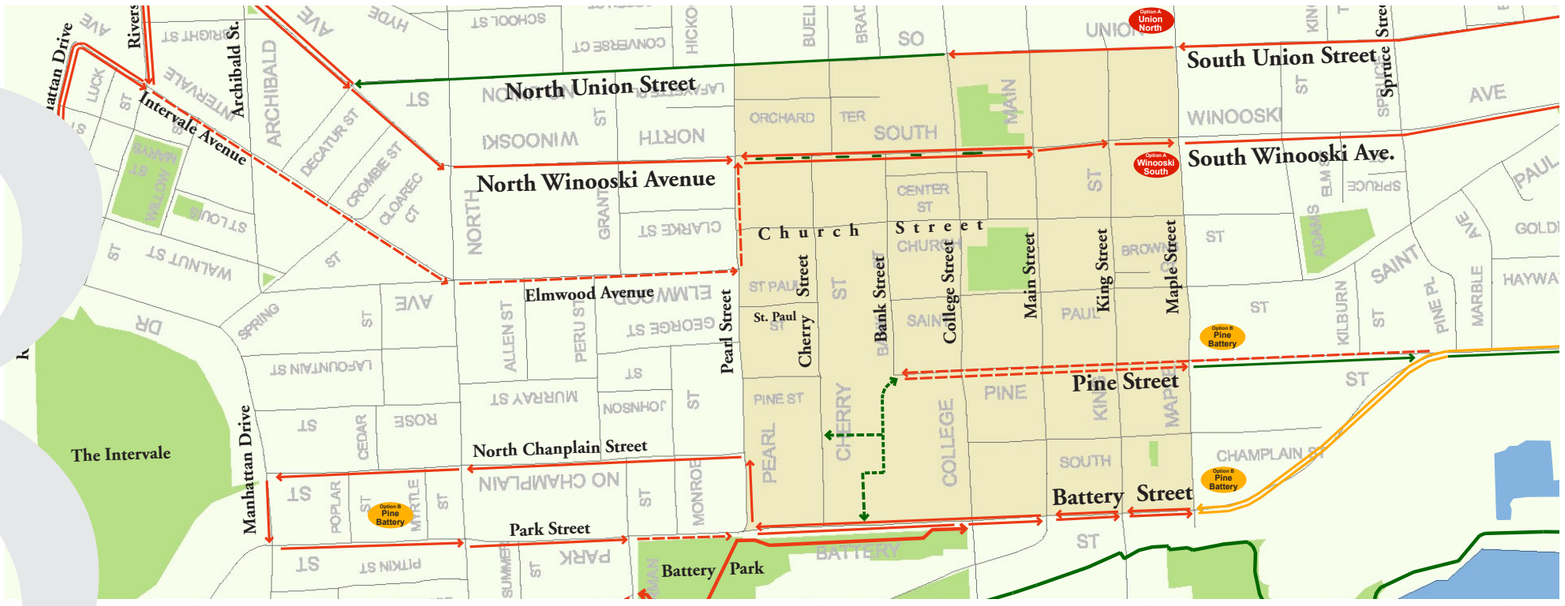

Burlington North/South Bicycle & Pedestrian Route Study

Final Report

November 2002

Prepared for: The Burlington Public Works Department

Prepared by: The Office of Robert A. White, ASLA, Landscape Architects and Environmental Planners

Funded by: Vermont Agency of Transportation Enhancement Program

City of Burlington, Vermont 2002

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1. Introduction

The City of Burlington has long promoted alternative transportation. The Burlington Shared Use Path*, waterfront redevelopment, parks, trails, greenways and the planned multi-modal transportation center are testaments to the city's commitment to alternative transportation venues. The Burlington Shared Use Path is perceived as a major amenity for residents and visitors alike, and hailed as a model for other urban areas.

The city's vibrant population of students at UVM and other colleges, professionals and workers of all types, living within walking distance of downtown lends itself to a system where people can bike and walk to work and school safely. The city's desire is to promote a network of bikeable, pedestrian friendly routes to access the downtown, and also promote safer, non vehicular traffic within the neighborhoods themselves such that travel to school, work, the store, the park or anyplace else can be made without a vehicle.

The Burlington City Council, in recognition of these interests, made a resolution in 1999 to address bike and pedestrian connections to the downtown from the neighborhoods to the north and south. In 2001, the City received a grant from the Vermont Agency of Transportation Enhancement Program to develop a plan for a North/South Bicycle and Pedestrian Route. The Office of Robert A. White, ASLA, Landscape Architects and Planners of Norwich, Vermont, was hired to conduct the study.

The purpose of the North/South Bicycle and Pedestrian Route study was to identify alternative routes for the north/south connections into downtown. From those options, the City will choose one north-south route for implementation. Because of the project's complexity and the potential costs involved, implementation of a preferred route may take several years, and involve a wide range of city, state and federal grants as well as private funds. Where required, interim steps have been identified. Concepts such as "share the road" and providing pedestrian/bike usable space such as bikeable shoulders at a lesser standard, have been identified as possible short term solutions, with the intent to fully develop the system as funding becomes available. After this route is created, it is likely that additional corridors for pedestrian/bike use will be created. For those projects, this report will be a point of beginning.

The North/South Bicycle and Pedestrian Route study area is from the waterfront to Union Street, the Old North End extending to Riverside and North Avenues, and the South End to the city line including Shelburne Street.

***What is a Shared Use Path?**

A shared use path is an off-road facility designed primarily for bicycles, but open to other types of non-motorized users including, but no limited to, pedestrians, joggers, dog walkers, people pushing baby carriages, people in wheelchairs, in-line skaters and skate boarders.

What are the goals of the North/South Bicycle and Pedestrian Route Study?

1. Define alternative north/south route options from the Old North End and South End into downtown.
2. Address, in conceptual design, the types of improvements needed for each alternative, so that any option can be utilized equally by bicyclists and pedestrians.
3. Evaluate the probable costs and level of bike serviceability for each route.
4. Make a recommendation to DPW about which of several alternatives would be the best choice for a north/south route.
5. Define, for future planning, possible east/west connecting routes.
6. Define route locations that maximize bike/pedestrian mobility, safety, and convenience, and enhance the ambiance of the city's streets.
7. Address fundamental safety problems that are inherent in multi-modal streets, and reduce auto-pedestrian-bike conflicts with appropriate design.
8. Serve the greatest number of potential users from the standpoint of bike/pedestrian origins and destinations.
9. Compliment other city bike facilities that already exist or are being planned, including bike lanes on Union Street, Willard Street, Main Street and Pine Street, as well as the Burlington Shared Use Path, the proposed Southern Connector Shared Use Path and the Route 127 Shared Use Path.
10. Create a bike/pedestrian corridor that is visually distinct as the preferred route and demonstrate, in strategic locations, what a well designed multi modal street should look like.
11. Integrate the north/south route with existing or planned regional bike/pedestrian routes.
12. Coordinate with long-term street improvement projects which should include bike/pedestrian enhancements, such as the Southern Connector, Shelburne Road, the Route 7 Rotary, the planned Intervale Shared Use Path, South Winooski Avenue from Pearl Street to Main Street, Battery Street from Main Street to Battery Park, and the Riverside

Resolution Relating to the North/South Bicycle Route

City of Burlington
In the year One Thousand Nine Hundred and Ninety Nine, Resolved by the City Council of the City of Burlington, as follows:

That, whereas the importance of a north/south bicycle route through downtown Burlington has been identified in the Burlington Master Plan and the 1997 Burlington Bicycle Report; and

WHEREAS, no such route exists today and as a result getting downtown by bicycle can be unsafe and difficult; and

WHEREAS, a 1997 resident survey with 140 responses identified the downtown area as the number one destination for which residents wanted better bicycle access;

NOW THEREFORE IT BE RESOLVED that the City Council requests the Department of Public Works to explore ways to create a North /South bicycle lane or path within the geographic boundaries of Battery Street and Union Street that connects the downtown to the North and South Ends; and

BE IT FURTHER RESOLVED that one option to be studied includes the creation of bicycle lanes on Winooski Avenue between Pearl Street and Main Street by reconfiguring travel lanes into a center turn lane, two travel lanes and bike lanes on each side; and

BE IT FURTHER RESOLVED that a report on the various options be provided to the City Council by March 2000.

A Note on Implementation

The City's goal is to implement the routes with the least amount of physical changes first. The Department of Public Works policy is to involve those neighborhoods where more significant changes are proposed such as the moving of curb or on-street parking. DPW staff would meet with the neighborhood and bring feedback to the DPW Commission who would make the final decision.

Pedestrian and Bicycle Access are Basic Elements of Burlington City Policy

Excerpts from the 2001 Burlington Municipal Development Plan that apply to this study

Downtown at Pearl and Battery

Willard Street

Pine Street

North Winooski Avenue

Transportation: Bike use objectives

Burlington has a growing reputation as a "bike-friendly" city. The popularity of the Burlington Bike Path and the Cycle the City theme-loop are but two examples. Bicycles play an important role in reducing auto dependence and improving the livability of the city. While bicycling may not be an option for everyone or for every day, properly designed and maintained bicycle facilities, coupled with a well developed education and enforcement program, can help provide a reasonable reduction in the use of cars and an enjoyable and healthy mode of transportation for many.

Choices for future bicycle facilities cannot be an either/or decision. In-the-road options typically serve the experienced cyclist and dedicated commuter.... In contrast, seperated shared use paths better accommodate users such as children and visitors who are less confident and experienced, and have proven an important economic development tool for the city. These paths should be used to provide access to destinations frequented by children such as schools, and major destinations where they may represent the shortest route.

It is the City's policy to develop enhancements for this mode of travel whenever possible. Currently the Dept. of Public Works (DPW) commits 2% of its Streets and Sidewalks Capital Budget to develop and enhance the bicycle transportation network. Improvements include the expansion of "in the road" options such as designated bike lanes and bike routes.

Other types of improvements include the Bike Ferry across the Winooski River to Colchester and a bicycle/pedestrian bridge to Winooski. Future improvements must also include amenities such as secure and sheltered bike parking, showers and lockers. The placement of bike racks on all CCTA vehicles has been a big step forward.

Major improvements to the city's bicycle network will be associated with the major roadway reconstruction projects planned (e.g. Southern Connector and Riverside Avenue). Additional improvements should include:

- A North/South bicycle link through the downtown,
- An east/west link across the New North End, and
- Making connections with similar routes and facilities in neighboring communities.

While we want to encourage a greater use of bicycles in the city, our standard measures of performance are based on vehicles. In order to measure the sufficiency of the transportation system to accommodate all travel modes, the City should utilize a Bicycle Compatibility Index (BCI) and develop Level of Service (LOS) standards for bicycles. Finally, the city should develop a system of hazard reporting where specific areas and hazards can be identified and evaluated for future improvement by the DPW.

Finally, residents have repeatedly expressed their concern that there is a general lack of understanding as to the rights and responsibilities of cyclists and pedestrians. If we are to have a multi modal transportation system that shares resources among users, education, marketing, and enforcement must be a central component of the city's overall program. Two important steps in this regard should be (1) the creation of a bicycle education program in association with the city's schools, and (2) placing Community-Based Police Officers on bicycles whenever possible. Additional ongoing education and awareness of bicycling rules also needs to be oriented towards the student population in the city's colleges and university.

Pedestrian Safety and Access to Schools

Areas around elementary and middle schools have become increasingly congested as parents drive children to and from school. This creates a cycle of dependence on motor vehicles as parents' concern for their children's safety grows along with more traffic and congestion. Burlington has conscientiously maintained its neighborhood schools, and wisely taken advantage of the public transportation system for middle and elementary students with a long walk.

Each neighborhood school must be connected to adjacent neighborhoods by a network of sidewalks, bicycle and pedestrian paths, and foot trails to provide safe and convenient access for school children. Mid-block crossings should be created at schools such as Edmunds, Smith, and Wheeler. City departments will continue to work with individual schools and PTO's to address these issues, identify opportunities, develop and implement solutions.

Pedestrian Safety and Access at Street Crossings

The City of Burlington has one of the most extensive systems of sidewalks in the state making nearly the entire city accessible on foot. Burlington continues to make gradual improvements to its pedestrian infrastructure. A study recommended five areas for improvements to overcome deficiencies in the pedestrian network. In response, the past five years have seen the addition of new sidewalks, pedestrian signals, ADA-compliant ramps, a reduction of excessive pavement widths by reducing curb radii and an aggressive crosswalk-striping program. As with bicycles, in order to measure the sufficiency of our existing and future transportation system to accommodate all modes, the City must develop Level of Service (LOS) standards for pedestrians.

The city has an ambitious traffic calming program whose goal is to return neighborhood streets to residents, offer more balanced use of public streets and reduce the dominating influence of the motor vehicle, with the effect of improving the pedestrian experience. One manifestation of this effort can be seen in the raised and textured crosswalks that have recently been installed throughout the central portion of the city. Residents have been vocal in their call for pedestrian education and, where necessary, enforcement programs.

2. Inventory and Analysis

Overview of the analysis process

What is the bike and pedestrian friendliness of Burlington's streets? The inventory and analysis phase of this project includes documentation of current conditions for bicycles and pedestrians for on-road bike access as well as the suitability of sidewalks and street crossings along major city streets.

Basis for bicycle analysis

This analysis of the bicycle compatibility for the city uses two unique data sets that loosely follow the same evaluation criteria. Both of the evaluations are useful planning tools that provide an overview of bicycle compatibility along Burlington's streets, thereby defining a starting point in developing a comprehensive bicycle network. The use of both systems marks the first occasion that a city-wide analysis of bike compatibility has been done in a Vermont community and one of a few examples of a broad assessment of a bikeable street network nationwide.

1. The first data set and evaluation is based on a system of "Bike Cards," where volunteers from the Burlington Bike Council (BBC) and Vermont Commons School scored street segments in Burlington. It is the first time the BBC "bike card" inventory of city streets has been used.

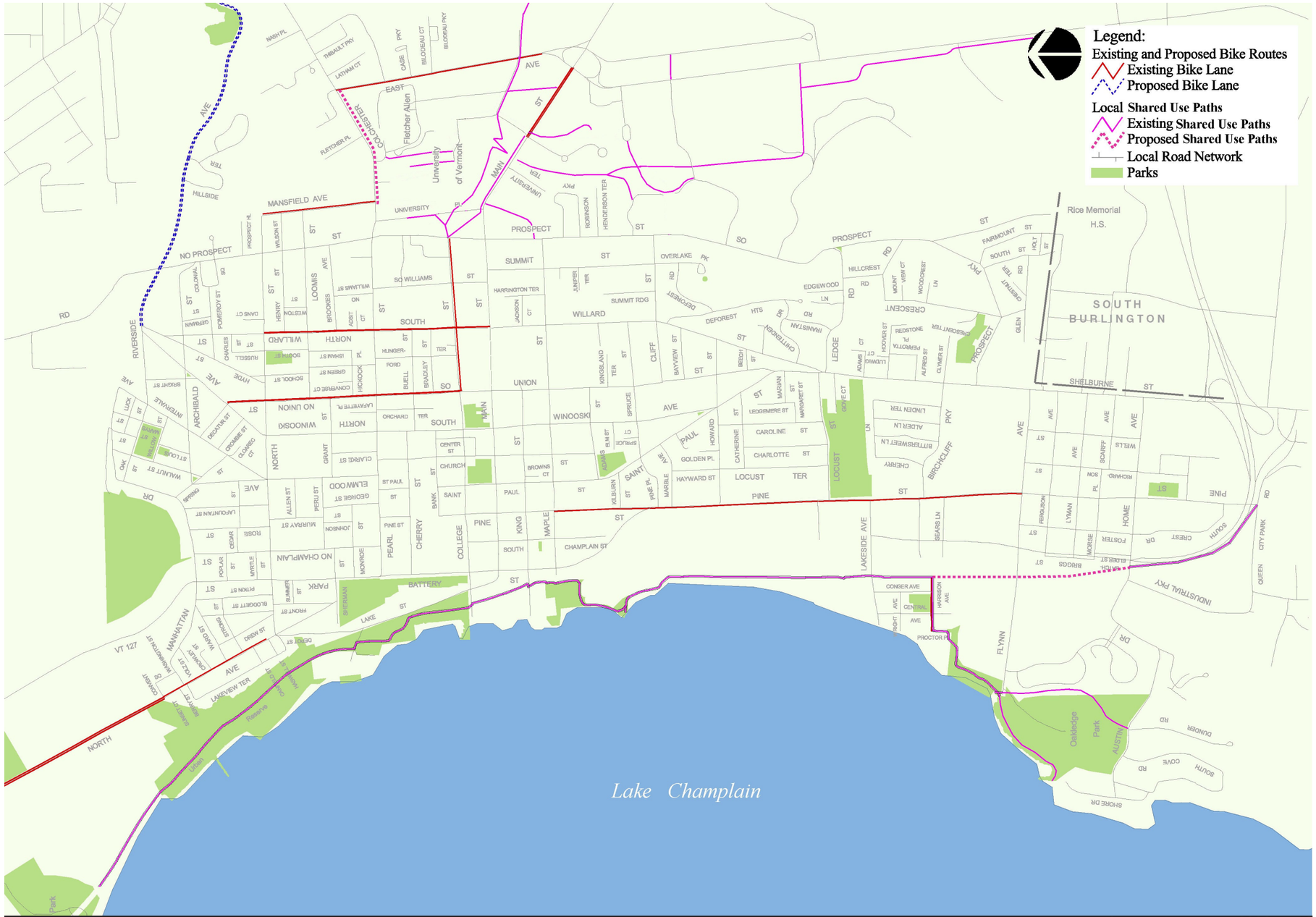
2. The second evaluation was based on a city-wide sample of major arterial streets from the Federal Highway Administration (FHWA) Bicycle Compatibility Index (BCI) or Level of Service (LoS). This planning tool is based on a review of cyclist responses to a variety of geometric and operational conditions along urban roadways.

The results of this analysis point to both the need for, and the potential benefits of, a north/south bike/pedestrian route as well as longer term city-wide improvements.

Existing bike facilities

- Route 127 Shared Use Path from the Ethan Allen Homestead to Ethan Allen Park
- Burlington Shared Use Path
- Bike lanes northbound on Willard Street and North Union Street
- Bike lane on Mansfield Avenue
- UVM Shared Use Path system
- Bike lanes on North Avenue from North Street to Burlington High School
- Wide shoulders on Pine Street, bike lanes on west side
- Bike lanes on East Avenue (west side)
- Bike lane on College Street (Union to Prospect-south side)
- Bike lanes on Main Street (East Ave. to University Terrace)

Existing bike facilities map



Regional Connections

As part of a regional system of alternative transportation, the north/south route provides a clear opportunity to link downtown Burlington to surrounding communities for both transportation and recreation bike mobility. Connections to regional bike/ped. corridors offer enhanced commuting options for getting to work, as well as vastly improving recreational opportunities.

Concurrent with the city study was a regional bike/ped. plan update commissioned by the Chittenden County Metropolitan Planning Organization(CCMPO)(see map at right). This map defines a wide range of regional bike connections along both roadways and shared use paths throughout the county.

The north/south route study coordinates with the CCMPO plan as much as possible, but because the CCMPO plan was directed at a much larger area in more general detail, the north/south study focused greater attention to the specific details of accomplishing the city's on-street routes as well as connections to the regional system.

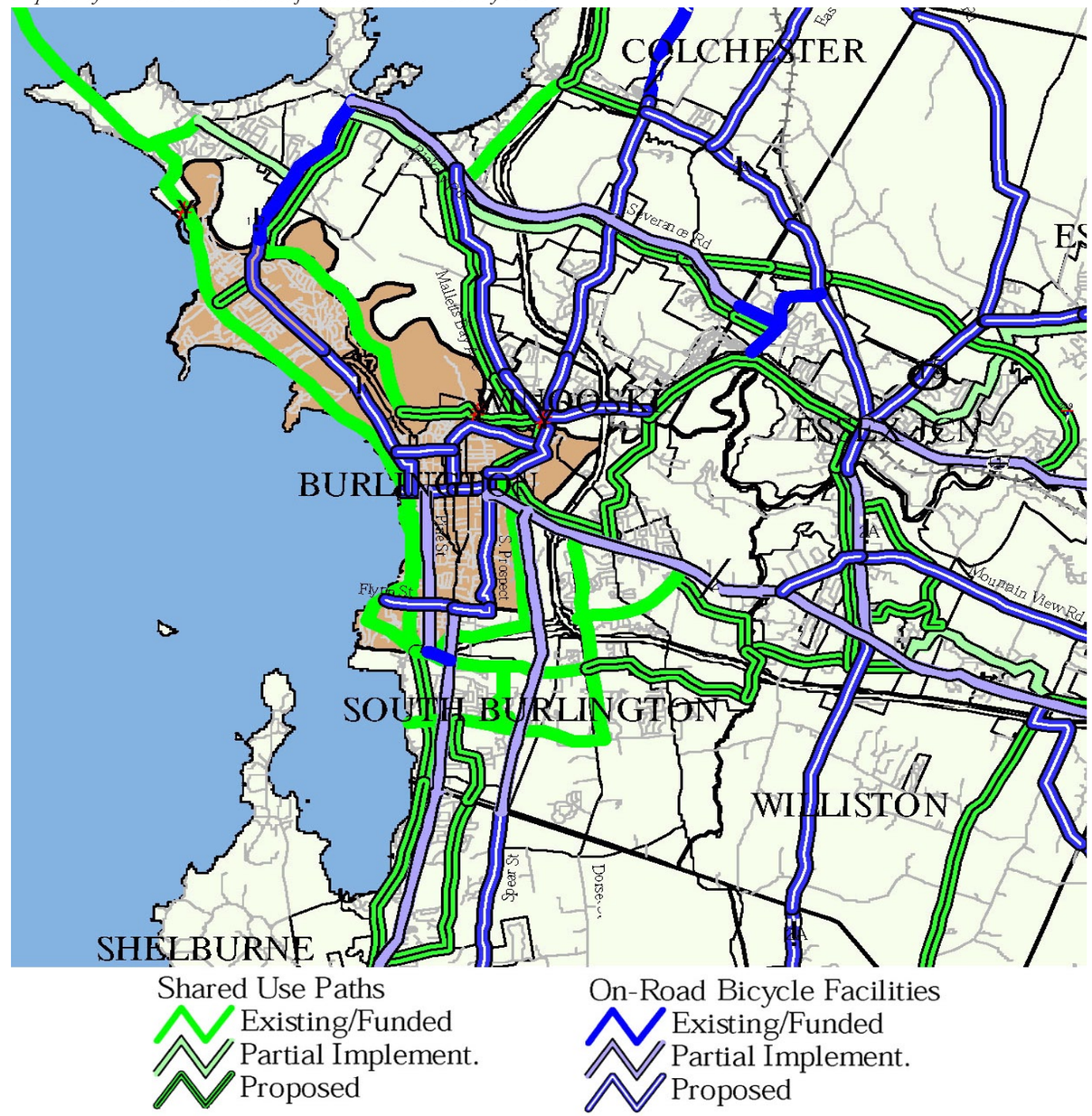
The following are the proposed relevant segments of the Regional Bike-Pedestrian Plan

Street name	From	To
Riverside Ave.	Winooski River/ Colchester Ave.	North St. Winooski Ave. No. Union Street
No./So. Union Street	North St.	College St.
Plattsburg Ave.	Winooski River	North Ave.
North Ave. Sherman St. Battery St.	Plattsburgh Ave.	College St.
Colchester Ave.	Winooski River	Prospect St.
North St.	North Union St.	North Ave.
So. Prospect St. Fairmont St.	Colchester Ave.	Proctor Ave./ So. Burlington
College St.	Prospect St.	Lake St./ Burlington Sh. Use Path
Pine St.	College St.	Queen City Park/ So. Burlington
Flynn Ave.	Burlington Bikepath	Route 7
Queen City Park Rd.	Pine St.	Route 7
Route 2	Prospect St.	So. Burling-ton Line

Where possible these proposed routes have been coordinated with the North South Bike - Pedestrian Route Plan.

