



Burlington Bike Path Intersections Scoping Study

In the City of Burlington, Vermont

Prepared for:



**Chittenden County Regional Planning Commission
Burlington Department of Parks and Recreation
Burlington Department of Public Works**

Prepared by:



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1. PROJECT OVERVIEW

The Burlington Bike Path (bike path) is an important contributor to downtown Burlington, Vermont's economic vitality. The nearly eight mile section within City limits is part of the regional Island Line trail and attracts a variety of users throughout the year. The path supports recreation and alternative transportation and is used by bicyclists, runners, walkers and other non-motorized users. Since its inception the path has continuously grown in popularity and is in great need of rehabilitation and improvement in a number of areas. The rehabilitation and reconstruction of the path is currently in design and the first phase of reconstruction is scheduled to begin in fall of 2014.

Acting on behalf of the City, the Chittenden County Regional Planning Commission (CCRPC) requested that VHB study potential short term and longer term crossing enhancements along the Burlington Bike Path. This study specifically addresses observed deficiencies and concerns at the 12 path/roadway intersections listed below.

1. Home Avenue
2. Austin Drive
3. Harrison Avenue West
4. Harrison Avenue East
5. Maple Street
6. King Street
7. College Street
8. Little Eagle Bay
9. Shore Road
10. Staniford Road
11. Starr Farm Road
12. North Avenue Extension

Two crossings that were not included in this study were Driftwood Lane and Penny Lane. Driftwood Lane is an extremely low volume privately owned roadway and was therefore excluded from the scope of the project per the City's request. The Penny Lane crossing is being redesigned through a separate initiative, Waterfront Access North, and will be constructed in 2014.

The first step in this process was the evaluation of existing conditions at each crossing including a field visit and written and photographic documentation. Each of the twelve crossings were reviewed for existing signs, speed limits, travel patterns, dimensions, opportunities, and constraints. Recommended improvements were then presented to the public and City staff, and their input was incorporated in the enclosed concept plans. This report summarizes the findings and improvement recommendations.

2. YIELD ANALYSIS

As an important facet of the intersections scoping study, VHB completed a yield control analysis of ten (10) of the bike path crossings. These crossings were identified by the City as candidates for conversion to yield control from the existing stop control on the path due to minimal vehicular traffic and/or slow traffic speeds in conjunction with high volumes on the bike path, and because of their high potential for very near-term improvements.

The following is a summary of the crossing analysis. The crossing locations are as follows:

- | | |
|--------------------------|------------------------------|
| ➤ Harrison Avenue (West) | ➤ Beachcrest Drive |
| ➤ Harrison Avenue (East) | ➤ Leddy Beach (South Access) |
| ➤ College Street | ➤ Leddy Beach (North Access) |
| ➤ Lake Street | ➤ Shore Road |
| ➤ Little Eagle Bay Road | ➤ North Avenue Extension |

A few at-grade crossings were excluded from the yield analysis per the City's request due to varying circumstances. For example, the crossings at Home Avenue and Austin Drive were not considered as these are transitions from an off-road to on-road section of the bike path and cyclists should continue to stop before entering the roadway.

The Manual on Uniform Traffic Control Devices (MUTCD) Section 9B.03 provides the following guidance for placement of stop vs. yield signs on shared-use paths:

"Where conditions require path users, but not roadway users, to stop or yield, the STOP or YIELD sign should be placed or shielded so that it is not readily visible to road users.

When placement of STOP or YIELD signs is considered, priority at a shared-use path/roadway intersection should be assigned with consideration of the following:

- A. *Relative speeds of shared-use path and roadway users,*
- B. *Relative volumes of shared-use path and roadway traffic, and*
- C. *Relative importance of shared-use path and roadway.*

Speed should not be the sole factor used to determine priority, as it is sometimes appropriate to give priority to a high-volume shared-use path crossing a low-volume street, or to a regional shared-use path crossing a minor collector street.

When priority is assigned, the least restrictive control that is appropriate should be placed on the lower priority approaches. STOP signs should not be used where YIELD signs would be acceptable."

To determine whether yield signs would be acceptable on the path at these locations VHB referred to the Vermont Pedestrian and Bicycle Facility Planning and Design Manual, the MUTCD, the 2012 AASHTO Guide for the Development of Bicycle Facilities (AASHTO Bike Guide), and the AASHTO Geometric Design of Highways and Streets Book (Green Book) for regulations and guidance. The AASHTO Bike Guide provides guidance for calculating the required sight distance for path users to safely cross an intersection with a roadway under a yield control scenario. Tables 5-7, 5-8, and Figure 5-15 from the AASHTO Bike Guide include equations to evaluate the necessary sight distance. Using these equations, known path information, and existing field conditions, VHB calculated the available sight distance at each at-grade crossing.

The findings of the yield control analysis indicate that providing yield signs for path users at the proposed crossings are not supported based on the existing available decision sight distance for cyclists using the path. The one exception to this exists at the crossing of Lake Street where there is adequate sight distance in all directions.

Given the very conservative decision stopping sight distance that AASHTO prescribes along the path it is very difficult to find intersection sight triangles of suitable length along the Burlington bike path to allow the use of yield control. The desired sight triangles are typically obstructed by vegetation, fences, signs or structures. VHB is therefore unable to support replacing stop signs with yield signs

where the site conditions do not provide at least the minimum sight lines required by the accepted design guidelines.

In addition, it should be noted that as stated by law, motorists are required to yield to pedestrians at crosswalks, but they are not required to yield to bikes unless the bikes are already in their path in the crosswalks or unless the cyclist dismounts and crosses the road on foot. The design guidelines do provide a certain amount of flexibility and the City may choose to weigh other site conditions such as low side street volumes in combination with lower than posted vehicle speeds and good visibility of an intersection to still consider yield controls. The current intersection concept plans include the conversion of path stop signs to yield signs at Little Eagle Bay Road and North Avenue Extension. Both of these intersections are very low volume and low speed and a high percentage of cyclists already disobey the stop signs due to those conditions. The side streets will be stop controlled at both locations. The Burlington Bike Path Rehabilitation Project (rehabilitation project) is a current initiative through the City as well which involves the reconstruction of the entire eight mile bike path. **As part of the rehabilitation project, it is advisable to reevaluate the intersections to assess potential for improved sight lines, crossing geometry, crossing visibility and bicyclist and motorist behavior.** One consideration is to introduce traffic and bicyclist calming measures that will reduce the size of the required sight triangles and thereby warranting conversion to bike yield controls. More information on the background, process, and results from the yield analysis can be found in Appendix A – Yield Sign Analysis Memorandum.

3. INTERSECTION IMPROVEMENTS

3.1 Home Avenue

Existing Conditions

The Burlington Bike Path approaches Home Avenue from the south and connects to an existing sidewalk on Home Avenue. At the corners of the path/sidewalk intersection there are large trees with somewhat overgrown vegetation that limits sight distance between path users and vehicles on the road or pedestrians and other users of the sidewalks. There are currently no appropriately designed entrances to the roadway from the path or the sidewalk. A cyclist wishing to head eastbound on Home Avenue is forced to either ride on the dilapidated sidewalk or to enter the road at the next closest driveway. Cyclists heading west to pick up the path on Austin Drive typically use the curb cut adjacent to the railroad tracks to enter the roadway. After entering the road, cyclists cross over the tracks between the median islands at a skewed angle as shown in the image to the right. It is recommended that bicyclists cross railroad tracks at a ninety degree angle to reduce the risk of falling, so it is preferable that they cross Home Avenue first and then head west across the tracks.



Tandem cyclists unsafely crossing the railroad tracks at a skewed angle

Wayfinding at this crossing is very limited and an unfamiliar path user would likely struggle to follow the Burlington Bike Path down Austin Drive to the next off-road section of the path. Likewise, the entrance to the path at the Home Avenue intersection is not well marked.

The existing pedestrian facilities in this area include sidewalks which are in very poor condition and are unsafe. Home Avenue and Austin Drive do not have dedicated bicycle facilities and lack advisory signage to indicate that these are a bike route and shared road.

This crossing location and adjacent pedestrian facilities will be heavily influenced by the planned Champlain Parkway roadway which will cross Home Avenue very close to the path entrance. The design plans currently depict bike and pedestrian accommodations at the resulting Home Avenue / Champlain Parkway intersection.

Recommended Solutions

Short term solutions at this crossing include enhanced pavement markings, additional wayfinding and signage, and vegetation trimming to improve sightlines. Painted shared lane markings (also known as “sharrows”) should be added to Home Avenue following accepted guidance on spacing and positioning. Other paint marking that should be incorporated to the area includes a “path ends” marking on the path prior to the crossing to warn users that a roadway connection is coming up.



View of Home Avenue from the Bike Path with limited sight distance to the east and west

A wayfinding sign at the intersection of the path and sidewalk should be added so that path users can easily determine where to go to continue along the Burlington Bike Path, which way to go for other local attractions, and how far they’ll need to travel to get there. Existing vegetation and tree branches in the area should be trimmed to improve the existing sight distance. Both of these improvements will also enhance user awareness of this connection and create a more visible entrance to the path for people traveling on Home Avenue.

As long term solutions in this area it is recommended that additional curb cuts be installed from the path and sidewalk to allow cyclists to access Home Avenue at better locations to head east or west. The center median island on Home Avenue should be shortened to accommodate a straight crossing from the path to the north side of Home Avenue. This will allow cyclists to then head west on the road, crossing the tracks at ninety degrees. Along with the additional road connections, the sidewalk should be widened and repaired to better accommodate a mix of cyclists and other path users. Existing path signage should also be modified to include the relocation of the existing stop sign, the addition of a warning sign for cyclists to yield to pedestrians on the sidewalk, and the addition of appropriate roadway warning signs as recommended by the MUTCD. All of these proposed improvements are shown in Figure 1.

Because Home Avenue and Austin Drive are a key connection to the rest of the bike path to the north, the signage and facilities through this segment should be improved. Through the rehabilitation project, additional roadway signage will be recommended to alert motorists that they should expect shared use of the road with cyclists, and to confirm for cyclists that they are on the correct route to connect to the path segments.

Discussion

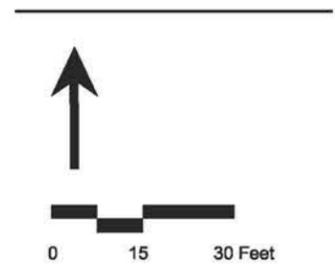
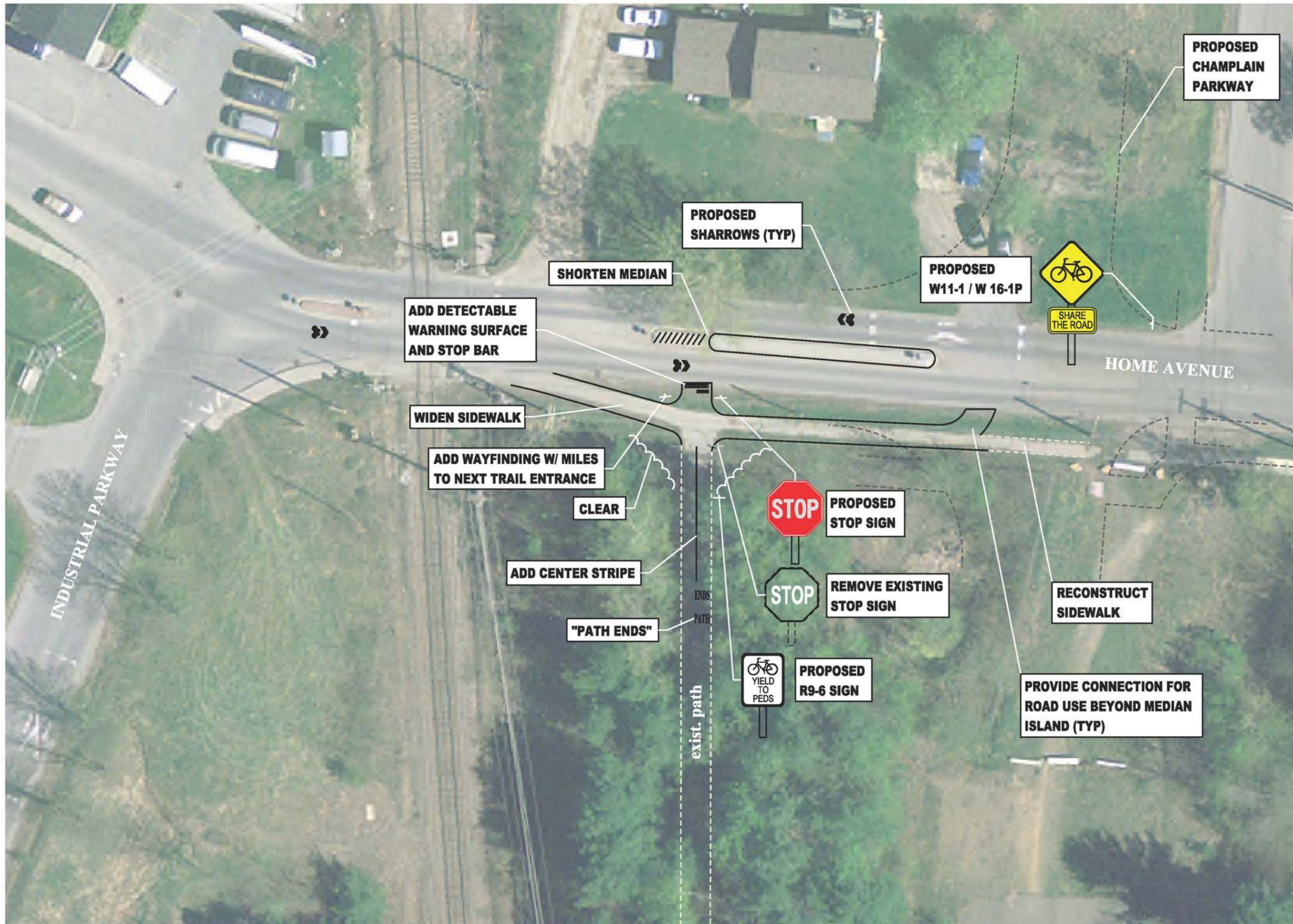
An important consideration in this area is the future Champlain Parkway. The proposed parkway design is shown on Figure 1 and the path related recommendations brought forth at this time are designed so as not to conflict with or in any way limit the planned parkway project.

Short Term Recommendations:

- ADD SHARROWS IN ROAD
- ADD "PATH ENDS" MARKING
- ADD WAYFINDING FOR TRAIL USERS
- SELECTIVE TREE TRIMMING TO IMPROVE SIGHT LINES
- ADD W11-1/W16-1P

Long Term Recommendations:

- WIDEN SIDEWALK TO 8'-10'
- ADD CONNECTIONS TO STREET BEYOND MEDIAN
- RELOCATE STOP SIGN
- ADD R9-6 SIGN
- ADD DETECTABLE WARNING SURFACE (DWS) AND STOP BAR



**Burlington Bike Path
 Home Ave Crossing**

Figure 1

Burlington, Vermont

January 17, 2014

3.2 Austin Drive

Existing Conditions

Austin Drive is a popular bike route to the Burlington Bike Path entrance and it is also an access point to Oakledge Park. There is a large boulder in the center of the entrance to the path to act as a deterrent for vehicle access to the park parking lot. As this is a paid parking lot there is a need to continue preventing vehicles from using the path to access the park but to do so in a safer manner and in accordance with accepted design guidance.

In addition, the alignment of this crossing currently allows cyclists approaching from the east from Home Avenue to cut the corner as they enter the path and travel at high speeds alongside the boulder. This adds a compounded safety concern as cyclists typically travel at high speeds to enter at this connection and then are required to maneuver around a large boulder which is not expected or otherwise warned.

While there are signs in the area noting that there is a crossing at this location, they are not up to current design standards and wayfinding signs are limited. As a major access to the Burlington Bike Path there is a definite need for wayfinding and informational signage.

Sight distance in this area for a south to eastbound path user is also limited due to horizontal and vertical curves on Austin Drive as well as vegetation on the north west corner of the crossing.

Recommended Solutions

Short term solutions in this area should include updating the existing signage, the addition of wayfinding or informational signs, and pavement markings. Similar to the intersection at Home Avenue, the path should utilize a “path ends” pavement marking to indicate that there will be a change from off-road to on-road facilities for a user heading east. Vegetation should be trimmed within City right-of-way to improve sight distance as path users enter onto Home Avenue. Wayfinding should be added at this location as connections are not as well known to the south. An informational kiosk and wayfinding signs should be added which also include mileage to different locations including the bike path connection to Queen City Park Road via Home Avenue. Signs already exist to warn vehicles of the path crossing but should be updated to current standards and relocated as necessary. In order to develop consistency in the warning signs throughout the path roadway crossings, W11-15 with W11-15P crossing signs on the street in advance of the crossing, and W11-15 with W16-7P signs at the crossing itself, are being recommended in all locations possible.

Long term improvements can also be made to this intersection to improve accessibility for all users. The path should be realigned to the west slightly so as to create a perpendicular crossing as opposed to the existing skewed alignment which encourages high speed cyclists to enter the path dangerously. A curb can be placed on the north east corner of the crossing to enforce this. In



Austin Drive bike path connection showing unmarked boulder and limited sight distance

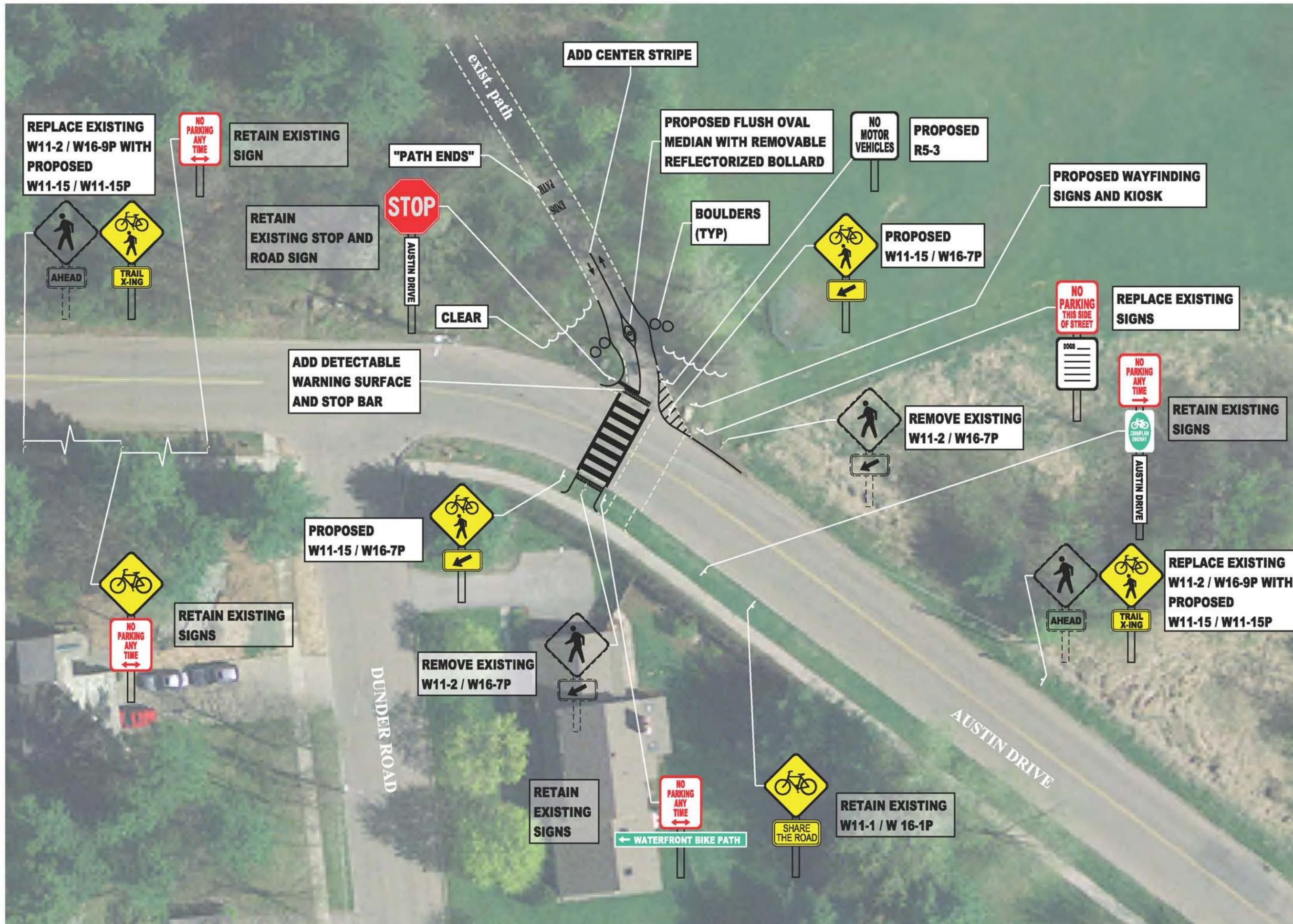


Example of existing pavement markings that can be enhanced as a short term solution

addition, to replace the hazardous boulder in the middle of the path, a splitter island should be designed to prevent motor vehicles from entering the park by the bike path and to also slow cyclist speeds as they enter the intersection of Austin Drive. The splitter island should include a reflectorized removable bollard and flush imprinted pavement as a base. During large scale athletic events, such as the marathon, when many users need to share the path it will be important not to have an obstruction constricting the path width. The existing boulders in the area can be utilized on the outside of the path to define the entrance if desired. Detectable warning surfaces (DWS) should also be added to the crossing in accordance with ADA guidelines similarly to all of the intersections present herein. All of these proposed improvements can be seen on Figure 2 on the following page.

