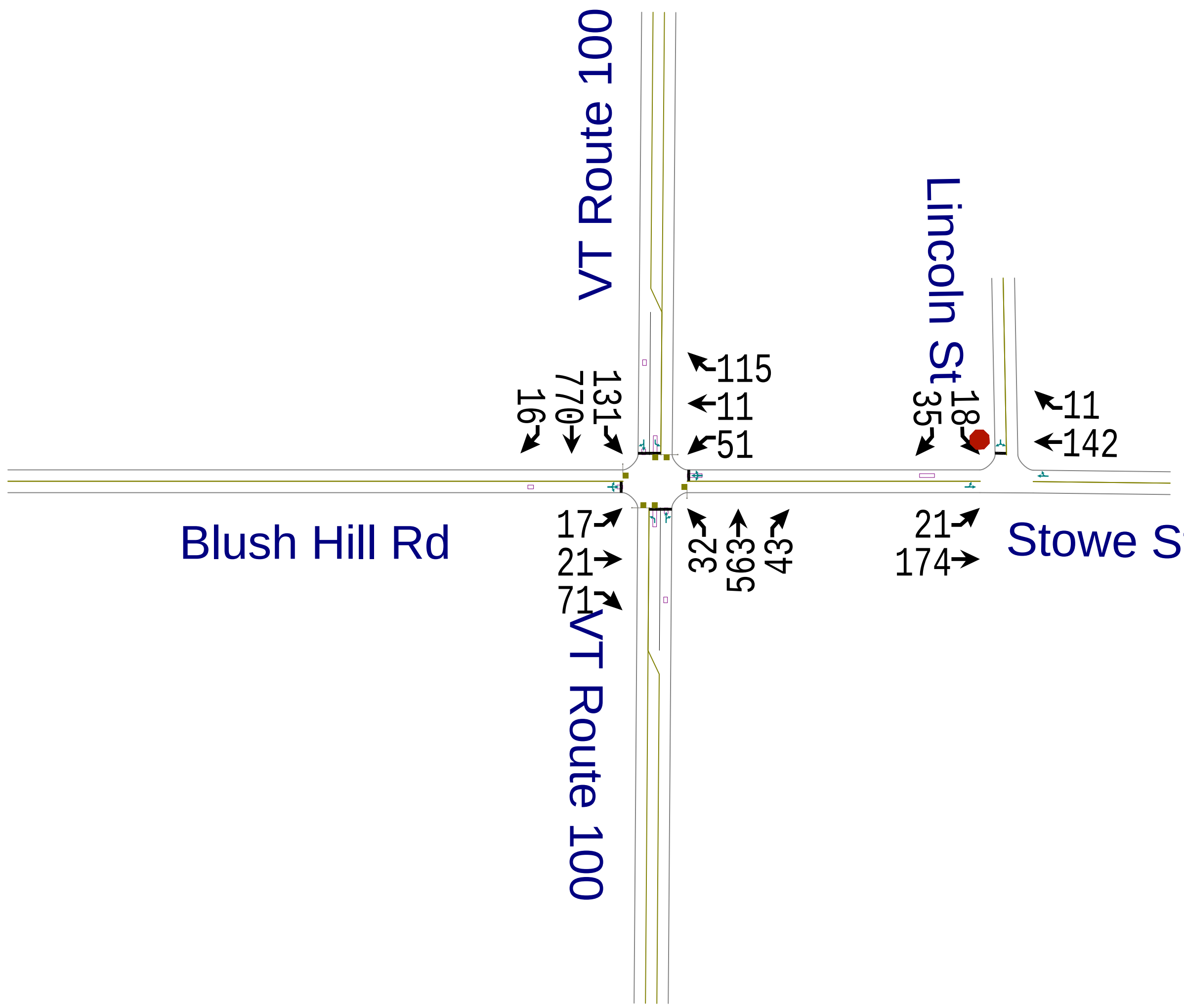
c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
6: Stowe St & Lincoln St

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	35	142	221	15	23	34
Future Volume (Veh/h)	35	142	221	15	23	34
Sign Control		Free	Free		Stop	
Grade		5%	-5%		0%	
Peak Hour Factor	0.90	0.90	0.91	0.91	0.90	0.90
Hourly flow rate (vph)	44	178	274	19	29	43
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)		175				
pX, platoon unblocked					0.98	
vC, conflicting volume	293				550	284
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	293				527	284
tC, single (s)	4.2				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.3				3.6	3.4
p0 queue free %	96				94	94
cM capacity (veh/h)	1230				471	730

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	222	293	72
Volume Left	44	0	29
Volume Right	0	19	43
cSH	1230	1700	597
Volume to Capacity	0.04	0.17	0.12
Queue Length 95th (ft)	3	0	10
Control Delay (s)	1.9	0.0	11.9
Lane LOS	A		B
Approach Delay (s)	1.9	0.0	11.9
Approach LOS			B

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	38.6%	ICU Level of Service	A
Analysis Period (min)	15		


VT Route 100
Lincoln St
115
11
51
16
770
131
35
18
11
142
Blush Hill Rd
17
21
71
32
563
43
21
174
Stowe St
VT Route 100

Queues
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	118	183	34	659	139	836
v/c Ratio	0.59	0.97	0.10	0.63	0.31	0.69
Control Delay	32.1	87.1	5.2	16.3	6.1	16.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	32.1	87.1	5.2	16.3	6.1	16.7
Queue Length 50th (ft)	28	73	4	220	17	308
Queue Length 95th (ft)	#88	#214	18	477	55	#750
Internal Link Dist (ft)	602	95		470		414
Turn Bay Length (ft)			340		200	
Base Capacity (vph)	200	189	338	1049	451	1205
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.59	0.97	0.10	0.63	0.31	0.69

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	15	19	63	45	10	102	28	498	38	116	681	14
Future Volume (vph)	15	19	63	45	10	102	28	498	38	116	681	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	11	12	12	12	11	11	11	11	11	11
Grade (%)		-10%			8%			0%			0%	
Total Lost time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.91			0.91		1.00	0.99		1.00	1.00	
Flt Protected		0.99			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1728			1562		1601	1667		1678	1761	
Flt Permitted		0.79			0.80		0.23	1.00		0.29	1.00	
Satd. Flow (perm)		1376			1265		383	1667		508	1761	
Peak-hour factor, PHF	0.92	0.92	0.92	0.97	0.97	0.97	0.92	0.92	0.92	0.94	0.94	0.94
Growth Factor (vph)	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%
Adj. Flow (vph)	18	23	77	52	12	119	34	612	47	139	819	17
RTOR Reduction (vph)	0	66	0	0	66	0	0	2	0	0	1	0
Lane Group Flow (vph)	0	52	0	0	117	0	34	657	0	139	835	0
Heavy Vehicles (%)	1%	1%	1%	5%	5%	5%	9%	9%	9%	4%	4%	4%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		10.0			10.0		66.3	62.5		72.9	65.8	
Effective Green, g (s)		10.0			10.0		66.3	62.5		72.9	65.8	
Actuated g/C Ratio		0.10			0.10		0.65	0.61		0.71	0.65	
Clearance Time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		134			124		294	1021		444	1136	
v/s Ratio Prot							0.00	0.39		c0.02	c0.47	
v/s Ratio Perm		0.04			c0.09		0.07			0.20		
v/c Ratio		0.39			0.94		0.12	0.64		0.31	0.74	
Uniform Delay, d1		43.1			45.7		8.9	12.6		7.0	12.2	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.9			63.3		0.2	3.1		0.4	4.2	
Delay (s)		45.0			109.0		9.1	15.7		7.4	16.5	
Level of Service		D			F		A	B		A	B	
Approach Delay (s)		45.0			109.0			15.4			15.2	
Approach LOS		D			F			B			B	

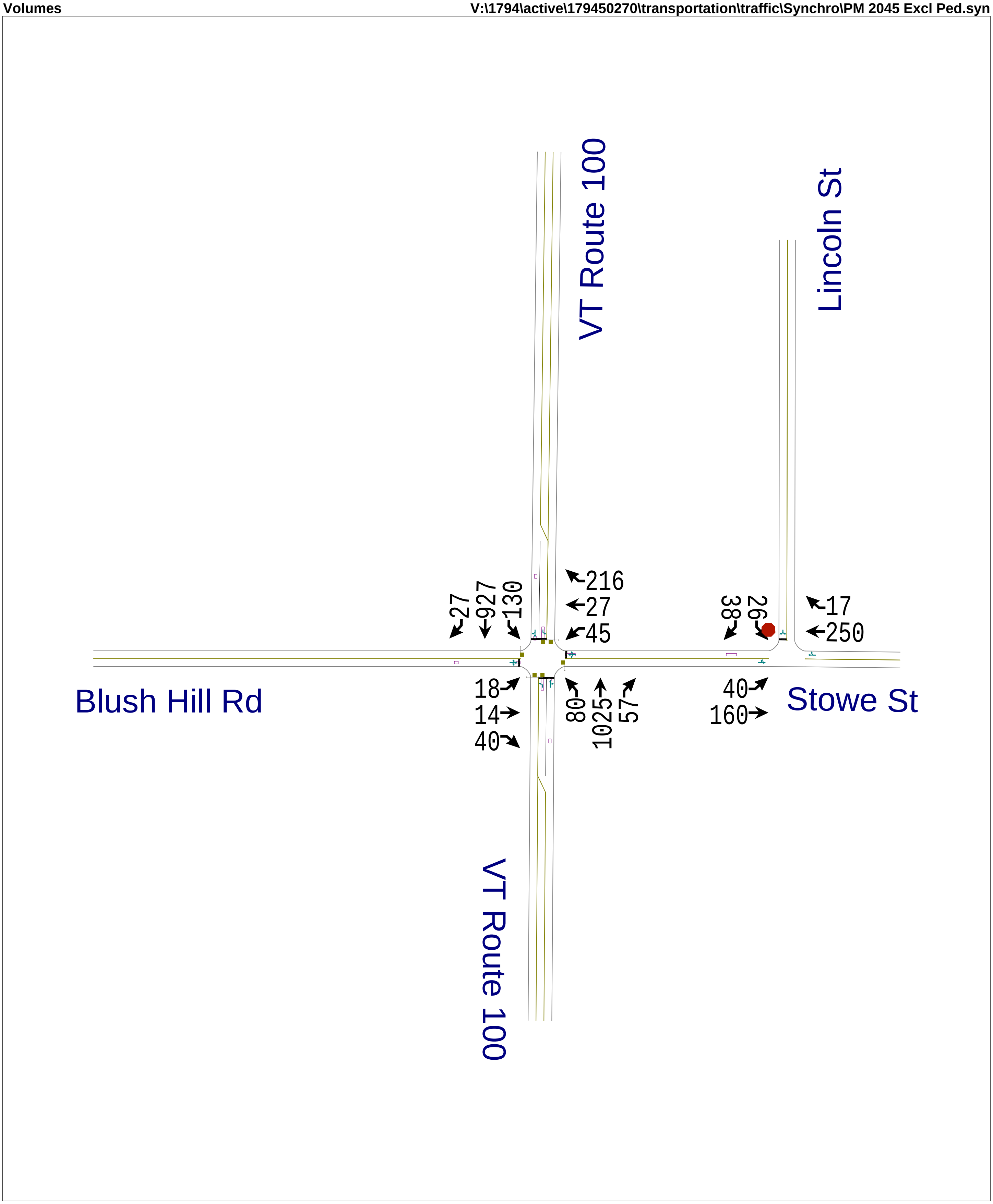
Intersection Summary			
HCM 2000 Control Delay	25.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	102.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	77.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	19	154	126	10	16	31
Future Volume (Veh/h)	19	154	126	10	16	31
Sign Control		Free	Free		Stop	
Grade		5%	-5%		0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	24	193	158	13	20	39
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)		175				
pX, platoon unblocked					0.98	
vC, conflicting volume	171				406	164
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	171				378	164
tC, single (s)	4.1				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.4
p0 queue free %	98				97	96
cM capacity (veh/h)	1388				580	867

