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Department of Public Works

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MEMORANDUM

Date: December 15, 2020
To: Transportation, Energy, and Utilities Committee
From: Elizabeth Ross, Planner
CC: Nicole Losch, Senior Transportation Planner, DPW
Max Madalinski, Associate Parks Project Coordinator, PR&W
James Sherrard, Stormwater Program Coordinator, DPW
Subject: Bikeway Connectivity, Pedestrian Safety, and Stormwater Management in Burlington's Old North End - Scoping Study

The Department of Public Works (DPW) solicited assistance from the Chittenden County Regional Planning Commission (CCRPC) through their Unified Work Program to evaluate and make recommendations to make walking and biking safer and more comfortable in the southwest section of Burlington's Old North End.

The project is funded through CCRPC and includes preferred alternatives and cost estimates for streets in the Old North End. The goals built into the alternatives in this plan are to:

- Provide low stress bicycle connections
- Modify streetscapes and intersections to make walking and riding bikes safer and more comfortable
- Identify opportunities for water infiltration through green stormwater infrastructure

Quick-build and long-term projects are recommended in several locations within the project area to meet these goals. The final draft of the Scoping Study, including concepts for recommendations, is attached and will be included in a short presentation to the members of the Transportation, Energy, and Utility Committee (TEUC) for their review and comments. The design alternatives for both quick-build and long term are summarized on page 20 of the report.

This does not require action by the TEUC at this time; this is being provided for informational purposes. Pending the TEUC's comments, the final report will be shared with City Council as an informational item on consent at an upcoming meeting.

BIKEWAY CONNECTIVITY PEDESTRIAN SAFETY STORMWATER MANAGEMENT

IN BURLINGTON'S OLD NORTH END

December 10, 2020

Chittenden County RPC
Communities Planning Together

Burlington, VT Public Works

PURPOSE & PROCESS

PURPOSE & PROJECT OVERVIEW

This project was initiated by Chittenden County Regional Planning Commission (CCRPC) and City of Burlington (the City) in their commitment to making walking and biking safer and more comfortable in Burlington. The project is funded through CCRPC and includes preferred alternatives and cost estimates for streets in the Old North End.

The goals built into the alternatives in this plan are to :

- Provide low stress bicycle connections
- Modify streetscapes and intersections to make walking and riding bikes safer and more comfortable
- Identify opportunities for water infiltration through green stormwater infrastructure

Quick-build and long-term projects are recommended in several locations within the project area to meet these goals.

PROJECT AREA

The project area is located within a portion of the Old North End, a neighborhood located just north of downtown Burlington. The bounds of the project area are shown in the map below left. They include Lakeview Terrace and North Avenue to the northwest, North Street to the north, North Champlain Street to the east, the full area of Battery Park, Pearl Street and Battery Street to the southeast, and Depot Street to the west. The streets are mostly two-way throughout the project area. However, Park Street runs one-way south for its entire length, and North Champlain Street heads one-way north throughout.

PARTICIPANTS

CCRPC and City planning staff met with the consultant, Toole Design, several times during the course of the project. Each step in analysis and conceptualization has also been guided by the Project Advisory Committee (PAC), which includes City, regional, and neighborhood representatives:

- Ethan Waldman, NPA Ward 3 Rep
- Mary Manghis, Burlington Walk Bike Council
- Barry Simays/Aaron Collette, Burlington Fire Department
- Max Madalinski, Burlington Parks, Recreation and Waterfront
- James Sherrard, Burlington Public Works (Stormwater)
- Nicole Losch/Elizabeth Ross, Burlington Public Works (Transportation)
- Bryan Davis/Marshall Distel, CCRPC

PAC members reviewed and provided feedback on materials, updated their organizations/constituents, and participated in developing recommendations.

TIMELINE

Data collection and analysis kicked off with a site visit in October 2019, and Toole Design provided a memorandum of existing conditions to the project team in November 2019. The project team presented to the public in-person in November as well to share the analysis and seek initial thoughts. The team then met with the PAC in December 2019 to review conditions and public feedback.

Concepts were explored throughout the winter into March 2020, and initial alternatives were discussed with the PAC virtually due to COVID-19. The project team edited concepts through multiple rounds based off feedback from the PAC.

Recommendations were presented to the public during an August 2020 meeting and through a recorded presentation and content posted online. They were also advertised via project signs posted throughout the project area in fall 2020. Preferred alternatives and a draft of this report were presented to the Transportation, Energy, and Utilities Committee (TEUC) in December 2020. [note approval date]

See the timeline below for an overview of key steps and engagement touchpoints with the public, PAC, and TEUC.

	Oct 2019	Nov	Dec	Jan 2020	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec 2020
Collect Data		PM	PAC												
Analyze Alternatives						PAC									
Recommend											PM*	PAC			
Report															TEUC

PAC - Project Advisory Committee Meeting
PM - Public Meeting
TEUC - Transportation, Energy, and Utilities Committee Meeting
*Besides a public meeting, in August 2020, the consultant recorded a presentation, and CCRPC provided a digital platform to seek public feedback.

PUBLIC PARTICIPATION

Public participation has been supported through meetings and online platforms. CCRPC supports a project website (http://bit.ly/ONE-bike-ped-stormwater) that fully documents the project process. It includes meeting schedules, all documents produced during the course of the project, and all materials and input received from public meetings. A summary of meetings with the public is provided below.

WARDS 2 & 3 NPA MEETING NOVEMBER 14, 2019

The project team shared background information about the project, the areas of focus and existing conditions. The team asked residents to share their experiences, concerns, and ideas. Public comments were published online, discussed with the PAC, and recorded as part of the existing conditions memorandum.

DECEMBER 2019 ONLINE SURVEY

A survey was made available in December 2019 that elicited 172 responses to 10 questions. The following are highlights of results from survey respondents:

TOP 3 UNSAFE INTERSECTIONS

- North Ave / North St
- North Ave / Sherman St / Battery Park Entrance
- Park St / Battery St / Pearl St

HIGHEST PRIORITY BIKE CONNECTIONS

- North St between Depot St and North Champlain St
- North Ave between Haswell St and Sherman St
- Park St between Sherman St and Battery Street Shared Use Path
- Battery Park Connection
- Front St between North St and North Ave

This information informed the team's focus during concept development and has helped guide CCRPC and the City in setting priorities for advancement of alternatives to implementation.

VIRTUAL ZOOM PRESENTATION AUGUST 19, 2020

A virtual public meeting was held over Zoom, where a small group of residents and advocates viewed and commented on proposed alternatives.

Recommendations were also presented to the public through a recorded presentation and content posted online in August 2020. Posters were placed in-field at project locations to help advertise. A month and a half was given to the public to respond with comments using the Konveio online platform, where people could comment directly on each proposed alternative plan.

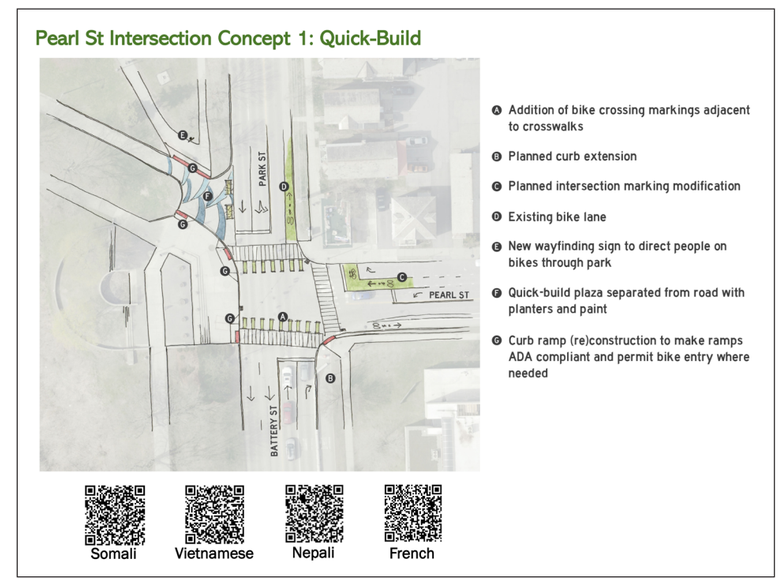
Public feedback was summarized and discussed by the project team and the PAC. Preferred alternatives were identified through this process, and some edits were made to concepts in response to people's questions, ideas, and concerns.

COMMON THEMES

Through the Konveio platform, emails, and comments made on the Front Porch Forum or during the August 19 community meeting, some common themes emerged.

- People supported proposals for improving tree growing conditions and incorporating green stormwater infrastructure into streetscapes. Some people questioned how green infrastructure would be maintained.
- Burlington residents are enthusiastic in supporting improved bike infrastructure, but they question tradeoffs. About twenty people expressed opposition to the removal of the left-turn lane at North Avenue and North Street intersection. See pages 10-11 for more details.
- People did not see the Front Street connection as a priority investment at this time but otherwise voted for Option 1. See page 16 for more information.
- Most people did not support reconfiguring North Avenue so the bike lane is moved to the west side of the road and parking is reduced, though at least one advocate supported removing parking from the road entirely.
- Several people called for a road diet on Park Street and Battery Street.

More of the public feedback received between August and October 2020 is provided in the *Quick-Build and Long-Term Alternatives* chapter per each location.



Example of the posters placed in-field with links to online PDFs. People were able to view and comment on all concepts using the Konveio online viewer platform, by email, or by phone.