Regional bike route map for Chittenden County (Detail)

Prepared by Wilbur Smith Associates for the Chittenden County MPO



Where do bicyclists and pedestrians come from and where are they going?

Origins & destinations

In order to determine the best location for the North/South Bike/ped. Route, fundamental questions must be asked:

- Where do bicyclists and pedestrians originate?
- Where are they going?
- What is the best route to take them on their way safely, comfortably, and conveniently?

The map on this page defines some of the information that is helpful to answer these questions. It was developed in response to the advice of the BBC, DPW staff and others, to define discernible neighborhood clusters so that the connecting streets where bicyclists/pedestrians might travel could be better understood.

Neighborhoods are the source of most bike and pedestrian travelers

Dispersed throughout the study area is a series of discernible neighborhood clusters (many of which are shown on the "bubble diagram" on the map). These include:

- Riverside, North Union, North Prospect, Mansfield Avenue.
- Old North End between North Winooski, North Union, Manhattan, North Avenue and Pearl Streets.
- Downtown "proper" including Church Street and the waterfront.
- Hillside neighborhoods between Pearl and Main Streets.
- Hillside neighborhoods at Prospect, Willard, North Union Streets, and between Main and Cliff Streets
- Neighborhoods between St. Paul, Shelburne Road and Pine Street

The selection of a location for the north-south route should unify these neighborhoods, serving as a spine of bike/pedestrian accessibility.

Access to key destinations

Scattered within these neighborhoods are also a series of specific destinations shown with the numbered circles: schools, public services, parks, and strategic business focal points, all of which should be easily accessible, directly or in close proximity, to the north/south route.

Major and minor streets

As a general rule, input from the Project Advisory Committee and the public identified the desire to promote major through-streets as the more likely route candidates. There are several reasons for this:

- The grid of neighborhood streets in their current condition and travel patterns seem to function well as a "share the road" system. Marked bike lanes on neighborhood streets do not offer a significantly enhanced bike compatibility.
- Major through-roads offer the most efficient cross-city route with minimal time lost to circulation as on a "woven route."
- Several through streets traverse the hillside topography instead of climbing steep sustained grades. As a general rule, the north-south route should follow this pattern and avoid major climbs and descents.
- Several major city through-roads are currently unsafe for bikes, per the Bike Card/BCI Analysis, and the expenditure of city funds on a bike route is an opportunity to solve these problems and improve bike safety.

Possible streets for the North/South Route

The results of this process of assembly and elimination identifies several streets that could be used for the north/south route. These are:

- Pine Street to Battery Street to North Avenue, connecting the south end, the Old North End and the New North End beyond with the waterfront and the lower edge of downtown.
- Shelburne Road to Union Street and Winooski Avenue, serving the upper end of downtown from the south end and the Old North End, with connections to the City of Winooski and the Intervale Bikepath.
- Strategic extensions into the heart of downtown.
- Locust Street as a key cross connection.

Analysis of Pedestrian Facilities

Currently, the City of Burlington maintains sidewalks and crosswalks along almost all city streets. In fact, there are very few places where adequate sidewalks or crosswalks don't exist. In light of that reality, the accommodation of pedestrians on the North/South Route is largely accomplished; the linear connections form neighborhoods to the downtown already exist. There is also a capital improvement plan for the upgrading of sidewalks so that the condition of pavement, provision of ADA access, and adequate crosswalks are maintained.

Since a nearly fully developed pedestrian system already exists, the location of where to put the north/south bike route will also dictate what corridor will be enhanced for pedestrians.

The map on this page shows locations where pedestrian accessibility is compromised. Using the same major street routes as the BCI Analysis for bicycle access, the same streets have been evaluated to identify the lack of sidewalks, and dangerous street corridors where walking alongside or attempted crossings are an issue.

Existing sidewalk deficiencies

This refers to missing segments of sidewalk or areas of long, open curb cuts.

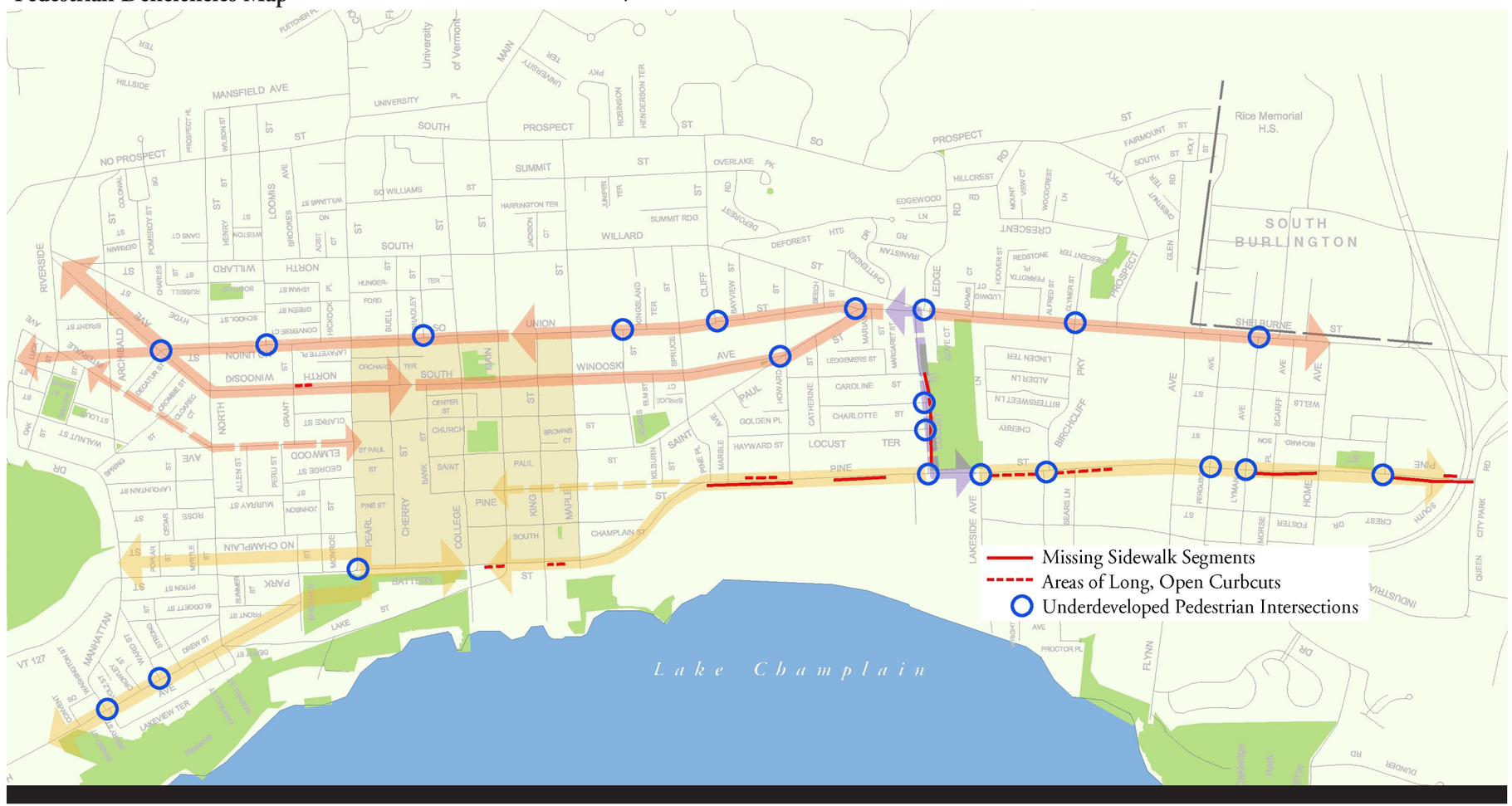
- Pine Street
- Battery Street
- Locust Street
- North Winooski Avenue

Underdeveloped pedestrian intersections

This refers to particular intersections where there is a need for more extensive pedestrian crossing facilities or where none exist and should.

- North Winooski Ave. and Decatur Street
- South Winooski Ave. and St. Paul Street
- North Union Street and Loomis Street
- South Union Street and Bradley Street
- South Union Street and Adams Street
- South Union Street and Cliff Street
- South Union Street and St. Paul Street
- The Rotary
- Shelburne Street and Birchcliff Parkway
- Shelburne Street and Lyman Ave.
- North Ave. and Washington Street
- North Ave. and Ward Street
- Battery Street and Pearl Street
- Pine Street and Locust Street
- Pine Street and Lakeside Ave.
- Pine Street and Birchcliff Parkway
- Pine Street and Ferguson Ave.
- Pine Street and Lyman Ave.
- Pine Street and Baird Street
- Locust Street and Locust Terrace
- Locust Street and Charlotte Street

Pedestrian Deficiencies Map



Analysis of Street Corridors for Bicycle Use

Part 1: Burlington Bike Card Analysis

The Burlington Bike Council (BBC) created a simple evaluation card for volunteers to complete for neighborhood streets in the city. In the first attempt at using the data, a database was developed using 142 street segment evaluations based on the bike cards supplied by the Department of Public Works (DPW). This database represents a broad but random sampling of streets in the entire city.

The Burlington Bike Compatibility evaluation cards appear to be based on criteria that are similar to the FHWA BCI analysis. However, there are fundamental differences between the systems that posed some challenges to making a uniform evaluation. The bike cards included five values that relate to the BCI:

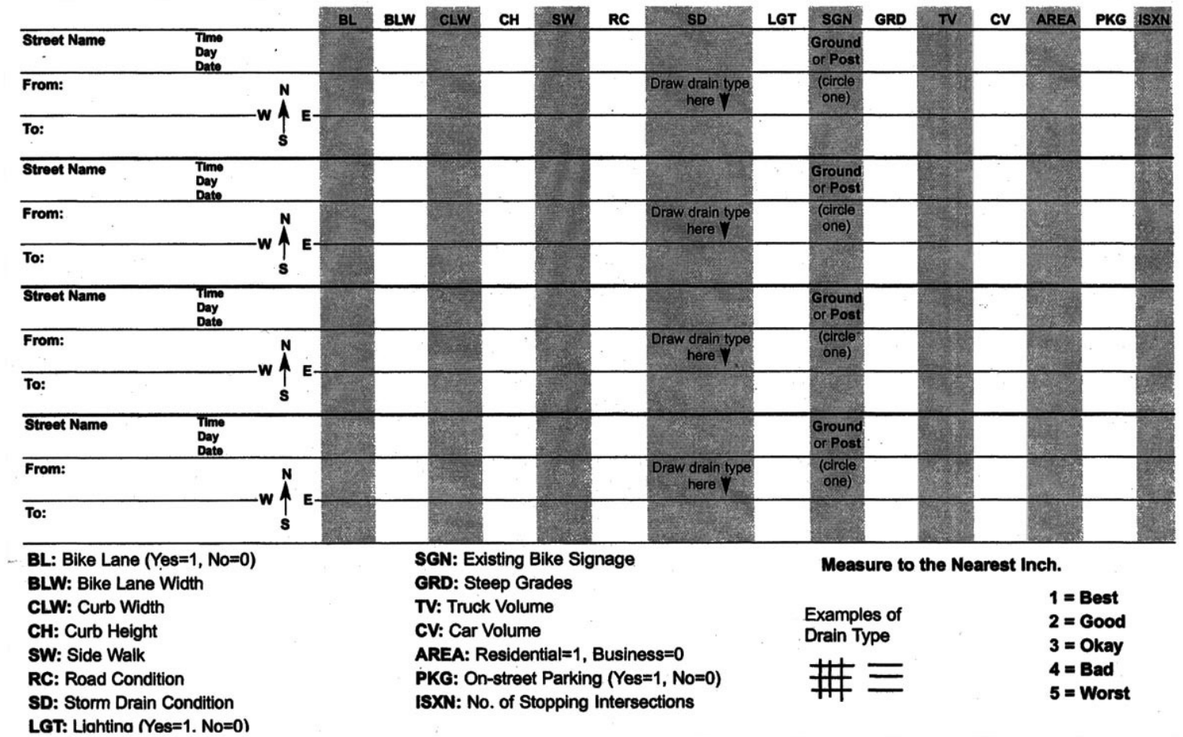
- the presence and width of a bike lane;
- truck volume (a range of 1 to 5, or best to worst);
- car volume (a range of 1 to 5, or best to worst);
- whether the area is residential or non-residential
- presence of parking along the street.

The rest of the information is not consistent with the BCI criteria.

For a comprehensive BCI analysis, approximately 12 values need to be reported. The remaining information listed on the bike cards can be useful in a review by Burlington staff or volunteers as a qualitative assessment or inventory.

Using the five BCI-related values, ORW developed a summary numerical analysis. From this evaluation, a compatibility index similar to the BCI that ranges from "Excellent" to "Very Poor" was developed (See separate Appendix for the tables used for this analysis). Parties interested in the complete data analysis process can request the complete spreadsheet files from the DPW.

Burlington Bike Compatibility Evaluation Card



For future reference, we believe that there were two bike card values that may have been misunderstood and should be reviewed:

- *CLW is identified as Curb Width. The nomenclature is consistent with the BCI value for Curb Lane Width (CLW) and we feel this information would be much more useful for street-bike compatibility.*
- *SW is identified as Side Walk (the presence of a sidewalk). There is a BCI value for the paved shoulder width that seems consistent with this acronym. Shoulder width along a road is more valuable to a cyclist's comfort than the presence of a sidewalk.*

Burlington Bike Card Data Entry and Analysis

Data entry and analysis spreadsheet (sample)

Burlington Bike Study - Field Data Analysis

Data Summary

Key: Data/Results Used in GIS Analysis Data Not Used

Location					BCI Model Variables											
Card No.		Midblock Identifier (Route/Intersecting Sts, Segment Number, Link Number, Etc.)	From	To	DIR - Direction	BL - Bike Lane (1/0)	BLW - Bike Lane Width (ft-in)	CLW - Curb Lane Width (ft-in)	CH - Curb Height	SW - Side Walk	TV - Truck Volume	CV - Car Volume	AREA - Res/Non-Res	PKG - Parking	ISXN - no. of stopping intersections	EVALUATION
25	251	Alder Lane	Birchberry Pkwy	Cherry Lane	N	0	0	4	7	5	1	1	1	1	0	2.46
21	211	Alexis Dr	Appletree Pt Rd	Stanburg Rd	E	0	0	4	8	-	1	1	1	1	0	2.46
21	212	Alexis Dr	Stanburg Rd	Appletree Pt Rd	W	0	0	4	8	-	1	2	1	1	0	3.46
24	241	Alfred St	Perrota	Shelburne	W	0	0	6	6	2	1	1	1	1	1	2.46
24	242	Alfred St	Shelburne St	Perrota	E	0	0	6	8	2	1	1	1	1	1	2.46
31	311	Allen St	Elmwood Av	Murray	W	0	0	6	8	2	1	2	1	1	1	3.46
36	361	Archibald	Intervale	Spring	W	0	0	6	5	Y?	3	4	1	0	0	5.16
36	362	Archibald	Intervale	Winooski	E	0	0	6	5	Y?	3	4	1	1	1	5.66
36	363	Archibald	Winooski	Intervale Av	W	0	0	5	3	Y?	3	4	1	0	0	5.16
6	61	Archibald St	Willard	Prospect	E	0	0	-	-	N?	2	4	1	1	0	5.56
6	62	Archibald St	Winooski	Willard	E	0	0	5	5	4	2	3	1	0	0	4.06
24	243	Austin Dr	Home Av	S Cove Rd	W	0	0	4	6	-	2	3	1	0	0	4.06
24	244	Austin Dr	S Cove Rd	Home Av	E	0	0	5	7	2	2	3	1	0	0	4.06
6	63	Bank St	Pine St	Winooski St	E	0	0	6	4	Y?	2	2	0	1	2	3.83
6	64	Bank St	Winooski	Pine St	W	0	0	6	5	Y?	2	2	0	1	2	3.83
21	213	Batchelder	Home Av	Morse Pl	N	0	0	-	-	-	1	2	1	1	0	3.46
21	214	Batchelder	Morse Pl	Home Av	S	0	0	-	-	-	1	2	1	1	0	3.46
17	171	Battery St	Main St	Pearl St	N	0	0	7	7	1	5	5	0	0	2	6.62
17	172	Battery St	Pearl St	Main St	S	0	0	7	7	1	5	5	0	0	2	6.62
35	3530	Battery St	North Av	Pearl St	S	0	0				4	4	0	0	3	5.52
35	3531	Battery St	Pearl St	North Av	N	0	0				4	4	0	0	3	5.52
26	261	Bayview St	S Union	Willard	E	0	0	4	5	2	1	1	1	1	0	2.46
26	262	Bayview St	Willard St	S Union	W	0	0	4	5	2	1	1	1	1	0	2.46
26	263	Bilodeau Court	East Av	End	E	0	0	5	3	-	1	1	1	1	0	2.46
26	264	Bilodeau Court	Ebd	East Av	W	0	0	5	3	-	1	1	1	1	1	2.46
46	461	Birchcliff Pkwy	Pine St	Cherry Lane	E	0	0	6	6	2	0	2	0	0	1	3.22
30	301	Blodgett St	North St	Manhattan Dr	N	0	0	5	6	2	1	2	1	1	1	3.46
14	141	Buell St	S Winooski	S Union	N	0	0	5	6	Y?	2	1	1	1	1	2.56
20	201	Caroline St	Howard St	Locust St	S	0	0	4	4	3	1	2	1	1		3.46
33	3310	Cedar St	Elmwood Av	Rose St	W	0	0	5	7	2	1	2	1	0	2	2.96
33	3311	Cedar St	Rose St	Elmwood Av	E	0	0	5	7	2	1	2	1	1	2	3.46
47	471	Cherry	Lynden St	Birchcliff Pkwy	S	0	0	6	10	1	1	3	1	1	2	4.46
14	142	Church St	Maple St	Main St	N	0	0	5	8	Y?	2	3	0	1	2	4.83
20	202	Cliff St	S Prospect	S Willard	W	0	0	4	5	3	1	3	1	1	2	4.46
6	65	College St	Pine St	Winooski	E	0	0	6	9	Y?	2	3	0	1	2	4.83
6	66	College St	Winsooki	Pine	W	0	0	6	5	Y?	2	4	0	1	2	5.83
10	101	College St	S Prospect	S Union	S	0	0	6	4	1	3	4	1	1	3	5.66

Burlington Bike Card Analysis Map

The map to the right illustrates the results of the Bike Card analysis. As a general trend, it should be noted that most of the heavily travelled arterial streets in the city ranked quite poorly, the result of heavy traffic and truck volumes and the lack of defined bike lanes. Most of the low volume/low truck side streets ranked neutral (fair) or relatively bike-friendly by their apparent lack of conflicts. Their degree of bike friendliness is not by intention but inherent in their location and use. These contrast streets with designated bike lanes that, by city initiative, create a safe bikeable environment.

What does this map mean?

There is a network of neighborhood streets that offer safe and comfortable bike access because they have low traffic volumes, adequate width, minimal conflicts with on-street parking or commercial strip driveway development.

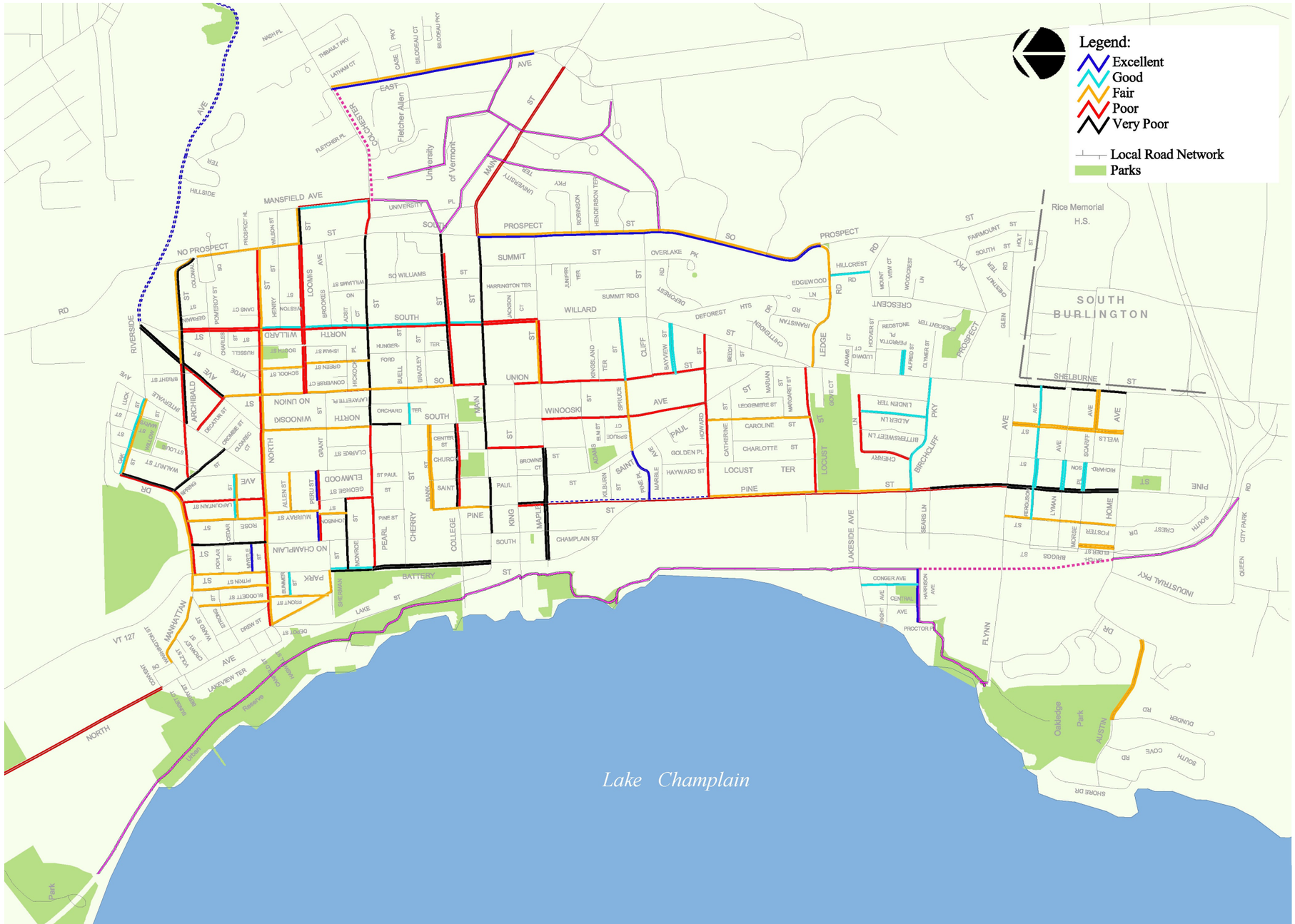
The following roads are poor-very poor for bike use and represent streets where bike safety is most at-risk and where bike mobility in the city is impeded.

