RSG INC.
RESOURCE SYSTEMS GROUP, INC.

Technical Report and Plans for:

CLIFF STREET MOBILITY STUDY

Burlington, Vermont

Prepared for the:

City of Burlington

FINAL REPORT – 13 March 2008

Submitted by:
Resource Systems Group **and** H. Keith Wagner Partnership

60 Lake Street, Unit 1E ▪ Burlington, Vermont 05401

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1.0 INTRODUCTION

The City of Burlington, Vermont has long been noted as one of the most walkable in Vermont with several miles of sidewalks connecting the entire city. The City continues to embody the walkable concept by supporting walking and biking infrastructure projects throughout the city. The City of Burlington Draft Transportation Plan (31 August 2007) envisions a fully walkable city – priorities for improving the City's walking infrastructure include improved maintenance, improved crossings, and safe routes to school.

The Cliff Street Mobility Study is a joint effort study by the City and the Chittenden County Metropolitan Planning Organization (CCMPO), and the local residents to examine a number of potential improvements that would improve pedestrian access and calm traffic.

The City received a *Transportation for Livable Communities Grant* from the CCMPO to pursue this study. Through a competitive bid process the City selected the consultant team of Resource Systems Group (RSG) and H. Keith Wagner Partnership (HKWP) to conduct the mobility study.

This feasibility study represents the culmination of the site investigation, analysis, design, and outreach efforts in the Cliff Street neighborhood. Through the analysis of existing conditions and public and steering committee input, a feasible alignment for new pedestrian facilities, on-street parking, and potential streetscape improvements have been identified.

The purpose of this planning and feasibility study is to develop a preferred set of strategies and cost effective mobility improvements that both maintains safe traffic flow through the study area and also enhances the accessibility of services and community resources for residents on foot or on bicycle.

The feasibility study includes the following sections:

- Summary of Existing Conditions: Existing transportation infrastructure, traffic volumes, roadway alignment vehicle crash history, and resource assessment.
- Conceptual Alignment Evaluation: Overview of proposed elements and concept alternatives.
- Evaluation Matrix
- Cost Estimates
- Alternatives Presentation
- Summary and Next Steps: Summary of project and discussion of potential next steps

Figure 1 shows the study area of upper Cliff Street and the study segment along South Willard Street.

Figure 1: Study Area

1.1 PROJECT HISTORY

Over the past three decades local citizens along Cliff Street and the adjacent side streets have petitioned the City to pursue sidewalk construction along the eastern most section between South Willard Street and South Prospect Street.

The issue has lingered largely because of the difficult nature of constructing a sidewalk along Cliff Street with its significant grades and exposed ledge. In the fall of 2006 the local Neighborhood Planning Assembly (NPA) began hearing numerous people raise it again as an important area for the City to focus on. The NPA then convened three public meetings facilitated by Ita Meno of CCAN (Center for Community and Neighborhoods) a division of CEDO (Community and Economic Development Office) and attended by the representatives of the City's Department of Public Works. The three meetings resulted in an approach that would obtain grant money to fund a consultant to more fully evaluate a number of design questions and alternatives that arose during the course of the public meetings.

Upon successful completion of the grant application, the City received a *Transportation Livable Communities Grant* to move forward with concept planning of transportation improvements along Cliff Street.

The City approached the local Neighborhood Planning Assembly (Ward 6) and asked members to participate in the Cliff Street Project Steering Committee. Approximately seven Ward 6 residents

were able to initially form the Project Steering committee along with representatives from the City, CCTA, and the Consultant team. Over the course of the project additional Ward 6 members were able to participate in the steering committee and substitute in for others unable to attend particular meetings. The Steering Committee provided the City and the Consultant team with a significant amount of feedback, insight, and direction while formulating potential improvements to the Cliff Street project area.

The City of Burlington has a long history of including the general public as a partner in transportation and land use projects. Public presentation and interaction are paramount to the study process. Table 1 shows the public process undertaken as part of this study.

Public outreach conducted during the course of the Cliff Street Mobility Study included the following:

Table 1: Project Meetings and Presentations

Kick Off Meeting with members of the Ward 6 NPA and project steering committee.	9 January 2007
Preliminary concepts and identified issues presented to Public Meeting and participated in a formal listening session.	22 March 2007
Findings of Listening Session and Existing Conditions Summary presented to the Steering Committee	24 April 2007.
Steering committee Meeting: Review of Preliminary Design Alternatives	3 October 2007
Alternatives Presentation Public Meeting	15 November 2007

2.0 SUMMARY OF EXISTING CONDITIONS

2.1 STUDY AREA OVERVIEW

Cliff Street is a local city street in the 'Hill Section' of Burlington running east-west connecting South Union Street to Prospect Street. The Cliff Street Mobility Study focuses on the section of Cliff Street between South Willard Street and South Prospect Street.

The Cliff Street study area consists of a residential neighborhood close to the University of Vermont and Champlain College campuses and within ½ mile to Edmunds Elementary and Middle School. The street is approximately 1 mile from the Church Street marketplace. These destinations attract both pedestrian, bicycle, and vehicular traffic from the Cliff Street study area.

Cliff Street is classified as a local city street. South Willard Street is a classified as an urban principal arterial. All streets within the study area are owned and maintained by the City. The City owns a right of way along Cliff Street 3.5 rods wide or 57.5 feet (16.5 feet per rod) from South Willard Street to

South Prospect Street. All design alternatives developed within this study would occur within the City right of way.

Figure 2 shows the importance of Cliff Street as an east-west connection between the top of the hill and the heart of Burlington at the bottom of the hill. The picture shows Main Street, Maple Street, Cliff Street, and Ledge Road connecting South Willard to South Prospect Street.

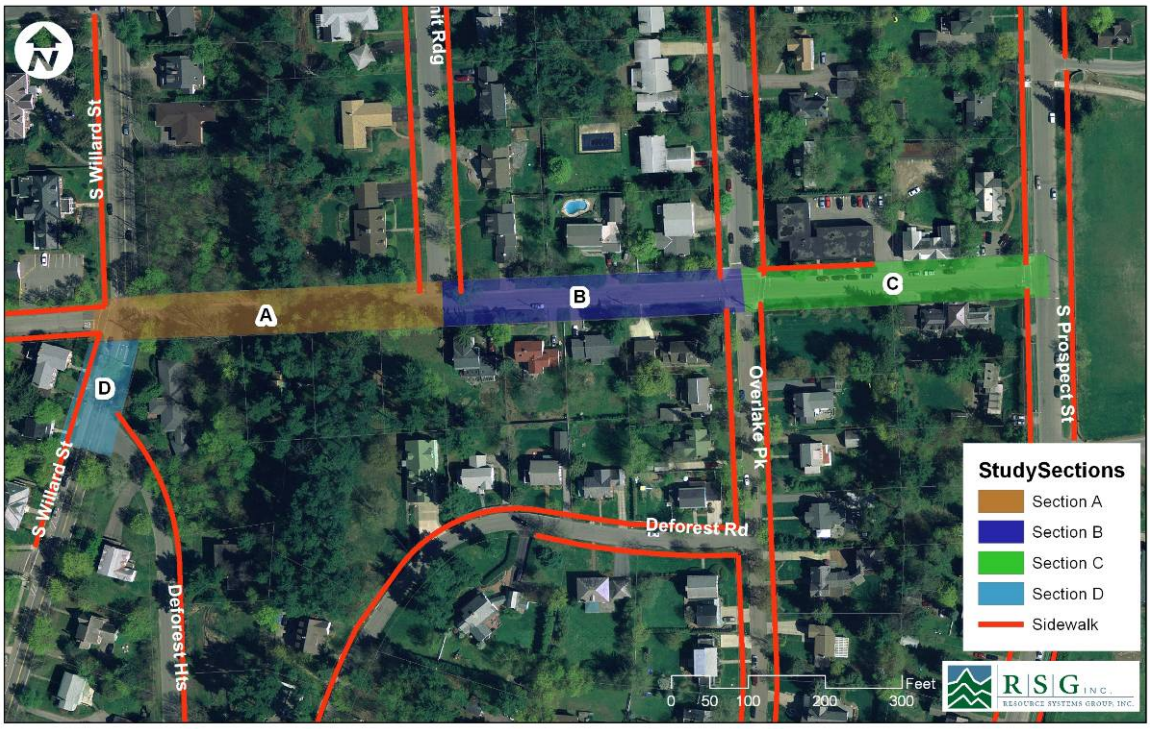
Figure 2: Cliff Street Study Vicinity - East/West Connections

2.2 PEDESTRIAN INFRASTRUCTURE

The City of Burlington has extensive sidewalk network. With 161 miles of sidewalks in the City it is the most comprehensive network in the State in the State of Vermont. Within the Cliff Street study vicinity all adjacent side streets have sidewalks as shown by Figure 3 below. From the figure it is clear that Cliff Street stands out as an anomaly within the overall sidewalk network.

The City's Transportation Plan calls for enhancements and improvements to the sidewalk network that would require at least one side of every street to have a sidewalk. The newly created Street Design Guidelines incorporate city standards to promote pedestrian use.

Figure 3: Sidewalks within the Study Area



2.3 INTERSECTION VEHICLE TRAFFIC VOLUMES

Resource Systems Group and the City Department of Public Works (DPW) conducted an AM and PM peak period turning movement count at the study intersections on Wednesday, 12 September 2007. The City DPW collected traffic data on Thursday, 25 January 2007 at the South Willard Street – Cliff Street intersection.

The two traffic counts were conducted to provide a better picture of traffic flow year round versus just one snapshot in time. Both counts were conducted while Champlain College and UVM were in session.