Discussion

The existing intersection includes stop sign on the bike path approach to Austin Drive. The City may desire to change this to a yield sign if sight distances and path/road speeds allow the conversion. By adding a splitter island and realigning the path, this area could possibly be a candidate for switching the stop sign to a yield sign due to the slowing of cyclist speeds and trimming vegetation at the City owned park entrance. This would need to be investigated further either in the development of the splitter island or through speed studies and sight distance analysis after the initial improvements.

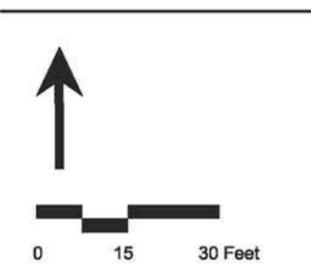


Short Term Recommendations:

- ADD PATH MARKINGS INCLUDING CENTERLINE STRIPES, "PATH ENDS", AND STOP BAR
- UPDATE W11-2 SIGNS WITH W11-15/W16-7P AND W11-15 / W11-15P
- ADD R5-3 SIGN
- ADD WAYFINDING FOR TRAIL USERS
- TRIM VEGETATION

Long Term Recommendations:

- RECONFIGURE PATH ENTRANCE TO BE MORE PERPENDICULAR
- SHIFT CROSSWALK
- ADD DETECTABLE WARNING SURFACE (DWS)
- USE CURB INSTEAD OF BOULDERS TO DEFINE TRAIL ENTRANCE
- CONSTRUCT SPLITTER ISLAND TO REPLACE BOULDER IN PATH WITH REMOVABLE BOLLARD TO RESTRICT MOTOR VEHICLES. DEFINE SPLITTER WITH FLUSH IMPRINTED PAVEMENT
- ADD PAINTED DIRECTIONAL ARROWS ON PATH



**Burlington Bike Path
 Austin Dr Crossing**

Figure 2
 Burlington, Vermont
 January 17, 2014

3.3 Harrison Avenue West

Existing Conditions

After passing through Oakledge Park the bike path follows along the side of Proctor Place and then connects to a final on-road connection at Harrison Avenue. As the path follows Proctor Place there is no distinct definition of the path as opposed to the roadway. The path is paved whereas the road is gravel which leads to stormwater and runoff expediting the deterioration of the edge of the path in this area. This also leads to cyclists and vehicles sharing both the road and the path which creates more potential for conflict.

Harbor Watch is a private development which is only accessible from Harrison Avenue. Motorists that regularly pass through this location are typically well aware that path users enter the road at the entrance to their development. However, the fence, hedgerow, and other vegetation at the corner of the path restrict sight distance for path users as they merge into east bound traffic. Warning signs for vehicles and path users exist at this crossing but are limited and in some cases blocked by overgrown vegetation. Paint markings at the crossing currently include sharrow on Harrison Avenue but no markings on the path.



Path deterioration and sight distance restrictions at Harrison Avenue

Recommended Solutions

Short term solutions near the western crossing of Harrison Avenue include similar treatments as other intersections such as paint markings, sign improvements, and vegetation trimming. Coordination with the Harbor Watch community should take place to either trim existing vegetation along the fence line at the corner of their property or to replace it with lower lying bushes that would not restrict sight distance. Signs in the area should be updated to be consistent with other similar warning signs at the intersections. The westbound sharrow should be replaced with more appropriate bike symbol and arrow markings to help reinforce the message that there is a path entrance at Proctor Place. Other paint markings that should be incorporated include a centerline stripe on the bike path, edge of path lines to delineate the path, and possibly green paint on the bike path to provide even more visual separation from Proctor Place.

As a long term improvement it is recommended that the City pave the entrance to Proctor Place. This would allow improved path/roadway delineation and also improve drainage and runoff at the intersection. If possible all of Proctor Place should be paved to prevent the path deterioration that is evident today. All of these proposed improvements are shown in Figure 3.

Discussion

Harbor Watch has a speed bump near the entrance to the development which acts as a traffic calming device for vehicles that are entering or exiting the development. This likely limits the severity of conflicts between vehicles and cyclists or path users as the vehicles are traveling slowly and are aware of the path crossing. Traffic calming and warning signs here should be maintained.

3.4 Harrison Avenue East

Existing Conditions

The eastern access of the bike path at Harrison Avenue connects the on-road portion of the path with the standard path near the railroad track crossing to Sears Lane. This crossing is unique in that the path doesn't necessarily cross or intersect Harrison Avenue, but rather it merges into it or continues off the road depending on the direction of travel. There is currently no stop or yield sign at this location as there is no direct crossing, but warning signs exist in the area to create awareness of the roadway and nearby railroad. As path users enter and exit this access point to the path, there is often conflict among users and congestion as the entry of the connection is narrow. These conflicts combined with the deficient guardrail and lack of paint markings at the access point create a potentially hazardous location for all path users.



Multiple users near Harrison Avenue navigating narrow corridor and congestion

Recommended Solutions

Short term solutions at the eastern connection to Harrison Avenue include enhanced wayfinding, signage, and paint markings. As cyclists or other path users head east on Harrison Avenue, it is unclear where the bike path connection is. This location should utilize larger wayfinding signs to allow ample guidance to users and to let them know they are still on the correct route. In addition, paint markings on the roadway can help to eliminate confusion in the area. It is recommended that a centerline be painted extending from the path to the road so as to keep users in the right hand travel lane. This should be supplemented with painted bike symbols and arrows to reiterate the direction of travel. Signs should be updated consistently with other crossings as shown in Figure 4 on the next page.

A primary long term solution here should include replacing the current guardrail on the west side of the path with a bike safe and appropriate height railing. These long and short term improvements are shown in Figure 4.

Discussion

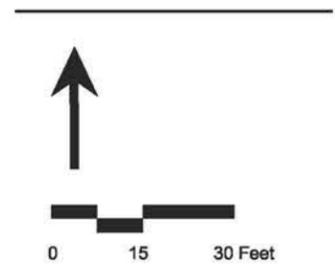
In addition to the long and short term solutions included here, this entry to the path could be widened and formalized further. These options will be further evaluated through the rehabilitation project. The City may also wish to pursue a wider path entrance by negotiating with the railroad to acquire additional right-of-way. This would allow the fence on the eastern side of the path to shift to the east and create a widened path.

Short Term Recommendations:

- ADD CENTER STRIPING AND DIRECTIONAL ARROWS TO MANAGE BIKE FLOW AT PATH ENTRANCE
- ADD BIKE SYMBOL AND ARROW AT ENTRANCE
- ENLARGE BIKE PATH DIRECTIONAL SIGN AT END OF ROAD
- UPDATE WAYFINDING SIGN
- REPLACE EXISTING W16-1P

Long Term Recommendations:

- REPLACE GUARDRAIL WITH DURABLE BIKE-SAFE RAILING



**Burlington Bike Path
 Harrison Ave Crossing**

Figure 4

3.5 Maple Street

Existing Conditions

The bike path crossing at Maple Street is a high volume area for path users as well as motorists accessing the Perkins Pier parking lot and boat access. Perkins Pier parking lot is a City owned paid parking lot and therefore currently includes a guard booth on Maple Street near the crossing of the bike path. As vehicles trailering boats stop at this guard booth they frequently obstruct the bike path as well as the nearby railroad crossing in some instances. Both of these occurrences are unsafe but difficult to regulate since the drivers need to stop at the guard booth.

The path is also unclearly defined where it runs parallel with Railway Lane near this intersection. The path and roadway are both paved and a faded painted line currently delineates one from the other. Although this is typically enough to encourage path users to stay within the bike path, there is no physical boundary or separation between the path and the road.

The path at this crossing is stop controlled and there is also an existing stop sign for vehicles traveling east out of the Perkins Pier lot. Other signs include two W11-1 signs prior to the path to warn westbound vehicles. Existing utilities on the northern path approach to this intersection also limit path realignment options.



Minimal path delineation makes it unclear where path users should safely travel

Recommended Solutions

Short term recommendations are similar to other intersections in the overall concepts. Path delineation should be improved by adding redefined lines along Railway Lane. Path markings would also include “stop ahead” warnings to the path users to alert them of the intersection.

The primary long term solution suggested here incorporates a pedestrian refuge area by extending a median island out from the guard booth. This is shown in more detail on the following page in Figure 5. DWSs should also be added to comply with ADA guidelines. Additional path delineation can be accomplished by the addition of a colorized path pavement treatment along Railway Lane as a long term solution. All of these proposed improvements are shown in Figure 5.

The rehabilitation project is considering a physical separation of the bike path along Railway Lane using a grass strip and a concrete curb which will further enhance the separation of vehicles and path users.

Discussion

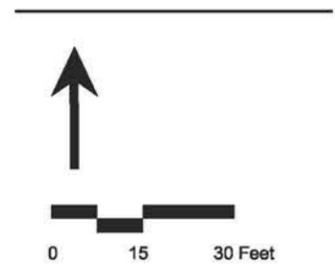
Through the Public Investment Action Plan (PIAP) process the City is investigating additional improvements for the Perkins Pier area. The above bike path recommendations have been developed in conjunction with discussions of the Perkins Pier improvements and will not conflict with or limit that proposed project in this area.

Short Term Recommendations:

- EXAMINE POTENTIAL SIGHT LINE IMPROVEMENTS BY MANAGING VEGETATION AND SIGNS AT CORNERS
- RE-STRIPE ALL PATH AND ROAD MARKINGS
- ADD PATH CENTERLINE
- ADD "STOP AHEAD" PATH MARKING
- UPDATE SIGNS TO W11-15/W16-7P AND W11-15/W11-15P AND ADD W11-15 / W11-15P
- ADD R9-6 SIGN

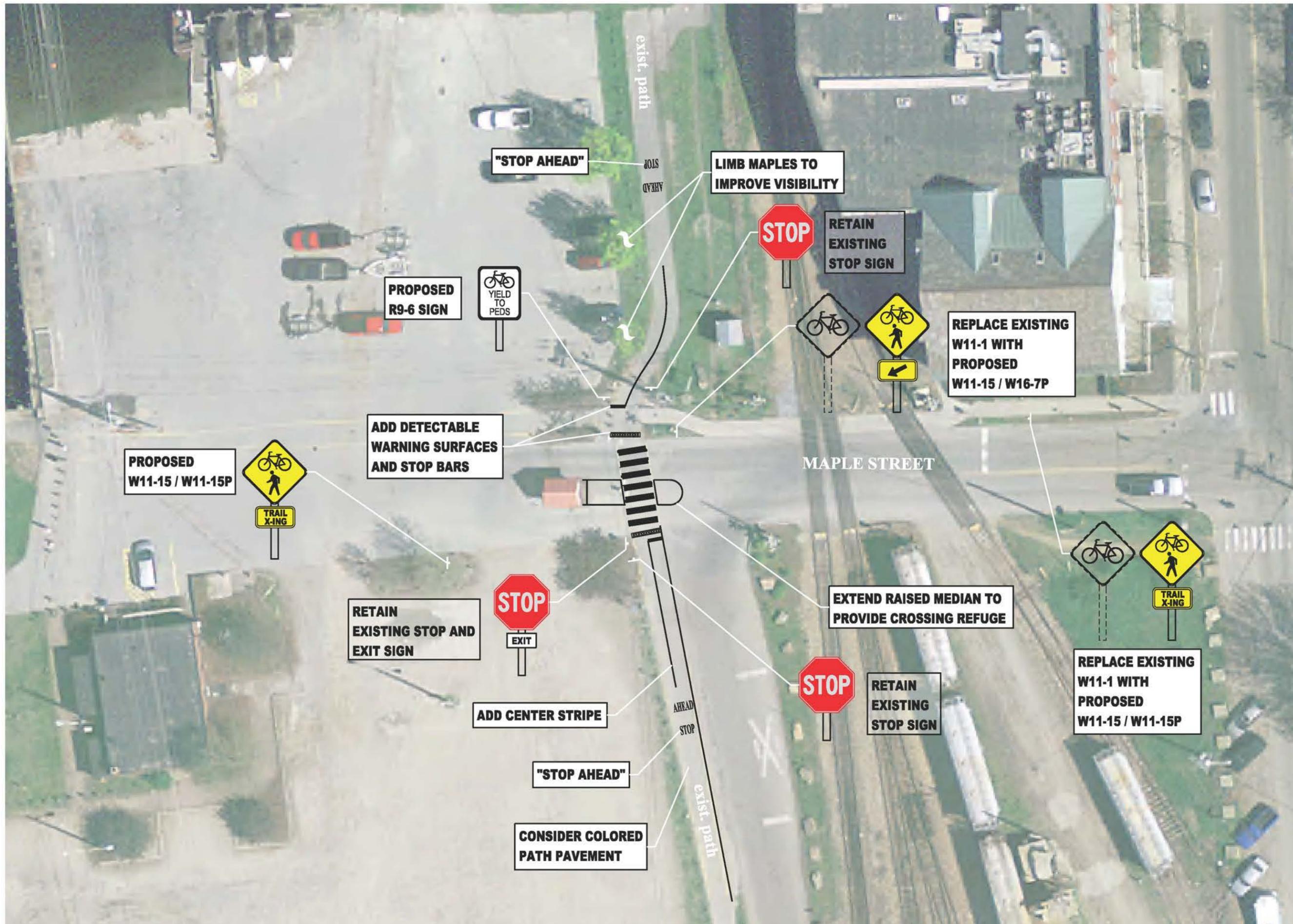
Long Term Recommendations:

- CONSIDER COLORED PATH PAVEMENT
- ADD DWS AT CROSSWALKS
- CONSIDER EXTENDING RAISED MEDIAN AT TICKET BOOTH
- WORK WITH UTILITY OWNERS TO IMPROVE PATH APPROACH WIDTH AND ALIGNMENT



**Burlington Bike Path
 Maple Street Crossing**

Figure 5



3.6 King Street

Existing Conditions

The bike path crossing at King Street is similar to Maple Street in that it is a high volume location for path use and roadway use. This intersection, however, also includes a path railroad crossing on the northern side of King Street. There is also an additional hazard of a low lying wooden guardrail on the north side just east of the railroad tracks. This is intended to deter path users from crossing the railroad track at a skew across the road, but if it goes unseen could remain an even greater hazard to cyclists in the area. The path is currently stop controlled and there are minimal warning signs for vehicles or path users. Path delineation at this crossing consists of a faded crosswalk marking which is unclear to new path users.



Minimal warning signs, path delineation, and the railroad crossing make this intersection one of the most complex

Recommended Solutions

Short term solutions include consistent signage improvements as noted at previous intersections, enhanced path delineation, and additional path warning signs. W10-1 signs and appropriate pavement markings should be added to the path to warn path users of the upcoming crossing. The existing signs in the area for vehicles should be updated appropriately. A repainted crossing and centerline stripes should be added for enhanced delineation so users understand where they should travel and cross the railroad at a ninety degree angle.

The imminent long term recommendation here is to widen the existing path railroad crossing to ten feet and remove the low wooden guardrail to replace it with flexible reflectorized bollards. This will provide a safer environment for multiple users taking the sharp corners and crossing the railroad tracks. The addition of colorized path pavement or green paint could be included to further delineate the path. All of these long and short term recommendations are shown in Figure 6.

Discussion

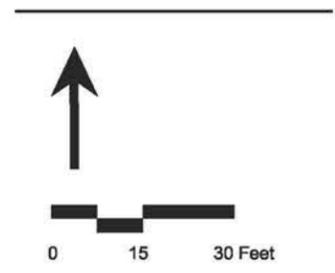
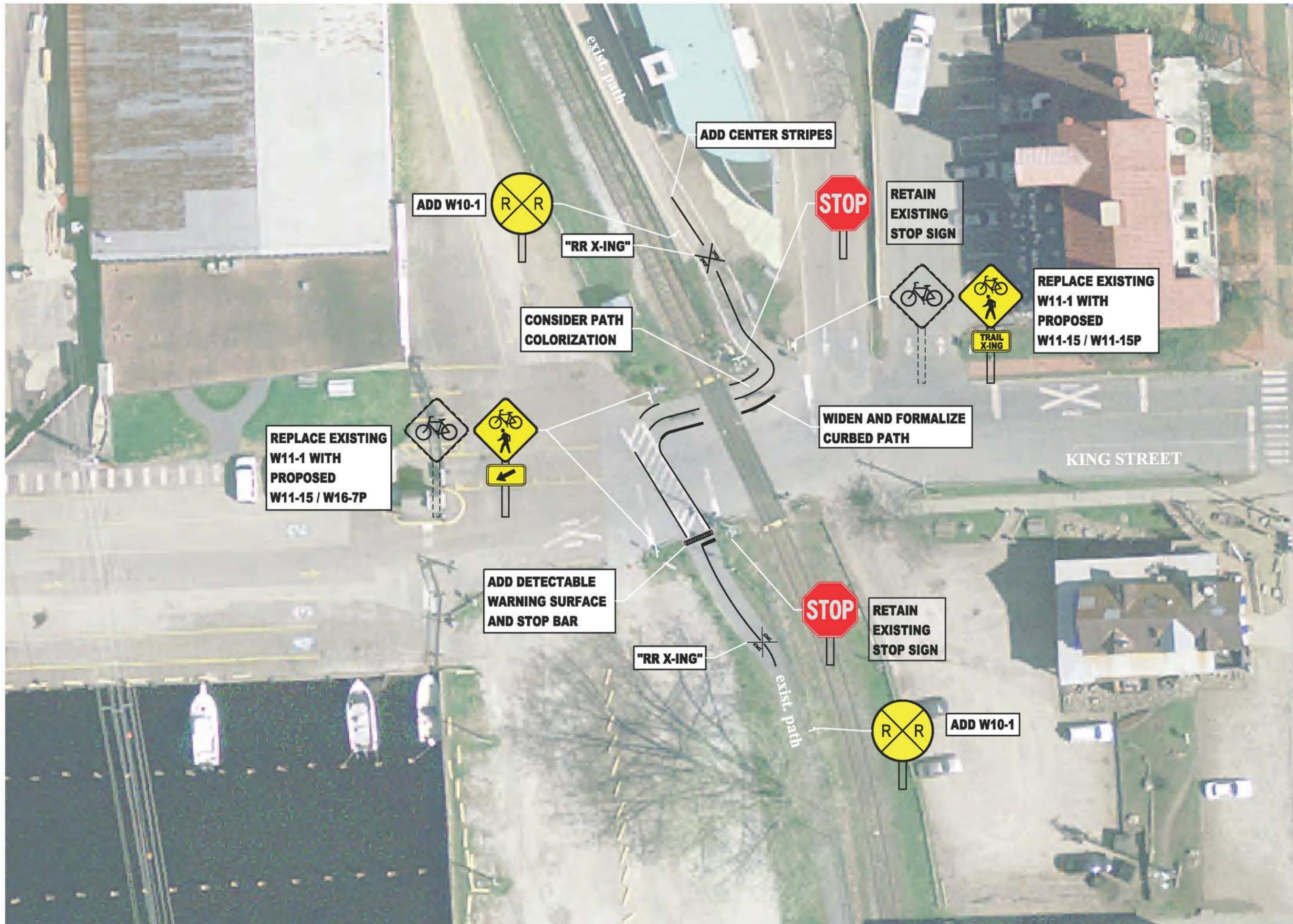
This crossing is commonly referred to as one of the most complex roadway crossings on the path. Many different variables contribute to this complexity. The City is seeking to eliminate the crossing of the railroad tracks to make this a less dangerous intersection. Through the rehabilitation project an alternative is under evaluation that could move the mainline of the bike path to the west side of the railroad tracks. If this option proves to be feasible, the existing path to the east will remain in place as a minor spur for access to destinations on the east side of the tracks. For this reason the improvements recommended above will still be applicable to possible future improvements through other projects.

Short Term Recommendations:

- UPDATE MARKINGS TO DEFINE PATH
- ADD PATH CENTER STRIPE AND RAILROAD CROSSING MARKING
- UPDATE SIGNS TO W11-15/W16-7P AND W11-15/W11-15P
- ADD W10-1 SIGNS
- ADD WAYFINDING FOR TRAIL USERS
- ADD RAILROAD CROSSING MARKINGS ON PATH

Long Term Recommendations:

- WIDEN CURBED SIDEWALK SECTION TO 10 FEET
- CONSIDER COLORIZED SURFACE AND FLEXIBLE REFLECTORIZED BOLLARDS ON CURB LINE
- ADD DWS TO CROSSING



**Burlington Bike Path
 King St Crossing**

Figure 6
 Burlington, Vermont
 January 17, 2014

3.7 College Street

Existing Conditions

College Street was recently reconstructed to create slower traffic speeds and limit the volume of traffic traveling down to the waterfront over the railroad tracks and the bike path crossing. This has created a safer environment for the heavy volume of pedestrians and path users in the waterfront area, however this crossing is still frequently very congested and seemingly disordered. A cyclist traveling north on the bike path would first pass by a locally owned creemee stand which often experiences long queues that congregate on or near the bike path and obstruct the width. The northbound cyclist would then proceed to enter a sidewalk on the south side of College Street which is heavily used by pedestrians accessing Waterfront Park, cross the railroad tracks, cross College Street at an angle, cross another pedestrian sidewalk, and then continue north on the bike path through the park.