- Shelburne Road and the Route 7 Rotary
- Pine Street
- Locust Street
- Howard Street
- Lower South Union Street and South Winooski Ave.
- Lower Main Street
- College Street
- Pearl Street
- Manhattan Drive and Intervale Ave.

The following roads with designated bike lanes appear to function well and could be considered as initial links in a north-south bike-pedestrian route to be developed by this study.

- South and North Union Street above Main Street
- South and North Willard Street above Main Street

Other examples of low volume streets that are bike safe:
- Spruce Street
- Pine Place
- Birchcliff Parkway
- Furguson Ave.
- Lyman Ave.
- Conger Ave.



Analysis of Street Corridors for Bicycle Use

Part 2: BCI - Bicycle Level of Service Analysis Process

BCI analysis

The Bicycle Compatibility Index (BCI) has been developed by the Federal Highway Administration as the first broadly accepted tool to assess the suitability of urban streets for bicyclists. The evaluation in this study targeted desire lines along arterials, collectors, and significant residential streets for north-south and east-west travel. As part of this process, roadway segments of traffic/truck percentage volumes were extracted from the CCMPO traffic model of Burlington. The different segments were entered into the BCI analysis spreadsheet and run through the BCI model. The model results were plotted back onto the GIS base and are reflected on the map on this page.

The streets analyzed included:

- Pine Street
- Flynn Avenue
- Battery Street
- North Avenue
- Shelburne Road
- North Street
- North Winooski Avenue
- South Winooski Avenue
- North Union Street
- South Union Street

What does this analysis mean?

The following streets with bike lanes, adequate width, lower truck/vehicular traffic volumes, are the best north/south streets for bike use:

- North Willard (between Pearl and North Streets)
- South Union (between Pearl and Buell Streets)
- North Avenue above Convent Square

The following streets are considered the worst for bike use:

- Main Street (South Union St. to South Winooski Ave. & beyond Prospect St.)
- Pearl Street (between Elmwood Ave. and Green Street)
- St. Paul Street (Shelburne Road to South Union Street)

Data Entry Spreadsheet

BCI Data Analysis		Add bike lanes to major routes (y/n):			**n**										
Adjustments according to analysis requirements:		Remove parking from major routes(y/n):			**n**										
A. Add/Remove Bike Lanes, B. Add/Remove Parking															
Data Entry															
Location			**Geometric & Roadside Data**					**Traffic Operations Data**					**Parking Data**		
Midblock Identifier (Route/Intersecting Streets, Segment Number, Link Number, Etc.)	**From**	**To**	**No. of Lanes (one direction)**	**Curb Lane Width (ft)**	**Bicycle Lane Width (ft)**	**Paved Shoulder Width (ft)**	**Residential Development (1=y/0=n)**	**Speed Limit (mi/h)**	**85th %tile Speed (mi/h)**	**Peak Hr Vol**	**Large Truck % (HV)**	**Right Turn % (R)**	**Parking Lane (1/0)**	**Occupancy (%)**	**Time Limit (minutes)**
Riverside Av	Colchester Av	Winooski Av	1	11	0		0	30	40	712	7%	15%	0	0%	0
Riverside Av	Colchester Av	Winooski Av	1	11	0		0	30	40	712	7%	15%	0	0%	0
N Willard St	Hyde St	Riverside Av	1	11	0		0	30	40	115	7%	15%	1	50%	400
N Willard St	Hyde St	North St	1	11	0		0	30	40	115	7%	15%	0	0%	0
N Winooski Av	Riverside	Archibald	1	11	0		0	30	40	229	7%	15%	1	50%	400
N Winooski Av	Archibald	North	1	11	0		1	30	40	229	7%	15%	1	50%	400
N Willard St	Archibald St	North St	1	11	0		1	30	40	115	7%	15%	1	50%	400
N Willard St	Archibald St	North St	1	11	0		1	30	40	115	7%	15%	1	50%	400
N Winooski Av	Decatur St	North St	2	11	0		0	30	40	229	7%	15%	1	50%	400
N Willard St	North St	College St	1	11	0		1	30	40	115	7%	15%	1	50%	400
N Willard St	North St	College St	1	11	0		1	30	40	115	7%	15%	1	50%	400
N Winooski Av	North	Pear	1	11	0		1	30	40	528	7%	15%	1	50%	400
N Willard St	North St	College St	1	11	0		1	30	40	115	7%	15%	1	50%	400
N Willard St	North St	College St	1	11	0		1	30	40	115	7%	15%	1	50%	400
N Willard St	North St	College St	1	11	0		1	30	40	115	7%	15%	1	50%	400
N Winooski Av	North	Pear	1	11	0		1	30	40	528	7%	15%	1	60%	120
S Winooski Av	Pearl	Main St	2	11	0		0	30	40	712	7%	15%	0	0%	0
S Willard St	North St	College St	1	11	0		1	30	40	291	7%	15%	1	50%	400
S Winooski Av	Pearl	Main St	2	11	0		0	25	40	712	7%	15%	0	0%	0
S Willard St	North St	College St	1	11	0		1	25	40	291	7%	15%	1	50%	400
S Winooski Av	Pearl	Main St	2	11	0		0	30	40	712	7%	15%	0	0%	0
S Willard St	North St	College St	1	11	0		1	30	40	291	7%	15%	1	50%	400
Main St	University Pl	S Prospect	2	11	3		0	30	40	1788	7%	15%	0	0%	0
Main St	S Prospect	S Union	1	11	0		1	30	40	850	7%	15%	1	50%	400
Main St	S Prospect	S Union	1	11	0		1	30	40	850	7%	15%	1	50%	400
Main St	S Prospect	S Union	1	11	0		1	30	40	850	7%	15%	1	50%	400
S Willard St	College St	Main St	1	11	0		1	30	40	291	7%	15%	1	50%	400
S Winooski Av	Pearl	Main St	2	11	0		0	30	40	712	7%	15%	0	0%	0
Main St	0	0	2	11	3		0	30	40	1788	7%	15%	0	0%	0
S Willard St	Main St	Maple St	1	11	0		1	30	40	291	7%	15%	1	50%	400
S Winooski Av	Main St	King St	1	11	0		0	30	40	712	7%	15%	0	0%	0
Main St	0	0	2	11	3		0	30	40	1788	7%	15%	0	0%	0
S Willard St	Main St	Maple St	1	11	0		1	30	40	291	7%	15%	1	50%	400
S Winooski Av	King St	Maple	1	11	0		0	30	40	712	7%	15%	0	0%	0
S Winooski Av	Maple St	Howard St	2	11	0		1	30	40	138	7%	15%	1	60%	120
S Willard St	Maple St	Shelburne St	1	11	0		1	30	40	275	7%	15%	1	50%	400
S Winooski Av	Maple St	Howard St	2	11	0		1	30	40	138	7%	15%	1	50%	400
S Willard St	Maple St	Shelburne St	1	11	0		1	30	40	275	7%	15%	1	50%	400
S Winooski Av	Maple St	Howard St	2	11	0		1	30	40	138	7%	15%	1	50%	400
S Willard St	Maple St	Shelburne St	1	11	0		1	30	40	275	7%	15%	1	50%	400
S Willard St	Maple St	Shelburne St	1	11	0		1	30	40	275	7%	15%	1	50%	400
S Willard St	Maple St	Shelburne St	1	11	0		1	30	40	275	7%	15%	1	50%	400
S Willard St	Maple St	Shelburne St	1	11	0		1	30	40	275	7%	15%	1	50%	400
S Winooski Av	Maple St	Howard St	2	11	0		1	30	40	138	7%	15%	1	50%	400
St Paul St	Maple St	S Union St	1	11	0		0	30	40	245	7%	15%	0	0%	0
S Willard St	Maple St	Shelburne St	1	11	0		1	30	40	275	7%	15%	1	50%	400
S Willard St	Maple St	Shelburne St	1	11	0		1	30	40	275	7%	15%	1	50%	400
St Paul St	Maple St	S Union St	1	11	0		0	30	40	245	7%	15%	0	0%	0
St Paul St	0	0	1	11	0		0	30	40	550	7%	15%	0	0%	0
S Willard St	Maple St	Shelburne St	1	11	0		1	30	40	275	7%	15%	1	50%	400

An Excerpt from the BCI - Bicycle Level of Service (LOS) Analysis Process

Data entry and analysis spreadsheet

The BCI uses approximately 12 geometric and traffic conditions for one travel direction of a street segment and calculates the compatibility for bicycle use on a scale from "Extremely High" to "Extremely Low" (along an alphabetical range of "A" to "F", similar to academic grades).

The data for this analysis includes:
- presence and width of a bike lane;
- number of travel lanes and curb lane width;
- traffic volume and proportion of right-turning traffic;
- truck volume, or proportion of overall traffic volume;
- presence of parking, occupancy, and parking residence time;
- residential or non-residential land use adjacent to the street,
- prevailing traffic speed along the street.

Geometric conditions, traffic volumes, the presence of parking, and prevailing speeds were based on site visits, data from City Staff, and traffic planning software from Burlington. The remaining data are assumptions based on knowledge and understanding of the Burlington street network. ORW has developed computer files that can be easily enhanced by City Staff and volunteers with some GIS and spreadsheet knowledge.

BCI & LOS Computations Spreadsheet

Bicycle Compatibility Index and Level of Service Computations

Location	BCI Model Variables									Results		
Midblock Identifier (Route/Intersecting Streets, Segment Number, Link Number, Etc.)	BL	BLW	CLW	CLV	OLV	SPD	PKG	AREA	AF	BCI	Level of Service	Bicycle Compatibility Level
Riverside Av	0	0.0	11.0	712	0	40	0	0	0.3	5.12	E	Very Low
Riverside Av	0	0.0	11.0	712	0	40	0	0	0.3	5.12	E	Very Low
N Willard St	0	0.0	11.0	115	0	40	0	0	0.1	3.73	D	Moderately Low
N Willard St	0	0.0	11.0	115	0	40	0	0	0	3.63	D	Moderately Low
N Winooski Av	0	0.0	11.0	229	0	40	0	0	0.2	4.06	D	Moderately Low
N Winooski Av	0	0.0	11.0	229	0	40	0	1	0.2	3.79	D	Moderately Low
N Willard St	0	0.0	11.0	115	0	40	0	1	0.1	3.46	D	Moderately Low
N Willard St	0	0.0	11.0	115	0	40	0	1	0.1	3.46	D	Moderately Low
N Winooski Av	0	0.0	11.0	115	115	40	0	0	0.2	3.87	D	Moderately Low
N Willard St	0	0.0	11.0	115	0	40	0	1	0.1	3.46	D	Moderately Low
N Willard St	0	0.0	11.0	115	0	40	0	1	0.1	3.46	D	Moderately Low
N Winooski Av	0	0.0	11.0	528	0	40	0	1	0.3	4.49	E	Very Low
N Willard St	0	0.0	11.0	115	0	40	0	1	0.1	3.46	D	Moderately Low
N Willard St	0	0.0	11.0	115	0	40	0	1	0.1	3.46	D	Moderately Low
N Willard St	0	0.0	11.0	115	0	40	0	1	0.1	3.46	D	Moderately Low
N Winooski Av	0	0.0	11.0	528	0	40	0	1	0.5	4.69	E	Very Low
S Winooski Av	0	0.0	11.0	356	356	40	0	0	0.3	4.55	E	Very Low
S Willard St	0	0.0	11.0	291	0	40	0	1	0.2	3.92	D	Moderately Low
S Winooski Av	0	0.0	11.0	356	356	40	0	0	0.3	4.55	E	Very Low
S Willard St	0	0.0	11.0	291	0	40	0	1	0.2	3.92	D	Moderately Low
S Winooski Av	0	0.0	11.0	356	356	40	0	0	0.3	4.55	E	Very Low
S Willard St	0	0.0	11.0	291	0	40	0	1	0.2	3.92	D	Moderately Low
Main St	1	3.0	11.0	894	894	40	0	0	0.4	4.60	E	Very Low
Main St	0	0.0	11.0	850	0	40	0	1	0.4	5.23	E	Very Low
Main St	0	0.0	11.0	850	0	40	0	1	0.4	5.23	E	Very Low
Main St	0	0.0	11.0	850	0	40	0	1	0.4	5.23	E	Very Low
S Willard St	0	0.0	11.0	291	0	40	0	1	0.2	3.92	D	Moderately Low
S Winooski Av	0	0.0	11.0	356	356	40	0	0	0.3	4.55	E	Very Low
Main St	1	3.0	11.0	894	894	40	0	0	0.4	4.60	E	Very Low
S Willard St	0	0.0	11.0	291	0	40	0	1	0.2	3.92	D	Moderately Low
S Winooski Av	0	0.0	11.0	712	0	40	0	0	0.3	5.12	E	Very Low
Main St	1	3.0	11.0	894	894	40	0	0	0.4	4.60	E	Very Low
S Willard St	0	0.0	11.0	291	0	40	0	1	0.2	3.92	D	Moderately Low
S Winooski Av	0	0.0	11.0	712	0	40	0	0	0.3	5.12	E	Very Low
S Winooski Av	0	0.0	11.0	69	69	40	0	1	0.3	3.60	D	Moderately Low
S Willard St	0	0.0	11.0	275	0	40	0	1	0.2	3.88	D	Moderately Low
S Winooski Av	0	0.0	11.0	69	69	40	0	1	0.1	3.40	C	Moderately High
S Willard St	0	0.0	11.0	275	0	40	0	1	0.2	3.88	D	Moderately Low
S Winooski Av	0	0.0	11.0	69	69	40	0	1	0.1	3.40	C	Moderately High
S Willard St	0	0.0	11.0	275	0	40	0	1	0.2	3.88	D	Moderately Low

BCI - Bicycle Level of Service Analysis Map

The map to the right illustrates the results of the BCI analysis. Similar to the Bike Card analysis, most of the heavily travelled arterial streets in the city ranked quite poorly, the result of heavy traffic and truck volumes. The BCI is weighted to favor defined on-road bike lanes, so roads without those facilities scored poorer than roads with bike lanes. Since this analysis was designed to assess complementary streets to the Bike Card Analysis - which looked to mostly neighborhood streets, there are very few low volume roads in the analysis.

What does this map mean?

The BCI looked at the twelve criteria previously discussed and shown on the spreadsheet excerpts. The map output from the roadway segments shows the relative scoring results of the analysis.

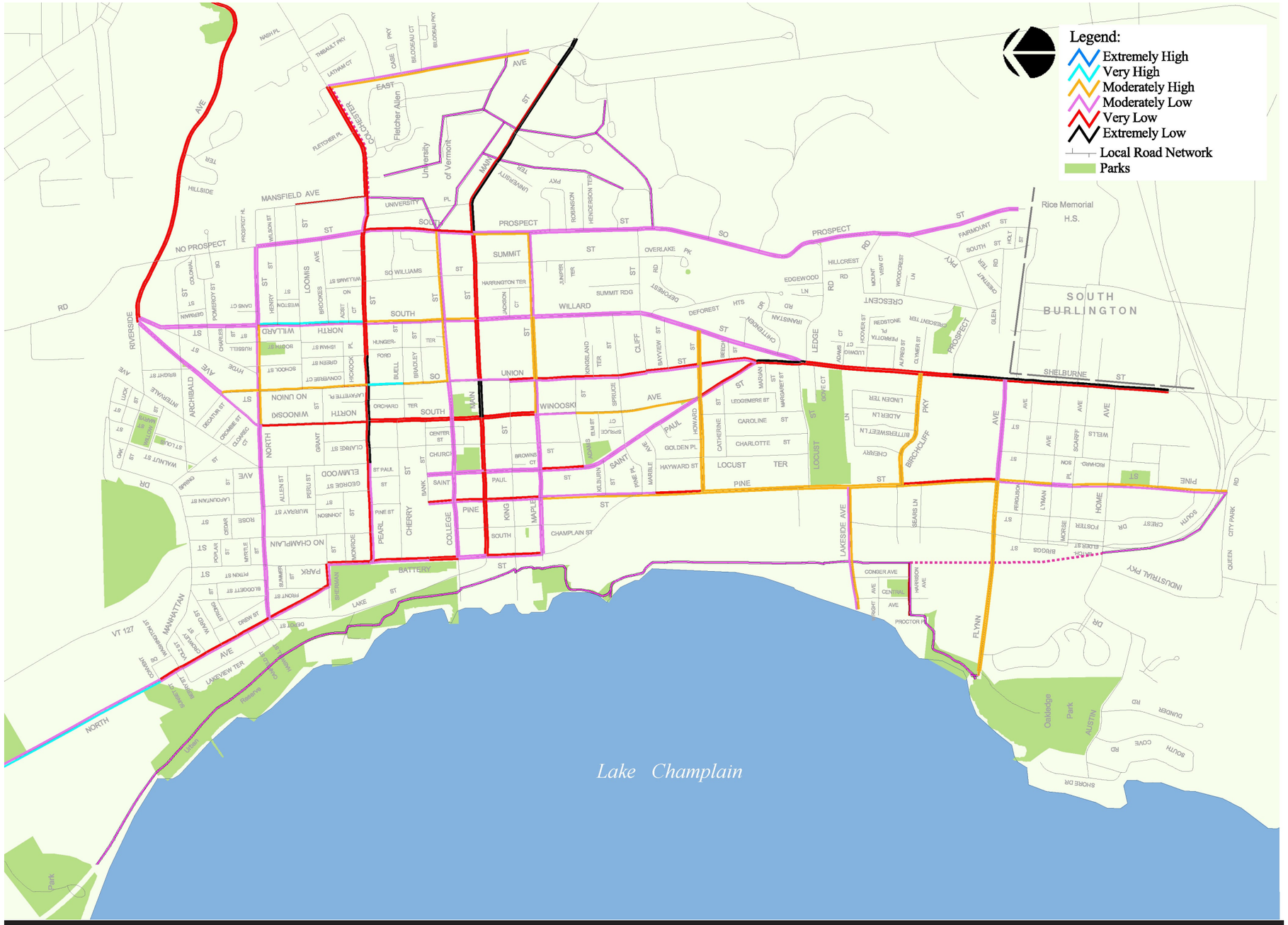
The following roads rank as poor-very poor for bike use according to the Bicycle Level of Service analysis model (BCI). These are streets where bike safety can be considered at-risk and where bike mobility in the city is impeded.

- Shelburne Road and the Route 7 Rotary
- Pine Street (Flynn to Birchcliff)
- Riverside Avenue
- Lower South Union and South Winooski
- Main Street
- Battery Street
- Pearl Street
- North Avenue (Northbound)

The following roads with wider shoulders, designated bike lanes, or roadsides without on-street parking scored well on the BCI. These routes should be considered as initial links in a north-south bike-pedestrian route.

- South and North Union Street north of Main Street
- Willard Street north of Main Street
- Pine Street between Birchcliff and Howard

It should be noted that no busy city streets without bike lanes scored above a moderately low level. This includes streets currently contemplated for designation as "Share the Road" corridors. This also strongly suggests that the designation of a North/South Bike Route for the city not include roadways where "Share the Road" is the only provision for bicycles.



How Would an Improved System of Bike Routes Perform?

Benefits of the overall system

With the two previous analyses completed (the BBC cards and BCI analysis), a number of corridors appeared to have significant challenges for bike use.

This map reflects the effects of making a basic improvement to bike compatibility: the creation of defined bike lanes. More than any other change in the parameters in the BCI analysis, this factor was the most sensitive in the analysis model - accounting for as much as a full assessment point on the scoring system.

Note: This analysis deals with this improvement only in the abstract. The actual implications of improvements such as the elimination or relocation of on-street parking, reduction in the number of travel lanes, and other physical changes that might be required to create defined bike lanes on any given street were not factored into the analysis.

What does this map mean?