These data are adjusted to the 2007 design hour by the following:

- A design hour adjustment factor based on VTrans Design Hour Volume (DHV)[1] Policy. The D140 automatic traffic recorder (ATR) on South Willard Street located just north of Spruce Street was used to determine the Design Hour. The 30th highest hour is considered the design hour volume in Vermont. The DHV adjustment increased traffic volumes from the September count by 23%.

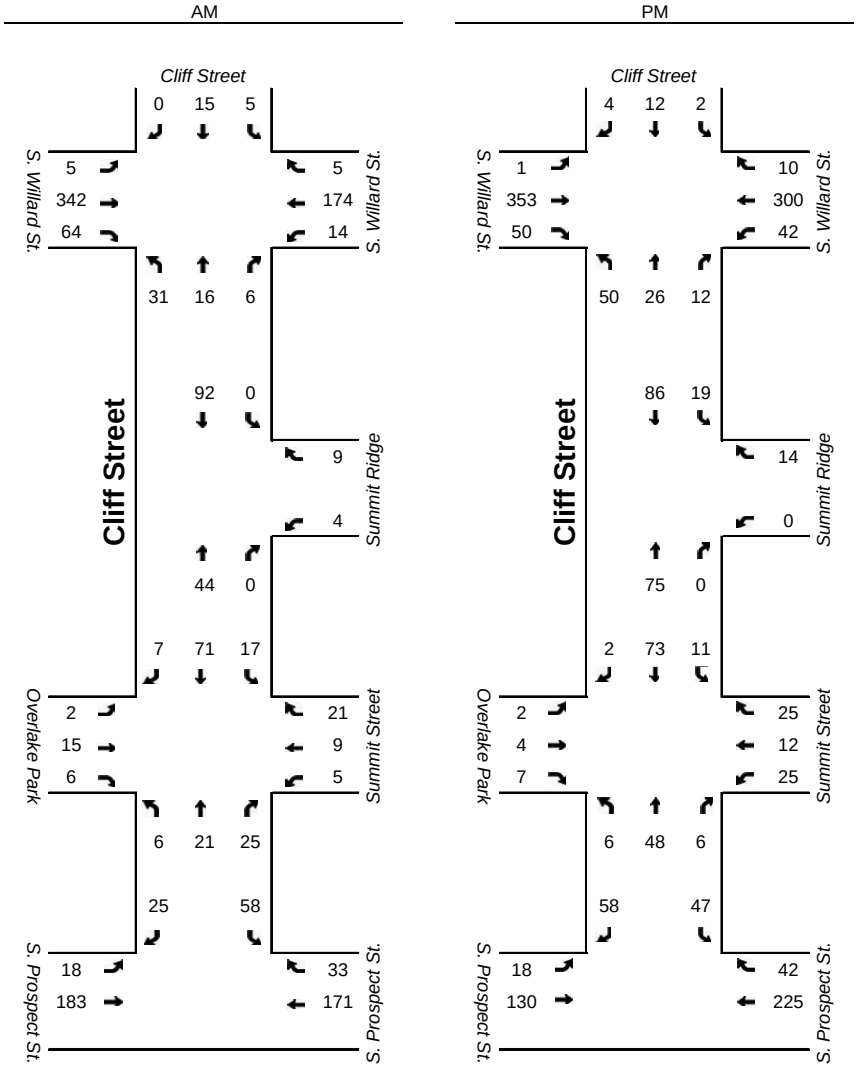
The AM peak hour of traffic at each of the study area intersections is from 7:45 AM to 8:45 AM. The PM peak hour is from 4:45 PM to 5:45 PM.

Figure 4 below shows the design hour adjusted 2007 AM and PM peak hour traffic volumes at the study intersections.

Raw turning movement count data and adjustments for the intersections in the study area are included in Appendix A.

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

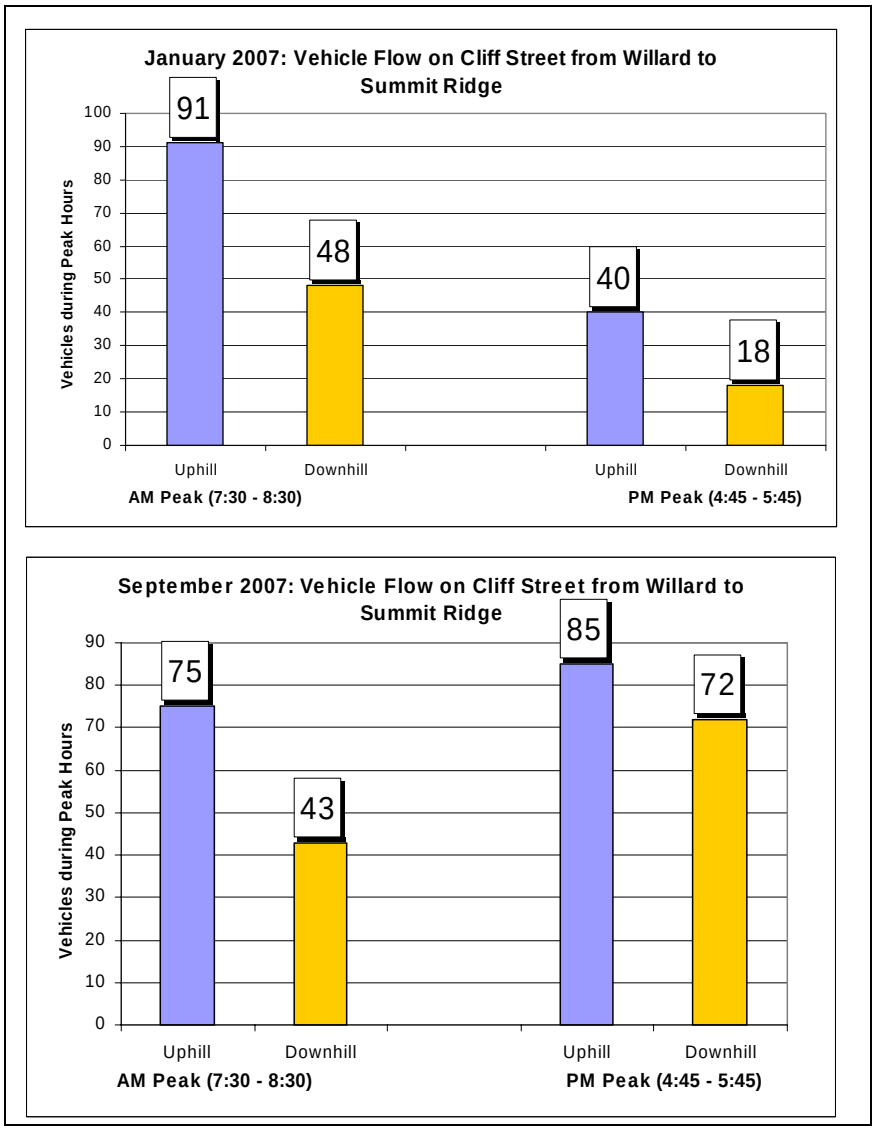
Figure 4: 2007 AM & PM Design Hour Traffic Volumes along Cliff Street



The traffic counts provide information on the directionality of traffic flow along Cliff Street. Both the January and the September traffic counts indicated that the majority of traffic along Cliff Street in the section between South Willard Street and Summit Ridge travel east, heading uphill toward South Prospect.

Figure 5 shows the number of vehicles per hour along Cliff Street east of South Willard Street during the January and September traffic count.

Figure 5: Vehicle Traffic Flow on Cliff Street between South Willard and Summit Ridge



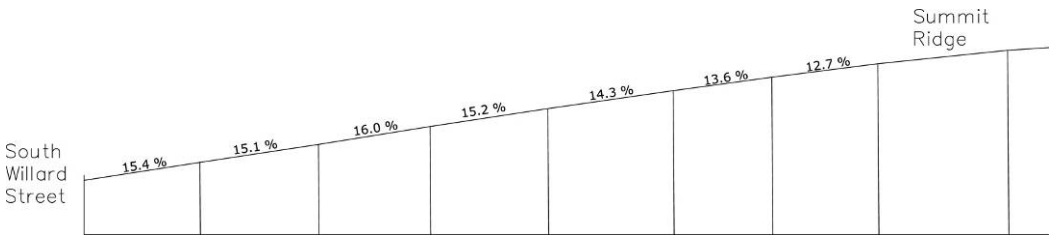
The data indicate that similar patterns exist in the winter and in the fall, with most vehicles traveling uphill along Cliff Street. The data further indicates that people may avoid the section of Cliff Street between South Willard Street and Summit Ridge in the winter.

2.4 STUDY AREA GRADE AND PROFILE

The Cliff Street study area varies in grade as it connects South Willard Street to South Prospect Street. Figure 6 through Figure 8 show the Cliff Street centerline profile for the study area.

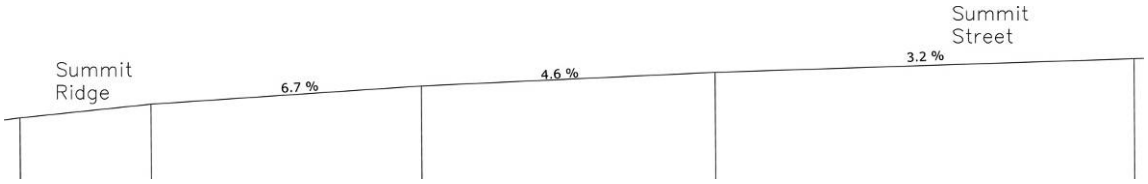
The steep grade found in Section A has a maximum grade of 16% and an average grade of 14.6%.