Creemee stand, railroad, sidewalk, and vehicle conflict points shown here

All of these conflict points contribute to potentially hazardous conditions at this crossing. Lack of wayfinding, signage, and path delineation also contribute to the perceived confusion through this area, and these could all be improved upon.

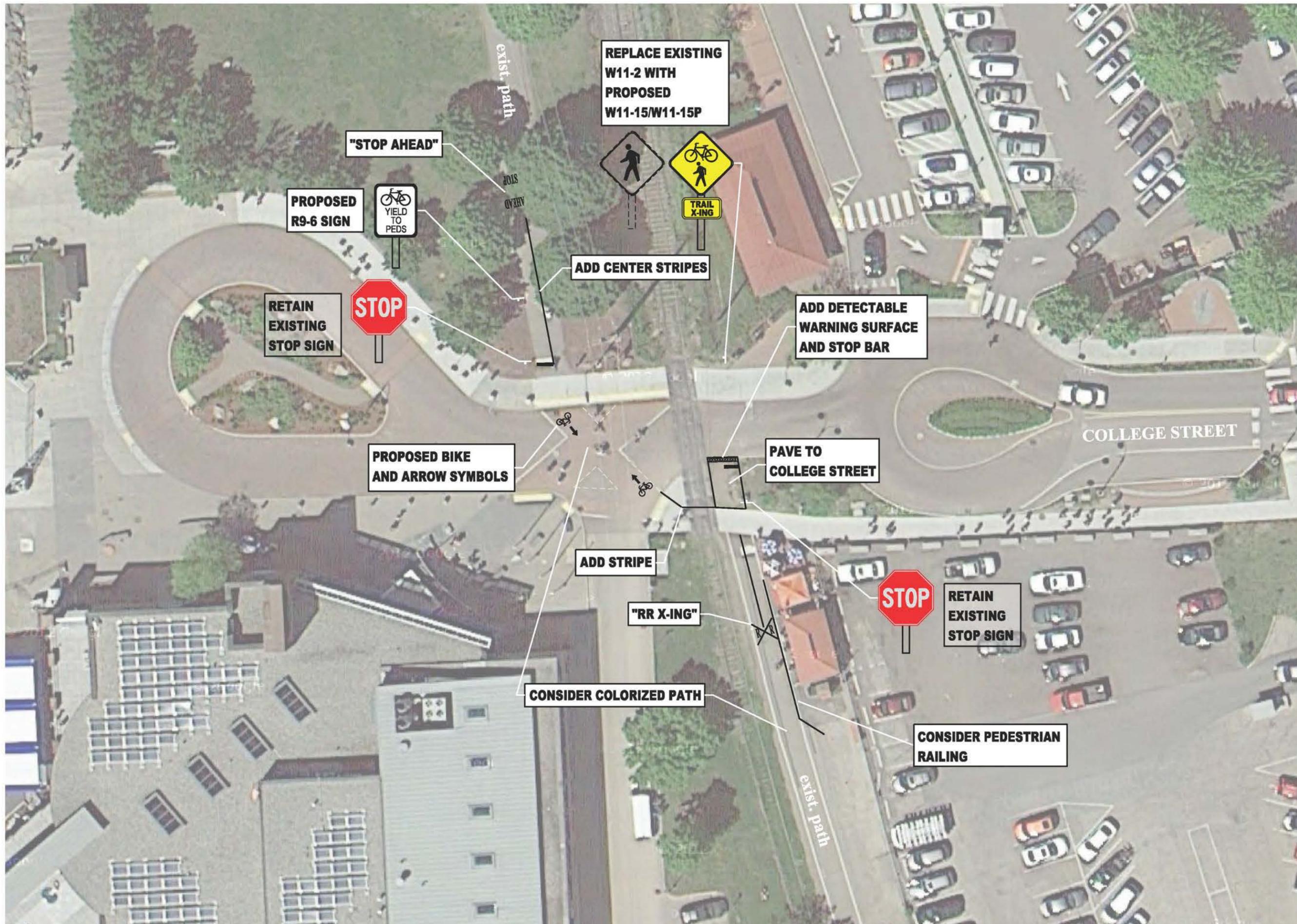
Recommended Solutions

Many short term solutions at this intersection include similar recommendations as previously discussed for other intersections such as consistent signage, wayfinding, and paint markings. Vehicular warning signs should be upgraded to reflect that the path is not only a pedestrian crosswalk, but also for cyclists and other users. The existing W11-2 should be replaced with an appropriate W11-15. Also a R9-6 warning sign for southbound path users should be added to give notice that pedestrians may be crossing on the existing sidewalk and that cyclists should yield. Path markings should include the standard centerline stripe, and the addition of painted lines directing path users where to cross the railroad tracks and the crossing of College Street. Colorized pavement or paint can be used to provide additional visual path delineation. “Stop Ahead” and “RR X-ING” markings should also be painted on the path to provide prior warning. The approximate locations of these are shown on Figure 7 on the following page but should be applied according to MUTCD guidance.

Other longer term improvements consist of paving a continuation of the bike path straight across the southern sidewalk creating an additional College Street access point. While a green painted path may generate additional awareness for creemee stand customers, it could be possible to work with the owner to install a pedestrian railing or other physical barrier that would eliminate the conflicts between their clients and path users. All of these proposed improvements are shown in Figure 7.

Discussion

Through the PIAP process and the path rehabilitation project the City is currently working on developing other solutions to this intersection and the Waterfront Park area. One such solution involves construction of the main path on the west side of the tracks from King Street to College Street, thereby eliminating two railroad crossings. The above crossing recommendations will not conflict with or inhibit those plans in any way, should they come to pass.

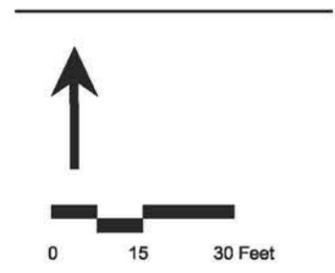


Short Term Recommendations:

- ADD PATH CENTERLINE STRIPES
- ADD BIKE AND ARROW SYMBOLS IN CROSSING
- UPDATE SIGN TO W11-15 / W11-15P
- ADD R9-6 SIGN
- ADD RAILROAD CROSSING MARKING TO NORTH BOUND APPROACH AND "STOP AHEAD" TO SOUTH BOUND
- COLORIZE THE PATH TO ENHANCE AWARENESS
- CONSIDER COLORIZING PATH CROSSING OF COLLEGE STREET

Long Term Recommendations:

- SEEK LONG TERM SOLUTIONS TO ICE CREAM STAND BIKE / PED CONFLICTS. CONSIDER SAFETY RAILING BETWEEN THE TWO.
- PAVE NORTHBOUND APPROACH UP TO COLLEGE STREET AND ADD DWS AND STOP BAR



**Burlington Bike Path
 College St Crossing**

Figure 7

3.8 Little Eagle Bay

Existing Conditions

Little Eagle Bay is a private roadway that provides access to a few homes that are located on a bluff between Lake Champlain and the bike path. The path is currently 8 feet wide in this area and is stop controlled. The road has no stop or yield control.

The primary concern at this location is that the driveway is screened by a dense row of high arborvitae that runs parallel to the path. Our observation is that path users ignore the stop signs since the motor vehicle traffic volumes and speeds on Little Eagle Bay are so low. These conditions result in a feeling by the cyclists that there is little inherent danger and some may slow down, but most do not stop.



Tall hedges restrict sight distance at Little Eagle Bay

Recommended Solutions

The primary near term solution is to eliminate the stop signs on the path. It is recommended that the stop signs be moved to the roadway instead. Yield signs would not be placed on the path since the roadway would be stop controlled and stop and yield signs are not placed within the same intersection per national guidance. Road crossing warning signs and pavement markings would also be added on the path near term, and “recreation path crossing” signs would be added to Little Eagle Bay drive to alert motorists. Standard crosswalk markings and stop bars would also be added. The installation of a convex driveway mirror is also suggested to help motorists exit the drive and help cyclists see whether there is a car approaching.

Long term recommendations include shifting the path a few feet east away from the hedgerow to improve the ability of motorists to see oncoming bikes. This would likely be accomplished under the overall Bike Path Rehabilitation Project. There is a concern that the alignment shift might not be allowed since there is already a court decision in place that limits the path width to 8 feet in this area. That decision also prohibits hedge and tree trimming and if the shift impacts the adjacent spruce trees it would likely not be allowed. All of these proposed improvements are shown in Figure 8.

Discussion

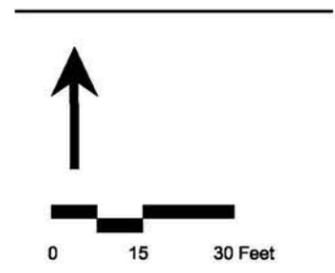
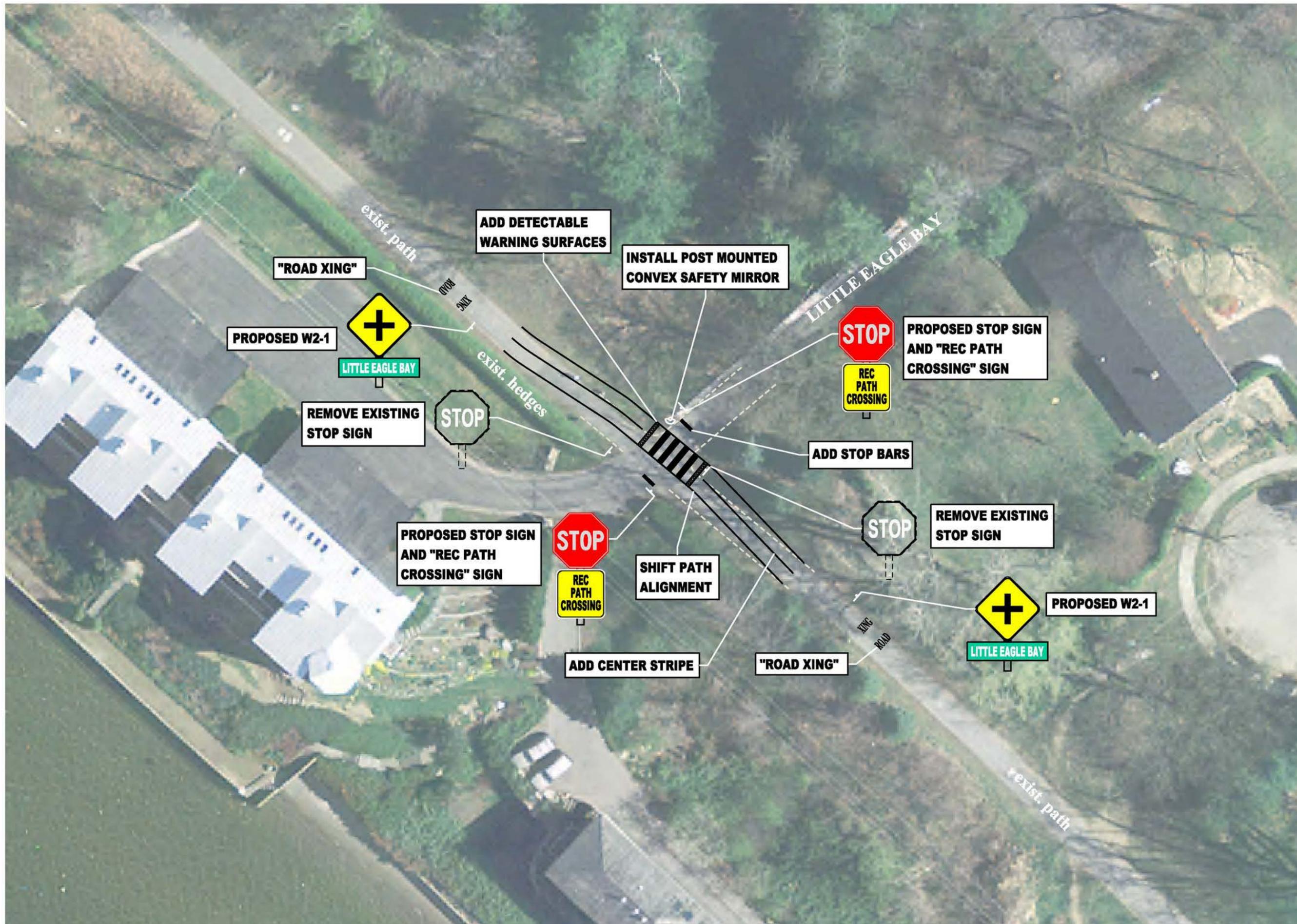
All of the above recommended improvements will involve working collaboratively with the property owners since the land in this area is privately owned. It is hoped that these changes are viewed positively by the residents since they should lead to more predictable behavior by all users.

Short Term Recommendations:

- INSTALL CONVEX SAFETY MIRROR TO IMPROVE VISIBILITY
- REMOVE PATH STOP SIGNS
- INSTALL ROAD AND DRIVE STOP SIGNS WITH "REC PATH CROSSING" SIGNS
- ADD STOP BARS AND DWS
- ADD W2-1 SIGNS WITH ROAD NAME PLACARDS

Long Term Recommendations:

- SHIFT PATH AWAY FROM HEDGE ROW TO IMPROVE SIGHT LINES AND ADD DWS



**Burlington Bike Path
 Little Eagle Bay Crossing**

Figure 8
 Burlington, Vermont
 January 17, 2014

3.9 Shore Road

Existing Conditions

Shore Road is a typical low volume neighborhood street that crosses the path at right angles. There are sidewalks on both sides and traffic calming measures have previously been implemented at the crossing by the City. These include an imprinted center median and speed bumps on either side of the crosswalk. The crosswalk has also been painted a rust red color between the white crosswalk stripes. There is an advance crossing sign (W11-2) with a “Trail Xing” sign (W11-15P) under it.



Traffic calming measures and existing conditions as seen at Shore Road

The primary consideration at this crossing is that many cyclists roll through the stop signs as opposed to coming to a complete stop. There is reportedly no crash history related to this behavior, and we observed some motorists stopping before crossing the crosswalk to make sure no bikes were coming. Motorists are required by law to yield to pedestrians at the crosswalks but they are not required to yield to bikes unless the bikes are already in their path in the crosswalks or unless the cyclist dismounts and crosses the road on foot.

Recommended Solutions

The short term improvements that are recommended at this location primarily include adding solid yellow centerline striping and new stop bars on the path, adding “stop ahead” markings on the path, and adding new W11-15 with W16-7P crossing signs on the street close to the crossing. Yield to ped signs (R9-6) would also be installed on the path in advance of the crossing since the path crosses the sidewalks before crossing the street. Vegetation clearing is recommended at the four corners to the extent possible within the right-of-way to improve sight lines.

Long term improvements would include minor curbed bump outs at the crossing to calm traffic even further and to improve the visibility of the crossing location as well as the trail users waiting to cross. To conform with ADA requirements the pedestrian ramps should be outfitted with Detectable Warning Surfaces (DWSs), also known as truncated domes. This would likely be accomplished within the overall rehabilitation project and a new analysis of sight triangles could be conducted concurrently to determine whether yield control can be instituted on the path in place of stop control. All of these short and long term improvements are shown in Figure 9.

Discussion

Yield controls were considered on the bike path at this crossing, but the sight triangles were inadequate and there is no bike/automobile crash history. There have also been requests from individuals in the bike community to stop the cars and allow the bikes to cross uncontrolled. One problem with that approach is that the stop signs would likely lead to motorist frustration and violations during the night and winter months when the number of crossing bikes would be minimal.

Rectangular Rapid Flashing Beacons (RRFB’s) could be effective at alerting motorists when bikes or pedestrians are intending to cross. These devices are not a traffic control but rather a means to increase motorist awareness. As a result, they would be most effective for pedestrians since motorists must yield to them. They are typically button activated which means cyclists would need

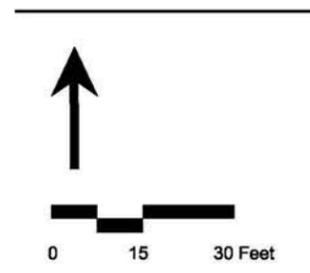
to navigate to them and stop long enough to activate them. One concern is that many people will not use them at all. Another is that so many people will use them on busy days that motorists will become complacent because they flash so frequently. Some of the local residents also expressed concern that the flashing would be visible from their homes. A similar warning device is a proprietary system called a Cross Alert system. That system automatically detects cars and flashes a red signal to bikes. Conversely it can detect bikes and flash a yellow signal to motorists. Concerns with this system, aside from its cost, are the potential induced complacency by either user group as well as potential confusion for motorists and bicyclists on whether the flashers provide added right of way for bikes. The Cross Alert system does not provide crossing control and is only meant to alert both user groups.

Short Term Recommendations:

- ADD W11-15 / W16-7P SIGNS AT CROSSING
- ADD R9-6 SIGNS
- ADD W11-15/W11-15P SIGNS
- SELECTIVE VEGETATION TRIMMING AT THE CORNERS TO IMPROVE SIGHT LINES
- UPDATE PATH STRIPING AND STOP BARS
- ADD "STOP AHEAD" PATH MARKINGS

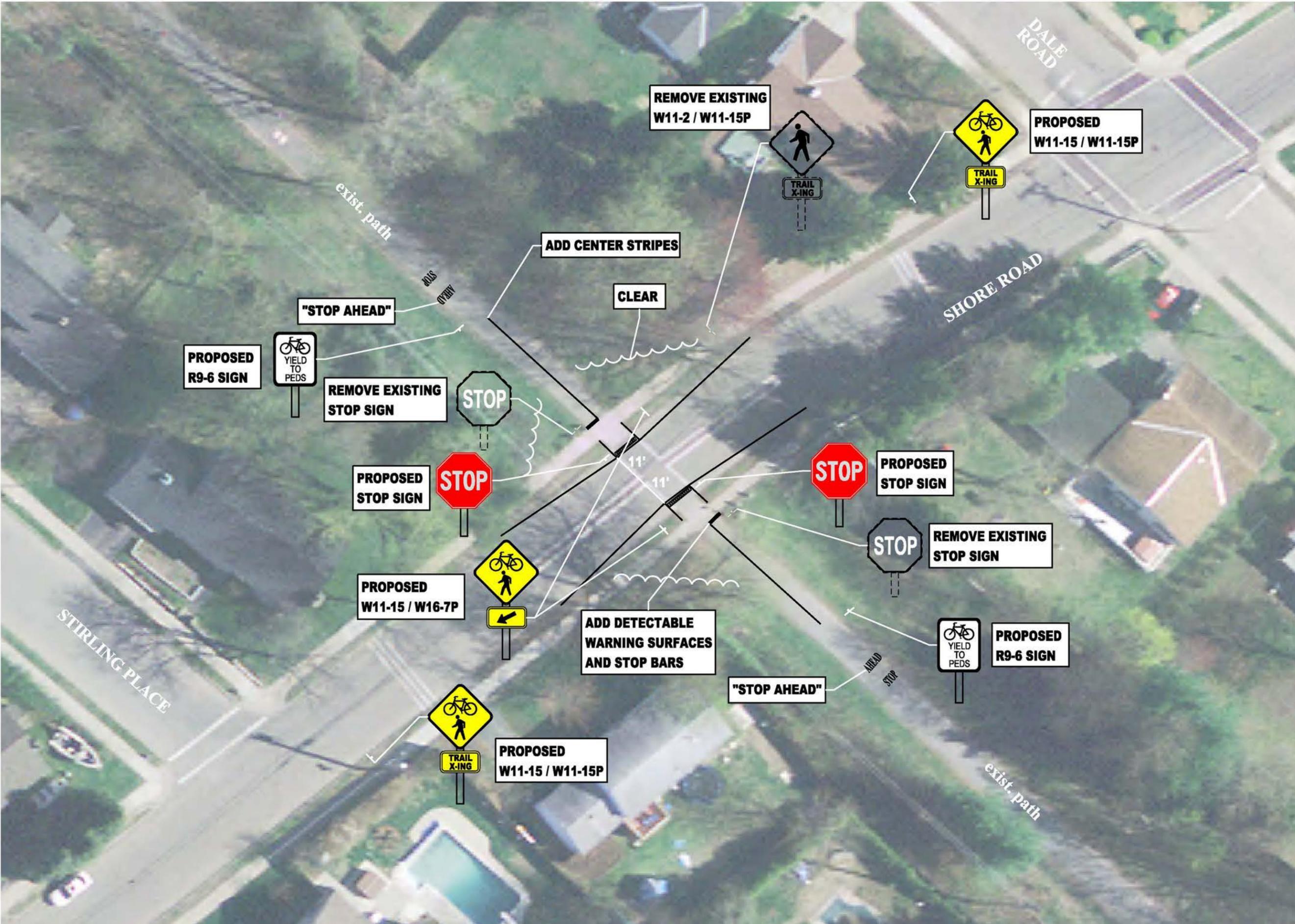
Long Term Recommendations:

- CONSIDER CURBED BUMP OUTS TO ACCENTUATE CROSSING LOCATION. BE AWARE OF DRAINAGE ISSUES
- ADD DWS AND RELOCATE STOP BARS
- CONSIDER "CROSS ALERT" FLASHERS OR SIMILAR



**Burlington Bike Path
 Shore Rd Crossing**

Figure 9
 Burlington, Vermont
 January 17, 2014



3.10 Staniford Road

Existing Conditions

The Staniford Road crossing is very similar to the Shore Road crossing. Staniford Road does not have a sidewalk on the south side but does include a sidewalk on the north side. In addition, the path is slightly curved on both approaches, and the northwest quadrant contains a large vegetated earth mound that limits sight distance to the west. There is also a side street, Appletree Place, which enters Staniford Road at a skew angle less than 100 feet away from the path crossing. All of these differences make this crossing less of a candidate for bike yield control.