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	217	171	59
Volume Left	24	0	20
Volume Right	0	13	39
cSH	1388	1700	742
Volume to Capacity	0.02	0.10	0.08
Queue Length 95th (ft)	1	0	6
Control Delay (s)	1.0	0.0	10.3
Lane LOS	A		B
Approach Delay (s)	1.0	0.0	10.3
Approach LOS			B

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	31.9%	ICU Level of Service	A
Analysis Period (min)	15		


VT Route 100
Lincoln St
27
927
130
216
27
45
38
26
17
250
Blush Hill Rd
18
14
40
80
1025
57
40
160
Stowe St
VT Route 100

Queues
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	78	313	85	1150	141	1036
v/c Ratio	0.52	1.17	0.41	1.07	0.64	0.88
Control Delay	36.6	138.3	11.9	71.0	34.6	27.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	36.6	138.3	11.9	71.0	34.6	27.9
Queue Length 50th (ft)	23	~188	11	~883	41	529
Queue Length 95th (ft)	73	#365	38	#1241	#184	#1064
Internal Link Dist (ft)	602	95		470		690
Turn Bay Length (ft)			340		200	
Base Capacity (vph)	151	267	205	1076	221	1174
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.52	1.17	0.41	1.07	0.64	0.88

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	16	12	35	40	24	191	71	907	50	115	820	24
Future Volume (vph)	16	12	35	40	24	191	71	907	50	115	820	24
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	11	12	12	12	11	11	11	11	11	11
Grade (%)		-10%			8%			0%			0%	
Total Lost time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.93			0.90		1.00	0.99		1.00	1.00	
Flt Protected		0.99			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1745			1610		1694	1769		1694	1776	
Flt Permitted		0.58			0.94		0.10	1.00		0.06	1.00	
Satd. Flow (perm)		1024			1521		171	1769		103	1776	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Growth Factor (vph)	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%
Adj. Flow (vph)	20	15	43	49	29	235	85	1090	60	141	1007	29
RTOR Reduction (vph)	0	38	0	0	100	0	0	2	0	0	1	0
Lane Group Flow (vph)	0	40	0	0	213	0	85	1148	0	141	1035	0
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	3%	3%	3%	3%	3%	3%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		12.0			12.0		70.0	64.6		79.2	69.2	
Effective Green, g (s)		12.0			12.0		70.0	64.6		79.2	69.2	
Actuated g/C Ratio		0.11			0.11		0.64	0.59		0.73	0.63	
Clearance Time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		112			167		185	1048		220	1127	
v/s Ratio Prot							0.02	c0.65		c0.06	c0.58	
v/s Ratio Perm		0.04			c0.14		0.27			0.41		
v/c Ratio		0.35			1.28		0.46	1.10		0.64	0.92	
Uniform Delay, d1		44.9			48.5		17.7	22.2		31.2	17.4	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.9			162.9		1.8	57.8		6.2	13.2	
Delay (s)		46.8			211.4		19.5	80.0		37.4	30.7	
Level of Service		D			F		B	E		D	C	
Approach Delay (s)		46.8			211.4			75.8			31.5	
Approach LOS		D			F			E			C	

Intersection Summary			
HCM 2000 Control Delay	71.5	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.05		
Actuated Cycle Length (s)	109.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	99.8%	ICU Level of Service	F
Analysis Period (min)	15		

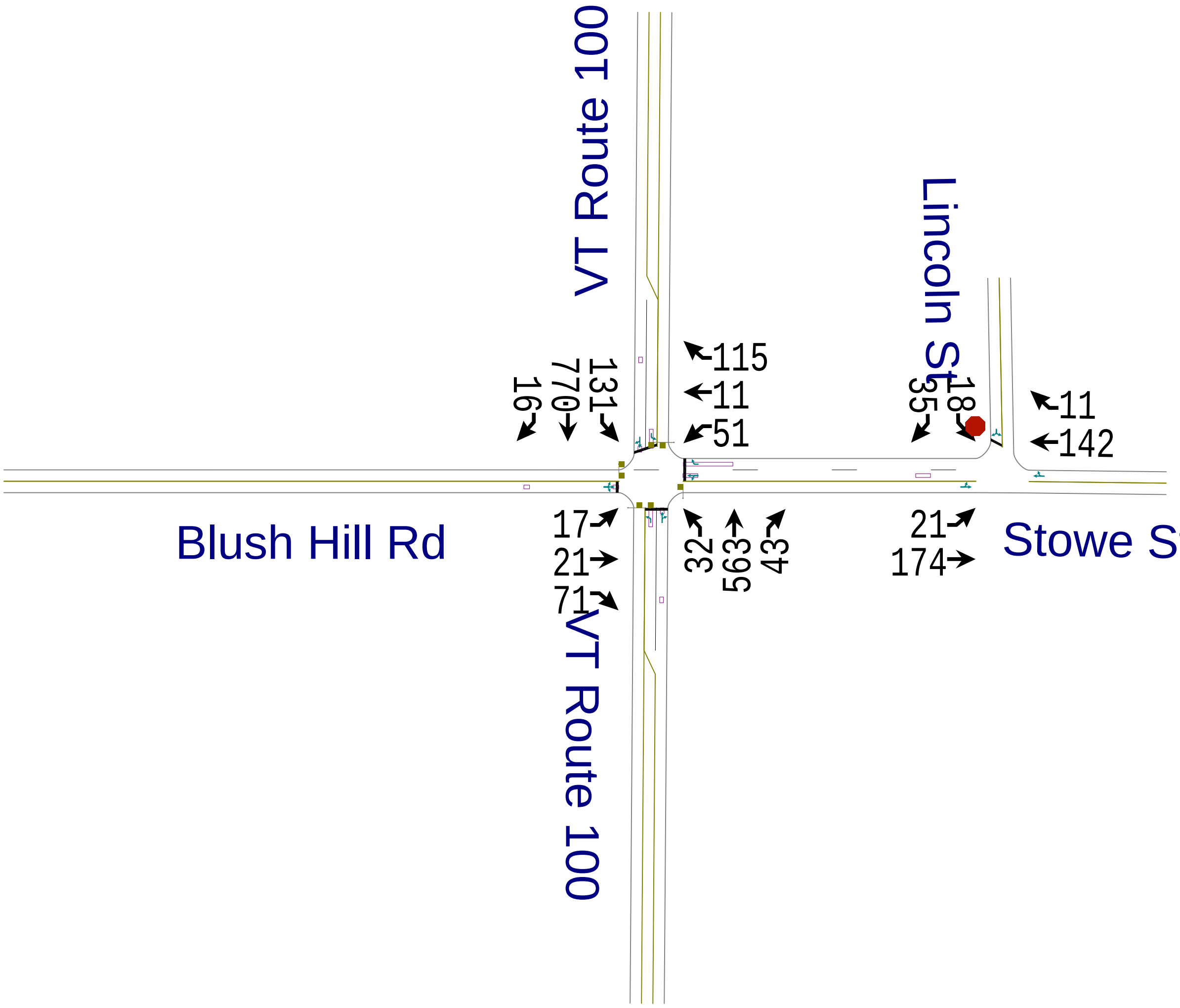
c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	35	142	221	15	23	34
Future Volume (Veh/h)	35	142	221	15	23	34
Sign Control		Free	Free		Stop	
Grade		5%	-5%		0%	
Peak Hour Factor	0.90	0.80	0.91	0.91	0.90	0.90
Hourly flow rate (vph)	44	201	274	19	29	43
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)		175				
pX, platoon unblocked					0.97	
vC, conflicting volume	293				572	284
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	293				547	284
tC, single (s)	4.2				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.3				3.6	3.4
p0 queue free %	96				94	94
cM capacity (veh/h)	1230				456	730

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	245	293	72
Volume Left	44	0	29
Volume Right	0	19	43
cSH	1230	1700	588
Volume to Capacity	0.04	0.17	0.12
Queue Length 95th (ft)	3	0	10
Control Delay (s)	1.7	0.0	12.0
Lane LOS	A		B
Approach Delay (s)	1.7	0.0	12.0
Approach LOS			B

