

Lowell Multimodal Complete Streets Plan



*City of Lowell, Massachusetts
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CONTENTS

INTRODUCTION	1
PLANNING PROCESS	4
Phase I: Existing travel patterns	5
Phase II: Developing the GoLowell network	7
Walking and biking in Lowell	10
Taking transit in Lowell	13
Getting to work	13
Strengthen ongoing & future opportunities	14
City of Lowell ongoing projects	15
EQUITABLE TRANSPORTATION IN LOWELL	18
WALKING IN LOWELL	20
Address High Need Streets	21
Establish Pedestrian Priority Zones	21
Road Safety Audit (RSA)	21
LOWELL BUS NETWORK VISION	23
Pilot Bus Program	24
Bus Stop Amenities	24
LOWELL BICYCLE NETWORK VISION	26
Who will bike in Lowell?	27
Building Better Bikeways	28
Go-LOWELL RECOMMENDED PROJECTS	30
Policies and Programs	31
Project Recommendations	33
DESIGN TOOLKIT	52
Marked Crosswalks	54
Leading Pedestrian Interval (LPI)	55
Crossing Island	55
Raised Crosswalk	56

Corner Radius Reduction	57
Facility Selection.....	58
Multi-Use Path	58
Sidepath	59
Separated Bike Lane.....	60
Bike Lane	62
Neighborway.....	63
Shared lane markings	66
Bike Parking.....	67
Bicycle and pedestrian bridge.....	68
Bike Crossings	69
Two-stage left turn.....	70
Floating Bus Stop.....	70
RESOURCES & CITATIONS	71

FIGURES

Map1: GoLowell Project Areas	3
Figure 1: Mode choice survey results	5
Map 2: GoLowell Top Pedestrian and Bicycle Destinations	6
Map 3: Lowell Bike Routes & destinations	11
Map 4: Lowell Top Pedestrian and Bicycle Crash Cluster Locations	12
Figure 2: Commuters traveling to Gallagher Terminal, 2015-2017	13
Figure 3: Getting to work in Lowell.....	14
Map 5: Ongoing Construction Projects	16
Map 6: Lowell Pedestrian Priority Zones.....	22
Map 7: Lowell Existing Transit Routes and Proposed Bus Pilot Routes	25
Figure 4: Bike rider type and stress tolerance.....	27
Map 8: Lowell Existing Bike Routes and Proposed Corridors	29
Map 9: Lowell Proposed Bike Network Priority Timeline	34
Map 10: Lowell Near-Term Project Locations	36
Figure 5: Intersection Concept Plan for Bridge Street at Massmills Drive	38
Figure 6: Intersection Concept Plan for Bridge Street at VFW Highway	39
Figure 7: Bus Stop and Intersection Concept Plan for Merrimack Street at City Hall	40
Figure 9: Intersection Concept Plan for John Street at Merrimack Street	42
Figure 10: Intersection Concept Plan for School Street at Broadway Street	43
Figure 11: Intersection Concept Plan for Chelmsford Street at Westford Street	45
Figure 12: Intersection Concept Plan for Chelmsford Street at Plain Street	46
Figure 13: Bus Stop Improvements Concept Plan for Dutton Street at Market Street	47
Figure 14: Intersection Concept Plan for Dutton Street at Merrimack Street - Alternative B	48
Figure 15: Intersection Concept Plan for Dutton Street at Merrimack Street - Alternative A	49
Figure 16: Bus Stop Improvements Concept Plan for Dutton Street at Broadway Street	50
Figure 17: Bus Stop Improvements Concept Plan for Hale Street at YMCA Drive	51
Figure 18: Bikeway facility selection for urban, urban core, suburban and rural contexts	58

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CHAPTER 1

INTRODUCTION

Introduction

The City of Lowell has outlined goals to make transportation decisions leading toward a multimodal future. Cities and mobility trends are changing rapidly, spurring the momentum to establish a clear, action-oriented, and inspiring vision for mobility in Lowell. Lowell's ambitious vision builds on ongoing efforts happening within the City in addition to the existing infrastructure and community assets. To understand the experience of living and moving through Lowell today, this Plan includes an analysis of mobility data, an understanding of previous and ongoing projects and planning efforts, and input provided from stakeholders and the public throughout the project.



NPS Trolley Downtown Lowell

Founded as a planned mill town for the exploding textile industry, Lowell's historic growth pattern can be traced from its original urban, compact downtown along the Merrimack River outwards to the more suburban neighborhoods along its bordering towns. As the third largest city in the Boston metro area, Lowell's history and its status as the center of commerce for the Merrimack Valley region brings in great potential for a multimodal future. To build this future, the City of Lowell has outlined in the GoLowell Plan policies, programs, 36 miles of bikeway network, pedestrian projects, and transit improvements.

GoLowell Plan

Lowell's large corporate and commercial businesses, schools, hospitals and institutions, National Parks historic sites and the University of Massachusetts provide jobs for thousands of residents and draw many more workers



The Lowell Riverwalk

and visitors from outside the city. Approximately 50,000 people commute into the City daily for work, with many commuters either driving alone or with one other person. Due to the prevalence of those driving, traffic congestion has become a major concern, particularly within the downtown core.

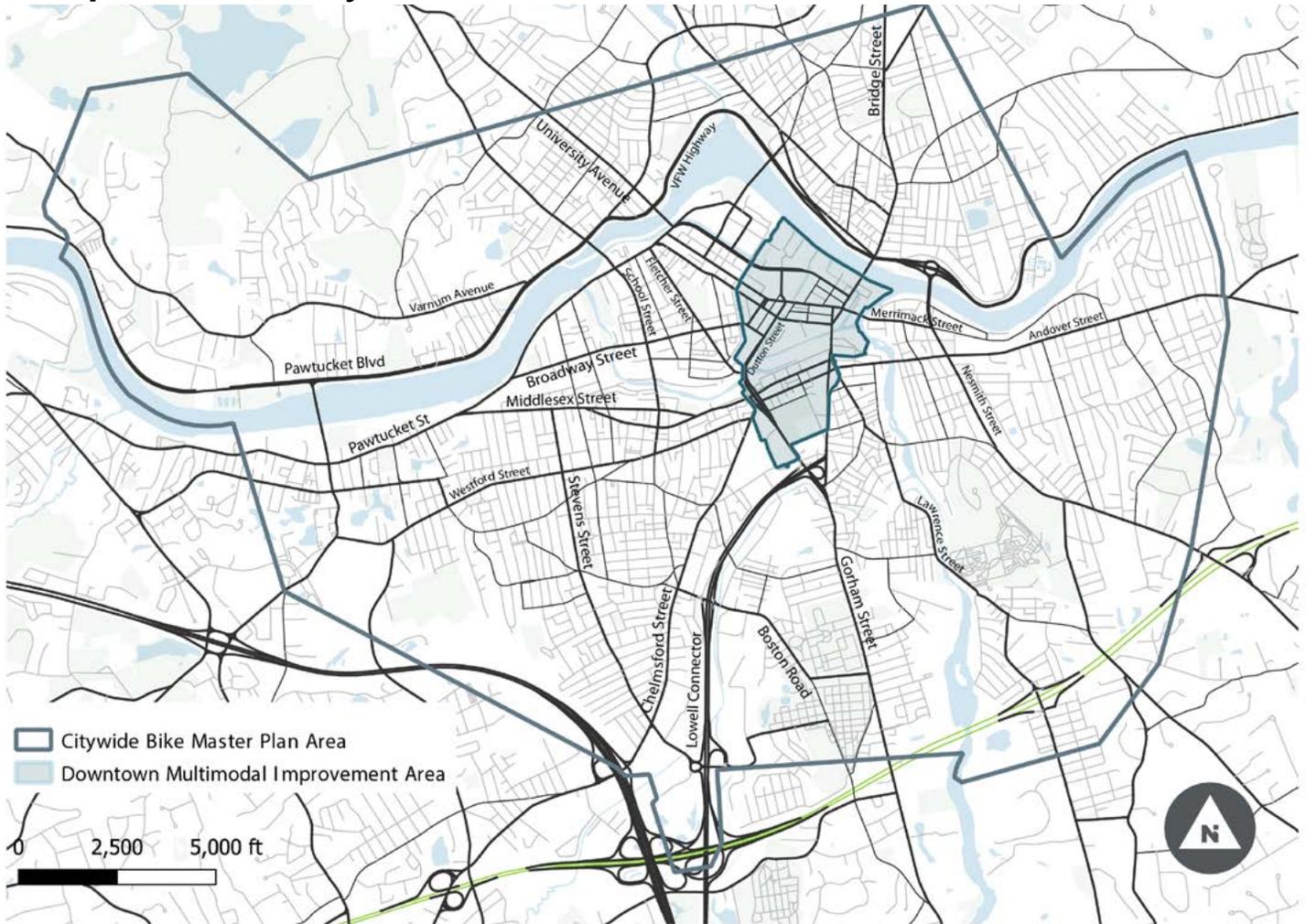
The Lowell Multimodal Complete Streets Plan (referred herein as "GoLowell") aims to reduce the vehicular traffic within downtown by creating a framework to enhance the multimodal transportation network, providing safer non-motorized and public transit transportation alternatives.

There are two focus areas within GoLowell based on funding sources: 1) Downtown Lowell Multimodal Plan (DLMP) with focus on transit improvements, and 2) city-wide Bike Master Plan (BMP) with focus on bicycle infrastructure improvements (**Map 1**).

The DLMP has been funded by the Paul S. Sarbanes Transit in the Parks grant program and is a collaboration between several stakeholders including the City of Lowell, Lowell Regional Transit Agency (LRTA), and Lowell National Historical Park (LNHP). The grant program proposes eight goals to be addressed:

1. Increase mobility and meet access needs of residents, commuters, visitors, and area schools' faculty, staff, and students;
2. To encourage transit use in order to reduce parking demand in targeted redevelopment areas;
3. To reduce vehicle miles traveled (VMT), delay and congestion, and improve travel time on the local roadway network;

Map1: GoLowell Project Areas



4. To foster environmental quality, conserve energy, reduce vehicle emissions, and address climate change through reduced greenhouse gas emission;
5. To promote economic development in the corridor and Greater Lowell region;
6. To meet the mission of LNHP to preserve and interpret the nationally significant historical and cultural sites, structures, and districts in Lowell;
7. To enhance character, livability, and vibrancy of the community through quality urban design;
8. To ensure the full and fair participation of the environmental justice communities throughout the transportation decision-making process.

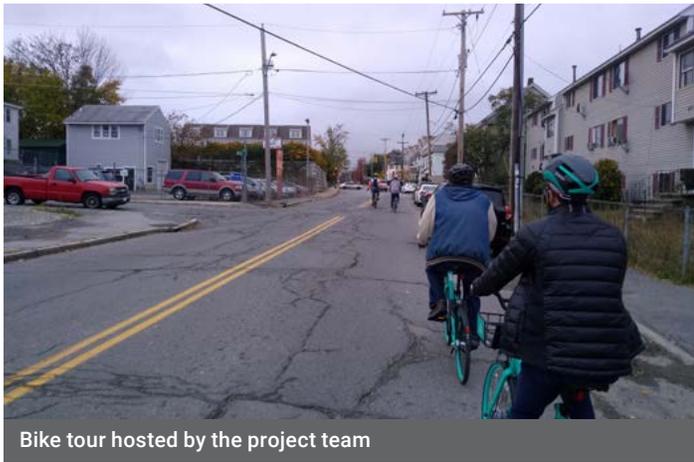
The BMP focus is city-wide and has been a key item in prior Lowell planning efforts including Sustainable Lowell 2025 and the Lowell Open Space and Recreation Plan. The goal of the BMP is to increase the share of cycling by residents and visitors to the City, ideally reducing vehicle congestion and parking demand in addition to enhancing health and quality-of-life. Managed by the City's Department of Planning and Development (DPD) with guidance from various bicycle advocacy groups, the BMP provides measurable goals, provides recommendations for specific treatments in network gaps to advance those goals, and prioritizes projects based on their relation to goals and cost.

CHAPTER 2

PLANNING PROCESS

Planning Process

The GoLowell project team set out to talk with people who live and work in Lowell, gathering information about how they get around the city, destinations and preferences. The project included three phases of public engagement, and the team utilized feedback from each phase to inform the next phase of work. Several outreach techniques and efforts were used during the project which included: hosted walk and bike tours, interviews with stakeholders, public meetings, neighborhood meetings, pop-up tables at community events, and surveys available in paper and online. The team captured feedback from hundreds of people who helped shape the recommendations in the GoLowell Plan. All outreach materials included in all phases were available in the major languages spoken in the City: Spanish, Khmer, Portuguese, and English.



Bike tour hosted by the project team



GoLowell pop-up table at community event

Phase I: Existing travel patterns

The project team kicked off the GoLowell Plan by hosting an in-person public meeting to introduce the project and to launch an online and paper-based survey. The survey questions were aimed at understanding where people were going, how they get there, and what problems exist in their experiences in getting around Lowell. The survey was available and promoted at various community events and through pop-up tabling at key locations including the Gallagher Terminal, Mill No.5, the Kinetic Sculpture Race, Boardinghouse Concert, and UMass Lowell campuses. Over 650 participants responded to the online survey and paper survey, and also shared comments during the September 2019 kickoff meeting and via the project email. One of the important data results collected showed that current mode preference is vehicle-dependent however, a preference to switch from vehicle to bus and bike modes if those options were improved (**Figure 1**).

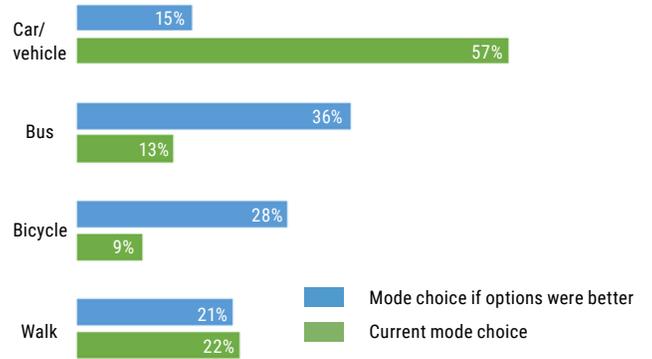
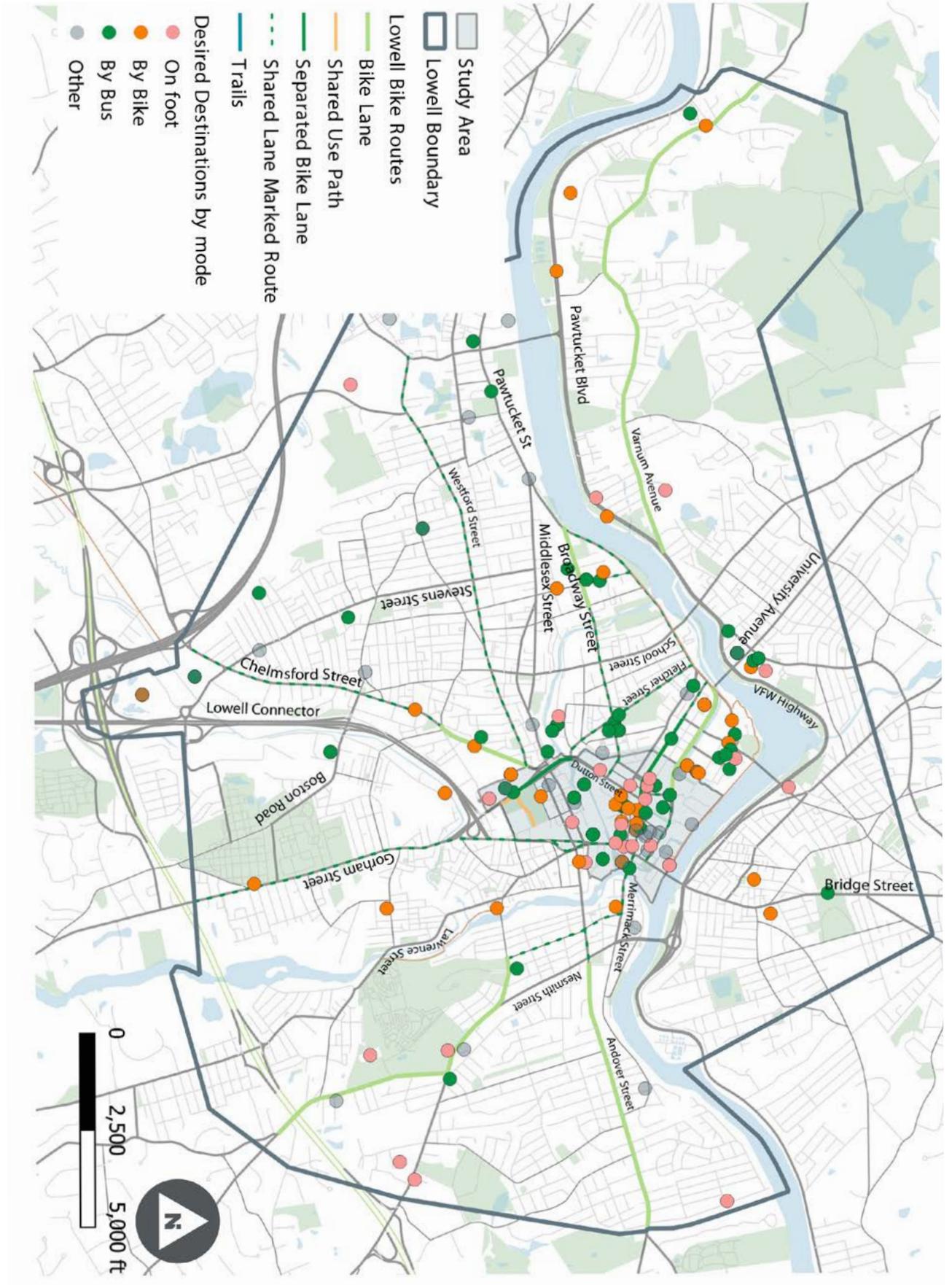


Figure 1: Mode choice survey results

Map 2 on the following page shows a snapshot of desired destinations and the mode used to get to the destinations as indicated by participants from the online survey. The results also showed that the survey input was collected from residents within the city as well as many that commute to the city from adjacent towns.

Overall, driving-related comments from the survey focused on traffic congestion; transit comments were related to reliability and frequency concerns; people who bike mentioned the lack of safe conditions; and many respondents who walk/roll noted concerns related to poor sidewalk connections, dangerous crosswalks, and snow removal. The survey results also included the desired destinations for respondents which was used to infer what the key origins and destinations are within

Map 2: GoLowell Top Pedestrian and Bicycle Destinations



Lowell. However, survey participants’ demographics, when compared to city-wide census data, showed key differences, especially in the racial distribution. Those who identified as white made up a much larger percentage of the survey as compared to the census data in the City. Acknowledging this limitation, the origin-destination mapping was supplemented to include known important areas and destinations such as schools, commercial/retail destinations, and health centers.

Phase II: Developing the GoLowell network

Building on the data from the first phase of public engagement, in July 2020, the project team launched a second phase in order to gather more specific feedback on the bicycle, pedestrian, and bus networks in Lowell. Due to the COVID-19 pandemic, options for engagement were limited to online resources including hosting an online public meeting and posting recorded videos of the online meeting that outlined the existing bicycle, pedestrian, and bus networks. The online meeting together with the recorded videos allowed for greater flexibility and access to the meeting content. Phase II public engagement also included an online interactive survey and mapping component that asked people to outline where they want to see better sidewalks, crosswalks, and paths; provide feedback on existing bicycle network as well as proposed network options;

indicate where they want to see new bus stops; and comment on proposed bus pilot options.

This survey had approximately 190 responses with a range of feedback from people walking and rolling, biking, and taking the bus. The survey demographics for this phase also showed a higher skewed representation of respondents who identified as white/caucasian, and those in the age group of 35-49 years. While definitive conclusions from public feedback may not be feasible, the survey comments below provide valuable input on improvements and the potential routes and locations for a multimodal network. The survey results included:

- Many survey respondents outlined the need to connect Bruce Freeman Rail Trail (BFRT) (which terminates at the southwest border of the city) to downtown Lowell and UMass campus.
- Bike connections to the Gallagher terminal and courthouse.
- Most of the responses for walking/rolling were concentrated downtown at the following locations and included:
 - Crosswalk improvements desired throughout Dutton Street and Bridge Street at Amory Street.
 - Sidewalk, lighting, and crossing improvements at most canal walkways.

The image shows three pieces of outreach material:

- English/Portuguese Flyer:** Titled "GO LOWELL COMPLETE STREETS PLANNING PROJECT". It includes the text: "A cidade de Lowell, o Lowell Regional Transit Authority, e Lowell National Historical Park convidam o público a dar a sua opinião sobre GoLowell, um plano para um sistema de transporte multimodal mais seguro, saudável e agradável para todos. GoLowell vai ajudar a cidade a planejar os seus investimentos em transportes durante os próximos anos." It features icons for a bicycle, car, pedestrian, bus, and motorcycle. Contact information includes www.LowellMA.gov/GoLowell and [Facebook.com/GoLowell](https://www.facebook.com/GoLowell).
- Spanish Instruction Card:** Text: "bicicletas, peatones y autobuses en Lowell. Use las pestañas a continuación para cambiar entre los mapas. Haga clic en puntos o líneas gruesas, o use las herramientas de dibujo, para dejar comentarios. Vea un video sobre ciclismo en Lowell aquí: youtu.be/i3_c-pfzSLI"
- Khmer Instruction Card:** Text: "ខ្ញុំចង់ឃើញ... តើអ្នកចង់ឃើញផែនការទូទៅនៃប្រព័ន្ធនៃទីក្រុង? ដូចជា ធុរកិច្ចណាមួយដែលអាចជួយដល់ការដឹកជញ្ជូនបាន។" It features a button that says "បន្ថែមចំណាត់ថ្នាក់ក្រុម" and a toggle switch for "មើល របាយការណ៍លម្អិតបន្ថែម អ្នកដទៃដែលបាន ផ្តល់យោបល់។"

GoLowell outreach materials were provided in English, Spanish, Portuguese, and Khmer

Phase III: Corridor Engagement

Priority bikeway corridors were established based on prior phases of public engagement feedback along with existing conditions data. The criteria used to inform the corridors included:

- Origin-destination considerations
- Existing safety and crash data
- Connections to other bikeways, open spaces, and transit options,
- Connection to environmental justice populations

The following priority bikeway corridors were established based on neighborhood areas:

- Downtown/Acre connections: Appleton Street between Central Street and Thorndike Street; Dutton Street between Appleton Street and Broadway Street; and Broadway Street between Dutton Street and Pawtucket Street
- Bridge Street between Amory Street and Hampshire Street (including Hampshire Street and Jewett Street alternatives)
- Chelmsford Street between Westford Street and Industrial Street/start of BFRT

The third phase of outreach involved meetings in smaller neighborhood-focused workshops for all proposed bike corridors in December 2020. Due to the COVID-19 pandemic, three workshops were held online with meeting content available online in PDF format. The GoLowell Team presented conceptual network routes and design options and cross sections for specific streets along the proposed routes. Flyers were distributed to residents and businesses along these corridors to ensure that people living and working in the corridors were able to provide feedback. While there were fewer attendees for these workshops compared to prior phases, the workshop format allowed for a deeper analysis and sharing of direct feedback.

The major take-aways from the workshops included:

- Downtown/Acre (Appleton St/Dutton St/Broadway St) connections: For both streets, bikeway options were favorable if paired with snow storage/removal plans. Participants noted that two-way bike lane options need to have easy to access/intuitive and safe entrance treatments.

Go
LOWELL COMPLETE STREETS PLANNING PROJECT
ACRE & DOWNTOWN
VIRTUAL PUBLIC WORKSHOP

Provide your feedback on all of these ideas for making Broadway, Appleton, and Dutton Streets safer for bikes, pedestrians, and busses. Shape which concepts go into our GoLowell master plan!

THURSDAY, DEC 10, 6:00 PM
FIND LINK ON:
WWW.LOWELLMAGOV/GOLOWELL
OR SEND COMMENTS VIA EMAIL:
GO@LOWELLMAGOV

Separated bike lanes
Reconfiguring or removing one side of street parking
Wider street planing buffers
Floating bus stops
Narrowing or reconfiguring traffic lanes
Pedestrian safety and new sidewalks
Bus stop improvements

Public workshop flyer

- Chelmsford Street: Bikeway options had positive feedback – especially the two-way separated bike lane on one side option since it would add more sidewalk space. There were some concerns brought up for difficult areas like the intersections of Plain Street/Chelmsford Street.
- Bridge Street: Additional outreach to residents and businesses is recommended to better understand parking need, snow storage, and vehicular congestion concerns. There were some streets mentioned that could serve as better bike corridors including Hildreth St and Lakeview Avenue.

CHAPTER 3

LOWELL TODAY

Lowell Today

Lowell is a compact city with many destinations within a walkable or bikeable distance. However, design decisions throughout the last century have prioritized the safety, speed, and convenience of people driving in cars over people walking, biking, and taking public transit. As a result, streets are not always safe, comfortable, or practical for people trying to get around Lowell without an automobile.

Incorporated nearly two hundred years ago, Lowell has absorbed the technological, cultural and economic changes since the Industrial Revolution in New England. Lowell is the region's urban hub and boasts many unique cultural, environmental and commercial aspects and amenities. The industrial history of the city is preserved through the National Park System's partnership with the City which supports museums, architectural preservation and events attracting over 5 million visitors each year. Located along the Merrimack River, Lowell offers many natural and man-made recreational opportunities to enjoy the Merrimack ecology. The city is also home to several major employers including the University of Massachusetts Lowell.

With this existing infrastructure and ambitious vision, Lowell has enormous potential for realizing a multimodal future. The GoLowell Plan provides building blocks and establishes a strategy for reaching the City's multimodal goals.

Walking and biking in Lowell

Lowell's compact street grid and development pattern in the core historic areas create ideal conditions for non-motorized transportation.

Providing access to many every-day destinations, Lowell's streets, trails and sidewalks, particularly within the Downtown area, are the backbone of walkable neighborhoods. These streets, however, also provide corridors for vehicles and available traffic volume data shows that many streets in Lowell's downtown core have high traffic volumes, creating safety concerns and barriers for people wishing to walk or bike.