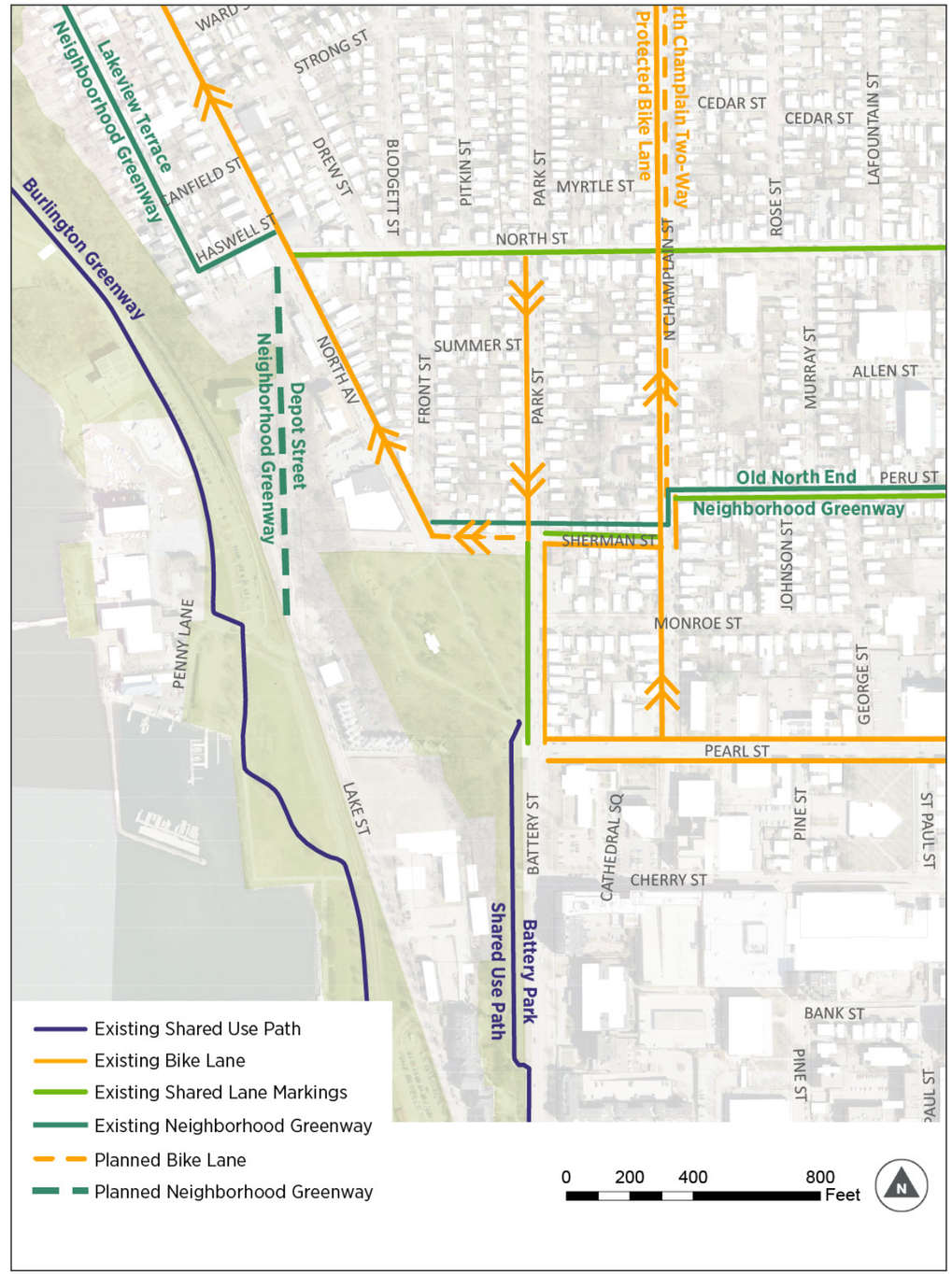
EXISTING CONDITIONS

Toole Design worked with CCRPC and City staff to review previous studies, plans, and 2018-2019 construction drawing sets to identify existing and planned bike infrastructure in Burlington. Toole Design also conducted an in-field observation of existing conditions on October 25, 2019. The result of this research is summarized in the map at right, which shows the locations of existing bicycle infrastructure and City planning priorities. The City has made some installations according to 2-5-year priorities identified in the 2017 planBTV Walk Bike Master Plan.

Toole Design conducted desktop analysis of available traffic data. The team also observed existing infrastructure and issues during the October 25th site visit. Many positive things were observed: multiple bicycle lanes, signage to make drivers aware of people on bikes and pedestrians at crossings, new sidewalks with good pavement conditions and detectable edges, plus a traffic signal that can be triggered by people at bikes at the intersection of North Avenue and North Street.

Toole Design staff also observed gaps in infrastructure devoted to people on bikes, intersections where pedestrian crossings were not adequately protected or up to ADA standards, and other locations where improvements could be made to clarify space for and to protect pedestrians and people on bikes. The *Quick-Build and Long-Term Alternatives* chapter of this report provides recommendations for addressing these issues plus opportunities for green stormwater infrastructure.

A full summary of existing conditions was provided to the project team as part of a memorandum in November 2019 and is accessible on the CCRPC project website. Key highlights from the analysis are shown at right.



Some bicycle riders use sidewalks and crosswalks to navigate intersections, as in this example from North Avenue and North Street.

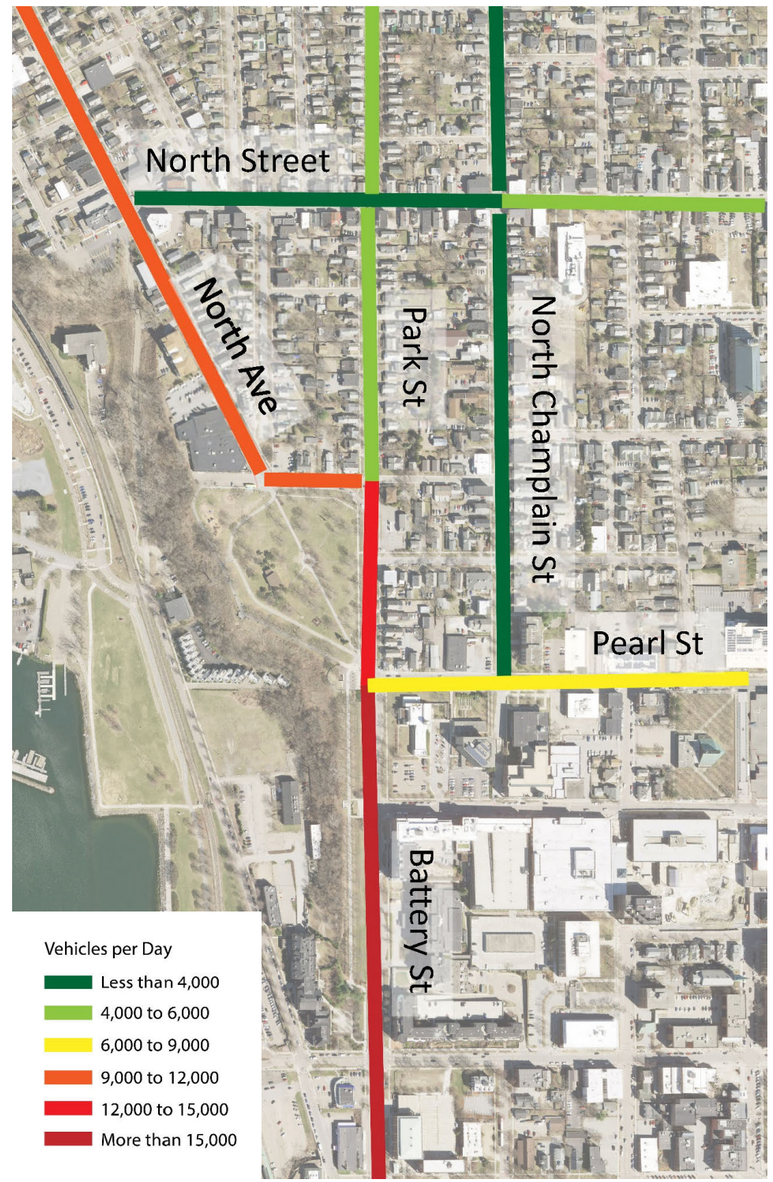
A stormwater inlet interrupts the crosswalk. Crosswalk markings do not meet current best practices for high visibility, and the detectable edge is cracked and awkwardly placed.

Broken pavement at the driveway exit of Battery Park near Park Street and Pearl Street intersection. Navigation from this point is unclear for people on bikes.

The North Avenue intersection with Sherman Street and Battery Park is wide and lacks high visibility crossings, detectable edges at each curb ramp, and smooth pavement at the entry to Battery Park.

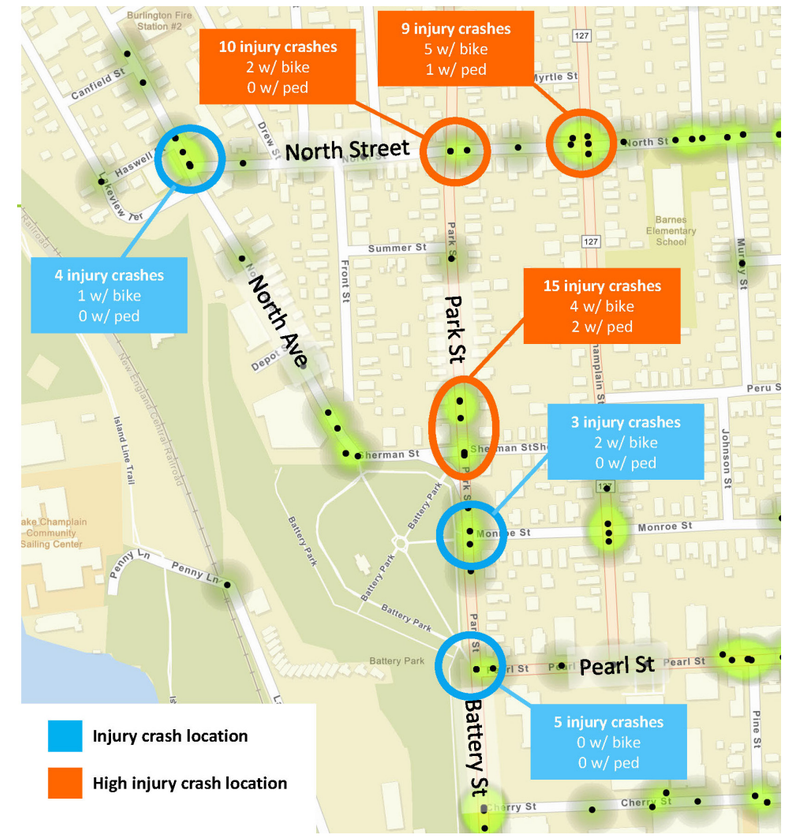
TRAFFIC VOLUME

Toole Design reviewed available traffic data to obtain a picture of traffic volumes. These inform ideas of what treatments to propose for each street.



CRASHES

The concentration of crashes at specific intersections between 2010 and 2019 informed the project team where infrastructure may be inadequate for multimodal users. Crashes are summarized in the map and bullets below.



- Sixty (60) total crashes involving injuries have occurred within the study area for people walking, people on bikes, and people driving motor vehicles.
- Sixteen (16) involve people on bikes
- Four (4) of the above bicycles riding on the sidewalk, and three (3) of these were along North St
- Five (5) involve pedestrians.