Figure 6: Section A Profile



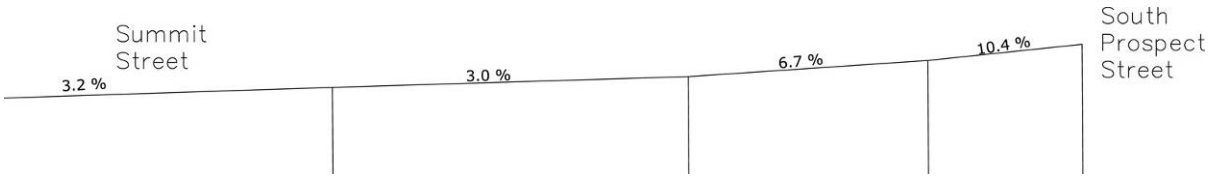
Section B has the flattest grades within the study area between Summit Ridge and Summit Street.

Figure 7: Section B Profile



Section C of Cliff Street varies in grade between 3% to almost 10.5% as it approaches South Prospect Street.

Figure 8: Section C Profile



The Cliff Street study section A is estimated to be one of the steepest streets in the City of Burlington. Other streets with notable grades include Depot Street at approximately 13% grade, North Prospect approaching Riverside Avenue at approximately 13% grade and Ledge Road at approximately 11%.

Figure 9 shows the 2 foot contour lines for the study area.

Figure 9: 2 foot Contours within the Study Area

2.5 VEHICLE CRASHES

VTrans' maintains a statewide database of reportable vehicle crashes. A reportable crash is a crash involving $1,000 or more in property damage, an injury, or a fatality. Between 2000 and 2004[1] there were 17 reported vehicle crashes occurring within the study area. The three study intersections where reported vehicle crashes have occurred are all all-way stops.

Six vehicle crashes were reported at the South Willard Street – Cliff Street intersection. Four of the six occurred during the winter months, with broadside, "t-bone" type crashes occurring in three of those four. This pattern of crash history suggests that winter conditions on the steep hill may contribute to the prevalence of broadside vehicle crashes due to vehicles unable to stop on the steep grade when reaching the intersection.

Two vehicle crashes were report at the Summit Street – Cliff Street intersection. The information provided by the crash records indicates human error and inattention as significant factors at this location.

Nine vehicle crashes were reported at the South Prospect Street – Cliff Street intersection. From the information provided by the crash records no discernable pattern of crash type was found.

Table 2 shows the reported vehicle crashes for the study area by intersection.

[1] Most recent data available at the time of report

Table 2: Vehicle Crash History in Study Area

South Willard Street

	Crash Type	Description	Date	Time
1	No Turns, Thru moves only, Broadside ^<	Unknown	1/23/2003	9:33 AM
2	Single Vehicle Crash	No improper driving	11/8/2002	5:28 PM
3	Single Vehicle Crash	Other improper action	4/3/2003	3:09 PM
4	Same Direction Sideswipe		7/28/2003	11:59 PM
5	No Turns, Thru moves only, Broadside ^<	No improper driving, Failed to yield right of way	12/29/2004	11:45 AM
6	No Turns, Thru moves only, Broadside ^<	No improper driving	12/27/2002	9:06 AM

Summit Street

	Crash Type	Description	Date	Time
1	No Turns, Thru moves only, Broadside ^<	Inattention	1/11/2003	10:41 AM
2	Rear End		3/8/2003	4:44 PM

South Prospect Street

	Crash Type	Description	Date	Time
1		Failed to yield right of way	5/31/2000	12:00 PM
2			7/20/2002	6:15 PM
3	Same Direction Sideswipe		9/4/2002	5:30 PM
4	Rear End		9/20/2002	5:35 PM
5		Failed to yield right of way	10/21/2002	11:50 AM
6	Right Turn and Thru, Angle Broadside -->^--	No improper driving	12/13/2002	12:00 PM
7	Head On	Visibility obstructed, Made an improper turn, No improper driving	1/27/2003	3:48 PM
8	Rear-to-rear	Inattention	9/29/2004	2:00 PM
9	Same Direction Sideswipe	Unknown	10/29/2004	1:11 AM

2.6 UTILITIES

The following underground and overhead utilities were identified within the study area:

- Overhead power, telephone and cable;
- Underground storm drainage combined sewer with catch basins; and
- Underground phone lines, water and gas lines, and fire hydrants.

The identification and location of these utilities is based on field observations and high resolution orthophotographs. CAD files developed for this study show the location of the known utility locations.

The sidewalk design alignments were developed to avoid significant utility impacts. Only two catch basins would be impacted by any of the proposed alternatives. The two locations are:

- Catch basin on South Willard that would be impacted by a bulb out on the north approach.
- Catch basin on the southeast corner of Summit Ridge and Cliff Street would be impacted by design Alternatives 3 or 4 because of new curbing on the north side.

During the construction of pedestrian facilities additional investigation is required to precisely locate the affected utilities and to proceed with necessary permitting and relocation plans.

2.6.1 Drainage

Cliff Street has is located along the top of a long slope extending west towards Lake Champlain. Cliff Street has limited catch basins feeding the combined stormwater/wastewater system. Frequently during typical storm events the catch basins fail to capture sufficient surface water resulting in streams flowing down the section between Summit Ridge and South Willard.

In addition to inadequate number and placement of catch basins, Cliff Street also has several naturally occurring springs that generate year round deposits of water onto the street. In the winter inadequate drainage has resulted in water seepage across the street often creating icy conditions.

The excess surface water not only affects roadway safety during weather events or during icy conditions, it can cause premature wear and tear of the roadway surface.

2.7 ENVIRONMENTAL CONDITIONS

Preliminary assessments of environmental impact within the study area were conducted by using GIS data prepared by the Agency of Natural Resources and in-field assessments. The following include environmental resources assessed:

- Deer Wintering Areas: None identified in study area
- Rare, Threatened or Endangered Species: None identified in study area
- Wetlands: No wetlands were identified within or adjacent to the study area.
- Archeological Resources: It is not anticipated that the any improvements within the City right of way would impact archeologically sensitive areas.
- Flood Zones: The Cliff Street study area is located above any flood zone.
- Historic Resources: All design elements of the improvement alternatives would occur within the City owned right of way and would likely not impact historic property.

- Hazardous Waste Sites: It is not anticipated that there are any hazardous waste sites within the City owned right of way along Cliff Street.
- Prime Agricultural Soils: It is not anticipated that there are any prime agricultural soils within the study area in City owned right of way.

3.0 CONCEPTUAL ALIGNMENT EVALUATION

This section provides an evaluation of the various alternatives proposed for each of the sections and the impacts on the Cliff Street study area.

3.1 DESIGN ELEMENTS

Alternative design configurations along Cliff Street are able to be quite flexible given they are owned and maintained by the City of Burlington. However, since it is assumed that federal funds may be used for sidewalk construction it is necessary that national design guidelines are adhered to. Federal guidelines would require the following:

- Minimum sidewalk width of 5 feet;
- Maximum grade of 8.3%, but if placed parallel to a roadway grade, the roadway grade is acceptable; and
- Constructed to ADA Standards to ensure proper materials and other sidewalk features such as accessible ramps.

Aside from the sidewalk the City of Burlington has the flexibility to reduce travel lane widths, greenbelts, or change the on-street parking configuration. The design alternatives developed within this study meet applicable design guidelines. ADA guidelines dictate eligibility for federal funding and materials such as concrete have a much longer design life than gravel or asphalt sidewalks.

3.2 STUDY GOALS AND OBJECTIVES

Each of the alternatives aims to provide vehicle mobility and accessibility to residents of the street as well as provide a safe place off the street for pedestrians. The following study objective statement was developed by the steering committee and used throughout the study as the guiding principle.

Study Objective:

"Create a plan that will provide for safe and efficient pedestrian, bicycle, and vehicle mobility. The concepts should be constructible and meet all applicable design standards. The plan will enhance the Cliff Street neighborhood and reflect the 'rural' characteristics while maintaining its importance as an east-west connection."

Within the overarching study objective the study aimed to incorporate other goals brought up in the local concerns meeting. These include:

- Calming vehicle traffic speeds;
- Heavy through trucks on the local street;
- Providing a safe off-street pedestrian route;
- Maintaining the on-street parking options;
- Safely accommodate bicycles; and
- Improve pedestrian scale lighting.

Each of the alternatives developed for each section of the study area meet the overarching study objective while trying to incorporate all other specific project goals noted above. The City also intends for all design alternatives to be developed within the City owned right of way.

The alternatives evaluation includes an overview of the proposed section elements, potential impacts, cost estimates, potential permitting issues, and advantages/disadvantages for each section.

Figure 10: Sections Used for Evaluation

3.3 PRELIMINARY ALTERNATIVES DEVELOPMENT

During the project steering committee meeting on 24 April 2007 it was recommended that any design alternative that is recommended for one study section of Cliff Street be evaluated for all study sections. Based on that recommendation, RSG collected additional data on traffic flow and existing site conditions to develop a matrix with eleven potential design alternatives for the Study Area. The eleven alternatives all included a sidewalk and changes in the roadway configuration to accommodate the sidewalk on the north side of the street.

Table 3 shows the preliminary design alternatives developed.