The following streets that ranked in either previous analysis as poor to very poor for bike use, when basic bike improvements were added, showed significant improvements to elevate their bike rating to moderate to high included:

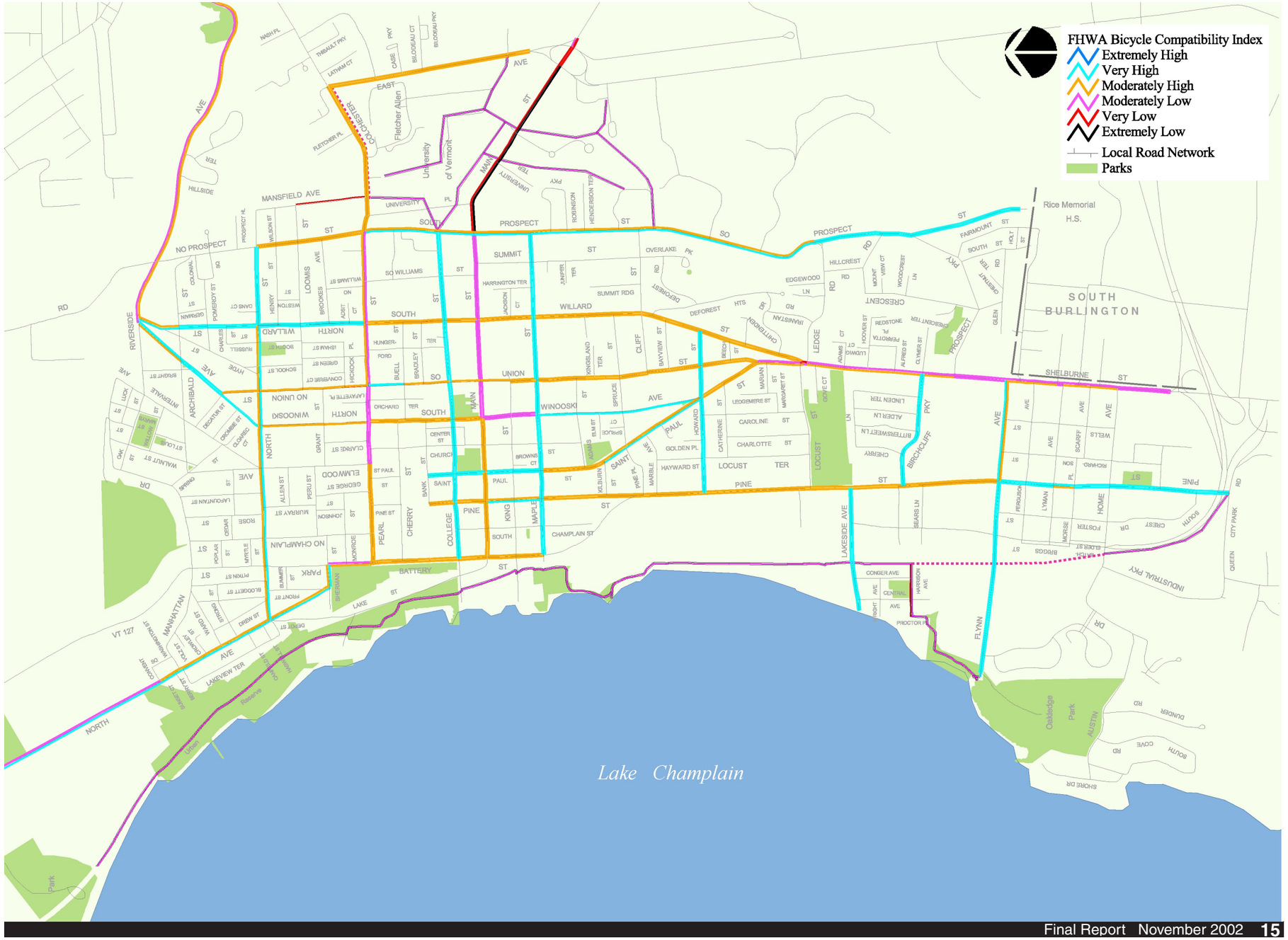
- Pine Street *(very high)*
- Lower South Union and South Winooski *(mod./very high)*
- Lower Main Street *(mod. high)*
- College Street *(very high)*
- Pearl Street *(mod. high)*

Streets that showed lesser change included:
- Shelburne Road *(mod. low)*
- Battery Street *(mod. high)*
- Upper Main Street *(mod. low)*
- South and North Union Street above Main Street*
- South and North Willard Street above Main Street*

  * = *Streets that already have designated bike lanes*

Conclusions?

The results of this investigation pointed to a significant benefit and improvement according to the bike safety scores defined by the BCI model. Streets with the most dramatic levels of improvements should be the highest candidates for North - South Route Designation.



3. Description of Route Options

Conceptual Route Diagram

Based upon the analysis of major city corridors, the study has identified three primary options for the North/South Bike Pedestrian Route.

These alternatives are portrayed in a general way on this map, with more detailed maps and descriptions on the following pages.

Option A Winooski South / Option A Union North

Complete the bike lanes on Union Street. New bike lanes on Winooski Avenue. Improve intersections for bike and pedestrian safety, and make street improvements on South Winooski between Pearl and Main Streets. Connect to the future southern segment of the Route 127 Shared Use Path. Bike lanes on Intervale Avenue and Elmwood Avenue are also an option. In a future phase, major work on Shelburne Road would install bike lanes. This route accesses the eastern/uphill edge of downtown.

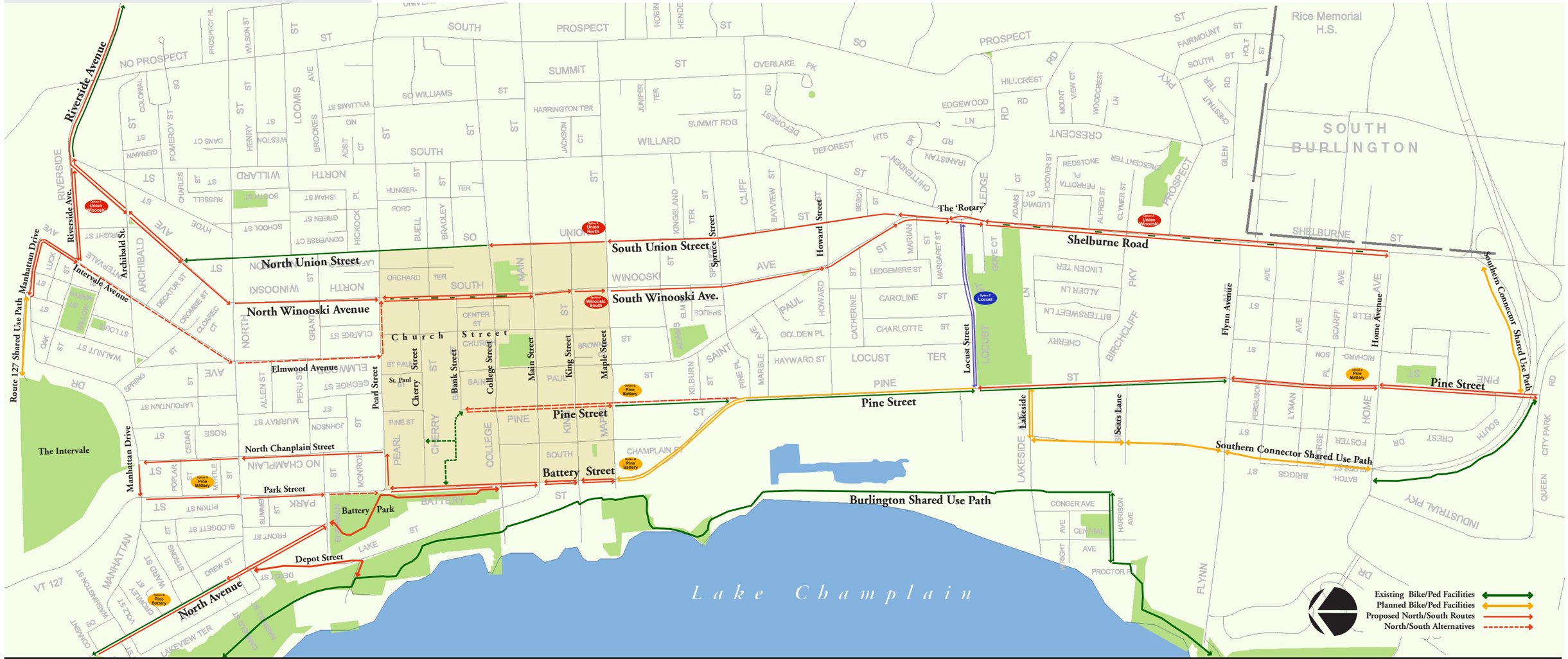
Option B Pine Battery

Defines bike lanes on Pine Street and connects to bike lanes and other improvements planned for the Southern Connector. It also installs bike lanes on Battery Street as part of the Transportation Center Project and/or a shared use path through Battery Park. Bike lanes continue on North Avenue, Park Street and North Champlain Street. This route accesses the western/downhill edge of downtown.

Option C Locust

Offers a connecting route in lieu of Shelburne Street improvements that uses the southern segment of Option B, from Pine Street to Locust Street, traverses across Locust Street to 'the rotary' (planned to be improved for safer bike and pedestrian use) and connects to the northern segment of Option A.

Specific Route Diagram



Union North | Winooski South

How do the Route Alternatives fit existing streets and what needs to change?

A segment by segment description of street widths and how bike lanes can be fit to them

Route Segments

Manhattan Drive

A1
Existing 26'-30' between St. Louis St. and Riverside Ave.
Proposed 4' BL – 9'to11'TL – 9'to11' TL – 4'BL = 28'

Riverside Avenue

A2
Existing 30' between Intervale Ave. and N. Winooski Ave.
Proposed 5' BL – 10'TL – 10' TL – 5'BL = 30'

North Winooski Avenue

A3
Existing 40' between Riverside and Archibald Street
Proposed 7.5'P – 5' BL – 9'TL – 9' TL – 5'BL – 7.5'P= 43'
(move curb 3')

A4
Existing 40' between Archibald and North Union Street
Proposed 8'P – 5' BL – 10'TL – 10' TL – 5'BL – 8'P = 46'
(move curb 6')

A5
Existing 40' between North Union Street and North St.
Proposed 8'P – 5' BL – 11'TL – 11' TL – 5'BL = 40'

A6
Existing 35' between North Street and Pearl Street
(one-way street)
Proposed 8'P – 6'BL – 13'TL – 8'P= 35'

South Winooski Avenue

A7
Existing 40' between Pearl and Main Streets
Proposed 4'BL – 11'TL – 10'TurnL – 11' TL – 4'BL = 40'
(4-lane to 3-lane conversion from Pearl to Main)

A8
Existing 40' between Main and King Streets
Proposed 8'P – 5'BL – 10' TL – 10' TL – 7'P = 40'

A9
Existing 30' between King and Maple Streets
Proposed 8'P – 10' TL – 10' TL – 4'BL = 32'
(move curb 2')

A10
Existing 30' between Maple & St. Paul Streets
(2 lane/one-way)
Proposed 6' BL – 11'TL – 8'P = 25'
(reduce to 1-lane/one-way, move curb 5')

Saint Paul Street

A11
Existing 35' between Howard Street and South Union St.
Proposed 5'BL – 11'TL – 11' TL – 8'BL = 35'

North/South Union Street

A12
Existing 30' from St. Paul St. to Maple St. (2-way street)
Proposed 8'P – 10' TL – 10' TL – 4' BL = 32'
(move curb 2')

A13
Existing 30' from Maple Street to College Street
(two-lane, one-way street)
Proposed 8'P – 10'TL – 10'TL - 4'BL = 32' (move curb 2')

A14
Existing 26' from No. Winooski Avenue to College Street
(one-way street w/bikelane)
Proposed no change

Saint Paul Street

A15
Existing 40' from South Union to the Rotary
Proposed 5'BL – 11' TL – 11' TL – 5'BL – 8'P = 40'

A16 **The Rotary** See separate plans

Shelburne Road

A17
Existing 40' between Rotary and Home Ave.
Proposed 4'BL – 11'Tl – 10'TurnLane – 11' TL – 4'BL = 40'
(4-lane to 3-lane conversion includes center turn lane with intermittent islands)

Pine Battery

Route Segments

North Avenue

B1
Existing 35' between Sherman Street and Convent Sq.
Proposed 8'P – 5'BL – 10'TL – 10' TL – 4'BL = 37' (move curb 2')

Park Street

B2
Existing 30' between Manhattan Drive and North Street (2-lane/one-way)
Proposed 6' BL – 14'TL – 10'P = 30' (convert to 1-lane/one-way)

B3
Existing 35' between North Street and Battery Street (2-lane/one-way)
Proposed 5'BL – 11'TL – 11'TL – 8'P = 35'

North Champlain Street

B4
Existing 35' between Manhattan Drive and Pearl Street (2-lane/one-way)
Proposed 8'P – 11'TL – 11'TL – 5'BL = 35'

Battery Park Path

B5
Proposed 10' wide shared use path through park with north segment on existing service drive/walk and south segment new.

Battery Street

B6
Existing 50' between Pearl St. and Main St. (4-lanes)
Proposed 5'BL –10'TL–10'TL–10'TL–10'T – 5'BL= 50'

B7
Existing 50' between Main Street and King Street
Proposed 8'P – 6'BL – 11'TL – 11'TL – 6'BL – 8'P = 50'

B8
Existing 46' between King Street and Maple Street
Proposed 8'P – 5'BL – 10'TL – 10'TL – 5'BL – 8'P =46'

Pine Street

B9
Southern Connector Project
From Maple Street to Locust Street

B10
Existing 38' from Locust Street to Flynn Avenue
Proposed 8'P – 5'BL – 10'TL – 10' TL – 5'BL = 38'

B11
Existing 30' from Flynn Avenue to Home Avenue
Proposed 5'BL – 10' TL – 10' TL – 5'BL = 30'

B12
Existing 30' from Home Avenue to the city line
Proposed 11' TL – 11' TL – 8'P = 30' (Bikes share the road)

Locust

Locust Street

C
Existing 33' to 40' between Pine Street and the Rotary
Proposed 4'BL – 10'TL – 10'TL – 5'BL – 8'P = 37' (move curb 4')
5'BL – 11'TL – 11'TL – 5'BL – 8'P = 40'

Route A Option

Union North **Winooski South**

Detailed Plans and Descriptions

This study proposes major changes to Shelburne Street reducing the four lane road to three lanes including a center turn lane with median islands and bike lanes. Bike lanes are created northbound on Union Street and southbound on Winooski Avenue. The route concludes with links to planned bike lanes on North Winooski Avenue and Riverside Avenue.

Summary of corridor improvements:

1. Bike lanes on North Winooski Avenue transition into planned bike lanes and shared use path on Riverside Ave.
2. Enhancements to the Riverside/North Winooski Avenue intersection for bike/ped. safety and crossings.
3. Two-way bike lanes on the remainder of North Winooski Avenue to intersection with Riverside Avenue. These are integrated with the planned North Winooski Avenue Streetscape Project.
4. Connections to the Route 127 Shared Use Path using Archibald, Intervale, Riverside and Manhattan. An alternative arrangement could include Elmwood Avenue, but with a significant loss of on-street parking.
5. Enhancements to the Archibald Street/North Winooski Avenue and North Union Street intersections for bike/ped. safety and crossings.
6. A northbound bike lane, with striping, already exists on Union from College Street to Winooski Avenue.
7. New bike lanes are planned for North Winooski Avenue, but there are several possible ways to accommodate them:
   - A. Widen North Winooski Avenue by approximately 5' to accommodate a southbound bike lane to pair with the northbound bike lane on Union Street.
   - B. Widen No. Winooski Avenue by as much as 10' for a two way bike lane system. Northbound bike lane on Union remains.
   - C. In the event that North Winooski Avenue is not available as a bike route, an alternative system of side streets has

been devised using Riverside Avenue, Archibald Street, Intervale Avenue, Elmwood Avenue and Pearl Street.

8 Enhancements to the Pearl Street/North Winooski Avenue intersection for bike/ped. safety and crossings.

9 Between Pearl Street and Main Street, reduce the number of travel lanes on South Winooski Avenue from four lanes to three. Use the space made available for the addition of bike lanes. This "road diet" will also require some redefinition of curb-cuts, access management at driveways, and accommodation of turning lanes for the City Market and islands for pedestrian crossings.

10 Enhancements to the College, Main, Maple/South Winooski Avenue intersections for bike/ped. safety and crossings.

11 Northbound bike lane along the length of North and South Union Streets.

12 The two lane, one way southbound section of South Winooski between King Street and St. Paul Streets is reduced to one lane plus a bike lane. On–street parking on South Winooski is shifted to the east side of the road.

13 Enhancements to the Howard and Spruce Streets/South Winooski Avenue and South Union Street intersections for bike/ped. safety and crossings.

14 The one way bike lane and street directions for South Union/South Winooski Avenue terminate at the St. Paul Street Intersection and transition to bike lanes along Shelburne Street.

15 Enhancements to the 'rotary' at Locust Street/Willard Street/Ledge Road intersection for bike/ped. safety and crossings.

16 Shelburne Street is reduced from four traffic lanes and no bike access to three lanes with bike lanes.

17 Enhancements to the Proctor Avenue, Home and Flynn Avenue intersections for bike/ped. safety and crossings.

Route B Option

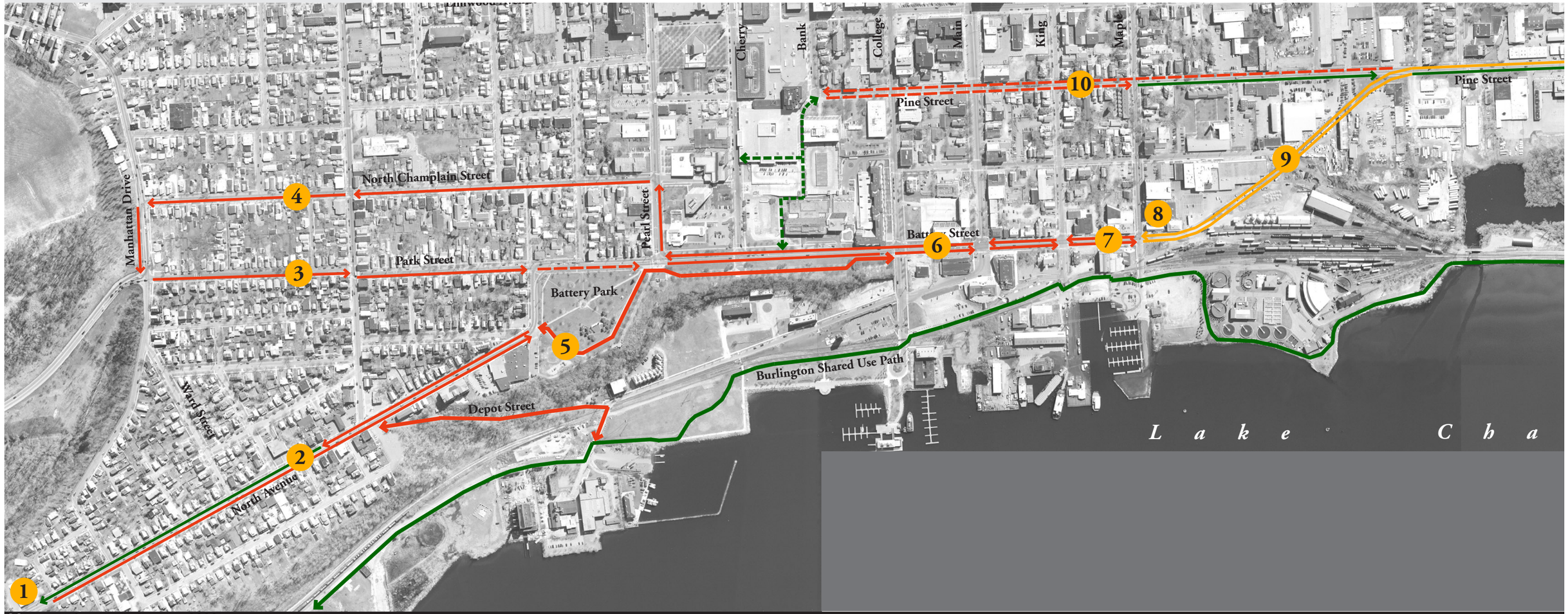
Pine Battery

Detailed Plans and Descriptions

The corridor integrates existing striped shoulders on Pine Street, links to the planned shared use path and bike lanes as part of the Southern Connector, planned improvements to Battery Street as part of the Multi-Modal Transportation Center, pedestrian linkages as part of the Draft Waterfront Transportation Plan, and concludes with bike lane improvements to North Avenue connecting to bike lanes near Burlington High School. Additional connections are made to downtown on Pine Street and one-way pairs of bike lanes on Park Street and North Champlain Street.

Summary of corridor improvements:

1. New bike lane ties into existing bike lane on North Ave. near Convent Square.
2. Additional bike lanes along North Ave. will require moving the curb if on-street parking is to be maintained.
3. A segment of Park Street from Manhattan to North Street is restriped from two lanes to one and an inbound bike lane is added on the west side all the way to Battery Street.
4. An outgoing bike lane is added to North Champlain Street.
5. Bike lanes transition to the west side of Battery Street at the Cherry Street intersection and follow the wide path through the park.
6. Battery Street is reduced from four lanes to a two lane boulevard with a landscaped median, turn, and bike lanes.
7. When the Southern Connector enters Battery Street/ Maple Street, bike lanes continue up Battery Street alongside parallel parking.
8. Enhancements to the Southern Connector/Battery Street/ Maple Street intersection for bike/ped. safety and crossings.
9. A shared use path continues as part of the Southern Connector from Battery Street to Lakeside Avenue.
10. A spur route into downtown could be extended along Pine Street, and an off-street connection made around Filene's Department Store.



11 Enhancements to the Lakeside Avenue intersection for bike/ped. safety and crossings as Pine Street meets the Southern Connector.

12 North of Flynn Avenue, define striped bike lanes past the Champlain School. Locate several bus/parent drop - off places and crosswalk refuge islands. The road here is wide, such that it can be narrowed to calm traffic and better define vehicular and bike/ped. patterns.

13 Enhancements to the Flynn Ave. intersection for bike/ped. safety and crossings.

14 Bike lanes continue from Flynn Ave to Home Avenue.

15 South of Home Avenue, bikes will continue to share the road as they do now.

16 The above route will link to a planned shared use path that will extend from Pine Street around the south side of the Price Chopper shopping center to Route 7. This will be funded as part of the Southern Connector Project. This path replaces the previously planned bike/ pedestrian bridge over the Southern Connector.

Linkages to this Corridor

- Extension of bike lanes on Pine Street from Southern Connector to the parking garage at the south side of Filenes. Define a bike park/walk site there at the corner of Bank Street.
- Improve and extend the walking paths at the Filenes – Garage -Radisson site.
- Connect to the planned Transportation Center at the foot of Main Street.
- Connect to Waterfront Park at College Street.
- Pedestrian connection from Battery Park to Waterfront behind Police Dept.
- Connect to Burlington Bikepath at Depot Street.

Route C Option

Locust

Detailed Plans and Descriptions

Locust Street is widened along Callahan Park to accommodate bike lanes in both directions. A new sidewalk is included in this segment along the park frontage, where none exists now.

The Route 7 Rotary is reconstructed under a separate project as either a five way signalized intersection or a five leg roundabout. The sketches at right illustrate these designs.

Five Way Signal

Five leg roundabout

East/West Cross City Routes

Cross Routes

The North/South routes are designed with East/West Connections in mind. Since the street system in Burlington is made up of relatively narrow streets, based upon a 30' typical width, there are a number of streets that cannot accommodate bike lanes in each direction without major reconstruction of curbs and sidewalks. Therefore as a long term supplement to the North/South route, a system of one-way bike route pairs have been defined to connect from the north/south corridor options to the downtown Central Business District and to cross town locations that are also prominent desire lines.

The routes have been only preliminarily defined for this report, since the purpose of this study is for defining the North/South options, but a summary description of the East/West connections appears in the table and the map below. First priorities would likely be given to those routes with fewest impacts on existing parking.