Existing conditions at Staniford Road including traffic calming and sight distance concerns

Recommended Solutions

The recommended short term improvements at this location primarily include adding solid yellow centerline striping and new stop bars on the path, adding “stop ahead” markings on the path, and adding new W11-15 with W16-7P crossing signs on the street close to the crossing. An additional W11-15 with W11-15P sign package should be added along Apple Tree Bay Road. Vegetation clearing is recommended at the four corners to the extent possible within the right-of-way to improve sight lines.

Long term improvements would include extending the sidewalk that exists on the northeast quadrant further west past the crossing to provide a consistent road width and better pedestrian accommodations. To conform with ADA requirements the pedestrian ramps should be outfitted with DWSs. This would likely be accomplished within the overall rehabilitation project. All of these proposed improvements are shown in Figure 10.

Discussion

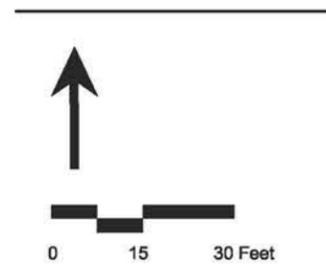
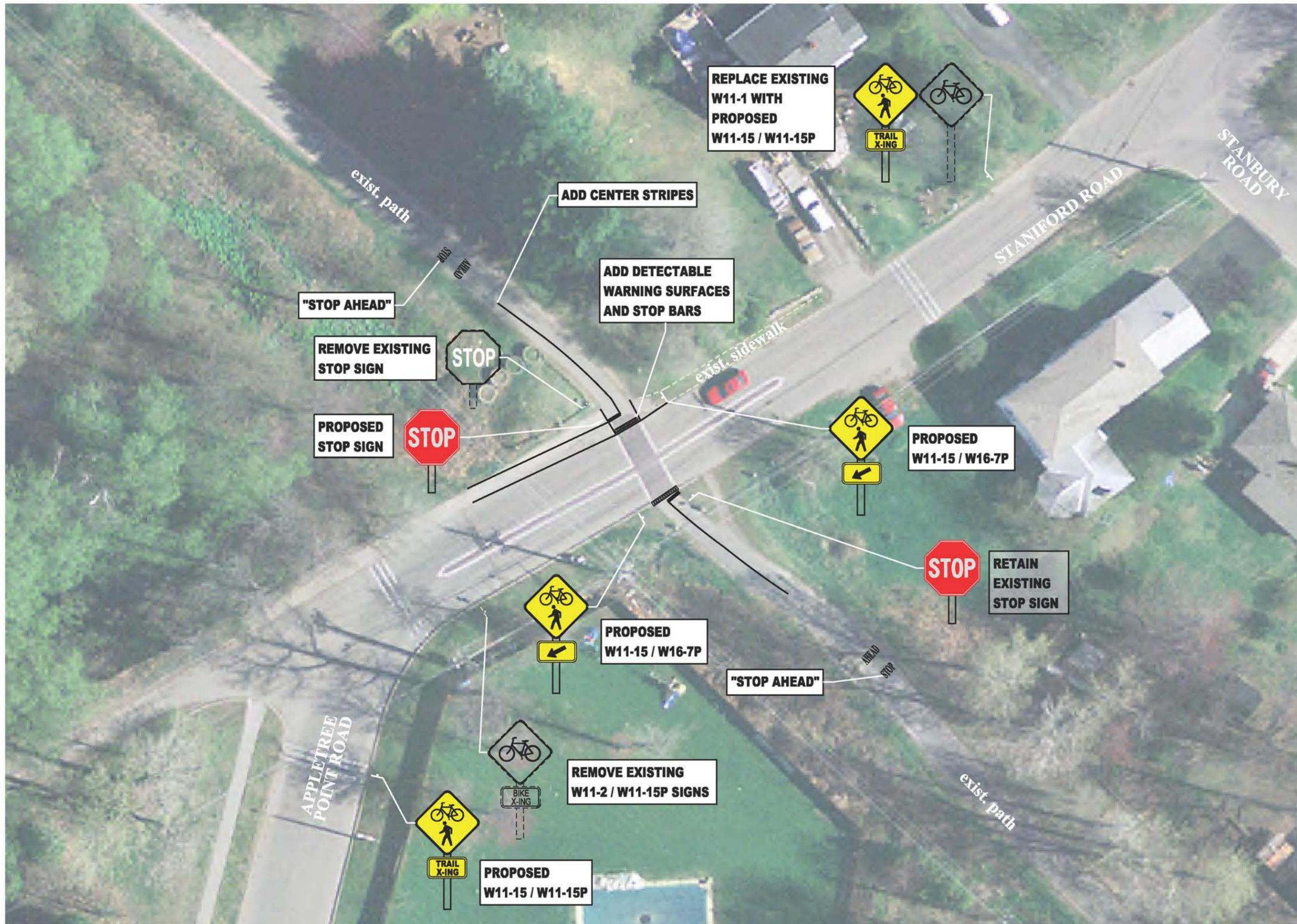
There is a large residential development planned on the land located in the northwest quadrant that will reportedly have an entrance opposite Appletree Point Road. That entrance will add traffic and potential turning conflicts very close to the path crossing so it is recommended that the conditions at this crossing be monitored as that project evolves. The remainder of the considerations and recommendations at this intersection are very similar to the Shore Road intersection and are not repeated here.

Short Term Recommendations:

- ADD W11-15 / W16-7P SIGNS
- UPDATE SIGN TO W11-15 / W11-15P AND ADD W11-15 / W11-15P TO APPLE TREE BAY ROAD
- SELECTIVE VEGETATION CLEARING AT THE CORNERS TO IMPROVE SIGHT LINES
- UPDATE PATH STRIPING AND ADD "STOP AHEAD" MARKING

Long Term Recommendations:

- CONSIDER MINOR BUMP OUT ON NORTH SIDE TO EXTEND SIDEWALK AND ADD DWS
- CONSIDER "CROSS ALERT" FLASHERS OR SIMILAR



**Burlington Bike Path
Stanford Rd Crossing**

Figure 10

3.11 Starr Farm Road

Existing Conditions

The Starr Farm Road crossing is very similar to the Shore Road and Staniford Road crossings. Starr Farm Road only has a sidewalk on the south side. The path is slightly curved on both approaches, and the north side is uncurbed. There is also a side street, Curtis Avenue, and the dog park entrance, which enter Starr Farm Road less than 100 feet away from the path crossing. All of these differences make this crossing less of a candidate for bike yield control.

Recommended Solutions

The short term improvements that are recommended at this location primarily include adding solid yellow centerline striping and new stop bars on the path, adding “stop ahead” markings on the path, and adding new W11-15 with W16-7P crossing signs on the street close to the crossing. The existing “stop” sign on the north bound approach should be relocated closer to the roadway. When this occurs it is also recommended that an R9-6 “yield to peds” sign should be added prior to the crossing to provide advanced warning that path users may need to yield to pedestrians on the sidewalk. Vegetation clearing is recommended at the four corners to the extent possible within the right-of-way to improve sight lines.



Starr Farm Park and Dog Park are nearby this path crossing but wayfinding should be improved

Long term improvements would include adding curbing along the north side of the road in either direction from the crossing to help define the road edge, thereby improving the traffic calming effect and protecting the path users. To conform with ADA requirements the pedestrian ramps should be outfitted with DWSs. This would likely be accomplished within the overall Bike Path Rehabilitation Project. All of these proposed improvements are shown in Figure 11.

Discussion

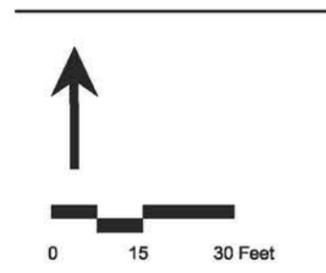
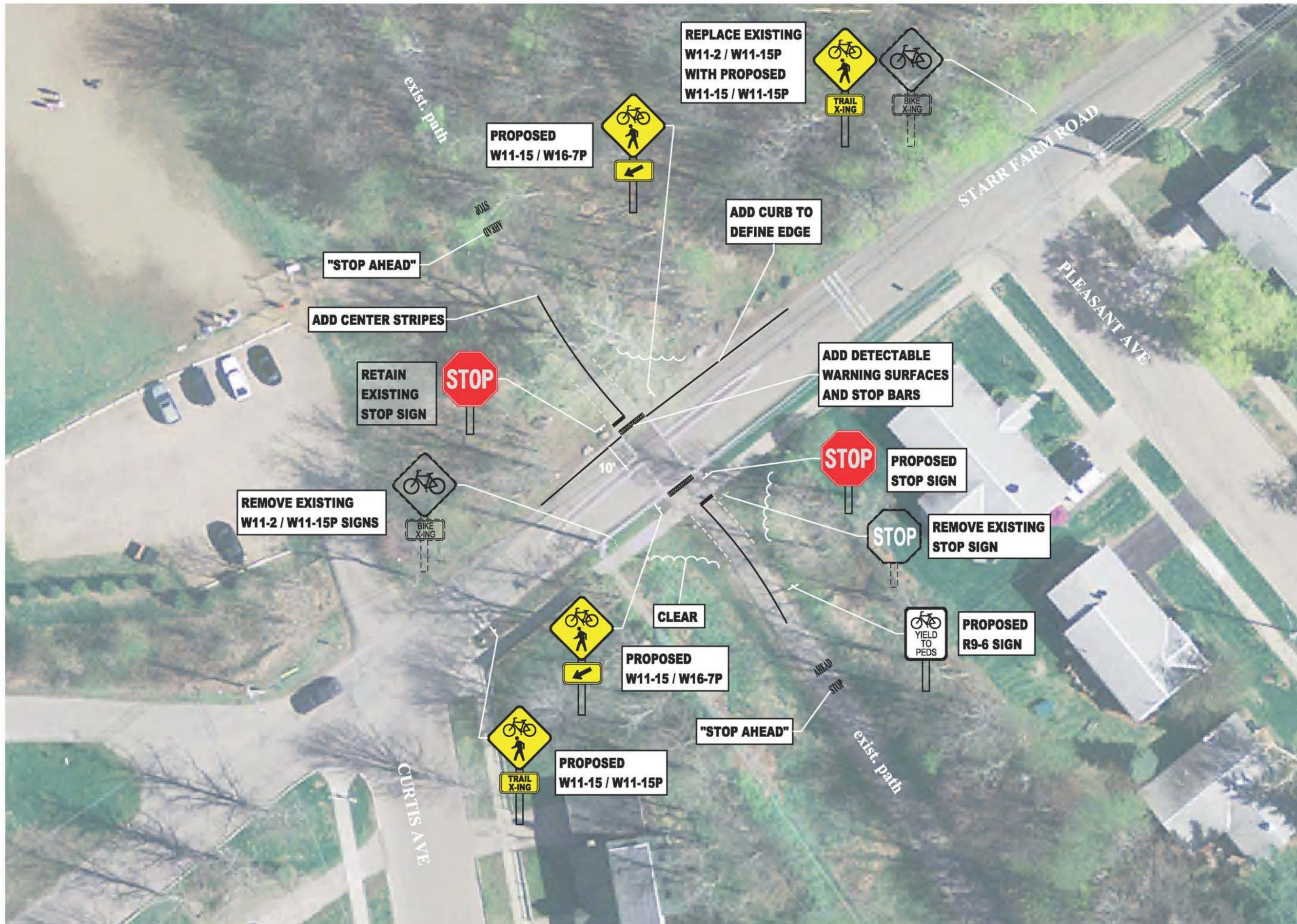
The considerations and recommendations at this intersection are very similar to the Shore road intersection and are not repeated here.

Short Term Recommendations:

- ADD W11-15 / W16-7P SIGNS AT CROSSING
- UPDATE SIGN TO W11-15 / W11-15P AND ADD W11-15 / W11-15P SIGN
- ADD R9-6 SIGN ON NORTH BOUND APPROACH
- SELECTIVE VEGETATION CLEARING AT THE CORNERS TO IMPROVE SIGHT LINES
- UPDATE PATH STRIPING AND STOP BARS

Long Term Recommendations:

- ADD CURB ON NORTH SIDE OF ROAD
- ADD DWS AT CROSSING
- CONSIDER "CROSS ALERT" FLASHERS OR SIMILAR



**Burlington Bike Path
 Starr Farm Rd Crossing**

Figure 11

3.12 North Avenue Extension

Existing Conditions

North Avenue Extension is a very low volume dead-end road that provides access to a number of lakeside cottages and campsites. The road takes a sharp bend to the north just west of the crossing. The path in this area is raised up above the surrounding ground on the former railroad embankment, but the path dips down as it crosses North Avenue Extension. This dip causes path users to accelerate toward the roadway crossing. Our observation is that many path users ignore the existing path stop signs so they can maintain their speed up the other side of the dip in the path. This is undesirable since sight lines are compromised on some of the corners by vegetation.



Existing path stop control and limited sight lines to the west at North Avenue Extension

Recommended Solutions

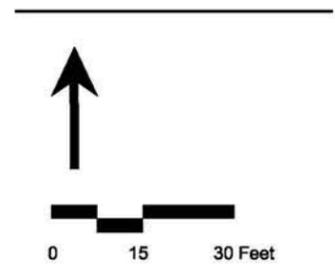
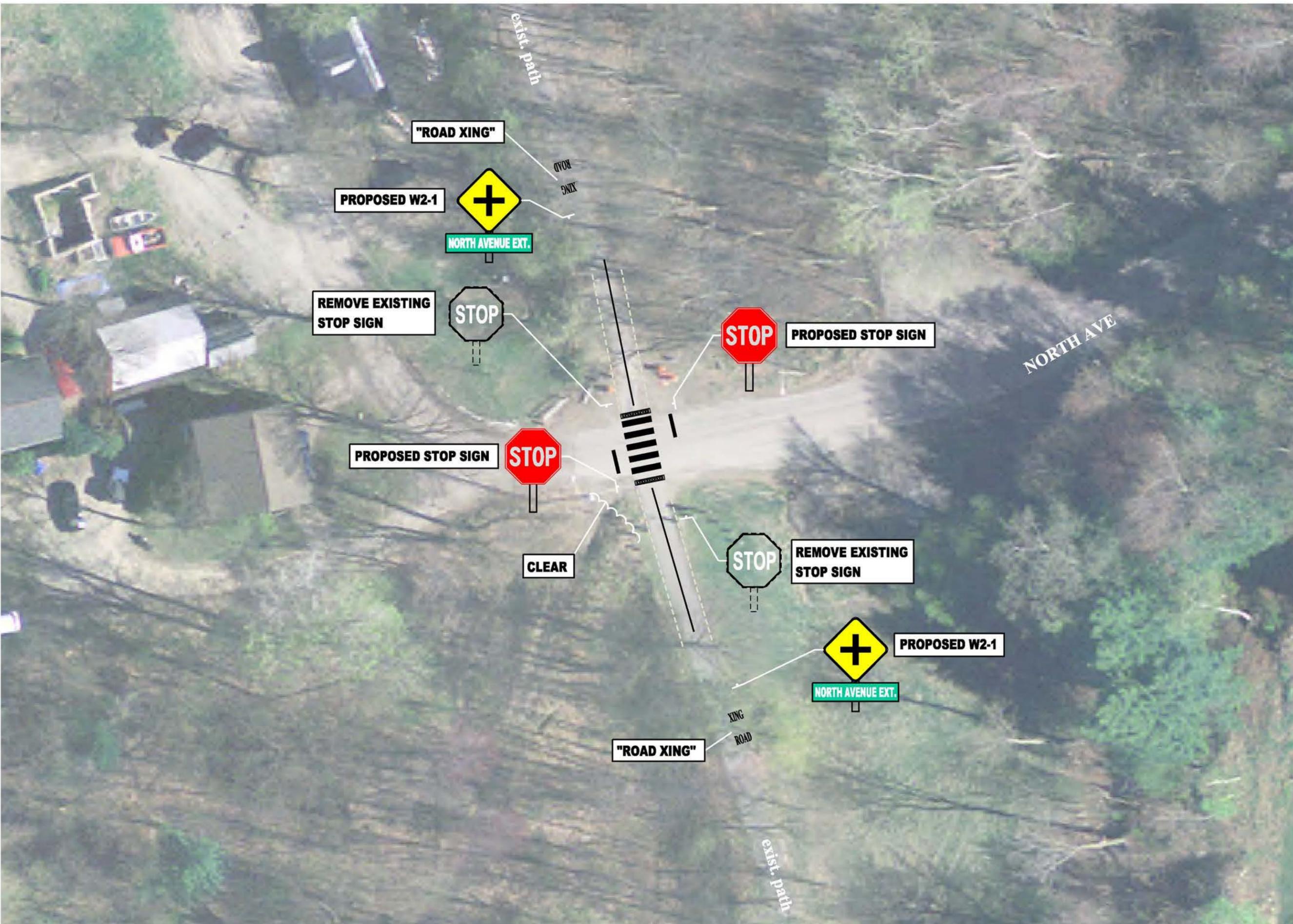
The very low speeds and volumes on North Avenue Extension combined with the observed bicyclist behavior through the “dip” leads us to recommend that the City consider switching the stop controls to the roadway from the bike path. The sight lines do not support yield controls on the path, but creating stop conditions on the road is more appropriate for the conditions. We observed that a portion of the motorists stop anyway since they have probably grown aware that the bicyclists are not stopping and some are in fact accelerating to make it up the opposing incline. It would still be beneficial to clear vegetation at the crossing to the extent possible within the right-of-way to improve sight lines. The southwest quadrant is currently the most in need of clearing. Road crossing signs (W2-1) with accompanying road name signs should be added on the path approaches. DWSs should also be added at the path crossing. These improvements can be considered near term solutions since they include minimal construction. These are shown in Figure 12.

Discussion

Switching the stop signs to the road at this location and at Little Eagle Bay may require some public outreach and education, and it may be advantageous to make the change during the off peak months when path volumes are lower so path and road users have adequate time to adapt. A concern is that the path users need to understand that these are the only crossings where stop controls are being removed.

Short Term Recommendations:

- REPLENISH CROSSWALKS
- SELECTIVE TREE TRIMMING TO IMPROVE SIGHT LINES
- UPDATE PATH STRIPING AND ADD DWS AT CROSSWALKS
- ADD STOP SIGNS FOR NORTH AVE. AND REMOVE PATH STOP SIGNS DUE TO GRADES ON PATH AND LOW VOLUME ON NORTH AVE.



**Burlington Bike Path
 North Ave Crossing**

Figure 12

4. CONCLUSIONS

Some consistent recommendations were developed for the Burlington Bike Path road crossings that were analyzed as part of this study. These include updating signs to current standards and painting consistent and appropriate path markings and centerlines. Wherever path delineation is of particular concern it is recommended that green colorization be used for the entire paved width for increased visibility and awareness of the paths location. Vegetation should be trimmed within the City owned right-of-way where possible on the corners of intersections to improve sight distances for all users and to potentially allow for future yield control. Wayfinding signs should be added at all of the major path connections, including the studied roadway crossings. The design and installation of these signs will be included in the rehabilitation project.

Each crossing has its own unique concerns and limitations and should be reviewed closely for any specific restrictions as stated in the above chapter. The crossing improvements should be prioritized and coordinated with the rehabilitation project to maximize efficiency and public benefit.

APPENDIX A – YIELD SIGN ANALYSIS MEMORANDUM



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Memorandum

To: Jen Francis, Park Planner
Burlington Department of Parks and
Recreation

Date: June 4, 2013

Project No.: 57614.00

From: Greg Bakos, P.E.
Project Manager

Re: Burlington Bike Path Crossings Study
Burlington, VT

Erin Parizo, EI
Project Engineer

Vanasse Hangen Brustlin, Inc. (VHB) has completed the yield control analysis of the ten (10) Bike Path crossings as directed by the City of Burlington Department of Parks and Recreation (DPR) and the Chittenden County Regional Planning Commission (CCPRC). These crossings have been identified by the City as candidates for conversion to yield control from the existing stop control on the path due to minimal vehicular traffic and/ or slow traffic speeds in conjunction with high volumes on the bike path. The crossing locations are as follows:

1. Harrison Avenue (West)
2. Harrison Avenue (East)
3. College Street
4. Lake Street
5. Little Eagle Bay Road
6. Beachcrest Drive
7. Leddy Beach (South Access)
8. Leddy Beach (North Access)
9. Shore Road
10. North Avenue Extension

This memorandum provides the following:

- Existing state laws and guidance pertaining to path yield control;
- A description of the methodology used to determine each crossing's eligibility for yield control;
- Decision sight distance and findings; and
- Conclusions and recommendations to move forward.