Table 3: Preliminary Alternatives Development

Alt #	Alternative	Two-Way Travel & Keep Parking (existing curb to curb)	Two-Way Travel & Remove Parking	One-Way Travel & Keep Parking	Close Street
1	S. Willard to Summit Ridge	X			
	Summit Ridge to Summit Street	X			
	Summit Street to S. Prospect	X			
2	S. Willard to Summit Ridge			X	
	Summit Ridge to Summit Street	X			
	Summit Street to S. Prospect	X			
3	S. Willard to Summit Ridge				X
	Summit Ridge to Summit Street	X			
	Summit Street to S. Prospect	X			
4	S. Willard to Summit Ridge			X	
	Summit Ridge to Summit Street		X		
	Summit Street to S. Prospect		X		
5	S. Willard to Summit Ridge				X
	Summit Ridge to Summit Street		X		
	Summit Street to S. Prospect	X			
6	S. Willard to Summit Ridge				X
	Summit Ridge to Summit Street		X		
	Summit Street to S. Prospect		X		
7	S. Willard to Summit Ridge			X	
	Summit Ridge to Summit Street			X	
	Summit Street to S. Prospect			X	
8	S. Willard to Summit Ridge	X			
	Summit Ridge to Summit Street	X			
	Summit Street to S. Prospect				X
9	S. Willard to Summit Ridge	X			
	Summit Ridge to Summit Street		X		
	Summit Street to S. Prospect				X
10	S. Willard to Summit Ridge	X			
	Summit Ridge to Summit Street				X
	Summit Street to S. Prospect	X			
11	S. Willard to Summit Ridge	X			
	Summit Ridge to Summit Street				X
	Summit Street to S. Prospect		X		

The preliminary designs were presented to the project steering committee at the 3 October 2007 project steering committee meeting. The steering committee paired down the eleven options arriving at the design alternatives that were carried through the rest of the study.

The alternatives consist of combinations of the following elements by study section:

- Closing the street to vehicles;
- One-way travel lane with on-street parking;
- Two-way travel with no on-street; and

- Two-way travel with on-street parking.

The four build design alternatives can be summarized by the table below:

sect.	A			B			C		
alt.	vehicle travel	parking	sidewalk offset	vehicle travel	parking	sidewalk offset	vehicle travel	parking	sidewalk offset
1	no-build / no change	no-build / no change	no-build / no change	no-build / no change	no-build / no change	no-build / no change	no-build / no change	no-build / no change	no-build / no change
2	no change	no change	max	no change	no change	minimal	no change	no change	minimal
3	close off	allow 2 sp.	n/a	no change	eliminate	good	no change	no change	minimal
4	one-way up	no change	good	no change	eliminate	good	no change	no change	minimal
5	one-way up	no change	good	no change	no change	minimal	no change	no change	minimal

Alternative 1: No Build/No Change

Alternative 2: Maintain 2-way traffic, on-street parking, and existing curb line, adding a sidewalk in the greenbelt on the north side.

Alternative 3: Close Cliff Street to motor vehicles between South Willard and Summit Ridge; maintain 2-way traffic but remove on-street parking between Summit Ridge and Summit Street, and move the northern curb line south into the existing street to add a new sidewalk and expanded greenbelt; maintain 2-way traffic, on-street parking, and the existing curb line to add a sidewalk in the greenbelt on the north side between Summit Street and South Prospect.

Alternative 4: Convert Cliff Street to 1-way uphill between South Willard and Summit Ridge, move the northern curb line south into the existing street to add a new sidewalk and expanded greenbelt, and accommodate limited on-street parking; maintain 2-way traffic but remove on-street parking between Summit Ridge and Summit Street, and move the northern curb line to the south to add a sidewalk in the new greenbelt; maintain 2-way traffic, on-street parking, and the existing curb line to add a sidewalk in the greenbelt on the north side between Summit Street and South Prospect.

Alternative 5: Convert Cliff Street to 1-way uphill between South Willard and Summit Ridge, move the northern curb line south into the existing street to add a new sidewalk and expanded greenbelt, and accommodate limited on-street parking; maintain 2-way traffic, on-street parking, and existing curb line between Summit Ridge and Summit Street, adding a sidewalk in the greenbelt on the north side; maintain 2-way traffic, on-street parking, and the existing curb line to add a sidewalk in the greenbelt on the north side between Summit Street and South Prospect.

3.4 SECTION A: SOUTH WILLARD TO SUMMIT RIDGE

Section A includes the length of Cliff Street between South Willard Street and Summit Ridge. The section is characterized by its steep grade sloping downhill toward South Willard Street and tree lined embankments on both sides of the road.

Any improvements would occur on the north side because of better side-slope grades, better sun exposure to the south, and less impact on adjacent structures.

The conceptual designs include:

- Alternative 1: No build
- Alternative 2: Install a sidewalk north of the existing street without affecting existing parking or vehicle travel. Use the primitive path for the sidewalk located in Section A. Use a minimal width for the green strip in Section B & C.
- Alternative 3: Similar to 2, but close Section A to vehicles creating a bicycle and pedestrian park and eliminate parking in Section B to maximize the green strip.
- Alternatives 4: Similar to 3, but allow one-way (uphill) on Section A and use the remaining road bed for a green strip and sidewalk,
- Alternative 5: Similar to 4 but use the minimal green strip (allowing parking) on Section B

Each of the build alternatives (Alts 2 - 5) place a sidewalk on the north side of the street.

All alternatives include traffic calming elements at the South Willard Street – Cliff Street and the South Prospect Street – Cliff Street intersections. Bulb-outs along will enhance pedestrian crossings and visually narrow the roadway cross section.

Alternative 2 would install a sidewalk along an existing alignment used as a walking path several years ago along the top of the bank along the northern edge of the Cliff Street right of way. Final design would determine the grade of the sidewalk on this alignment depending on the depth of ledge. It is estimated that the slope could be slightly less than the existing roadway grade of approximately 15%.

Alternative 3 is the most drastic - closing off this section to vehicles. A park-like space would be created that would allow bicyclists and pedestrians to use the right of way free from vehicle conflicts.

Alternative 4 and 5 would install a sidewalk along and within the existing street, on the north curb. Cliff Street would thus be narrowed to create one travel lane uphill, on-street parking for three vehicles, and a green belt between the sidewalk and the new street curb.

Public comment received indicated that since the sidewalk is a long-term plan, they would like to evaluate short and medium term improvements that may meet some of the study objectives.

In the short term:

- Sign to prohibit through trucks using Cliff Street (this improvement was implemented during the course of this study)

- Setup a short-term field study to evaluate the one-way alternative using "Jersey Barriers". Community members suggested this inexpensive test should be undertaken in the summer months and then evaluated.