East/West connection streets for bike lanes and enhanced pedestrian connections

Home Avenue	bike lanes each way	no other changes
Flynn Avenue	bike lanes each way	no other changes
Sears Lane	bike lanes each way	no other changes
Howard Street	bike lane westbound	OSP(on-street parking) shifts from N to S side of the street
Pine Place/Spruce Street	bike lanes eastbound	no other changes
Maple Street	bike lane westbound	OSP shifts from N to S side of the street
Main Street	bike lanes eastbound	no other changes
College Street	bike lane westbound	OSP shifts from N to S side of the street
Cherry Street	bike lane westbound	no other changes
Pearl Street	bike lane eastbound	no other changes
Archibald/Manhattan/Ward Street	bike lane westbound	OSP shifts on Ward Street

4. Design Guidelines for Bicycle and Pedestrian Facilities

Recent years have seen considerable progress in the form of technical research and documentation for the design of safe bicycle and pedestrian facilities. Planning principles and design details for bike/ped. mobility have become better defined and have been embraced by planning, design and engineering professionals, as well as community activists.

It is prudent for the City of Burlington to take advantage of the research and development of national "Best Practices" to ensure that bike/ped. corridors are safe and use a sound professional basis for their planning and design. At the same time, there may be specific characteristics of Burlington streets that make the direct application of national standards problematic.

For the purpose of this study, the DPW wanted to define the basic technical parameters for the bike/ped. system as they would apply to the north/south bike routes. To meet this expectation the following major sources have been assessed:

- The draft Vermont Bike /Ped. Planning and Design Manual that was released by VTrans for public review in April 2002.
- The 1999 AASHTO "Green Book" Guide for the Development of Bicycle Facilities.
- The 1999 FHWA and Bicycle Federation of America publication: "Implementing Bicycle Improvements at the Local Level."
- Other resource materials include: the Minnesota DOT Bicycle Design Manual, "Street Design for Healthy Neighborhoods": by Dan Burden and Co. and the ITE publication "Traditional Neighborhood Development Street Design Guidelines".

What are the basic features of a bike-friendly street?

New draft guidelines for pedestrians and bicycles (Vermont Pedestrian and Bicycle Facility Planning and Design Manual) is available from the Vermont Agency of Transportation and the Bicycle Federation of America. It defines bike lanes as "a portion of a roadway that has been designated by signs and pavement markings for preferential or exclusive use by bicyclists." Design concepts in the manual that pertain to this report include recommendations that bike lanes:

- should be one-way facilities that carry bike traffic in the same direction as adjacent traffic.
- should never be placed between a parking lane and curb;
- should be level and smooth.
- should be delineated from motor vehicle lanes with a minimum of a 6", but optimally an 8" solid white stripe.
- Be well marked with (preferably) bicycle symbol signage, lane striping, lane symbols and directional arrows.
- Width: The following minimum distances have been recommended for use by the City of Burlington:
  A. Single bike lane along curb: 4' wide
  B. Single bike lane next to parallel parked cars: 5' wide
  C. Minimum width of parking space and bike lane is 13'

The following are specifically recommended to avoid:

- Bike lanes against traffic.
- Single side of street, two-way bike lanes.
- A bike lane on one side of a two-way street, unless "paired" with a lane going the opposite way nearby.
- Use of extruded, or rolled curbs to separate bike lanes from vehicles lanes.

What do these standards mean for the North/ South Bicycle Pedestrian Route for Burlington?

1. Improve all road corridors for bicycle use with striping and signage.

2. Where needed, narrow travel lanes to 10 feet, and reallocate pavement widths to balance bike and vehicular use.

3. Where needed, widen or narrow streets to accommodate bike lanes. (See sections A1 and A2 on page 28)

4. Provide bike lanes four feet in width as a typical condition and five feet along parallel parking (see sections). Avoid bike lanes next to parking where possible.

5. When bike lane width cannot be achieved, utilize one of two strategies. Either use a "fog-line" to identify a bikeable shoulder along a curb, or use "share the road" signage and "MacKay" markers.
These strategies are better than nothing, but should only be used as a temporary measure until a true bike lane can be accommodated.

6. Most of Burlington's neighborhood streets are 30 feet wide. This typically allows for two lanes of travel ways and parking on one side. Streets such as Union Street, North Avenue, Pearl St. and College Street are typical of this condition.

Adding a bike lane to 30' wide two- way street implies that parking should be on one side and the bike lane on the other, so bikes and parked cars aren't in conflict. Travel lanes must be narrowed to 10' wide, and the curb must be moved to widen the road by 1 to 2 feet to achieve a full 4-foot bike lane. See Section A1 on page 28.

7. There are a number of two lane-one way streets in Burlington with parking on one side such as South Winooski Ave. below Maple Street, Park Street and North Champlain Street. Several of these streets are proposed to be made into one-lane, one-way with bike lanes as part of the North/South Bicycle and Pedestrian Route. Accomplishing this means a narrowing of the width of the road by 5 feet. The benefits of this "road diet" as has been coined by transportation planners in recent years, will calm traffic speeds by removing the passing lane, and trade paved area from vehicular uses to bicycle use. In a road diet, the prudent driver sets the speed instead of the impatient or aggressive driver. All the streets mentioned above have serious neighborhood concerns about speeding traffic.

Extra wide lanes or "Share the road" designations are commonly used techniques to create bikeable space on roads. These have been avoided as much as possible in these alternatives because they are more of an accommodation of bikes, rather than a dedicated system for the exclusive use of bikes.

Basic Features of a Pedestrian Friendly Street:

Making streets pedestrian friendly is an exercise in the "Art of Accommodation." It is both an art and a science:

The art of pedestrian design is the creation of an environment that looks and feels walkable. There are essential aspects of a street that make people feel more comfortable. These are the basics:

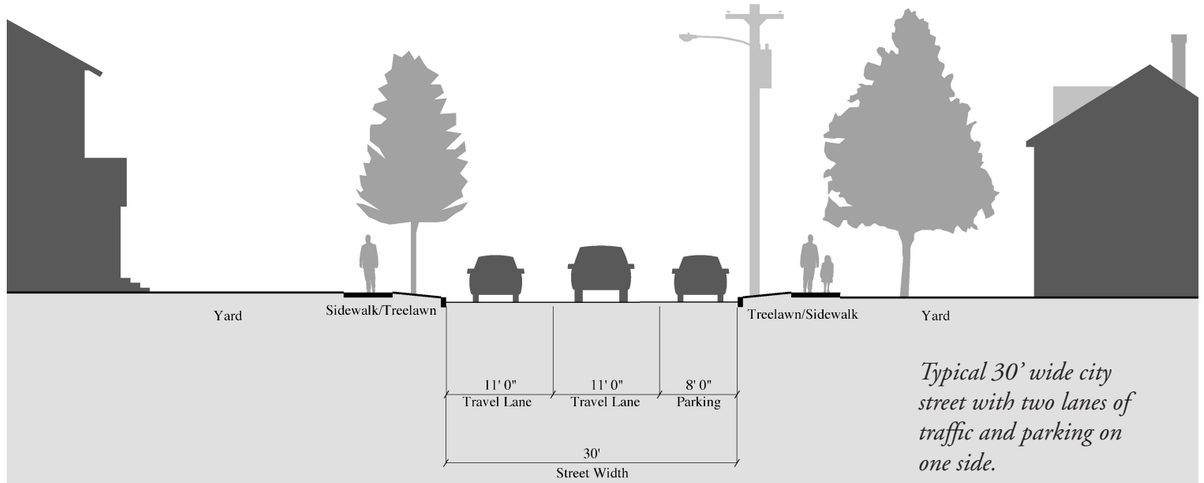
- Moderate traffic speeds
- A separation from traffic with a grass verge, tree lawn, ornamental paving or on-street parking.
- Lots of street trees and landscaping for shade and seasonal interest.
- Comfortable places or 'edges' on which to rest such as benches seating walls, and small parks.
- Visual accessibility and orientation so you know where you are, and who else is around.

The making of a successful street does not require using expensive materials and detailing. Brick pavers, ornamental streetlights, benches, banners, etc., won't, in themselves make a beautiful and functional street. If the basic street relationships aren't present, then accessorizing won't save it. Appropriate materials must be integrated into a larger palate of street improvement concepts such as are illustrated on pages 31.

Accommodation is the providing of a physical environment conducive to walking:

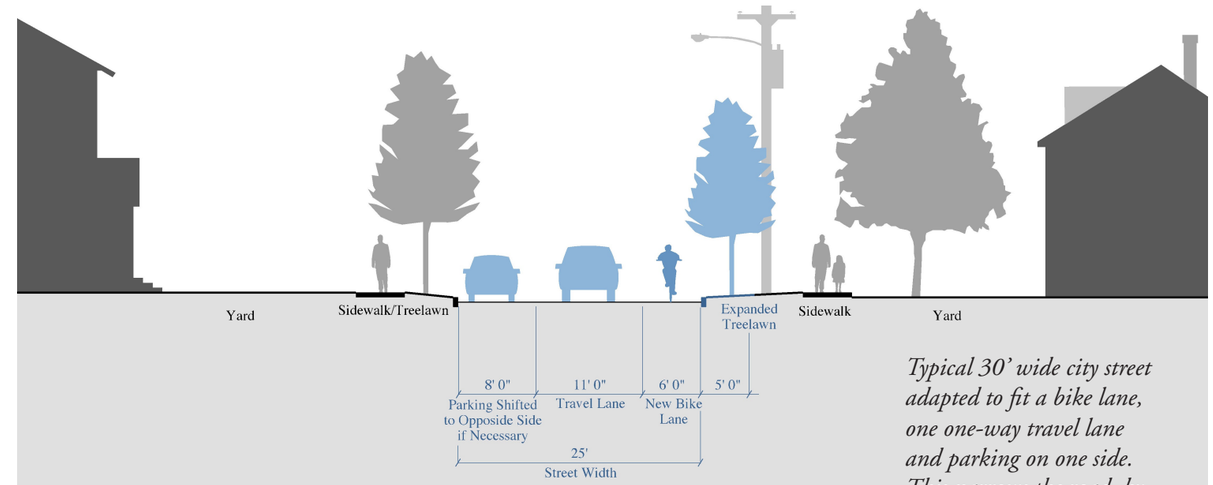
- Provide continuous sidewalks on both sides of all major streets.
- Width of a sidewalk should be in proportion to the number of people who use it. In Burlington that means 5' neighborhood sidewalks and 8-15' commercial street frontages.
- Providing an environment that is fully accessible and complies with the Americans with Disabilities Act (ADA).
- Providing signage and markings that clearly designate a pedestrian corridor.
- Curb extensions make intersections more pedestrian friendly by reducing exposure to vehicles.
- Calm traffic on higher speed/volume roads.
- Introduce mid-block crossings where appropriate.

Applying the Guidelines to Bicycle Improvements



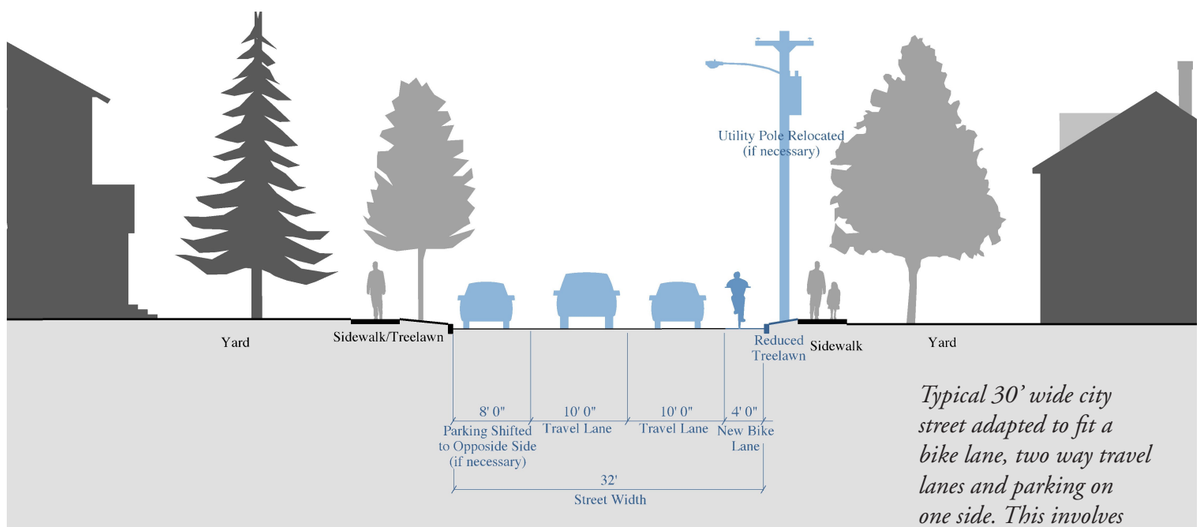
Typical 30' wide city street with two lanes of traffic and parking on one side.

A Section thru typical Burlington Street



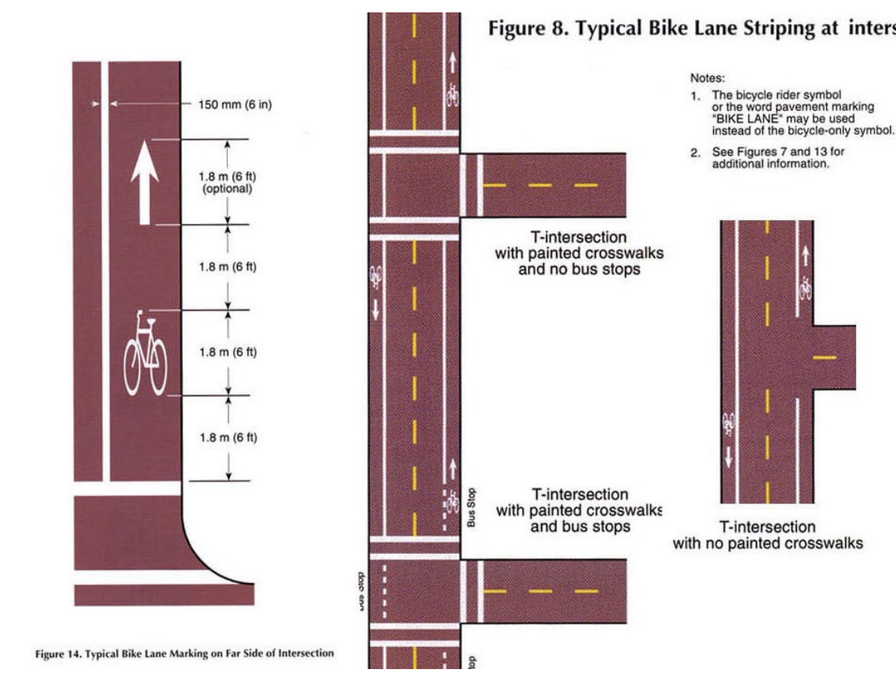
Typical 30' wide city street adapted to fit a bike lane, one one-way travel lane and parking on one side. This narrows the road by 5' with a curb shift.

A2 Section thru Street with a 5' Curb Shift



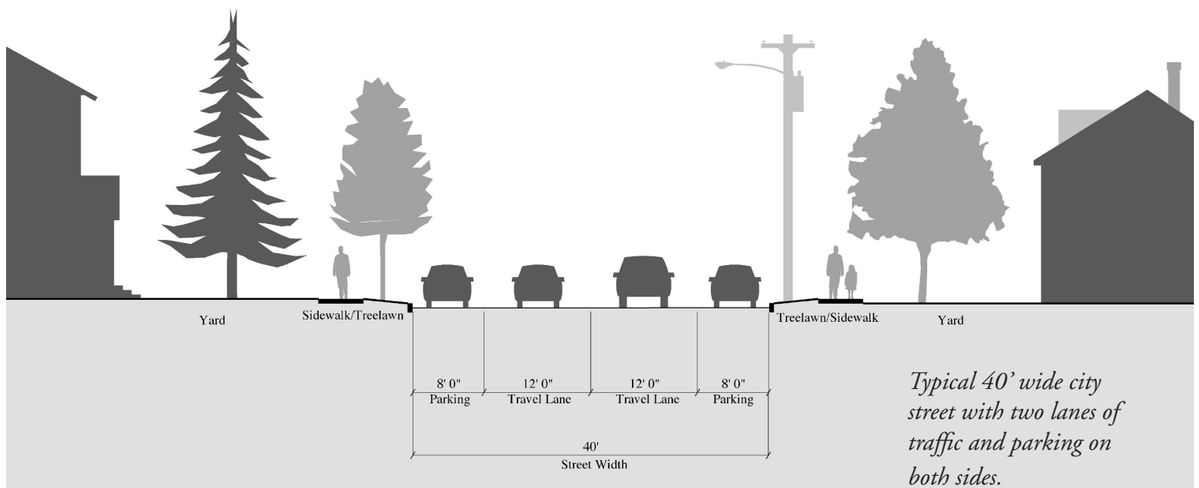
Typical 30' wide city street adapted to fit a bike lane, two way travel lanes and parking on one side. This involves widening the road with a 2' curb shift.

A1 Section thru Street with a 2' Curb Shift



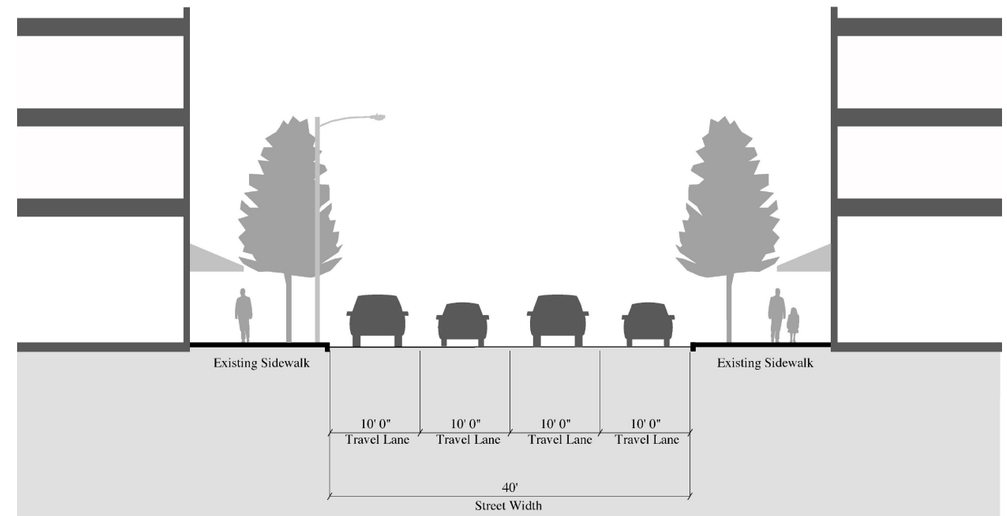
Bike Lane Striping Protocol per AASHTO

Typical 4' or 5' wide bike lane shown in different conditions for roadway designation. Refer to AASHTO and MUTCD for more detailed information about street marking for bikes and pedestrians.



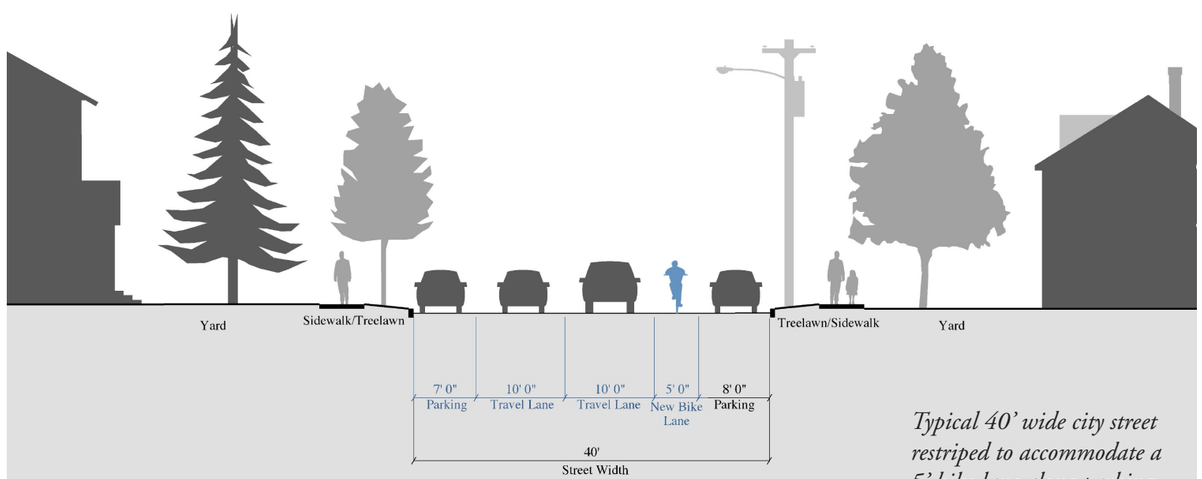
Typical 40' wide city street with two lanes of traffic and parking on both sides.

B Section thru typical Burlington Street



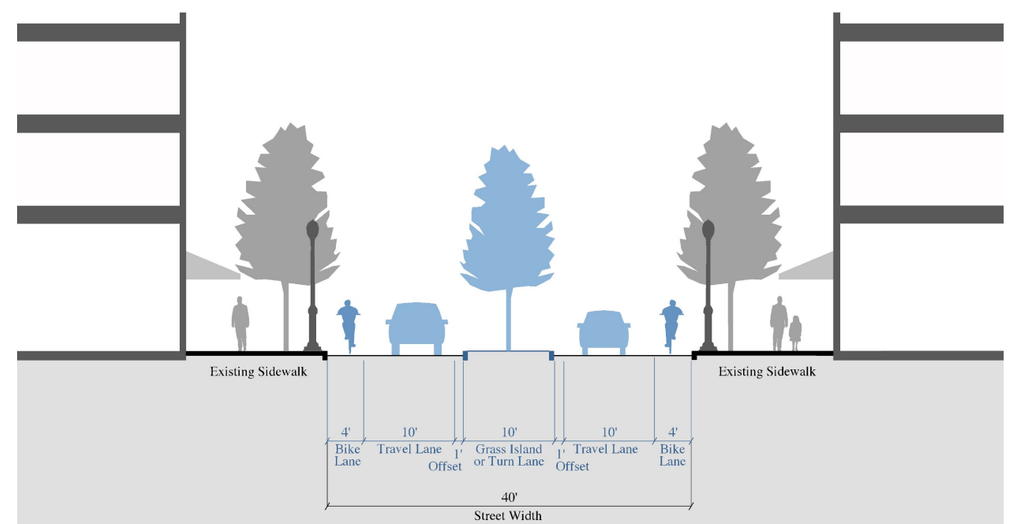
South Winooski Avenue is typical of a 40' wide city street with four lanes of traffic and no parking

C Existing Section thru South Winooski



Typical 40' wide city street restriped to accommodate a 5' bike lane along parking.