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QUICK-BUILD AND LONG-TERM ALTERNATIVES

QUICK-BUILD AND LONG-TERM ALTERNATIVES

After analyzing existing conditions, the project team proposed actions and improvements to address the identified safety, connectivity, and stormwater issues at each location. The team created three rounds of alternatives for each location, revising the concepts each round according to feedback from CCRPC, the City, and the PAC. AutoTurns were conducted for each alternative to ensure the feasibility of turning movements for large vehicles, and geometry was adjusted where necessary.

Alternatives were developed on two timelines, quick-build and long-term:

- **Quick-build** schemes are designed to be implemented within 2 years of the finalization of this report. Quick-build alternatives incorporate temporary and/or low-cost materials such as paint, flexpost delineators, and moveable planters. They may also include some curb ramp reconstruction but do not otherwise include curb or drainage reconstruction.

- **Long-term** alternatives are designed to be implemented within 2-10 years with more intensive construction work and durable, long-lasting materials. This may include new/moved curb and sidewalk, drainage improvements, and roadway and intersection reconfiguration with modifications to signal equipment and various utilities. Long-term alternatives tend to be more costly and require more complex design efforts.

Both quick-build and long-term alternatives were presented to the community to identify any major concerns and establish preferences for each location. Edits were made to some plans or timelines altered according to the input received. The preferred alternatives for both quick-build and long-term timelines are presented in the following pages.

Each alternative contains a plan, descriptive bullets, and considerations for further planning, design, and implementation. This chapter is followed by *Cost Estimates* for each alternative and *Prioritization and Implementation* information.

The plan at right illustrates the connectivity gaps that are addressed through the alternatives in this chapter.

NORTH STREET

As North Street contains multiple intersections that have been incorporated into other planning processes, this report does not attempt to provide a concept for the full length of the street within the Old North End. Rather, the following are suggested improvements, including some from those other planning processes that require additional analysis and conceptual design before advancing into design development and construction.

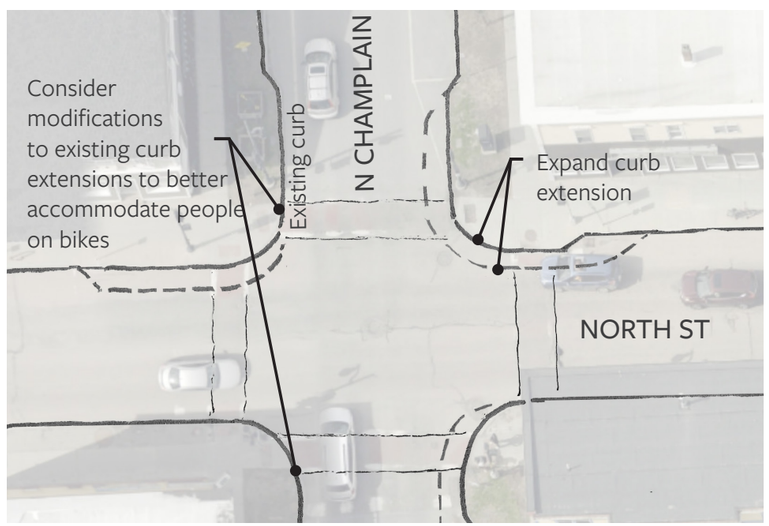
INTERSECTION SAFETY

As identified in the planBTV Walk Bike, North Street is not wide enough to support parking on one side plus bike lanes. The plan recommended to establish North Street as a slow zone with shared lane markings and pointed to the closely spaced intersections along North Street as opportunities for physical changes to calm traffic.

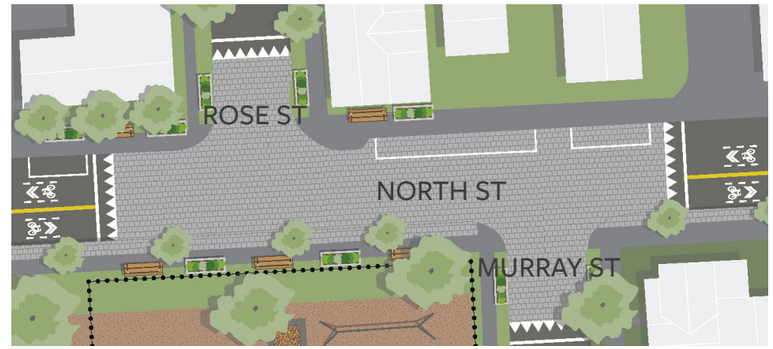
Within the study area of this project, intersections are proposed to be modified by widening curb extensions while reducing turn radii at high crash locations:

- North Street and Park Street
- North Street and N Champlain Street (*NOTE: this intersection to be addressed as part of the existing bikeway project for N Champlain Street*)

This can be achieved while continuing to allow turns by delivery trucks. Modification of existing curb extensions should also consider current and potential movement by people on bikes. The existing curb at the northwest and southwest corners of N Champlain St and North Street cuts off the bike lane, for instance, and should be studied for potential modifications.



The master plan recommended a raised treatment for the offset intersection of North Street, Rose Street, and Murray Street. This addition will create a shared street and establish priority for pedestrians.



Concept graphic of a raised intersection at North Street, Rose Street, and Murray Street from Walk Bike PlanBTV.

A crosswalk at the offset intersection of North Street, Front Street, and Blodgett Street was proposed by advocates and supported by residents during the public input period. Best placement of this crosswalk can be determined through further analysis by the City.

SIDEWALKS

The Department of Public Works has processes in place to update sidewalks annually in order to address North Street in the future once more in-depth planning is completed for the street. Sidewalk updates along North Street will greatly enhance public space and accessibility.

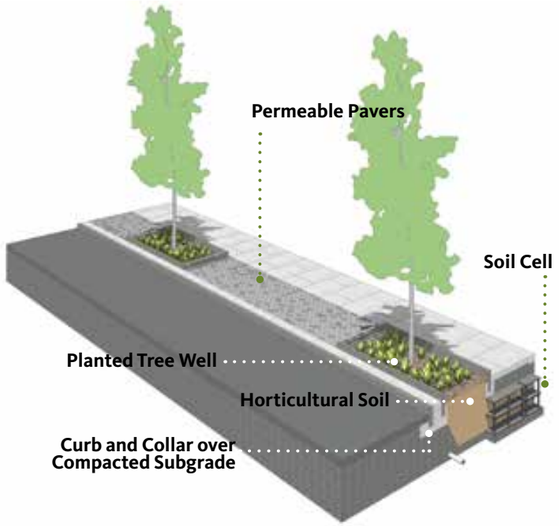
Sidewalk space can be increased at intersections as part of curb extension additions or expansions. Pedestrian crossings should be updated as part of these modifications to meet ADA standards.

TREES AND STORMWATER

Residents identified trees and drainage improvements as important considerations for North Street. A significant visual feature of the sidewalks, existing trees are located in pits with small grates that will not support the growth of the rapid taper zone, the area of structural roots directly around the tree trunk. Very little soil is exposed to stormwater and air through either the grates or adjacent impervious pavers.
The soil volume underground was not determined through this study but should be analyzed and increased as much as possible along with exposed surface area without damaging existing root systems. It may be possible to combine the soil areas of existing tree pits.

Consider working with an arborist to determine which tree species can best handle construction stresses. Also consider air spading, a process that uses compressed air to break up soil, to expose and avoid impacting critical root zones. Using trenchless technology may further minimize impacts. Where new trees are to be planted, consider installing narrow tree trenches that help infiltrate stormwater and deliver it to trees (see graphic below from Great Streets BTV Downtown Street Standards).

Consider replacing existing pavers with pervious and placing pavers that can be easily removed up to the tree opening. Also consider treatments such as stormwater planters at curb extensions to help infiltrate water and relieve the sewer system.



Example of a tree belt with permeable pavers and tree wells from Great Streets BTV Downtown Street Standards. A tree trench for new trees may be formed by connecting the subsurface soil volumes of tree wells together, which increases available soil volume for each tree.

RECOMMENDATIONS SUMMARY

- Widen curb extensions and reduce turn radii at North Street and Park Street and at North Street and N Champlain Street
- Add crosswalk across North Street at Front Street and Blodgett Street
- Update sidewalks
- Replace pavers and tree wells with permeable systems that support tree growth

NORTH AVE AT NORTH ST

The North Avenue at North Street intersection is a primary access point to North Street, which residents identified as a principle cycling route. The challenge of this intersection is its narrow width, which will not accommodate a southbound bike lane while both a left turn lane and thru lane are maintained.

Residents – drivers and cyclists alike – strongly opposed removing the southbound left turn lane due primarily to concerns about traffic congestion. Current cyclists expressed a reasonable level of comfort with using the left turn lane to connect onto North Street. However, observation and input from other residents suggests that less confident bike riders use the sidewalk and pedestrian crosswalks to avoid vehicles. See an example of this on page 4.

QUICK-BUILD, WITHIN 2 YEARS

In the short-term, maintain existing conditions while adding shared lane markings for southbound cyclists to pair with the existing bike lane headed north. Consider adding signage that clarifies to cyclists the option to walk their bikes on the sidewalk and use existing crosswalks to access North Street.