Intersection Summary			
Average Delay	2.1		
Intersection Capacity Utilization	38.6%	ICU Level of Service	A
Analysis Period (min)	15		

Map - Bridge 36 Stowe Street Waterbury 01/12/2021
Volumes V:\1794\active\179450270\transportation\traffic\Synchro\AM 2045 Excl Ped w WB RTL.syn



Queues
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	118	64	119	34	659	139	836
v/c Ratio	0.53	0.66	0.30	0.10	0.61	0.30	0.68
Control Delay	29.9	78.1	7.3	5.3	15.7	6.1	16.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.9	78.1	7.3	5.3	15.7	6.1	16.3
Queue Length 50th (ft)	31	43	0	4	237	19	331
Queue Length 95th (ft)	90	#105	39	19	480	58	#761
Internal Link Dist (ft)	602	95			470		414
Turn Bay Length (ft)			150	340		200	
Base Capacity (vph)	241	108	399	344	1079	460	1230
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.49	0.59	0.30	0.10	0.61	0.30	0.68

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	15	19	63	45	10	102	28	498	38	116	681	14
Future Volume (vph)	15	19	63	45	10	102	28	498	38	116	681	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	11	12	12	12	11	11	11	11	11	11
Grade (%)		-10%			8%			0%			0%	
Total Lost time (s)		6.0			6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Frt		0.91			1.00	0.85	1.00	0.99		1.00	1.00	
Flt Protected		0.99			0.96	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1728			1669	1477	1601	1667		1678	1761	
Flt Permitted		0.93			0.57	1.00	0.24	1.00		0.30	1.00	
Satd. Flow (perm)		1624			985	1477	397	1667		524	1761	
Peak-hour factor, PHF	0.92	0.92	0.92	0.97	0.97	0.97	0.92	0.92	0.92	0.94	0.94	0.94
Growth Factor (vph)	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%
Adj. Flow (vph)	18	23	77	52	12	119	34	612	47	139	819	17
RTOR Reduction (vph)	0	63	0	0	0	100	0	2	0	0	0	0
Lane Group Flow (vph)	0	55	0	0	64	19	34	657	0	139	836	0
Heavy Vehicles (%)	1%	1%	1%	5%	5%	5%	9%	9%	9%	4%	4%	4%
Turn Type	Perm	NA		Perm	NA	pm+ov	pm+pt	NA		pm+pt	NA	
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		10.8			10.8	17.8	72.5	68.8		79.1	72.1	
Effective Green, g (s)		10.8			10.8	17.8	72.5	68.8		79.1	72.1	
Actuated g/C Ratio		0.10			0.10	0.16	0.67	0.63		0.73	0.66	
Clearance Time (s)		6.0			6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		160			97	241	304	1052		454	1164	
v/s Ratio Prot						0.01	0.00	0.39		c0.02	c0.47	
v/s Ratio Perm		0.03			c0.06	0.01	0.07			0.20		
v/c Ratio		0.34			0.66	0.08	0.11	0.62		0.31	0.72	
Uniform Delay, d1		45.8			47.3	38.7	8.8	12.2		6.9	11.9	
Progression Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.3			15.1	0.1	0.2	2.8		0.4	3.8	
Delay (s)		47.1			62.4	38.8	8.9	15.0		7.2	15.7	
Level of Service		D			E	D	A	B		A	B	
Approach Delay (s)		47.1			47.1			14.7			14.5	
Approach LOS		D			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	19.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	109.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	73.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

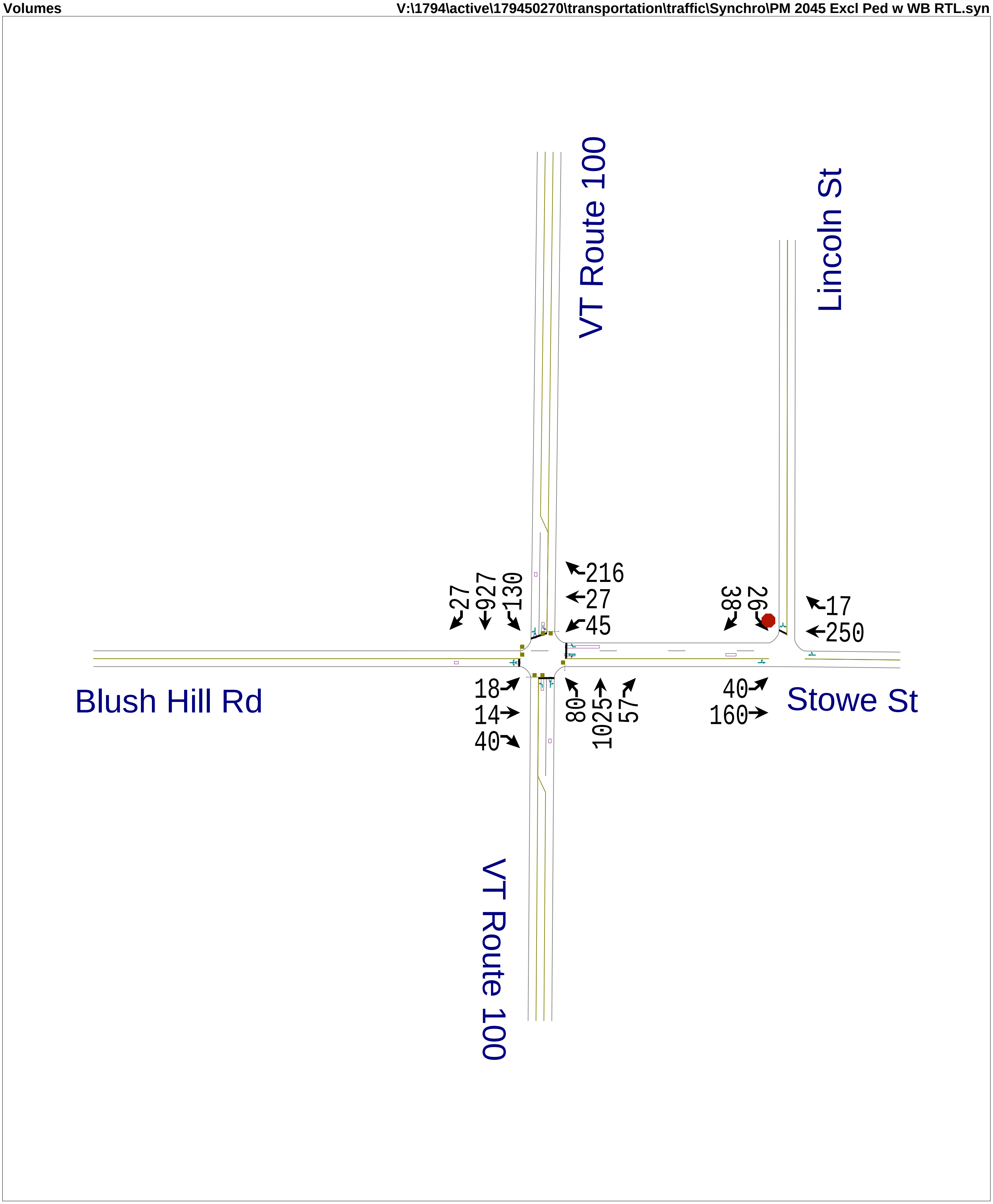
HCM Unsignalized Intersection Capacity Analysis
6: Stowe St & Lincoln St

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	19	154	126	10	16	31
Future Volume (Veh/h)	19	154	126	10	16	31
Sign Control		Free	Free		Stop	
Grade		5%	-5%		0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	24	193	158	13	20	39
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)		175				
pX, platoon unblocked					0.98	
vC, conflicting volume	171				406	164
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	171				379	164
tC, single (s)	4.1				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.4
p0 queue free %	98				97	96
cM capacity (veh/h)	1388				579	867

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	217	171	59
Volume Left	24	0	20
Volume Right	0	13	39
cSH	1388	1700	742
Volume to Capacity	0.02	0.10	0.08
Queue Length 95th (ft)	1	0	6
Control Delay (s)	1.0	0.0	10.3
Lane LOS	A		B
Approach Delay (s)	1.0	0.0	10.3
Approach LOS			B

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	31.9%	ICU Level of Service	A
Analysis Period (min)	15		

Map - Bridge 36 Stowe Street Waterbury 01/13/2021
Volumes V:\1794\active\179450270\transportation\traffic\Synchro\PM 2045 Excl Ped w WB RTL.syn



Queues
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	78	78	235	85	1150	141	1036
v/c Ratio	0.53	0.81	0.45	0.27	0.97	0.59	0.80
Control Delay	41.3	104.6	7.2	4.9	39.2	31.0	17.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	41.3	104.6	7.2	4.9	39.2	31.0	17.5
Queue Length 50th (ft)	27	58	0	9	730	47	460
Queue Length 95th (ft)	77	#146	61	16	#1167	110	778
Internal Link Dist (ft)	602	95			470		690
Turn Bay Length (ft)			150	340		200	
Base Capacity (vph)	147	96	528	312	1187	240	1296
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.53	0.81	0.45	0.27	0.97	0.59	0.80

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
3: VT Route 100 & Blush Hill Rd/Stowe St