B1 Section thru Street with New Bike Lane

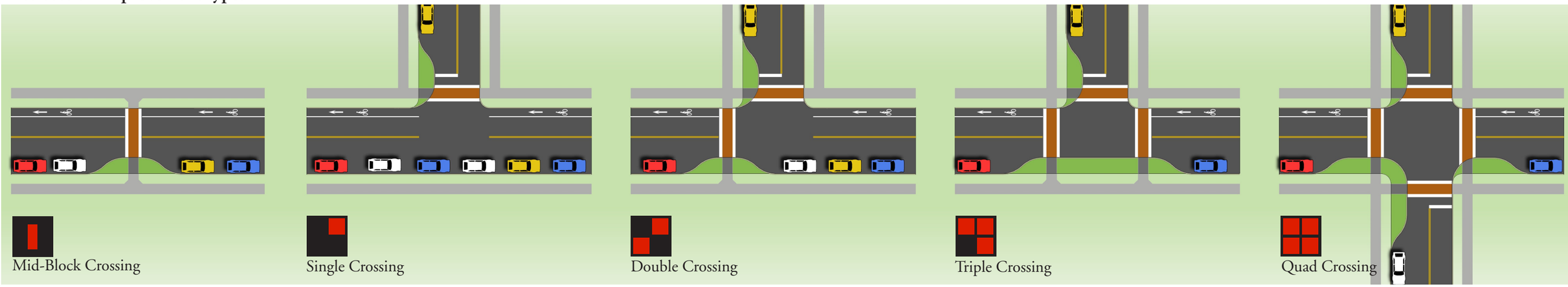


South Winooski redesigned as a two lane road with center turn lanes, median and bike lanes

C1 Proposed Section thru South Winooski

Applying the Guidelines to Pedestrian Improvements

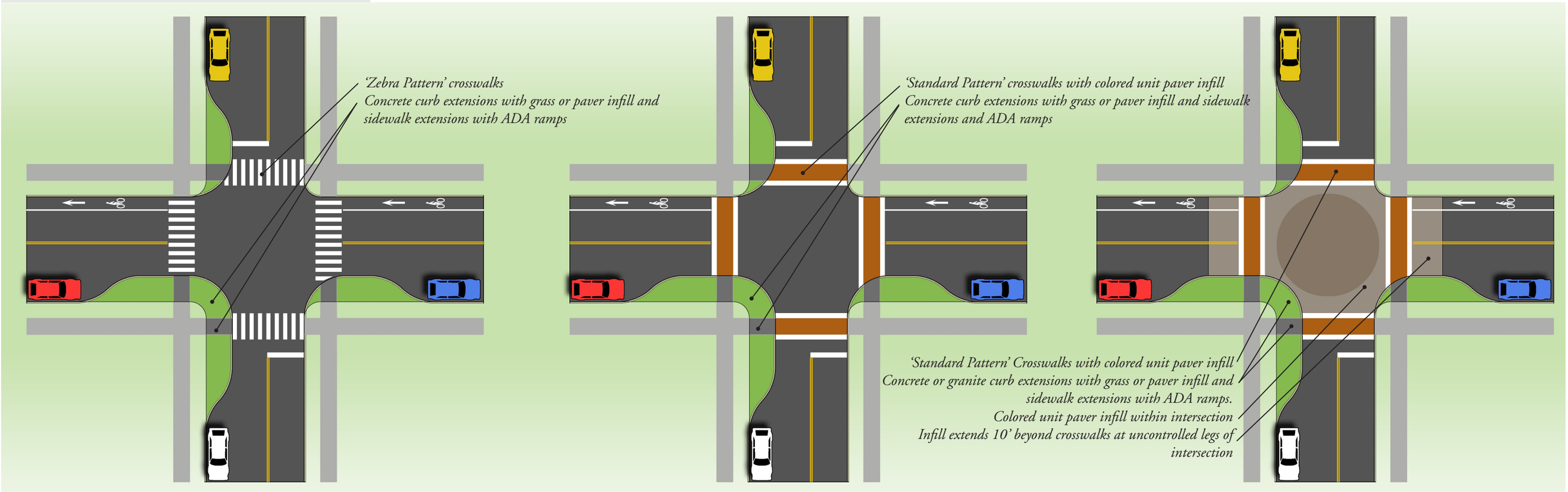
Intersection improvement types



Intersection improvement key plan

Intersection design and materials options

Below is a range of materials that could be applied to intersection improvements in light of cost and maintenance considerations, and the prominence of the intersection. Example: The Deluxe option may be used at important downtown intersections or other key intersections that are major orientation points within the city.



Minimal Option

Standard Option
Cost estimates are based on this option

Deluxe Option

Wayfinding

The map below identifies primary wayfinding locations along the various route options. It also locates intersections that are likely to be connections to future cross-city routes. To the right is a concept for a north/south wayfinding sign system that utilizes the city's existing format, but with a cyclists twist.

W Primary North/South Wayfinding Locations
W Cross Connection Wayfinding Locations

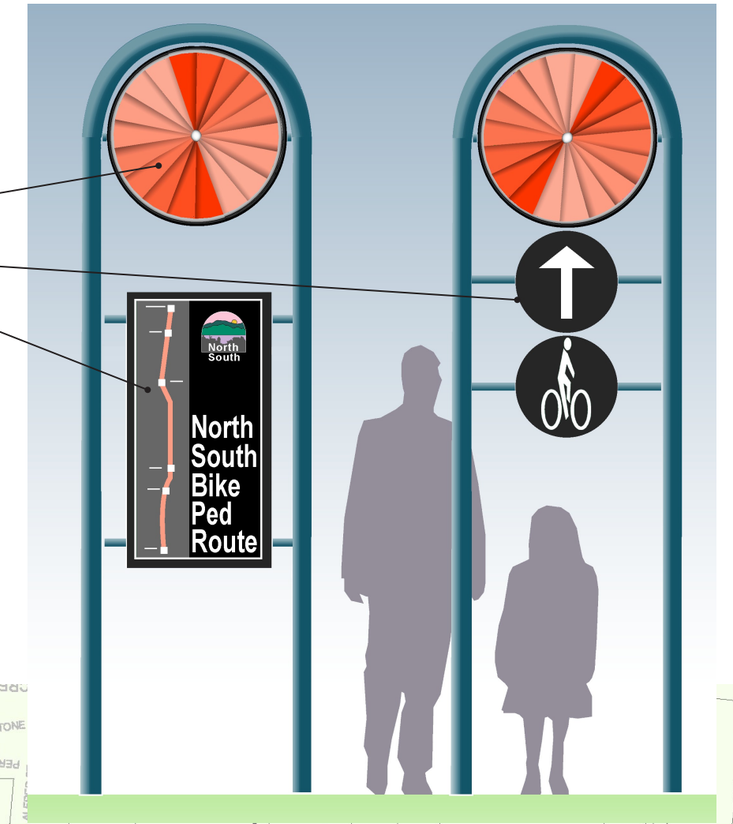
Sign Concept

(see appendix for more sign options)

Recycled bicycle wheel attached to standard 'hairpin' signpost with fins clipped to the spokes to catch the breeze and spin the wheel

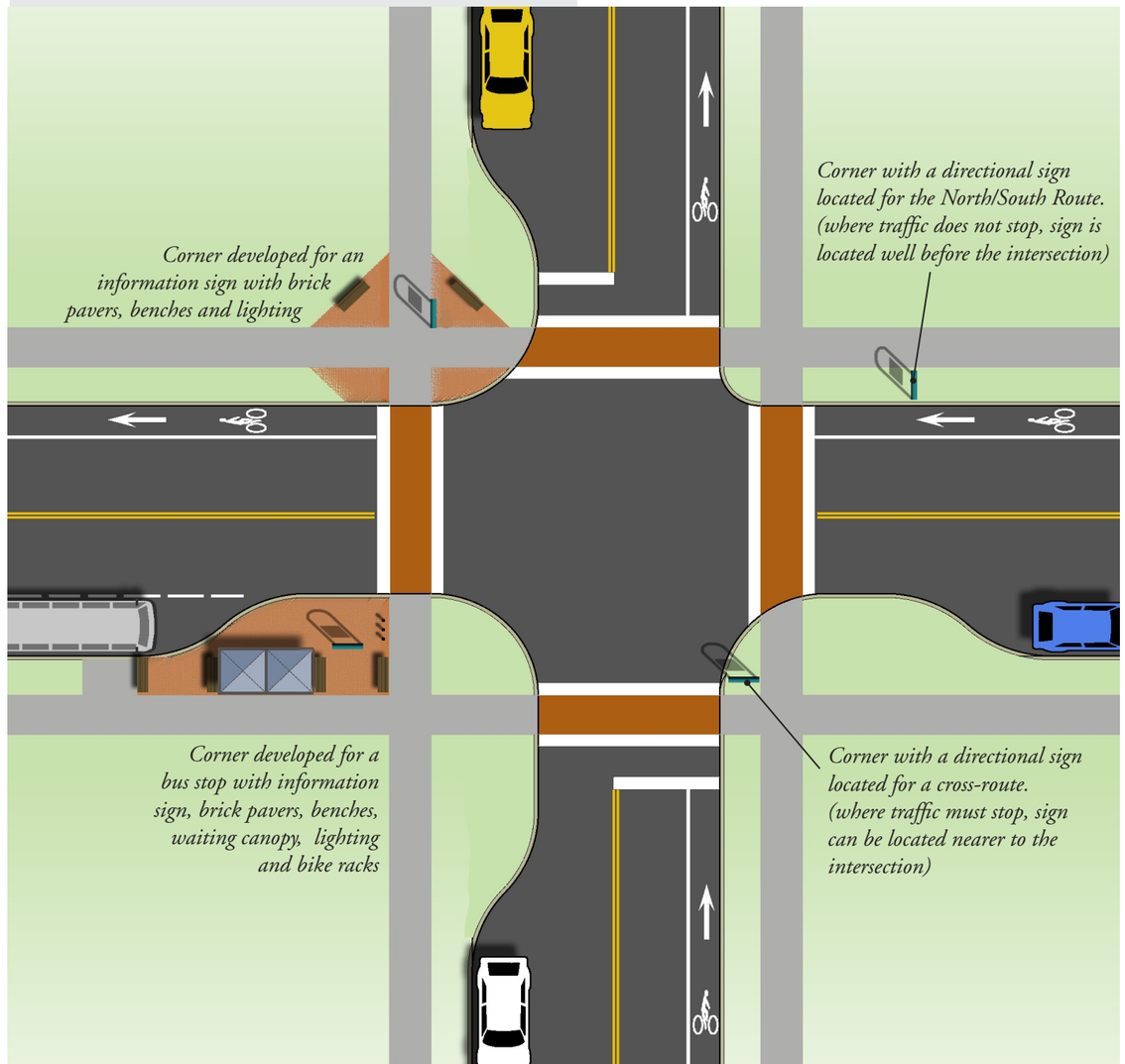
Typical directional sign

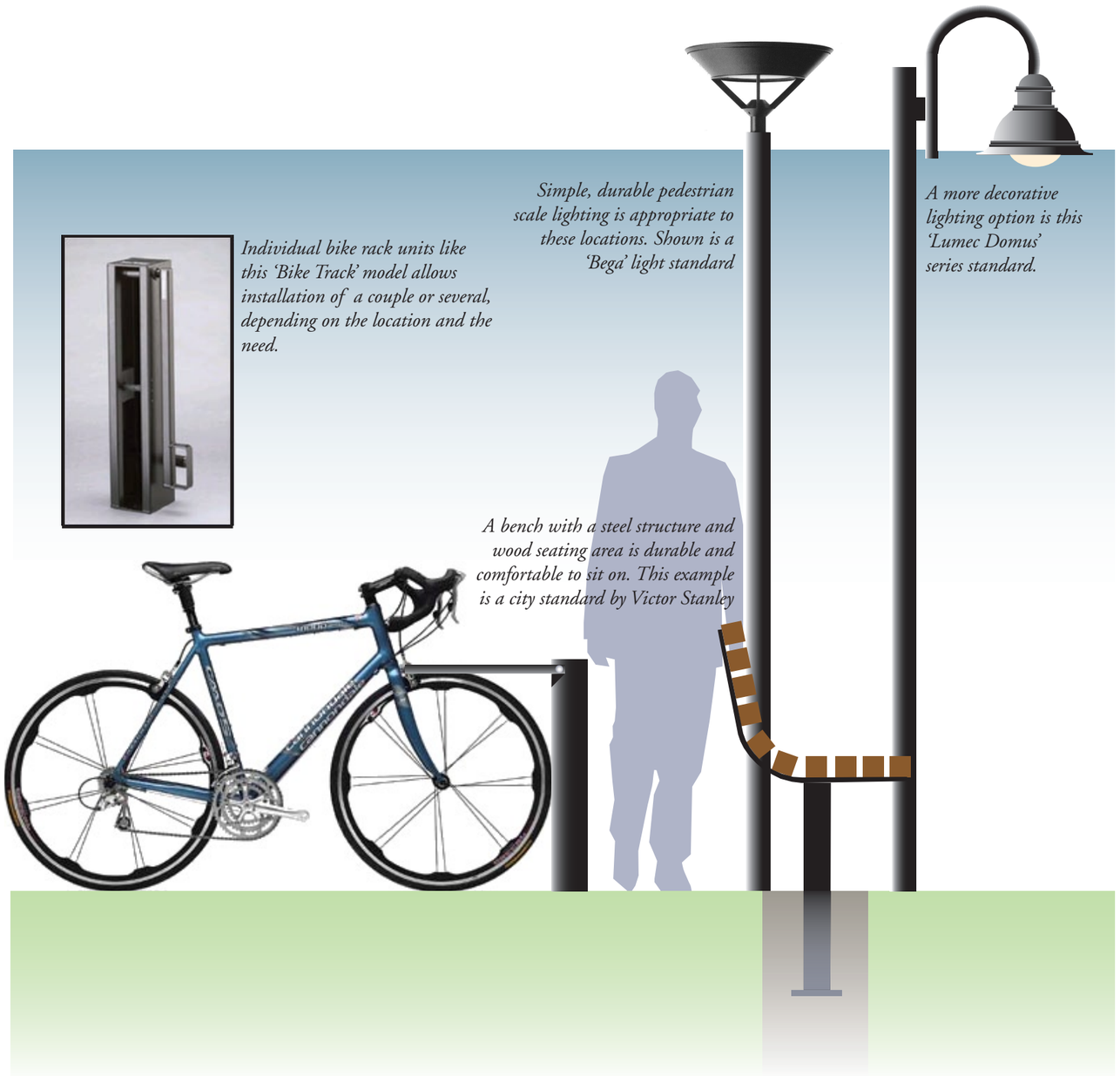
Typical informational sign



Street Furniture and Lighting

Below is a typical intersection plan illustrating several pedestrian/bike amenity treatments. The individual treatment or combination of treatments depends on the importance of the location within the city-wide system. These treatments are shown on a single plan for the convenience of the reader, and not intended to be installed all at the same location.





5. Putting it all together

Specific Street Designs

Segment A7 - Base Scheme

South Winooski Avenue between Pearl and Main

Public input to the planning process as well as the Burlington City Council resolution have indicated that this is by far one of the most bike and pedestrian unfriendly streets in the downtown. Four lanes wide, numerous commercial driveways, loading docks, and high traffic volumes make this both an uncomfortable and indeed unsafe road for bicyclists, pedestrians and motorists. There are no bike lanes and pedestrians must cross 40 feet of unprotected street with fast moving traffic in both directions.

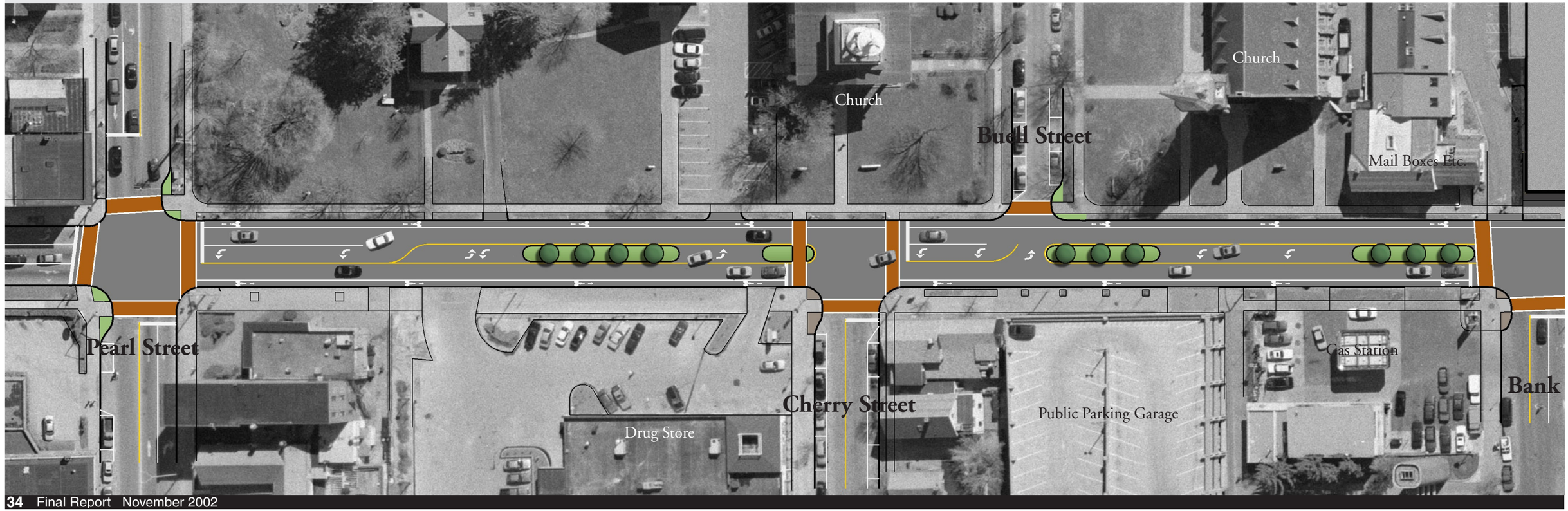
A redesigned street that improves safety and useability for bikes, pedestrians and vehicles is a win-win situation for all.

The base scheme (below) has the essential ingredients for transforming the road into a balanced, multi-modal corridor. Using the principle called a "road diet", the street is transformed from a four lane highway into a two lane road with center turn lanes and medians. Whereas the four lane road promotes unsafe passing at high speeds in the same lane as left turning vehicles *(see diagram at right)*, the thin road lets the prudent driver dictate the pace while providing protected left turns, and with enough room left over for bike lanes in both directions. All this can be accomplished within the existing curbs, leaving the sidewalk width unchanged.

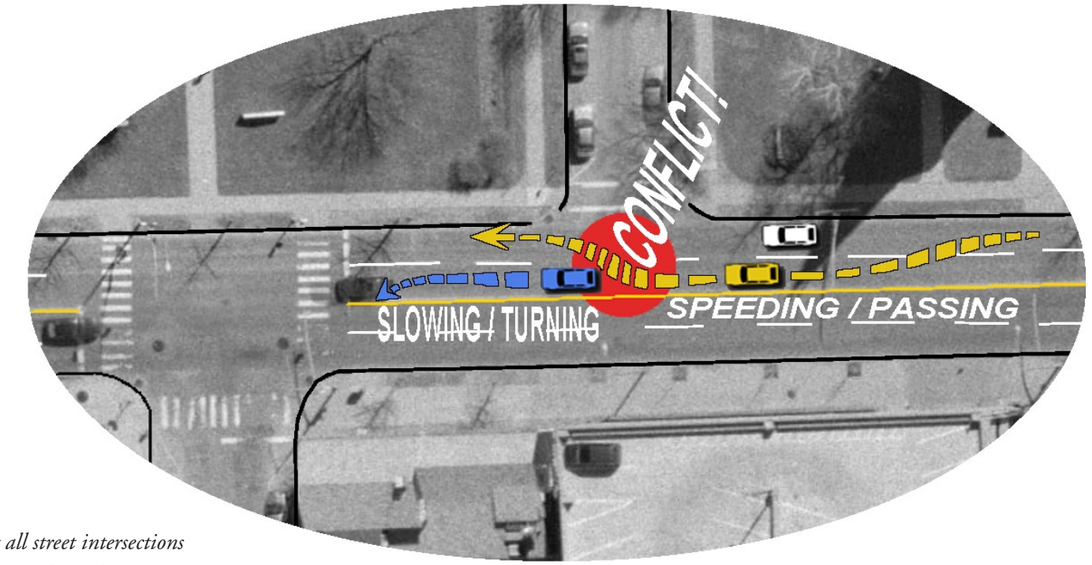
A preliminary engineering analysis of the implications of this "road diet", done by Resource Systems Group, indicates a general viability of the concept. The segment between College and Main Street would preserve the existing through lane and two dedicated turn lanes to support the high level of turns onto Main Street from South Winooski. This plan generally features dedicated left turn lanes for public streets and two way turn lanes for low volume commercial driveways.

Although a more detailed engineering analysis is required to confirm the findings of the preliminary study and to pin down the final design, this concept reflects a growing national practice of traffic calming design that seeks to balance all modes of transportation, not just address the needs of the motorist.

In the final public meeting for the North/South Study, when residents of the city were presented with the base plan for South Winooski, the question was asked "was this enough? Did this plan go far enough to meet their expectations of what a bike and pedestrian friendly street should look like?" The answer from almost all meeting attendees was that they wanted the road redesign taken to the next level. Thus the "enhanced" scheme was born.



Example of a pedestrian/vehicular scale lighting fixture that could be used on a redesigned South Winooski Avenue.



The Existing Road

South Winooski Avenue is a 40' wide, four lane affair with no room for bike lanes and long, unprotected crossings for pedestrians.

The two center lanes act as both passing lanes and left turn lanes, which creates a clear conflict of interest. One motorist accelerates into the left lane to pass, while another in front is slowing to make a left turn. This creates a dangerous situation and encourages aggressive driving to avoid rear end accidents. The pedestrian is left to deal with this situation and must attempt a full 40' cross unprotected.

Dedicated left turn lanes are created at all street intersections

The four lane road is transformed to a two lane boulevard with a landscaped median

Bike lanes in both directions are accommodated between Pearl and College Streets

Breaks in the median allow for left turning traffic into private driveways

'Standard' intersections are installed at all intermediate streets.