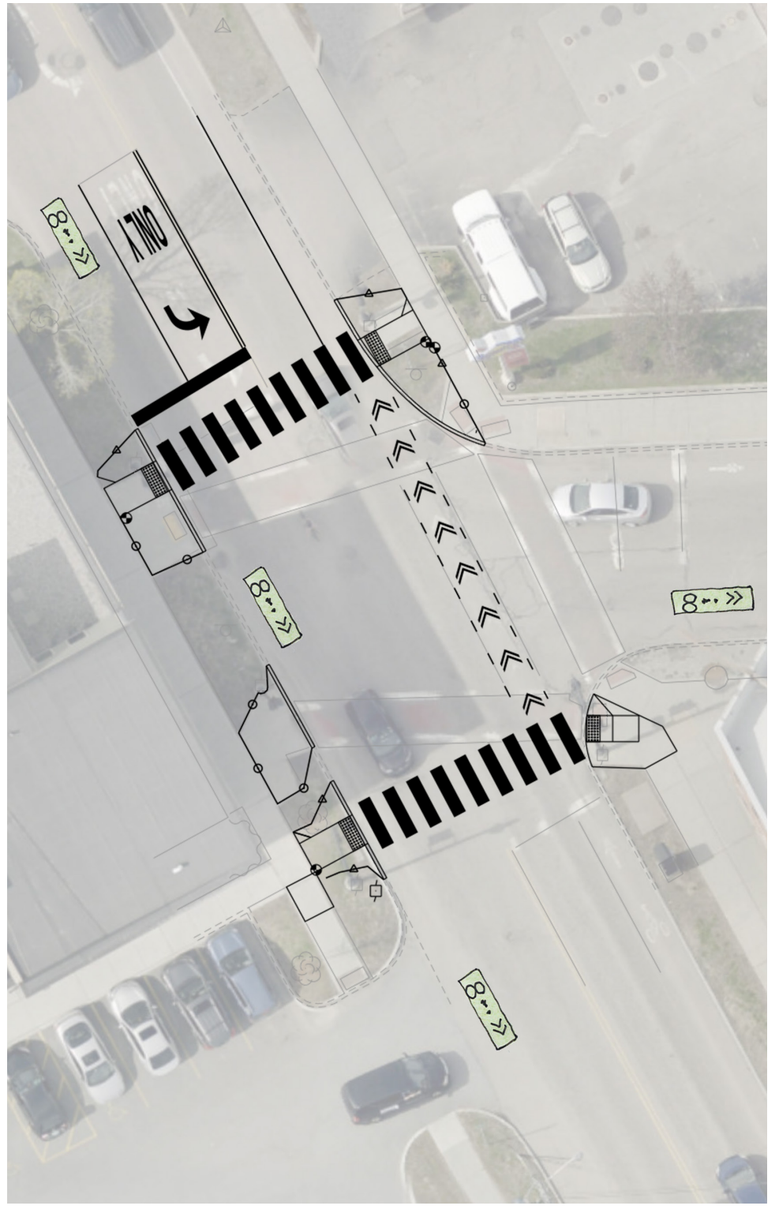
Crosswalk realignments were proposed for this intersection at the outset of this project. Those realignments were installed in Fall 2020 and align the crosswalks with pedestrian signal equipment. Movement of the northern crosswalk away from the intersection helps drivers be able to see pedestrians from a straighter angle as they make their turns. The southern crossing is now aligned with the existing sidewalk to the south side of COTS.

LONG-TERM, 2-10 YEARS

In the long-term, the City should consider removing the left turn lane in order to provide the bicycle infrastructure envisioned in planBTV Walk Bike for this corridor.

A traffic analysis was conducted for this intersection that accounted for projected future development of both local and through traffic to understand the changes that will result from removing the left turn lane. Left turn lanes are warranted when there are greater than 100 left turns during the peak hour, or when the left turning traffic is greater than 20% of the total traffic on that approach. The volumes at this intersection are well below those thresholds in both the morning and evening peak hours.

An analysis of the potential intersection delays shows that only minor increase in delay for southbound traffic will change from the existing conditions. Another outcome of this change would be lower speeds on North Avenue, as oncoming traffic will at times need to slow down or stop while a vehicle ahead them waits for a gap and makes a left turn. While this will be noticeable, it will be at most a minor inconvenience, and will bring significant safety benefits for people biking through the intersection.



The crosswalks at the intersection of North Avenue with North Street were realigned in Fall 2020 to match the plan as shown. Shared lane markings are still proposed to be marked in the short-term however.

Despite the results of the analysis, the recommendation of removing the left turn generated substantial public comment and opposition. In order to better understand and address these concerns, the following process is suggested:

1. New traffic counts should be conducted after all developments along North Avenue and Lakeview Terrace are completed and fully occupied. In addition, conduct observation and measurements of traffic speeds and vehicle queuing and delay.
2. Public engagement tools are used to understand the community's concerns about the intersection, and to develop metrics for a pilot test.
3. A pilot test of removing the left turn lane is conducted, with measurements of queueing, delays, and traffic speeds so that the community can understand the consequences.

If the pilot test results in public acceptance of the left turn lane removal, the City would move ahead with the proposed long term recommendations.

The long-term alternative is currently proposed to include a turn pocket that essentially allows a two-stage left turn for people on bikes. This pocket will require the reconfiguration of the lawn strip and curb. It is necessary to connect the proposed southbound bike lane on North Avenue from Haswell Street to the turn pocket to ensure people on bikes are not pressured to move by drivers. An alternate option is to widen the roadway to support this lane, but greater impacts to the lawn strip, trees, and signal equipment will be incurred.

Finally, the long-term vision for this intersection incorporates a stormwater curb extension on the northeast corner. This can be constructed so it does not prevent buses from turning right from North Street to North Avenue.

RECOMMENDATIONS SUMMARY

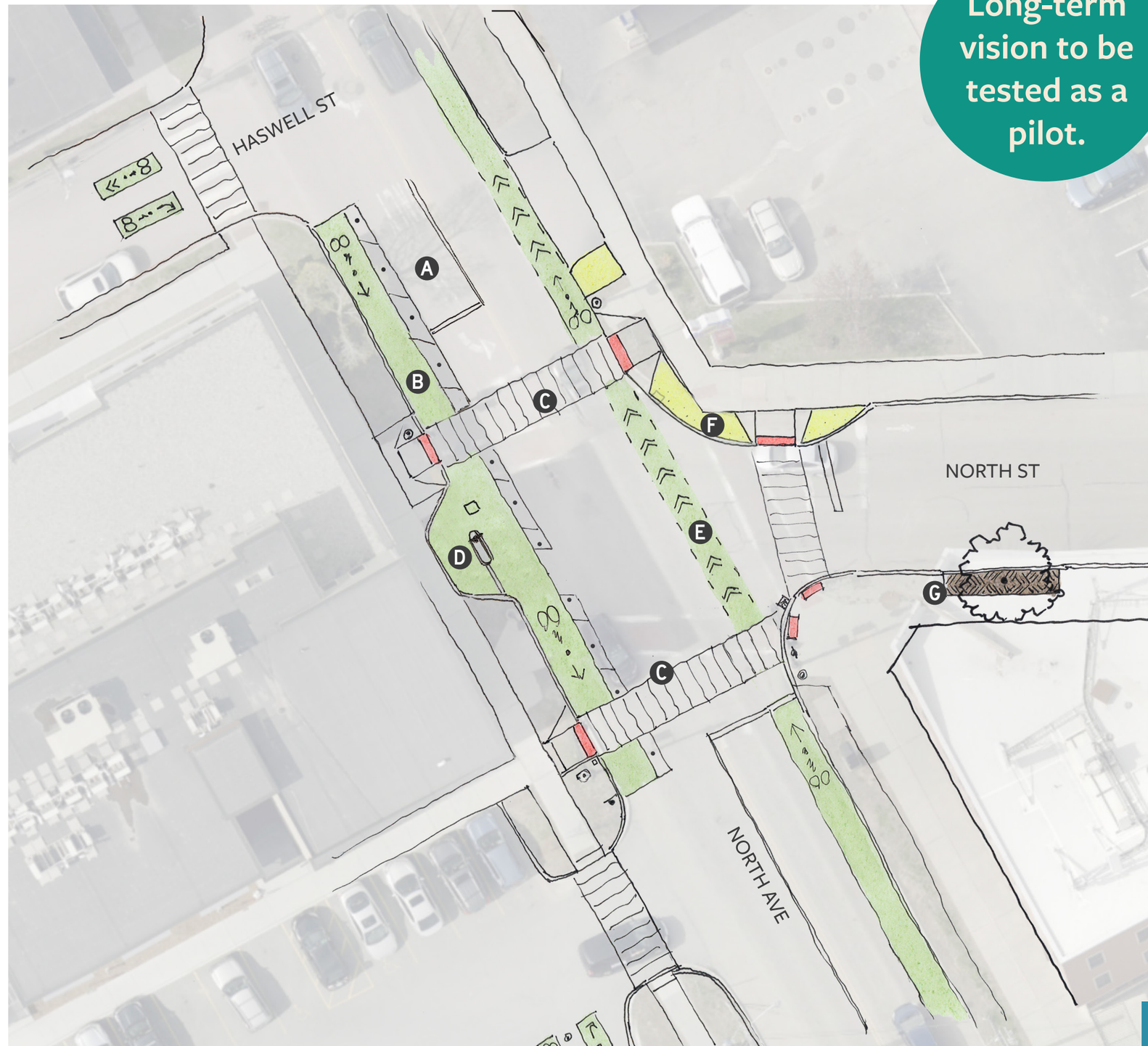
In the short-term, maintain existing while adding shared lane markings for southbound cyclists. In the long-term:

- Pilot the removal of the left turn lane to provide space for a southbound bike lane
- Add a turn pocket for cyclists turning left onto North Street
- Or, widen the roadway to accommodate a bike lane without the removal of the left turn lane
- Incorporate a stormwater curb extension on the northeast corner

Long-term vision to be tested as a pilot.

- **A** Removal of left turn lane to provide space for protected bike lane on west side
- **B** Bike lane, protected with flexposts or other vertical delineator, leads through intersection to connect Haswell St to Depot St
- **C** Existing crosswalk alignment as of Fall 2020
- **D** Protected pocket for cyclists to turn onto North Street. Ensure pedestrian signal is visible, and sign so cyclists may follow it.
- **E** Existing bike lane maintained northbound
- **F** Curb extension to slow turning cars, shorten crosswalk distance, and provide opportunities for stormwater infiltration.
- **G** Expansion of street tree grates laterally on North St for improved water infiltration

Stormwater Curb Extension in Portland, OR



NORTH AVE / SHERMAN ST / PARK ST [QUICK-BUILD]

This location includes the intersections of North Avenue with Sherman Street, and Sherman Street with Park Street, plus Sherman Street as is falls between these intersections. A quick-build scheme is recommended primarily to focus on improvements at North Avenue and Sherman Street. The long-term plan is shown on pages 20-21 and incorporporates intensive treatments for both intersections.

NORTH AVENUE AND SHERMAN STREET

At the intersection of North Avenue with Sherman Street, create a painted plaza to narrow the curve in the road while expanding the entry to Battery Park. Add flexposts or planters in this area as necessary to block vehicles while ensuring that crosswalks and a bike crossing are maintained.

Realign crosswalks to help square up the space and to shorten crossings. The exsting westbound bike lane can continue up North Avenue, but add a bike conflict marking for people on bikes to turn left and enter Battery Park.

To provide advance warning to drivers and increase pedestrian visibility, install Rectangular Rapid Flashing Beacons in the locations shown. Adjust for trees or other vertical obstructions to ensure visibility.