Figure 11: Section A - Photos

Section A: Looking East

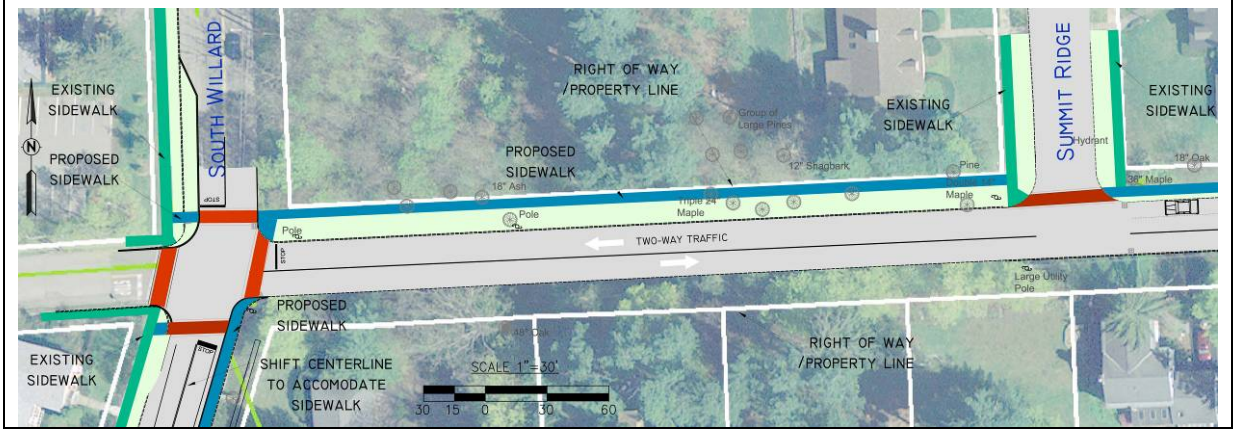
North slope at South Willard

South slope at South Willard

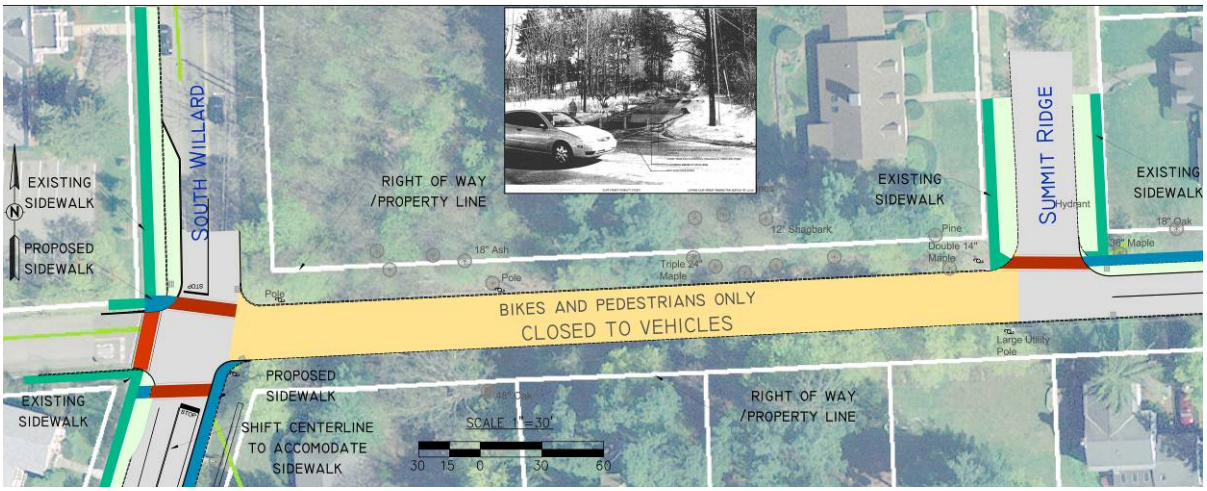
North slope looking west

Alternative 1: No Build

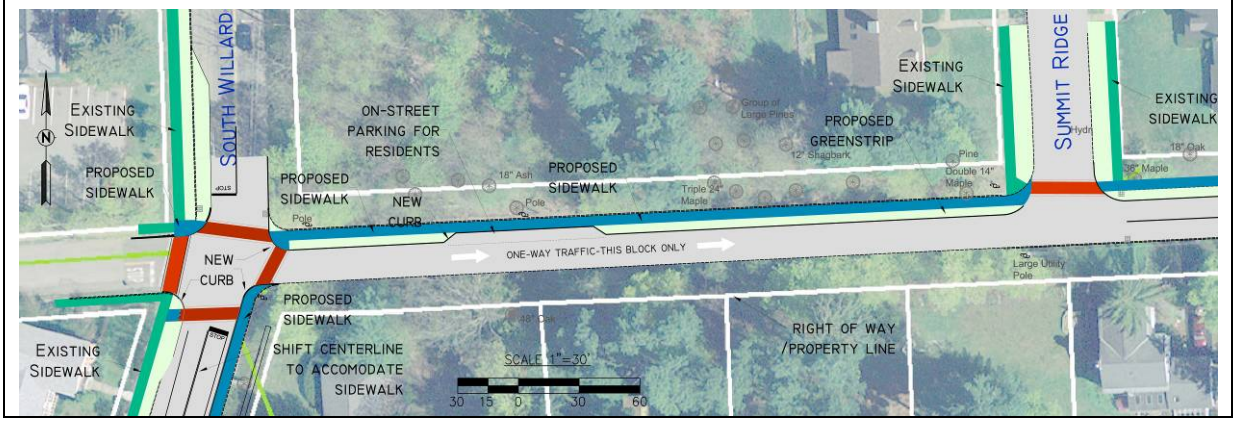
Alternative 2



Alternative 3



Alternative 4 & 5



3.4.1 Advantages & Disadvantages

	Alternative 1	Alternative 2	Alternative 3	Alternatives 4 & 5
Advantages	No Cost	Mobility Improved	Provides exclusive access to pedestrians and bicyclists	Ease of construction
		Pedestrians out of street away from vehicles	Maintains rural and 'natural' feel of the street	Mobility Improved
		No changes to traffic pattern	Significant reduction in impervious surface and improved stormwater treatment	Traffic calming benefits pedestrians, bicycles, and vehicles
Disadvantages	Not ADA compliant	Difficult to construct	Significant impact on vehicle flow and may adversely impact adjacent streets	Change in traffic flow pattern may divert vehicles to adjacent streets
	Does not meet goals and objectives of study	Impact on existing trees on north slope		
	Does not adhere to the City transportation plan or City pedestrian policy	No impact on vehicle speeds or traffic calming		

3.5 SECTION B: SUMMIT RIDGE TO SUMMIT STREET

Section B encompasses the section of Cliff Street between Summit Ridge and Summit Street/Overlake Park. The section has the flattest grade within the study area with five residential driveways and households along the street. Any improvements would occur on the north side because of better grades, south face for sun exposure, and less impact on adjacent structures.

The conceptual designs include:

- Alternative 1: No build
- Alternatives 2 & 5: Install a sidewalk north of existing curb with a 2 foot green strip
- Alternatives 3 & 4: Narrow road and install a sidewalk north of new curb with a 5 foot green strip

Each of the build Alternatives (Alts 2 - 5) propose to install a sidewalk on the north side of the street.

Alternatives 2 & 5 would install a sidewalk along the north slope of the street with a 2 foot green strip between the traveled way and the sidewalk. Cliff Street would remain in its existing configuration with two-lanes in each direction and on-street parking.

Alternatives 3 & 4 would narrow Cliff Street by removing on-street parking and shifting the northern curb south creating a 5 foot wide green strip between the curb and the sidewalk. The loss of existing on-street parking could be accommodated by shifting the resident only parking onto adjacent side streets such as Summit Ridge or Summit Street.

All alternatives would require removing the large tree on the north east corner of Cliff Street & Summit Ridge. Alternatives 2 & 5 are likely to require removal of the crabapple trees in the middle of the study segment to accommodate the proposed sidewalk. Alternatives 2 & 5 are more likely to adversely impact the trees compared to Alternatives 3 & 4 since the sidewalk would be located slightly further north, away from the road. All trees are within the City right of way and are recommended that they be replaced if damaged by sidewalk construction. The sidewalk in Alternatives 2 & 5 would require a steeper embankment from the sidewalk to the existing grade. A retaining wall is not anticipated to be required.

Short term improvements could include the following:

- Bulb outs at the Summit Ridge and the Summit Street/Overlake Park intersections. Bulb outs would physically narrow the street to provide definition to the on-street parking as well as provide a visual cue to slow down.

Figure 12: Section B - Photos

Northeast corner of Summit Ridge intersection. This tree would be removed under all build scenarios

North side looking east

North side looking east

North side looking east

North side looking west

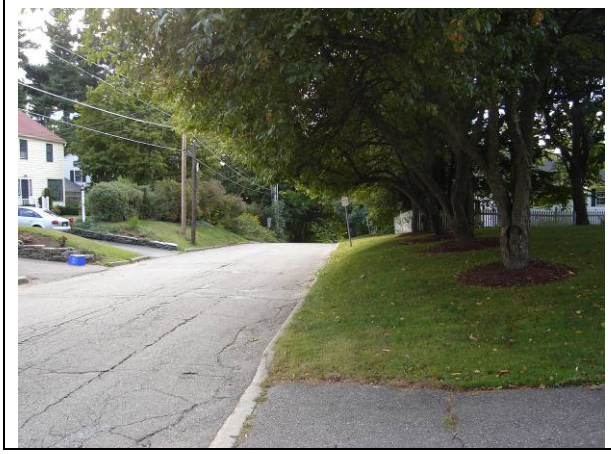
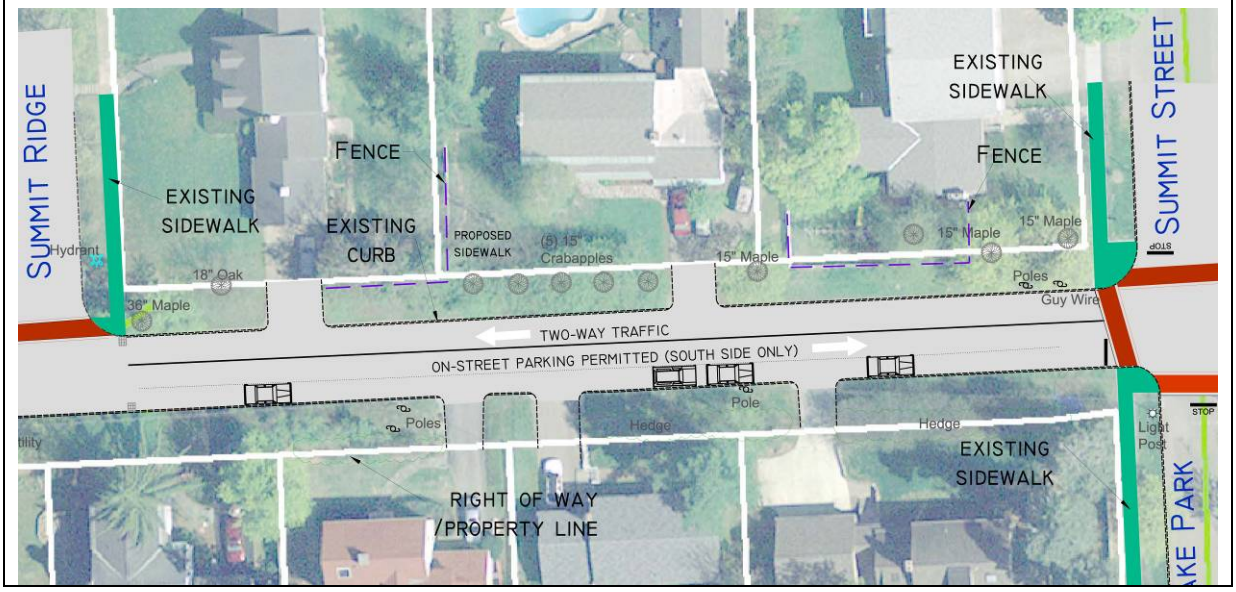
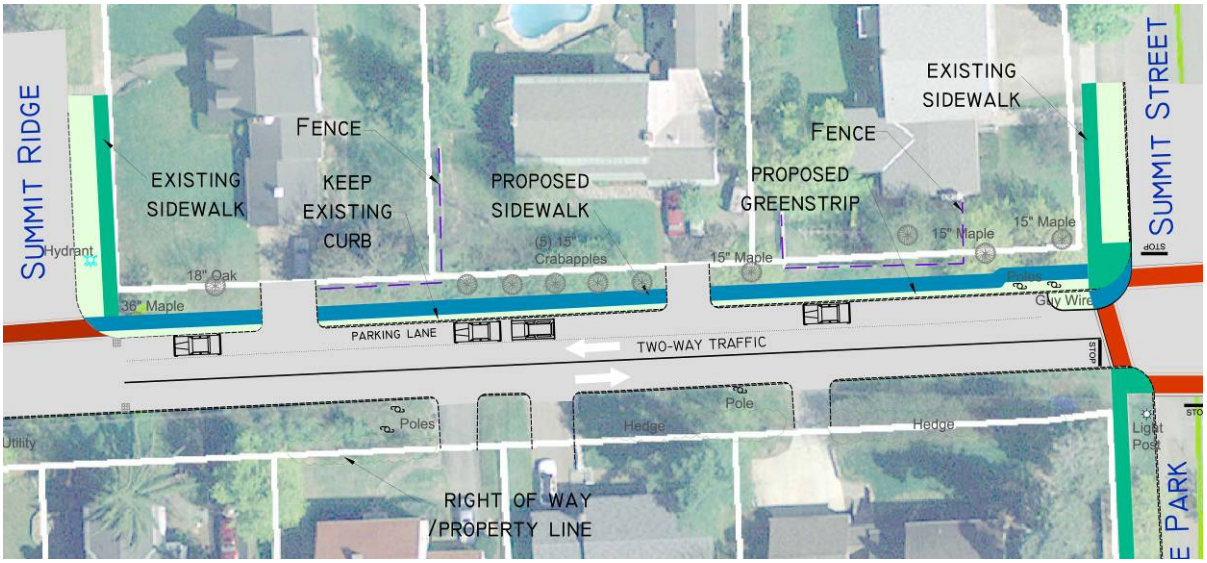