02/05/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	16	12	35	40	24	191	71	907	50	115	820	24
Future Volume (vph)	16	12	35	40	24	191	71	907	50	115	820	24
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	11	12	12	12	11	11	11	11	11	11
Grade (%)		-10%			8%			0%			0%	
Total Lost time (s)		6.0			6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Frt		0.93			1.00	0.85	1.00	0.99		1.00	1.00	
Flt Protected		0.99			0.97	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1745			1751	1535	1694	1769		1694	1776	
Flt Permitted		0.89			0.77	1.00	0.17	1.00		0.05	1.00	
Satd. Flow (perm)		1568			1386	1535	302	1769		90	1776	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Growth Factor (vph)	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%	113%
Adj. Flow (vph)	20	15	43	49	29	235	85	1090	60	141	1007	29
RTOR Reduction (vph)	0	38	0	0	0	194	0	1	0	0	1	0
Lane Group Flow (vph)	0	40	0	0	78	41	85	1149	0	141	1035	0
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	3%	3%	3%	3%	3%	3%
Turn Type	Perm	NA		Perm	NA	pm+ov	pm+pt	NA		pm+pt	NA	
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		8.0			8.0	19.9	83.4	77.1		94.6	82.7	
Effective Green, g (s)		8.0			8.0	19.9	83.4	77.1		94.6	82.7	
Actuated g/C Ratio		0.07			0.07	0.17	0.73	0.67		0.82	0.72	
Clearance Time (s)		6.0			6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		109			96	345	295	1185		240	1277	
v/s Ratio Prot						0.01	0.02	c0.65		c0.06	c0.58	
v/s Ratio Perm		0.03			c0.06	0.01	0.19			0.42		
v/c Ratio		0.37			0.81	0.12	0.29	0.97		0.59	0.81	
Uniform Delay, d1		51.1			52.8	40.1	10.0	17.8		34.1	10.9	
Progression Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		2.1			38.8	0.2	0.5	19.8		3.6	5.7	
Delay (s)		53.2			91.5	40.3	10.5	37.6		37.7	16.5	
Level of Service		D			F	D	B	D		D	B	
Approach Delay (s)		53.2			53.1			35.7			19.1	
Approach LOS		D			D			D			B	

Intersection Summary			
HCM 2000 Control Delay	31.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	115.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	92.4%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
6: Stowe St & Lincoln St

02/05/2021

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	35	142	221	15	23	34
Future Volume (Veh/h)	35	142	221	15	23	34
Sign Control		Free	Free		Stop	
Grade		5%	-5%		0%	
Peak Hour Factor	0.90	0.90	0.91	0.91	0.90	0.90
Hourly flow rate (vph)	44	178	274	19	29	43
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)		175				
pX, platoon unblocked					0.98	
vC, conflicting volume	293				550	284
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	293				531	284
tC, single (s)	4.2				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.3				3.6	3.4
p0 queue free %	96				94	94
cM capacity (veh/h)	1230				470	730

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	222	293	72
Volume Left	44	0	29
Volume Right	0	19	43
cSH	1230	1700	597
Volume to Capacity	0.04	0.17	0.12
Queue Length 95th (ft)	3	0	10
Control Delay (s)	1.9	0.0	11.9
Lane LOS	A		B
Approach Delay (s)	1.9	0.0	11.9
Approach LOS			B

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	38.6%	ICU Level of Service	A
Analysis Period (min)	15		

APPENDIX H

Local Concerns Meeting Minutes

Meeting Minutes

Local Concerns Meeting

Stowe St. over Thatcher Brook – Existing Conditions Report / 195311625

Date/Time:	July 17, 2018 / Time
Place:	Steele Community Room, Waterbury, Vermont
Next Meeting:	TBD
Attendees:	See List
Absentees:	None
Distribution:	To be included in existing conditions report

The meeting was convened at 6:30 pm. Tom Knight from Stantec gave a brief presentation discussing the purpose of the project, known deficiencies, previous studies and current improvement projects and initiatives. The meeting then moved into discussion of the local concerns and public comments on the following topics:

Width / Skew / Geometry

Several Residents commented on the existing bridge being too narrow for modern uses and included the following concerns and suggestions:

- Design should consider a separated pedestrian/cycling facility in parallel to the traffic bridge.
- The current bridge has insufficient room for pedestrians and cyclists.
- Pedestrians not sufficiently protected from traffic by curb and / or guard rail.
- Insufficient width for bus turning movements.
- It was generally agreed that a right turn lane onto VT100 would help ease congestion.
- There was broad consensus that the new sidewalk or pedestrian walkway should be located on the upstream side of the bridge.

Safety

Several Residents commented regarding safety as follows:

- There was some concern expressed for the longevity of the bridge and regarding the structural safety of the bridge based on the current condition. Tom Knight explained that the bridge is monitored on a frequent basis and VTrans will notify the Town if the load carrying capacity of the bridge needs to be reduced.
- The side distance from Lincoln St. looking up and down Stowe St. is poor.
- Pedestrians and cyclist do use the route frequently, and it is felt that they would use it more frequently if they felt safer.
- Turn lanes and shoulders are poorly defined.

- The alignment of Stowe St. with VT 100 is skewed, resulting on a very wide pavement area at the intersection with VT 100.
- Residents noted school bus stop are located just below Lincoln St. on Stowe St., and on Lincoln St. near of the intersection. They voiced concerns about the speed of vehicles on Stowe St.
- There were many residents speaking in support of traffic calming measures to reduce speed on Stowe St. below the Lincoln St. intersection.
- One resident suggested a mini traffic circle as an option for the Lincoln St./Stowe St. intersection.

Aesthetics

Several Residents commented and discussed bridge aesthetics as follows:

- The bridge is a pedestrian gateway to the Village.
- Many visitors and residents utilize the bridge for pedestrian access to downtown from Blush Hill and points North on VT 100.
- Aesthetics of this structure are important to the village.

Anticipated Changes in Development / Transportation Patterns

- Residents noted that developments on Perry Hill may increase traffic on Lincoln Street.
- Residents discussed potential for relocating the park-and-ride. Town officials noted that relocation has been studied by regional planning. The study did not locate a suitable alternate site.
- Residents suggested having the transit bus stop at the state office complex, in addition to, or in place of stopping at the park and ride.

Bridge Closure for Construction

Stantec discussed the concept of closing the bridge during construction to avoid the need for a temporary bridge and asked for input from the residents on this issue. The following issues were noted:

- Residents did not object to a reasonable closure duration because alternate routes are available.
- 6 months would be too long, 1-2 months would be tolerable.
- A temporary pedestrian bridge or shuttle system for pedestrians during the closure would be helpful. If a separate pedestrian bridge were installed as part of the permanent design, it would be nice to install it as a temporary pedestrian crossing during construction.
- Providing a temporary location for the Park and Ride would be needed.

APPENDIX J

Alternative Concept Plans

Stantec	Subject:	Waterbury BO 1446(40)		
	Project No.:	179450270		
	Calculated by:	JDG	Date:	3/18/2021
	Checked by:	TEK	Date:	
	Revised by:		Date:	
	Checked by:		Date:	

Roadway Costs

Say $452,901.00

Neely, Sean
To Knight, Tom
Cc Grigas, Jared; Maynard, Israel

Reply | Reply All | Forward | ...
Tue 4/20/2021 9:12 AM

Tom,

Looking at the roadway portions of the spreadsheet from Laura ('Generic bridge estimate – Roadway.xlsx' in directory below), making some adjustments and additions (below) and discussing it with Israel, we've gotten to a roadway conceptual cost estimate of $452,901.

This starts with an estimate of $392,216 from the VTrans spreadsheet from Laura and adds the items below:

- $20,160 for curb (630 LF x $32/LF) (extending south to the proposed xwalk on Stowe St and along Lincoln St to tie back into existing sidewalk)
- $6,600 for common excavation for stone slope stabilization for the sidewalk portion along the south side of VT 100
- $750 for associated solid rock excavation
- $11,250 for associated stone fill, type II
- $1,625 for associated remove/reset guardrail
- $20,300 for signal items:
  - 2 new pedestal post signal assemblies with pedestrian signal heads and accessible push buttons, audio signal and signs
  - 1 new 5-section LED signal head
  - 425 LF of electrical wiring

\\us0286-ppfss01\workgroup\1794\active\179450270\transportation\calculations\Scoping Cost Estimate

Sean

	$392,216.00	from Vtrans Cost Estimating Spreadsheet
	$20,160.00	for curb
	$6,600.00	Common Ex for Stone Stabilization
	$750.00	For associated solid rock Excavation
	$11,250.00	Stone Fill, Type II
	$1,625.00	remove/reset guardrail
	$20,300.00	for Signal Items
	$452,901.00	
Round	$47,099.00	
Say	$500,000.00	

Stantec	Subject:	Waterbury BO 1446(40)		
	Project No.:	179450270		
	Calculated by:	JDG	Date:	3/18/2021
	Checked by:	TEK	Date:	
	Revised by:		Date:	
	Checked by:		Date:	

1 - Superstructure Rehabilitation

Scope of Work: Mill off existing pavement, prepare deck for membrane and pave. Concrete Surface repair to beam and underside of deck. Abutment surface repairs. Reconstrct concrete railing. New Approach Rail

Use Estimated Costs from Bennington

Note: Bennington is a larger structure but has a larger repair area.