SHERMAN STREET BIKE LANE

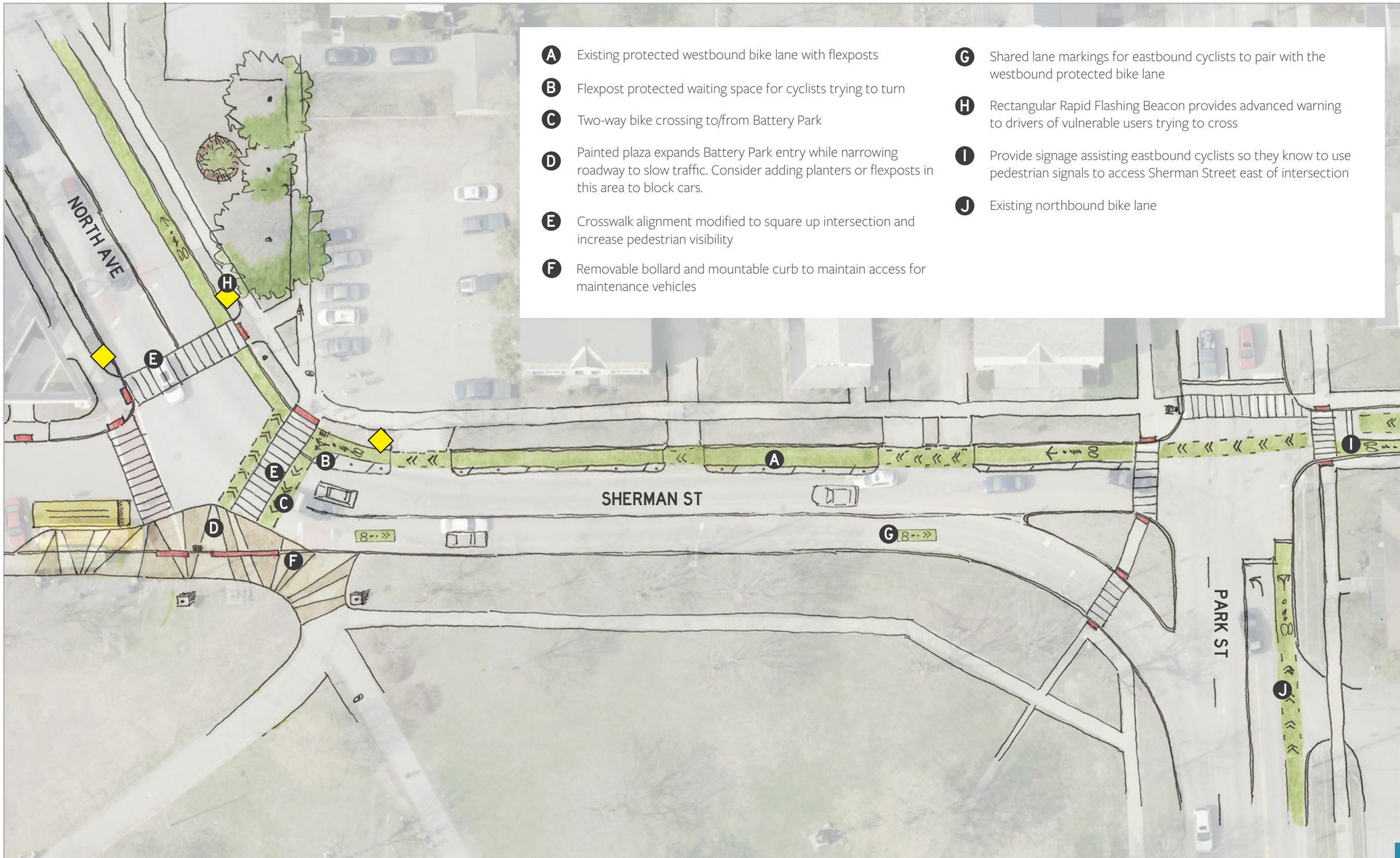
The public did not support creating a two-way bikeway on Sherman Street in the short-term. Instead, pair the existing westbound bike lane on Sherman Street with shared lane markings for the eastbound direction.

SHERMAN STREET AND PARK STREET

Maintain existing conditions for the existing westbound bike lane. Provide signage for eastbound cyclists on Sherman Street so they know to follow pedestrian signals to access Sherman Street east of the intersection with Park Street.

RECOMMENDATIONS SUMMARY

- Create painted plaza to tighten intersection of North Avenue and Sherman Street
- Realign crosswalks within North Avenue/Sherman Street intersection
- Provide advance warning through Rectangular Rapid Flashing Beacons
- Maintain westbound bike lane, and pair with eastbound shared lane markings



- **A** Existing protected westbound bike lane with flexposts
- **B** Flexpost protected waiting space for cyclists trying to turn
- **C** Two-way bike crossing to/from Battery Park
- **D** Painted plaza expands Battery Park entry while narrowing roadway to slow traffic. Consider adding planters or flexposts in this area to block cars.
- **E** Crosswalk alignment modified to square up intersection and increase pedestrian visibility
- **F** Removable bollard and mountable curb to maintain access for maintenance vehicles
- **G** Shared lane markings for eastbound cyclists to pair with the westbound protected bike lane
- **H** Rectangular Rapid Flashing Beacon provides advanced warning to drivers of vulnerable users trying to cross
- **I** Provide signage assisting eastbound cyclists so they know to use pedestrian signals to access Sherman Street east of intersection
- **J** Existing northbound bike lane

NORTH AVE / SHERMAN ST / PARK ST [LONG-TERM]

The long-term alternative for North Avenue with Sherman Street and Sherman Street with Park Street includes intensive modifications to both intersections..

NORTH AVENUE AND SHERMAN STREET

The intersection of North Avenue with Sherman Street is recommended to be raised, with a modified curb that expands the entrance to Battery Park. This configuration narrows the roadway and establishes a shared space, which a decorative paving treatment will help emphasize. Detectable warnings should be located along the full length of each sidewalk edge, and consider incorporating crosswalk markings and even detectable paving bands or edges within the shared space to assist the visually impaired.

To provide advance warning to drivers and increase pedestrian and cyclist visibility, install rectangular rapid flashing beacons in the locations shown. Adjust for trees or other vertical obstructions to ensure visibility.

The entry to Battery Park can be greatly expanded once the intersection is narrowed. This provides the opportunity for building a stronger gateway into the park and for adding seating and areas for stormwater infiltration. Any entry modifications should follow a master plan for Battery Park.

SHERMAN STREET BIKE LANE

Pair the existing westbound bike lane on Sherman Street with an eastbound lane. Due to space restraints, neither lane can be protected, and the existing protection on the westbound lane must be removed. Alternately, consider widening the road to create protected lanes.

Add a No Turn on Red sign for drivers turning right from Park Street to Sherman Street to help protect cyclists in the westbound bike lane.

SHERMAN STREET & PARK STREET

At the Sherman Street and Park Street intersection, the public supported removing the existing slip island and lane and creating a protected space for people on bikes at the southwest corner of the intersection. However, people expressed concern about the protected waiting area creating an awkward turn south onto Park Street. Several people also expressed that a road diet should be made on Park Street. Thus, the final turn radii and configuration of the Park Street and Sherman Street intersection should follow the completion of a master plan for the park in cooperation with a road diet study for Park Street. Signalization updates would need to be incorporated into the study for this intersection as well.

Example of a raised intersection with interlocking pavers in Somerville, MA

Protected intersection for bike lanes in Salt Lake City. Item B in the concept on the next page.

RECOMMENDATIONS SUMMARY

- Raised intersection at North Avenue and Sherman Street
- Provide advance warning through rectangular rapid flashing beacons
- Expand entry to Battery Park with opportunities for stormwater infiltration
- Pair westbound lane with eastbound lane on Sherman Street
- Remove the slip island, and create a protected space for people on bikes
- Update signals as needed to support movement by cyclists

- **A** Eastbound bike lane to pair with existing westbound. Westbound protection to be removed to allow width for both west and eastbound lanes to be buffered. East-west path within Battery Park may be widened for off-street bike movement
- **B** Protected waiting area for cyclists
- **C** Slip lane and island removed. Improved corner entry to be developed as part of a master plan for Battery Park
- **D** Bicycle crossing phase with signal specifically for people on bikes
- **E** Curb extension to help manage stormwater
- **F** Raised intersection provides flexible travel space for pedestrians and people on bikes
- **G** Rectangular Rapid Flashing Beacon provides advanced warning to drivers of vulnerable users trying to cross
- **H** Entry plaza to be provide gateway into park, seating, vegetation, and stormwater infiltration. Battery Park master plan needed to study widening of park paths for southbound movement by bike
- **I** Front St pedestrian and bike connection. Detailed concept on page 16.
- **J** Existing northbound bike lane

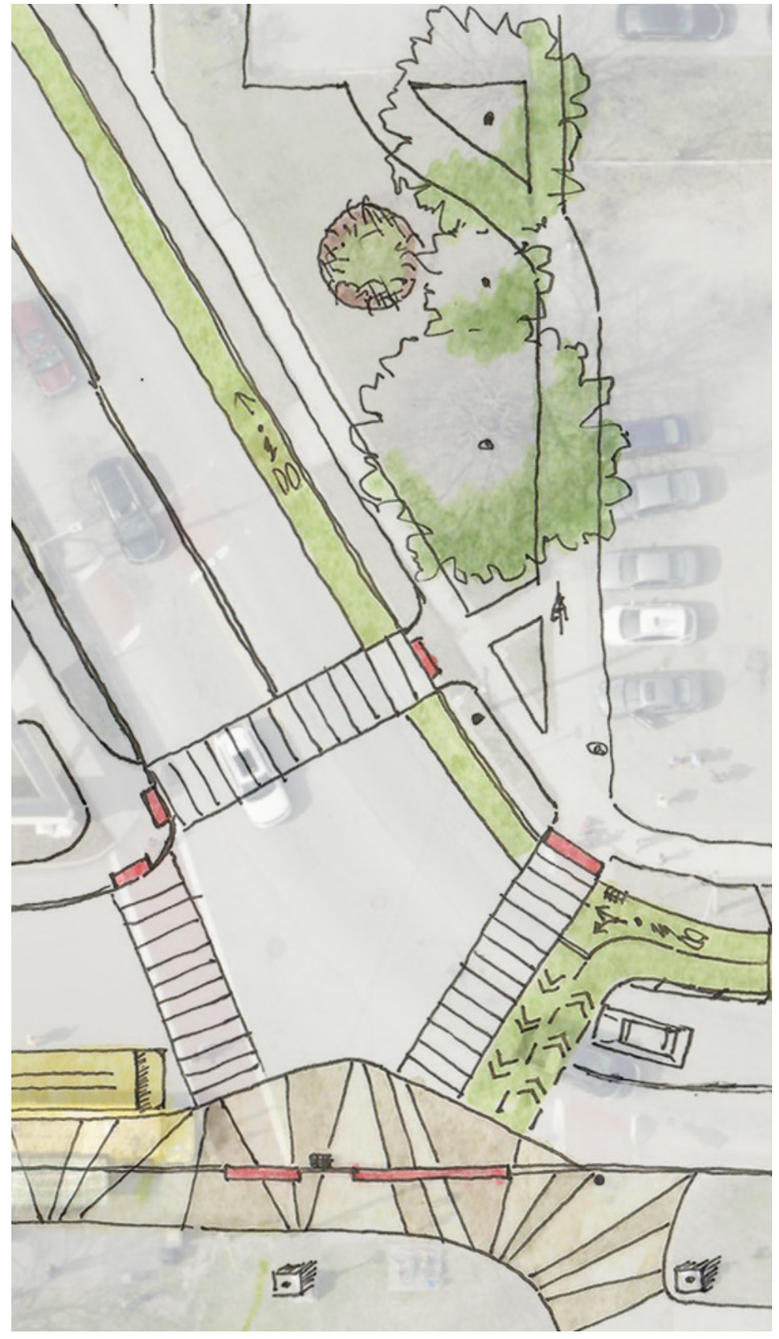
FRONT STREET PASSAGE

The project team proposed a passage for people on bikes from Front Street to the intersection of North Avenue with Sherman Street. This passage would support the use of Front Street as a lower-traffic and more comfortable option for traveling north-south than North Avenue. If pursued, this passage should be paired with a Neighborhood Greenway on Front Street.