EXISTING STATE LAWS AND GUIDANCE

Existing state laws regarding the right of way between bicyclists in a road crossed by a shared use path and vehicles on the roadway are somewhat vague. The Vermont Bicycling Laws 23 VSA §1051(a) state that "...the driver of a vehicle shall yield the right of way, slowing down or stopping if necessary, to a pedestrian crossing the roadway within a crosswalk." A pedestrian using the shared use path would have the right-of-way, by law, once in the crosswalk due to vehicles being required to yield the right of way. In addition, 23 VSA §1051(b) states that "No pedestrian may suddenly leave a curb or other place of safety and walk or run into the path of a vehicle which is so close that it is impossible for a driver to yield." It is both the pedestrian's responsibility to ensure they have sufficient crossing time, and the vehicle's responsibility to stop to allow the pedestrian in the crosswalk to cross if they can do so safely. The laws are different for cyclists however. The Vermont Bicycle and Pedestrian Coalition compiled the Vermont Bicycling Laws and within their summary they state that "Bicyclists do not have the right-of-way in crosswalks under state law unless they dismount and walk." This would mean unless a cyclist were to dismount at a road crossing and act as a pedestrian, they would be responsible for yielding the right of way to vehicles. This would be accomplished by enforcing a stop or yield control on the shared use path.

The Manual on Uniform Traffic Control Devices (MUTCD) Section 9B.03 provides the following guidance for placement of stop vs. yield signs on shared-use paths:

"Guidance:

Where conditions require path users, but not roadway users, to stop or yield, the STOP or YIELD sign should be placed or shielded so that it is not readily visible to road users.

When placement of STOP or YIELD signs is considered, priority at a shared-use path/roadway intersection should be assigned with consideration of the following:

- A. Relative speeds of shared-use path and roadway users,*
- B. Relative volumes of shared-use path and roadway traffic, and*
- C. Relative importance of shared-use path and roadway.*

Speed should not be the sole factor used to determine priority, as it is sometimes appropriate to give priority to a high-volume shared-use path crossing a low-volume street, or to a regional shared-use path crossing a minor collector street.

When priority is assigned, the least restrictive control that is appropriate should be placed on the lower priority approaches. STOP signs should not be used where YIELD signs would be acceptable."

DECISION SIGHT DISTANCE METHODOLOGY

VHB first referred to the Vermont Pedestrian and Bicycle Facility Planning and Design Manual and the MUTCD for regulations on the appropriate use of stop vs. yield signs on shared use paths at roadway crossings. These offered little direction on the subject aside from general guidance which is detailed in the previous section. The AASHTO Geometric Design of Highways and Streets Book (Green Book) includes guidance pertaining to the Decision Sight Distance as traditionally applied to motorists. This is defined as "the distance required for a driver to detect an unexpected or otherwise difficult-to-perceive information source or hazard in the roadway environment that may be visually cluttered, recognize the hazard or its threat potential, select the appropriate speed and path, and initiate and complete the required safety maneuver safely and efficiently". The motor vehicle decision sight distances for each intersection were calculated using equation 3-4 in the Green Book and the results are presented in the next section. The equation is as follows:

$$d = 1.47 * V * t + 1.075 (V^2 / a)$$

Where t = pre-maneuver time, s (Assumed to be 3.0s from Green Book guidance)

V = design speed, mph (Field verified at each crossing)

A = driver deceleration, ft/ s² (Assumed to be 11.2 ft/ s²)

Next, VHB utilized the 2012 AASHTO Guide for the Development of Bicycle Facilities. This provides guidance for calculating the required sight distance for path users to safely cross an intersection with a roadway under a yield control scenario. Tables 5-7, 5-8, and Figure 5-15 from the AASHTO Bike Guide are shown below to demonstrate the necessary sight distance. Figure 5-15 illustrates the appropriate concepts and dimensions that would be needed for a bicyclist on the path to see a motor vehicle at a crossing and decide whether there is sufficient time to cross the intersection or if they must slow down and proceed when safe (i.e. the action required by a yield sign).

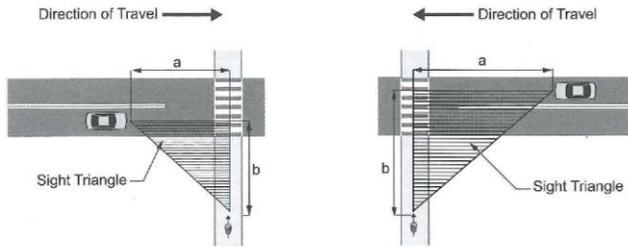


Figure 5-15. Yield Sight Triangles

Table 5-7. Length of Roadway Leg of Sight Triangle

U.S. Customary		Metric	
$t_a = \frac{S}{1.47V_{path}}$		$t_a = \frac{S}{0.278V_{path}}$	
$t_b = t_a + \frac{w + L_v}{1.47V_{path}}$		$t_b = t_a + \frac{w + L_v}{0.278V_{path}}$	
$a = 1.47V_{road}t_b$		$a = 0.278V_{road}t_b$	
where:			
t_a	= travel time to reach and clear the road (s)	t_a	= travel time to reach and clear the road (s)
a	= length of leg sight triangle along the roadway approach (ft)	a	= length of leg sight triangle along the roadway approach (m)
t_b	= travel time to reach the road from the decision point for a path user that doesn't stop (s)	t_b	= travel time to reach the road from the decision point for a path user that doesn't stop (s)
w	= width of the intersection to be crossed (ft)	w	= width of the intersection to be crossed (m)
L_v	= typical bicycle length = 6 ft (see Chapter 3 for other design users)	L_v	= typical bicycle length = 1.8 m (see Chapter 3 for other design users)
V_{path}	= design speed of the path (mph)	V_{path}	= design speed of the path (km/h)
V_{road}	= design speed of the road (mph)	V_{road}	= design speed of the road (km/h)
S	= stopping sight distance for the path user traveling at design speed (ft)	S	= stopping sight distance for the path user traveling at design speed (m)

Table 5-8. Length of Path Leg of Sight Triangle

U.S. Customary		Metric	
$t_a = \frac{1.47V_a - 1.47V_b}{a_1}$		$t_a = \frac{0.278V_a - 0.278V_b}{a_1}$	
$t_b = t_a + \frac{w + L_v}{0.88V_{road}}$		$t_b = t_a + \frac{w + L_v}{0.167V_{road}}$	
$b = 1.47V_{path}t_b$		$b = 0.278V_{path}t_b$	
where:			
t_a	= travel time to reach and clear the path (s)	t_a	= travel time to reach and clear the path (s)
b	= length of leg sight triangle along the path approach (ft)	b	= length of leg sight triangle along the path approach (m)
t_b	= travel time to reach the path from the decision point for a motorist that doesn't stop (s). For road approach grades that exceed 3 percent, value should be adjusted in accordance with AASHTO's A Policy on Geometric Design of Highways and Streets (5)	t_b	= travel time to reach the path from the decision point for a motorist that doesn't stop (s). For road approach grades that exceed 3 percent, value should be adjusted in accordance with AASHTO's A Policy on Geometric Design of Highways and Streets (5)
V_a	= speed at which the motorist would enter the intersection after decelerating (mph) (assumed $0.60 \times$ road design speed)	V_a	= speed at which the motorist would enter the intersection after decelerating (km/h) (assumed $0.60 \times$ road design speed)
V_b	= speed at which braking by the motorist begins (mph) (same as road design speed)	V_b	= speed at which braking by the motorist begins (km/h) (same as road design speed)
a_1	= motorist deceleration rate (ft/s^2) on intersection approach when braking to a stop not initiated (assume $-5.0 ft/s^2$)	a_1	= motorist deceleration rate (m/s^2) on intersection approach when braking to a stop not initiated (assume $-1.5 m/s^2$)
w	= width of the intersection to be crossed (ft)	w	= width of the intersection to be crossed (m)
L_v	= length of the design vehicle (ft)	L_v	= length of the design vehicle (m)
V_{path}	= design speed of the path (mph)	V_{path}	= design speed of the path (km/h)
V_{road}	= design speed of the road (mph)	V_{road}	= design speed of the road (km/h)

Note: This table accounts for reduced motor vehicle speeds per standard practice in AASHTO's A Policy on Geometric Design of Highways and Streets (5).

The length of the roadway leg (a) is comparable with the vehicle decision sight distance which was calculated based on the above equations in the AASHTO Green Book. The length of the path leg (b) is also necessary to complete the sight triangle and has been calculated using the equations in Table 5-8 above. Additional guidance from the AASHTO Bike Guide indicates that "20 miles per hour is the minimum design speed to use when designing a trail". This value is specific to a paved multi-use path. For this reason VHB used a speed of 20 mph for a cyclist approaching an intersection in the design calculations where existing bicyclist speed data was not able to be acquired. The CCRPC gathered bicyclist speed and volume data on the days of Saturday, May 18th 2013, through Tuesday, May 21st 2013 at two locations along the bike path. The first location was between the crossings of College Street and Lake Street and the second location was between the two Leddy Park Access Roads. These locations were chosen due to the existing sight distance and because they were the four crossings (College, Lake, and two Leddy Roads) with the greatest sight distances that might most feasibly entertain a yield path control. The four day average of the 85th percentile cyclist speeds collected at the Waterfront location was 13.3 mph and at the Leddy Park location was 15.1 mph so these speeds were used for calculations at those crossings. The approach speed of the motor vehicles is dependent upon the posted speed limit for each roadway that crosses the path, so this value varies

from intersection to intersection. The width of each crossing was verified in the field and also varies among crossings.

Using these variables, each of the equations from Table 5-8 above were calculated and the results are shown in the next section.

VEHICLE DECISION SIGHT DISTANCE AND PATH SIGHT DISTANCE CALCULATIONS

The decision sight distance for motor vehicles and the sight distance for bicyclists at a crossing were calculated per the methodologies described above. Crossings such as College Street, Beachcrest Drive, and North Avenue Extension include two rows since one is the posted speed limit and the other is the apparent speed in which vehicles are able to travel in these areas. Results from the calculations are shown in Table 1:

**TABLE 1
 DECISION SIGHT DISTANCE**

Crossing	Driver Decision Sight Distance (ft)	Calculated Bike Path Leg (ft)
Harrison (West)	130	125
Harrison (East)	130	125
College Street – 10 mph	55	95
College Street – 25 mph	175	90
Lake Street	130	85
Little Eagle Bay Road	55	140
Beachcrest Drive – 10 mph	55	140
Beachcrest Drive – 25 mph	175	130
Leddy Beach (South)	90	95
Leddy Beach (North)	90	95
Shore Road	175	130
North Avenue Extension – 10 mph	55	140
North Avenue Extension – 25 mph	175	130

The driver decision sight distance was calculated at each crossing to provide a factor of safety on the chance a cyclist does not stop or yield at the crossing and a vehicle is forced to stop to avoid a collision. VHB verified that each of the ten crossings have sufficient decision sight distance for a vehicle to make a complete stop or avoidance maneuver before conflicting with a user of the bike path who has already entered the crossing.

The crossings of the path with College Street, Beachcrest Drive, and North Avenue Extension all have either un-posted speed limits (which in Burlington implies that the speed limit is 25 mph), or are posted at 25 mph. They were all observed to have slower moving vehicles than the posted speed limit due to the design, population, use, or context of the surrounding area. Beachcrest Drive and North Avenue Extension both lead to private homes or developments and vehicles were observed traveling approximately 10 mph due to the horizontal alignments of the road. Based on an analysis of the crossings using the posted speed limit, yield signs on the path would not be recommended. Even if vehicles only travel 10 mph in these locations, a yield sign would still not be recommended for replacing the stop control due to limited sight distance from the path user's point of view.

CONCLUSIONS AND RECOMMENDATIONS

The findings of the Yield Control Analysis indicate that providing yield signs for path users at the proposed crossings are not supported based on the existing available decision sight distance for cyclists using the path except at the crossing of Lake Street. The table below displays a summary of findings for each of the crossings. The Calculated Bike Path Leg column matches the one in Table 1 above as these distances are what would be required for the bike path leg in the field. From the

vantage point of a potential driver, the bike path leg was measured and these numbers are shown in the Observed Bike Path Leg column. As an example, a vehicle near the intersection at Harrison Ave (West) would need to be able to see 125 ft down the bike path in either direction in order for a yield sign to be applied to the path. This would provide sufficient sight distance for the cyclist to see on coming vehicles and slow or stop as needed before crossing. The field verification revealed that a vehicle was not able to see any length of the bike path due to fencing and shrubs and thus this column shows 0 ft. The fourth column summarizes whether or not the sight distances will allow for a yield control on the path based on the limiting sight distance, and the last column provides notes on what physical constraints at the intersection limit the existing sight distance.

TABLE 2
EXISTING SIGHT DISTANCE SUMMARY

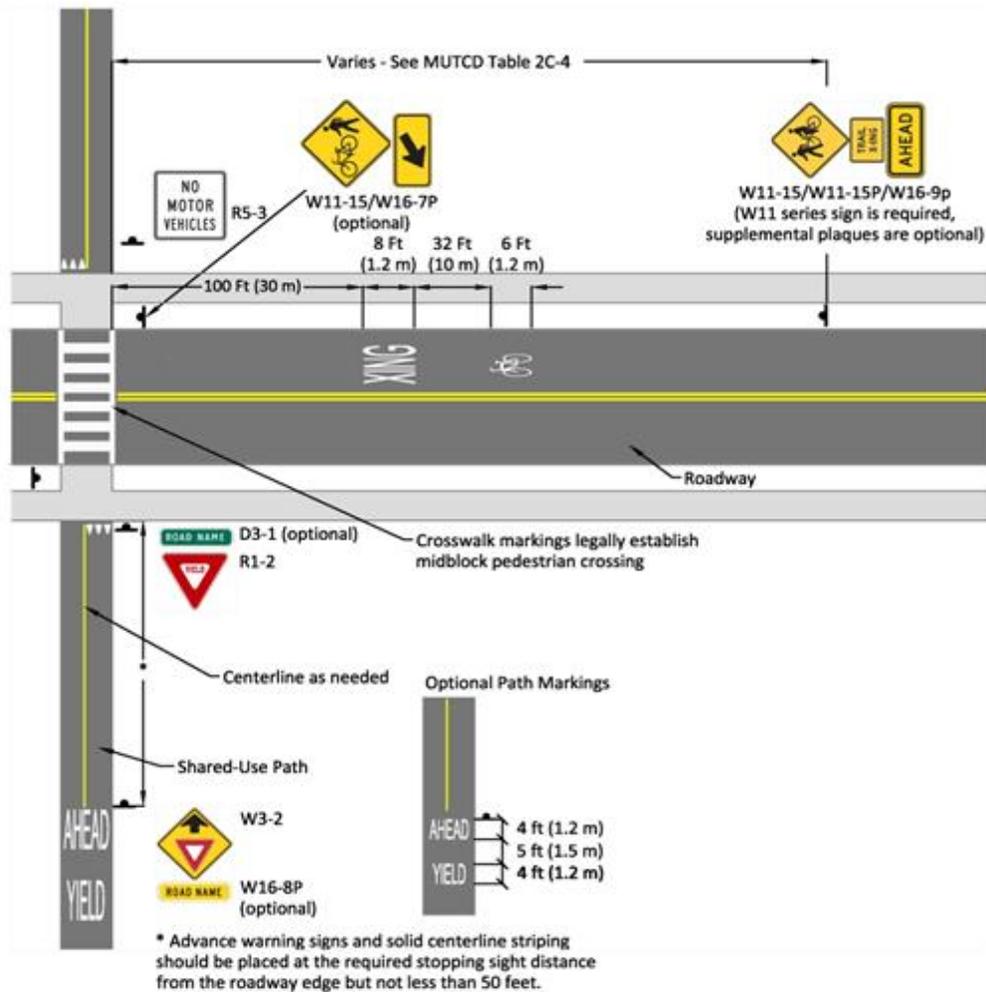
Crossing	Calculated Bike Path Leg (ft)	Observed Bike Path Leg (ft)	Acceptable for Yield?	Notes
Harrison (West)	125	0	No	Fence and shrubs on the southwest corner block all visibility to the path for eastbound vehicles.
Harrison (East)	125	0	Yes	Entrance to Harrison Ave. rather than a crossing, so a yield path control here would be acceptable.
College Street – 10 mph	95	100	Yes	If it can be proven that vehicles only travel 10 mph through this crossing, this would be acceptable.
College Street – 25 mph	90	65	No	
Lake Street	85	85	Yes	
Little Eagle Bay Road	140	10	No	Hedges on the west side of path limit sight distance for eastbound vehicles.
Beachcrest Drive – 10 mph	140	15	No	Hedges on northeast corner limit sight distance for westbound vehicles.
Beachcrest Drive – 25 mph	130	5	No	
Leddy Beach (South)	95	20	No	Trees on southwest corner limit sight distance for eastbound vehicles.
Leddy Beach (North)	95	60	No	Trees on the northeast corner limit sight distance for westbound vehicles.
Shore Road	130	10	No	Trees and fencing on various corners limit sight distance.
North Avenue Extension – 10 mph	140	20	No	Trees on various corners limit sight distance.
North Avenue Extension – 25 mph	130	10	No	

The East crossing of Harrison Avenue currently does not have any sort of path control. This is because rather than crossing the road it is more of an entrance into Harrison Avenue. For this reason it could be justified to add a yield sign at that location. It could also be justified to add a yield sign at the crossing of College Street if data can show that vehicles travel 10mph or less through that crossing.

Given the very conservative decision stopping sight distance that AASHTO prescribes along the path it is very difficult to find intersection sight triangles of suitable length along the Burlington Bike path to allow the use of yield control. The desired sight triangles are typically obstructed by vegetation, fences, signs or structures. VHB is therefore unable to support replacing stop signs with yield signs where the site conditions do not provide at least the minimum sight lines required by the accepted design guidelines.

The City may, however, choose to weigh other site conditions such as low side street volumes in combination with lower than posted vehicle speeds and good visibility of an intersection to still consider yield controls. The 2013 ITE Traffic Control Devices Handbook (ITE TCD Handbook) offers guidance on assigning priority at bike path/ roadway crossings in Chapter 14: Bicycle Facilities. This handbook states that “A number of factors should be considered in determining priority, including volume and type of users on the path, volume of traffic on the intersecting roadway, available sight distance, and other factors.” There may be a concern under the current stop controls that the high volume of cyclists is leading to bike-bike crashes as some cyclists stop at every crossing while others perform a “rolling” stop maneuver. This type of cyclist action is also discussed in the ITE TCD Handbook at locations where there are routinely placed stop signs. “Observation has noted that bicyclists often treat STOP signs as YIELD signs at these locations, slowing, scanning for conflicting traffic, and then proceeding if no conflicting traffic is detected... Yield control (either for the roadway or pathway) can be an effective and efficient treatment as it encourages appropriate scanning behavior without unneeded restriction (or routine disobedience).” While we cannot formally endorse yield controls where the required sight lines do not support them, the City may wish to selectively convert to yield control where stop controls are observed to be routinely ignored, as described above.

For locations where yield control is considered, it is important to note that yield control does not remove responsibility on the part of the cyclists to control their approach speed and to stop if motor vehicles are approaching the crossing. Placing Yield Ahead pavement markings and W3-2 signs along the path in advance of the road crossings would help alert cyclists to start slowing down in advance of where they would see approaching vehicles. This speed reduction would reduce the required sight triangle lengths, which would be a favorable modification. The below graphic from the AASHTO Design Guide provides guidance on the suggested yield control signing and striping layout.