Much of Downtown Lowell is served by this network of sidewalks and canal trails. However, narrow sidewalks, poor pavement conditions, expansive intersections, and



GoLowell hosted Walking Tour of Downtown

canal trail dead-ends are barriers to efficient, safe and joyful walking in Downtown Lowell. This is reflected in the pedestrian crash patterns that depict accidents involving pedestrians in the Downtown area clustered around busy arterial streets. Similar crash clusters are found in areas located between the Gallagher Terminal and South Common. **(Map 4)** This trend continues outside of downtown where the most pedestrian crashes are clustered around the busiest vehicular streets.

In addition to inadequate sidewalks and street crossings, some critical streets lack adequate sidewalk infrastructure completely. Dutton Street is one such example. The major spine between downtown and Gallagher Terminal, Dutton Street is a critical link in the mobility infrastructure, providing access for transit at various bus stops, access to the developing Hamilton Canal District, City Hall, and new Courthouse. However, sidewalks and bicycle facilities are lacking.



Trolley tracks and LRTA bus stop along Dutton street

The bike network in Lowell is sparse. While a few individual bike facilities exist in the City, they are not part of a connected network, making it difficult for bicyclists to navigate. There are currently on-street bikeways and off-street trails in Lowell. Many of these are not connected to one-another, making consistent travel by bike impossible for most people. **Map 3** below shows the existing bike routes within Lowell as well as key destinations and top employment zones.

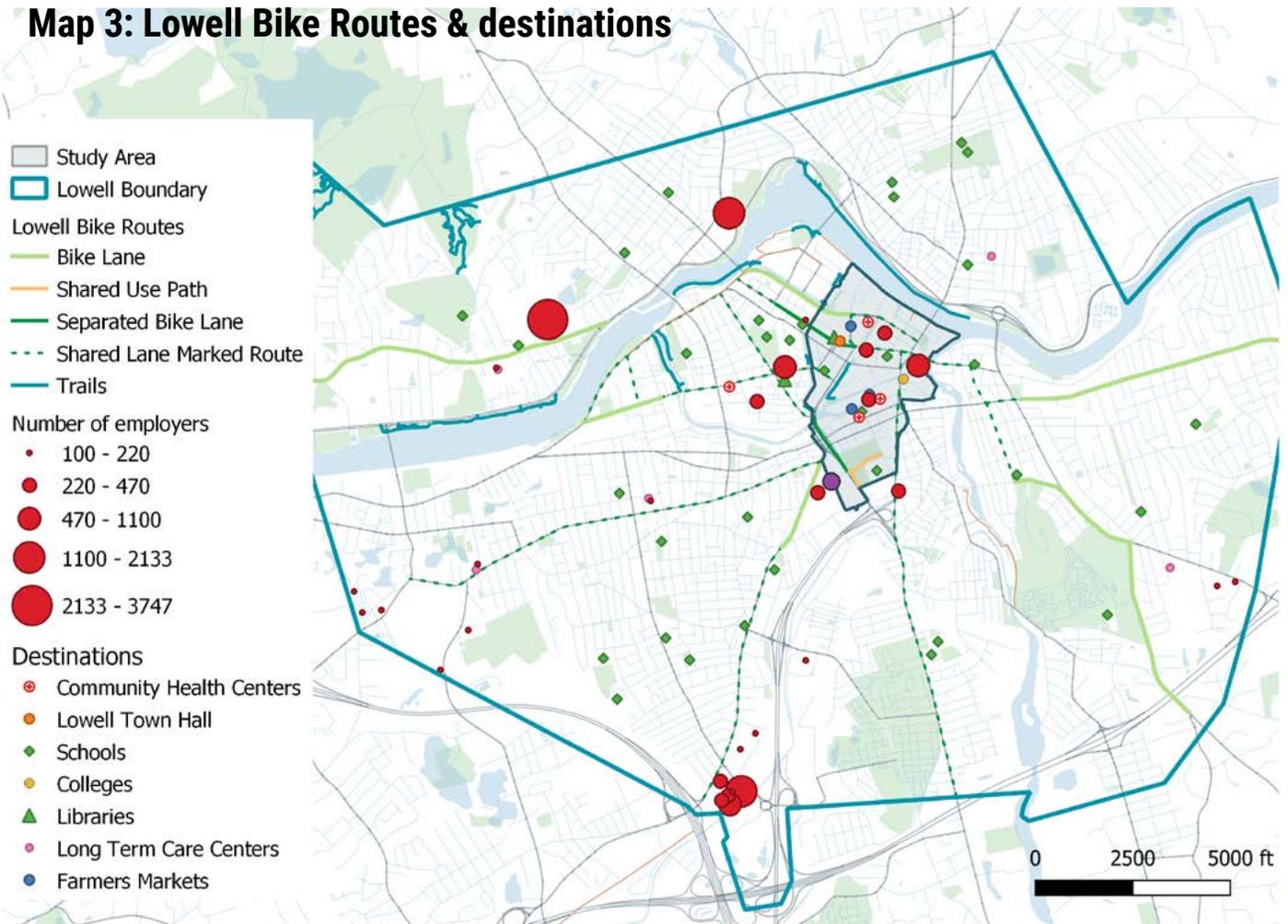
In April 2019, the City of Lowell launched a dockless bikeshare program, through VeoRide, servicing the different UMass Lowell campuses. During its operation, bikes were used for over 30,000 rides by about 7,600 individual riders, with an average ride time of 18 minutes. While ridership data is limited, the overall numbers show that people were receptive to shared micromobility options. Prior to winter, the bikeshare program was suspended for various reasons including the timing of the pilot as it coincided with UMass Lowell campus

schedules. While there was discussion on introducing e-scooters in partnership with VeoRide, the City’s proposed pilot size and area did not match the scale needed for Veoride’s interests. As a result, a bikeshare program does not exist in Lowell today.

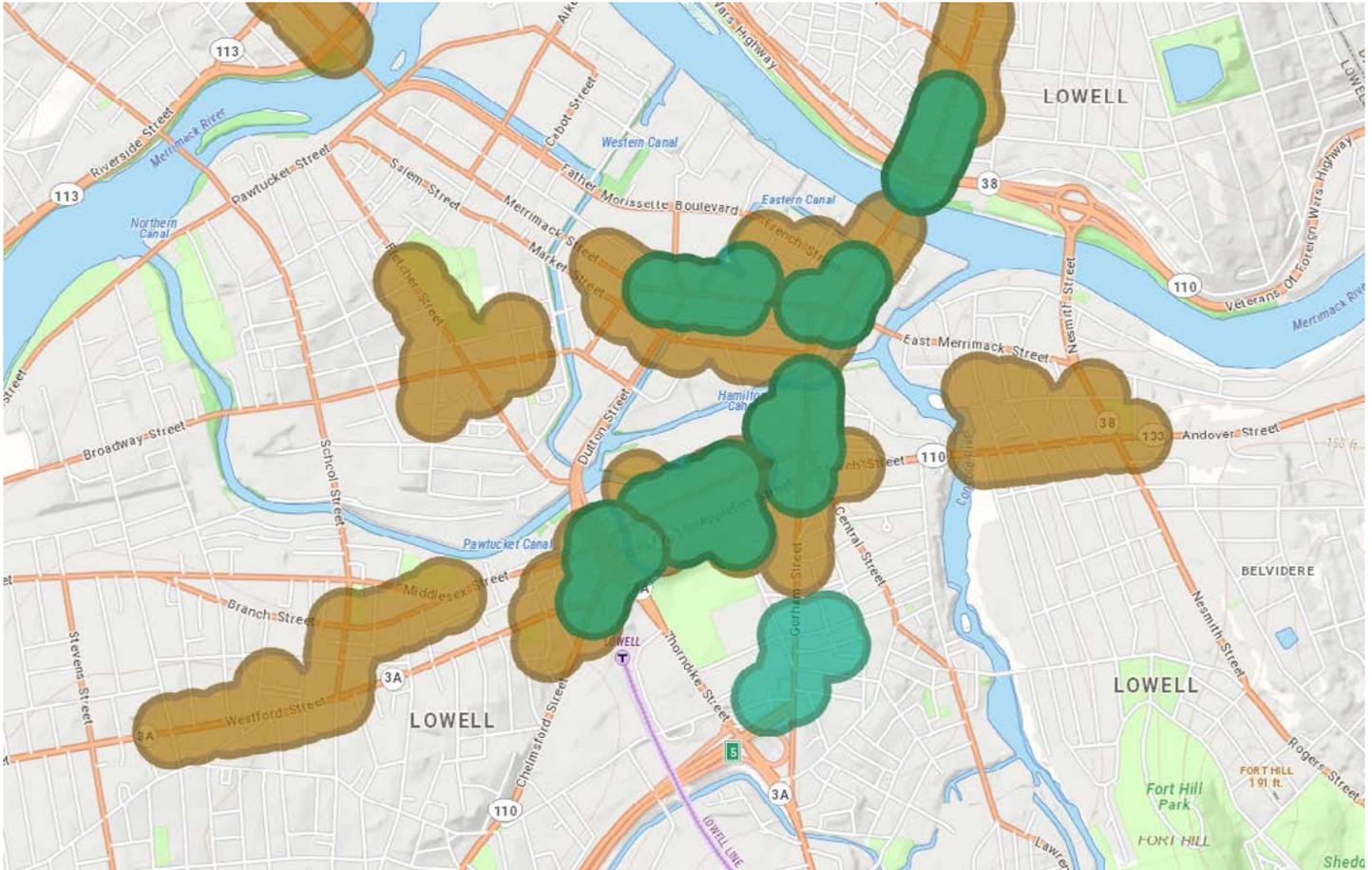
Safety is a primary concern; currently, due to the lack of a safe and connected bike network people are biking on streets without designated bikeways. A majority of bicyclist crashes occurred in or near to the Lord Overpass, the area surrounding the Merrimack Street at Bridge Street intersection, the area surrounding the Merrimack Street at Arcand Drive intersection, and on areas of Gorham Street between Merrimack Street and Lord Overpass.

It should be noted, however, that the crash data obtained for this report predates the newly constructed Lord Overpass which will provide separated bike facilities when completed.

Map 3: Lowell Bike Routes & destinations



Map 4: Lowell Top Pedestrian and Bicycle Crash Cluster Locations



Crash Clusters

2008-2017 HSIP Bicycle Clusters



2008-2017 HSIP Pedestrian Cluster



Map 4 shows the high pedestrian and bicycle crash cluster locations in Lowell based on available 2015-2017 MassDOT data.

Taking transit in Lowell

The Lowell Regional Transit Authority (LRTA) provides fixed route and demand-response paratransit services in the City of Lowell and the surrounding towns of Billerica, Burlington, Dracut, Chelmsford, Tewksbury, Tyngsborough, Westford, and Wilmington. Twenty fixed routes offer weekday service, and eight offer service on Saturdays. Limited Sunday service was introduced on a pilot basis in June 2019 but has been withdrawn on account of the coronavirus pandemic.

The Kennedy Center (bus operations) and Gallagher Terminal (train operations) is an intermodal transit complex and the major mobility hub for the Greater Lowell region. Of the 20 LRTA routes, 19 end their trip at Kennedy/Gallagher Terminal which provides connections to the MBTA Lowell Commuter Line and various intercity bus routes, making the Terminal the central hub of the LRTA bus network. The terminal is located off Thorndike Street near the end of the Lowell Connector and south of downtown Lowell. The complex includes an MBTA commuter rail station, the Kennedy Bus Transfer Center, and two parking garages with a total of 695 parking spaces.

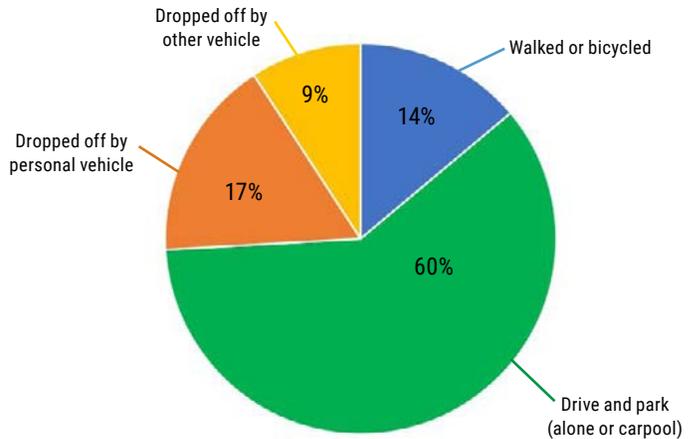


Figure 2: Commuters traveling to Gallagher Terminal, 2015-2017

The Kennedy Bus Transfer Center serves as a station and transfer point for LRTA local bus routes, Merrimack Valley Regional Transit Authority (MVRTA) Route 41, and several intercity bus routes that provide connections throughout New England and New York.

There are two principal transit corridors presently used by LRTA buses between downtown Lowell and the Gallagher Terminal: one via Dutton and Thorndike Streets, which is a shorter and faster route, and one via Central and Appleton or Middlesex Streets, which takes longer but serves more stop destinations.

There are currently no bikeways that access Gallagher terminal and the large, vehicle-oriented complex makes accessing the terminal on foot confusing and unpleasant. Improvements along Thorndike Street/Lord Overpass will improve access for both walking and biking on the north side of the complex.

Bus operations are slower in Downtown Lowell and adjacent areas than the rest of the LRTA network. Buses in downtown are operating in congestion and the bus stop density in downtown is higher. Efficiencies in routes and signalization could improve this important mobility service



1,770

daily boardings on MBTA Commuter Rail at the Lowell Station



117,210

monthly boardings on Lowell Regional Transit Authority buses

The MBTA reports an average of 1,770 people boarding the train at Gallagher Terminal every weekday. According to the 2015–2017 passenger survey, 60 percent of all commuter rail passengers boarding at Gallagher Terminal parked at the commuter rail station and 77 percent of all passengers traveled to the station in a personal vehicle.

The commuter rail station at Gallagher is the northern terminus of the Lowell Line and is a major park-and-ride station serving commuters from the greater Lowell region and other parts of northern Massachusetts, and southern New Hampshire. The MBTA provides half hourly service in the peak and hourly service in the off peak to Boston.

Getting to work

A high percentage of Lowell’s current working population drive to work. People traveling to and from Downtown Lowell for work walk, carpool, and use public transit at a slightly higher rate than workers in the rest of the city. Lowell also serves as a bedroom community for people who work in City of Boston and Greater Boston area which contributes to high vehicle mode travel.

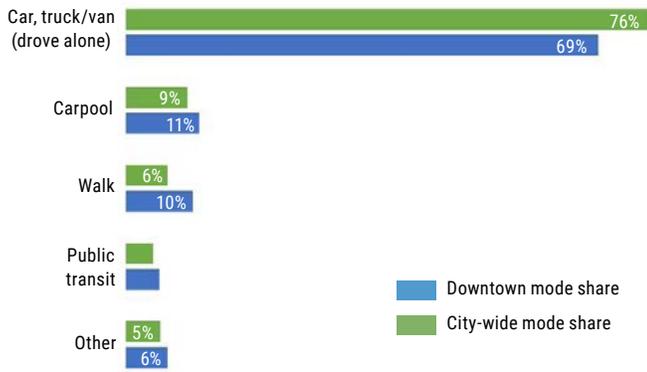


Figure 3: Getting to work in Lowell

Approximately 31 percent of residents in the City of Lowell work in the city. To understand where employees are traveling to work within the city, GoLowell gathered information about the top employers and employment centers in the city. These top worker destinations include the downtown area, Lower Highlands retail area, Lowell General Hospital area, and UMass Lowell campuses.

Strengthen ongoing & future opportunities

The multimodal goals and actions outlined in GoLowell support Lowell’s existing planning efforts at a citywide and neighborhood scale. Creating compact neighborhoods where multimodal transportation is safe, inviting, and encouraged by policy, is supported by several ongoing planning efforts in the City of Lowell.

Walkable and Bikeable Neighborhoods

The Sustainable Lowell 2025 Plan calls for the creation and strengthening of sustainable neighborhoods. The plan calls for prioritizing land-use policies that promote walkable, well-networked neighborhoods and establishing long-term policies and a shared vision for smart, responsible development within the city.

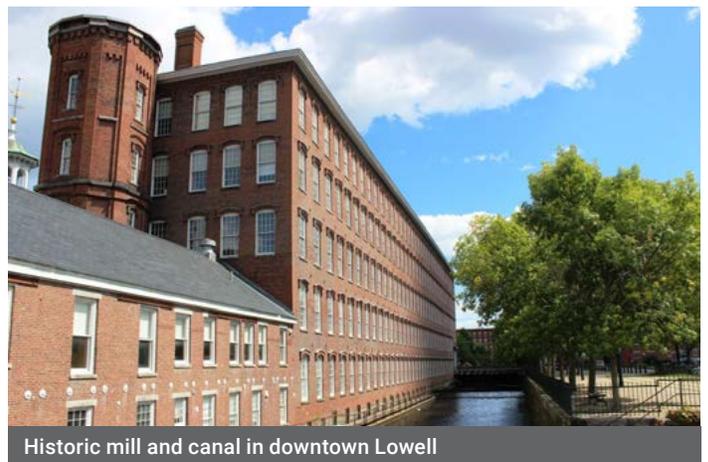
Part of changing the future of transportation in Lowell is promoting policies that will create a city that can be navigated without the need for a personal automobile. The UMass Lowell Transportation Master Plan 2018 Update outlines a collaborative approach with City, State, and other regional jurisdictions to address transportation challenges for commuter students and find solutions to



roadway congestion. The Plan emphasizes shifting away from focusing on infrastructure geared toward efficient vehicular movement at the expense of those on foot, traveling by bus, or on a bike.

Connecting Downtown and Historic Areas

The Lowell National Historic Park (LNHP) is a major land manager in Downtown Lowell which is designated as a National Historic Park. LNHP works in close partnership with the City government. The Park’s property includes historic mill infrastructure including canals, buildings and public spaces in Downtown Lowell. As such, people who live and visit Lowell traverse the LNHP to get around as it integrates seamlessly with the City’s mobility networks. Through the work of LNHP millions of visitors come to Lowell each year bolstering the local economy. The Park’s General Management Plan, created in 1981, outlines the full redevelopment of the Hamilton Canal District and wayfinding improvements to make Market Mills Center and nearby garage parking more visible and accessible. LNHP is a key partner in achieving the GoLowell goals.

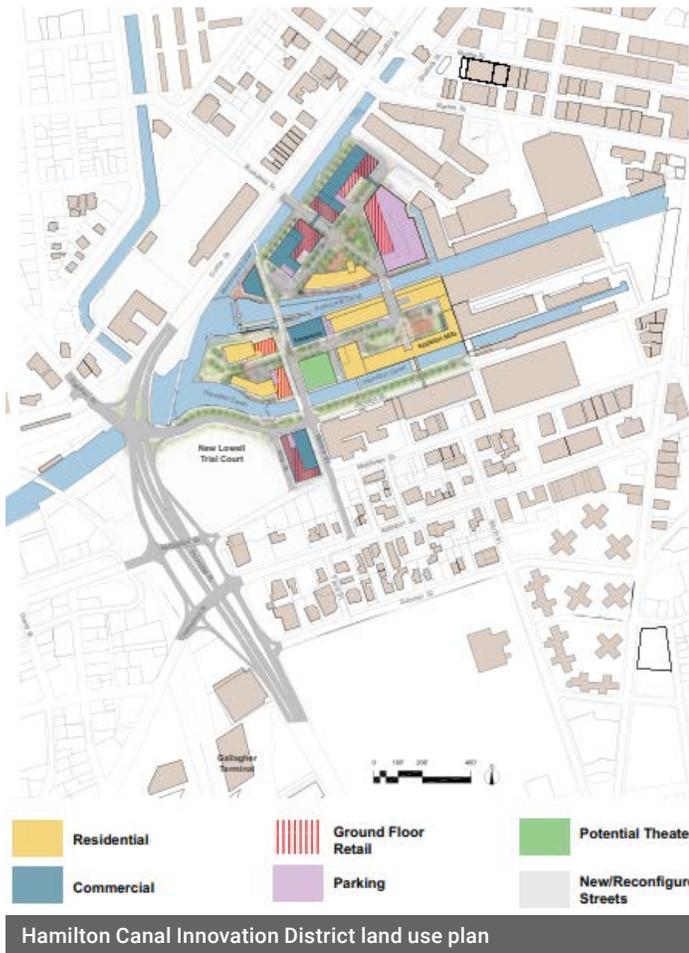


Historic mill and canal in downtown Lowell

Regional connections

It is less than a mile from the intersection of Dutton Street and Merrimack Street in Downtown Lowell to the Gallagher Transit Terminal. However, walking or biking to the Terminal to connect to the bus or train can feel much longer and unsafe due to physical barriers and insufficient infrastructure. Improving connections to and from Gallagher is a primary goal and objective of several ongoing projects (including projects recommended in this plan).

The Hamilton Canal Innovation District, just south of Downtown Lowell, is a collection of 17 land parcels that are being redeveloped. Plans for the project will strengthen multimodal connections between the downtown area and the transportation hub at the Gallagher Terminal and Lowell Connector. The development includes plans to create a stronger pedestrian link to Gallagher Terminal, more activated streets throughout the district, and connected pedestrian infrastructure. In addition, the planned garage will add to the city’s parking supply currently provided in the City’s five municipal parking garages within walking distance to downtown.



The Lord Overpass Project is a major infrastructure project that will replace the aging overpass and critical junction of streets. When completed the project will include dedicated and bicycle and pedestrian facilities. The project will also connect Jackson Street to Thorndike Street, improve the intersections of Dutton Street/Thorndike Street/Fletcher Street/Jackson Street, and provide dedicated bus lanes and update traffic signals. This project will improve multimodal transportations for all modes.

Lowell Trolley Study

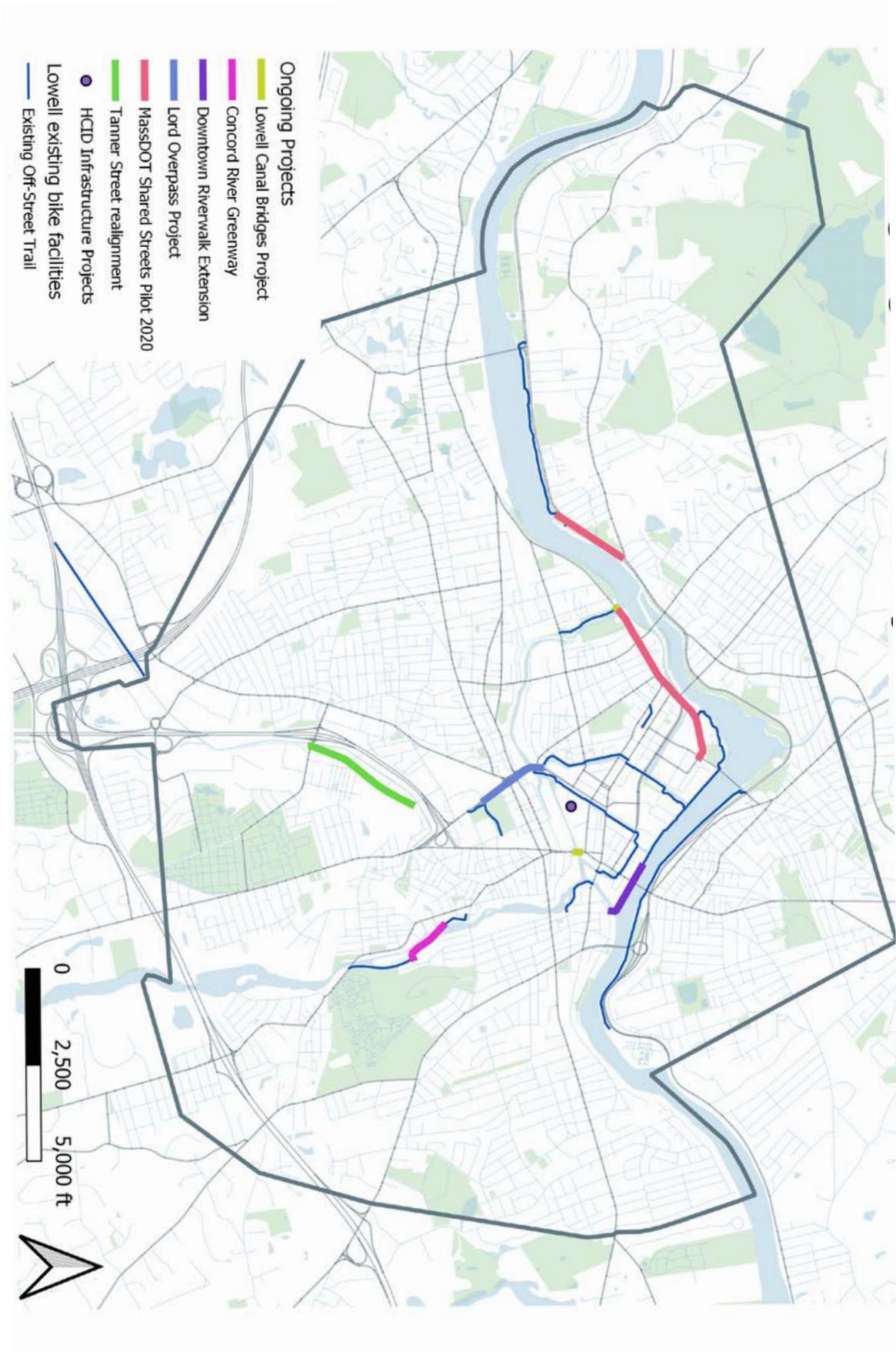
The Trolley Study was the impetus for the GoLowell project. The study proposed extending the Lowell Trolley operated by LNHP to 6.9 miles from its current length of 1.2 miles. While the trolley expansion project was ultimately considered infeasible due to cost, the issues of service, livability, and, the carbon footprint impacts are relevant and were the basis of the GoLowell goals.

City of Lowell ongoing projects

In addition to transportation plans, the City of Lowell has several ongoing construction projects that are relevant to the GoLowell Plan. These are shown on **Map 5** on the following page.