Four options were presented to the public, and people expressed unanimous support for the alternative shown at right. However, a few people also mentioned that they generally did not see this alternative as a high priority, as those who use Front Street as a cut-through use the existing sidewalk.

The preferred alternative provides a widened path where the sidewalk exists today next to the parking area. An additional path is provided from the sidewalk through the green space to the end of Front Street. This is to maintain a wider path where the existing sidewalk to the east must remain narrow as it passes private property adjacent to Front Street. The construction of this additional path is likely to affect the health of the existing trees and may require removal of the smaller middle tree.

The passage will connect to realigned crosswalks at the North Avenue and Sherman Street intersection.



RECOMMENDATIONS SUMMARY

- Widen the sidewalk between North Avenue / Sherman Street and Front Street to better accommodate movement by people on bikes
- Consider adding a path to the center of Front Street due to narrowness of sidewalk

CROSSING: PARK ST AT MONROE ST

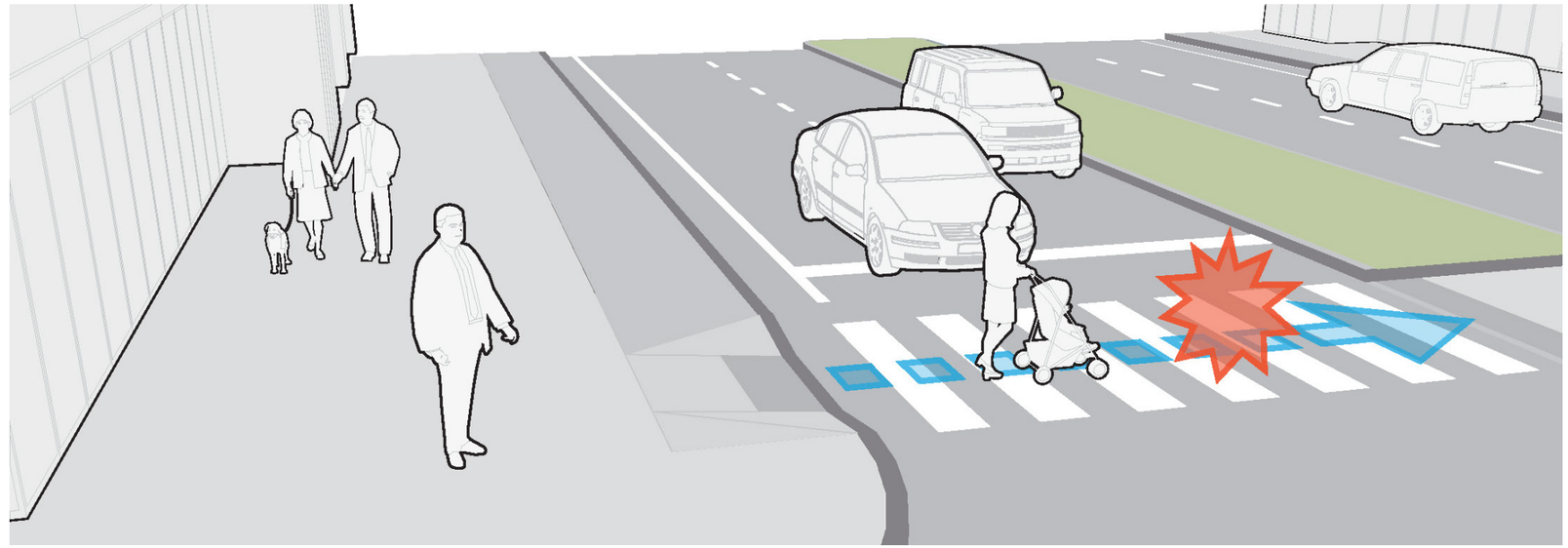
Where Park Street meets Monroe Street, the City has already installed a crosswalk, yield lines, and pedestrian warning sign. Given that Park Street southbound has two lanes, this crossing has multiple threat crash potential. One vehicle may block visibility of pedestrians for a vehicle in the adjacent southbound lane.

Consider installing a Rectangular Rapid Flashing Beacon (RRFB) to provide advance notice to drivers that pedestrians are at/in the crossing. A RRFB will have yellow warning signs, and lights will activate when pedestrians are at the crossing. The public expressed concern about whether a RRFB will be sufficient, with some people proposing a road diet. Analyze Park Street for the potential for a road diet, and collect data to determine whether RRFB is adequate or if other features should be implemented.

Update curb ramps with detectable edges to assist people with vision disabilities

RECOMMENDATIONS SUMMARY

- Install a Rectangular Rapid Flashing Beacon and/or other treatments based on further analysis
- Update curb ramps



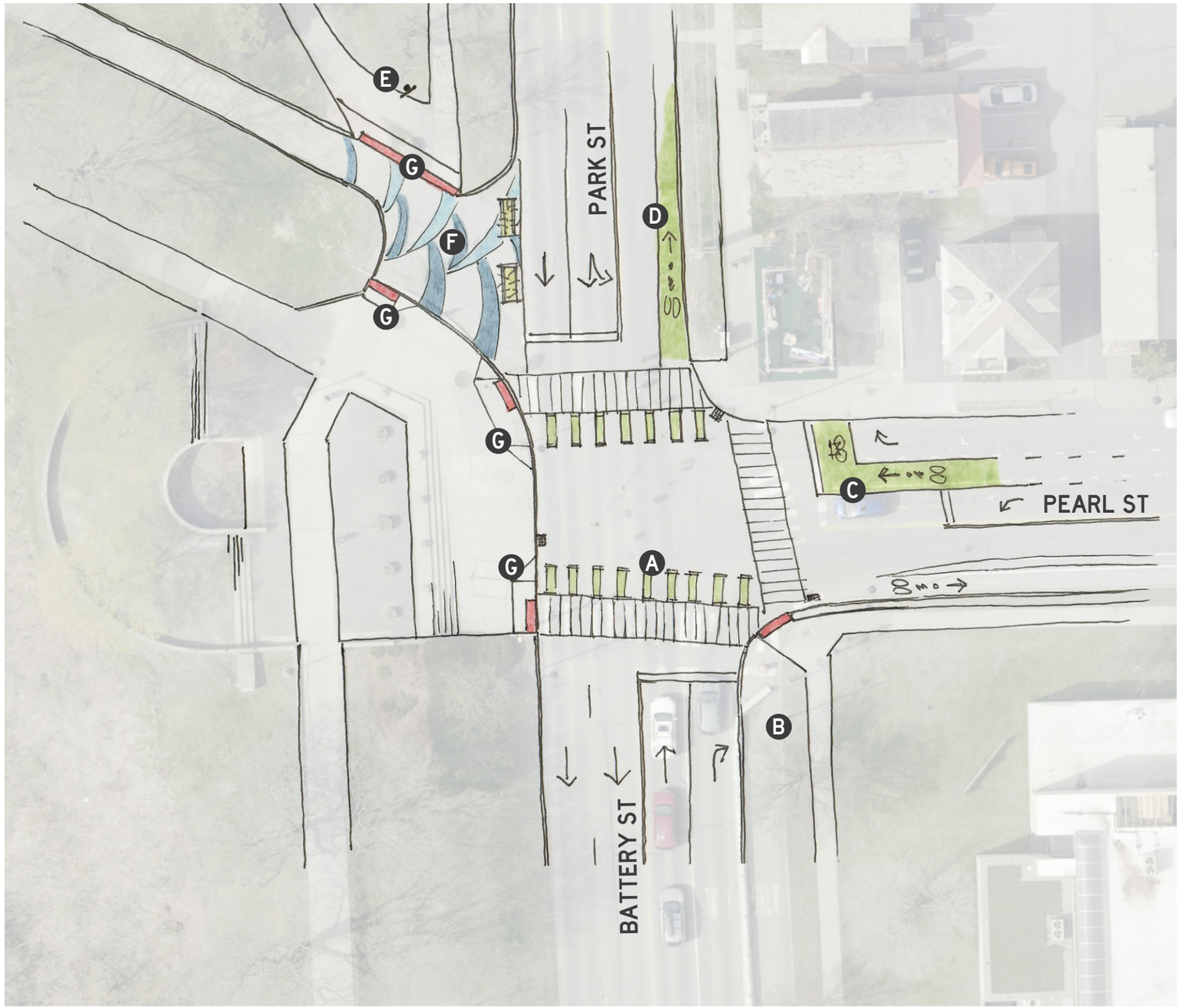
PARK ST / BATTERY ST AND PEARL ST [QUICK-BUILD]

In 2020, during the course of this project, the City completed some modifications to the Park Street / Battery Street and Pearl Street intersection. The City constructed a curb extension on the southeast corner of the intersection and modfied pavement markings on the eastern side of the intersection. A bike lane was painted on the northbound side of Park Street.

The quick-build alternative includes bike conflict markings to aid cyclists to and from the Battery Park entry. Curb ramps are recommended to be widened to accommodate movement by people on bikes. Additionally, paint and planters are recommended to be added to the driveway entry to Battery Park to designate the space for park users.