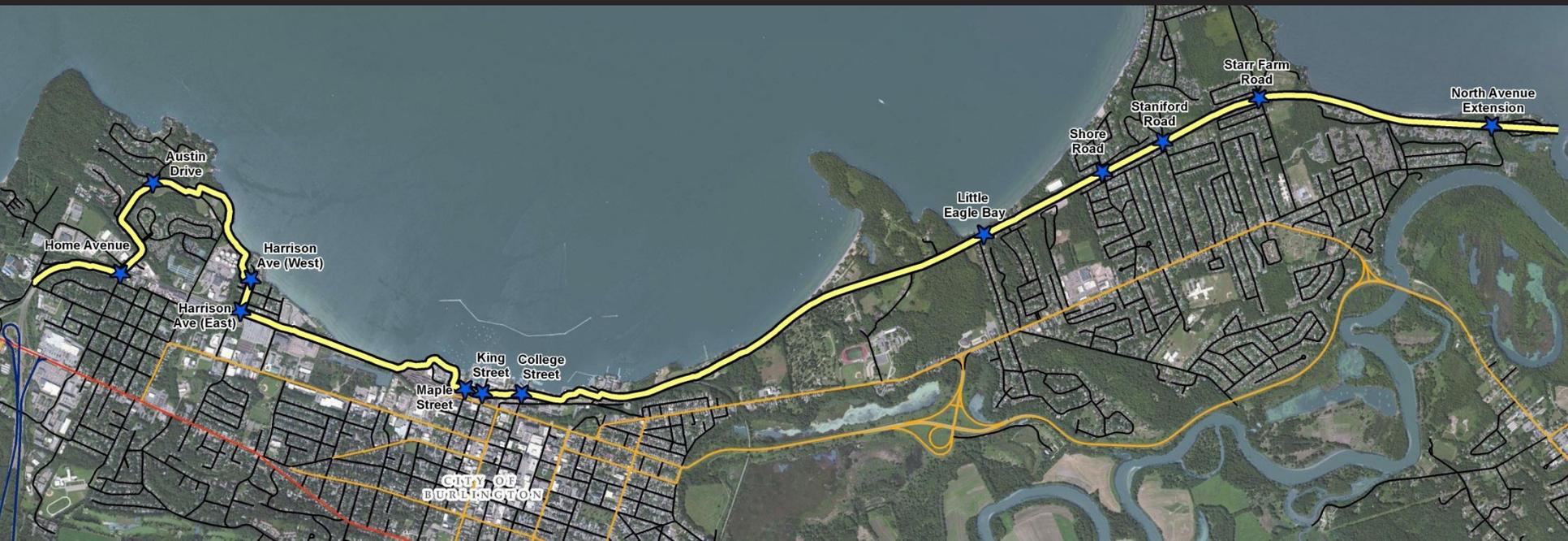
APPENDIX B – ALTERNATIVES PRESENTATION PUBLIC MEETING

Alternatives Presentation Meeting

Burlington Bike Path Intersections Scoping Study

August 20, 2013

Burlington Police Department, Community Room



Introductions

Peter Keating

CCRPC Project Manager

Jen Francis

Jesse Bridges

Burlington Department of Parks and Recreation

Nicole Losch

Burlington Department of Public Works

Greg Bakos

VHB Engineering

Erin Parizo

VHB Engineering



Purpose of Meeting

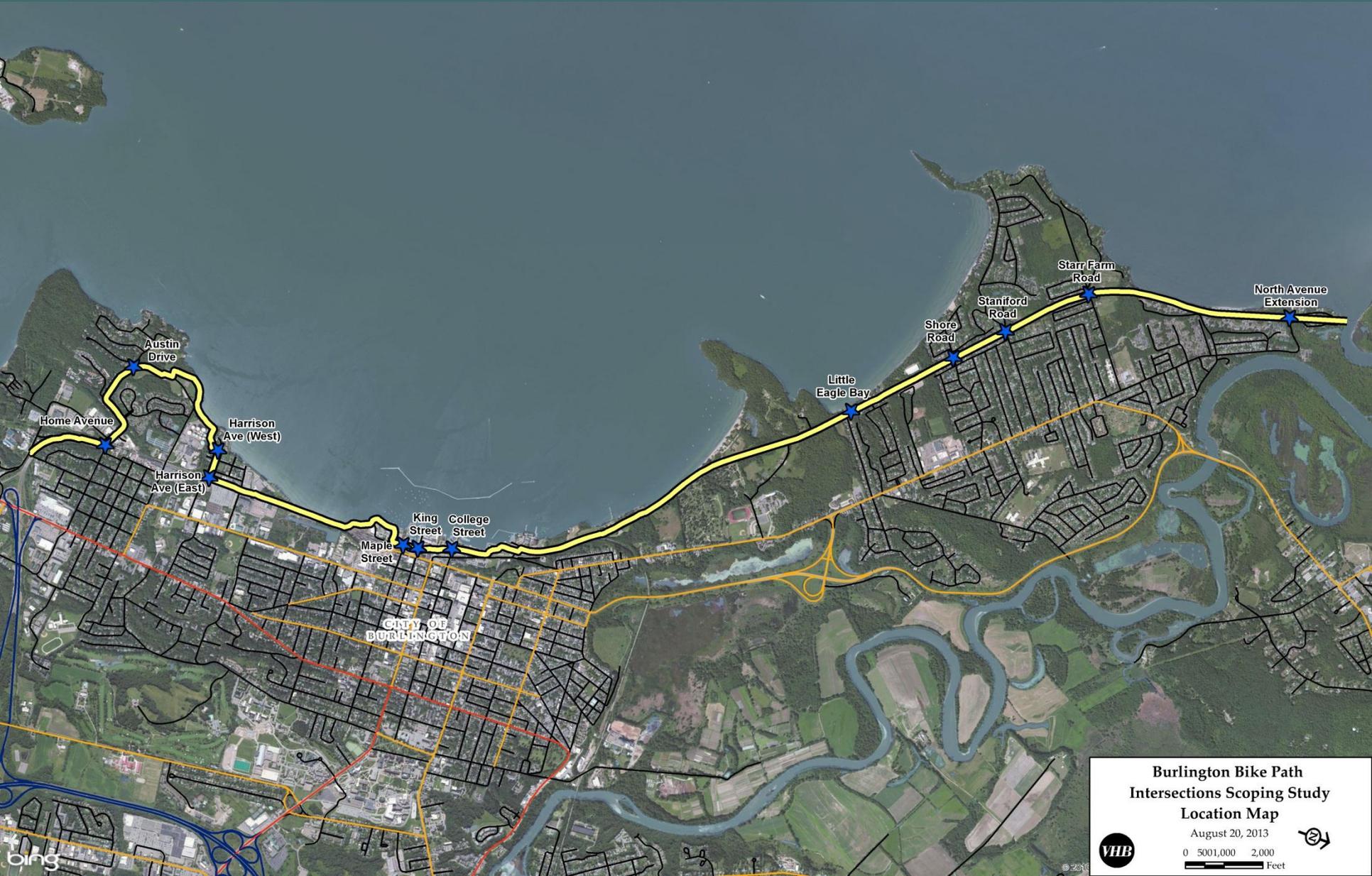
- Project Overview
 - Scoping Study
 - Rehabilitation Project
- Intersection Alternatives
- Q&A / Public Input
- Next Steps

Presentation Handouts

- Meeting Agenda/Project Description
- Aerial Map
- Tri-Fold Mailer for Public Comments
- Bike Path Website: <http://www.BTVBikePath.com>

Comments Due Wednesday, August 28th, 2013

Project Limits



**Burlington Bike Path
Intersections Scoping Study
Location Map**

August 20, 2013

0 500 1,000 2,000
Feet

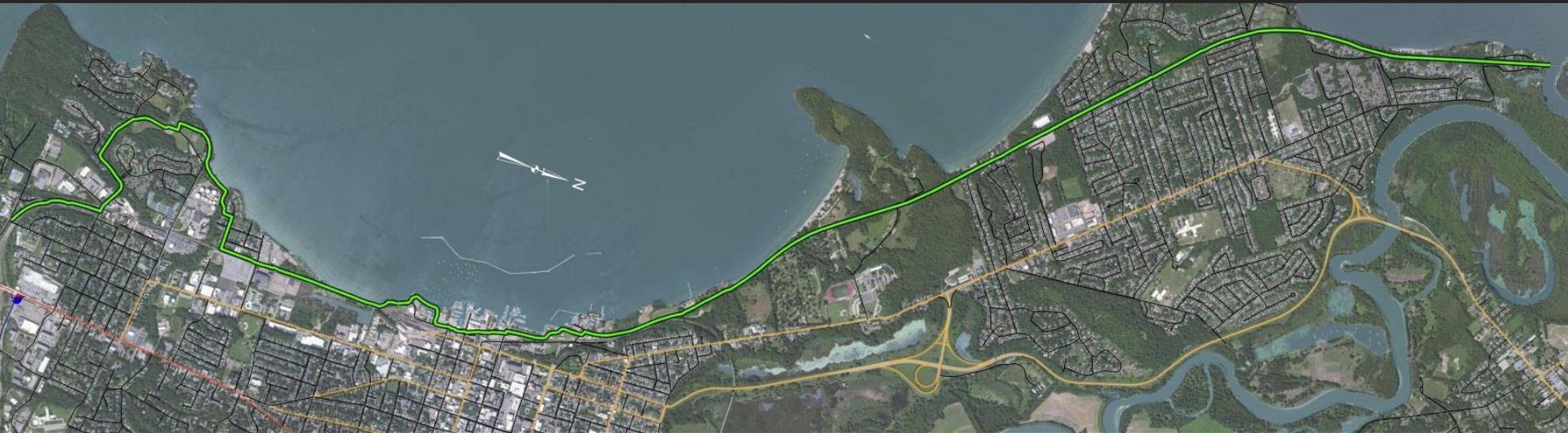


Study Process Overview

- 12 Intersections
- Evaluate Existing Conditions ✓
- Develop Improvement Plans (Near and Long Term) ✓
- Solicit Public Input – Tonight through August 28th
- Select Improvement Alternatives – August 30th
- Develop Summary Report with Recommendations – September

Rehabilitation Project Overview

- Rehabilitation of 8 mile path from Queen City Park Road to the Winooski River Bridge
- Fall 2014 Construction



Rehabilitation Project Overview

- Incorporate long term recommendations from Intersection Scoping Study into Rehabilitation Project plans
- Project Website :

www.BTVBikePath.com

Intersection Study Overview

12 Intersections:

- Home Avenue
- Austin Drive
- Harrison Ave (West)
- Harrison Ave (East)
- Maple Street
- King Street
- College Street
- Little Eagle Bay
- Shore Road
- Staniford Road
- Starr Farm Road
- North Avenue Extension

Yield Sign Analysis



VS.



- Currently Path is Stop Controlled
- Can Yield Signs be Used on the Path?
- Path Observations
- 2012 AASHTO Guide for the Development of Bicycle Facilities
- Manual on Uniform Traffic Control Devices (MUTCD)

Yield Sign Analysis

- Calculated Sight Triangle Legs
- Path Speed of 20 MPH
- CCRPC Speed Study
 - Leddy Park (15.1 MPH)
 - College Street (13.3 MPH)
 - Lake Street (13.3 MPH)
- Field Approach

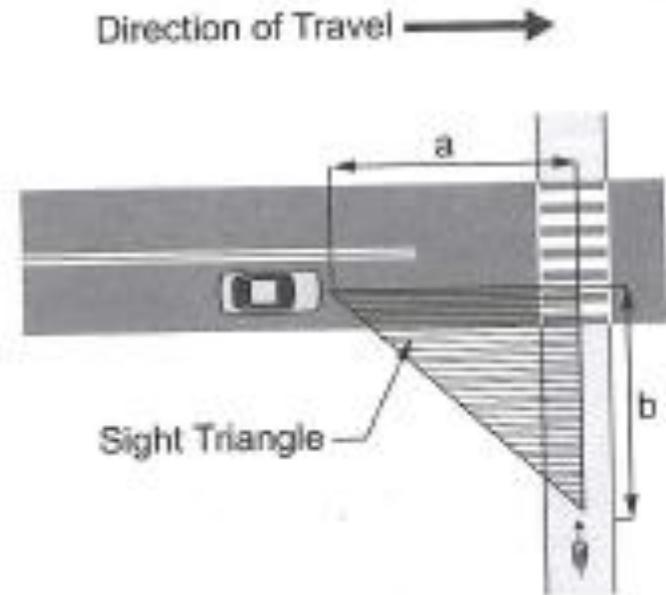


Figure 5-15. Yield Sight Triangles

Crossing	Calculated Bike Path Leg (ft)	Observed Bike Path Leg (ft)	Acceptable for Yield?
Harrison (West)	125	0	No
Harrison (East)	125	0	Yes
College Street – 10 mph	95	100	Yes
College Street – 25 mph	90	65	No
Lake Street	85	85	Yes
Little Eagle Bay Road	140	10	No
Beachcrest Drive – 10 mph	140	15	No
Beachcrest Drive – 25 mph	130	5	No
Leddy Beach (South)	95	20	No
Leddy Beach (North)	95	60	No
Shore Road	130	10	No
North Avenue Extension – 10 mph	140	20	No
North Avenue Extension – 25 mph	130	10	No

Tool Box of Improvements

- Paint Markings
- Signage
- Detectable Warnings
- Improve Sight Lines
- Bump Outs
- Speed Tables
- Rectangular Rapid Flashing Beacons
- Cross Alert Systems
- Realignment
- Splitter Islands

Home Avenue



AUSTIN DR

AMBER PL

SOUTHERN CONNECTOR
SOUTHERN CONNECTOR

BATCHELDER ST

FOSTER

Home Avenue

S CREST DR

INDUSTRIAL PKWY

Existing Bike Path

Home Avenue



Home Avenue

Concerns:

- Limited Wayfinding
- Limited Access to Path
- Poor Sidewalk Condition



Home Avenue

Solutions:

- Add Sharrows and Share the Road Signs
- Add Wayfinding
- Trim Vegetation to Improve Sight Lines
- Widen Sidewalks
- Add Bike Connections to Street

Home Avenue



WIDEN PATH

CLEAR

PROPOSED SHARROWS (TYP)

PROPOSED W11-1 / W 16-1P



RETAIN EXISTING STOP SIGN

PROVIDE CONNECTIONS FOR ROAD USE BEYOND MEDIAN ISLAND (TYP)

HOME AVENUE

exist. path



Austin Drive

Oakledge park

Existing Bike Path

Dunder Rd.

Austin Drive



Austin Drive



Austin Drive

Concerns:

- Boulders
- Bike Cut Through
- Limited Wayfinding
- Skewed Alignment



Austin Drive

Solutions:

- Add Path Markings
- Update Signage
- Add Wayfinding
- Realign Path and Shift Crosswalk
- Add Bike Path Splitter Island in Place of Boulder
- Add Curb to Define Path Entrance

Harrison Avenue (West)



Harrison Ave

Existing Bike Path

Harrison Avenue (West)



Harrison Avenue (West)

Concerns:

- Visibility from Harbor Watch Property
- Limited Signage
- Limited Wayfinding
- Proctor Place/Cut Through



Harrison Avenue (West)

Solutions:

- Replace High Corner Shrub with Low Lying Vegetation to Improve Corner Sight Lines
- Add Path Markings
- Pave Entrance to Proctor Place to help Define Path / Road Boundary

Harrison Avenue (West)



Harrison Avenue (East)



Harrison Ave

Existing Bike Path

Harrison Avenue (East)



Harrison Avenue (East)

Concerns:

- Limited Signage
- Limited Paint Markings
- Minimal Sight Distance
- Path Alignment



Harrison Avenue (East)

Solutions:

- Add Striping and Pavement Markings
- Update Wayfinding and Signs

RETAIN EXISTING SIGNS



WATERFRONT BIKE PATH →

RETAIN EXISTING W11-1 / W 16-1P



SHARE THE ROAD

exist. path

ADD CENTER STRIPE AND ARROWS

PROPOSED BIKE / TURN ARROW MARKINGS

Harrison Avenue (East)

UPGRADE EXISTING SIGN TO LARGER AND RECOGNIZABLE BIKE PATH "DIRECTIONAL" SIGN

EXISTING SIGN:

Maple Street



Maple Street

Existing Bike Path

Maple Street



Maple Street

Concerns:

- Utility Conflicts
- Sight Lines
- Bike Cut Through



Maple Street

Solutions:

- Trim Trees
- Add Road and Path Markings
- Update Signs
- Add Detectable Warning Surface
- Coordinate with Utilities
- Extend Raised Median from Gate Attendant Booth

Maple Street

path

LIMB MAPLES TO IMPROVE VISIBILITY



RETAIN EXISTING STOP SIGN

PROPOSED R9-6 SIGN



REPLACE EXISTING W11-1 WITH PROPOSED W11-15 / W16-7p

MAPLE STREET

RETAIN EXISTING STOP AND EXIT SIGN



EXTEND RAISED MEDIAN TO PROVIDE CROSSING REFUGE



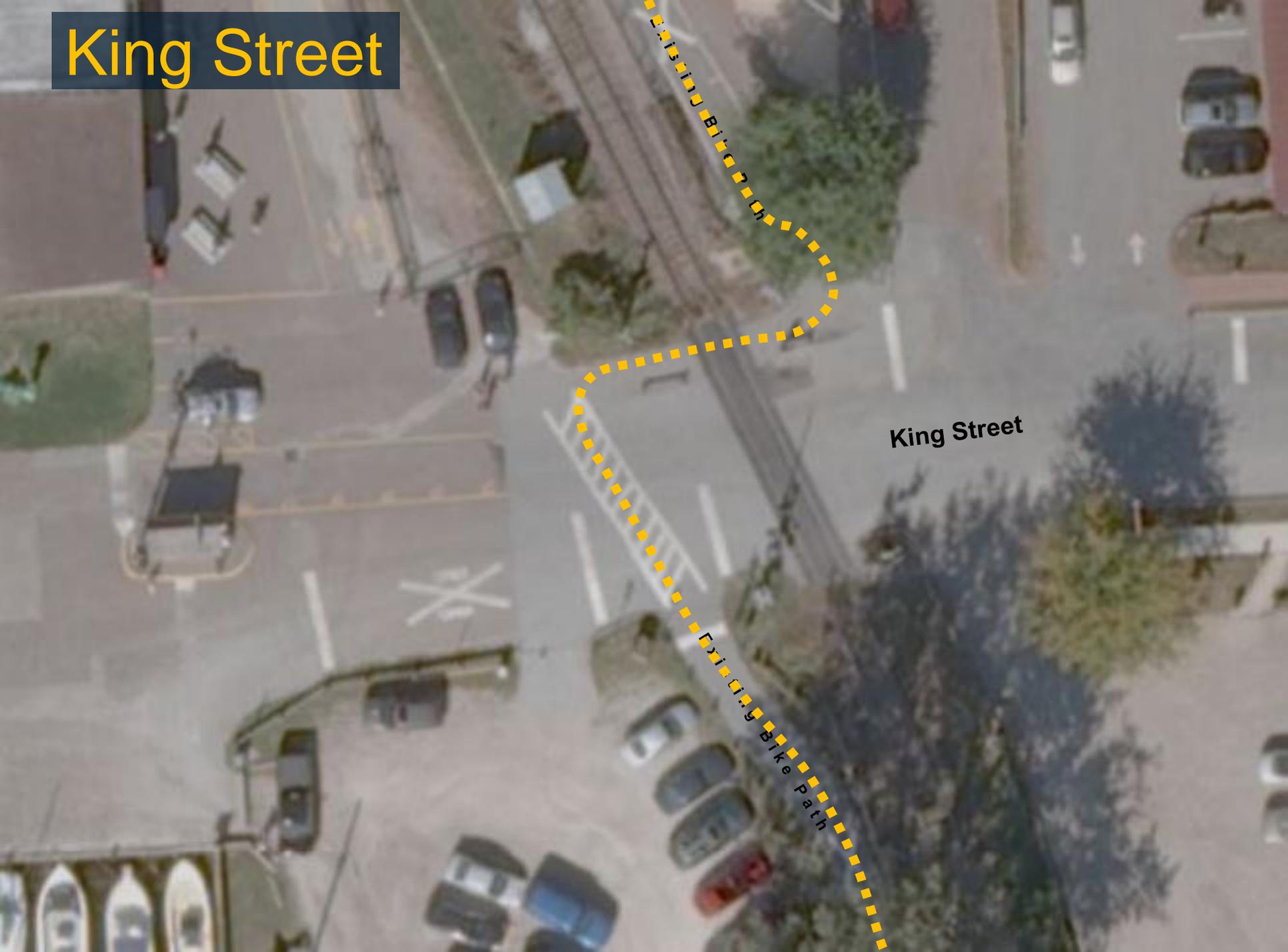
RETAIN EXISTING STOP SIGN



RETAIN EXISTING W11-1 SIGN

exist. path

King Street



King Street

Existing Bike Path

Existing Bike Path

King Street



King Street

Concerns:

- Alignment
- RR Track Crossing
- Limited Wayfinding/Signage
- Lack of Travel Path Definition



King Street

Solutions:

- Update Path Markings
- Update Signs
- Widen and Formalize Path
 - Adjust Curbing and Railings
- Add Wayfinding

King Street

"STOP AHEAD"