- **Lord Overpass Project:** This project involves the removal of aging overpass bridges. In addition, the project will connect Jackson Street to Thorndike Street, improve intersections of Dutton Street/Thorndike Street/Fletcher Street/Jackson Street, and update traffic signals.
- **Hamilton Canal Innovation District (HCID) North Infrastructure Projects:** These projects involve major development in the HCID including the construction of two streets, Canal District Garage, and a new bridge to connect north and south sides of HCID. In addition, the project will install utility infrastructure in the northern section of HCID with major pedestrian and traffic improvements to the bridge at Dutton Street and Broadway Street.

Map 5: Ongoing Construction Projects



- **Lowell Canal Bridges Project:** This project is funded by a federal TIGER grant and involves the repair and reconstruction of five existing bridges in the City. Currently, there are three bridges still under construction: Central Street over the Pawtucket Canal completion anticipated in September 2021; and Pawtucket Street over the Pawtucket Canal, completion anticipated in April 2022.
- **MassDOT Shared Streets Pilots:** In July 2020, the City received nearly \$166,000 from MassDOT to repurpose 5,900 linear feet of roadway to pilot cycle tracks and multi-use paths on upper Merrimack Street, Pawtucket Street, and VFW Highway. The projects will use temporary materials to gauge community reactions and inform future interventions.
- **Tanner Street Realignment:** This project involves the continuation of New Tanner Street from Plain Street to its final intersection at Lincoln Street. The improvements are intended to improve traffic safety and expand access for commercial trucks. The construction is supposed to break ground in summer 2020 and will support future development of the Ayers City Industrial Park region.
- **Concord River Greenway:** Phase 2B and Phase 3A of the Concord River Greenway expansion is ongoing and set to be completed in June 2021. This will include continue the existing greenway, add two bridges connecting across Concord River, and join another segment of the existing greenway near Rogers Street bridge.
- **Downtown Riverwalk Extension:** This project involves the extension of the downtown Riverwalk from its current end at Boott Mills under Cox Bridge, and around the Massachusetts Mills complex, to a new pedestrian bridge over the Concord River linking with Concord River Greenway. The project is currently in design phase.

CHAPTER 4

EQUITABLE TRANSPORTATION IN LOWELL

Equitable Transportation in Lowell

The weight of Lowell’s current unbalanced transportation system falls unequally on the City’s most vulnerable people; those who do not have access to, or choose not to use, a vehicle. Over the last century Lowell, along with many American cities, has prioritized the convenience and comfort of people driving in private automobiles over all other modes. This policy has resulted in significant quality of life costs for those who rely on walking, biking, or taking public transit.

People who take transit spend a longer time commuting than those who drive, and therefore have less time for other daily tasks. It takes much longer to navigate Lowell using public transit than by a personal automobile. People who take transit are also more likely to live below the poverty line and the challenges resulting from inconvenient transportation are more keenly felt.



People who take transit spend 2x as much time as drivers to get to work.

More than 60 percent of commutes in Lowell that are over an hour are those that are made by public transit. Although this figure is likely skewed somewhat by people who take the commuter rail (it takes approximately 45 minutes by rail from Gallagher to Boston North Station), it is important to understand commute time lengths and addressing the disparities between them.

The safety risk for people who walk or bicycle to get around the city is greater than for those who drive. Crashes or accidents involving vehicles and people walking and biking typically result in much more severe injury and/or death. In a review of the 1,411 crashes within the greater Downtown area between 2015-2017, bicyclists and pedestrians were involved in only 6% of the crashes but 19% of the crashes that result in a fatality or serious injury. This same trend exists in state-wide analysis where pedestrian and bicyclist crashes made up only 3 percent of all crashes within the same 2015-2017 time period.



Fatal and injury crashes state-wide comprised 24 percent of all crashes with the remaining 76 percent as non-injury and not reported crashes.

The City of Lowell and the study area has one of the top crash clusters identified by MassDOT. The highest density of crashes occurred in the vicinity of the intersections of Gorham Street, Central Street, Middlesex Street/ Green Street, and Appleton Street/Church Street. People walking and biking account for six percent of crashes, but disproportionately represent 19 percent of crashes resulting in fatality or injury. In order to balance the streets of Lowell and provide safe, comfortable and enjoyable public transit, walking, rolling and biking options, it is important to ensure that public transportation and other modes are convenient and viable options. Encouraging and incentivizing people to shift away from driving will improve the quality of life for all in Lowell; decreasing traffic congestion will improve safety for all modes, improve transit efficiency, improve air quality, and make the streets more enjoyable public spaces.

The following chapters will outline recommendations and specific projects with the goal of balancing Lowell's multimodal options. These recommendations are focused on improvements for people walking and rolling, people biking and people taking the bus.

CHAPTER 5

WALKING IN LOWELL

Walking in Lowell

Lowell's pedestrian network is the fundamental building block for all mobility in the city. Most trips start and end by walking. Safety and accessibility improvements to sidewalks, crosswalks and paths will enhance the experience for people walking and taking public transit as well as people who ride bikes and drive. A dense network of high-quality sidewalks with consistent curb ramps and safe crossings will encourage more people to choose to walk short distances rather than driving in a car. The following recommendations outline prioritized strategies for strengthening Lowell's existing sidewalk network and improving some of the most difficult streets to currently navigate on foot or with a mobility device.

Address High Need Streets

To strategically improve walking in Lowell, the following routes have been identified. These corridors were chosen through analysis of frequent public transit use, commercial and other key destinations, high crash locations, an absence of sidewalks, and a high number of public comments during GoLowell outreach. These routes should be prioritized for further analysis to identify improvements surrounding major transit stops, business districts and other key pedestrian generators along each corridor. Each corridor should be examined using a Road Safety Audit (RSA) or Walkability Audit to identify the improvements needed:

1. Bridge Street from Merrimack Street to Bridge Street
2. Riverwalk from Bridge Street to Aiken Avenue
3. Merrimack Street from Aiken Avenue to Nesmith Street
4. Chelmsford Street from Northwest Expressway to Plain Street
5. Dutton Street from Merrimack Street to Lords Overpass
6. Plain Street from Chelmsford Street to Main Street
7. Rogers Street from Nesmith Street to Route 495 Interchange
8. Middlesex Street from School Street to Gorham Street
9. Andover Street from Nesmith Street to Clark Road
10. Drum Hill Road from Westford to Northwest Expressway

Road Safety Audit (RSA)

Road Safety Audit (RSA) is a formal safety performance examination of an existing or future road or intersection by an independent, multidisciplinary team. It qualitatively estimates and reports on potential road safety issues and identifies opportunities for improvements in safety for all road users.

Federal Highway Administration. Road Safety Audits: <https://safety.fhwa.dot.gov/rsa/>

Walkability Audit

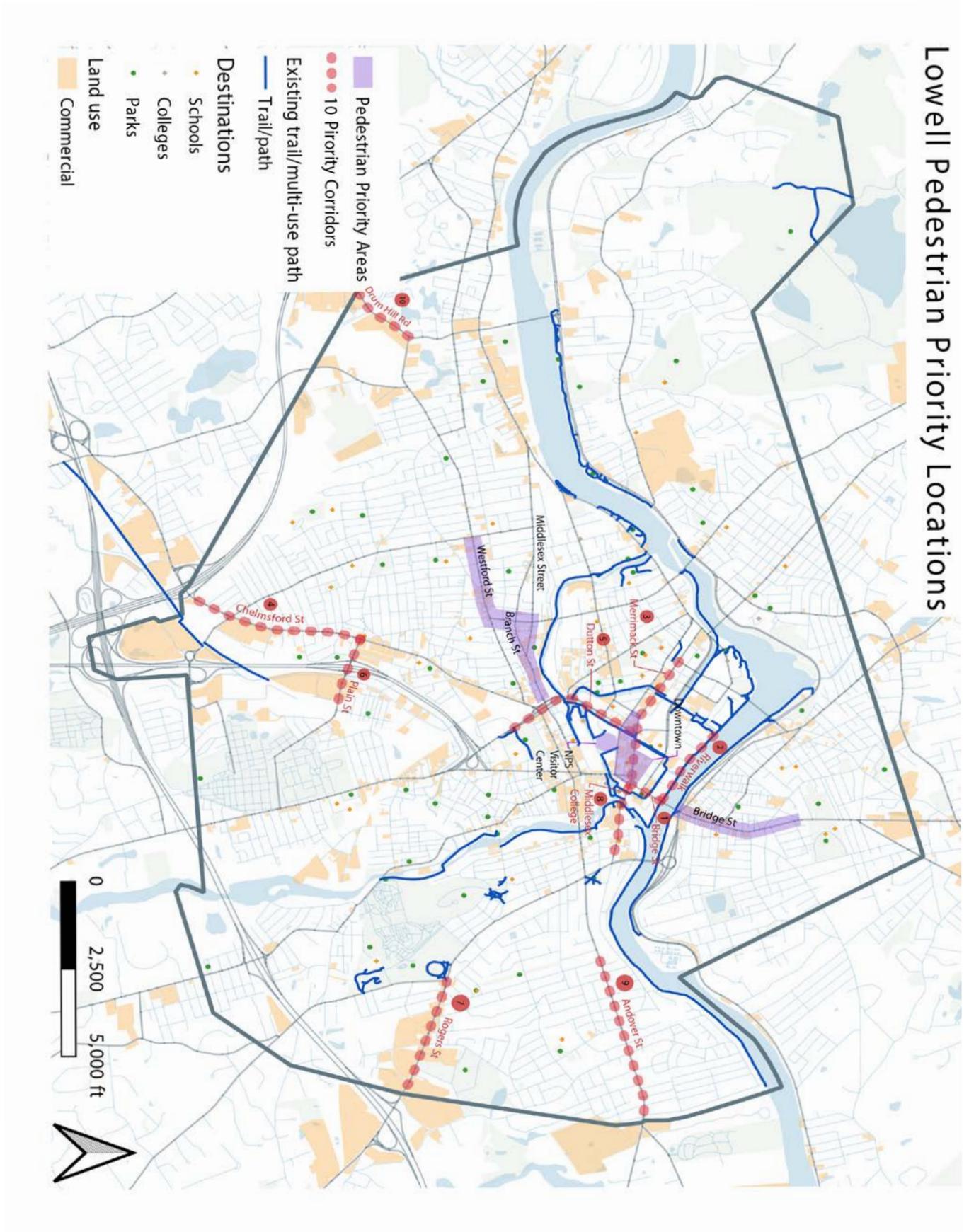
A Walkability Audit is similar to an RSA that is focused on the pedestrian experience. They are helpful tools that lead a community to discuss pedestrian issues and opportunities, document concerns and needs through photos, and engage stakeholders and decision-makers in the conversation about pedestrian safety. Walkability audits can be conducted by safety experts but also by interested communities and residents.

Pedestrian and Bicycle Information Center. Audit Tools: http://www.pedbikeinfo.org/resources/resources_details.cfm?id=5085

Establish Pedestrian Priority Zones

A high-quality pedestrian realm must be established or preserved in business districts, streets with high frequency transit service and pedestrian activity. These areas provide an important role in the local economy and neighborhood vitality. Priority zones are shown on **Map 6** on the following page. As detailed in Chapter 8 of this Plan, the City of Lowell will review the major corridors within these Priority Zones for systemic improvements that will elevate the pedestrian experience.

Map 6: Lowell Pedestrian Priority Zones



CHAPTER 6

LOWELL BUS NETWORK VISION

Lowell Bus Network Vision

Transit improvements are a central element of the GoLowell Plan. The goal of the transit recommendations is to make taking the bus a safe and efficient transportation option, in order to encourage more people who live or work in Lowell, or who are visiting downtown, to choose walking or using transit over traveling by single occupancy vehicle. Recommendations for improvements include two primary components: a transit pilot program to improve service to major bus routes within the downtown area; and improvements to key bus stops including shelters, accessibility, passenger comfort and wayfinding.



Bus connections to newly renovated mill housing

Pilot Bus Program

The GoLowell Team, in close coordination with LRTA, developed a pilot bus program that would be implemented with Sarbanes Transit in the Parks funding in 2022, after the Lord Overpass project is complete. The pilot consists of two major elements:

- A reconfigured Route 18 for more efficient travel between Gallagher Terminal and the downtown area. The proposed pilot would route the 18 bus from John & Merrimack Streets back to the Kennedy Center via Dutton Street instead of looping around Downtown.

- A “Crosstown Express” that would travel from Stadium Plaza in Belvidere to Drum Hill in North Chelmsford during peak hours. This would provide a faster, more direct one-seat trip from these locations to Downtown and to one another. This could also provide a pilot satellite parking location at Cawley Stadium.

These Transit Pilot projects were selected by the GoLowell Team and LRTA based on ridership data, bus frequency and proposed improvement impacts to level of service. Both of these pilots share a “Dutton Street Spine” along with many other LRTA routes, the primary connection between Downtown and Gallagher Station. See **Map 7** on the following page.

Bus Stop Amenities

In addition to the Transit Pilot projects, improvements to bus amenities, sidewalks and pedestrian accessibility, and LRTA branding along this spine are proposed. Bus stop improvements were chosen based on user frequency and downtown proximity. These stops include:

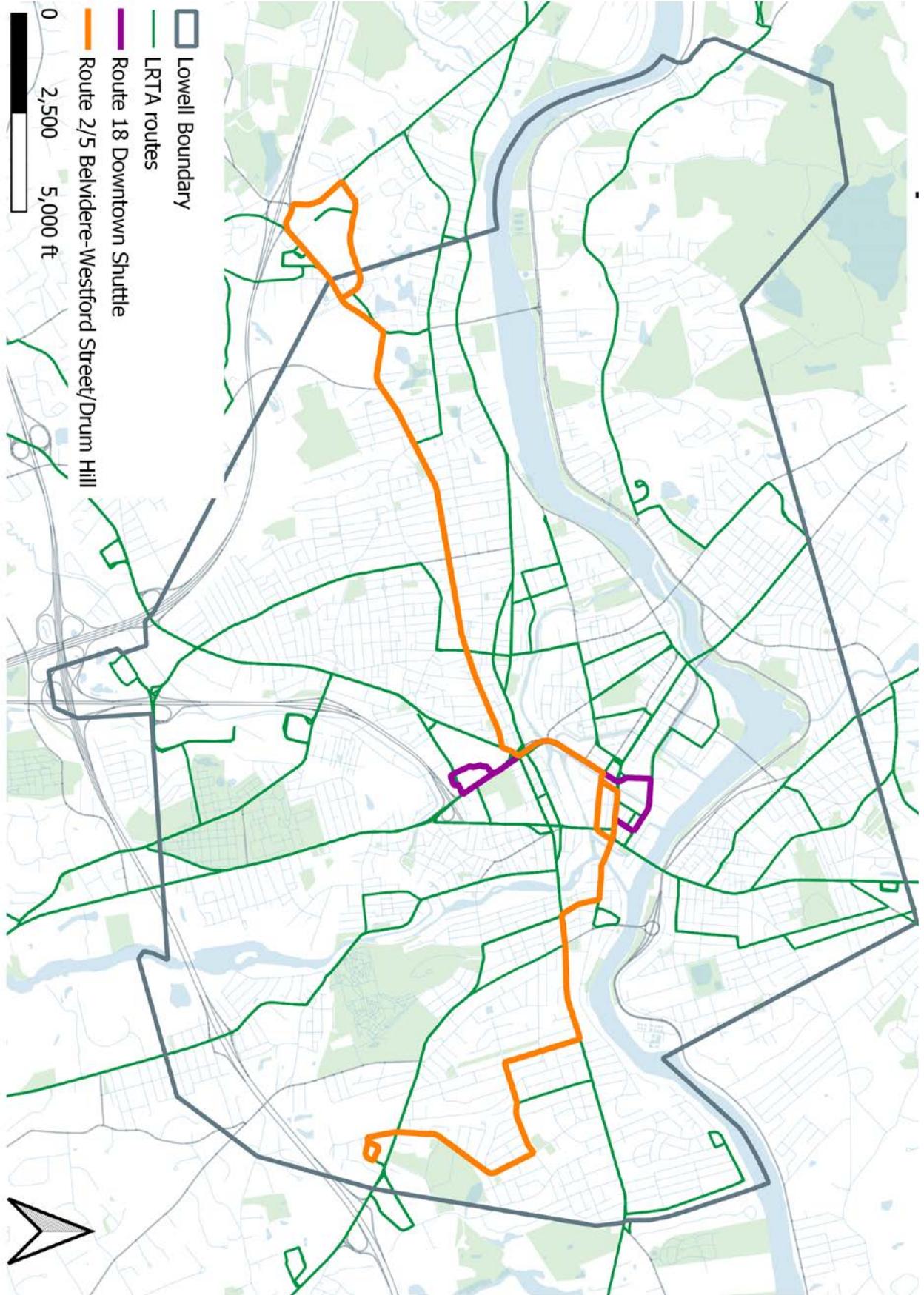
- Merrimack Street and Kirk Street
- Merrimack Street and Cardinal O’Connell Parkway
- Merrimack Street at City Hall
- Hale Street
- Dutton Street at Market Street
- Dutton Street at Broadway Street

These recommendations are illustrated in Chapter 8: Projects.



Existing bus stop at City Hall

Map 7: Lowell Existing Transit Routes and Proposed Bus Pilot Routes



CHAPTER 7

LOWELL BICYCLE NETWORK VISION

Lowell Bicycle Network Vision

This section outlines a connected network of bikeways reaching every corner of Lowell and supporting policies and programs that will make it possible for biking to become a more viable transportation option throughout the city. The City's goal is to provide the opportunity to those who wish to bike to do so safely and conveniently, while coexisting with those who prefer to drive vehicles. The complete connected network is extensive and will require a phased approach. This section will guide Lowell's investment in better bikeway planning, design, and implementation over the next 10 years. The Bicycle Network Vision includes a complete network map, prioritization framework, and design toolkit (see Chapter 9) to help Lowell apply up-to-date best practices in bikeway design. See **Map 8**.

Who will bike in Lowell?

The planning and construction of bikeways has evolved since the installation of the majority of Lowell's bikeways. Numerous surveys nationwide have shaped the understanding of individual hesitancy to try and continue biking. Through these, cities have learned that only a small portion of the general population feel comfortable riding a bike on busy streets without substantial separation from automobiles. Most of the bikeways installed in Lowell consist of painted bike lanes on busy streets and do not feel comfortable to most people.

Bikeways that are appealing to "Interested but Concerned"

riders, the largest group of the general population, are called "low-stress" bikeways. The term "low-stress" bikeway or "low-stress" bike network refers to the use of bikeway designs that feel comfortable to a broad range of users, including those that are not comfortable sharing the roadway with automobiles.

These low-stress bikeways are appropriate for all ages and abilities of riders and are also called 8-to-80 bikeways because they are appropriate for those who are eight years old to eighty years old.

To encourage more people to choose biking, Lowell must build bikeways that are more separated from vehicle traffic or are on low-volume, low-speed streets. These will appeal to most people. This includes separated bike lanes, multi-use paths, and bicycle boulevards on calm streets. If any part of a person's trip feels unsafe, they are less likely to try or continue biking. For this reason, to see a major increase in people biking the City must provide a connected network of bikeways that feel comfortable to more riders.

Although bikeways may not be for everyone, this plan is. Even those that don't choose to bike can benefit from a connected bikeway network. More people biking can reduce the number of vehicles on Lowell's roads, reduce friction between bike riders and drivers, reduce parking demand, and result in improved air quality.

Refer to the Design Toolkit in Chapter 9 in this Plan for more guidelines on selecting the right bike facility for a street's context.

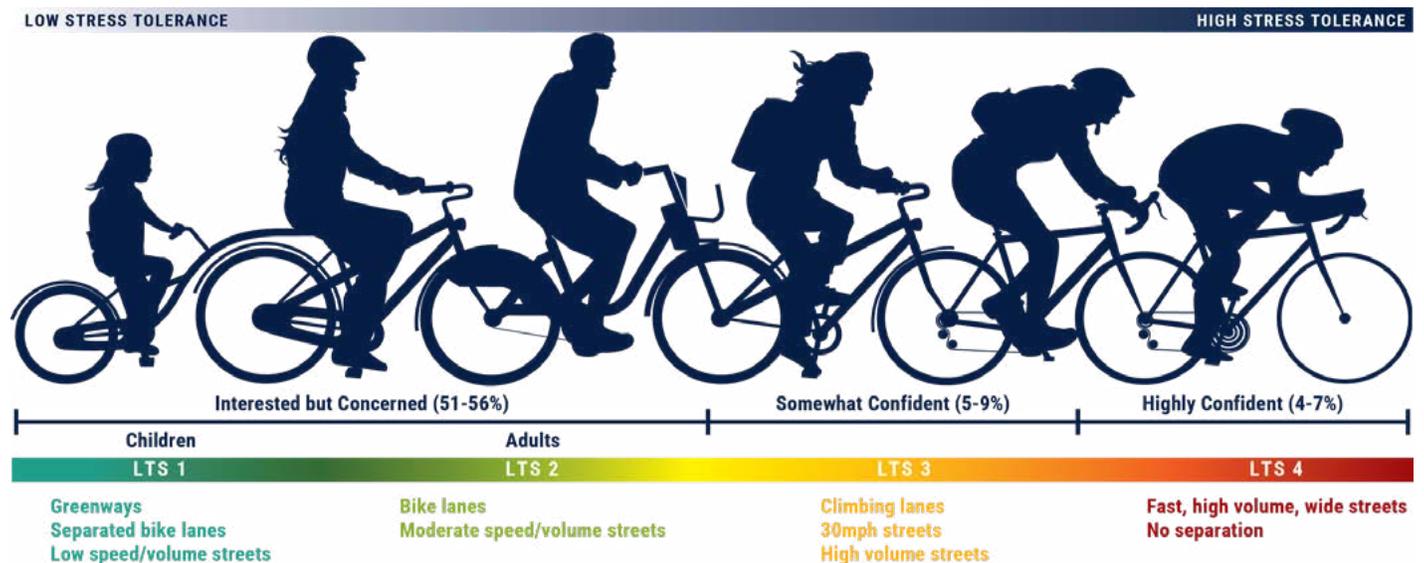


Figure 4: Bike rider type and stress tolerance



Constrained sidewalk and biking facilities on Chelmsford St.

- **Objective 2.2:** Reduce the severity of crashes involving people bicycling
- **Objective 2.3:** Implement bicycle facilities along major roads that are physically separated from higher-speed traffic
- **Objective 2.4:** Establish bicycle routes on neighborhood streets by designing them for low motor vehicle speeds
- **Objective 2.5:** Encourage and support bicycle safety education for people bicycling and driving

Goals for bikeways in Lowell

The City of Lowell worked with members of the Bicycle Advisory Working Group (BAWG) through meetings and public events to develop goals that meet the community's needs and set ambitious, measurable targets for the City. They are intended to guide Lowell staff and stakeholders on decision making while implementing this plan. Three goals provide the framework for measuring the success of this plan and for organizing the plan's recommendations. Each goal is supported by objectives which provide data-driven methods for evaluating implementation. The target for each objective is included where available.

Goal 1: Increase the number of people riding bicycles

- **Objective 1.1:** Complete a network of low-stress bicycle facilities throughout Lowell's neighborhoods, providing seamless connections to the regional bicycle network, public transit, and other key destinations
- **Objective 1.2:** Extend shared use paths within Lowell and connect them to the regional trail network
- **Objective 1.3:** Maintain and expand high-quality end-of-trip bicycle facilities (e.g. bike racks)

Goal 2: Improve safety for people riding bicycles

- **Objective 2.1:** Reduce the number of crashes involving people bicycling

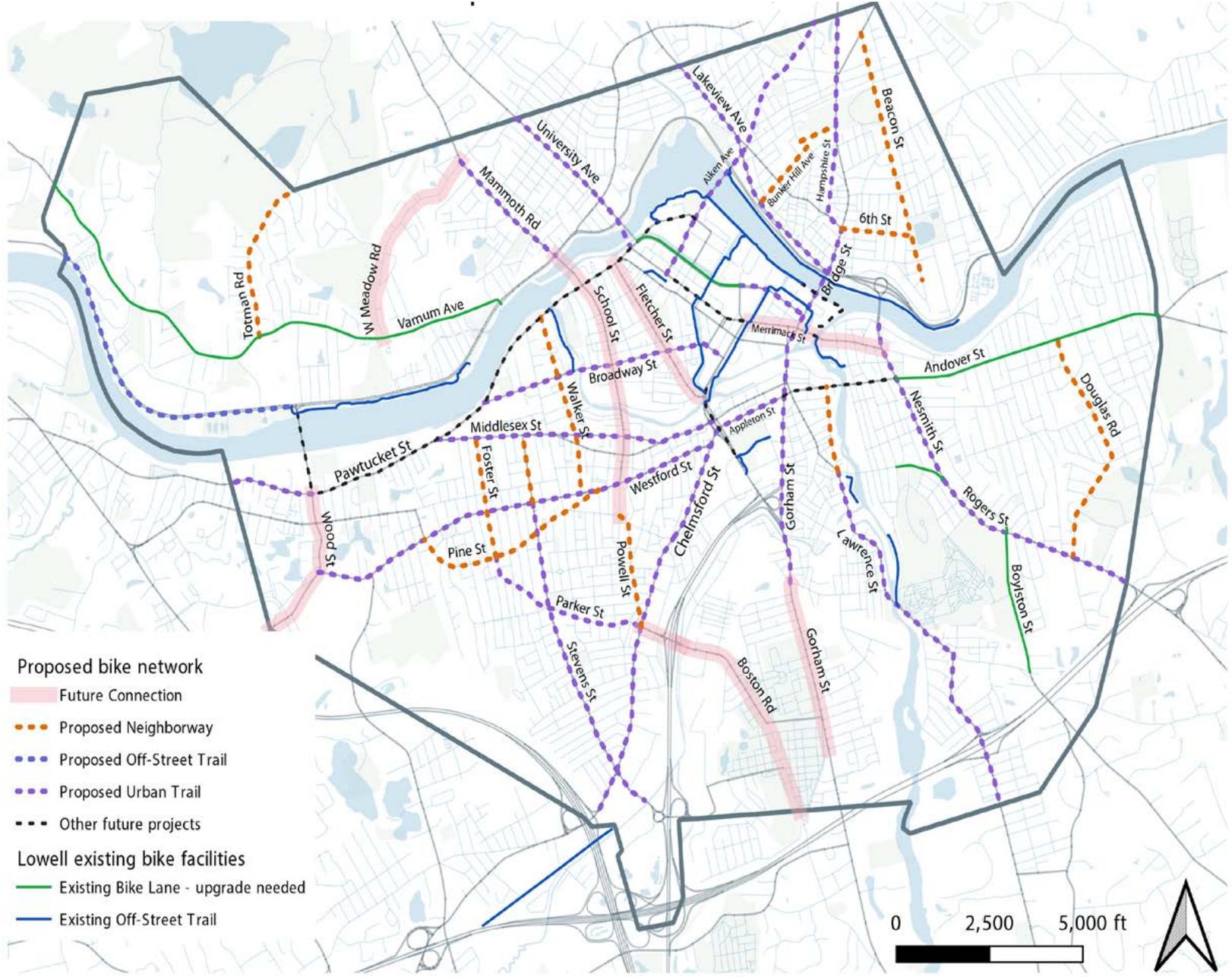
Goal 3: Build bicycle facilities that are welcoming for people of all ages, abilities, and identities, and ensure that all members of the Lowell community have equitable access to bicycling

- **Objective 3.1:** Ensure that the low-stress bicycle network reaches every neighborhood in Lowell, with a special focus on providing bicycle facility connections desired by neighborhoods that are experiencing more challenging existing conditions for bicycling and other disadvantages
- **Objective 3.2:** Provide convenient connections between bicycling and other modes (e.g. to LRTA buses) to enhance mode choice options for every trip
- **Objective 3.3:** Increase the comfort and convenience of riding a bicycle for commuting to work and school and all other trips (e.g. recreation, shopping, dining, etc.)
- **Objective 3.4:** Provide an inclusive network that is guided by wayfinding in all languages and/or iconography responsive to Lowell's diverse population

Building Better Bikeways

Completing a connected network of high-quality bikeways throughout Lowell will take time. This Plan includes about 36 miles of bikeways (with approximately half being separated bikeways) and identifies focus projects that meet the goals and objectives of the Plan and will advance bike riding in Lowell.