RECOMMENDATIONS SUMMARY

- Provide bike conflict markings across intersection and widened curb ramps to help people enter and exit Battery Park
- Use paint and planters to extend the entry plaza in Battery Park for the use of pedestrians and people on bikes
- Help clarify use of paths for cyclists through Battery Park with signage



- **A** Addition of bike crossing markings adjacent to crosswalks
- **B** Curb extension constructed in 2020
- **C** Pavement marking modification completed in 2020
- **D** Existing bike lane
- **E** New wayfinding sign to direct people on bikes through park
- **F** Quick-build plaza separated from road with planters and paint
- **G** Curb ramp (re)construction to make ramps ADA compliant and permit bike entry where needed

PARK ST / BATTERY ST AND PEARL ST [LONG-TERM]

The long-term alternative for Park Street/Battery Street and Pearl Street includes the bike conflict markings and modified curb ramps proposed in the quick-build scheme. New additions include a stormwater curb extension on the northeast corner and bioswale on the west side of the intersection at the Battery Park entry. The right-turn lane on Pearl Street is recommended for removal to accommodate the curb extension and to prevent vehicles from transitioning across the westbound bike lane before their turn.

The Battery Park entry is proposed to be modfied so that the driveway is raised up to surface level, better accommodating park users on foot and riding bikes. The plaza is also proposed to be redesigned following the park master plan.

RECOMMENDATIONS SUMMARY

- Provide bike conflict markings across intersection and widened curb ramps to help people enter and exit Battery Park
- Reconstruct entry plaza to park following analysis through park master plan
- Provide stormwater curb extension on northeast corner
- Remove right turn lane on east side of intersection

A Stormwater curb extension

B Driveway ramp with removable bollards to allow vehicular access for event setup

C Wayfinding sign to direct people on bikes through park.

D Battery Park master plan needed to study widening of park paths

E Plaza proposed to be modified following further study to enhance the park entry and improve access and circulation

F Curb ramp (re)construction to make ramps ADA compliant and permit bike entry where needed

G Westbound vehicular lanes are proposed to be modified to remove the right turn lane, reducing conflict between those turning right and cyclists in the bike lane.

ALTERNATIVES SUMMARY

The design alternatives presented on previous pages are summarized here for both quick-build and long-term. The next sections provide cost estimates for these alternatives and a list of priorities for implementation, which includes planning projects that will further help define the design recommendations for these locations.

NORTH STREET

- Widen curb extensions and reduce turn radii at North Street and Park Street and at North Street and N Champlain Street
- Add crosswalk across North Street at Front Street and Blodgett Street
- Update sidewalks
- Replace pavers and tree wells with permeable systems that support tree growth

NORTH AVE AT NORTH STREET

In the short-term, maintain existing while adding shared lane markings for southbound cyclists. In the long-term:

- Pilot the removal of the left turn lane to provide space for a southbound bike lane
- Add a turn pocket for cyclists turning left onto North Street
- Or, widen the roadway to accommodate a bike lane without the removal of the left turn lane
- Incorporate a stormwater curb extension on the northeast corner

NORTH AVE / SHERMAN ST / PARK ST [QUICK-BUILD]

- Create painted plaza to tighten intersection of North Avenue and Sherman Street
- Realign crosswalks within North Avenue/Sherman Street intersection
- Provide advance warning through Rectangular Rapid Flashing Beacons
- Maintain westbound bike lane, and pair with eastbound shared lane markings

NORTH AVE / SHERMAN ST / PARK ST [LONG-TERM]

- Raised intersection at North Avenue and Sherman Street
- Provide advance warning through rectangular rapid flashing beacons
- Expand entry to Battery Park with opportunities for stormwater infiltration
- Pair westbound lane with eastbound lane on Sherman Street
- Remove the slip island, and create a protected space for people on bikes
- Update signals as needed to support movement by cyclists

FRONT STREET PASSAGE

- Widen the sidewalk between North Avenue / Sherman Street and Front Street to better accommodate movement by people on bikes
- Consider adding a path to the center of Front Street due to narrowness of sidewalk

CROSSING: PARK ST AT MONROE ST

- Install a Rectangular Rapid Flashing Beacon and/or other treatments based on further analysis
- Update curb ramps

PARK ST / PEARL ST / BATTERY ST [QUICK-BUILD]

- Provide bike conflict markings across intersection and widened curb ramps to help people enter and exit Battery Park
- Use paint and planters to extend the entry plaza in Battery Park for the use of pedestrians and people on bikes
- Help clarify use of paths for cyclists through Battery Park with signage

PARK ST / PEARL ST / BATTERY ST [LONG-TERM]

- Provide bike conflict markings across intersection and widened curb ramps to help people enter and exit Battery Park
- Reconstruct entry plaza to park following analysis through park master plan
- Provide stormwater curb extension on northeast corner
- Remove right turn lane on east side of intersection

COST ESTIMATES

ALL SITES

LOCATION	COST
North Ave at North St	$130,000
North Ave at Sherman St and Park St - Quick Build	$330,000
North Ave at Sherman St and Park St - Long Term	$600,000
Park St at Pearl St - Quick Build	$120,000
Park St at Pearl St - Long Term	$200,000
TOTAL:	$1,380,000

The planning-level costs for each site alternative are summarized above and detailed per location and treatment timeline on the following pages. The estimates include all costs related to construction and are meant to inform planning and prioritization. The estimates do not include survey or design costs.

DISCLAIMER: Opinions of probable cost were developed by identifying major pay items and establishing rough quantities to determine a rough order of magnitude cost. Additional pay items have been assigned approximate lump sum prices based on a percentage of the anticipated construction cost. Planning-level cost opinions include a 30% contingency to cover items that are undefined or are typically unknown early in the planning phase of a project. Unit costs are based on 2020 dollars and were assigned based on historical cost data from VTRANS and the City of Burlington. Cost opinions do not include [easement and right-of-way acquisition; permitting, inspection, or construction management; engineering, surveying, geotechnical investigation, environmental documentation, special site remediation, escalation, or the cost for ongoing maintenance]. A cost range has been assigned to certain general categories such as site engineering; however, these costs can vary widely depending on the exact details and nature of the work. The overall cost opinions are intended to be general and used only for planning purposes. Toole Design Group, LLC makes no guarantees or warranties regarding the cost estimate herein. Construction costs will vary based on the ultimate project scope, actual site conditions and constraints, schedule, and economic conditions at the time of construction.

NORTH AVE AT NORTH ST

[LONG-TERM]

TYPE	ITEM	QTY	UNIT	UNIT PRICE	AMOUNT
General - pavement	Common Excavation	33	CY	$28.13	$937
	Excavation of Surfaces and Pavement	34	CY	$40.96	$1,412
	Subbase of Crushed Gravel, Coarse Graded	47	CY	$50.00	$2,336
	Fine-milling, Bituminous Pavement	17	SY	$50.00	$867
Curb	Concrete Curb, type B	110	LF	$30.48	$3,353
	Removal of Existing Curb	90	LF	$10.00	$900
	Install Wheelchair Ramp	3	EA	$810.00	$2,430
	Detectable Warning Surface	30	SF	$44.56	$1,337
Drainage	Moving Catch Basins	2	EA	$8,000.00	$16,000
	Topsoil	2	CY	$54.37	$105
	Add Stormwater Planting/Rain garden	2	EA	$1,500.00	$3,000
Sidewalk	Add Concrete Sidewalk, 5 inch	90	SY	$75.00	$6,750
Pavement markings	Eradicate Existing Markings As Needed	413	SF	$8.38	$3,458
	High Visibility Crosswalk	124	LF	$6.50	$806
	Letter or Symbol, Waterborne Paint	90	SF	$10.00	$900
	Green Paint for Crossbike Marking (Intersections)	250	SF	$12.00	$3,000
	Green Paint for Crossbike Markings (Driveways)	120	SF	$12.00	$1,440
	Green Paint for Bike Box/Turn pocket/Intersection	801	SF	$12.00	$9,612
	Durable 12 Inch White Line	41	LF	$1.50	$62
	6 inch White Line, Waterborne Paint	429	LF	$1.40	$601
	4 inch Yellow Line, Waterborne Paint	180	LF	$1.40	$252
	Add Bike Lane Symbol	18	SF	$10.00	$180
	Add Sharrows Symbol	36	SF	$10.00	$360
	Add Flexposts	11	EA	$75.00	$825
				Construction SUBTOTAL =	$61,000
				CONTINGENCY (30%) =	$18,300
				Traffic control (10%) =	$6,100
				Mobilization (10%) =	$6,100
				Inspection (15%) =	$9,150
				Erosion control (5%) =	$3,050
				Admin (5%) =	$3,050
				Engineering (25%) =	$15,250
				TOTAL =	$130,000

NORTH AVE / SHERMAN ST / PARK ST

[QUICK-BUILD]

TYPE	ITEM	QTY	UNIT	UNIT PRICE	AMOUNT
General - pavement	Common excavation	46	CY	$28.13	$1,305
	Excavation of Surfaces and Pavement	47	CY	$40.96	$1,934
	Subbase of Crushed Gravel, Coarse Graded	64	CY	$50.00	$3,207
Curb	Concrete curb, type B	386	LF	$30.48	$11,765
	Removal of existing curb	356	LF	$10.00	$3,560
	Install wheelchair ramp	14	EA	$810.00	$11,340
	Detectable Warning Surface	170	SF	$44.56	$7,575
Drainage	Topsoil	1	CY	$54.37	$31
	Add Stormwater Planting/Rain garden	1	EA	$1,500.00	$1,500
Sidewalk	Add Concrete Sidewalk, 5 inch	196	SY	$75.00	$14,683
	Add Concrete Sidewalk, 8 inch	60	SY	$85.00	$5,091
Pavement markings	Eradicate existing markings as needed	1805	SF	$8.38	$15,129
	Add high visibility crosswalk	117	LF	$6.50	$761
	Letter or symbol, waterborne paint	6	SF	$10.00	$60
	Green paint for Crossbike Marking (Intersections)	1050	SF	$12.00	$12,600
	Green paint for Crossbike Markings (Driveways)	1045	SF	$12.00	$12,540
	Green paint for Bike turn pocket/bike box/intersection bike lane	140	SF	$12.00	$1,680
	Durable 12 Inch White Line	21	LF	$1.50	$32
	6 inch White Line, Waterborne Paint	802	LF	$1.40	$1,123
	4 inch Yellow Line, Waterborne Paint	850	LF	$1.40	$1,190
	Add Bike Lane Symbol	36	SF	$10.00	$360
	Add Sharrows Symbol	9	SF	$10.00	$90
	Painted mural	2082	SF	$5.00	$10,410
Signs & signals	RRFB	3	EA	$15,000.00	$45,000
				Construction SUBTOTAL =	**$163,000**
				CONTINGENCY (30%) =	$48,900
				Traffic control (10%) =	$16,300
				Mobilization (10%) =	$16,300
				Inspection (15%) =	$24,450
				Erosion control (5%) =	$8,150
				Admin (5%) =	$8,150
				Engineering (25%) =	$40,750
				TOTAL =	**$330,000**