RETAIN EXISTING STOP SIGN



RETAIN EXISTING W11-1 SIGN

WIDEN AND FORMALIZE CURBED PATH



RETAIN EXISTING STOP SIGN

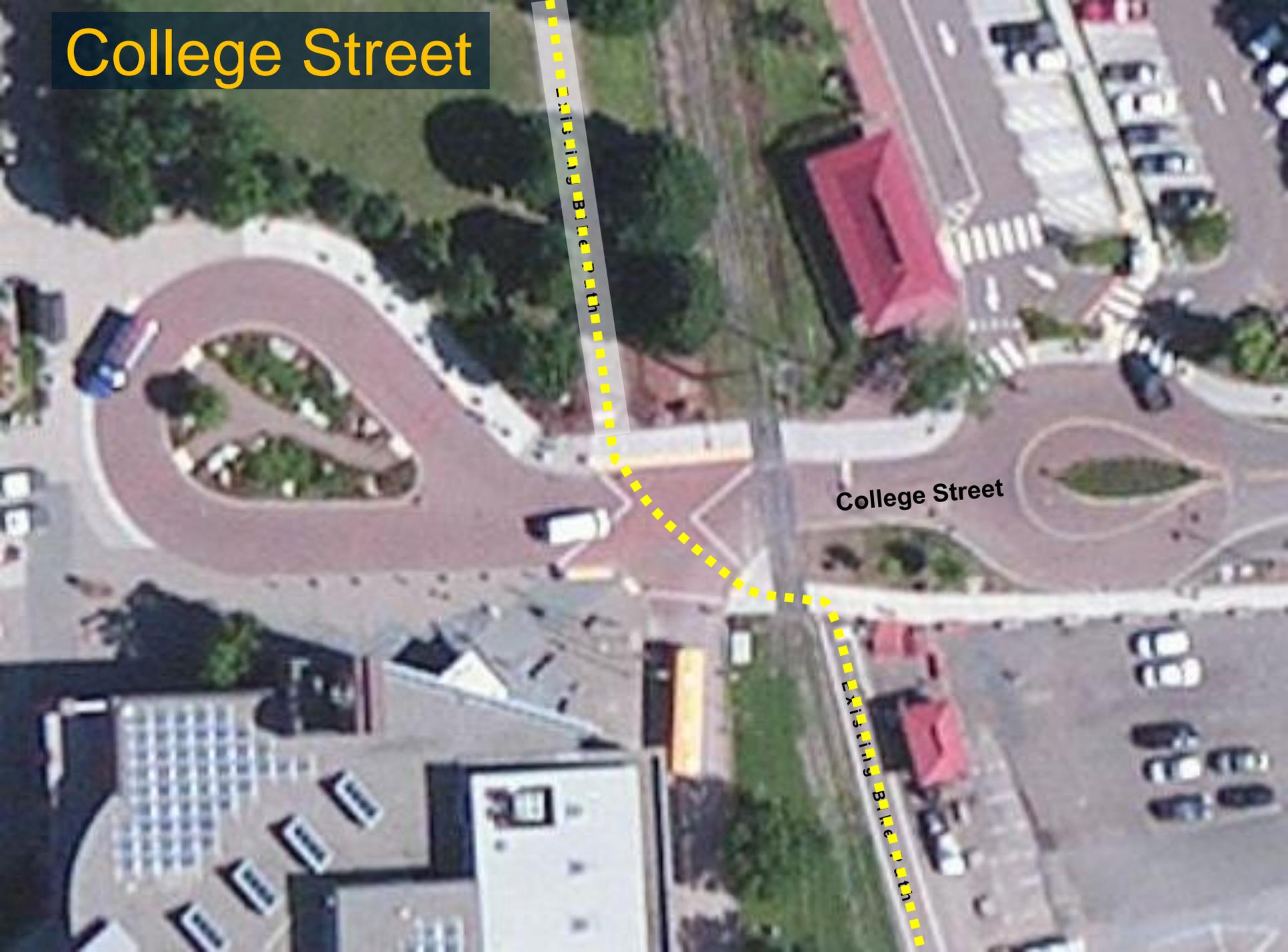
REPLACE EXISTING W11-1 WITH PROPOSED W11-15 / W16-7p



KING STREET

exist. path

College Street



Exploring Bike Path

College Street

Exploring Bike Path

College Street



College Street



College Street



College Street

Concerns:

- Bike / Ped Conflicts
- Jogged Alignment
- RR Track Crossing
- Lack of Clear Definition
- Ice Cream Stand



College Street

Solutions:

- Enhance Path Markings
- Update Signs
- Pedestrian Railing to Separate Ice Cream Stand from Path



College Street

PROPOSED R9-6 SIGN



REPLACE EXISTING W11-2 WITH PROPOSED W11-15



RETAIN EXISTING STOP SIGN



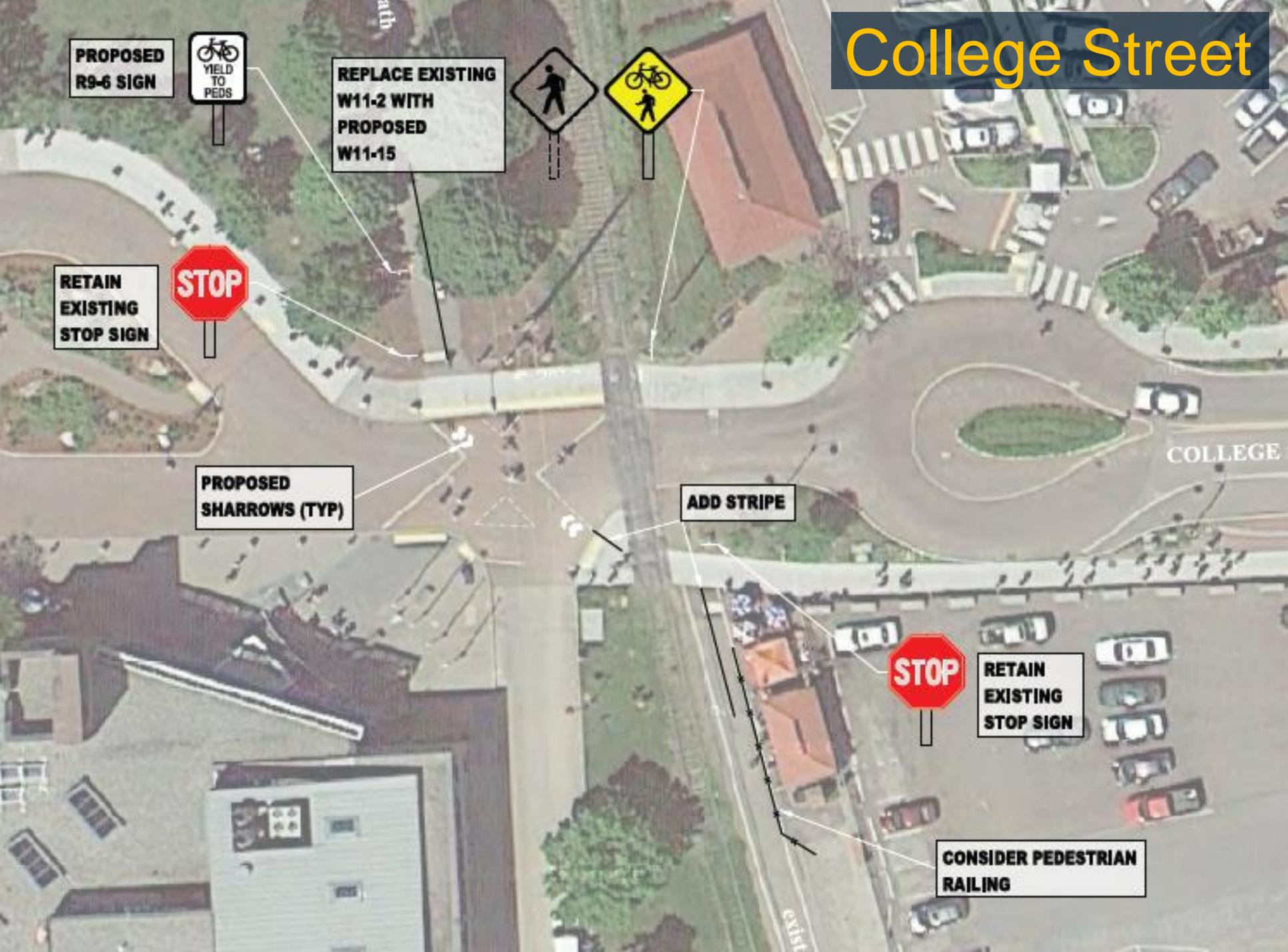
PROPOSED SHARROWS (TYP)

ADD STRIPE



RETAIN EXISTING STOP SIGN

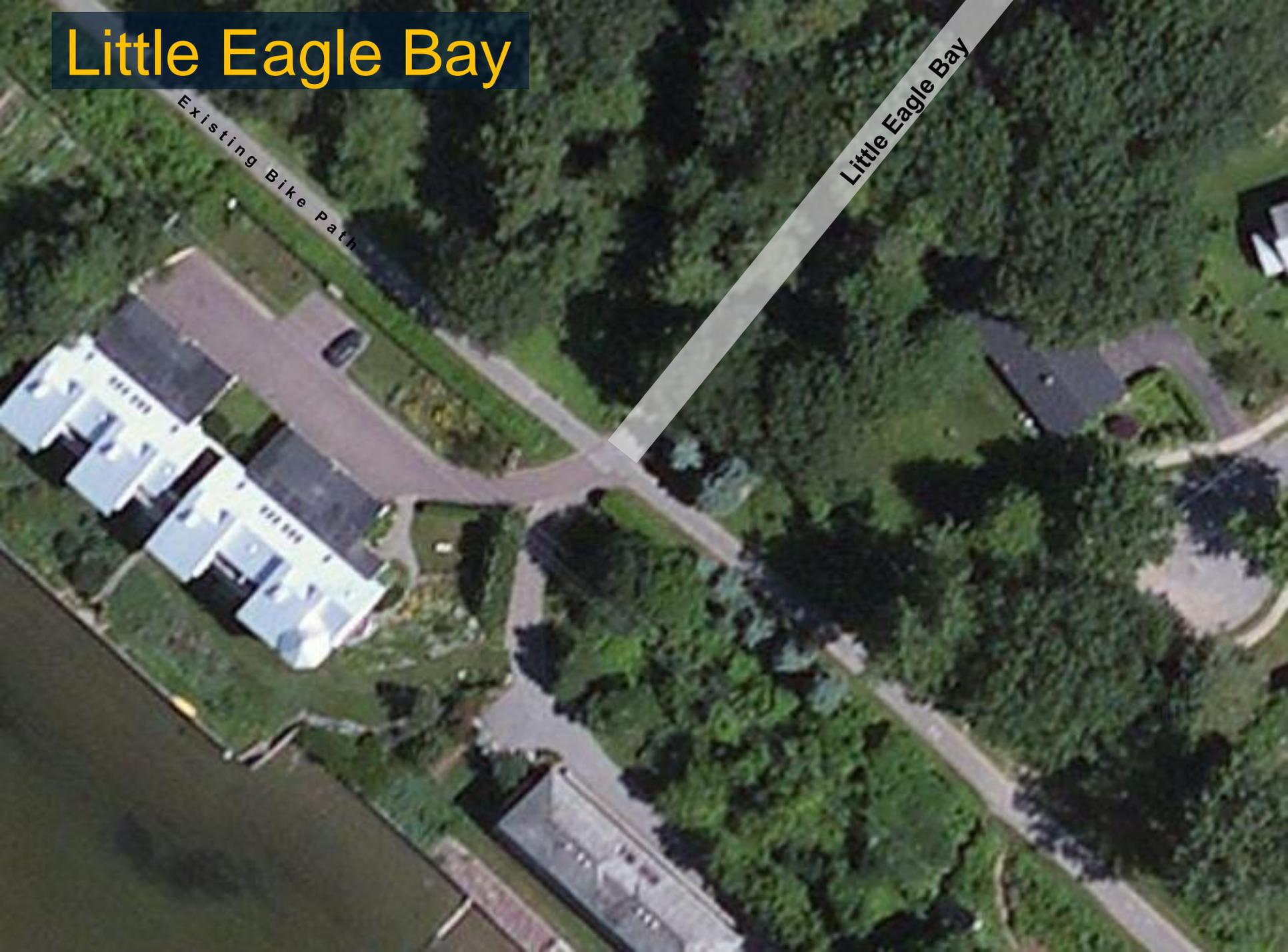
CONSIDER PEDESTRIAN RAILING



Little Eagle Bay

Existing Bike Path

Little Eagle Bay



Little Eagle Bay



Little Eagle Bay

Concerns:

- Hedges Limit Visibility
- Extremely Low Car Volume Leads to Cyclist Complacency

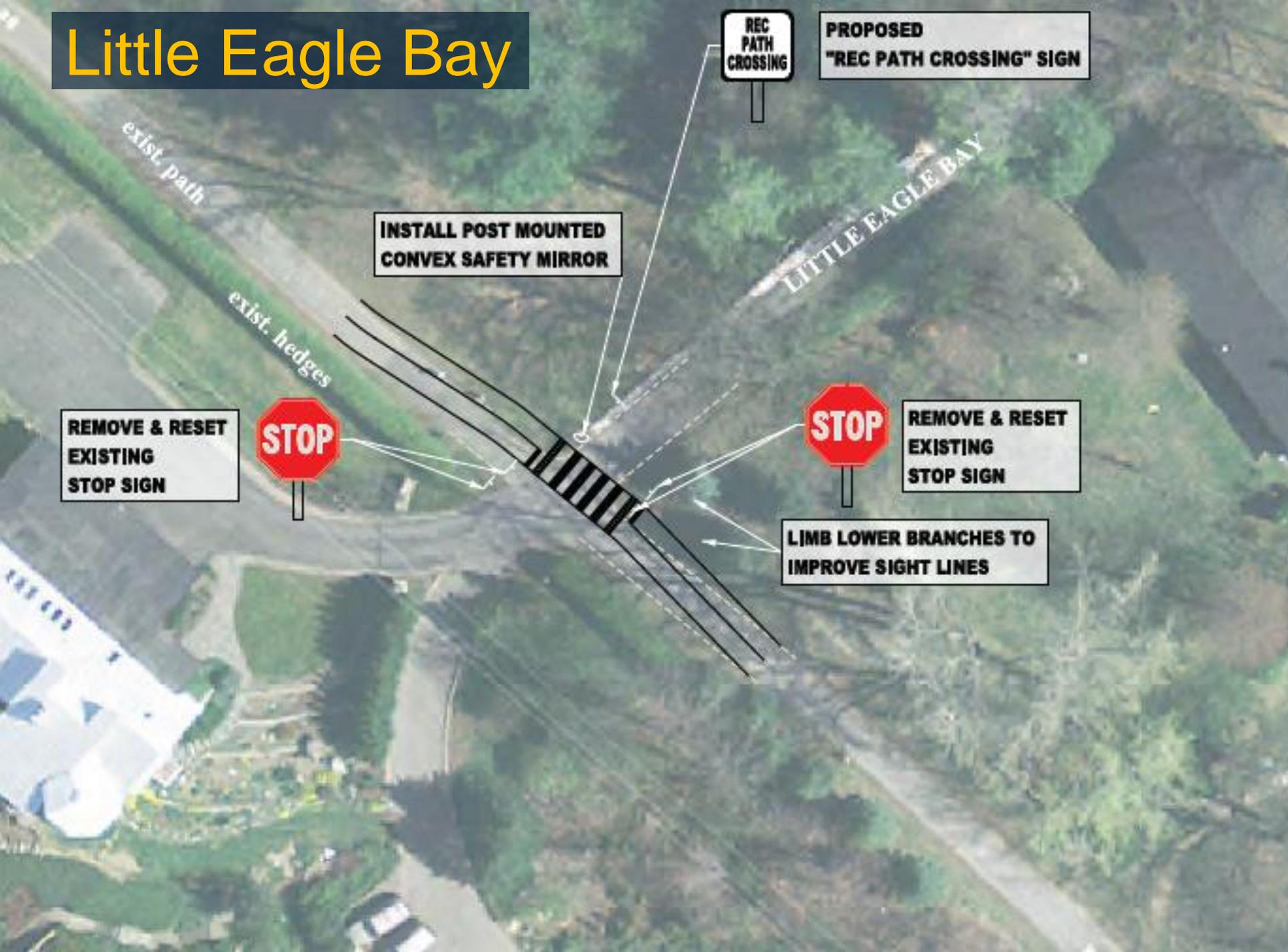


Little Eagle Bay

Solutions:

- Trim Trees
- Add/Update Signs
- Add Convex Safety Mirror
- Shift Path to East

Little Eagle Bay



**REMOVE & RESET
EXISTING
STOP SIGN**



**INSTALL POST MOUNTED
CONVEX SAFETY MIRROR**

**REC
PATH
CROSSING**

**PROPOSED
"REC PATH CROSSING" SIGN**



**REMOVE & RESET
EXISTING
STOP SIGN**

**LIMB LOWER BRANCHES TO
IMPROVE SIGHT LINES**

exist. path

exist. hedges

LITTLE EAGLE BAY

Shore Road



Dale Rd

Existing Bike Path

Stirling Pl.

Shore Road

Shore Road



Shore Road

Concerns:

- Constrained Sight Lines at Crossing
- Lacking Crossing Signs



Shore Road

Solutions:

- Trim Trees
- Update Signs
- Update Path Markings
- Consider:
 - Bump Out for Additional Sight Distance and Traffic Calming
 - RRFB's or "Cross Alert" Flashers

Shore Road



Staniford Road



Existing Bike Path

Staniford Road

Stanbury Road

Existing Bike Path

Appletree Point Rd.

Staniford Road



Staniford Road

Concerns:

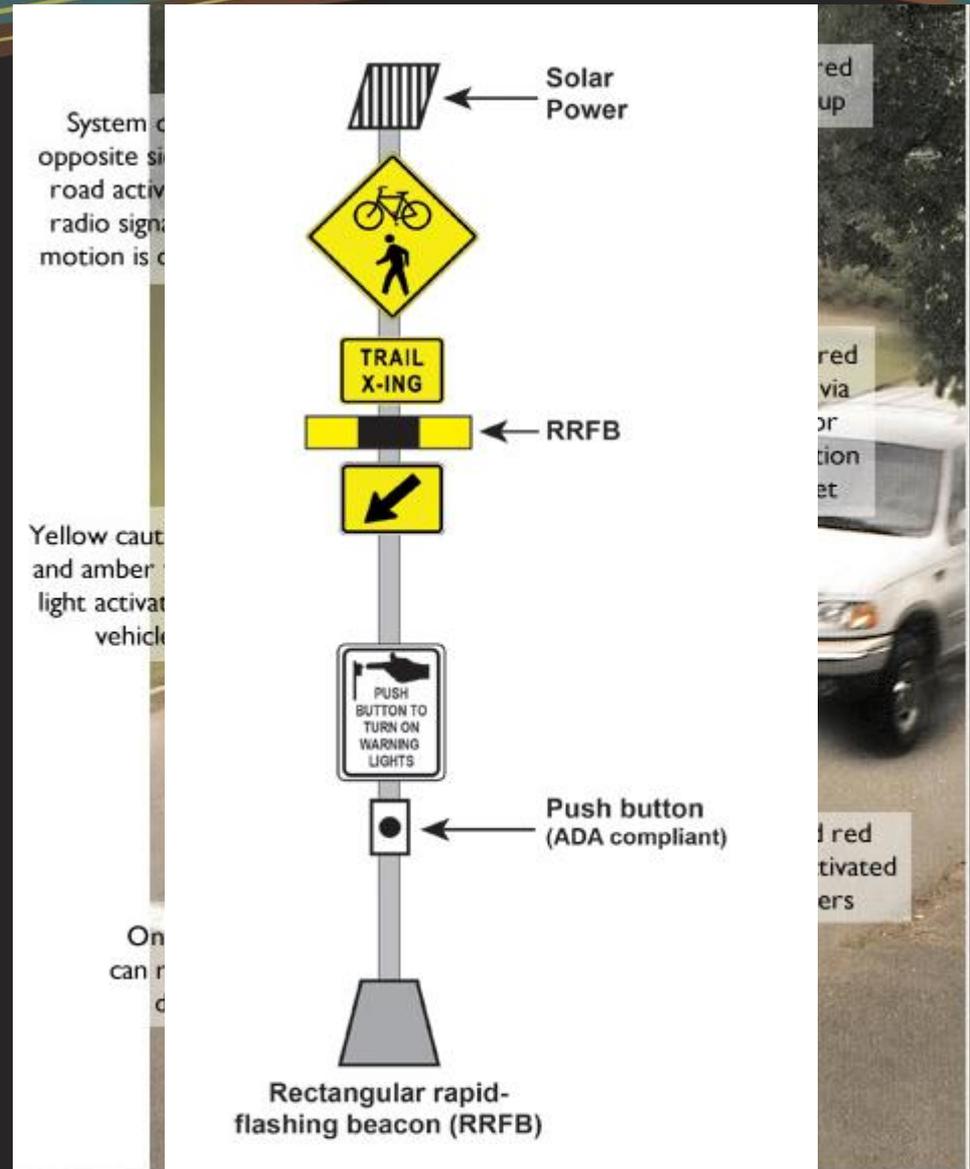
- Bike Cut Through
- Constrained Sight Distances
- Lacking Crossing Signs



Staniford Road

Solutions:

- Update Signs
- Add Pavement Markings
- Consider:
 - Bump Out on North Side
 - RRFB's or "Cross Alert" Flashers



Staniford Road

RETAIN EXISTING SIGN



exist. path

STANIFORD ROAD

exist. sidewalk

RETAIN EXISTING STOP SIGN



10'



PROPOSED W11-15 / W16-7p



RETAIN EXISTING STOP SIGN



PROPOSED W11-15 / W16-7p



RETAIN EXISTING W11-2 / W11-15P SIGNS

APPLETREE POINT ROAD

exist. path

Starr Farm Road



Starr Farm Road

Pleasant Ave.

Existing Bike Path

Curtis Ave.