Bennington BF 1000(20)		Do Nothing	Alt 1 Superstructure Patching Short Term Lane Closures
COST	Bridge Cost	$0	256,200
	Removal of Structure	$0	0
	Roadway	$0	61,000
	Maintenance of Traffic	$0	29,040
	Construction Costs	$0	346,240
	Construction Engineering & Contingencies	$0	103,872
	Total Construction Costs w CEC	$0	450,112
	Preliminary Engineering[3]	$0	103,872
	Right of Way	$0	15,000
	Total Project Costs	**$0**	**568,984**
	Annualized Costs	$0	37,932
TOWN SHARE			28,449
TOWN %			5%
SCHEDULEING	Project Development Duration[4]		4 years
	Construction Duration		2 months
	Closure Duration (If Applicable)		N/A
ENGINEERING	Typical Section - Roadway (feet)	40	40
	Typical Section - Bridge (feet)	40	40
	Geometric Design Criteria	Meets Minimum Standard	Meets Minimum Standard
	Traffic Safety	No Change	Improved
	Alignment Change	No Change	No Change
	Bicycle Access	No Change	No Change
	Pedestrian Access	No Change	No Change
	Hydraulics	No Change	Substandard Hydraulics and BFW
	Utilities	No Change	No Change
OTHER	ROW Acquisition	No	Yes
	Road Closure	N/A	No
	Design Life	<10 years	15

Say $310,000.00

Stantec	Subject:	Waterbury BO 1446(40)		
	Project No.:	179450270		
	Calculated by:	JDG	Date:	3/18/2021
	Checked by:	TEK	Date:	
	Revised by:		Date:	
	Checked by:		Date:	

2 - Superstructure Replacement and Widening

Say $1,200,000.00

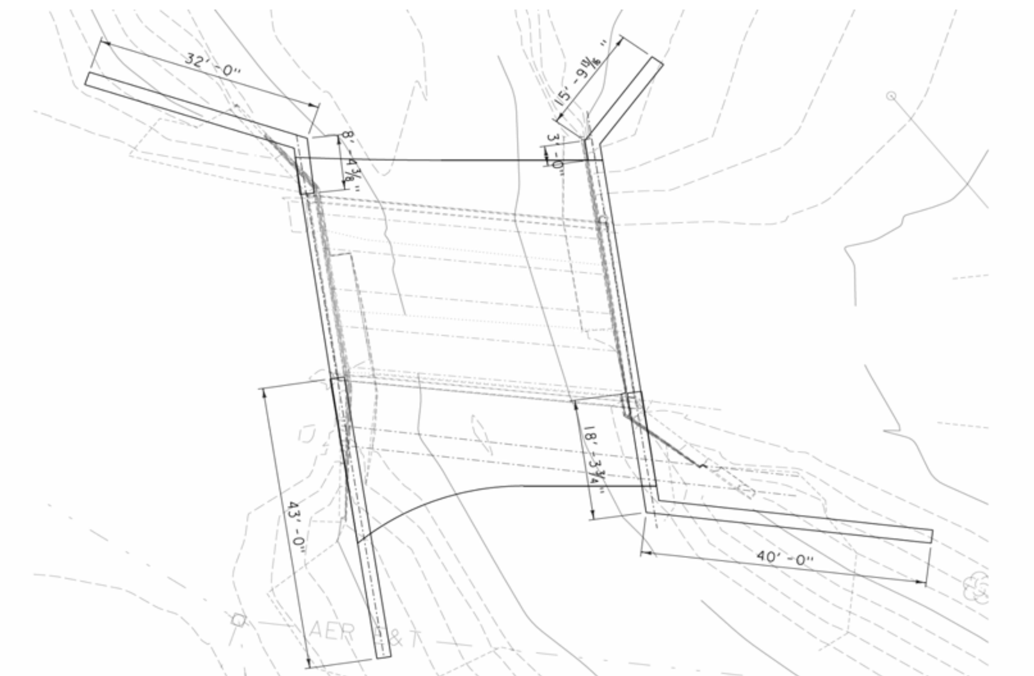
Scope of Work: Widen the existing abutments to accommodate a new superstructure. Assume widening to be centered on the existing bridge centerline. Span of proposed superstructure to match span of existing bridge (40 feet). Assume 6 beam lines and a deck width of 49.5'.

Superstructure Costs

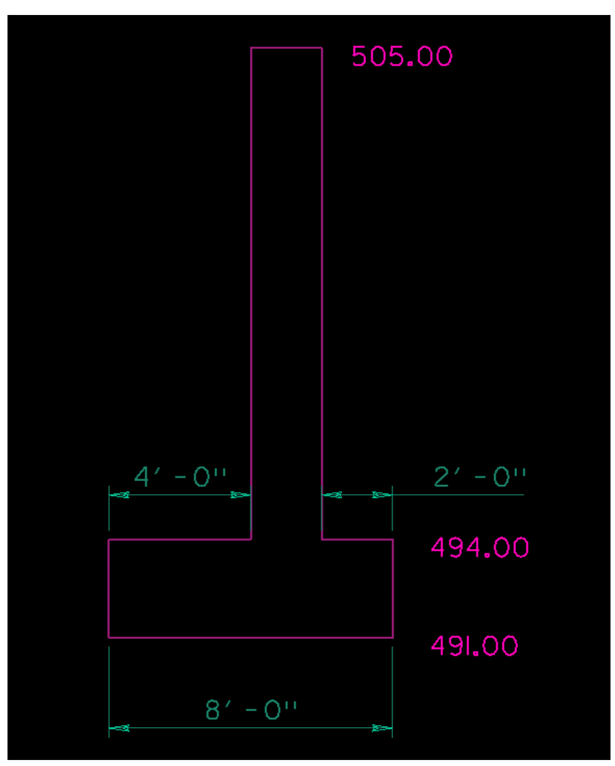
Say	200.00	$/SF	Assumed Superstructure Replacement Cost
x	1980.00	SF	Square Foot Area of Superstructure Replacement (49.5'x40')
	$396,000.00		Total Superstructure Costs of Widening

Substructure Costs

Assume Wingwalls are removed. Abutment and Wing walls extended 142' . Use $1800/CY of Concrete to account for excavation, backfill, dewatering, shoring.



Stem Height =	11.00	ft
Stem Thickness =	2.00	ft
Stem Area =	22.00	SF
Footing Thickness =	3.00	ft
Footing Width =	8.00	ft
Footing Area =	24.00	SF
Total Area =	46.00	SF
Length =	142.00	ft
Volume =	6532.00	CF
	241.93	yd
x	1800.00	$/yd
	435466.67	
Total =	831466.67	- Super and Substructure Costs
x	1.20	for Unaccounted Items
	997760.00	
Round	202240.00	
Say	1200000.00	



Stantec	Subject:	Waterbury BO 1446(40)		
	Project No.:	179450270		
	Calculated by:	JDG	Date:	3/18/2021
	Checked by:	TEK	Date:	
	Revised by:		Date:	
	Checked by:		Date:	

3 - Conspan Arch

Say $1,600,000.00

BRIDGE REPLACEMENT - ARCH OPTION

$60K	REMOVAL OF EXISTING SUPERSTRUCTURE
	ASSUME $500/SY OF DECK → (40')(27.67')(1/9)($500/SY) ≈ $60K
$100K	REMOVAL OF EXISTING WW & ABUT STEMS & FTGS
	ASSUME $350/CY FOR CONC. EXCAV. → ($350CY)(275CY) ≈ $100K
$525K	CONSPAN O-SERIES (71.6'W × 50'L × 9'-5 3/8" RISE)
$150K	TEMP. EARTH SUPPORT
	ASSUME $500/SY OF EXPOSED FACE OF EARTH SUPPORT
	ESTIMATE AREA AS 75'L × 18'H EACH SIDE OF BROOK
	($500/SY)(75' × 2ABUTS)(18')(1/9) ≈ $150K
$60K	EARTHWORK
	ASSUME $30/CY EXCAV. & $45/CY BACKFILL
	ESTIMATE EXC. VOLUME AS 75'L × 18'H × 10'W EACH SIDE
	ESTIMATE FILL VOLUME AS 75'L × 18'H × 5'W E.S. & 5' DP. ABOVE ARCH
	($30/CY)(75' × 2ABUTS)(18')(10')(1/27) ≈ $30K
	($45/CY)[(75' × 2ABUTS)(18')(5') + (72')(50')(5')](1/27) ≈ $30K
$60K	C.I.P. PEDESTALS & FOOTINGS
	ASSUME $800/CY, 10SF X-SECT AREA, 100 L.F. EACH SIDE ≈ $60K
$200K	MISC. APPROACH WORK & UTILITIES
$50K	CONTROL OF WATER
$150K	MOB/DEMOB
$75K	EPSC
= $1.4 M	⇒ SAY $1.5M

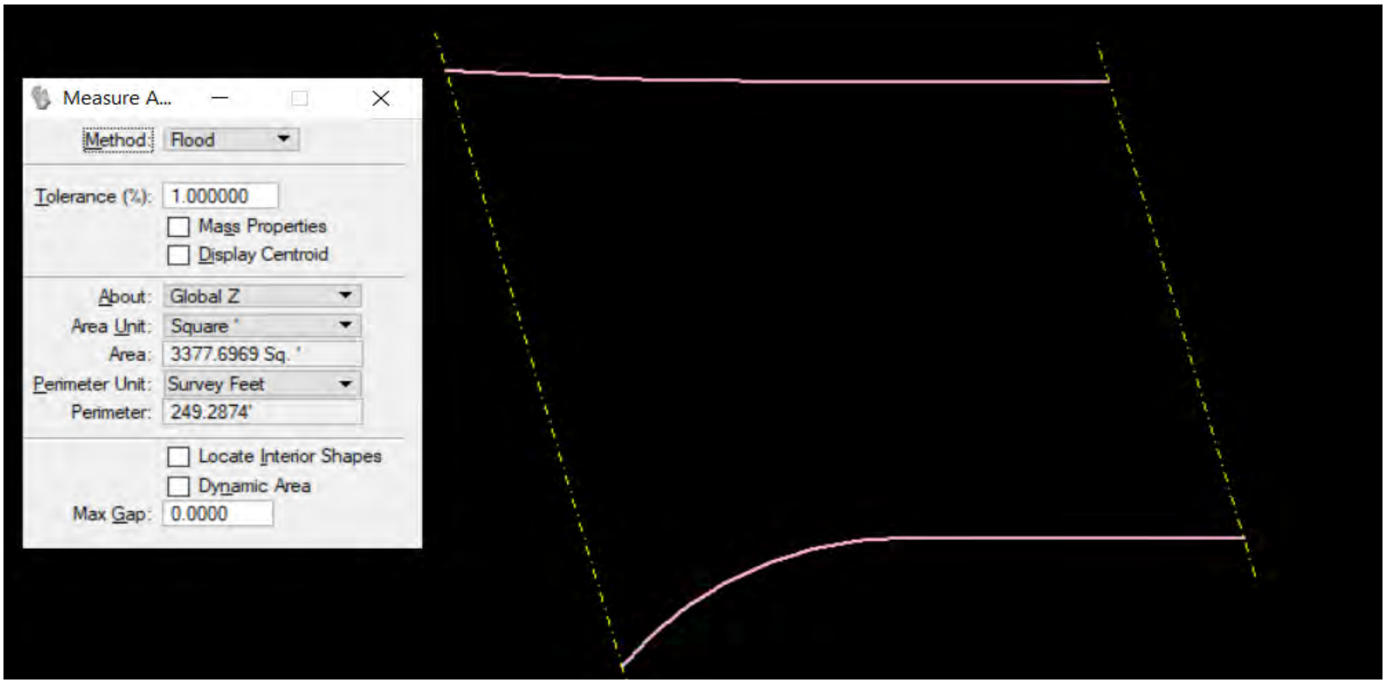
Based on recent cost increases, use $1.6M