Map 8: Lowell Existing Bike Routes and Proposed Corridors



CHAPTER 8

GO-LOWELL RECOMMENDED PROJECTS

GoLowell Recommended Projects

Completing a network of high-quality bicycle and pedestrian facilities will take time. However, the suggested sequence of project implementation outlined below will quickly result in a strong backbone of bikeways, pedestrian improvements to high-use areas, and transit improvements for multimodal transportation. The recommended projects are prioritized into near-term, medium-term and long-term time frames with a goal of implementation within a ten-year period. The list of projects also reflects an overlap in ongoing work and feasibility.

Policies and Programs

Addressing policy changes and programs that will support the recommendations of the GoLowell Plan will play a key role in achieving the project goals. Recommended programs and policies are centered on building a culture of walking and biking, and providing supportive programming. New construction projects focused on bicyclists and pedestrians are only useful if they are well maintained, in a convenient location, and if people feel comfortable using them. The GoLowell Plan makes the following recommendations:

1. Encourage snow clearing by property owners.
2. Establish a sidewalk maintenance program.
3. Transportation Demand Management (TDM) – Implement TDM measures focused on reducing congestion in greater downtown, including:
 - a. Start a TDM subcommittee including City staff and representatives from all large employers.
 - b. Develop a TDM menu of options for small businesses and large developments that can be used in development agreements.
 - c. Implement TDM programming for City staff including beginning a commuter benefits program, offering discounted transit passes and/or bikeshare memberships, starting a carpool program, installing shower facilities in city buildings, hosting transportation fairs, and implementing alternative work arrangements such as telework and alternate schedules. Broadcast the program's successes and make the framework available publicly.
4. Publish a signal policy that addresses signal modifications that favor pedestrians and bicyclists and traffic signal prioritization for transit. Standardize traffic signal phasing and design.
5. Conduct pedestrian-focused RSAs and walkability audits - Allocate budget for three pedestrian-focused Road Safety Audits per year to address all 10 priority corridors within the 10-year timeline for this plan.
 - a. Walkability audits should focus on walkable routes to transit stops, businesses, and schools, and identify a short list of priority infrastructure investments that are proven to reduce crash risk and the severity of crashes for pedestrians.
 - b. Existing capital investment programs, such as repaving, utility projects, and public and private-led street/streetscape projects to install/upgrade pedestrian facilities along the priority corridors.
 - c. Establish a dedicated line item in the yearly Capital Budget for the implementation projects identified in walk audits.
6. Update parking policies - Update parking policies with the aim of reducing the area of urban space dedicated to parking.
 - a. Encourage balanced use of public right-of-way to include non-vehicular transportation.
 - b. Modify parking requirements to respond to the context of differing commercial land uses.
 - c. Adopt shared parking ordinances and encourage business owners to pursue shared-parking agreements for private parking lots and garages.
 - d. Modify zoning regulations to include requirements for both short-term and long-term bicycle parking for new developments.
- d. Subsidize transit passes for residents of new buildings that don't include parking.

- e. Adopt the implementation strategies found in the 2021 City-wide parking study. (<https://www.lowellma.gov/1517/Citywide-Parking-Study>)
- f. Leverage multimodal paths for economic development - Leverage the paths along Lowell’s canals and rivers by installing wayfinding signage directing people in town to the trails and directing trail users to commercial areas. These strategies will spur connections between the trails, the National Park Service destinations, and local businesses adjacent to the trails. Also improve existing trails by improving trail crossings of major streets and widening trails to accommodate bike riders.

for near-term projects and identify funding sources long-term and large projects. Through the State of Massachusetts, Lowell has a variety of funding tools available to assist with the design and construction of complete street projects including:

- a. State or regional transportation improvement plan (<https://www.mass.gov/service-details/state-transportation-improvement-program-stip>)
- b. MassDOT Complete Streets Program (<https://www.mass.gov/complete-streets-funding-program>)
- c. Safe Routes to School - Capital Investment Plan (<https://www.mass.gov/safe-routes-to-school>)
- d. MassWorks Infrastructure Program Grants (<https://www.mass.gov/service-details/massworks-infrastructure-program>)
- e. US Rebuilding American Infrastructure with Sustainability and Equity (RAISE) grants (<https://www.transportation.gov/RAISEgrants>)

- 11. Support a bike culture through providing financial and communications support for bike programming happening throughout Lowell, for instance:

- a. Promote yearly bike to work/school days among City staff
- b. Support and expand educational bicycle programs for kids and families
- c. Work to renew a bike-share program collocated with transit
- d. Include bicycle requirements and modeling in development traffic demand studies and proposals



- 7. Standardize roadway markings – Create and publish a roadway marking memo or design guidelines. With many public design guidelines available to Lowell, formally adopt nationally recognized options noting which are applicable to Lowell and create design guidelines for Lowell-specific items that aren’t addressed. This will serve as a guide for developers, new city staff, advocates, and the public and improve design consistency in the public realm.
- 8. Support school walking and biking programs – Work with partners to fund walking and biking education and programming.
- 9. Create an ADA transition plan – The ADA outlines several provisions including Title III Public Accommodations which requires places of public accommodation to be accessible to and usable by persons with disabilities. Assess existing infrastructure and establish a timeline and set policies to transition facilities to be ADA-accessible.
- 10. Create a funding plan for near-term projects and multi-year projects – Establish a dedicated budget line item



12. Create dedicated funding for crosswalks including roadway evaluation, new crosswalk installation and frequent maintenance and refreshment.
13. Adopt Vision Zero and create a Vision Zero Action Plan to systematically eliminate traffic deaths and serious injuries. Use the crash analysis in this plan to further prioritize projects in this plan.
14. Conduct a bus stop audit and systematically improve bus stops starting with the priority routes established in this plan. Collect data on bus stop accessibility, maintenance, amenities, accurate signage, and shelter.
15. Improve transit app to provide reliable real-time transit information accessible from a variety of platforms. Install real-time travel information at high frequency and high-transfer bus stops.

Project Recommendations

Project recommendations in this section are intended to guide Lowell in implementing incremental changes to build safe walking, biking, and public transit networks. Near-term bicycle recommendations strengthen the existing biking network and extend a spine of north-south bike connections. Pedestrian recommendations prioritize providing access to transit and key intersections. Transit recommendations improve access to critical transit facilities and enhance the experience of waiting for the bus at important bus stops. Recommendations extend over the next 15 years and will build up a network of high-comfort biking and walking improvements. Eventually, these networks will grow to include improvements in every corner of Lowell. The list below outlines all the projects with the near-term projects incorporating bike, pedestrian, and transit improvements and the medium and long-term projects pertaining to bike projects only.

Near-term Projects:

- Aiken Avenue - Merrimack Street to city limit
- Appleton Street - Thorndike Street to Nesmith Street
- Bridge Street/Hampshire Street - Merrimack Street to city limit
- Broadway Street - Dutton Street to Pawtucket Street
- Gorham Street - Merrimack Street to Moore Street
- Merrimack Street - Aiken Avenue to Nesmith Street
- Westford Street - Chelmsford Street to Wood Street
- Middlesex Street - Thorndike Street to Pawtucket Street
- Stevens Street - Chelmsford Street to Middlesex Street
- Chelmsford Street - Thorndike Street to Northwest Expressway
- Dutton Street Transit Improvements
- Neighborways at various locations

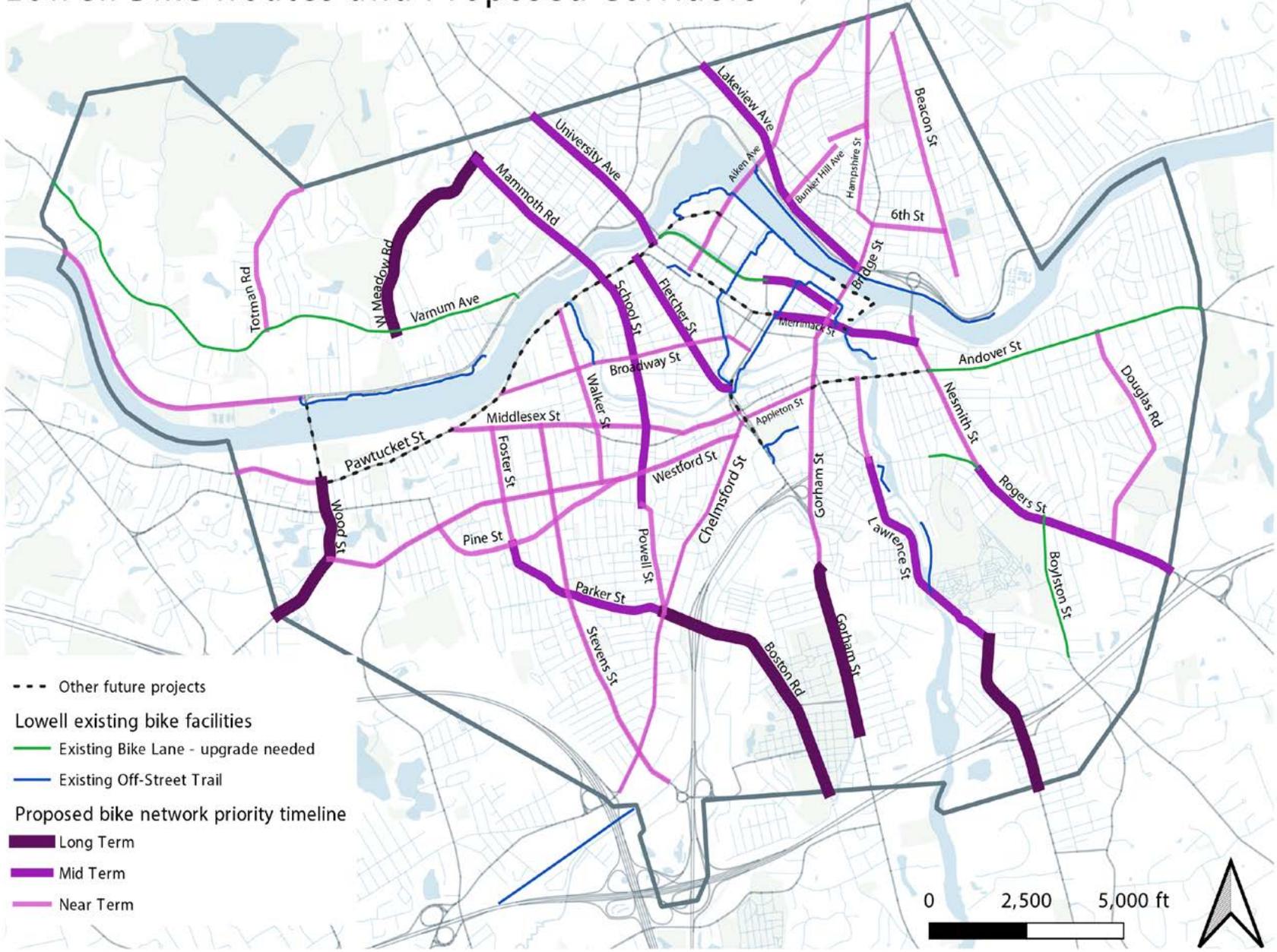
Medium-term Projects:

- Fletcher Street - Pawtucket Street to Dutton Street
- Lakeview Ave - Bridge Street to city limit
- Lawrence Street - Rogers Street to Woburn Street
- Mammoth Road - Varnum Avenue /VFW to W Meadow Road
- Nesmith Street / Rogers Street- Stackpole Street to city limit
- Parker Street - Pine Street to Chelmsford Street
- Plain Street - Boston Street to Chelmsford Street
- University Avenue - Father Morrisette Boulevard to Old Meadow Road
- Merrimack Street - Dutton Street to Nesmith Street
- School Street / Powell Street - VFW to Chelmsford Street

Long-term Projects:

- Boston Road - Plain Street to Ventura Field
- Gorham Street - Moore Street to Carlisle Street
- Lawrence Street - Woburn Street to Boylston Street
- Pawtucket Street - Father Morrisette Blvd to Middlesex Street
- West Meadow Road - Mammoth Road to Varnum Avenue
- Woburn Street - Lawrence Street to city limit
- Wood/Westford Street - Middlesex Street to Technology Drive

Map 9: Lowell Proposed Bike Network Priority Timeline



Map 9 shows all the bike projects categorized based on this timeline.

Near-term Projects

This section provides more details on the near-term projects as well as relevant concept plans for specific intersection and bus stops. **Map 10** on the following page highlights all of the near-term project locations.

Aiken Avenue

Merrimack Street to city limit on Centralville

- **Type:** Bike
- **Description:** Implement protected bike lanes connecting downtown Lowell to UMass East campus on Aiken Avenue and Centralville neighborhood.

Appleton Street

Thorndike Street to Gorham Street

- **Type:** Bike, Pedestrian, Transit
- **Description:** Create a high-comfort east-west bikeway using a separated bikeway design. Incorporate transit stops in the 'flex zone' along with parking, loading zones, trees, and chicanes that manage traffic speeds. Control the number of bike/vehicle conflicts by working with adjacent businesses to consolidate, narrow, or close the near-continuous curb cuts. Widen sidewalks where possible and move light poles and other sidewalk barriers out of the pedestrian clear width. Use the FHWA STEP Guide to provide appropriate pedestrian crossing countermeasures at major crossings. (https://safety.fhwa.dot.gov/ped_bike/step/resources/)

Bridge Street / Hampshire Street

Merrimack Street to city limit

- **Type:** Bike, Pedestrian, Transit
- **Description:** Create a high-comfort north-south bikeway extending from Downtown into Centralville and to McPherson Park. Install a separated bikeway between Merrimack and VFW Highway in coordination with the bridge's repaving. Continue the separated

bike lanes from VFW Highway to 6th Street, facilitating a left turn at 6th Street to continue the route as a neighborway on Hampshire Street from 6th Street to Bridge Street. Facilitate bike turning movements at Bridge St and VFW Highway and 6th Street.

- At Bridge Street and Massmills Drive, provide a curb extension on the northwest corner to provide more space for the bus stop. Connect the canal path on Jack Kerouac Park to the bikeway on Bridge Street heading northbound. See **Figure 5** for the concept plan at this location.
- At Bridge Street and the VFW Highway, connect high-comfort bikeways with a protected intersection connecting to Bridge Street – north and south, - the existing riverfront trail, and the future Lakeview Ave bikeway. See **Figure 6** for the concept plan at this intersection.

Broadway Street

Dutton Street to Pawtucket Street

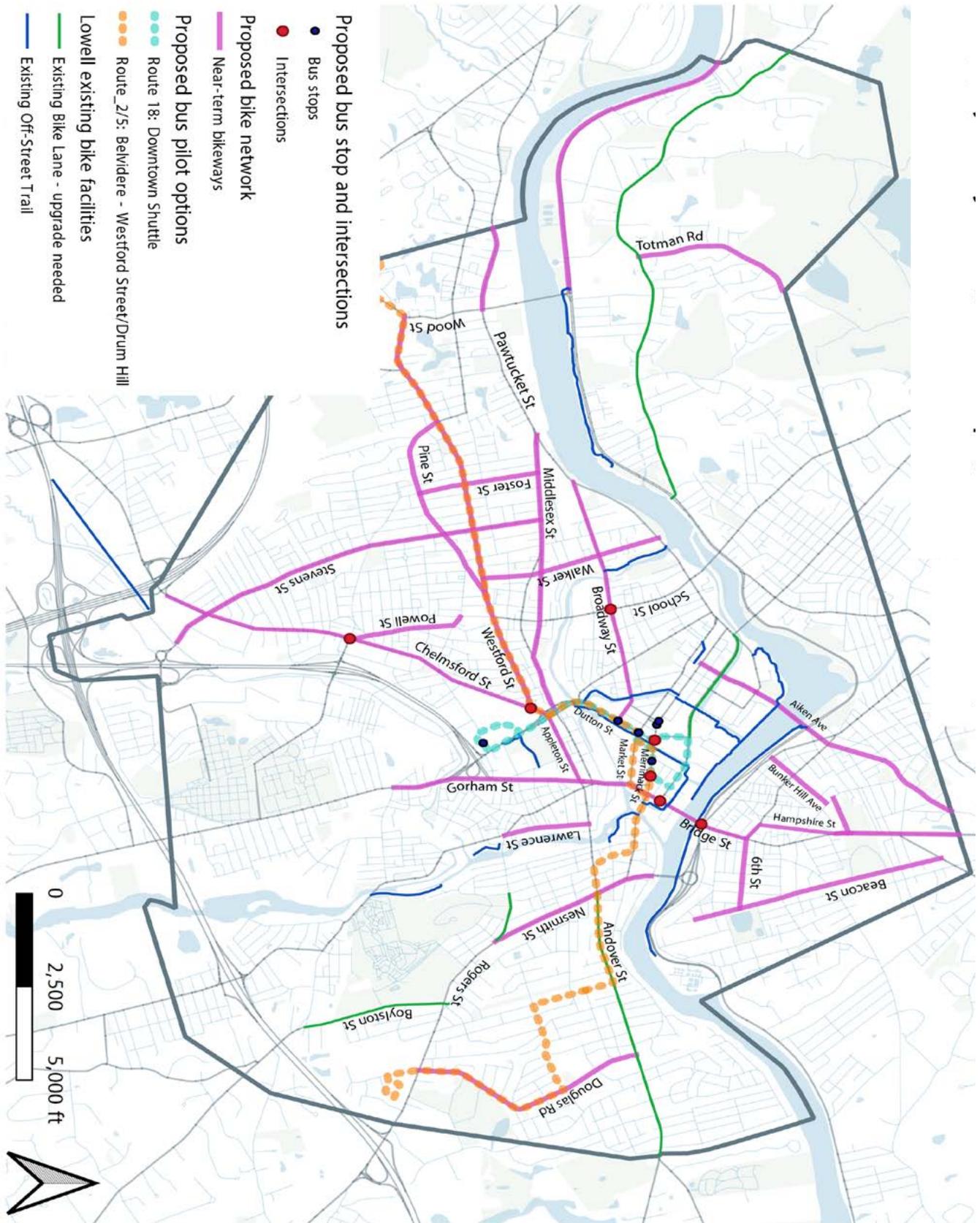
- **Type:** Bike, Pedestrian, Transit
- **Description:** Create a high-comfort east-west bikeway using a separated bikeway design. Incorporate transit stops in the 'flex zone' along with parking, loading zones, trees, and chicanes that manage traffic speeds. Control the number of bike/vehicle conflicts by working with adjacent businesses to consolidate, narrow, or close the near-continuous curb cuts.

Gorham Street

Merrimack Street to Moore Street

- **Type:** Bike, Pedestrian
- **Description:** Install a high-comfort bike facility on Gorham Street to begin to establish a north-south connection on the east side of Downtown. Widen sidewalks where possible and simplify complex intersections. Use the FHWA STEP Guide to provide appropriate pedestrian crossing countermeasures at major crossings.

Map 10: Lowell Near-Term Project Locations



Merrimack Street

Aiken Avenue to Nesmith Street

- **Type:** Bike, Pedestrian, Transit
- **Description:** Upgrade and complete existing bike lanes on Merrimack.

Merrimack Street at City Hall

- **Type:** Pedestrian, Transit
- **Description:** Upgrade and bus stops and crossings on Merrimack.
- Improve pedestrian safety and user comfort at this high-frequency bus stop and coordinate with upcoming bicycle and pedestrian improvements. Provide additional bus waiting space, shorten the pedestrian crossing, and improve visibility by expanding the sidewalk on the north side leading to Lowell City Hall and Pollard Memorial Library.

Merrimack Street at Kirk Street

- **Type:** Transit
- **Description:** Relocate bus stop in downtown core on Merrimack.



Long crosswalk at Dutton and Merrimack Street intersection

- Relocate the Merrimack and John Street bus stop to Merrimack Street and Kirk Street to counter the elimination of the Shattuck Street stop as a result of the proposed bus pilot route. Extend the existing curb bumpout to install a heated bus shelter and improve pavement markings.

Merrimack Street at John Street

- **Type:** Pedestrian, Transit
- **Description:** Remove bus stop (relocate to Kirk St.) Improve sidewalks
- Remove the bus stop at this location (relocated to Kirk Street). Widen the sidewalk and install a curb extension at Merrimack Street and John Street to shorten pedestrian crossing distance across John Street and provide expanded public realm opportunities to this central commercial core intersection. This intersection is a high pedestrian traffic area, more space for people walking/rolling is recommended.

School Street at Broadway Street

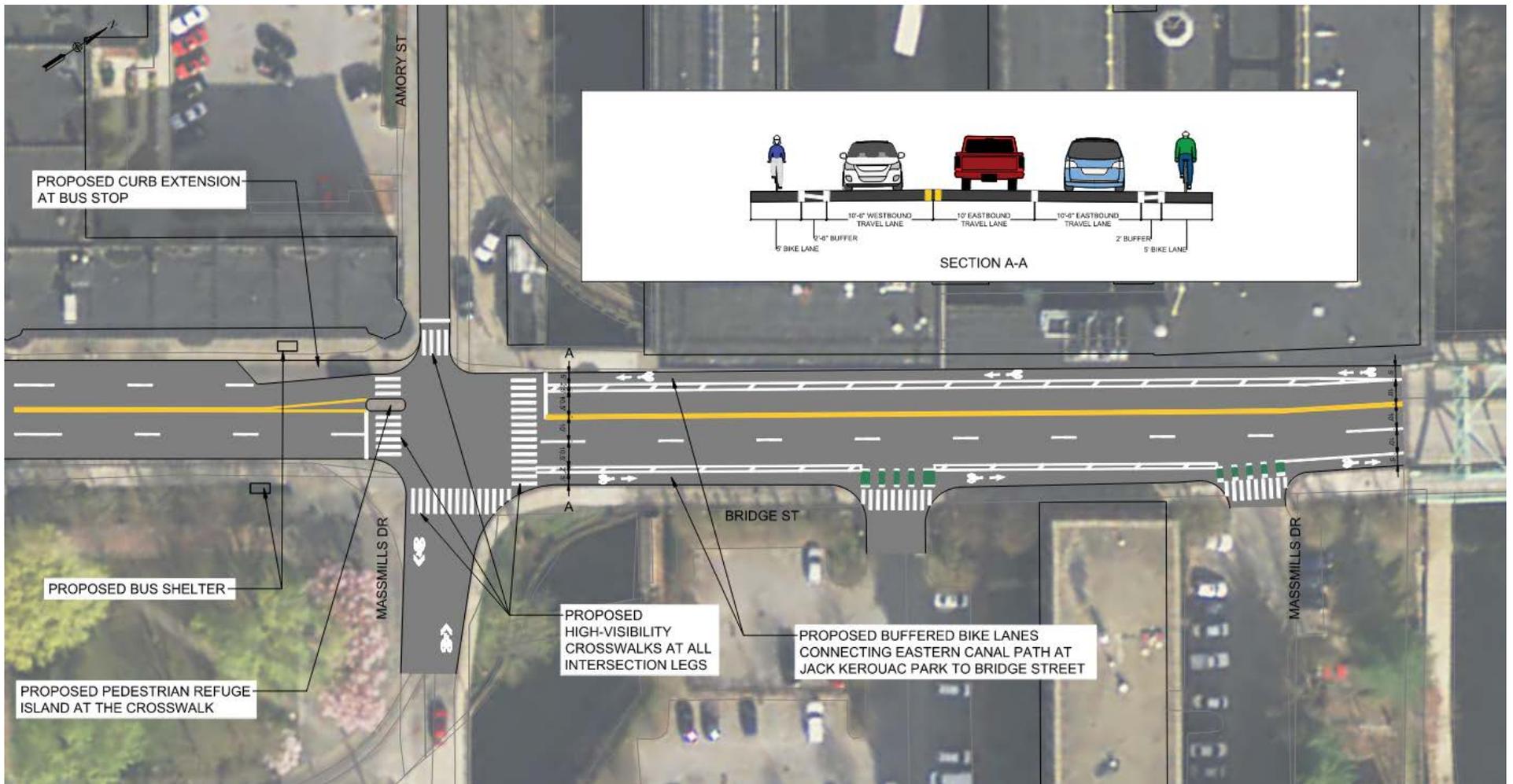
- **Type:** Pedestrian
- **Description:** Install curb extensions along all corners of the intersection to shorten pedestrian crossing distance and delineate the start of parking.