[LONG-TERM]

TYPE	ITEM	QTY	UNIT	UNIT PRICE	AMOUNT
General - pavement	Common excavation	175	CY	$28.13	$4,909
	Excavation of Surfaces and Pavement	218	CY	$40.96	$8,929
	Subbase of Crushed Gravel, Coarse Graded	320	CY	$50.00	$15,983
	Fine-milling, Bituminous Pavement	72	SY	$50.00	$3,583
Curb	Concrete curb, type B	659	LF	$30.48	$20,086
	Removal of existing curb	680	LF	$10.00	$6,800
	Install wheelchair ramps	8	EA	$810.00	$6,480
	Detectable Warning Surface	298	SF	$44.56	$13,279
Drainage	Changing Elevation of Drop Inlets, Catch Basins, or Manho	2	EA	$800.00	$1,600
	Moving catchbasin	1	EA	$8,000.00	$8,000
	Topsoil	13	CY	$54.37	$720
	Add Stormwater Planting/Rain garden	3	EA	$1,500.00	$4,500
Sidewalk	Add Concrete Sidewalk, 5 inch	243	SY	$75.00	$18,233
	Add Concrete Sidewalk, 8 inch	60	SY	$85.00	$5,138
	Brick Sidewalk (Plaza)	153	SY	$300.00	$46,033
Pavement markings	Eradicate existing markings as needed	2005	SF	$8.38	$16,805
	Add high visibility crosswalk	155	LF	$6.50	$1,008
	Letter or symbol, waterborne paint	51	SF	$10.00	$510
	Green paint for Crossbike Marking (Intersections)	750	SF	$12.00	$9,000
	Green paint for Crossbike Markings (Driveways)	627	SF	$12.00	$7,524
	Durable 12 Inch White Line	165	LF	$1.50	$248
	6 inch White Line, Waterborne Paint	569	LF	$1.40	$797
	4 inch Yellow Line, Waterborne Paint	726	LF	$1.40	$1,016
	Add Bike Lane Symbol	36	SF	$10.00	$360
Raised intersection	Common excavation	75	CY	$28.13	$2,102
	Excavation of Surfaces and Pavement	100	CY	$40.96	$4,081
	Subbase of Crushed Gravel, Coarse Graded	283	CY	$50.00	$14,144
	Superpave Bituminous Concrete Pavement	151	TON	$200.00	$30,263
Signs & signals	RRFB	3	EA	$15,000.00	$45,000
				Construction SUBTOTAL =	**$297,200**
				CONTINGENCY (30%) =	$89,160
				Traffic control (10%) =	$29,720
				Mobilization (10%) =	$29,720
				Inspection (15%) =	$44,580
				Erosion control (5%) =	$14,860
				Admin (5%) =	$14,860
				Engineering (25%) =	$74,300
				TOTAL =	**$600,000**

PARK ST AT PEARL ST

[QUICK-BUILD]

TYPE	ITEM	QTY	UNIT	UNIT PRICE	AMOUNT
General - pavement	Common Excavation	33	CY	$28.13	$933
	Excavation of Surfaces and Pavement	39	CY	$40.96	$1,599
	Subbase of Crushed Gravel, Coarse Graded	56	CY	$50.00	$2,799
Curb	Concrete Curb, type B	237	LF	$30.48	$7,224
	Removal of Existing Curb	230	LF	$10.00	$2,300
	Install Wheelchair Ramp	5	EA	$810.00	$4,050
	Detectable Warning Surface	94	SF	$44.56	$4,189
Drainage	Topsoil	12	CY	$54.37	$634
	Add Stormwater Planting/Rain garden	2	EA	$1,500.00	$3,000
Sidewalk changes	Add Concrete Sidewalk, 5 inch	103	SY	$75.00	$7,692
Pavement markings	Eradicate Existing Markings As Needed	360	SF	$8.38	$3,017
	High Visibility Crosswalk	151	LF	$6.50	$982
	Letter or Symbol, Waterborne Paint	135	SF	$10.00	$1,350
	Green Paint for Crossbike Marking (Intersections)	721	SF	$12.00	$8,652
	Green Paint for Bike Box/Turn pocket/Intersection	397	SF	$12.00	$4,764
	Durable 12 Inch White Line	76	LF	$1.50	$114
	6 inch White Line, Waterborne Paint	279	LF	$1.40	$391
	4 inch Yellow Line, Waterborne Paint	400	LF	$1.40	$560
	Add Bike Lane Symbol	12	SF	$10.00	$120
	Add Bike Box Symbol	6	SF	$10.00	$60
	Painted Mural	197	SF	$5.00	$985
Other	Planters	2	EA	$650.00	$1,300
				Construction SUBTOTAL =	**$56,800**
				CONTINGENCY (30%) =	$17,040
				Traffic control (10%) =	$5,680
				Mobilization (10%) =	$5,680
				Inspection (15%) =	$8,520
				Erosion control (5%) =	$2,840
				Admin (5%) =	$2,840
				Engineering (25%) =	$14,200
				TOTAL =	**$120,000**

[LONG-TERM]

TYPE	ITEM	QTY	UNIT	UNIT PRICE	AMOUNT
General - pavement	Common Excavation	52	CY	$28.13	$1,449
	Excavation of Surfaces and Pavement	61	CY	$40.96	$2,509
	Subbase of Crushed Gravel, Coarse Graded	88	CY	$50.00	$4,409
	Fine-milling, Bituminous Concrete	45	SY	$50.00	$2,250
Curb	Concrete Curb, type B	308	LF	$30.48	$9,388
	Removal of Existing Curb	292	LF	$10.00	$2,920
	Install Wheelchair Ramp	7	EA	$810.00	$5,670
	Detectable Warning Surface	70	SF	$44.56	$3,119
Drainage	Moving Catch Basins	2	EA	$8,000.00	$16,000
	Topsoil	15	CY	$54.37	$810
	Add Stormwater Planting/Rain garden	2	EA	$1,500.00	$3,000
Sidewalk	Add Concrete Sidewalk, 5 inch	122	SY	$75.00	$9,183
	Brick Sidewalk (Plaza)	46	SY	$300.00	$13,667
Pavement marking	Eradicate Existing Markings As Needed	360	SF	$8.38	$3,017
	High Visibility Crosswalk	137	LF	$6.50	$891
	Letter or Symbol, Waterborne Paint	180	SF	$10.00	$1,800
	Green Paint for Crossbike Marking (Intersections)	763	SF	$12.00	$9,156
	Green Paint for Bike Box/Turn pocket/Intersection	385	SF	$12.00	$4,620
	Durable 12 Inch White Line	71	LF	$1.50	$107
	6 inch White Line, Waterborne Paint	292	LF	$1.40	$409
	4 inch Yellow Line, Waterborne Paint	318	LF	$1.40	$445
	Add Bike Lane Symbol	12	SF	$10.00	$120
	Add Bike Box Symbol	6	SF	$10.00	$60
	Bollards	2	EA	$1,155.00	$2,310
				Construction SUBTOTAL =	**$97,400**
				CONTINGENCY (30%) =	$29,220
				Traffic control (10%) =	$9,740
				Mobilization (10%) =	$9,740
				Inspection (15%) =	$14,610
				Erosion control (5%) =	$4,870
				Admin (5%) =	$4,870
				Engineering (25%) =	$24,350
				TOTAL =	**$200,000**

PRIORITIES & IMPLEMENTATION

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PRIORITIES & IMPLEMENTATION

Recommendations for short- and long-term priority projects are listed at right. These recommendations were primarily informed by public input and by identifying the steps needed to bring every long-term recommendation for the project area to fulfillment.

The table does not include all of the design elements of the long-term alternatives because they may be affected by upcoming City plans or projects. In fact, the majority of the potential project locations are connected to Battery Park and/or may require larger changes outside the scope of this report, so planning projects have been recommended as priorities in the table in place of design alternatives. Please note that the planning projects were assumed to be long-term, as their completion may fall outside of the two-year range to qualify for quick-build.

QUICK-BUILD: WITHIN 2 YEARS

LOCATION	WHY IS THIS IMPORTANT?	IMPLEMENTATION ACTION
NORTH AVE AND NORTH ST INTERSECTION	This intersection was identified as one of the most unsafe and is one of the highest priority bike connections.	Add shared lane markings for southbound cyclists through the intersection to pair with the existing northbound bike lane. Consider signage that lets people on bikes know they may use pedestrian signals to turn onto North Street.
NORTH AVE AND SHERMAN ST INTERSECTION	This intersection was identified as one of the most unsafe.	Add painted plaza. Realign crosswalks, and reconstruct curb ramp into Battery Park. Install Rectangular Rapid Flashing Beacons.
PARK ST / BATTERY ST / PEARL ST INTERSECTION	This intersection was identified as one of the most unsafe and is part of high-priority Battery Park connections for people on bikes.	Reconstruct curb ramps, and add bike conflict markings at the least. Provide clarity through signage and/or paint for paths cyclists may use through Battery Park. Close off the driveway exit with moveable planters and paint to improve the park entry.

LONG-TERM: 2-10 YEARS

LOCATION	WHY IS THIS IMPORTANT?	IMPLEMENTATION ACTION
NORTH AVE AND NORTH ST INTERSECTION	This intersection was identified as one of the most unsafe and is one of the highest priority bike connections.	Pilot left-turn lane removal. If successful, implement left-turn lane removal, the addition of a protected bike lane to left-turn pocket through the intersection.
ROAD DIET STUDY FOR PARK ST / BATTERY ST	The intersections this study affects were identified as some of the most unsafe. The public called for a study as many cyclists ride south on Park St now. People also identified a shared use path between Sherman St and Battery St along Park St as a desired bike connection, but a path within the park may be infeasible.	Collect traffic data, and conduct study to identify whether Park Street and Battery Street may be narrowed. Consider prioritizing this in coordination with a master plan for Battery Park.
MASTER PLAN FOR BATTERY PARK	Connections through Battery Park were identified as the highest priority low stress bike connections. Many of the locations for the long-term alternatives are also directly connected to Battery Park.	Develop a master plan for the park to cover the full scope of potential park improvements, including transportation and mobility within the park and connecting intersections and streets. Start the master plan within 2 years to be able to implement the master plan within 2-10 years.