Figure 13: Section B Design Alternatives

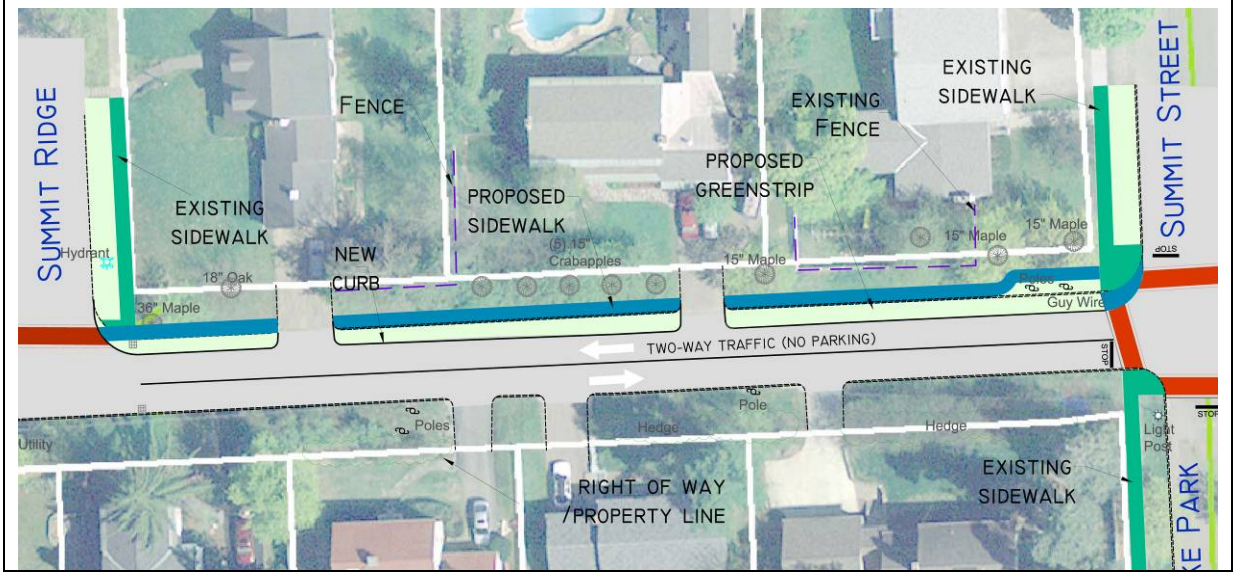
Alternative 1 – No Build



Alternatives 2 & 5



Alternatives 3 & 4



3.5.1 Advantages & Disadvantages

	Alternative 1	Alternatives 2 & 5	Alternatives 3 & 4
Advantages	No Cost	Mobility Improved	Mobility Improved
		No changes to traffic pattern	Traffic calming by narrower street width
Disadvantages	Not ADA compliant	Likely to impact existing trees on north slope	Significant impact on vehicle flow and may adversely impact adjacent streets
	Does not meet goals and objectives of study	Narrow green strip width may limit full use of sidewalk in winter due to inadequate space for snow storage	On-street parking shifted to adjacent streets
	Does not adhere to the City transportation plan or City pedestrian policy		May impact existing trees on north slope

3.6 SECTION C: SUMMIT STREET TO SOUTH PROSPECT STREET

Section C encompasses the section of Cliff Street between Summit Street/Overlake Park and South Prospect Street including improvements at the South Prospect Street intersection.

The conceptual designs include:

- Alternative 1: No build
- Alternatives 2 – 5: Install a sidewalk north of existing curb with a variable width green strip

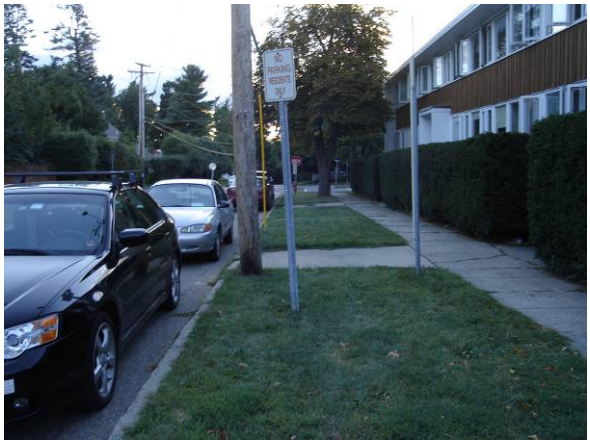
Each of the build alternatives (Alternatives 2 - 5) install a sidewalk on the north side of the street. The new sidewalk would tie into the existing sidewalk on the north side of the street. The north side along this segment remains the best side because of better grades, southern sun exposure, and the presence of a section of an existing sidewalk.

Alternatives 2 - 5 would install a sidewalk along the north slope of the street that connects to the existing section of sidewalk from Summit Street heading east. The sidewalk would then parallel the curb with a variable green strip between 2 to 4 feet to provide adequate snow storage and enough space to avoid utility poles.

The build alternatives include traffic calming elements at the South Prospect Street – Cliff Street intersection. A curb extension is proposed along the east curb that would physically narrow South Prospect Street and provide a visual cue to drivers that the intersection is ahead. Upgraded pedestrian crossings will also enhance the intersection and notify drivers of the intersection.