Westford Street

Chelmsford Street to Wood Street

- **Type:** Bike
- **Description:** High-comfort bike facility
- Install a high-comfort bikeway to establish this east-west spine leading from Downtown to the Highlands neighborhood. Evaluate the street to determine the best bikeway type using the FHWA Bikeway Selection Guide and process. Consider bike movements in all major intersections along the route.

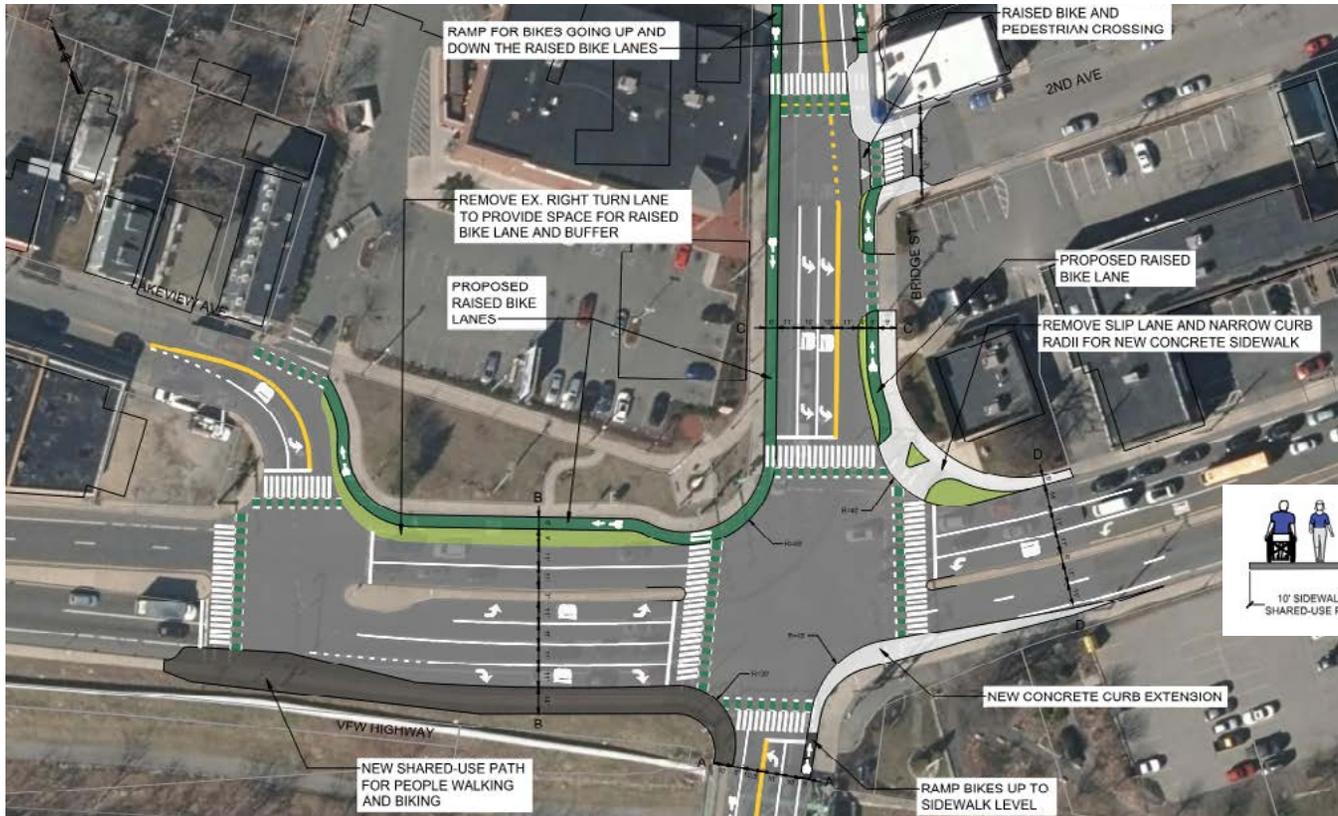
Figure 5: Intersection Concept Plan for Bridge Street at Massmills Drive



The Bridge Street concept plan focuses on improving pedestrian crossing safety and creating network connections needed for bicycling. Ongoing trail and bikeway projects include: Riverwalk extension project, the Canal Way, and Lower Locks

projects. Bike lanes will connect to the anticipated MassDOT project to restripe Bridge Street Bridge to allow for bike lanes. On the north side of the Merrimack River these bike lanes will provide safer bike routes from the Centralville Neighborhood.

Figure 6: Intersection Concept Plan for Bridge Street at VFW Highway

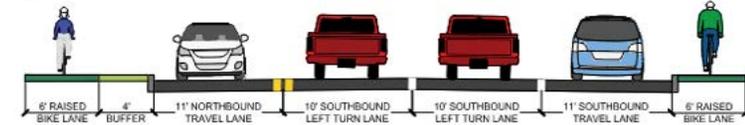


Improvements at VFW Highway and the northern leg of Bridge Street in the Centralville neighborhood are proposed to provide bicycle facilities connecting to the Riverwalk pathway along the north side of the Merrimack River and across Bridge Street to downtown Lowell. The concept plan includes multimodal path connections from Lakeview Avenue and striped bicycle crossings at the intersection.

SECTION B-B



SECTION C-C



SECTION D-D

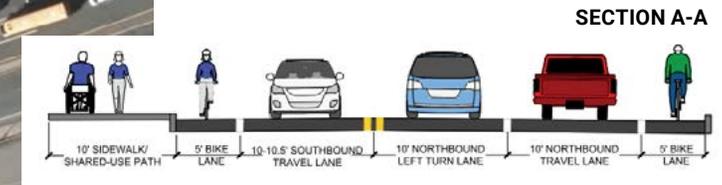
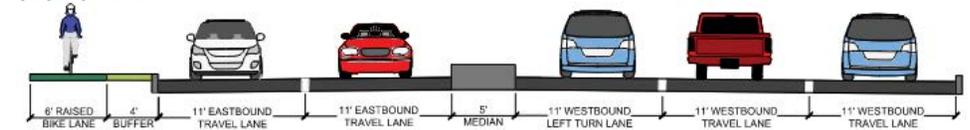
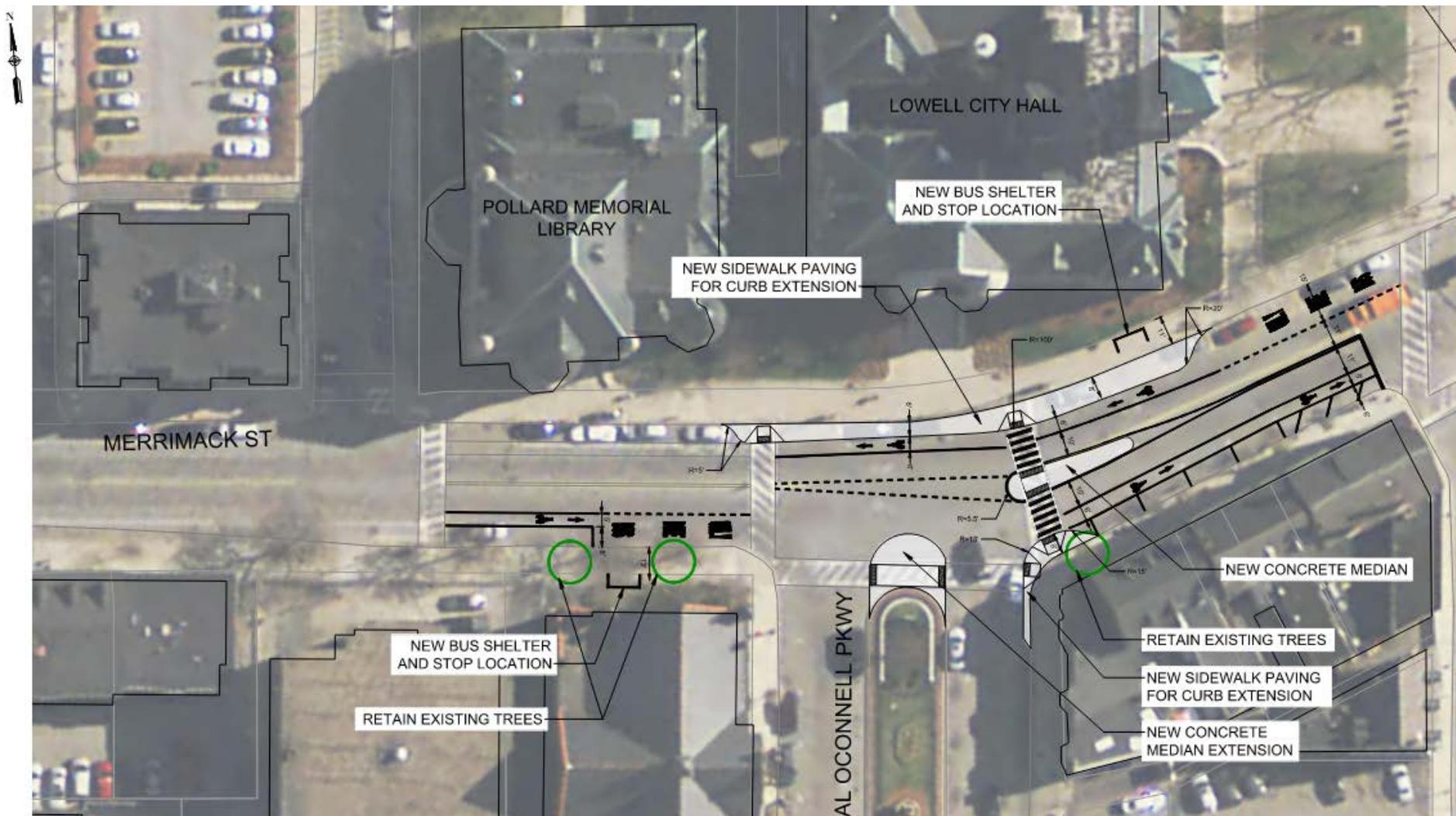


Figure 7: Bus Stop and Intersection Concept Plan for Merrimack Street at City Hall

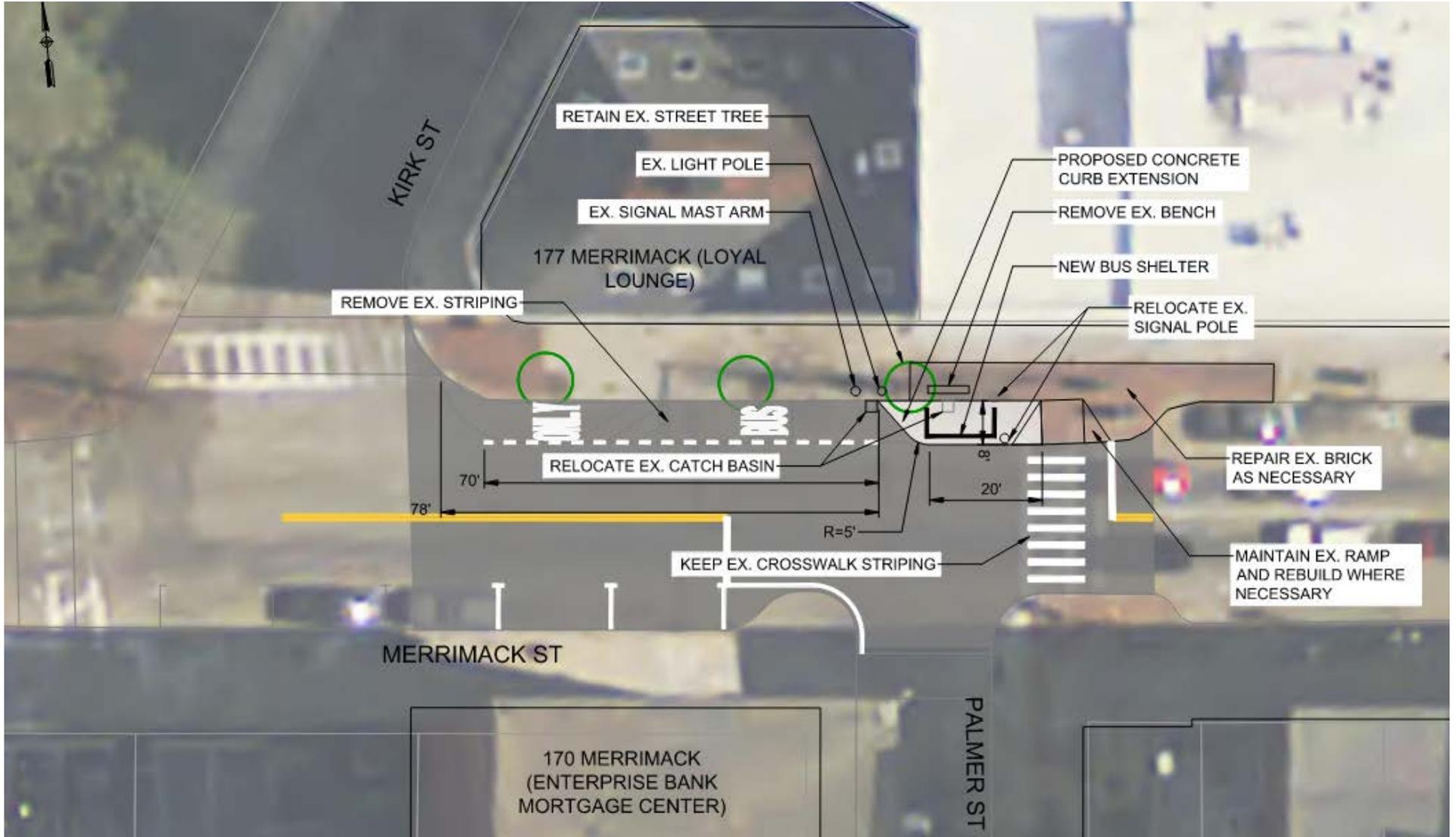


This concept plan focuses on improved crosswalk safety and bus stop facilities. The curb extensions provide better visibility of people crossing Merrimack Street and limits vehicles attempting to pass stopped buses at City Hall bus stop.

This Plan would include custom designed bus shelters to reflect the historic architecture of City Hall and adjacent buildings. The GoLowell Team worked with

the City to incorporate design features of the proposed bike lane pilot project. In 2020 the Lowell DPW initiated a pilot to test this configuration that proved successful and reiterated the need for this design to become a permanent modification.

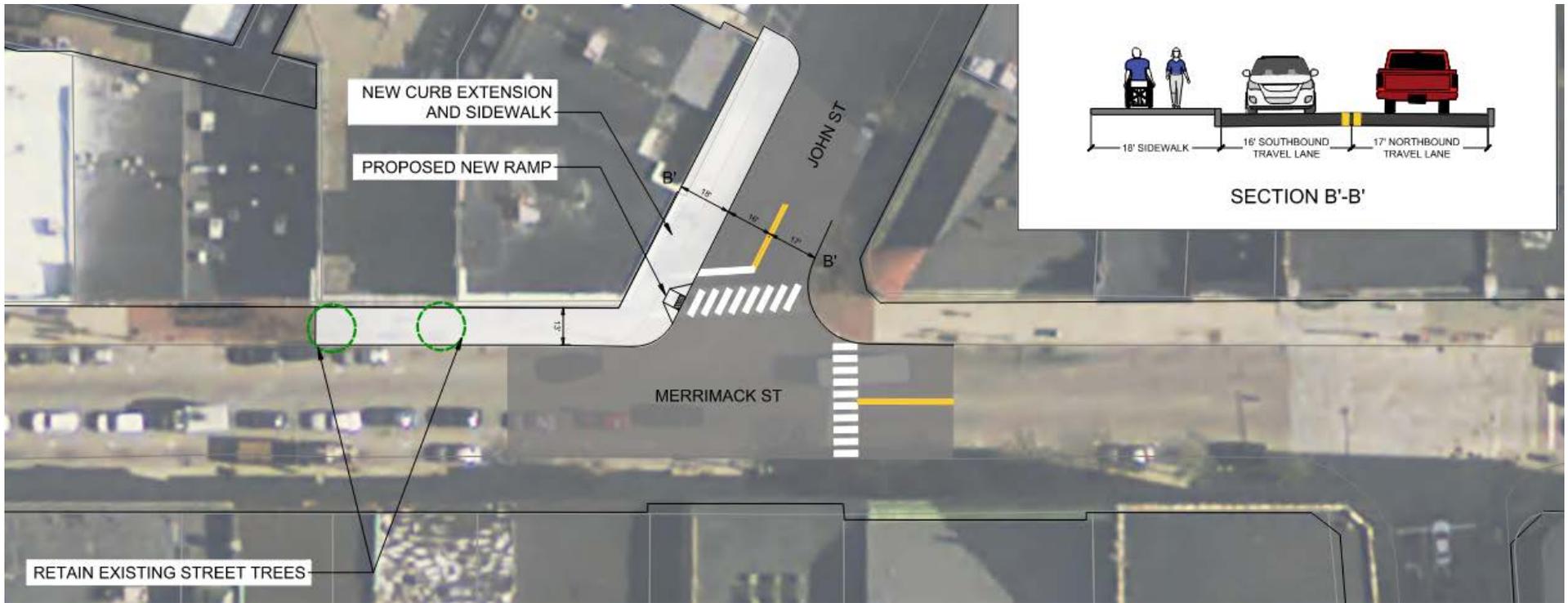
Figure 8: Bus Stop Concept Plan for John Street at Kirk Street



This concept plan relocates the existing LRTA bus stop currently at the corner of Merrimack and John Streets to this location at Merrimack and Kirk St. The plan includes expanding the existing curb bumpout to allow for a new heated bus shelter, signage and

real-time bus schedule information. This stop will also replace the existing stop on Palmer St. to be eliminated through the Transit Pilot project.

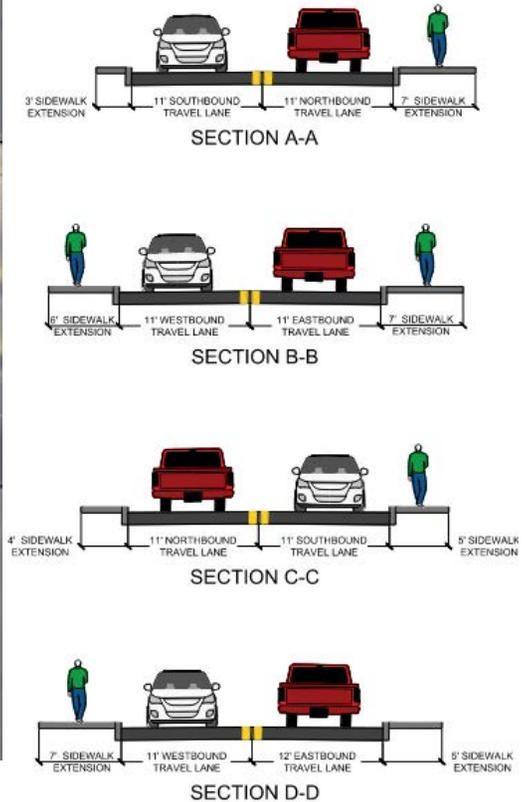
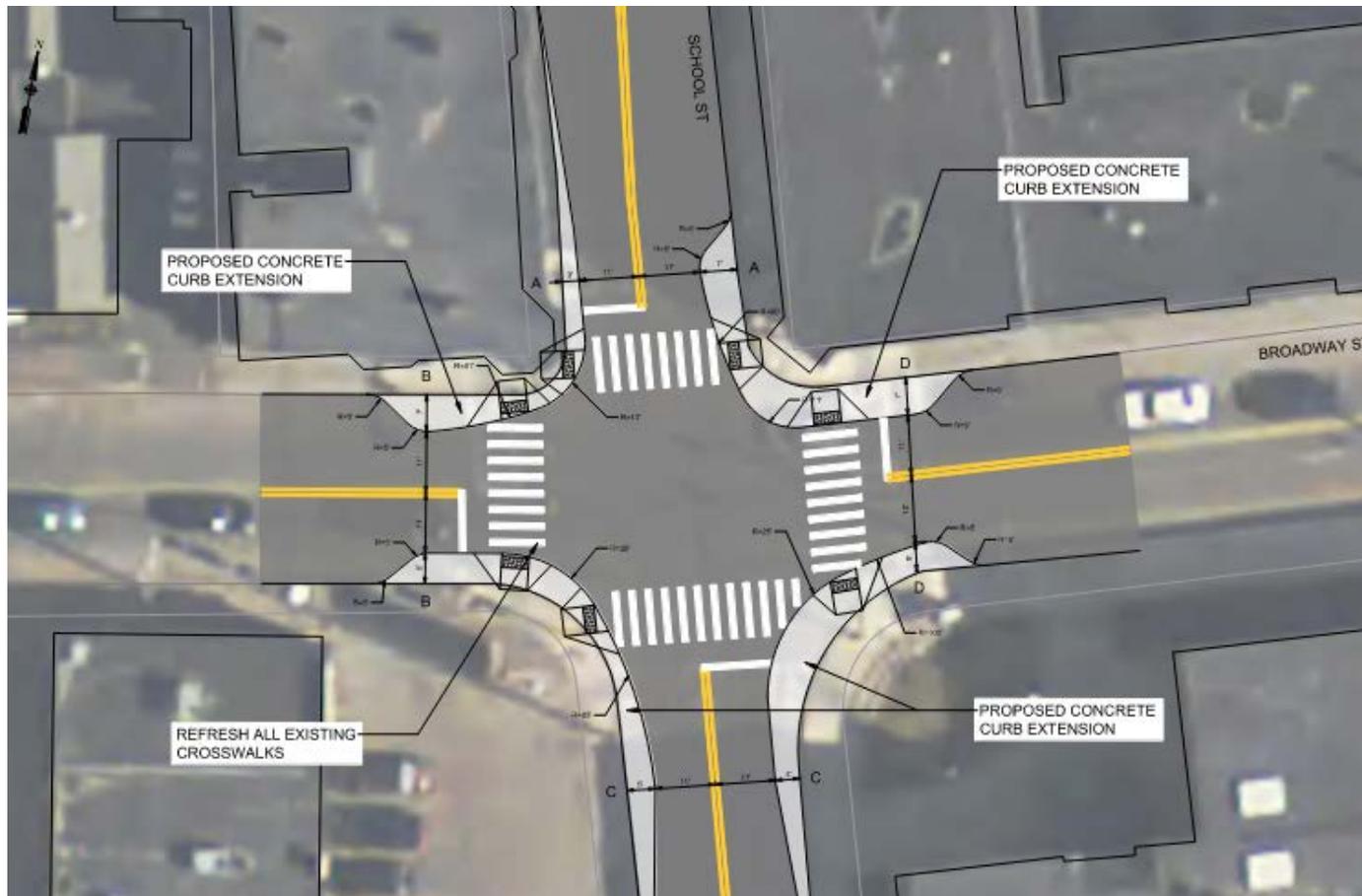
Figure 9: Intersection Concept Plan for John Street at Merrimack Street



This Concept Plan focuses on pedestrian safety and expanded public realm area at this very busy intersection in the center of the downtown commercial area. The existing bus stop in this location is proposed to be relocated to the adjacent block at Merrimack and Kirk Street, removing bus activity at this intersection, and relieving some of the traffic congestion.

Expanded sidewalks on the northwest corner would allow for increased outdoor dining or other sidewalk retail and seating. This curb extension will also shorten the crosswalk for pedestrians on John Street. Restriping of crosswalk paint and markings is also proposed.

Figure 10: Intersection Concept Plan for School Street at Broadway Street



Improving pedestrian safety is the primary focus of this Concept Plan. Broadway and School Street is a busy intersection for vehicles and pedestrians, particularly with the Stoklosa Middle School located at the southeast corner. The plan proposes curb extensions at all corners to shorten the crossing distance, improve accessibility, create better visibility of people crossing, and provide traffic calming.

Improve Access to Gallagher Terminal

Chelmsford Street

Thorndike St to Northwest EXPY

- **Type:** Bike, Pedestrian, Transit
- **Description:** Construct a two-way protected bike lane on the east curb Chelmsford Street connecting the Bruce Freeman Rail Trail to the Gallagher Terminal.
- Provide a direct and intuitive bikeway connection to Gallagher Terminal at Chelmsford St at Westford. Use this intersection and signal to transition from a two-way protected bike lane to two, one-way protected bike lanes connecting to the ongoing Lords Overpass project. Use this opportunity to implement pedestrian enhancements including reducing pedestrian exposure by shortening crosswalks, reducing vehicle turning speeds by installing tighter turning radii, and constructing a complete sidewalk leading to the terminal's entrance. See **Figure 11** for the concept plan at this intersection.
- Connect to other proposed bikeways at Plain Street and continue a protected bike facility south on Chelmsford to the Northwest Expressway either as a raised sidepath or a well-protected on-street bikeway. As the land uses change south of Plain Street, this bikeway will provide an important connection to commercial and employment destinations. Although the east side of Chelmsford has fewer major intersections than the west side, there are many wide curb cuts. Control the number of bike/vehicle conflicts by working with adjacent businesses to consolidate, narrow, raise to sidewalk level, or close the near-continuous curb cuts. See **Figure 12** for the concept plan at this intersection.

Dutton Street Transit Improvements

- **Type:** Bike, Pedestrian, Transit
- Thorndike Street and Dutton Street are, collectively, the most heavily traveled transit corridor in Lowell. These two streets carry the important Route 18 which provides frequent transit service between Gallagher Terminal and Central Lowell. These streets also carry Routes 1, 6, 7, 8, and 10. Upgrading the transit experience along this corridor Street is a high priority and high impact project and connects to the ongoing Lords Overpass project. Dutton Street from Salem Street to Broadway is bordered on the west side with sidewalks and dense buildings.

On the east side, however, it lacks sidewalks and is bordered by the NPS historic site's streetcar tracks and the Upper Pawtucket Canal. South of Broadway and the Lords Overpass, Dutton Street continues as Thorndike Street which assumes the characteristics of a major urban arterial as it approaches Gallagher Terminal. The recommendations below will improve key access points to transit along the corridor and to Gallagher Terminal. Overtime, the City should continue to improve pedestrian and bicycle access along this important corridor holistically.