Say $1,600,000.00

Stantec	Subject:	Waterbury BO 1446(40)		
	Project No.:	179450270		
	Calculated by:	JDG	Date:	3/18/2021
	Checked by:	TEK	Date:	
	Revised by:		Date:	
	Checked by:		Date:	

4 - Steel Superstructure

Say $1,800,000.00

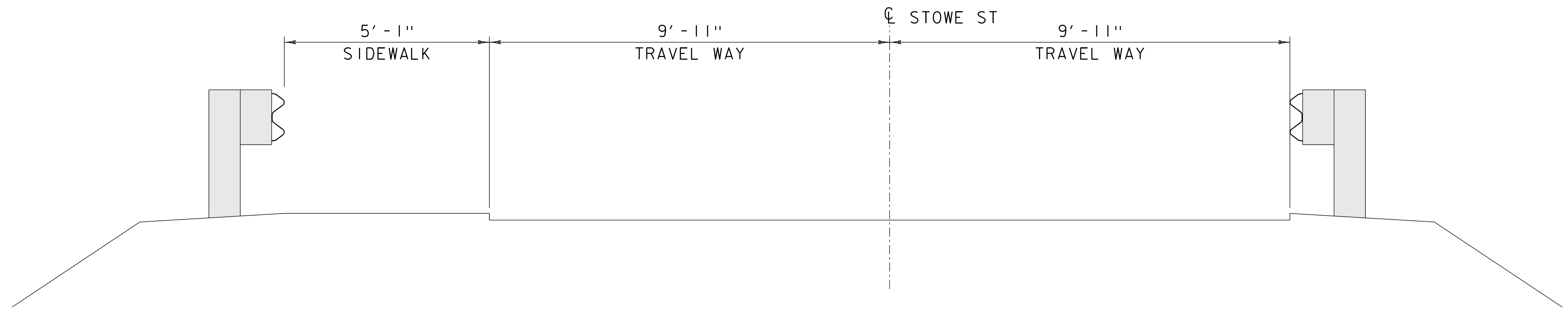


State	Total Number of SD NHS Bridges 2017*	Total Area of SD NHS Bridges 2017 (ft²)*	Replacement Unit Costs of NHS Bridges (dollars/ft²)			
			2015 Costs Collected in 2016	2016 Costs Collected in 2017	2017 Costs Collected in 2018	Cost Used For 2017 Estimates**
Vermont	9	142,886	468	437	323	409

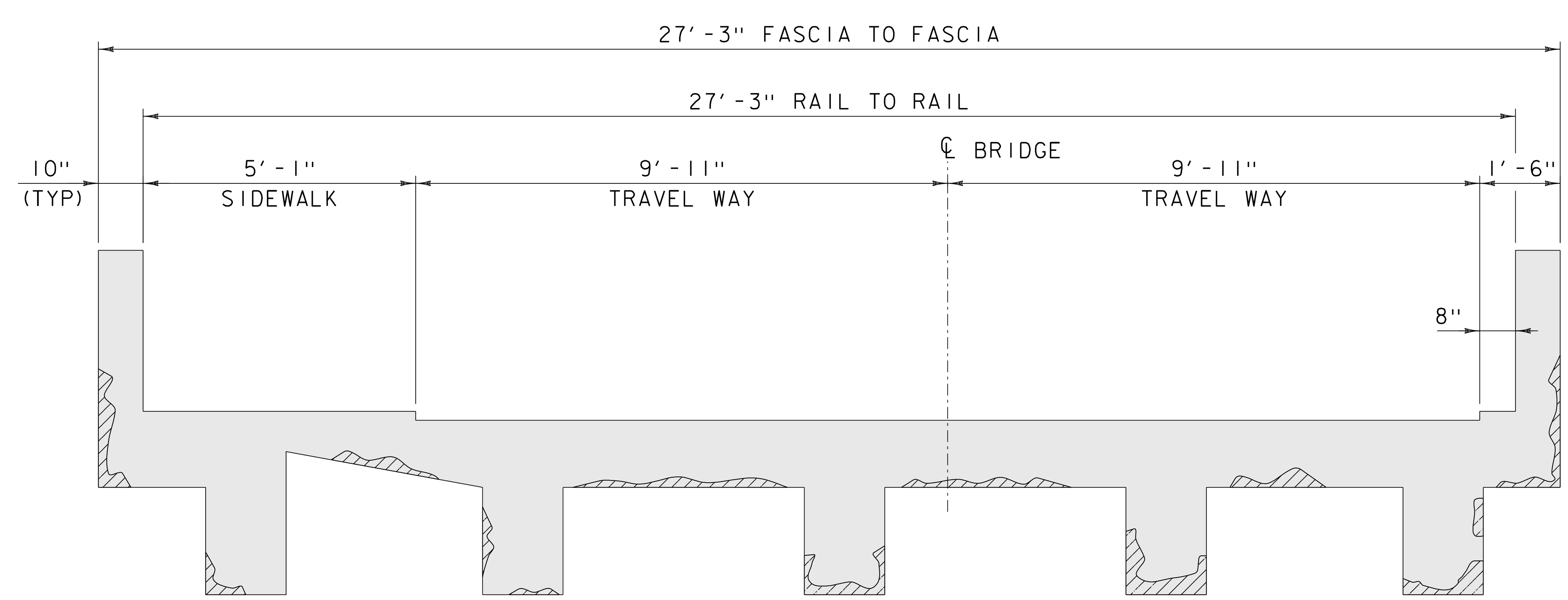
Square Foot Area of Bridge =	3378	SF
	470	$/FT
	$1,587,660.00	
Round	$212,340.00	
Say	$1,800,000.00	

APPENDIX I

Cost Estimates



EXISTING ROADWAY TYPICAL SECTION



EXISTING BRIDGE TYPICAL SECTION

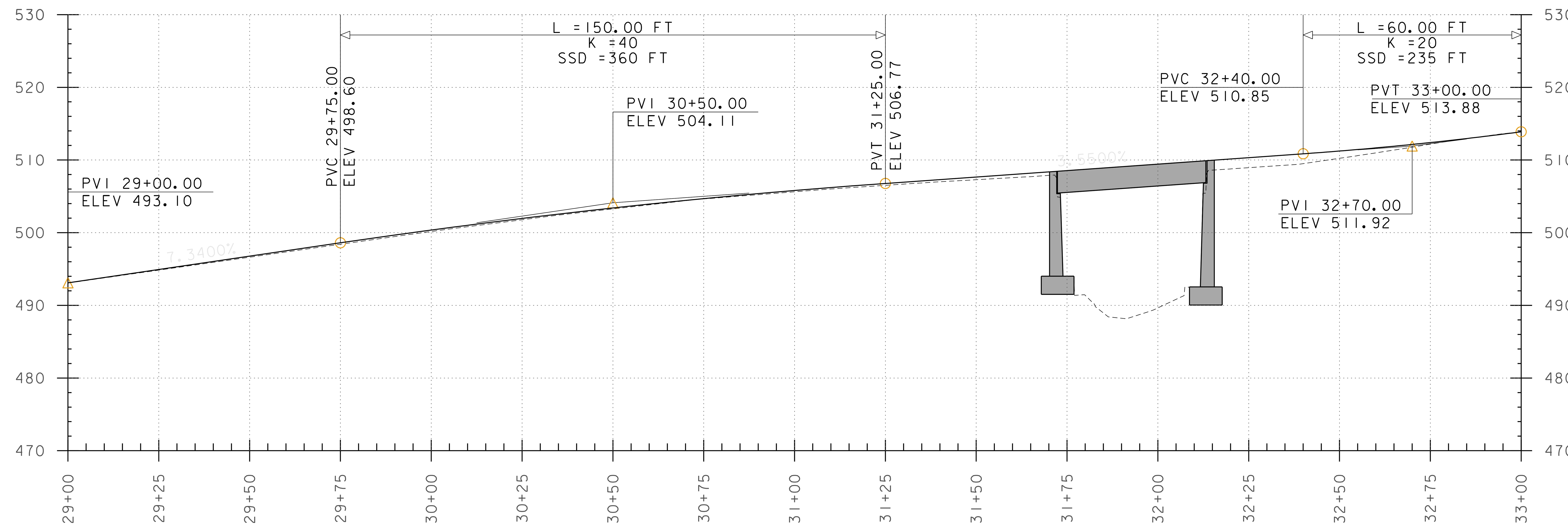
Stantec

PROJECT NAME: WATERBURY	
PROJECT NUMBER: BO 1446(40)	
FILE NAME: TYPICAL SECTIONS.dgn	PLOT DATE: 4/20/2021
PROJECT LEADER: ------	DRAWN BY: ------
DESIGNED BY: ------	CHECKED BY: ------
EXISTING TYPICAL SECTIONS	SHEET 1 OF 5

PROJECT NAME: WATERBURY
PROJECT NUMBER: BO 1446(40)

FILE NAME: PLAN_EXCOND.dgn
PROJECT LEADER: T. KNIGHT
DESIGNED BY: ------
EXISTING CONDTIONS LAYOUT

PLOT DATE: 4/20/2021
DRAWN BY: ------
CHECKED BY: ------
SHEET 1 OF 8



EXISTING PROFILE

PROJECT NAME: WATERBURY
PROJECT NUMBER: BO 1446(40)