North side looking west

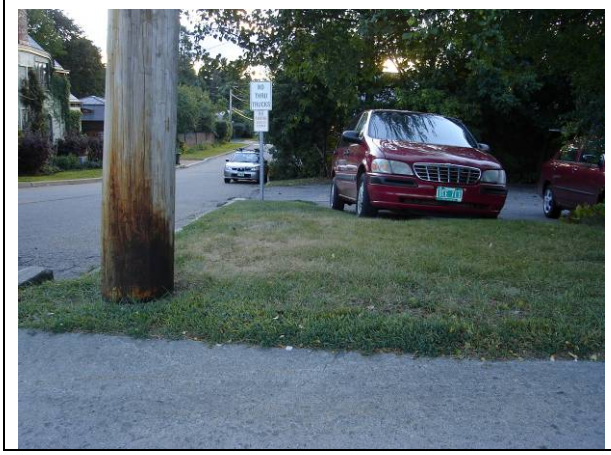
North side looking west



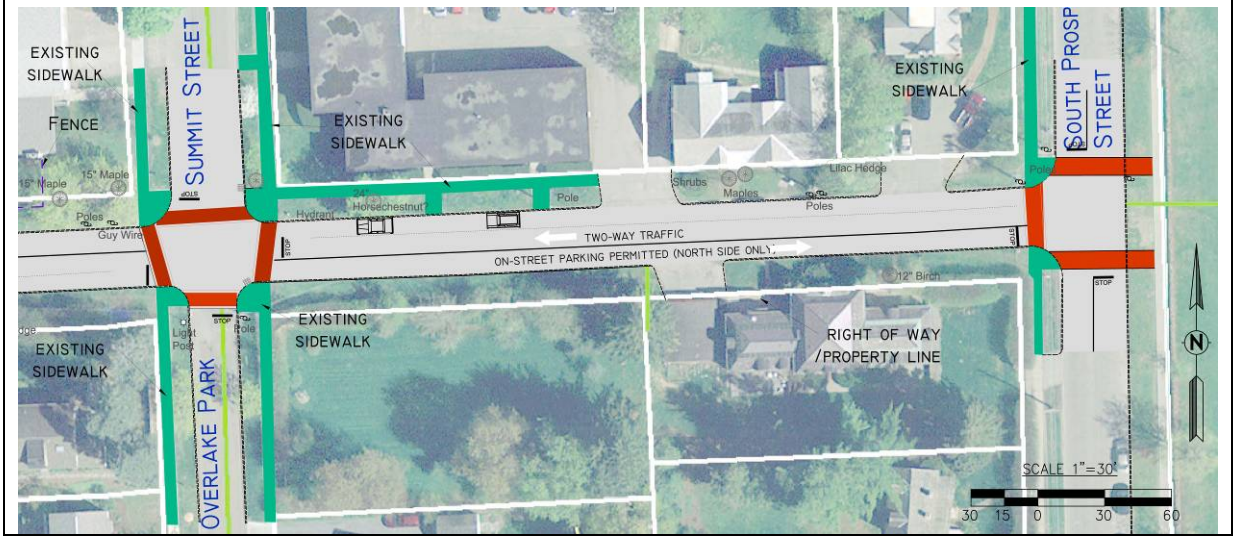
North side looking east

North side looking east

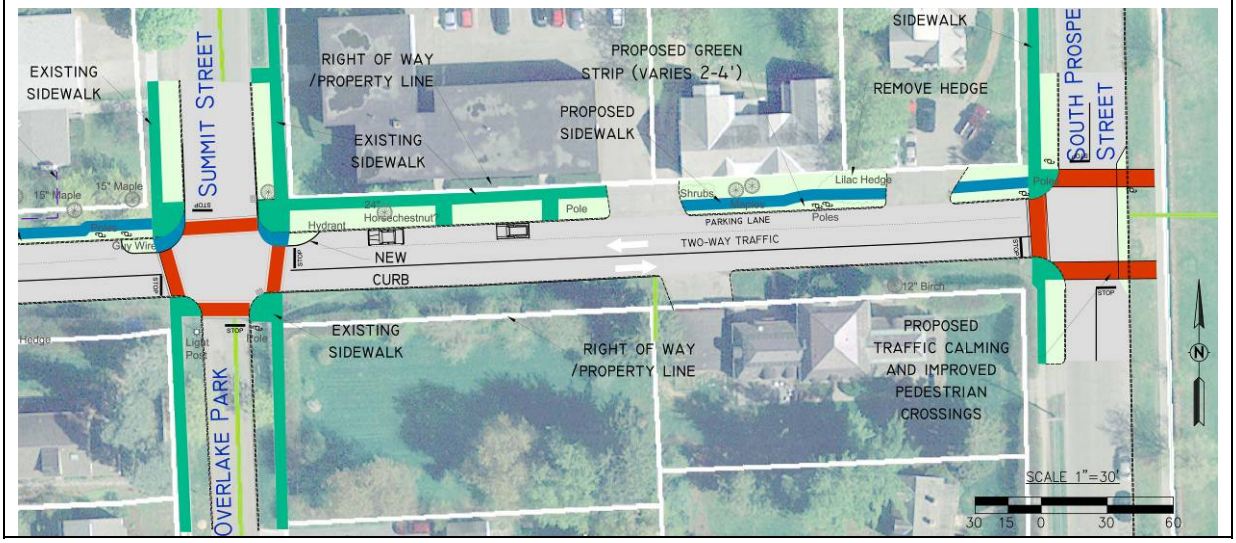
North side looking west from South Prospect Street



Alternative 1: No Build



Alternatives: 2-5



3.6.1 Advantages & Disadvantages

	Alternative 1	Alternatives 2 - 5
Advantages	No Cost	Mobility Improved
		No changes to traffic pattern
		Completes sidewalk network between S. Prospect and Summit Street
		Traffic calming at South Prospect Street intersection
Disadvantages	Not ADA compliant	May impact existing trees on north slope
	Does not meet goals and objectives of study	Narrow green strip width may limit full use of sidewalk in winter due to inadequate space for snow storage
	Does not adhere to the City transportation plan or City pedestrian policy	

3.7 SECTION D: SOUTH WILLARD STREET

Section D encompasses the segment of South Willard Street from Deforest Heights to Cliff Street. The section is 120 feet long and includes one travel lane in each direction, and on-street parking along the west side of South Willard Street.

The conceptual design shows a proposed sidewalk on grade along the eastern curb of South Willard Street. The sidewalk would be accommodated by shifting the center line of South Willard to the west and removing approximately three on-street parking spaces. A catch basin just north of Deforest Heights Road would have to be moved west to match the new curb line of the proposed sidewalk.

The pedestrian route extending from Deforest Heights to South Willard Street currently ends at the unsignalized intersection at South Willard Street. The Deforest Heights sidewalk provides a convenient way for many Hill residents to get to South Willard en route to the Edmunds School and other points west using Maple Street. However, the pedestrian route mandates that a pedestrian must either walk in the street or cross an unmarked unsignalized intersection across South Willard Street.

Previously proposed sidewalks have focused on maintaining the existing roadway alignment and placing the sidewalk into the eastern curb by cutting into the steep slope. With ledge and grade being a concern the sidewalk has never been constructed. This proposed alternative places the sidewalk in its preferred location along the east side with limited impact on the steep slope.

South Willard: East slope looking south

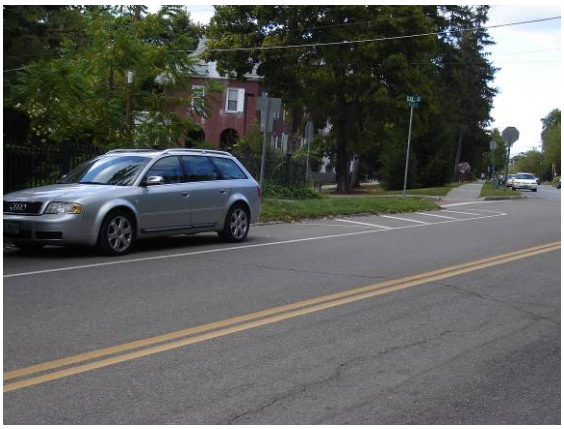
South Willard: East slope looking north

Southeast corner of South Willard – Cliff Street intersection

South Willard: East slope looking south

South Willard – Deforest Road intersection looking north

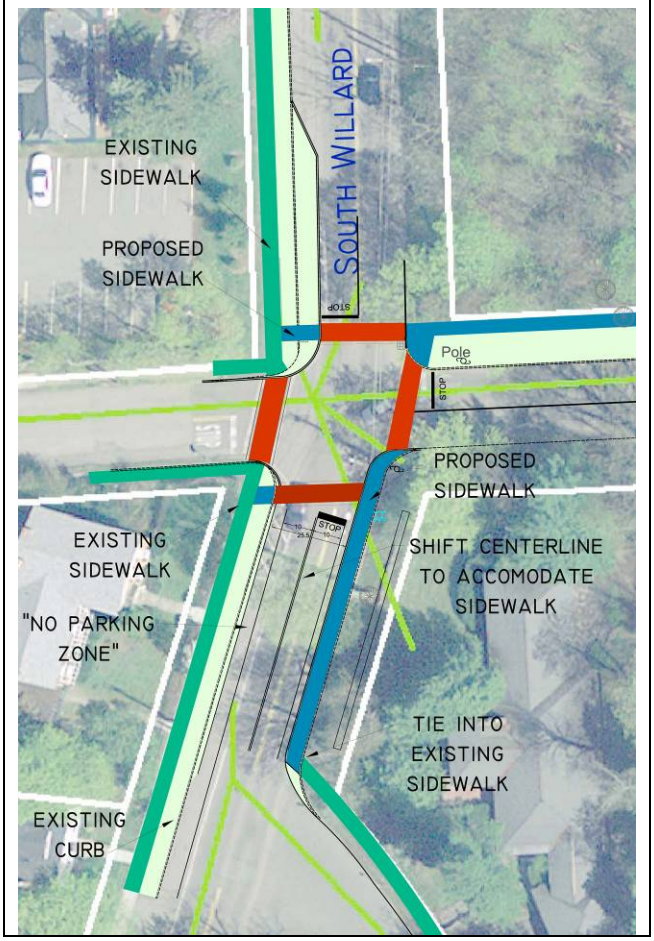
South Willard west slope looking north



The design alternative places a sidewalk on the east curb of South Willard Street by shifting the centerline of South Willard Street to the west, creating additional space for the sidewalk without significantly cutting into the steep slope on the east side of the street. It is anticipated that three parking spaces on the west side of South Willard Street would be impacted.

This sidewalk design eliminates the need for pedestrians to cross South Willard Street just downstream of an all-way stop controlled intersection.

Figure 14: Section D Design Alternative



3.7.1 Advantages & Disadvantages

	Alternative 1	Alternatives 2 - 5
Advantages	No Cost	Mobility Improved
		No changes to traffic pattern
		Provides connected sidewalk network
Disadvantages	Not ADA compliant	May impact existing tree on east slope
	Does not meet goals and objectives of study	No green strip may limit full use of sidewalk in winter due to inadequate space for snow storage
	Does not adhere to the City transportation plan or City pedestrian policy	Loss of three on-street parking spaces on South Willard Street

4.0 EVALUATION MATRIX

The project steering committee developed a set of metrics used to evaluate the five project alternatives. Table 4 and Table 5 show the metrics and the evaluation of each of the five project alternatives. Because each of the alternatives affects the operations of the entire study area the evaluation matrix is not divided into sections.

Alternative 1 shows the no build alternative. Alternatives 2 – 5 show the alternatives with a sidewalk.