Dutton Street at Merrimack Street

- **Alternative A:** Install a roundabout at Dutton Street and Merrimack organizing the five-leg intersection, creating a safer, low-speed environment, and creating placemaking opportunities. Create a more compact intersection by reallocating some of the pavement for pedestrian refuge islands, landscaping, widened sidewalks, and pedestrian crossing enhancements. Eliminate signal Maintenance cost.
- **Alternative B:** Reconstruct intersection corners to extend curbs, improving pedestrian safety at crossings and a lower vehicle speeds through the intersection. Upgrade and improve signalization for pedestrians and prioritized transit phases through the intersection

Dutton Street at Market Street

- Construct a new sidewalk and sheltered bus stop on Dutton Street that connects to NPS property to the north. Coordinate closely with NPS on the design and construction.

Dutton Street at Broadway Street

- Install a short section of sidewalk providing a safe place to wait for the bus at Dutton Street and Broadway Street. Coordinate closely with NPS on the design and construction.

Hale Street at YMCA Drive

- **Type:** Transit
- **Description:** Expand this high-frequency bus stop on the Kennedy Center Busway by providing accessible walkways to the existing location from YMCA Drive sidewalk, a paved bus platform and new bus shelter and signage.

Figure 11: Intersection Concept Plan for Chelmsford Street at Westford Street

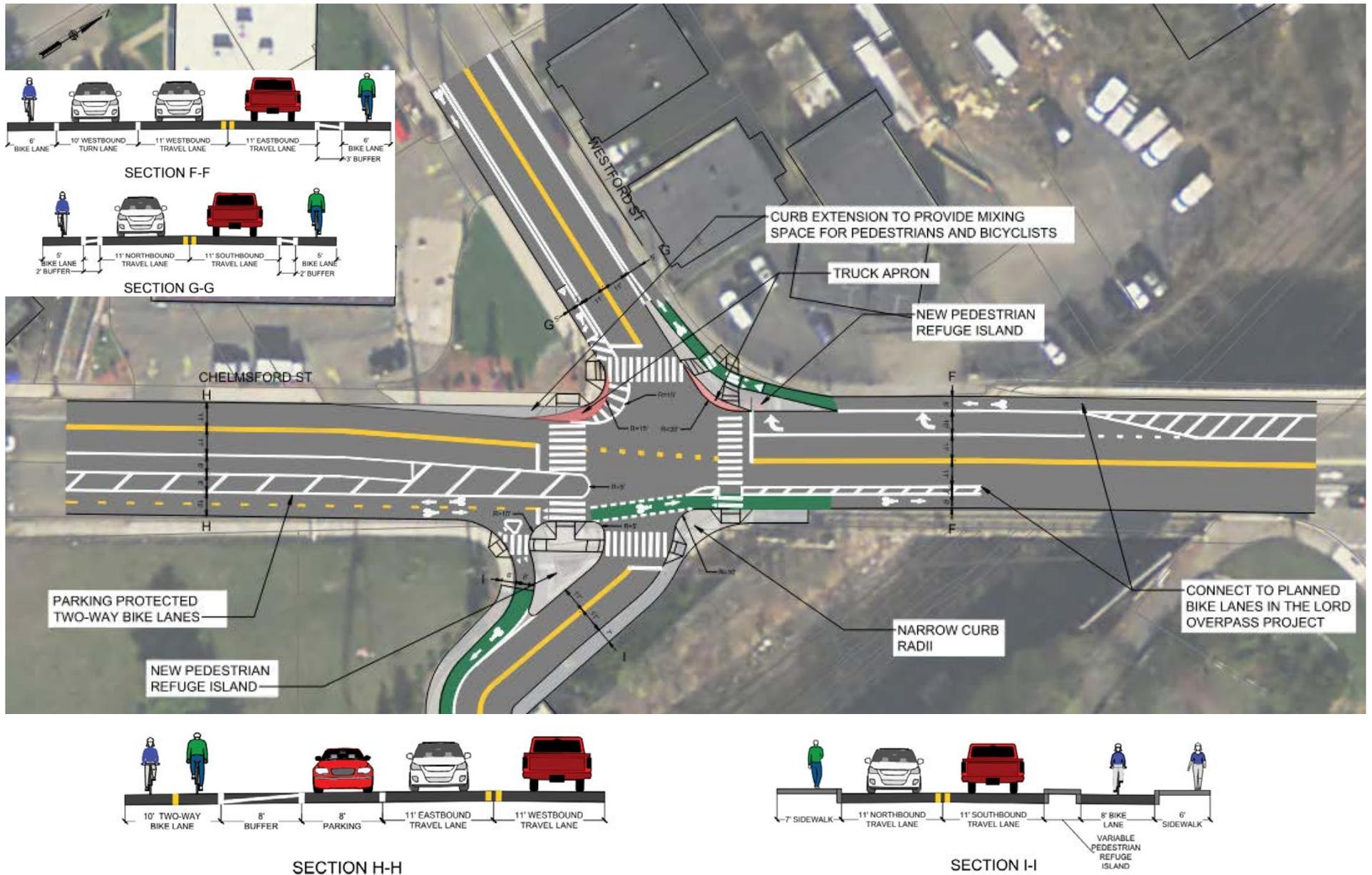


Figure 12: Intersection Concept Plan for Chelmsford Street at Plain Street

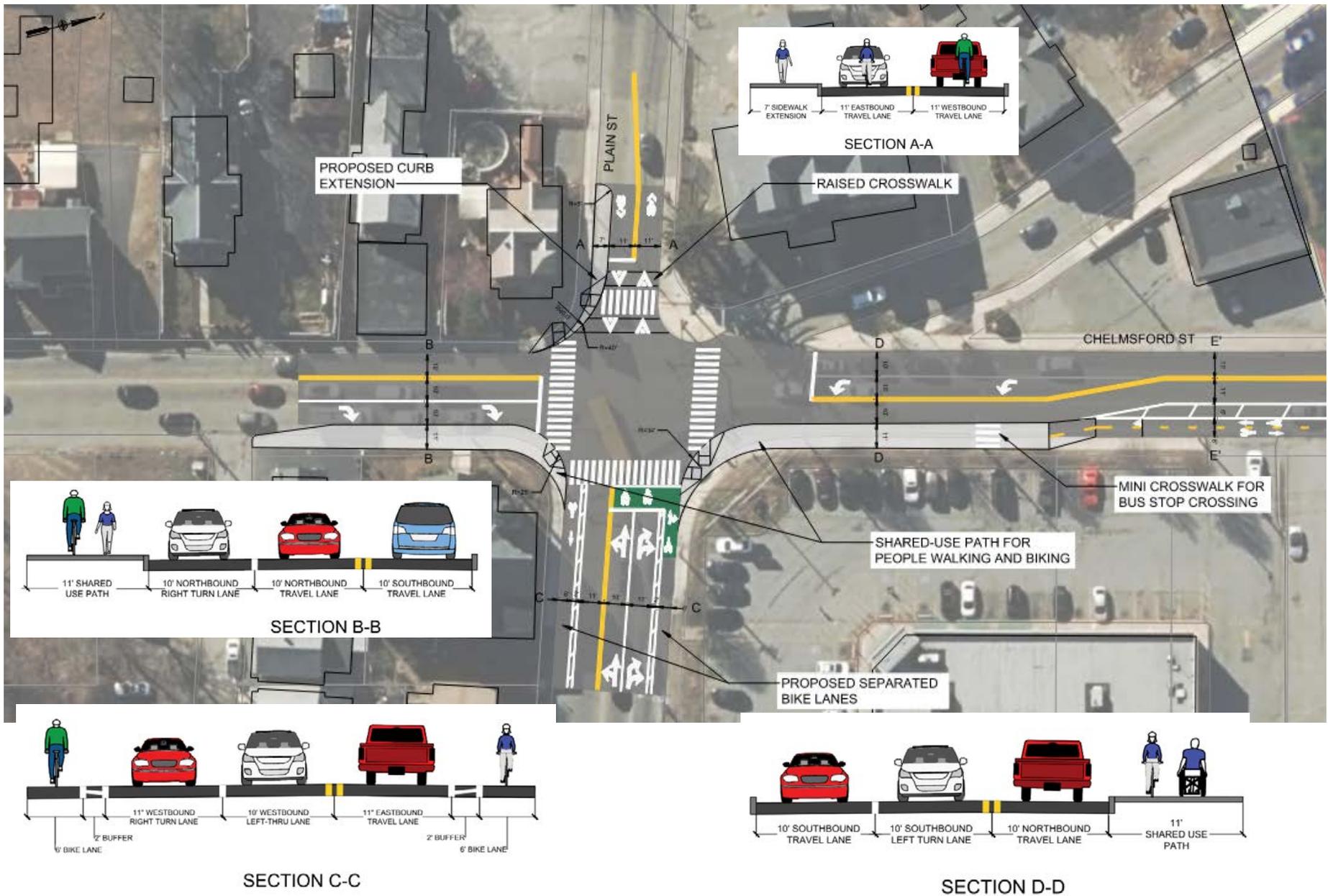


Figure 13: Bus Stop Improvements Concept Plan for Dutton Street at Market Street

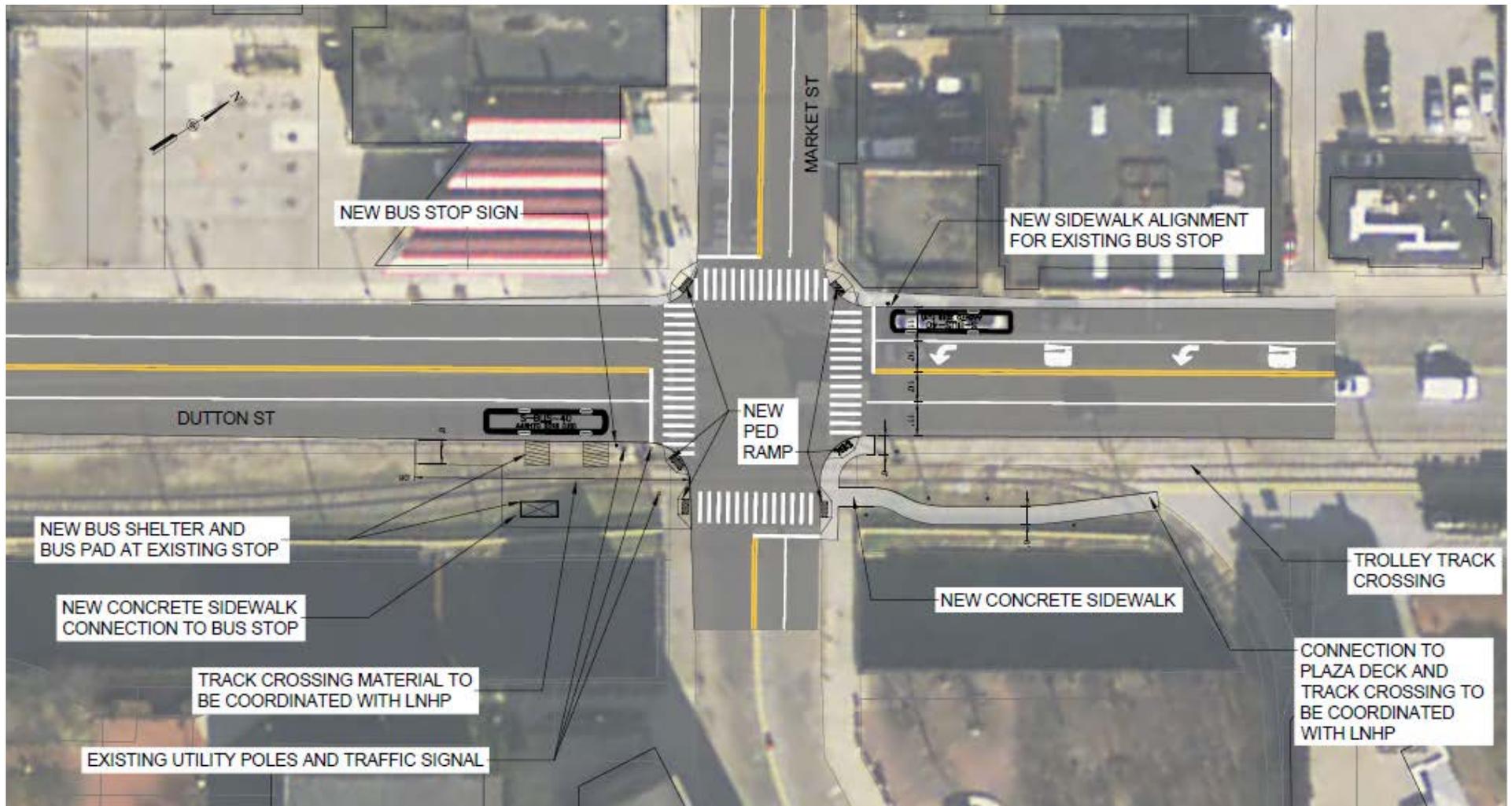
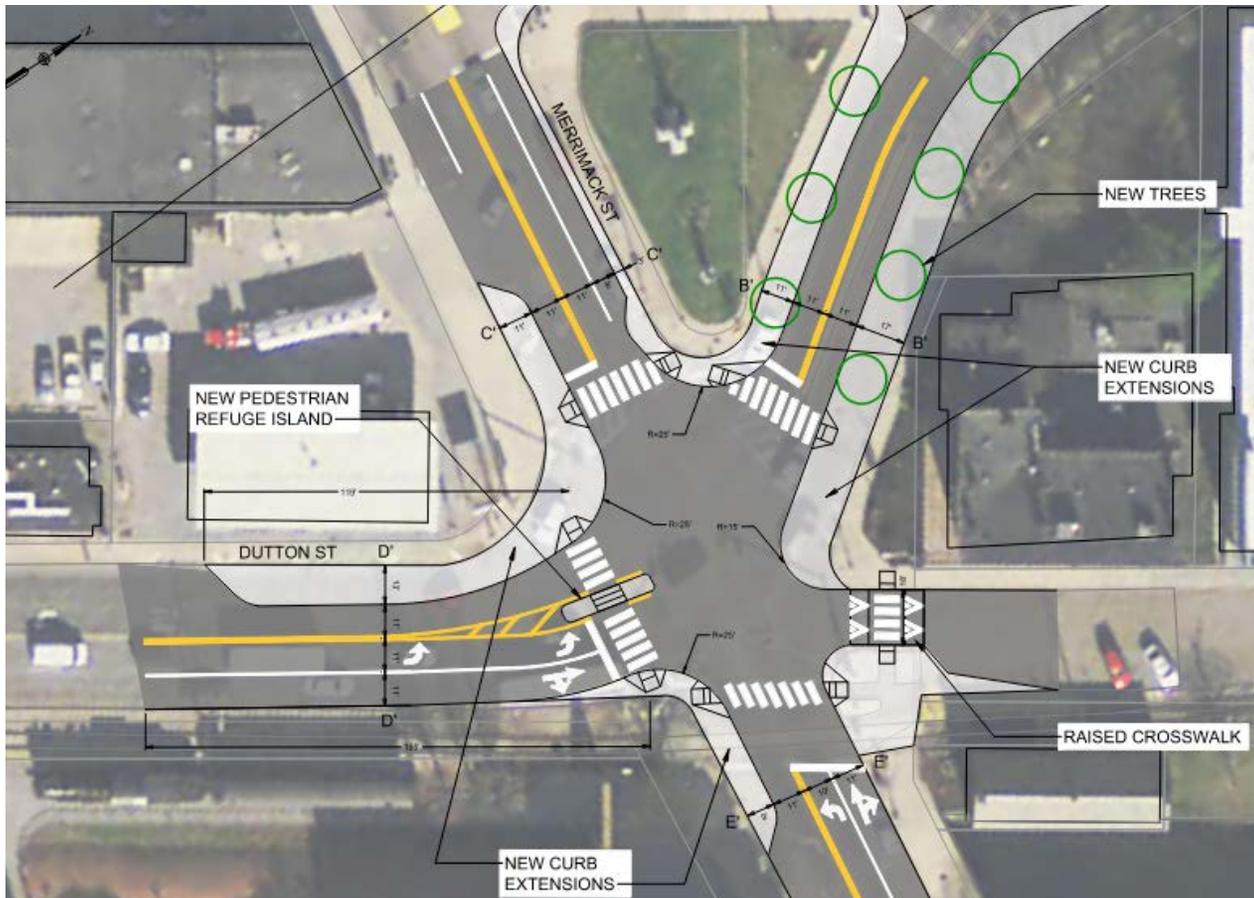
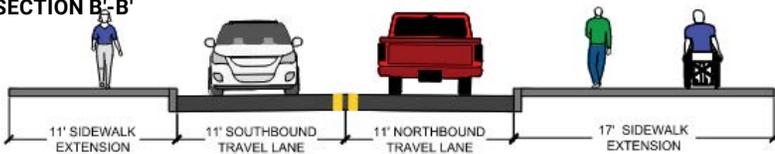


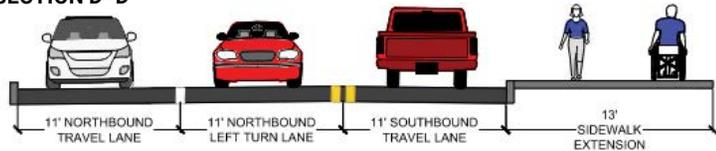
Figure 14: Intersection Concept Plan for Dutton Street at Merrimack Street - Alternative B



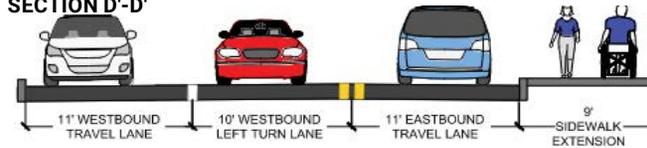
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SECTION D'-D'



SECTION E'-E'

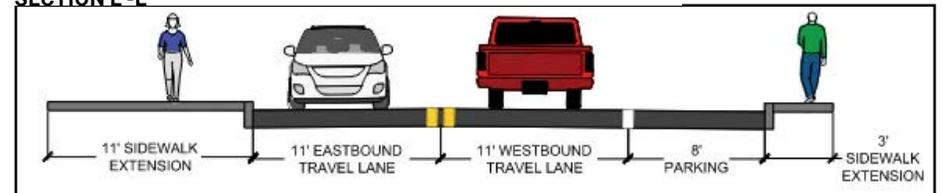
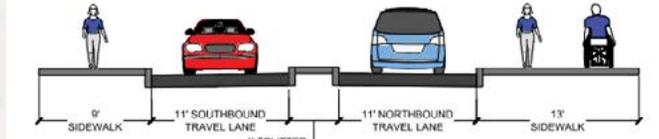
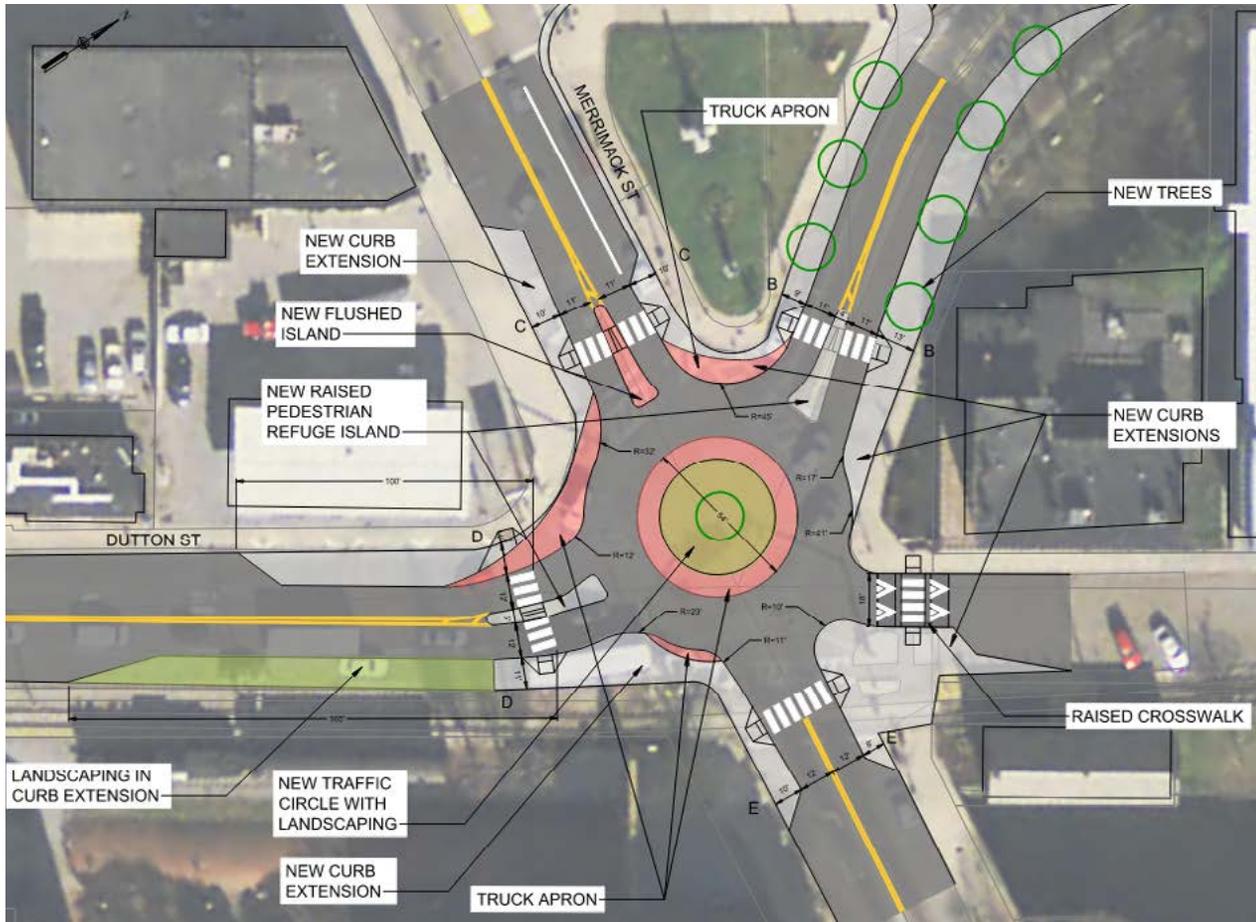
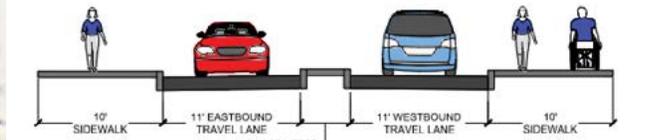


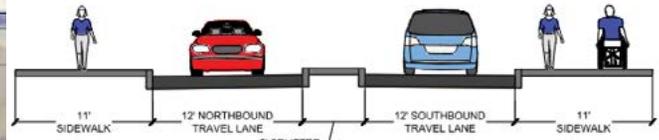
Figure 15: Intersection Concept Plan for Dutton Street at Merrimack Street - Alternative A



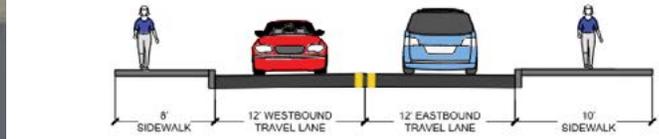
SECTION B-B



SECTION C-C



SECTION D-D



SECTION E-E

Figure 16: Bus Stop Improvements Concept Plan for Dutton Street at Broadway Street