Starr Farm Road



Starr Farm Road

Concerns:

- Limited Sight Distances
- Lacking Crossing Signs

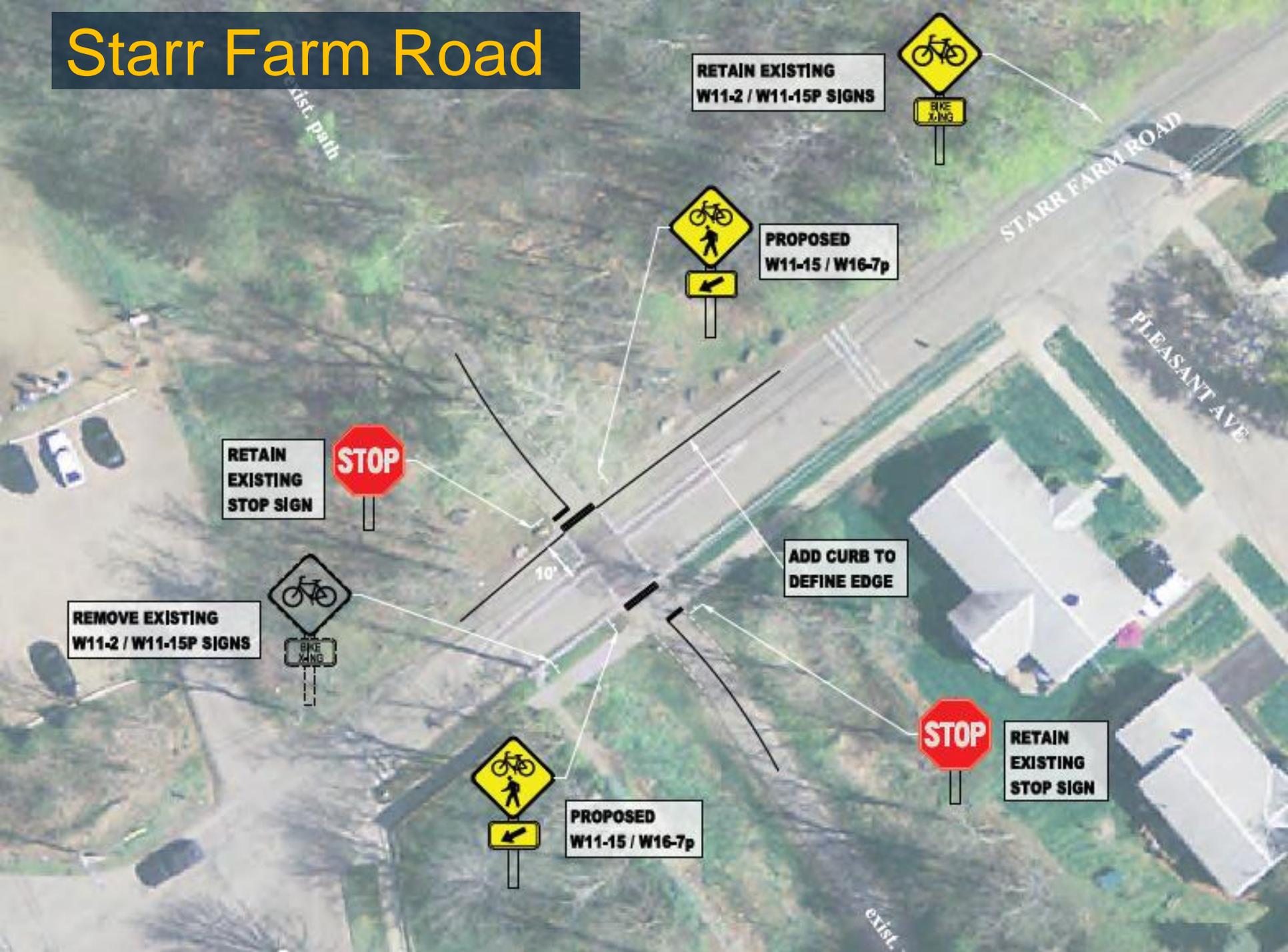


Starr Farm Road

Solutions:

- Update Signs
- Trim Trees
- Update Path Markings
- Add Curb to North Side of Road
- Consider RRFB's and "Cross Alert Flashers"

Starr Farm Road



RETAIN EXISTING
W11-2 / W11-15P SIGNS



PROPOSED
W11-15 / W16-7p

RETAIN
EXISTING
STOP SIGN



REMOVE EXISTING
W11-2 / W11-15P SIGNS



ADD CURB TO
DEFINE EDGE

PROPOSED
W11-15 / W16-7p



RETAIN
EXISTING
STOP SIGN

North Ave. Extension

Existing Bike Path

North Ave. Extension



North Avenue Extension



North Avenue Extension

Concerns:

- Downhill Path Grades
- Lack of Markings
- Lack of Wayfinding Signs



North Avenue Extension

Solutions:

- Add Pavement Markings
- Add Detectable Warnings
- Update Signs
- Consider North Ave. “Stop” Control

North Ave. Extension



Next Steps

- Select Recommended Improvements
- Develop Draft Scoping Report
- City/Stakeholder Review of Draft Report
- Finalize Scoping Report
- Implement Near Term Improvements
- Incorporate Long Term Improvements in Rehabilitation Project

Additional Questions and Comments

- Mailer in Handout
- Bike Path Website:
 - www.BTVBikePath.com

Comments Requested by:

Wednesday, August 28th, 2013





**Meeting
Notes**

Attendees: Peter Keating, Jen Francis,
Nicole Losch, Greg Bakos,
Erin Parizo, and public
participants

Date/Time: August 20, 2013
6:30 PM – 8:00 PM

Project No.: 57614.00

Place: Burlington Police Dept.
Community Room

Re: **Alternatives Presentation Meeting**
Burlington Bike Path
Intersections Scoping Study

Notes taken by: VHB

1. Introductions

- a. Peter gave a brief overview of the project, why we're meeting this evening, and that this project is officially managed through the Chittenden County Regional Planning Commission (CCRPC), but that the Burlington Department of Parks and Recreation (DPR) and the Department of Public Works (DPW) are also funding and managing design aspects of the project.
 - i. This is a scoping study which will develop a recommendations report for improvements to the intersections along the bike path.
 - ii. This is the Alternatives Presentation Meeting where we will show our conceptual improvements to the intersections and get input from the audience and any concerns, questions, or additional thoughts they have.
- b. Peter introduced Jen, Nicole, Greg, and Erin and then turned over the presentation to Greg from VHB.

2. Intersections Presentation

- a. See attached powerpoint presentation for additional details on recommended improvements for each intersection.
- b. Greg discussed the handouts that everyone received as they entered the room and explained that there is a project description, location map, and a mailer form in this handout.
 - i. The mailer form can be used for additional feedback regarding the project and sent in the mail to Jen.
 - ii. Please have any additional comments in by 8/28/13.
- c. Project Limits
 - i. The project limits were noted as the southern terminus of Queen City Park Road and follows the path northerly to the Winooski River Bridge.
- d. Project Overview
 - i. The final product of this study will be recommendations for near and long term improvements to the 12 intersections in question along the path.

- ii. This report will be made available to the public via the Bike Path website.
www.BTVBikePath.com
 - iii. Public input will be solicited through August 28th.
 - iv. The recommended improvements will be selected based on feedback on August 30th.
 - v. The draft report will be developed and finalized throughout September.
- e. Bike Path Rehabilitation Project
- i. This is a separate project which is funded through the City which VHB was also awarded.
 - ii. This project includes the rehabilitation of the 8 mile path from Queen City Park Road to the Winooski River Bridge.
 - iii. VHB will incorporate long term recommendations from the intersections scoping study into the plans for the rehabilitation project.
 - iv. Information and updates for both of these projects can be found on the BTVBikePath website.
- f. Yield Sign Analysis
- i. Erin presented the initial task of examining the possibility of converting some path stop signs to yield signs for path users at the intersections.
 - ii. Path observations reveal that the majority of cyclists will not stop appropriately at the stop signs at the crossings in question. Typically they will use it as a yield sign where they'll slow down, check for traffic, and then proceed when it is safe.
 - iii. Yield signs can be used if path and roadway geometry provide the required sight distance triangles.
 - 1. VHB calculated the required sight distance that would be needed at each intersection based on equations from the AASHTO Guide for the Development of Bicycle Facilities and the Manual on Uniform Traffic Control Devices (MUTCD).
 - 2. Used a design speed of 20 MPH for cyclists on the path for the calculations.
 - 3. The CCRPC performed a speed study in locations where required sight distance may be achievable to see what actual speeds on the path are.
 - a. The location at Waterfront Park resulted in an 85th percentile speed of 13.3 MPH.
 - b. The location at Leddy Park resulted in an 85th percentile speed of 15.1 MPH.
 - iv. Of the intersections examined College Street and Lake Street may be able to allow a yield sign based on sight distances.
 - v. A resident mentioned that he felt it didn't necessarily matter whether stop signs were used on the path in place of yield signs as long as there was consistency.
 - 1. If you have to stop and some intersections and yield at others he believes the message will be more convoluted for path and road users.
 - vi. Another resident believed that the best thing to do would be to place yield signs on both the path and the roadway so that everyone needs to yield and can then make an appropriate decision.

1. VHB pointed out that according to national guidelines it is not appropriate to place yield signs at all of the approaches of a four-way intersection as this would essentially indicate that nobody has the right-of-way (ROW).
- vii. A resident also mentioned that a cyclist in the crosswalk does not have the right-of-way.
1. VHB clarified that that statement is true in the state of Vermont. Vermont state law says that a pedestrian in a crosswalk has the ROW and a vehicle would need to stop for the pedestrian. However, a cyclist crossing on a crosswalk does not have the ROW unless they were to dismount their bike and cross on foot, thereby requiring they be treated as a pedestrian.
- g. Tool Box of Improvements
- i. VHB presented various options for improvements at the intersections including:
 1. Paint markings, signage, detectable warnings, improving sight lines, bump outs, speed tables, rectangular rapid flashing beacons (RRFB's), cross alert systems, path realignment, splitter islands, etc.
 - ii. One resident mentioned the scale of the existing stop signs appeared "childlike", reflecting that the small size did not support signs being taken seriously.
- h. Home Avenue
- i. Greg explained the location and existing issues at the Home Avenue crossing.
 - ii. Concerns include:
 1. Limited wayfinding, limited access to path, and poor sidewalk condition.
 - iii. Potential solutions include:
 1. Adding shared lane markings (sharrows), share the road signs, wayfinding, and bike connections to the street, trimming vegetation, and widening and/or reconstructing sidewalks.
 - iv. One resident asked how these proposed solutions would coexist with the proposed Champlain Parkway.
 1. VHB responded that while we have seen very conceptual plans for the new intersection of the Champlain Parkway with Home Avenue it is still undetermined how the proposed Parkway would impact this intersection.
 2. The City mentioned that because that project is still on hold it is best to move forward with the recommendations from this study and then incorporate the Parkway into the new existing infrastructure.
 3. The concepts for the Parkway show the path alignment shifting east in the future though.
 - v. A resident mentioned that she would prefer to cross diagonally over the railroad crossing in between the medians rather than as we proposed more to the east.
 - vi. A resident mentioned that the vines along the fence just south of the barge canal are always overgrown and are intrusive to cyclists, pedestrians, and other path users.
 1. VHB mentioned that while this is likely included in routine City maintenance, finding a solution for this is not within the scope of the intersections. This will be treated as an area of concern during the rehabilitation project.

- i. Austin Drive
 - i. VHB reviewed the location and existing issues at the Austin Drive crossing.
 - ii. Concerns include:
 - 1. Boulder in path, bike cut through, limited wayfinding, and skewed alignment.
 - iii. Potential solutions include:
 - 1. Adding path markings, wayfinding, a splitter island, and curbing, realigning the path, shifting the crosswalk, and updating signage.
 - iv. A resident pointed out that having the boulder in the middle of the path at Austin Drive was a liability as it is not painted, signed, or otherwise warned to path users.
- j. Harrison Avenue (West)
 - i. VHB reviewed the location and existing issues at the Harrison Avenue West intersection.
 - ii. Concerns include:
 - 1. Visibility from Harbor Watch property, limited signage and wayfinding, condition of Proctor Place, and cut through on the adjacent property.
 - iii. Potential solutions include:
 - 1. Replace the high corner shrub with low lying vegetation, add path markings, and pave entrance to Proctor Place to define the path/road boundaries.
 - iv. Resident expressed concern regarding the existing disintegrating road (Proctor Place) and how, if not included in the path improvement strategy, this old road could potentially undermine the new path once complete. Paving all of Proctor Place could be the solution to this.
 - 1. This idea has merit and the City may want to evaluate the added expense vs. the benefit.
- k. Harrison Avenue (East)
 - i. VHB reviewed the location and existing issues at the Harrison Avenue East intersection.
 - ii. Concerns include:
 - 1. Limited signage and paint markings, minimal sight distance, and path alignment.
 - iii. Potential solutions include:
 - 1. Add striping and path markings, and update wayfinding and signs.
 - iv. A resident asked whether the path will be an entirely consistent width or whether there may be some areas that are narrower than others.
 - 1. The preferred goal would be to create a consistent typical section of 2' aggregate shoulders on each side of an 11' path. This may not be achievable in some locations as you mentioned due to constraints.
- l. Maple Street
 - i. VHB reviewed the location and existing issues at the Maple Street crossing.
 - ii. Concerns include:
 - 1. Utility conflicts, sight lines, bike cut through.

iii. Potential solutions include:

1. Trim trees, add road and path markings and detectable warning surfaces, update signs, coordinate with utilities, and extend a raised median from the existing gate attendant booth.

iv. It was asked whether this crossing could be straightened out especially on the north side.

1. The utility conflict would be the biggest constraint preventing this, but it will be analyzed in more depth during the rehabilitation project as a possibility.

m. King Street

i. VHB reviewed the location and existing issues at the King Street crossing.

ii. Concerns include:

1. Alignment, railroad track crossing, limited wayfinding and signage, and lack of path definition.

iii. Potential solutions include:

1. Update path markings and signs, widen and formalize path, and add wayfinding.

iv. A resident brought up the discussions in the past with adjacent property owners regarding the relocation of the bike path to the west side of the tracks between King Street and College Street.

1. VHB has been made aware of these discussions and this will definitely be evaluated during the alternatives for the rehabilitation project since the new alignment could solve problems at both ends.

n. College Street

i. VHB reviewed the location and existing issues at the College Street crossing.

ii. Concerns include:

1. Bike/ped conflicts, jogged alignment, railroad crossing, lack of definition, and ice cream stand customers.

iii. Potential solutions include:

1. Enhance path markings, update signs, add pedestrian railing or separation from the ice cream stand.

iv. A woman pointed out that she'd think the owner of the ice cream stand would think it's a hazard to have his customers standing on the bike path.

1. She mentioned that finding out who the owner is could be helpful for any needed correspondence.
2. There is currently a sign near the picnic tables on the north side that says "bike path" for warning.

v. It was suggested that perhaps the City extend the rubber matting on the railroad tracks to the south and have the cyclists cross over the tracks south of the ice cream stand.

1. VHB mentioned that the railroad may not want two crossings so close together but it could be looked into.

- vi. Peter asked where there is a history of crashes here. Does the Burlington Police Department have any records?
 - 1. Greg mentioned that we have not heard of many crashes in the area but that isn't to say that there aren't any. It may be an issue with a lack of reporting of the crashes.
 - 2. The City is also unaware of any reported crashes.
 - 3. Also this may be a case where it is so poorly set up that it works. Everyone is likely more alert at this crossing, paying close attention to their surroundings, and going slow.
- vii. The City is aware of who owns the the parking lot parcel just east of the path here. It may be beneficial to get her and adjacent land owners in a room with the City to discuss the King Street to College Street section of the path.
- o. Little Eagle Bay
 - i. VHB reviewed the location and existing issues at the Little Eagle Bay crossing.
 - ii. Concerns include:
 - 1. Hedges limit visibility and low car volume leads to cyclist complacency.
 - iii. Potential solutions include:
 - 1. Trim trees, add or update signs, add a convex safety mirror, and shift the path east.
 - iv. A resident agreed that no one ever stops here because no one ever sees vehicles crossing here.
 - v. It was mentioned that there is also existing legal documentation here that prevents the path from being any wider than 8' with 2' shoulders, that the City does not own the hedge row and may not alter the hedges, and that the City may not alter the three blue spruce trees on the south east corner.
 - 1. We will need to confirm land ownership in this location.
 - vi. It was mentioned that perhaps placing a stop sign for vehicles at this crossing would make more sense.
 - vii. There was general consensus and support from attendees and City staff that this would be a good option.
- p. Shore Road
 - i. VHB reviewed the location and existing issues at the Shore Road crossing.
 - ii. Concerns include:
 - 1. Constrained sight lines and lack of signs.
 - iii. Potential solutions include:
 - 1. Trim trees, update signs and path markings, and consider adding bump outs, RRFB's, or crossing alert systems.
 - iv. A resident mentioned that people frequently park on Shore Road and Dale Road near here to access the path and that should be limited somehow.
 - 1. This comment came from the owners of the home on the south east corner of this crossing.

2. This relates to the need to define trail heads and access points and will be considered in recommendations.
- v. A resident mentioned that bump outs can be hard to plow around so that will need to be a consideration.
- vi. If we're recommending 10' lanes through Shore Road the amount of truck traffic should be looked into. A resident mentioned that there are many trucks through here.
- vii. It was brought up that likely the best solution for now would be to add new signs and cut vegetation but not to implement the bump outs until later per a resident.
 1. This will likely be what will happen as the short term solutions will be implemented as the City can but the long term solutions such as bump outs will be looked at more in the rehabilitation project and implemented later.
- viii. A resident pointed out that all four corner lots here have had major flooding issues over the last couple years. Maybe this is something that could be considered in any redesign of this area as well.
- q. Staniford Road
 - i. VHB reviewed the location and existing issues at the Staniford Road crossing.
 - ii. Concerns include:
 1. Bike cut through, lack of signs, and limited sight distances.
 - iii. Potential solutions include:
 1. Update signs, add pavement markings, and consider a bump out on the north side, RRFBs, or cross alert systems.
 - iv. A resident pointed out that the jog in the sidewalk on the north east side of the road was developed after the section on the northwest. This sidewalk was built so as not to affect any residential property and therefor was built within City ROW causing it to be off alignment with the existing sidewalk.
 - v. Eric Farrell owns the street from the NW quadrant to the SW quadrant as well as Appletree Point Road and is planning development for 32 new houses on the NW quadrant.
 1. The new development will have its main access point just west of the bike path. The hope is for Eric to begin development as soon as he can sell the houses.
 2. Plans for this are available in the Planning and Zoning Office per Nicole.
 - vi. One resident mentioned having seen accidents at this crossing.
 - vii. The dirt mound on the North West corner of the crossing was originally placed there to help insulate City water pipes which would often freeze in the winter. Removing this mound has been suggested in the past but may be controversial.
 - viii. Discussions about the look and concepts of RRFBs and the cross alert system took place at this point. Graphics shown in slideshow presentation.
 1. RRFBs and cross alert can also include infrared sensors so that they are passively activated.
 2. A resident mentioned that light through peoples windows at night would be a concern.

- a. Per VHB this would be a consideration in the design and model of the RRFB or other system.
 - b. Nicole has previously received information on the brightness and design of these from a few vendors so the community can understand potential impacts.
 - c. Peter mentioned that South Burlington has been placing these all around their City and perhaps we could check with them on the restrictions they've been using.
 3. Perhaps a RRFB or cross alert system could be a good test at one of these northern intersections per a resident near Staniford Road.
- ix. It was suggested that there shouldn't be any parking along the street here.
- x. One resident said that there is commonly illegal parking in this area.
- xi. A resident mentioned that bump out on the north side to straighten the sidewalk would not be needed.
- xii. A resident suggested that this entire intersection should be reconfigured.
- r. Starr Farm Road
 - i. VHB reviewed the location and existing issues at the Starr Farm Road crossing.
 - ii. Concerns include:
 1. Limited sight distance and lack of crossing signs.
 - iii. Potential solutions include:
 1. Trim trees, update signs and path markings, add curb to the north side of the road, and consider RRFBs or cross alert systems.
 - iv. A resident mentioned that lately the sight lines are much more open as there was a lot of work done there in preparation for the marathon.
- s. North Avenue Extension
 - i. VHB reviewed the location and existing issues at the North Avenue Extension crossing.
 - ii. Concerns include:
 1. Downhill path grade and lack of wayfinding and signs.
 - iii. Potential solutions include:
 1. Adding pavement markings and detectable warnings, updating signs, and considering adding stop signs on North Avenue.
 - iv. The general consensus was that a stop sign for vehicles on North Avenue here rather than for the cyclists would be preferred.
- t. Next Steps
 - i. Select the recommended improvements through a meeting with the CCRPC, City, and VHB taking into consideration all input received to date and through 8/28/13.
 - ii. VHB will develop a draft scoping report for review by all key entities.
 - iii. VHB will finalize the report and make it available for public consumption.
 - iv. Near term improvements can be made as the City is able.

v. Long term improvement recommendations will be incorporated into the rehabilitation project.

3. Other Questions/Comments

- a. There was more emphasis from a resident that everything should be consistent including the path width, stop/yield signs, wayfinding signs, pavement markings, and everything throughout Burlington and the rest of the Island Line Trail.
 - i. Another resident countered this argument by saying that users of the path should just follow whichever signs are at the specific intersection rather than relying on consistency. Some intersections may have drastically different needs and not warrant the same signage as the next intersection down.
- b. A resident mentioned that the updated signs for warning vehicles of the path are great additions and she is happy to see those.

The recorder has attempted to summarize discussions held during this meeting as accurately as possible. If there are any items that are misrepresented, please contact the recorder within ten working days. In the absence of any corrections or clarifications, it will be understood that these notes accurately summarize the discussions at the meeting.