FILE NAME: PLAN_COMM.dgn
PROJECT LEADER: T. KNIGHT
DESIGNED BY: ------
COMMON FEATURES PLAN

PLOT DATE: 4/20/2021
DRAWN BY: ------
CHECKED BY: ------
SHEET 2 OF 8

PROJECT NAME: WATERBURY
PROJECT NUMBER: BO 1446(40)

FILE NAME: PLAN_TRUCK.dgn
PROJECT LEADER: T. KNIGHT
DESIGNED BY: ------
COMMON FEATURES PLAN - TRUCK TURNS

PLOT DATE: 4/20/2021
DRAWN BY: ------
CHECKED BY: ------
SHEET 3 OF 8

Stantec

PROJECT NAME:	WATERBURY
PROJECT NUMBER:	BO 1446(40)

FILE NAME: PLAN_COMM_PBR.dgn	PLOT DATE: 4/20/2021
PROJECT LEADER: T. KNIGHT	DRAWN BY: ------
DESIGNED BY: ------	CHECKED BY: ------
COMM. FEATURES PLAN - PEDESTRIAN BRIDGE	SHEET 4 OF 8

PROJECT NAME: WATERBURY
PROJECT NUMBER: BO 1446(40)

0 20 40
SCALE IN FEET

Stantec

FILE NAME: PLAN_COMM_TBR.dgn
PROJECT LEADER: T. KNIGHT
DESIGNED BY: ------
COMM. FEATURES PLAN - TEMPORARY BRIDGE
PLOT DATE: 4/20/2021
DRAWN BY: ------
CHECKED BY: ------
SHEET 5 OF 8

PROPOSED ROADWAY TYPICAL SECTION

ALTERNATIVE 2 - SUPERSTRUCTURE REPLACEMENT
AND WIDEN EXISTING SUBSTRUCTURE

Stantec

PROJECT NAME: WATERBURY
PROJECT NUMBER: BO 1446(40)

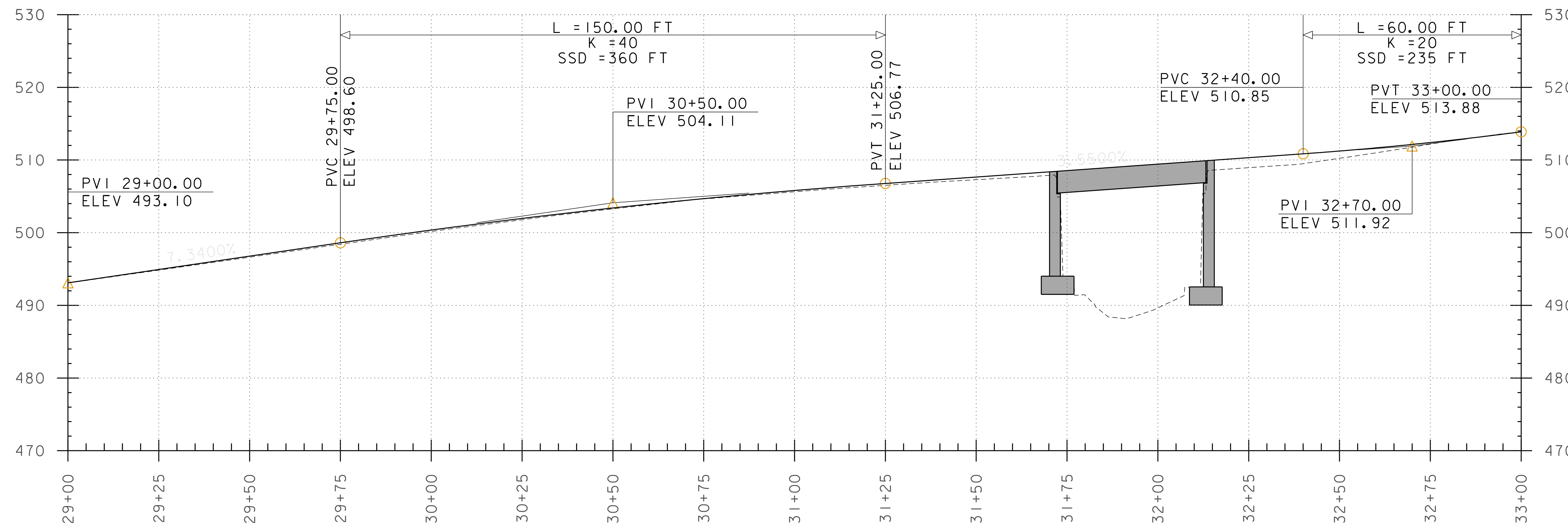
FILE NAME: TYPICAL SECTIONS.dgn
PROJECT LEADER: ------
DESIGNED BY: ------
ALTERNATIVE 1- TYPICAL SECTION

PLOT DATE: 4/20/2021
DRAWN BY: ------
CHECKED BY: ------
SHEET 3 OF 5

PROJECT NAME: WATERBURY
PROJECT NUMBER: BO 1446(40)

FILE NAME: PLAN_ALT1.dgn
PROJECT LEADER: T. KNIGHT
DESIGNED BY: ------
ALTERNATIVE 2 LAYOUT

PLOT DATE: 4/20/2021
DRAWN BY: ------
CHECKED BY: ------
SHEET 6 OF 8

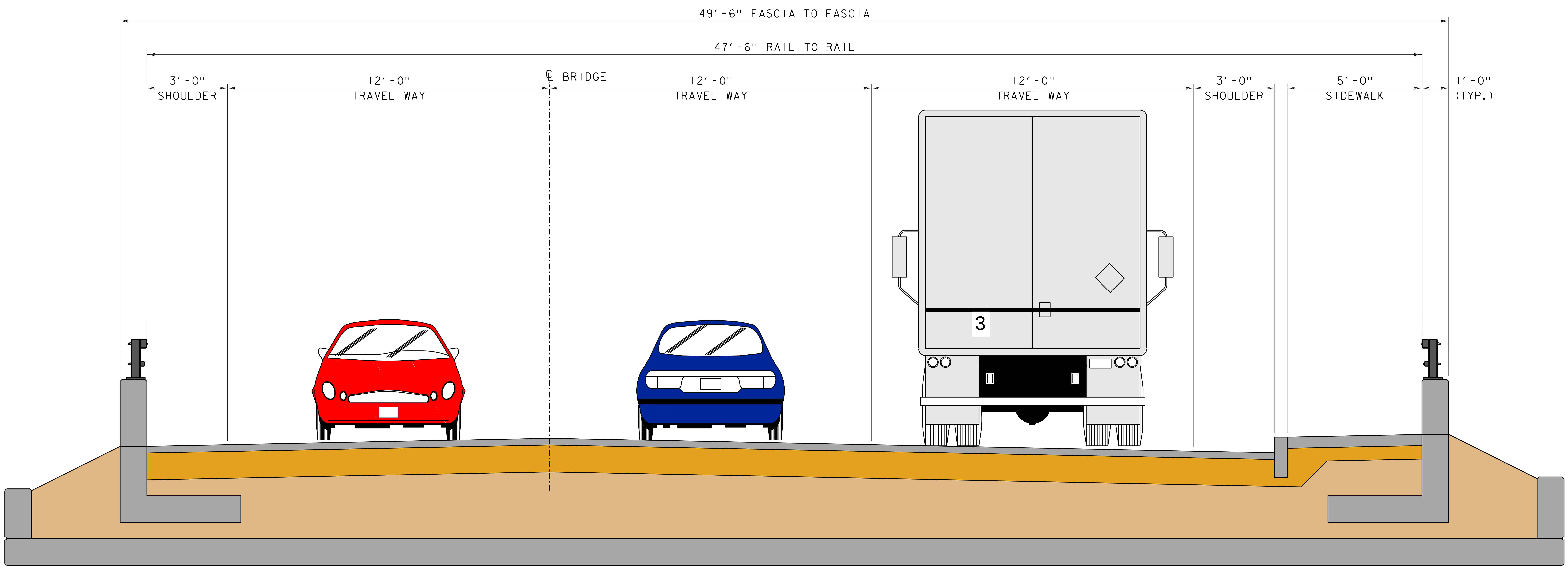


ALTERNATIVE 1 - PROPOSED PROFILE

PROJECT NAME: WATERBURY	
PROJECT NUMBER: BO 1446(40)	
FILE NAME: PROFILES.dgn	PLOT DATE: 4/20/2021
PROJECT LEADER: T. KNIGHT	DRAWN BY: ------
DESIGNED BY: ------	CHECKED BY: ------
ALTERNATIVE 2 PROFILE	SHEET 3 OF 5

Stantec

PROPOSED ROADWAY TYPICAL SECTION



ALTERNATIVE 3 - BRIDGE REPLACEMENT WITH BURIDE STRUCTURE

Stantec

PROJECT NAME: WATERBURY
PROJECT NUMBER: BO 1446(40)