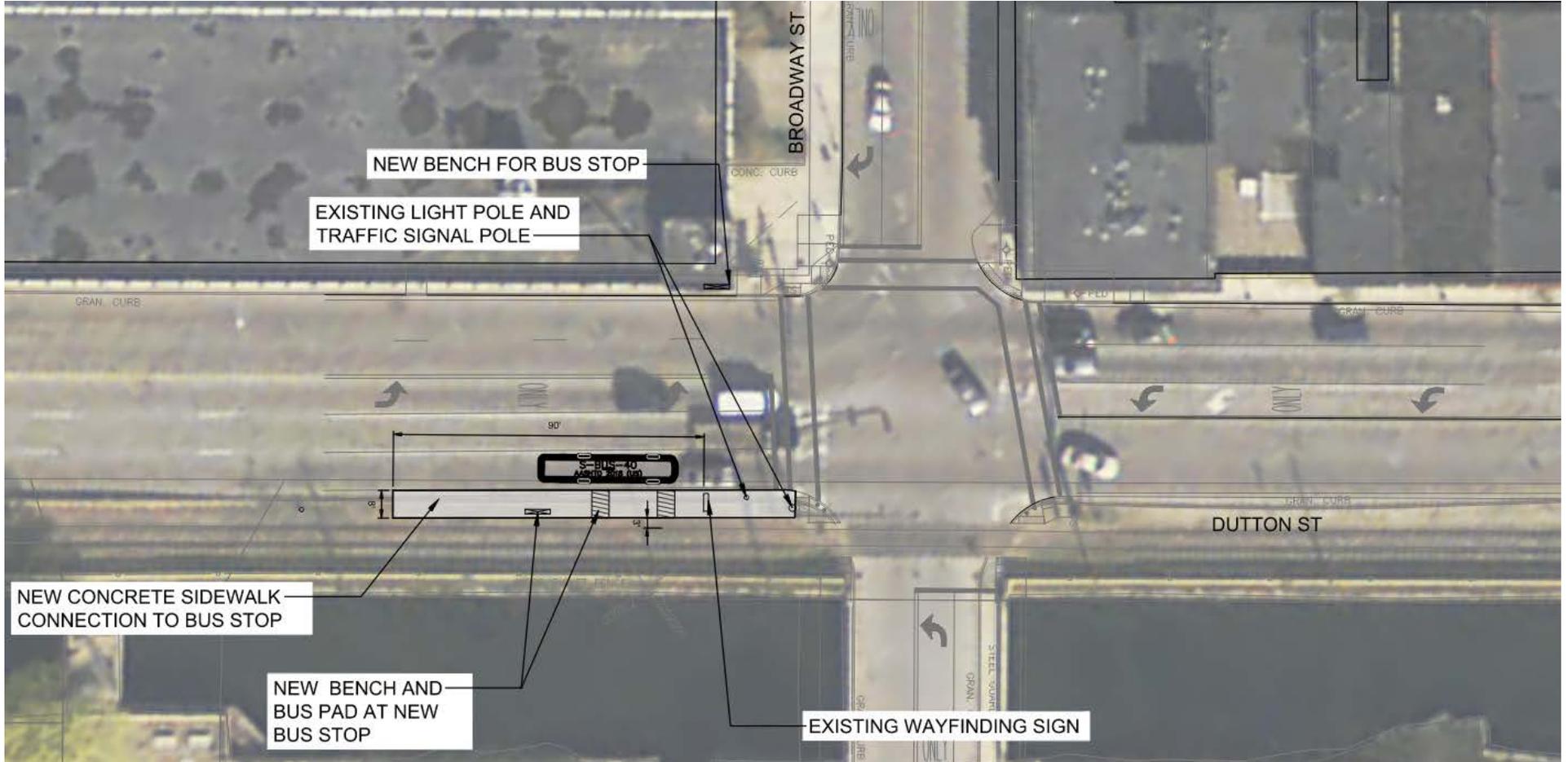
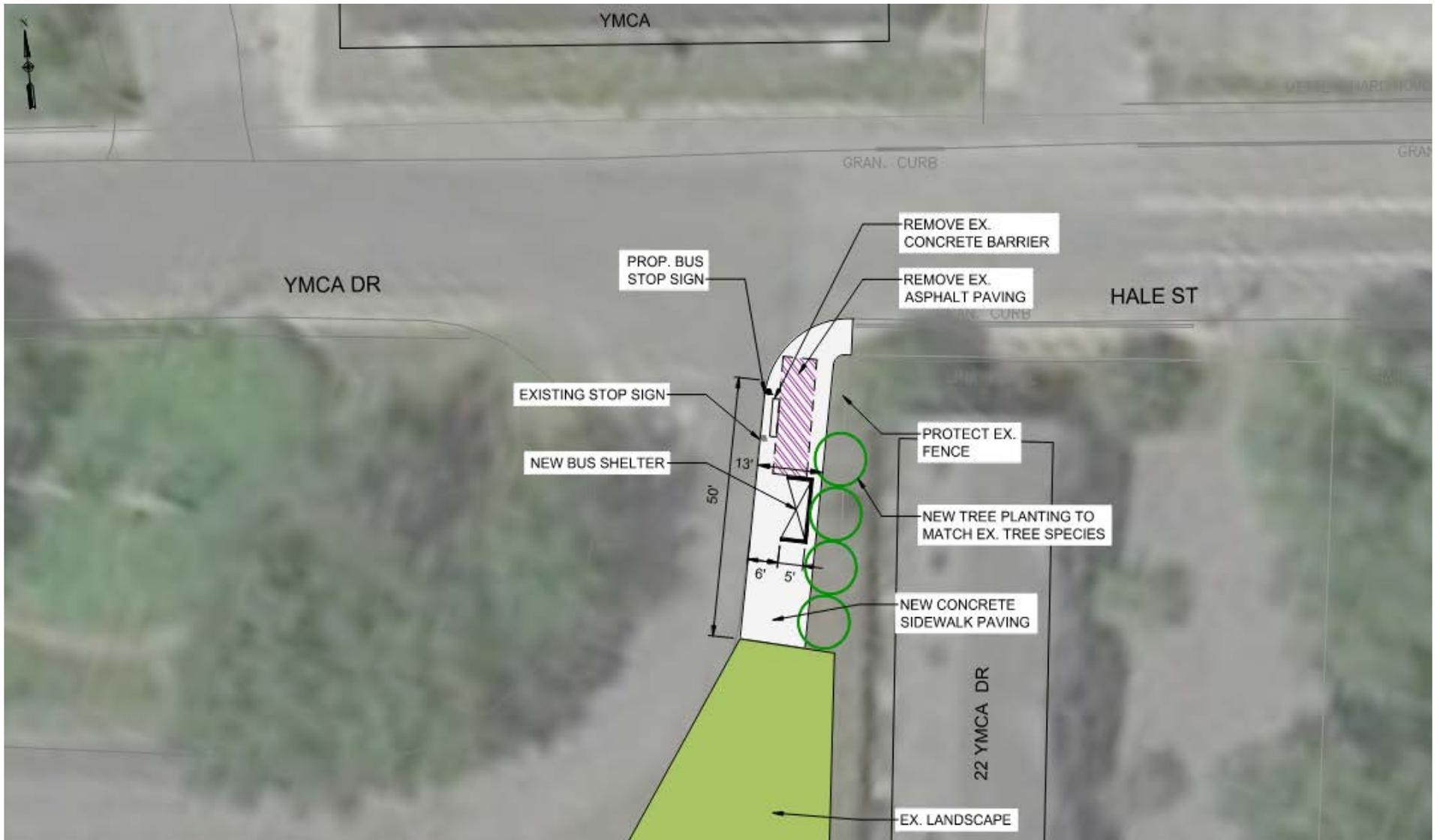


Figure 17: Bus Stop Improvements Concept Plan for Hale Street at YMCA Drive



CHAPTER 9

DESIGN TOOLKIT

Design Toolkit

As described in Chapter 8 of this Plan, priority projects include specific design concepts for certain locations. For other street projects, including private developments and those not initiated by the City, designers should prioritize the safety and comfort of the most vulnerable road users, often people walking and people riding bikes.

Safety treatments designed to support Lowell's goal of improving the safety and experience of people walking, biking and taking public transit are outlined below and respond to Lowell's priority projects. Although the following design guidelines are broken into designs for people walking and designs for people biking, both of these groups should be considered holistically in every project. The following chapter describe a selected sampling of design guidelines. During project Development a more complete set of design guidelines should be referenced using the following resources:

- FHWA's Safe Transportation for Every Pedestrian (STEP) program (safety.fhwa.dot.gov/ped_bike/step/)
- FHWA Bikeway Selection Guide
- MassDOT Separated Bike Lane Planning & Design Guide
- NACTO Urban Street Design Guide
- AASHTO Policy on Geometric Design of Highways and Streets

The guide is organized beginning with the types of facilities that provide the most separation from vehicle travel and ending with the types of designs that provide the least separation from motor vehicle traffic. Each topic is divided into 4 sections, as defined below. When considering bike facilities on any street, first refer to the Facility Selection section to within this chapter to look at how roadway network context factors into the type of facility before selecting treatment options.

- **Introduction:** Short description of how the facility functions, its advantages, and why it forms an important part of a bike network.
- **Application:** Guidance on conditions where the facility should be applied and factors to consider when choosing corridors or locations for application.
- **Considerations:** General considerations for design of the facility drawn from national standards; may include considerations related to width, signage, materials, recommended amenities, potential conflicts, related topics for cross-referencing, and other areas of guidance.
- **Additional resource:** List of relevant sources for additional design guidance

Designing for People Walking

This section provides guidance on various safety treatments that improves the safety of people walking bike. A large number of streets in Lowell have sidewalk facilities. The city also has canal paths that are a unique and historic. Connecting the sidewalk/canal paths and making crosswalks safer is a big priority for GoLowell. The guidance below outlines various treatment methods aimed at improving the safety of people walking in Lowell.

Marked Crosswalks

Painted, or marked, crosswalks indicate the optimal locations for pedestrians to cross the street and designate right-of-way for motorists. In conjunction with a well placed crosswalk location, the following treatments should be considered to help reinforce the required driver yielding to the right-of-way of pedestrians at crossing locations.

High-visibility Crosswalk Markings – High visibility crosswalk markings are preferred to parallel (standard) markings because drivers can see them more easily.



High visibility crosswalks (L) are preferred to parallel markings (R)

Parking restriction on crosswalk approach – Signs, pavement markings, curb extensions, or vertical delineators that restrict on-street parking near a crosswalk to ensure that pedestrians and drivers can see one another. Parking should be restricted to a minimum

of 20 feet in advance of the crosswalk where speeds are 25 mph or less, and 30 feet where speeds are between 26 and 35 mph.

Curb Extension - This treatment, also referred to as bulb-outs, extends the sidewalk or curb line out into the parking lane, which reduces the effective street width and physically restricts parking approaching a crosswalk. This treatment should be considered at controlled or uncontrolled crosswalks where parking is present and should be prioritized in locations where parked vehicles often encroach on crosswalk setbacks.



Curb extension reduces the effective street width and restricts parking encroaching on a crosswalk

Improved Nighttime Lighting - Well-placed lighting improves visibility for all road users. Pedestrian-scale lighting can effectively illuminate sidewalks and crossings and are typically at a lower height than roadway-scale lighting, which helps to concentrate the light on the sidewalk and pedestrian areas. Uniform, consistent lighting should be provided on crosswalk approaches. If a crossing has a refuge island, additional lighting may be provided

Application

- Marked crosswalks can be considered at a controlled intersection, uncontrolled intersection, or midblock.
- Crosswalks should be placed at locations that are both convenient for people walking and safe with adequate visibility

Considerations

- Uncontrolled pedestrian crossing locations correspond to higher crash rates. By focusing on uncontrolled locations, the FHWA STEP Guide helps cities implement crosswalk designs that are based on a location's specific need.
- Lighting should be installed on both sides of wide streets.
- Light levels should be uniform throughout the pedestrian areas and meet applicable standards.
- Lights should be placed in advance of midblock and intersection crossings, for both approaches, in order to effectively illuminate the front of the pedestrian so as not to create a silhouette effect.
- On multi-lane roadway crossings where vehicle AADTs are in excess of 10,000, a marked crosswalk alone is typically not sufficient. In these locations, more substantial crossing such as a crossing island or a RRFB are needed.

Additional Resources

- FHWA's Safe Transportation for Every Pedestrian (STEP) program (safety.fhwa.dot.gov/ped_bike/step/)

Leading Pedestrian Interval (LPI)

Leading pedestrian intervals (LPIs) are adjustments to traffic signal timing to give the pedestrian signal a three to seven second head start before motorists enter the intersection. LPIs should be installed with high-visibility crosswalk markings, curb ramps, accessible pedestrian signals, and No Right Turn on Red restrictions. Additional resources and decision making tools for the following design elements can be found in the FHWA Step Guide (safety.fhwa.dot.gov/ped_bike/step) and the FHWA Pedestrian Safety Guide and Countermeasure Selection System (<http://www.pedbikesafe.org/PEDSAFE/>)

Application

LPIs are a treatment option at all signalized intersections that have crosswalks. They should be prioritized at



intersections with a significant number of turning vehicles and pedestrian volumes.

Considerations

- LPIs can be provided actively or provided only when actuated. Active detection requires an accessible pushbutton.
- The length of LPIs can be increased where pedestrian or bicyclist volumes are high.
- Right turn on red rules may limit the effectiveness of LPIs.
- LPI may be accompanied with an audible noise for visually-impaired pedestrians.

Crossing Island

Median crossing islands have a cut out area for pedestrian and bicyclist refuge and are used as a supplement to a crosswalk. Also known as pedestrian refuge islands.

- Crossing islands should be a minimum of 6 feet wide. Crossing islands that are planned to accommodate people on bicycles should be a minimum of 8 feet wide to allow room for bicycles towing a trailer. The refuge is ideally 40 feet long.
- Ramps or island cut-throughs are required for accessibility. They should be the full width of the crosswalk, 5 feet minimum.

- All medians at intersections should have a “nose” which extends past the crosswalk. The nose protects people waiting on the median and slows turning drivers.
- At mid-block locations, install with applicable warning signs (MUTCD W11-2, W11-16-7P, R1-6a).
- On multi-lane approaches, place Stop Here for Pedestrians or Yield Here to Pedestrians signs (MUTCD R1-5 series).
- Mark with a high-visibility crosswalk.



Application

- Crossings at the midblock or at intersections.
- Most beneficial at uncontrolled crossings, multi-lane roads, wide signalized crossings, or complex intersections.
- On roads with operating speeds of 30 mph or more and roads with 2 or more lanes of through traffic.
- Roads with insufficient gaps in traffic.
- Roads with high pedestrian crossing volumes.

Considerations

- Pedestrians may get caught on the crossing island if motorists do not yield or signal timing is too short.
- Crossing islands at intersections may restrict left turning.

- Curb extensions can be built along with crossing islands to restrict on-street parking, improve visibility, and reduce crossing distance.
- Temporary crossing islands can be constructed with temporary curbing or flex posts.

Raised Crosswalk

Crosswalks elevated at least three inches above the roadway, up to the sidewalk level, are called raised crosswalks. Raised crosswalks extend all the way to the sidewalk eliminating the need for a sloped curb ramp, though truncated domes are still necessary.

- Place ramps on each vehicle approach.
- Raised crossings are often demarcated with different paving materials and additional paint markings.
- Mark the crossing with high-visibility crosswalk markings.
- Install with applicable warning sign (MUTCD W11-2, W11-16-7P, R1-6a).
- Raised crossings do not require curb ramps, though truncated domes should be included at each crossing entrance.

Application

- Raised crossings are a treatment option often used at the midblock. However, intersections can also have raised crosswalks or the entire intersection can be raised.
- Roadways below 35 mph.



- Common on school campuses, shopping centers, and pick up/drop off zones.
- Intersections parallel to a busy street.

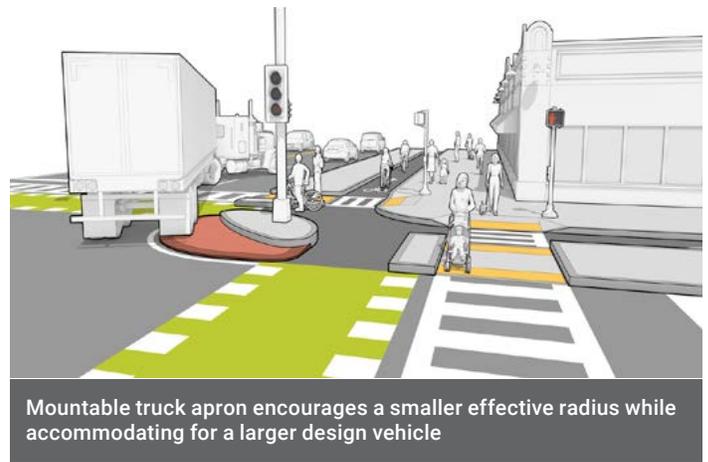
Considerations

- Raised crossings at sidewalk level are preferred for pedestrian accessibility and comfort, and safety.
- Raised crossings should not be used on sharp curves or roadways with steep grades.
- May be used for bicyclists along crossings for shared use paths.
- Consider drainage needs.
- Further consideration is needed for roadways heavily used by trucks, buses, and emergency vehicles.

Corner Radius Reduction

Reducing the turning radius at intersections will reduce motor vehicle turning speeds, reduce pedestrian crossing distances, increase pedestrian visibility and expand waiting areas for pedestrians crossing. Motorists will generally reduce their speed to navigate a sharper turn. Change the curb line at intersections using temporary materials such as paint and bollards.

- Implementation should tailor the design to the largest design vehicle size that frequently uses the intersection. This effective turning radius should determine actual curb radius.
- Install with curb ramps and high-visibility crosswalk markings. Corner radius reduction allows for better placement of curb ramps and crosswalks.
- Lowell should adopt a standard recommended corner radius and design vehicle.
- Mountable truck aprons can be implemented to encourage a smaller effective radius for passenger cars or small trucks, while accommodating for a larger design vehicle.



Application

Reducing the corner radius is applicable to all street types and can be applied to intersections in all contexts depending on vehicle design needs.

Considerations

- The corner radius should make intersections as compact as possible while accommodating large vehicles that frequent the intersection.
- Corner radii that are too small may result in large motor vehicles to drive over the curb and onto sidewalks and bikeways.
- In some instances, large vehicles may encroach on the opposing travel lane when turning. See MassDOT Project Development & Design Guide for specific guidance on allowable encroachment.
- A reduced crossing distance may allow for shorter traffic signal cycle lengths, increasing compliance.

Designing for People Riding Bikes

This section provides guidance for the different types of bike facilities used to accommodate bicycle travel throughout Lowell. One goal of GoLowell is to increase the number of people riding bicycles by providing a connected bicycle network welcoming and comfortable for people of all ages, abilities, and identities, and those who prefer to use biking as a means of transportation. From research in Lowell as well as nationally, most people do not feel comfortable riding bikes while sharing lanes with busy or fast motor vehicle traffic. Priority projects were assessed for the feasibility of installing a bikeway type that would appeal to people of all ages and abilities and future projects will need to go through a similar process using the guidance below.

Facility Selection

The quality of the bikeway selected will impact the level of comfort and by extension the amount of people in the community that will benefit from it. Bikeway selection is a context-sensitive decision that involves a planning and engineering based analytical process. This process accounts for the broader network and roadway context

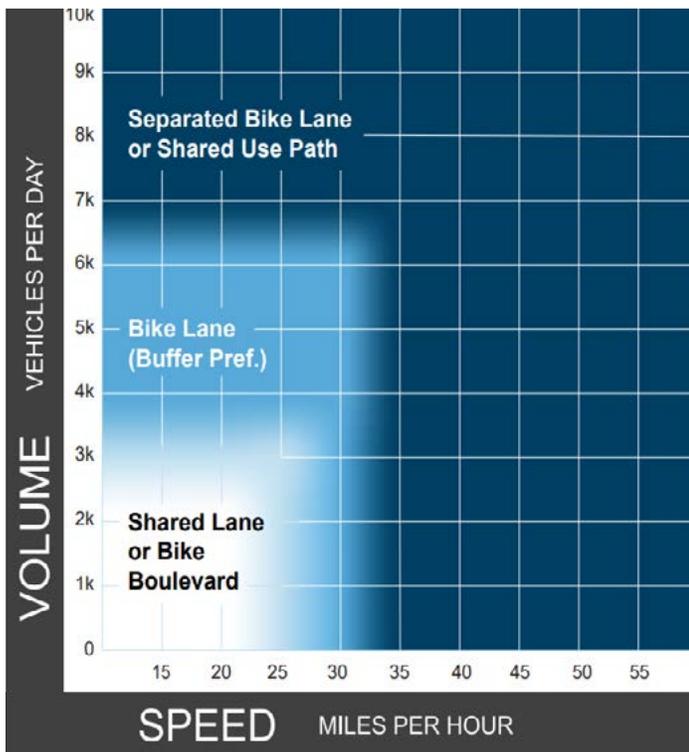


Figure 18: Bikeway facility selection for urban, urban core, suburban and rural contexts

and then drills down on a specific corridor. It starts with the identification of a desired facility and then gets refined based on real-world conditions such as available right-of-way and budget.

Figure 18 provides guidance for how motor vehicle volume and speed can be taken into consideration to identify a preferred bikeway type. The higher the speed and volume of a road, the more protective the recommended bikeway. Shared lanes or neighborways are recommended for the lowest speeds and volumes; bike lanes for low speeds and low to moderate volumes; and separated bike lanes or shared use paths for moderate to high speeds and high volumes.

Multi-Use Path

Multi-use paths (MUPs) are separated off-street facilities providing two-way travel for walking, bicycling, jogging, skating, and other nonmotorized users. They can serve both as corridors to provide connections between origins and destinations, and as destinations.

- The recommended paved width for a trail is 10 feet, with a minimum of 8' in constrained conditions. Anticipated future traffic volumes should be used to guide design decisions. The minimum width to enable side-by-side travel and passing is 11 feet. <https://www.mass.gov/lists/separated-bike-lane-planning-design-guide>
- Separation modes in areas with existing or anticipated higher levels of activity by delineating a 10 foot (min) bikeway and a 5 foot (min) walkway.
- Maximum grade should not exceed 5 percent. Grades less than 0.5 percent should be avoided to facilitate drainage.
- Ideally, provide a graded shoulder area of 3 - 5 feet separating the street from the trail.
- Lighting should be provided at path/roadway intersections at a minimum and at other locations where personal security may be an issue or where nighttime use is likely to be high.
- Ensure sight distances are designed per the AASHTO Bike Guide.

Application

In addition to using this guidance for trails that are not attached to Lowell's street network, such as those along canals and rivers, multi-use trails are an appropriate bike facility on street with the following conditions:

- 3 or more total travel lanes
- 30mph speed limit or greater
- 6,000 daily vehicles (ADT) or greater
- Frequent parking turnover
- Frequent loading, pick-up/drop-off
- Designated truck or bus route



Lowell has a large network of canal trails



MUPs provide two-way travel for walking, bicycling, jogging, and other nonmotorized uses

Considerations

- Consider enhanced crossing treatments at trail crossings.
- Trails expected to serve a high percentage of pedestrians (30 percent or more) or be used by large maintenance vehicles should be wider than 10 feet.
- Trails on steep grades (over 3 to 5 percent) should be wider to account for higher bicycle speed in the downhill direction and additional space for faster bicyclists to pass slower bicyclists and pedestrians in the uphill direction.
- On sections with long steep grades, provide periodic sections with a flat grade to permit users to stop and rest.
- Lighting should be pedestrian-scale.

Additional Resources

- AASHTO Guide for the Development of Bike Facilities, 2012
- United States Access Board. Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way; Shared Use Paths. Washington, DC, February, 2013. <https://www.access-board.gov/guidelines-and-standards/streets-sidewalks/shared-use-paths/supplemental-notice>

Sidepath

Sidepaths are multi-use paths located parallel to and within the road right-of-way, providing two-way travel for walking, bicycling, jogging and skating. Sidepaths often replace and extend the space typically inhabited by a sidewalks.

- The minimum width for a sidepath is 10 feet and should be outside of all intrusions, including temporary intrusions such as car and building door opening.
- The preferred width, which enables side-by-side travel and passing, is 11 feet.
- Separation of modes in areas with existing or anticipated higher levels of activity can be accomplished by delineating a 10 foot (min) bikeway and a 5 foot (min) walkway.
- Ideally, separate the sidepath with a 5-foot minimum buffer from traffic.

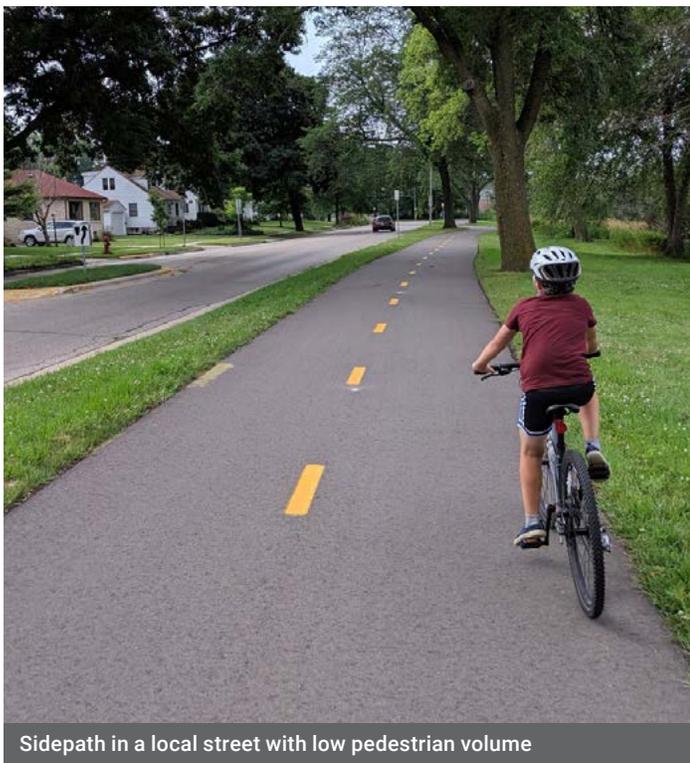
Application

Side paths may be preferable in locations where pedestrian volumes are likely to be low and the right-of-way width is insufficient for a separated bike lane. Additionally, sidepaths may be installed for short distances where the right-of-way narrows or in transitions between different types of bike facilities. Consider on all roads with the following characteristics:

- 3 or more total travel lanes
- 30mph speed limit or greater
- 6,000 daily vehicles (ADT) or greater
- Frequent parking turnover
- Frequent loading, pick-up/drop-off
- Designated truck or bus route
- Infrequent intersections
- Designated truck or bus route

Considerations

- Some separation types, such as full height curb, will require more in-depth drainage design.



Sidepath in a local street with low pedestrian volume

Additional Resources

- MassDOT. Separated Bike Lane Planning and Design Guide. 2015.
- AASHTO. Guide for the Development of Bicycle Facilities. 2012.

Separated Bike Lane

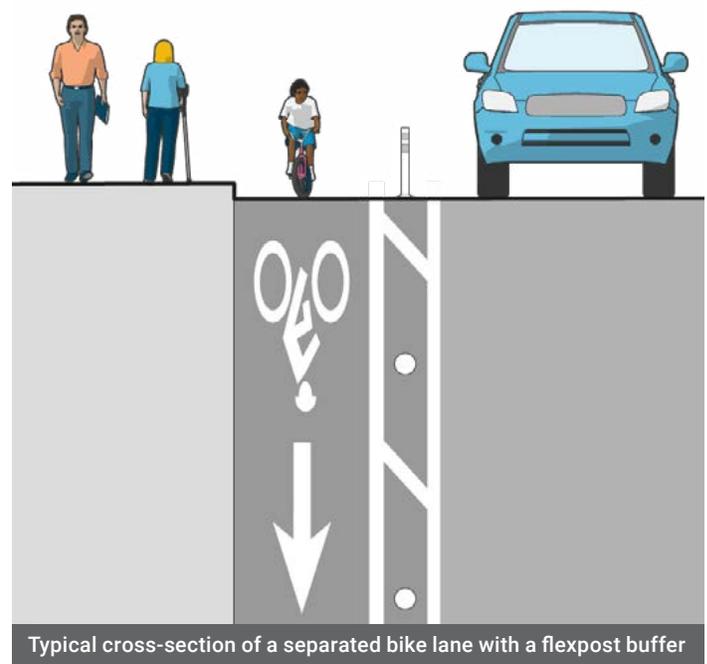
For most people to feel comfortable riding a bike, they must be physically separated from motor vehicle traffic. Separated bike lanes, also called “protected bike lanes” and “cycle tracks”, provide physical separation from motor vehicles while also being part of a street. They include two fundamental elements:

1. Dedicated space for bicycling separated from motor vehicles with a physical barrier. Barriers are typically a vertical element, such as a bollard, curb, or flexpost, or a change in elevation.
2. Separation from pedestrians with a vertical element, such as a change in elevation, or a change of surface material.