Segment A7 - Enhanced Scheme

South Winooski Avenue between Pearl and Main

An enhancement of the base plan takes the "road diet" further with the addition of modern roundabouts at the Pearl Street and Main Street intersections. Regarded for their efficiency to move large volumes of traffic, improved safety for both vehicles and pedestrians, accommodation for bicyclists, opportunity for civic design, and improvements in air quality due to reduced vehicle idling, roundabouts are being used more commonly as an alternative to signalized intersections.

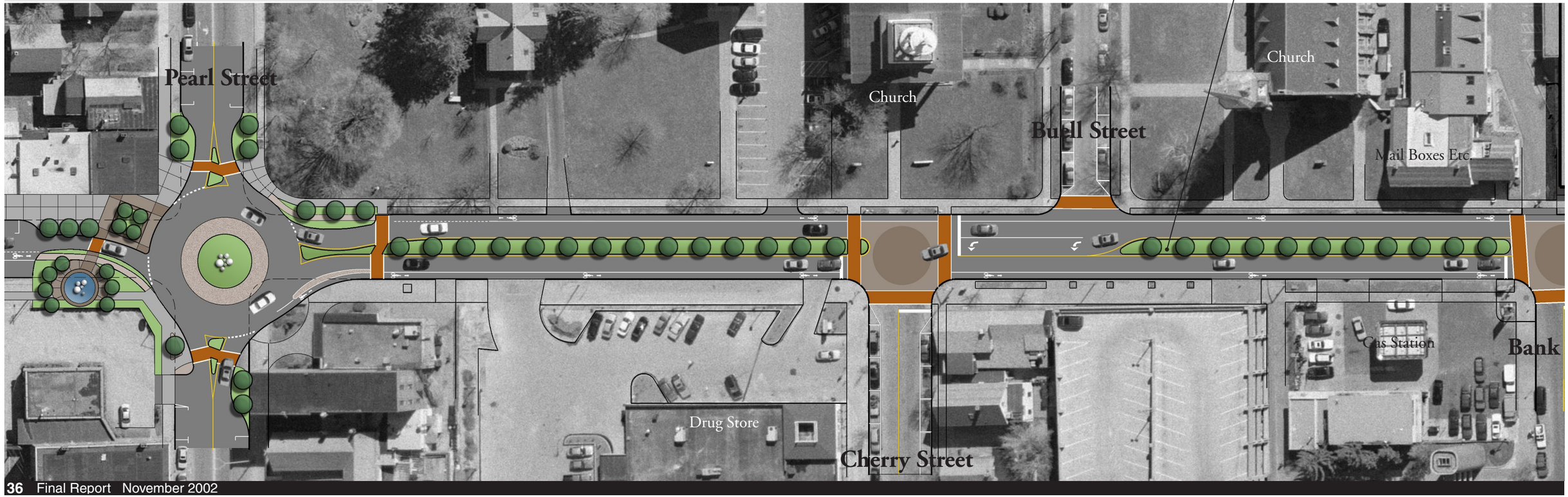
Whereas the signalized intersections in the base plan have dedicated left turn lanes, the roundabouts can accommodate all turning movements from a single travel lane in each direction. They also allow for easy U-turns at either end of the segment, eliminating the need for many of the left turns in and out of commercial driveways thereby dramatically increasing the amount of landscaped median. The angle of deflection entering the roundabout guarantees that traffic will be slow moving – between 10-20 mph, for safety. Curbed islands offer pedestrian refuges such that any crosswalk doesn't have to be more then 12-15' wide and a pedestrian doesn't have to contend with traffic coming from multiple directions.

Roundabouts can also be placemakers in the cityscape. Note the examples of public art possibilities shown on the illustrated plans: Pearls at Pearl Street, and environmental art at Main Street. With a center diameter of 40-50 feet, there is ample room for installations at these important intersections that are currently pedestrian unfriendly and unattractive. Also note the new park space created at the Pearl and South Winooski intersection.

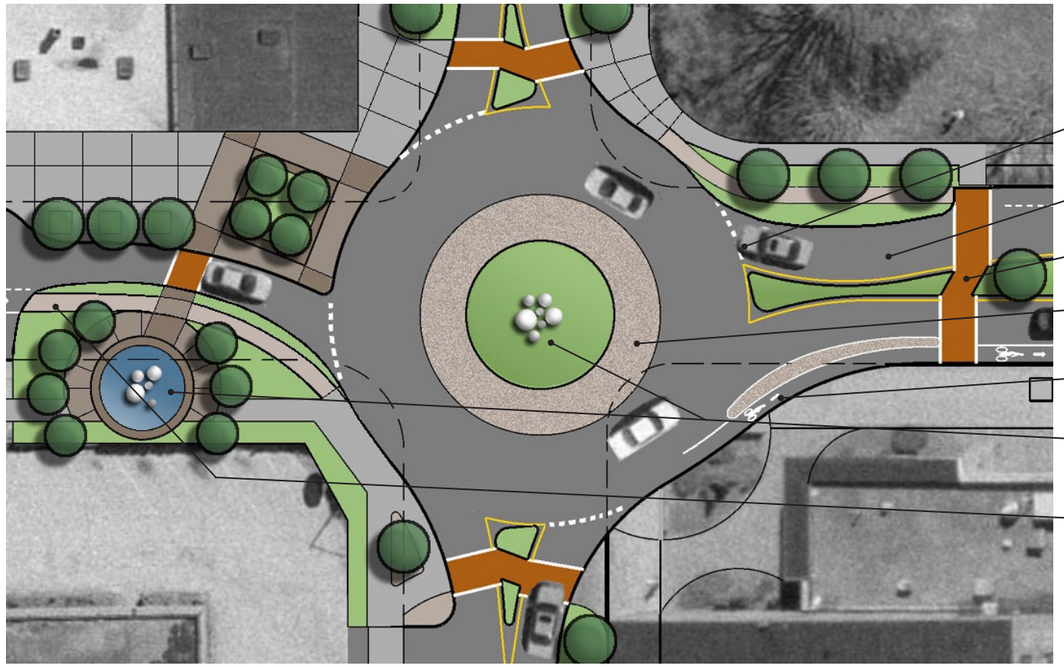
Both of these plans are provided to exhibit the possibility of improving both the functional aspects of Burlington's streets for bicycles and pedestrians, but also the whole premise of creating a "Great Street" as a model for Burlington's future.

These principles can readily be applied to other multilane city streets such as Battery Street, Shelburne Street, Park Street, North Champlain. South Winooski Avenue was selected for development because of its challenges as a central link in the north/south system for bicycles and pedestrians. If it can be done here, it can probably be done most anywhere.

Roundabouts at each end mean vehicles can easily change direction, eliminating much of the left turning and dramatically increasing the length of the landscaped medians.



Detail of intersection design at South Winooski Ave. and Pearl Street



Everyone entering a roundabout must yield to others already within. Circulation is counterclockwise, eliminating left turns, and making this intersection type generally safer than signalized intersections.

Cars must pass through a series of deflections to negotiate the intersection, forcing them to slow down. This improves safety for all.

Crosswalks have an island of refuge between the two directions of traffic. A pedestrian need only cross one leg at a time.

Raised and cobbled 'truck apron' and lane separators allows larger trucks to negotiate the intersection while still channelizing smaller vehicles.

These roundabouts are made more bike friendly by designing separate approach and exit lanes for bicycles and vehicles.

Opportunities for new parks with public art abound in the new spaces created by this intersection design.

Also created are exit ramps for bicyclists that wish to dismount and cross at the crosswalks, rather than ride around the roundabout.

'Roundabout' intersection design at Main Street could deliver an improved Level of Service over a standard intersection design and create a strong 'sense of place' at this critical downtown location. (See detail at left for more roundabout features)

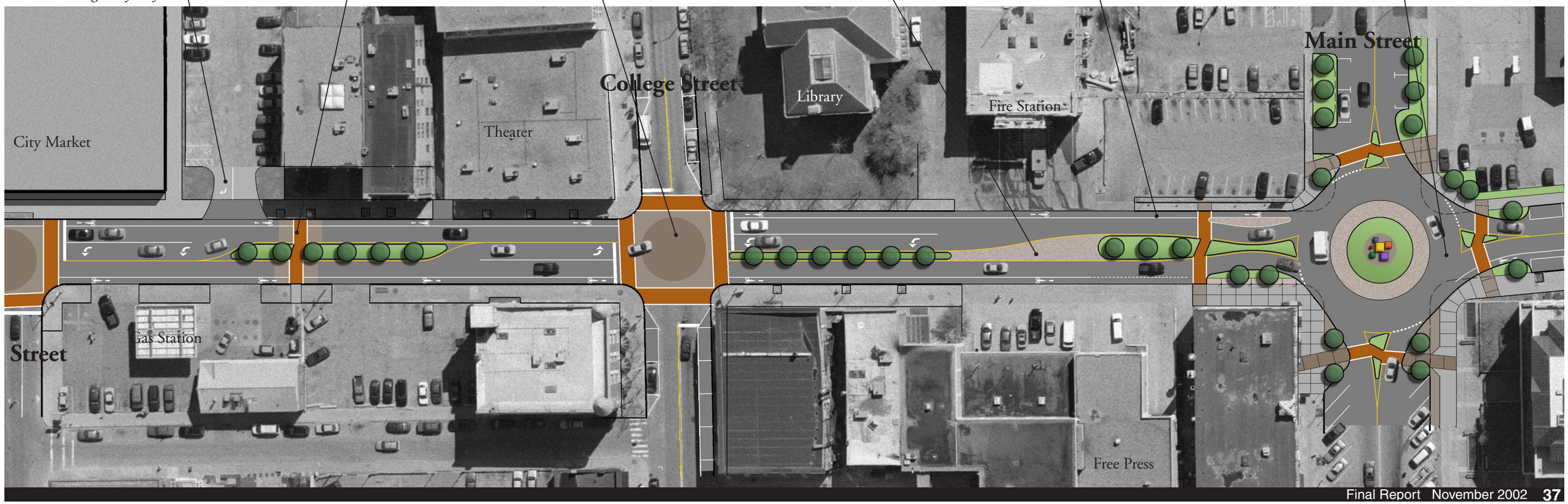
Bike lanes in both directions can be accommodated between Main and College Streets because of the reduced number of turn lanes

Entrance and exit at the market is with right turns only, eliminating many conflicts

'Enhanced' intersections are installed at all intermediate streets.

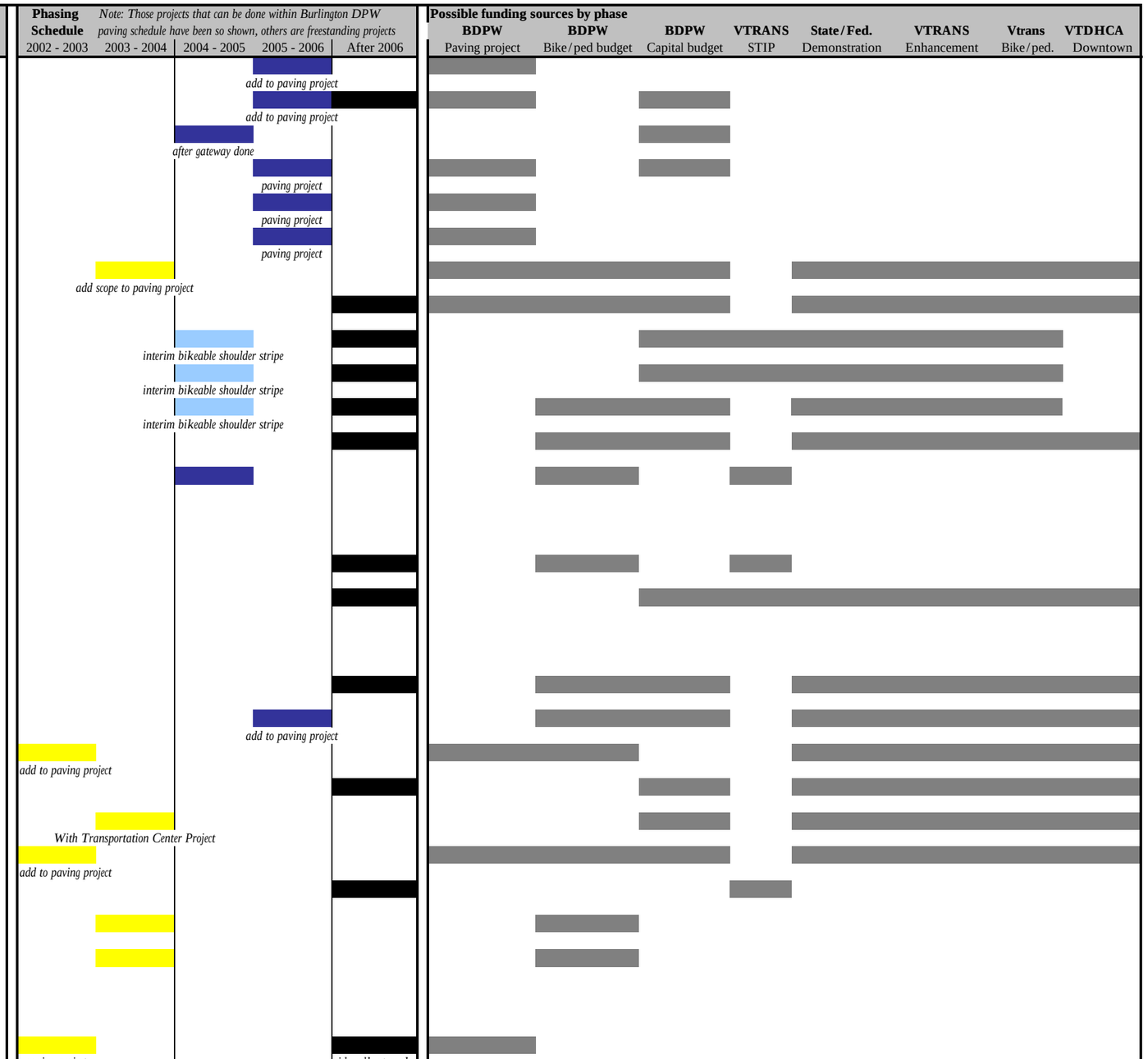
Mid-block crossing for market foot traffic

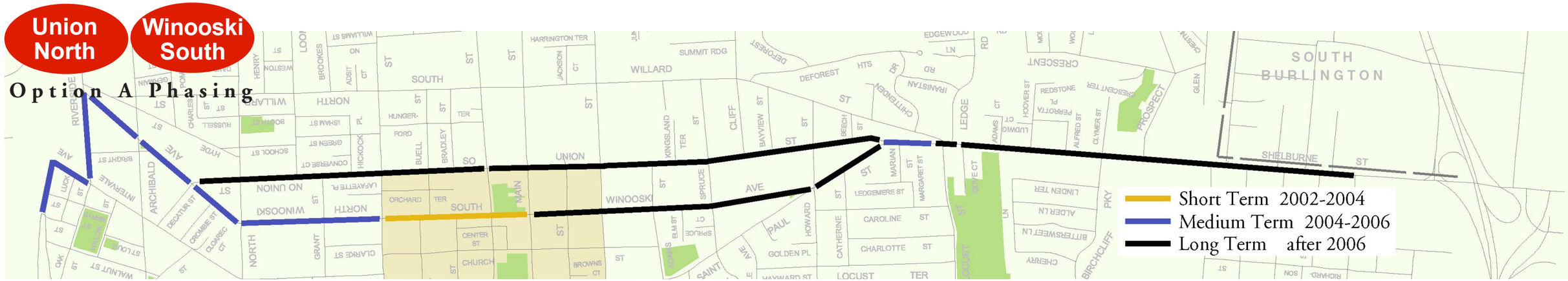
Cobbled break in the median for fire truck access



6. Costs and Phasing

Segment Alternative A	Street (See Page 18)	from	to	cost	Cost per Phase Total	City share % assumed	Grant share % assumed
A1	Manhattan/Intervale	RT. 127 Path	Riverside	$27,000.00		$5,400.00	$21,600.00
						20.00%	80.00%
A2	Riverside	Intervale	No. Winooski	$75,000.00		$15,000.00	$60,000.00
						20.00%	80.00%
A3	N. Winooski Streetscape	Riverside	Archibald	$80,300.00		$16,060.00	$64,240.00
						20.00%	80.00%
A4	North Winooski	Archibald	No. Union	$159,000.00		$31,800.00	$127,200.00
						20.00%	80.00%
A5	No. Winooski	No. Union	North Street	$21,000.00		$4,200.00	$16,800.00
						20.00%	80.00%
A6	No. Winooski	North Street	Pearl	$30,000.00		$6,000.00	$24,000.00
						20.00%	80.00%
A7 Base	So. Winooski	Pearl	Main	$276,000.00		$27,600.00	$248,400.00
						10.00%	90.00%
A7 Enhanced	So. Winooski	Pearl	Main	$820,000.00		$82,000.00	$738,000.00
						10.00%	90.00%
A8 - 10	So. Winooski	Main	St. Paul	$436,000.00		$87,200.00	$348,800.00
						20.00%	80.00%
A11	St. Paul	Howard	So. Union	$36,000.00		$7,200.00	$28,800.00
						20.00%	80.00%
A12 -13	South Union	St. Paul	College	$652,000.00		$130,400.00	$521,600.00
						20.00%	80.00%
A14	South/North Union	College St.	North Winooski	$114,000.00		$22,800.00	$91,200.00
						20.00%	80.00%
A15	St. Paul Street	South Union	Rotary	$15,000.00		$3,000.00	$12,000.00
					A1 - A15	20.00%	80.00%
					$1,921,300.00		
					$2,465,300.00		
A16	Shelburne Road Rotary Imp.			$364,000.00		$72,800.00	$291,200.00
						20.00%	80.00%
A17	Shelburne Street	Rotary	Home Ave.	$1,600,000.00		$320,000.00	$1,280,000.00
					A16-A17	20.00%	80.00%
					$1,964,000.00		
Alternative B	*(See Pages 19)*						
B1	North Ave.	Convent Sq.	Sherman/ Battery	$517,000.00		$103,400.00	$413,600.00
						20.00%	80.00%
B2 - 3	Park	Manhattan	Battery	$127,000.00		$25,400.00	$101,600.00
						20.00%	80.00%
B4	No. Champlain	Manhattan	Pearl	$93,000.00		$18,600.00	$74,400.00
						20.00%	80.00%
B5	Battery Park Pathway	North/Sherm	Pearl	$110,000.00		$22,000.00	$88,000.00
						20.00%	80.00%
B6	Battery	Pearl	Main	$65,000.00		$13,000.00	$52,000.00
						20.00%	80.00%
B7 - 8	Battery	Main	Maple	$52,000.00		$10,400.00	$41,600.00
						20.00%	80.00%
B9	Southern Connector	Maple	Locust	N/A		by others...	
B10	Pine	Locust	Flynn	$93,000.00		$18,600.00	$74,400.00
						20.00%	80.00%
B 11-12	Pine	Flynn	City Line	$163,000.00		$32,600.00	$130,400.00
					B1-B12	20.00%	80.00%
					$1,220,000.00		
					plus So. Conn.		
Alternative C	*(See Pages 19)*						
C	Locust	Rotary	Pine	$124,000.00	C	$24,800.00	$99,200.00
					$124,000.00	20.00%	80.00%




Union North
Winooski South
Option A Phasing
Short Term 2002-2004
Medium Term 2004-2006
Long Term after 2006

Pine Battery
Option B Phasing
Short Term 2002-2004
Medium Term 2004-2006
Long Term after 2006
Lake Champlain

Locust
Option C Phasing
Short Term 2002-2004
Medium Term 2004-2006
Long Term after 2006

7. Evaluation of the Options

The following table outlines the points of assessment of the route options based upon a wide range of criteria. Among the evaluation criteria are:

1. Cost
2. Pedestrian connectivity, convenience and proximity to destinations
3. Connectivity to Regional Bike /Ped. Routes
4. Is the route redundant with other nearby bike facilities?
5. Bike LoS per the BCI analysis least vs. greatest improvement in the BCI score
6. Eligibility for grant funds to save the city capital cost
7. Impacts to adjacent properties
8. All these add up to an (averaged) factor that characterizes the overall practicality of the option; whether the route can be accomplished in a reasonable time and cost, and whether the benefits of the system, once in place, clearly create a superior route for north/south bike and pedestrian travel across the city.

Scores of 1-5 have been assigned to the different criteria for the purpose of the evaluation matrix below, and supplemented by additional comments on this page. The lower the score, the higher the route rates.

Evaluation scale:1 - best to 5 - worst	Cost	Regional connectivity	Redundancy with other facilities	Pedestrian: connectivity	Pedestrian: convenience	Bike LoS per the BCI	Eligibility for grant funds	Impacts to adjacent properties	total points for the alternative	Overall practicality and realism	total for the alternative - lowest is best
Option A:											
A1	1	1	1	2	2	1	2	1	11	1	
A2	3	1	1	2	2	3	2	4	18	2	
A3	2	1	1	2	1	3	2	2	14	2	
A4	4	1	1	2	1	3	2	2	16	2	
A5	2	1	1	2	1	3	2	2	14	2	
A6	2	1	1	2	1	3	2	2	14	2	
A7 base	2	1	1	3	1	2	2	2	14	2	
A7 enhanced	4	1	1	2	1	2	2	2	15	2	
A8	2	1	1	2	1	3	2	1	13	1	
A9	2	1	1	2	1	2	2	2	13	1	
A10	4	1	1	2	1	2	2	2	15	2	
A11	4	1	1	3	1	2	2	2	16	2	
A12	4	1	1	2	1	2	2	2	15	2	
A13	1	1	1	2	1	2	2	1	11	1	
A14	1	1	1	2	1	2	2	1	11	1	
A15	1	1	1	2	1	2	2	1	11	1	**score of 1.4**
Rotary	4	2	1	2	2	3	2	4	20	2	**score of 2.5**
Shelburne Road	4	1	1	2	2	3	2	1	16	2	**score of 2**
Option B:											
B1	4	3	3	2	2	3	2	3	22	2	
B2	4	3	3	2	2	3	2	3	22	2	
B3	4	3	3	2	2	2	2	3	21	2	
B4	3	3	3	2	2	3	2	2	20	2	
B5	3	3	3	1	1	3	2	2	18	2	
B6	2	3	3	1	1	4	2	2	18	2	
B7	2	3	4	3	3	3	2	2	22	2	
B8	2	3	4	3	3	3	2	2	22	2	
B9	5	3	4	3	1	3	2	3	24	3	
B10: So Conn.	5	3	5	4	4	3	2	4	30	3	
B11	3	3	5	2	2	2	2	3	22	2	
B12	3	3	4	2	2	2	2	3	21	2	**score of 2.1**
Option C:											
C	4	3	3	1	1	2	3	2	19	2	**score of 2.3**

Cost

Option A: Costs on parts of this alternative are relatively low because there are several segments of bike lanes that are already in place. Of the seventeen Option A segments, four are higher cost street alterations. These include South Union Street, South Winooski, the Route 7 rotary and Shelburne Road. In the case of Shelburne Road, unknown factors could increase costs above the estimates provided. The larger unknown on the Shelburne Road segment is the proposed reduction in travel lanes to make space for bike lanes, and whether that would be acceptable from a traffic capacity perspective.