FILE NAME: TYPICAL SECTIONS.dgn
PROJECT LEADER: ------
DESIGNED BY: ------
ALTERNATIVE 3 - TYPICAL SECTION

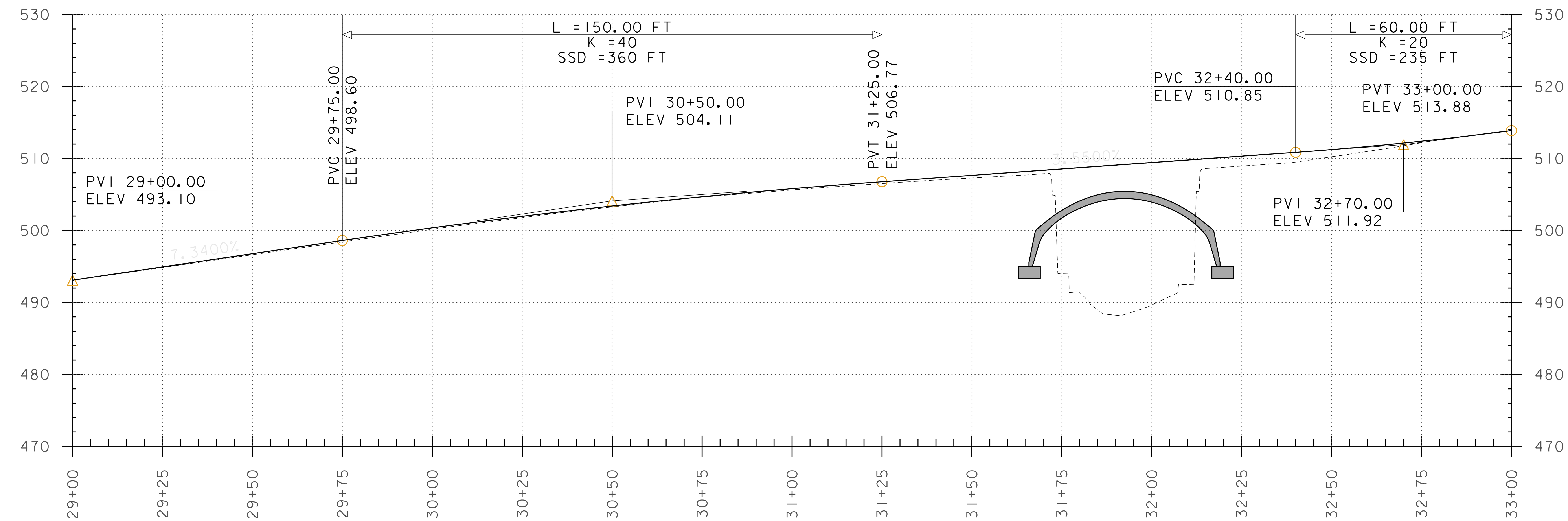
PLOT DATE: 4/20/2021
DRAWN BY: ------
CHECKED BY: ------
SHEET 4 OF 5

Stantec

PROJECT NAME: WATERBURY
PROJECT NUMBER: BO 1446(40)

FILE NAME: PLAN_ALT2.dgn
PROJECT LEADER: T. KNIGHT
DESIGNED BY: ------
ALTERNATIVE 3 - LAYOUT

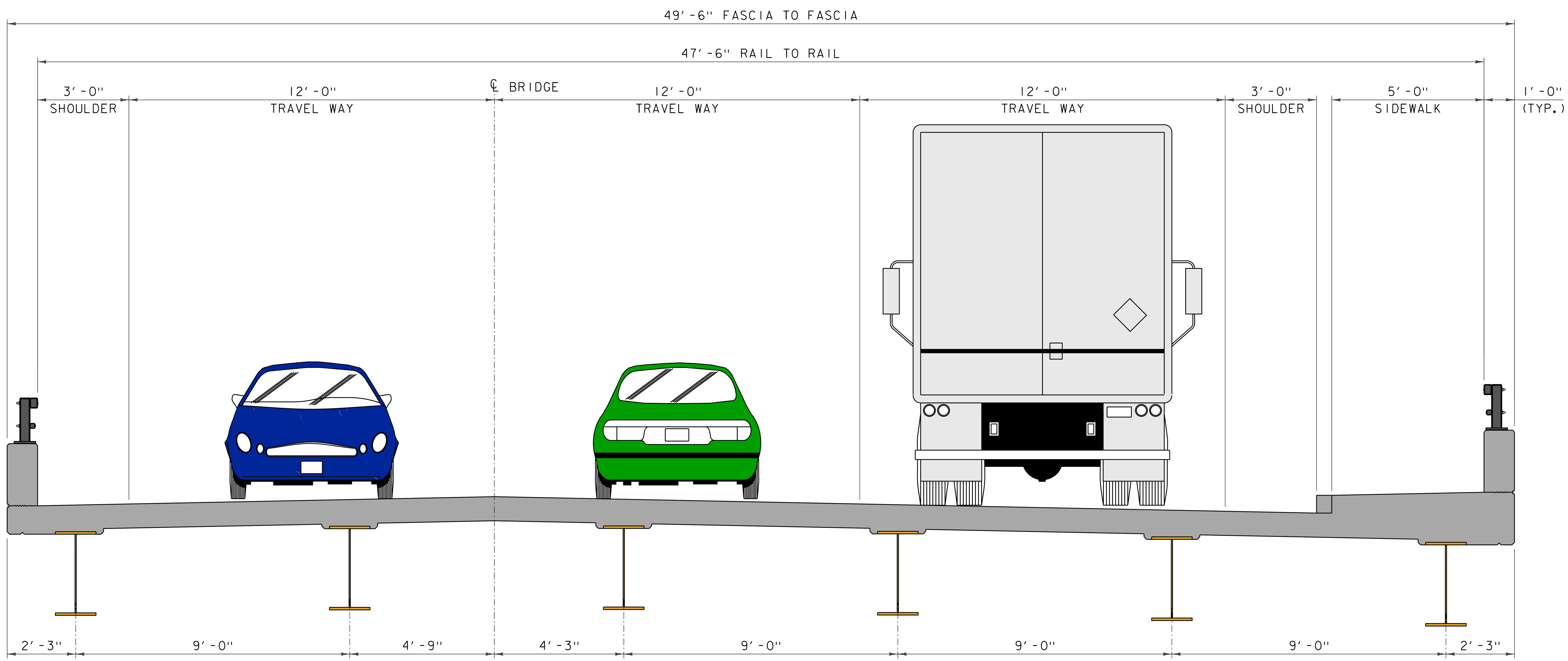
PLOT DATE: 4/20/2021
DRAWN BY: ------
CHECKED BY: ------
SHEET 7 OF 8



ALTERNATIVE 3 - PROPOSED PROFILE

PROJECT NAME:	WATERBURY
PROJECT NUMBER:	BO 1446(40)
FILE NAME: PROFILES.dgn	PLOT DATE: 4/20/2021
PROJECT LEADER: T. KNIGHT	DRAWN BY: ------
DESIGNED BY: ------	CHECKED BY: ------
ALTERNATIVE 3 - PROFILE	SHEET 4 OF 5

PROPOSED ROADWAY TYPICAL SECTION



ALTERNATIVE 4 - BRIDGE REPLACEMENT WITH
STEEL BEAM SUPERSTRUCTURE, INTEGRAL ABUTMENTS

Stantec

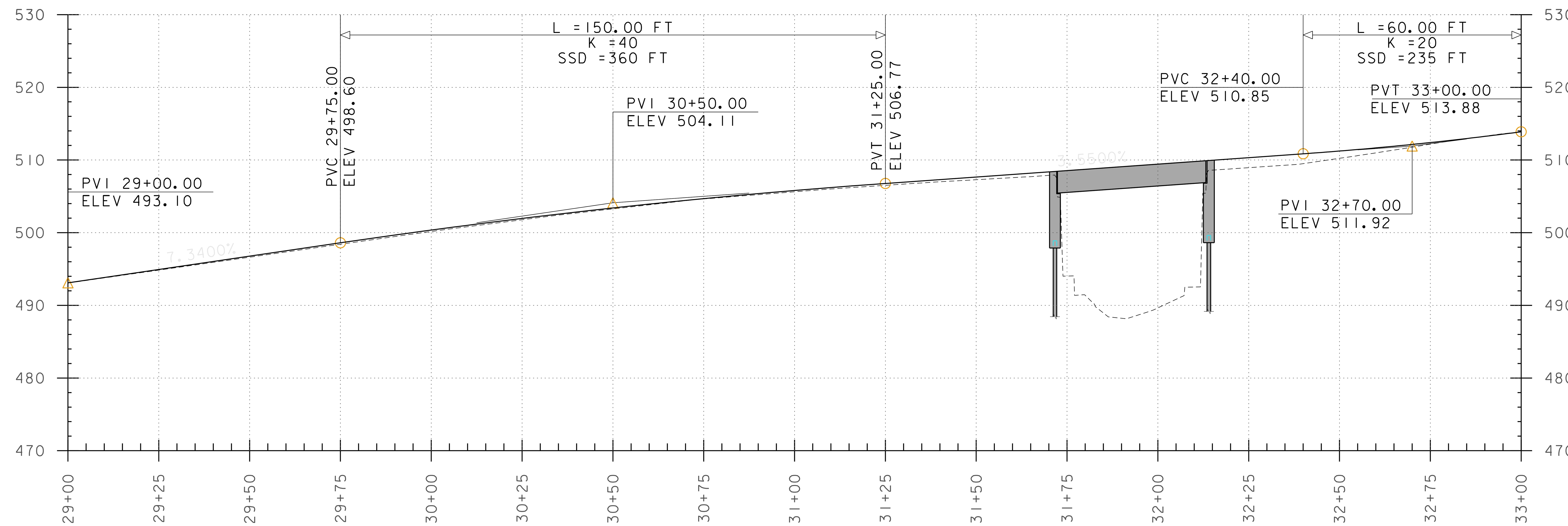
PROJECT NAME:	WATERBURY
PROJECT NUMBER:	BO 1446(40)

FILE NAME: TYPICAL SECTIONS.dgn	PLOT DATE: 4/20/2021
PROJECT LEADER: ------	DRAWN BY: ------
DESIGNED BY: ------	CHECKED BY: ------
ALTERNATIVE 4 - TYPICAL SECTION	SHEET 5 OF 5

PROJECT NAME: WATERBURY
PROJECT NUMBER: BO 1446(40)

FILE NAME: PLAN_ALT3.dgn
PROJECT LEADER: T. KNIGHT
DESIGNED BY: ------
ALTERNATIVE 4 - LAYOUT

PLOT DATE: 4/20/2021
DRAWN BY: ------
CHECKED BY: ------
SHEET 8 OF 8



ALTERNATIVE 4 - PROPOSED PROFILE

PROJECT NAME:	WATERBURY
PROJECT NUMBER:	BO 1446(40)

FILE NAME: PROFILES.dgn
PROJECT LEADER: T. KNIGHT
DESIGNED BY: ------
ALTERNATIVE 4 PROFILE

PLOT DATE: 4/20/2021
DRAWN BY: ------
CHECKED BY: ------
SHEET 5 OF 5

Stantec