Application

Consider on all roads with the following characteristics:

- 3 or more total travel lanes
- 30mph speed limit or greater



Typical cross-section of a separated bike lane with a flexpost buffer

- 6,000 daily vehicles (ADT) or greater
- Frequent parking turnover
- Frequent loading, pick-up/drop-off
- Designated truck or bus route

Considerations

One-way vs Two-way

In most instances on two-way streets, one-way separated bike lanes on each side of the street is preferred over a two-way separated bike lane or sidepath. One-way bike lanes in the direction of motor vehicle travel are typically the easiest option to integrate into the existing roadway and signals. This option also provides intuitive and direct connections with the surrounding street network.

In some situations, one-way protected bike lanes are not practical due to right-of-way constraints or other reasons. Two-way separated bike lanes do present some design challenges and should not be considered on streets with the following characteristics:

- Two-way cycle tracks or bike lanes may require special considerations at driveways and side street crossings.
- Special signage and design considerations must be considered where a 2-way facility connects to a one-way facility to minimize directional conflicts.

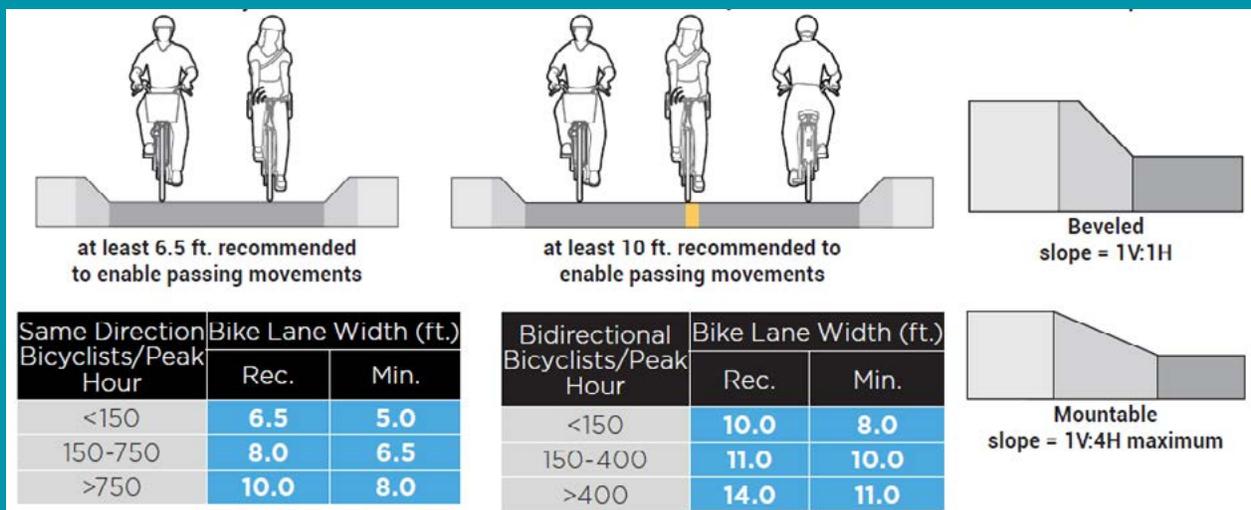


On-street two-way separated bike lane

Width

A separated bike lane is made up of the bike lane (1), the street buffer (2) and the sidewalk buffer (3).

- The bike lane width should correspond with anticipated bicycle volumes as illustrated in table X. A wider bike lane allows bicyclists to pass.
- The street buffer provides safety and comfort for people bicycling and driving by physically separating them from motor vehicles with a series of vertical objects or a raised median.
- The street buffer eliminates the risk of a bicyclist being hit by an opening car door.
- The width of the street buffer influences intersection operations and bicyclist safety.
- A sidewalk buffer minimizes encroachment between the bike lane and sidewalk zones.

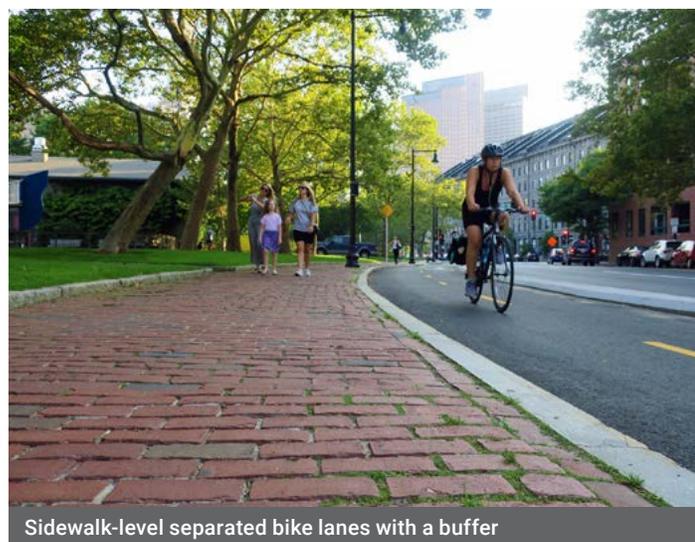


One-way and two-way bike lane width and curb options

Sidewalk Level

Separated bike lanes may be installed at the same level as a sidewalk. Raising the bike lane to sidewalk level can minimize the overall width since it reduces the shy space needed surrounding a curb or vertical separation. This design is typically used in the following situations:

- At pinch points, when the right-of-way narrows temporarily;
- To reduce conflicts with transit and other curbside activities.
- At a location where motor vehicles frequently drive, stop, or wait in the bikeway.
- The design of sidewalk-level separated bike lanes should include a sidewalk buffer that provides some type of delineation between the bike lane and the adjacent sidewalk. This can be achieved by providing vertical elements (such as street trees, lights, benches, etc.), A low landscaped buffer, or other surfaces detectable by cane and 6 underfoot between the sidewalk and bike lane. Visual contrast between the bike lane and sidewalk surface is beneficial. There are many considerations regarding pedestrians who are blind or have low vision when designing sidewalk-level separated bike lanes.



Sidewalk-level separated bike lanes with a buffer

Separation

- Flexible delineator posts (“flex posts”) offer the least separation and are appropriate as an interim solution.
- Raised buffers provide the greatest level of separation from traffic, but will often require road reconstruction.



Flexposts and raised buffer treatment for separated bike lanes

- On-street parking offers a high-degree of separation, but may require raised buffer treatments at intersections.

Additional Resources

- MassDOT Municipal Resource Guide for Bikeability, May 2019
- MassDOT. Separated Bike Lane Planning and Design Guide. 2015.
- NACTO. Urban Bikeway Design Guide, 2nd Edition.

Bike Lane

A conventional bike lane is a portion of a street designated for the exclusive use of bicycles and distinguished from traffic lanes by striping, signing and pavement markings. Where a separated bike lane or sidepath is infeasible or undesirable, a bike lane provides greater safety benefits to cyclists than a shared lane. Bike lanes should be 6 feet wide with a minimum width of 4 feet in constrained conditions.

Application

Conventional bike lanes will generally be considered on any road with one or more of the following characteristics:

- 3 lanes or fewer
- 30 mph speed limit or slower
- 9,000 daily vehicles (ADT) or fewer



Bike lanes with a painted buffer

- Infrequent parking turnover
- Bike lane obstruction likely to be infrequent

Considerations

- Bike lanes can be improved with the addition of a painted buffer between the bike lane and vehicle traffic.
- On physically constrained streets that climb a hill, it is often preferable to install a single, wider bike lane in the uphill direction with shared lane markings in the downhill direction. This is called a climbing lane.
- Contra-flow bike lanes may be used to allow two-way bicycle travel on one-way streets for motorists, improving bicycle network connectivity.
- Stopping, standing and parking in bike lanes may be problematic in areas of high parking demand and deliveries, especially in commercial areas.
- When installed directly adjacent to on-street parking, a wider bike lane is necessary to allow bicyclists to maneuver around car doors opening unexpectedly.
- Wider bike lanes or buffered bike lanes are preferred at locations with high parking turnover.

Additional Resources

- MassDOT Municipal Resource Guide for Bikeability, May 2019
- AASHTO Guide for the Development of Bicycle Facilities, 2012



Contra-flow bike lane adjacent to a one-way street

Neighborway

Neighborways (also called Bicycle Boulevards and Neighborhood Greenways) can be installed on low traffic, low speed streets that provide direct bike connections, usually through more residential areas. On these streets, people biking and walking are the prioritized modes and the street is designed to feel safe for all. This is achieved using signs, pavement markings, gateway features, and speed and volume management measures to discourage through trips by motor vehicles and create safe, comfortable crossings of busy arterial streets.

Application

- Neighborhood greenways use existing low-stress streets that often parallel a major corridor.
- Streets with speeds less than or equal to 25 mph and volumes less than 3,000 ADT.

Guidance

The following treatments should be used continuously along the Neighborway. If speeding is present, ensure that speed reduction treatments are installed frequently (about every 300') to encourage a uniform speed of 25mph or less.

Gateway Treatments

Create an entrance to the Neighborway that alerts drivers to the slower design speeds using geometric features as well as signage.

Traffic Calming

These treatments lower the speed differential between bicyclists and cars, increasing bicyclist comfort. They are typically used where traffic controls are less frequent, for instance, along a segment where stop signs may have been removed to ease bicyclist travel.

- **Speed Cushion** - Where traffic calming must not slow an emergency vehicle, speed cushions or raised crosswalks should be considered. Speed cushions provide gaps spaced for an emergency vehicle's wheelbase to pass through without slowing. These gaps also provide a space for bicyclists to pass through unabated.
- **Speed Hump** - Speed humps and raised crosswalks affect bicyclist comfort. The approach profile should preferably be flat-topped, but sinusoidal and circular profiles are acceptable.
- **Raised Crosswalk** - Consider using raised crosswalks at intersections to slow traffic turning onto the neighborhood greenway from a major street.
- **Chicane** - Chicanes slow vehicle speeds by creating a horizontal deflection in the travel lane, a curve. This is often achieved by alternating parking from one side of the street to the other.
- **Traffic Circle** - Neighborhood traffic circles should be considered at local street intersections to prioritize the through movement of bicyclists (by removing stop control or converting to yield control) without increasing motorist speeds.
- **Curb Extension** - Curb extensions shorten the crossing distance for pedestrians and physically narrow the vehicle travel lanes by extending the sidewalk into a parking lane.



Speed cushion slow speeds while allowing emergency vehicles and bicyclists to pass through



People riding bikes through a neighborhood traffic circle

Traffic Diversion

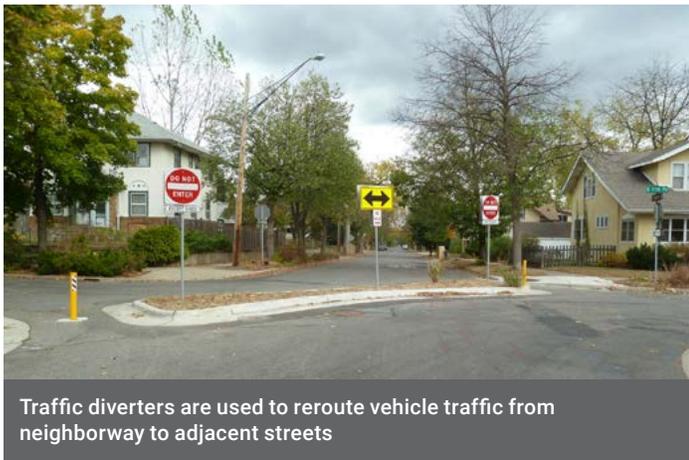
Traffic diversion strategies are used to reroute vehicle traffic from a neighborway onto other adjacent streets by installing design treatments that restrict motorized traffic from passing through. Diversion is most applicable in areas with a grid of streets to disperse traffic and may not be appropriate in some areas.

- **Diversion** shifts trips from the neighborhood greenway onto adjacent streets. This change in traffic volume on other local streets should be identified and addressed during the planning, design and evaluation process.
- Where motor vehicle volumes are already within the desired range, diversion may be considered to maintain desired volumes.
- Temporary materials may be used to test diversion impacts before permanent, curbed diverters are installed.
- Consultation with emergency services will be necessary to understand their routing needs.

- Diversion treatments must be designed to provide a minimum clear width of 6 feet for a bicyclist to pass through.
- Some treatments may require a separate pedestrian accommodation.

Major Crossings Treatments

While the street segments of a neighborway may be generally comfortable for bicyclists without significant improvement, locations where the route crosses a major street must provide the same level of comfort for someone biking as the route itself. Crossing treatments should provide waiting space for bicyclists, ensure visibility for all parties, control cross traffic and ease bicyclist use for travel along the neighborhood greenway route.



Traffic diverters are used to reroute vehicle traffic from neighborway to adjacent streets

- Offset Intersection - Neighborways follow local streets that are often discontinuous and broken up by intersections at major streets. Offset intersections are junctions where two connecting Neighborways align asymmetrically with an intersecting roadway.
- Bicycle Refuge Island - a refuge island allows bicyclists to cross one direction of traffic at a time when gaps in traffic allow. Refuge islands should be wide enough to accommodate more than one bicyclist or longer bikes such as cargo or trail-a-bikes.
- Marked crosswalk - standard crosswalks can be used to highlight to cross traffic that bicyclists are crossing the roadway in that location. Standard crosswalks can also be enhanced through the use of bicycle crosswalks.

- Left turning box - pavement markings can be used to encourage people on bikes to use a two-stage turn. A two-stage turn box placed in an on-street parking lane allows bicyclists to better position themselves to observe the whole street and to wait for a crossing opportunity in a protected location.

Considerations

- Traffic calming elements must be designed to deflect motor vehicle traffic without forcing the bicycle path of travel to be directed into a merging motorist.
- Costs for infrastructure will range depending on complexity and permanence of design. Simple, interim treatments, such as striping and flexposts are low-cost. Curbed, permanent treatments that integrate plantings or green infrastructure are higher cost.



Offset neighborway intersection with shared lane markings to route people riding bikes



Left-turning box provided adjacent to crossing

Additional Resources

- MassDOT Municipal Resource Guide for Bikeability, May 2019
- NACTO. Urban Bikeway Design Guide. 2nd Edition.

Shared lane markings

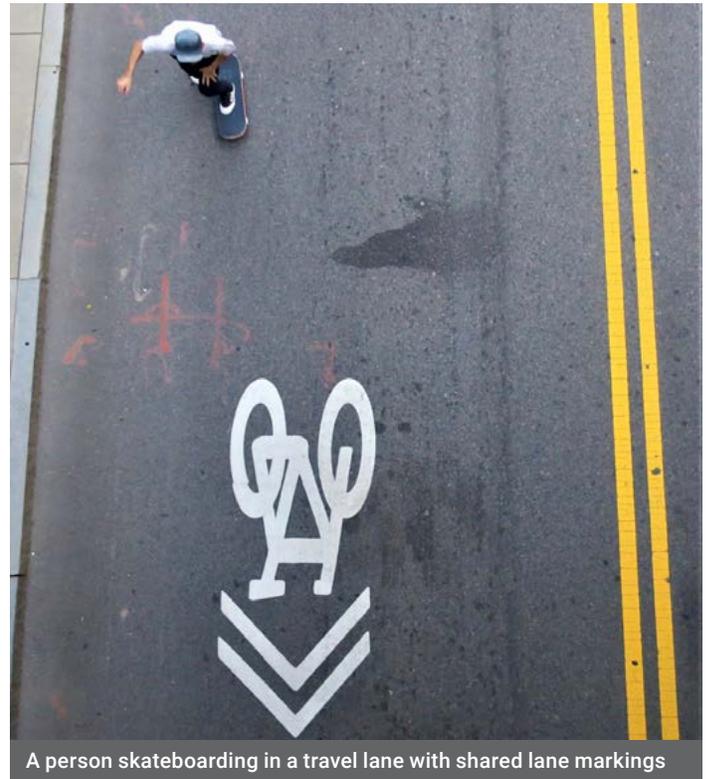
Shared lane markings (or “sharrows”) are pavement markings used to indicate a shared lane environment for bicyclists and motorists. They reinforce the legitimacy of bicycle traffic on the street, recommend proper bicyclist positioning, and may be configured to offer directional and wayfinding guidance. The shared lane marking has a variety of uses to support a bicycle network but should not be considered a substitute for bike lanes or other separation treatments where space permits.

Application

- On local or collector streets with low target vehicle speeds and traffic volumes, where there is no opportunity to install dedicated bicycle facilities
- On neighborways, to reinforce the priority for bicyclists
- As temporary interim treatments to fill gaps between bike lanes or other dedicated facilities
- To designate movements and positioning of bicyclists through intersections
- For downhill travel in conjunction with climbing lanes
- Not appropriate for streets with posted speeds greater than 30 mph or ADT higher than 3,000

Considerations

- The marking’s centerline must be at least 4 ft. from the curb or edge of pavement where parking is prohibited to direct bicyclists away from gutters, seams, and other obstacles.
- The marking’s centerline must be at least 11 ft. from curb where parking is permitted so that it is outside the door zone of parked vehicles.
- On streets with posted speeds of 25 mph or lower, the preferred shared lane marking placement is in the center of the travel lane to minimize wear from motor



A person skateboarding in a travel lane with shared lane markings

vehicles and encourage bicyclists to use the full travel lane.

- May be accompanied by “BIKES MAY USE FULL LANE” signs.

Additional Resources

- MassDOT Municipal Resource Guide for Bikeability, June 2019 (https://www.mass.gov/files/documents/2019/06/13/2019_Municipal_Resource_Guide_for_Bikeability.pdf)
- AASHTO Guide for the Development of Bicycle Facilities, 2012
- NACTO Urban Bikeway Design Guide
- MUTCD- Manual on Uniform Traffic Control Devices (<https://mutcd.fhwa.dot.gov/>)

Wayfinding and Signage

A bicycle wayfinding system consists of signing and/ or pavement markings to guide bicyclists to their destinations. Wayfinding can reduce any stress bicyclists may experience due to navigation and serve as an opportunity for economic development.



Wayfinding signage showing route direction and destination information at a neighborway

Application

- Bike routes
- Downtown areas, business districts, and other high-activity areas
- Important destinations for recreation and/or tourism

Considerations

- Effective wayfinding should feature information about route direction, destination, and travel distance.
- Signage should be consistent and located at predictable intervals and/or important route junctions.



Wayfinding signage provided adjacent to bike trail

Additional Resources

- AASHTO Guide for the Development of Bicycle Facilities
- NACTO Urban Bikeway Design Guide
- MUTCD

Bike Parking

Bike parking provides designated structures for people to securely lock their bicycles. Bike racks can be placed on sidewalks or in bike parking corrals, which can accommodate twelve bicycles in a single vehicle parking space. They allow people who bike to school, work, business districts, and to access other services and amenities to comfortably end their trips by leaving their bicycles near their final destinations. Bike parking accommodates bicycles of varying shapes and sizes and those with attachments like baskets.



A bike corral can accommodate twelve bicycles in a single parking space

Application

- Near important origins and destinations for biking trips, such as business districts, schools, libraries, government buildings, employment centers, service organizations, busy bus stops, transit stations, and parks
- On sidewalks between the walking path of travel and the curb where there is enough width to accommodate parked bicycles without encroaching on the clear sidewalk area.
- Within parking corrals, which can be placed in a single vehicle space in curbside parking lanes.

Considerations

- Bike parking on the sidewalk should not encroach on the clear pedestrian zone when a bicycle is parked. A minimum clear width of 4' should be maintained.
- To provide enough space to park a bicycle, sidewalk bike racks should be placed so a bicycle 6' in length will fit on the curb and not be damaged by cars in adjacent parking or travel lanes. Racks parallel to the curb should be set 24" back from the curb, and perpendicular racks should be set 48" back.
- Bicycle racks grouped together should be placed at least 36" apart and at least 4' from other streetscape elements.
- In-street parking corrals should be clearly delineated with vertical elements like parking stops or flexposts.
- Bike parking should be placed in visible, well-lit locations
- Consider requiring as part of zoning regulations, particularly in areas close to major transportation facilities



Covered bike parking at a busy bus stop

Additional Resources

- MassDOT Municipal Resource Guide for Bikeability, May 2019
- APBP Essentials of Bike Parking
- PROWAG

Bicycle and pedestrian bridge

A bicycle and pedestrian bridge carries a shared use path or other facility for non-motorized travel across a natural or artificial barrier, such as a body of water, highway, rail corridor, or natural topography.

Application

Over natural and artificial barriers as needed to maintain continuity and connectivity on a biking and walking route.



People walking and biking on a shared bicycle and pedestrian bridge

Considerations

- The minimum width of a bicycle and pedestrian bridge depends on the width of the approaching shared use paths. At least 2' of width should be provided on either side of the receiving facility to provide shy distance from the railing and offer the needed maneuvering space to avoid conflicts.
- Personal safety issues can be a concern on bridges spanning long distances. It may be necessary to install emergency call boxes, surveillance cameras, pedestrian scale lighting, or other measures to ensure user comfort.
- Connections for bicyclists and pedestrians between the bridge and roadway may require significant ramping in order to make the connection accessible.

Additional Resources

- AASHTO Guide for the Development of Bicycle Facilities

- NACTO Urban Bikeway Design Guide
- AASHTO Guide Specifications for Design of Pedestrian Bridges
- FHWA Shared Use Path Level of Service Calculator

Bike Crossings

Bike Crossings are pavement markings that indicate a path or crossing at intersections or across driveways. They direct people riding bicycles to the safest direct path through an intersection and provide a warning to people driving to look for through movements before making a turn.

Use white edge lines (which may be 6" to 24" in width) spaced 2' apart where not adjacent to a crosswalk. Apply green pavement markings along with edge lines to improve visibility and delineation of the crossing, especially when adjacent to a crosswalk. White edge lines may be used without green paint.

Application

- Where off-street shared use paths cross roadways
- Where bicycle/motor vehicle conflicts are frequent
- Intersections with a complex path of travel
- Across wide, high-volume streets
- Conflict locations such as driveways, intersections, turn lanes, etc.
- At bus stops where buses pull into or across a bike lane.



Bike crossing at a route with motorist and transit movement

Considerations

- Maintain the width of the bike crossing by aligning the outside lines of the crossing with the feeding and receiving legs of the bike lane or shared use path.
- Align bike crossing markings with crosswalk markings where directly adjacent.
- Include a dashed yellow centerline in two-way bike crossings.
- Use crossings with bike boxes, two-stage left turn boxes, and protected intersections.
- The marking material must be high friction surface to reduce skidding when pavement is wet.

Additional Resources

- MassDOT Municipal Resource Guide for Bikeability, May 2019
- MUTCD
- NACTO Urban Bikeway Design Guide
- AASHTO Guide for the Development of Bicycle Facilities

Protected Intersections

Protected intersections are a type of intersection design that improves safety by reducing the speed of turning traffic, improving sight lines, continuing separated bike lane configuration, and designating space for all road users. Protected intersections reduce conflict points between motorists and bicyclists.

Application

- Signalized and non-signalized intersections on corridors with separated, buffered, or conventional bike lanes
- Signalized and non-signalized intersections where it is desirable to mitigate conflicts between through bicyclists and turning vehicles, for example due to crash history or turning vehicle volume



A protected intersection providing designated space for all road users and reducing conflicts with motorists

Two-stage left turn

A two-stage bicycle turn box is a marked location in an intersection where bicyclists may pull right or left to wait to make a left or right turn across vehicular traffic. This treatment provides a low stress alternative at intersections where making turns would otherwise require bicyclists to merge across one or more vehicle lanes. It is also useful for roads with separated bike lanes where bicyclists are not able to exit the separated bike lane upstream from an intersection.

Two-stage bicycle turn boxes should be adjacent to the bike crossing and must be located outside of the turning or through vehicle paths. Depending upon the design of connecting bikeways, two-stage bicycle turn boxes may be on either side of the bike crossing.



A bicyclist waiting at a two-stage left turn box

Floating Bus Stop

Bike lanes and separated bike lanes can create a conflict between buses trying to access the curb or between transit users and a stopped bus. A floating bus stop is a short bikeway segment that routes bicycle traffic along the back side of a bus stop in order to eliminate this bus-bike conflicts. This treatment creates a dedicated passenger platform between the motor vehicle lane and the bike lane that provides space for bus passenger amenities such as shelters, seating, and trash receptacles. Floating bus stops must be accessible for people with disabilities with sufficient space for accessible pedestrian routes, a dedicated boarding and alighting area, and a rear door clear zone.

Application



Floating bus stops provide a dedicated passenger platform between motor travel lane and bike lane

- Any corridor with bus stops and a dedicated bikeway

RESOURCES & CITATIONS

National

- AASHTO *Guide for the Development of Bicycle Facilities*, 4th Edition, 2012.
- AASHTO *Guide Specifications for Design of Pedestrian Bridges*, 2009.
- AASHTO *Policy on Geometric Design of Highways and Streets*, 7th Edition, 2018.
- APBP *Essentials of Bike Parking*, 2015.
- FHWA [Bikeway Selection Guide](#)
- FHWA [MUTCD- Manual on Uniform Traffic Control Devices](#)
- FHWA [Pedestrian Safety Guide and Countermeasure Selection System](#)
- FHWA [Road Safety Audits](#)
- FHWA [Shared Use Path Level of Service Calculator](#)
- FHWA [STEP Guide](#)
- NACTO [Urban Bikeway Design Guide](#)
- NACTO [Urban Street Design Guide](#)
- Pedestrian and Bicycle Information Center. [Audit Tools](#)
- US Access Board. [Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way; Shared Use Paths](#). Washington, DC, February, 2013.
- US Access Board [PROWAG](#)
- US DOT [Rebuilding American Infrastructure with Sustainability and Equity \(RAISE\) grants](#)

State

- [MassDOT Complete Streets Program](#)
- MassDOT *Municipal Resource Guide for Bikeability*, May 2019.
- MassDOT. *Separated Bike Lane Planning and Design Guide*. 2015.
- [MassWorks Infrastructure Program Grants](#)
- [Safe Routes to School - Capital Investment Plan](#)
- [State Transportation Improvement Program](#)

City of Lowell

- [Citywide Parking Study](#)
- [LNHP General Management Plan](#)
- [Lowell Open Space Recreation Plan](#)
- [Sustainable Lowell 2025](#)
- [UMass Lowell Transportation Master Plan 2018 Update](#)