Table 4: Evaluate Matrix A

DESCRIPTION		Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
		No Build	**Build**	**Build**	**Build**	**Build**
ENGINEERING	Pedestrian Safety	No change	Improved pedestrian infrastructure.	Improved pedestrian infrastructure.	Improved pedestrian infrastructure.	Improved pedestrian infrastructure.
	Vehicle Traffic	No change	No change	Reduced traffic volumes. Eliminates vehicle conflicts at South Willard and Cliff Street from the east. Traffic calming at the ends of the project.	Elminates the potential safety hazard of sliding down Cliff Street in icy weather at South Willard. Traffic calming at the ends of the project.	Elminates the potential safety hazard of sliding down Cliff Street in icy weather at South Willard. Traffic calming at the ends of the project.
	Level of Service/Congestion	No change	Negligible Impact	Negligible Impact	Negligible Impact	Negligible Impact
	Alignment Change	No change	No change	Re-Routing due to street closure between S. Willard and Summit Ridge. Impacts east-west travel in Burlington.	One-Way Uphill between S. Willard and Summit Ridge.	One-Way Uphill between S. Willard and Summit Ridge.
	Bicycle/Pedestrian Access	No change	Improve	Improve	Improve	Improve
	Hydraulic Performance	No change	Approx. 4,000 sq.ft. of additional impervious surface (net)	Approx. 150 sq.ft. less impervious surface (net). Minus any reduction in impervious surface with Bike & Ped Park	Approx. 1,400 sq.ft. less impervious surface (net)	Approx. 320 sq.ft. of additional impervious surface (net)
LOCAL & REGIONAL ISSUES	Historic Structures/Sites	n/a	No	No	No	No
	Fish and Wildlife	n/a	No	No	No	No
	Rare, Threatened & Endangered	n/a	No	No	No	No
	Public Lands	n/a	No	No	No	No
	Noise	n/a	No	No	No	No
	Community Character	n/a	Improve	Improve	Improve	Improve
	Economic Impacts	n/a	No	No	No	No
	Conformance to Regional & Local Transportation Plans	No	Sidewalks support City Transportation Plan and national Safe Routes to School programs.	Sidewalks support City Transportation Plan and national Safe Routes to School programs.	Sidewalks support City Transportation Plan and national Safe Routes to School programs.	Sidewalks support City Transportation Plan and national Safe Routes to School programs.

Table 5: Evaluation Matrix B

DESCRIPTION		Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
		No Build	Build	Build	Build	Build
PERMITS	Storm Water Discharge	No	No	No	No	No
	Endangered & Threatened Species	No	No	No	No	No
	ROW Impacts	No	No	No	No	No
	State Historic Preservation Office Clearance	No	No	No	No	No
LOCAL ITEMS OF CONCERN	Snow Management/Storage	n/a	2 foot green belt will provide partial snow storage. Sidewalk may be restricted part of the winter with snow.	Significant less plowing with partial street closure. 5 foot green strip provides ample snow storage and full use of sidewalk in the winter.	5 foot green strip provides ample snow storage and full use of sidewalk in the winter.	5 foot green strip on segment between S. Willard and Summit Ridge provides ample snow storage. 2 foot green belt will provide partial snow storage and restrict part of the sidewalk during the winter.
	Phasing of Improvements	n/a	Improvements could be phased and implemeted over time.	Improvements could be phased and implemeted over time.	Improvements could be phased and implemeted over time.	Improvements could be phased and implemeted over time.
	Parking	No change	No change	No on-street parking on 1 block. Net Loss of 11 spaces. Parking would be accomodated for residents adjacent to bike and ped park.	No on-street parking on 1 block. Net Loss of 11 spaces. On-Street spaces would be resident parking between S. Willard and Summit Ridge.	On-Street spaces would be resident parking for residents between S. Willard and Summit Ridge.
	Meet Town Design Standards	No	Yes	Yes	Yes	Yes
	Meet ADA Requirements	Existing non-compliant pedestrian ramps	Yes - with grade variance on segment between S. Willard and Summit Ridge.	Yes - with grade variance on segment between S. Willard and Summit Ridge.	Yes - with grade variance on segment between S. Willard and Summit Ridge.	Yes - with grade variance on segment between S. Willard and Summit Ridge.
	Power/Communication Pole Impacts	No change	None	None	None	None
	Transit Routes	No change	No change	No change	No change	No change
	Impacts Mature Trees	No change	~13 trees impacted	~2 trees impacted	~2 trees impacted	~5 trees impacted
	Implementation Challenges	n/a	Steep grades and unknown surface on segment between S. Willard and Summit Ridge.	Complications of building a new of constructing a new park within the City while providing access to residents. Loss of some on-street parking. Impacts due to re-routing vehicle traffic.	Loss of some on-street parking. Impacts of re-routing vehicle traffic for westbound vehicles.	Impacts of re-routing vehicle traffic for westbound vehicles.

5.0 COST ESTIMATES

Order of magnitude cost estimates were developed for each of the alignments. It is important to note that these cost estimates are preliminary and should be used for planning purposes only. Once a final design is developed, the cost estimates should be revisited and revised based on a more precise understanding of quantities and materials.

Costs for sidewalk and curbing are based on the 2006 *VTrans Report on Shared Use Path and Sidewalk Unit Costs*. Unit costs for other elements (signage, striping, landscaping, drainage, etc.) are based on a manual survey of recent contractor bid prices received by VTrans.

The preliminary cost estimates for each section are presented below in Table 6.

Table 6: Preliminary Cost Estimates for Design Alternatives

		Estimated Cost
Section A		
	Alternative 2: Existing roadway configuration with sidewalk on north slope. Includes sidewalk elements, and removal of medium sized trees.	$ 36,000
	Alternative 3: Cost estimate is not estimated because of the variability in cost of constructing a bike & pedestrian park.	na
	Alternative 4 & 5: Narrow roadway to one-way uphill with sidewalk on north side. Includes sidewalk elements, and new curb.	$ 55,000
Section B		
	Alternative 2 & 5: Maintain existing roadway configuration. Sidewalk would be placed north of existing curbing with 2 foot grass strip. Includes sidewalk elements.	$ 31,000
	Alternative 3 & 4: Narrow roadway to two-way travel with no on-street parking. Sidewalk would be placed on north side with grass strip and new curbing. Includes sidewalk elements, relocated catch basin, and new curb.	$ 46,000
Section C		
	All Build Alternatives: Existing roadway configuration with sidewalk on north slope. Includes traffic calming improvements at the South Prospect - Cliff Street intersection.	$ 18,000
Section D		
	All Build Alternatives: Shifted centerline to accommodate sidewalk on east side of street and created traffic calming elements at the Cliff Street - South Willard Street intersection. Includes traffic calming improvements and sidewalk.	$ 26,000

Summarizing by Alternative:

	Estimated Cost of Construction
Alternative 1:	$ -
Alternative 2:	$ 85,000
Alternative 3: (does not include Section A)	$ 64,000
Alternative 4:	$ 119,000
Alternative 5:	$ 104,000
Section D: South Willard Sidewalk	$ 26,000

6.0 ALTERNATIVES PRESENTATION

The four build alternatives were presented at a public meeting held on 15 November 2007. RSG presented an overview of the study area, existing traffic conditions, vehicle crash records, and the goals and objectives of the study.

The public in attendance was polled through a process termed "Dot-Mocracy" to determine which of the four build alternatives was the most and least favorable options. The "Dot-Mocracy" voting process is often used in the City of Burlington; consisting of small sticker dots that are counted as a vote. This visual method of polling provides effective, non-invasive, and instant vote results.

Table 7 presents the results from the Dot-Mocracy voting.

Table 7: Dot-Mocracy Voting Results

	Blue	Red	Total
Alternative 2	9	1	10
Alternative 3	1	2	3
Alternative 4	8	4	12
Alternative 5	2	0	2

The voting tally attempted to capture input from all residents but also differentiate between those residents with properties along Cliff Street and those residents who live outside of the immediate study area. The Blue stickers were given to residents who do not immediately abut the study area. Red stickers were given to residents of Cliff Street within the study area.

The Dot-Mocracy results indicate that Alternative 4 and Alternative 2 are the two preferred build alternatives.

7.0 SUMMARY AND NEXT STEPS

This study evaluated the feasibility of constructing three new sidewalk segments along upper Cliff Street between South Willard Street and South Prospect Street in Burlington, Vermont.

The main goal of this study and accompanying designs are to determine which improvements could be made to the Cliff Street area that could provide safe and efficient mobility and access options in the study area.

> "Create a plan that will provide for safe and efficient pedestrian, bicycle, and vehicle mobility. The concepts should be constructible and meet all applicable design standards. The plan will enhance the Cliff Street neighborhood and reflect the 'rural' characteristics while maintaining its importance as an east-west connection."

The primary funding sources which can be used to advance these plans include the Safe Routes to School (SR2S) grant program, the Transportation Enhancement (TE) grant program, the CCMPO Sidewalk Grant Program, the VTrans Transportation Improvement Program, and local municipal funding sources. The SR2S, TE,

and sidewalk grant programs will provide the City with the best opportunities for advancing these sidewalk segments in a timely manner.

- Safe Routes to School (SR2S) program: The City of Burlington is currently enrolled in SR2S program to develop non-infrastructure activities including programs to educate students and parents about walking to school. This enrollment enables the Town to pursue funding for infrastructure activities – including the design and construction of sidewalk improvements that bridge an identified barrier on a designated school route. The SR2S program is funded with 100% Federal funds, so no local matching funds would be needed. The ½ mile distance to Edmunds is slightly longer than most SR2S funding parameters, however, since Cliff Street is one of the few missing sidewalk links within the City the project may qualify. Currently, only the two New North End schools are enrolled in the program. Edmunds should continue their efforts to be included in the SR2S program.
- Transportation Enhancement (TE) program: The City of Burlington has successfully received TE grants in the past. The TE program requires a 20% local match, so the City will need to budget for that amount prior to the grant application.
- CCMPO Sidewalk Grant Program: The program is designed to improve and expand the region's sidewalk infrastructure through grants to member municipalities for preliminary engineering and sidewalk construction. The next round of applications for this program will begin in April 2007. This program uses 80% federal funds and 20% local funds from the community. The program began in FY05 and makes available $250,000 per year.

The Cliff Street design alternatives can be divided in to sections and individual tasks. As such, the City has the opportunity to plan for and integrate elements of the concept designs into future capital budgets and sidewalk construction schedules. Traffic calming elements of the designs can be pursued separately at the intersections of South Willard and South Prospect Streets.