Option B: Costs on this alternative to the north and south of the proposed Southern Connector are relatively low with few major street alterations required. However, the viability of the route financially is because the Southern Connector could largely pay for the route. The timing of the implementation of the Southern Connector is unknown at this time and has been delayed until at least 2005. The unknown time schedule makes this alternative undesirable in the short term.

Option C: This option avoids the expensive Shelburne Road segment, but at the expense of a more direct route to and from the south end of the city.

Completion of pedestrian connectivity, convenience and proximity to destinations

Option A: This alternative creates a strong linear north south pedestrian connectivity from south to north across the entire city. Almost all major downtown destinations are accessed within a few blocks of the route, and there are relatively few segments of the corridor that are not already well equipped with sidewalks. Including Shelburne Road as the southern anchor of this alternative would be the optimal connection –to improve the major through corridor for the whole city to be highly bike/ ped friendly, but, as previously stated, there are unknown factors that challenge that option.

Option B: This route also serves connections to neighborhoods very well, but the portion of the route that follows Battery Street is removed from the Central Business District and is well downhill topographically from the center of city activity. Connecting from this route into downtown proper such as the Church Street area is problematic, making this route less desirable. In addition, much of this route is redundant with the Burlington Shared Use Path, which also serves the waterfront.

Option C: This alternative is best described as a connector between the two major route alternatives A and B. As such it is a possible link, but on its own, does not reflect a practical route to downtown from the south.

Connectivity to Regional Bike /Ped. Routes

Option A: Connects well with the planned regional improvements on the north end of the city at Riverside Ave. Route 127 Shared Use Path, and College Street.
Option B: Connects well with regional routes on Pine Street, Flynn Ave.
Option C: Connects between regional routes but is not a regional route into itself.

Is the route redundant with other nearby bike facilities?

Option A: This alternative has some redundancy with the northbound bike lanes on Willard Street but has a unique integrity as the major north south route across the whole city.

Option B: This route is redundant with several existing and planned routes: the Burlington Shared Use Path parallels much of this route, and the planned bikepath along the Southern Connector will be redundant. In many ways, the majority of this corridor will be implemented regardless of this study as the planning for the Southern Connector proceeds. If it is the city's desire to create a north/south bike and pedestrian route, alternative A would go much further to serving those needs, and making the right connections.

Option C: This route is a short connecting segment, and is not redundant with other existing facilities. Once a city and regional east/west bike and pedestrian connections plan is put in place, there will be redundancies, but that is desirable for a future city-wide bike network.

Bike LoS per the BCI analysis least vs. greatest improvement in the BCI score

Option A: All segments of this route show moderate to excellent gains in bike mobility and safety per the BCI before/ after analysis. Shelburne Street shows less gain in improvements because of the high traffic/truck volumes on that road. Experience from other "road diets" nationwide has shown that reducing travel lanes from four to two with a designated center turn lane protected by islands and definition of bike lanes could dramatically improve bike safety.

Option B: All segments of this route show moderate to excellent gains in bike mobility and safety per the BCI before/ after analysis.

Option C: Was not analyzed in the BCI, improvements scenario. Improvements will not likely be very high because Locust Street is a local street with relatively wide shoulders and low traffic volumes, but on the other hand it is a safe street to begin with.

Eligibility for grant funds to save the city capital cost

Option A: Almost all of this alternative is highly grant eligible, although it is relatively expensive and would take multiple grants and funding cycles over a period of years. The Pearl to Main Street section is an excellent EPA Smart Growth project that would serve well as a national model in street retrofitting for bike and pedestrian friendliness. The roundabouts could well be funded with CMAQ funds for improved air quality, since Chittenden County is a designated Air Quality Attainment Area.

Option B: This alternative is highly grant eligible, and a large portion is fully funded through the Southern Connector project.

Option C: This alternative is highly grant eligible, although the cost is relatively low. It may be more prudent to use city funds to implement it sooner and for less overall cost. (Grant funded projects tend to run 20-40% more expensive than locally funded projects and can take many years longer to implement.)

Impacts to adjacent properties

Option A: There are no land takings in this alternative but widening South Union Street for bike lanes will impact within the ROW.

Option B: Numerous land takings and Row impacts for the Southern connector. Widening North Ave. for bike lanes will impact within the ROW.

Option C: There are no land takings in this alternative but adding sidewalks and bike lanes along the park will create impacts within the ROW and minimally on the park land.

What is the preferred alternative?

Option A: This alternative is highly feasible from the Route 7 Rotary north. Shelburne Road is less feasible because of the traffic/cost implications, but still represents the most beneficial bike/pedestrian corridor in the entire city. This is true because of its proximity and centrality, and the fact Shelburne Road is presently the greatest obstacle to east/west bike and pedestrian mobility and would benefit those users most if improved.

8. Potential Funding Sources

Federal Funding Opportunities

Sources of federal financial and technical assistance are compiled in the Catalog of Federal Domestic Assistance (www.gsa.gov/fdac). The Catalog is available at depository libraries nationwide or contact the Federal Domestic Assistance Catalog Staff, General Services Administration, 300 7th St. S.W., Washington, D.C., 20407, Telephone 1-800-669-8333.

Periodically, the National Center for Recreation and Conservation of the National Park Service compiles a guide to Federal Funding and Assistance for Rivers, Trails and Open Space Conservation. Contact the National Center for Recreation and Conservation, National Park Service, Room 3606, 1849 C Street, NW, Washington, DC 20240-0001, 202-565-1200, www.ncrc.nps.gov/rtca

Capital Budget through the Federal Legislature – contact your federal legislators.

Land and Water Conservation Fund
LWCF funding for grants to municipalities has recently been reinstated; $170,000 is available for the FY 2001 round, with a minimum 50% match required. Eligible activities include outdoor recreation facility development, and land acquisition to serve conservation or future outdoor recreation development. Contact Laurie Adams-Smith, VT Dept of Forests, Parks and Recreation, at 802-241-3690.

National Park Service Rivers & Trails Program
RTCA provides technical and planning assistance to states, communities and conservation organizations for a wide variety of trail, river, and greenway projects. NPS staff works cooperatively with local trail groups, conservation organizations, and state agencies on greenways, rail-trails, river corridors, publications and workshops. September 1 deadline. Contact the Vermont/New Hampshire Field Office at 802-457-3368 ext 21 (PO Box 178, Woodstock, VT 05091), www.ncrc.nps.gov/rtca

State Sources:

Capital Budget through the Vermont Legislature – contact your local Legislators.

Certified Local Government Program/ Vermont Downtown Program. For information contact Jane Lendway, Vermont Division for Historic Preservation, National Life Building, Drawer 20, Montpelier, VT 05602-0501, telephone 802-828-3042.

Community Development Block Grant Program. For information please contact the Department of Housing and Community Affairs, 109 State Street, 4th Floor, Montpelier, VT 05609-0501, Tel: 802-828-3211.

Lake Champlain Partnership Program
The goal of the Partnership Program is to encourage grassroots projects that demonstrate practical ways to address economic and conservation challenges that enhance historic, cultural, scenic and natural resources within the Lake Champlain watershed. Eligible trail-related projects include planning and development of new trails, trail improvement, land conservation, public access, bikeways enhancements, signage and publications. Project support is generally between $500 and $5,000. Spring deadlines. For Lake Champlain watershed projects, contact the Lake Champlain Basin Program at 802-372-3213 (PO Box 204, 54 West Shore Rd, Grand Isle, VT 05458), www.anr.state.vt.us/champ/grants.htm

VTrans Bicycle and Pedestrian Program
The VT Agency of Transportation works with the regional planning commissions (RPC) and metropolitan planning organizations (MPO) each year to identify bicycle and pedestrian facility projects that can be funded through the Local Transportation Facilities Program. $2M in planning and construction funds available for bicycle/pedestrian planning and construction of bikepaths, sidewalks, and rail-trails. April deadline.
Contact Amy Bell, VT AOT Bicycle and Pedestrian Coordinator, 802-828-5799 (VT AOT, 133 State St., 5th Floor, Montpelier, VT 05633), Amy.Bell@state.vt.us

VTrans Enhancements Program
Funding is available for transportation enhancements including: provision of facilities for pedestrians and bicycles, acquisition of scenic easements and scenic or historic sites, scenic or historic highway programs, landscaping and other scenic beautification, historic preservation, rehabilitation and operation of historic transportation, buildings, structures or facilities (including historic railroads and canals), preservation of abandoned railway corridors and conversion to bicycle trails, control and removal of outdoor advertising, archeological planning and research, mitigation of water pollution due to highway runoff, tourist and welcome centers, and transportation museums. September letter of intent, November deadline. Contact Curtis Johnson or Scott Fortney at the VT Agency of Transportation, 802-828-3885 (VT AOT, 133 State St., Montpelier, VT 05633-5001), Scott.Fortney@state.vt.us

VTrans Scenic Byways Program
For projects including acquisition, development and planning along designated scenic byways. January application request. *Contact Paul Tober at 802-828-2822 (VT Agency of Transportation, 133 State St., Montpelier, VT 05633)*

Vermont Housing and Conservation Board
Funds for land conservation and affordable housing projects. Contact: VHCB, 136 ½ Main Street, Drawer 20, Montpelier, VT 05602-3501, Tel: 802-828-3250.

Vermont Recreation Trails Grants
VRTF provides funds to develop and maintain recreational trails and trail-related facilities for both non - motorized and motorized recreational trail use. The grants program is financed by the portion of state and federal gas tax monies attributable to off-highway vehicle use (such as snowmobiles, all-terrain vehicles, etc). Eligible projects include trail development, maintenance, and restoration, development of trail-side and trailhead facilities, creating accessible trails, acquisition of trail easements or fee acquisition of trail corridors, maps/ publications, and purchase of trail-building hand tools. Two grant programs are offered: an 80-20 match grant ($3,000 - $10,000+; a reimbursable program) and a mini-grant ($3,000 or less; paid up front with no match requirements). February deadlines. Contact the Recreation & Trails Administrative Assistant, VT Department of Forests, Parks and Recreation at 802-241-3690 (VT Recreation Trails Grant Program, 103 South Main St., 10 South, Waterbury, VT 05671-0601).

Vermont Watershed Grants
Funded by sales of Vermont's Conservation License Plates, mini-grants of $200-$1,000 and larger grants of over $1,000 are available for a wide range of water-related projects, including developing or enhancing recreational access and trails. November deadline. Contact Vermont Watershed Grants at 802-241-3770 (VT Agency of Natural Resources, Water Quality Division, Building 10 North, 103 South Main St, Waterbury, VT 05671-0408).

Vermont State Infrastructure Bank
This State loan program has $1.3 million available to lend to eligible and qualified municipal and private sector borrowers for projects that improve transportation facilities and provide economic development benefits. Contact: Steve Greenfield, Vermont State Infrastructure Bank, 58 East State Street, Montpelier, VT 05602, Tel: (802) 828-5627.
Rehabilitation Investments Tax Credit.
Ongoing eligibility. Provides a 20% federal tax credit for qualified rehabilitation of qualified income-producing historic buildings. The credit can apply to access improvements within the historic building and to new construction, such as added ramps if they are clearly for access purposes. For information contact Curtis Johnson, Vermont Division for Historic Preservation, National Life Building, Drawer 20, Montpelier, VT 05620-0501, Tel: 802-828-3047.

Vermont Youth Conservation Corps
Since 1985 VYCC, a non-profit organization, has coordinated trail crew work with VT youths in a variety of conservation projects including trail building and wildlife habitat enhancement projects. VYCC leaders provide expertise and oversight for crews. Communities can either hire a trail crew through the Fee-for-Service program or apply for a Greenways Crew funded by AOT and FHWA. January deadline. Contact the Youth Corps at 1-800-639-8922 or 802-241-3699 (PO Box 482, Waterbury, VT 05676), ycorps@together.net

State and National Organizations

American Hiking Society's National Trails Endowment
A new fund designed to support trail organizations in building trails, improving existing trails, securing land for future trails, or increasing the constituency for a specific trail project. Recent grant amounts $2,000 to $9,500. November deadline. Contact AHS at 888-766-4453 (AHS, PO Box 20160, Washington, DC 20041-2160), ahs.simplenet.com

American Greenways Awards / Conservation Fund
Non-profit organizations, public agencies, and individuals are eligible for $500 to $2,500 to stimulate the planning and implementation of greenways in communities throughout America. March 1 and June 1 deadlines. Contact the American

Greenways Coordinator at The Conservation Fund, (703) 525-6300 (1800 North Kent St., Suite 1120, Arlington, VA 22209), www.conservationfund.org

Bikes Belong Coalition
Grants of up to $10,000 each for projects funded by TEA-21 transportation monies, to develop bicycle facilities and put more people on bicycles. Contact Bikes Belong Coalition at 617-734-2800 (1368 Beacon St., Suite 116, Brookline, MA 02446-2800), www.bikesbelong.org/grants.htm

D.I.R.T. (Direct Impact on Rivers and Trails) Grant Program
Supported by PowerBar, this program supports projects that increase or maintain access to the outdoors, or increase the size of an outdoor recreational resource. Grants range from $1,000 to $5,000. June deadline. Contact DIRT Program PowerBar, Inc.(2150 Shattuck Ave., Berkeley, CA 94704), www.powerbar.com

National Trust for Historic Preservation:
Preservation Services Fund, Joanne Favrot Fund, 7 Fanueil Hall Marketplace, 5th Floor, Boston, MA 02109

Preservation Trust of Vermont.
Technical assistance grants and large grants program. For information contact Paul Bruhn, Preservation Trust of VT, 104 Church Street, Burlington, VT 05401, Tel: 802-658-6647.

Recreational Equipment, Inc. (REI) Grants
Conservation Grants – grants averaging $5,000 for grassroots organizing and D.C. lobbying to protect lands and waterways, make them more accessible to people who enjoy the outdoors, and better utilize and preserve our natural resources for recreation. March-Oct deadline. Community Recreation Grants – grants of $500 to $5,000 for outdoor programs that increase access, encourage involvement, and promote safety for outdoor muscle-powered sports. March-Oct deadline. Great Places Grants - $15,000 to $25,000 for projects protecting muscle-powered recreation sites. Feb 15 deadline. Contact the Grants Administrator at 1-800-426-4840 (REI, PO Box 1938, Sumner, WA, 98352), www.rei.com

River Network's Watershed Assistance Grants
A new grants program to support innovative efforts that build the capacity of community-based partnerships to conserve or restore watersheds. Two types of grants are available: Project Grants ($4,000 to $30,000) and Mini-Grants (under $4,000). Feb/June deadlines. Contact Kathy Luscher at 503-241-3506 ext. 16 (Watershed Program, River Network, PO Box 8787, Portland, OR 97207), kluscher@rivernetwork.org

Vermont Historical Society's Cultural Facilities Grants Program.
For information contact the Vermont Historical Society, 109 State Street, Pavilion Building, Montpelier, VT 05609-0901, Tel: 802-828-2291.

Foundations

Many foundations support conservation initiatives, including trails and greenways development. It is important with any foundation prospecting to call ahead to discuss your project and request specific guidelines, and to focus on specific project needs that best fit the goals of the foundation's giving program.

In Vermont, a good place to start is the Vermont Directory of Foundations ($40) published by CPG Enterprises, PO Box 199, Shaftsbury, VT 05262 (802-447-0256). The Directory covers foundations incorporated in Vermont as well as those outside of Vermont making regular Vermont contributions, and is the only publication specifically designed for VT grantseekers. CPG also publishes a newsletter NonProfit Vermont, to facilitate communication within the nonprofit community (One yr/6 issues $24).

The VT Community Foundation website (www.vermontcf.org/link.html) has many good nonprofit resource links.

New England Grassroots Environment Fund
A project of the NH Charitable Foundation; small grants of $500 to $2,500 are available to both non-profit and ad hoc groups for projects that foster and give voice to community-based environmental initiatives in New England. Jan/May/Sept deadlines. *Contact NEGEF at 802-223-4622 (PO Box 1057, Montpelier, VT 05601),www.grassrootsfund.org, cfischer@plainfield.bypass.com*

The Foundation Center is a national information center on corporate and private foundations, community foundations, and grantmaking public charities. They publish The Foundation Directory, a national reference with detailed descriptions and giving histories that you can find at most libraries. You can also subscribe to it online at the Foundation Center's website.

You can also check the Environmental Grantmakers Association directory (212-812-4260, 437 Madison Ave., 37th Flr., NY, NY 10022). Their web site, includes many nonprofit and foundation links.

The Directory of Funding Sources for Grassroots River and Watershed Conservation Groups in New England and New York is an extensive resource from the Northeast Watershed Round Table and River Network (202-364-2550). Several organizations offer help in nonprofit management, organizational leadership, and grantmanship. These include the Vermont Community Foundation(TAP-VT 802-388-3355), The Grantsmanship Center (800-421-9512), and the Nonprofit Management Institute (in Boston at 617-728-9151). Vermont Community Foundation (VCF) provides modest grants to projects that leverage other resources and make a significant difference to the state and address a clear community need in the areas of environment, public affairs, community development, social services, education or the arts. Recent grant amounts have been in the $2,000 - $8,000 range. April and October deadlines. *Contact VCF at 802-462-3355 (PO Box 30, Middlebury, VT 05753),* www.vermontcf.org

Funders' Network for Smart Growth and Livable Communities is a consortium of funders who recognize the link between community design, land development and investment patterns and public health. Their mission is to inform, strengthen, support and connect organizations working to advance social equity, create better economies, build livable communities, and protect and preserve natural resources. For more information: www.fundersnetwork.org

Robert Wood Johnson Foundation: Member of the Funders Network (above). For information, see www.rwjf.org

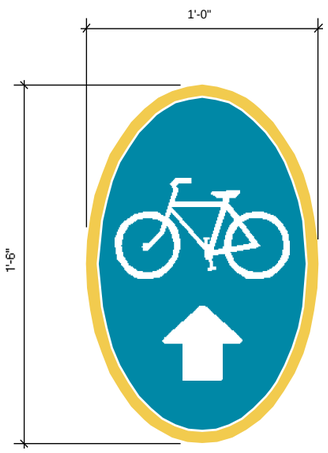
9. Appendix

Relevant exerpts from Burlington's Signing & Wayfinding Plan

by LandWorks

Pedestrian/Bus Oriented Sign Family

Bikeway Sign



Features

Bold edge and color graphic concept to follow Burlington and District Logotype example

For use on Riverside Avenue Bike Path, Burlington Bike Path, etc.

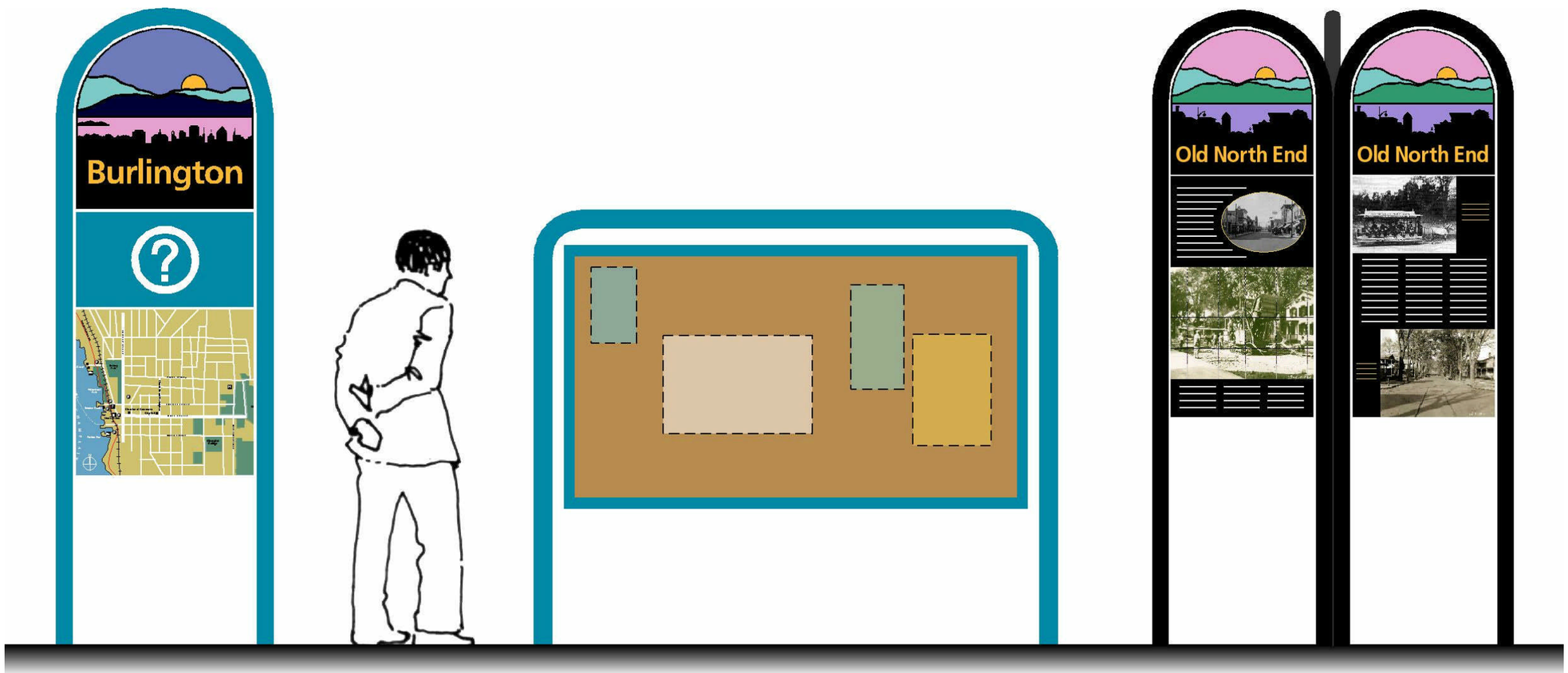
Proportions and arrow match Cycle the City/Champlain Bikeway signs

Universal bike symbol

Aluminum sign panel with vinyl graphics and lettering
Smaller (6"x9") version can be developed to fit to many applications (existing sign posts, light standards, etc.), fabricated from durable PVC plastic sign with vinyl graphics.

Bikeway marker **District banner** **1'6" Bus stop hairpin w/ LED option** **1'6" Bus stop sign**

Pedestrian/Information Oriented Sign Family



Map/interpretive
2'6" hairpin

Bulletin board

Gateway/triple hairpin