4

Alternatives Development and Screening

The analysis of existing and future transportation conditions and development of issues, opportunities and constraints in the study area identified areas of the transportation network that require improvements. A range of transportation improvements were identified through Working Group guidance and extensive public outreach throughout the study.

This chapter describes the alternatives that were identified as having the potential to address the transportation system issues and deficiencies and meet the goals and objectives of this study. This preliminary screening evaluation is the equivalent of a "fatal flaw" assessment that helped to discard recommendations that are either outside the scope of this study, do not address the goals or objectives, or deemed to be not realistic or feasible. Chapter 5 will present an evaluation of the screened alternatives from this chapter.

Alternatives Grouping and Methodology

From the outset of the study, ideas for transportation system improvements were solicited from the public, stakeholders, and the Working Group. These ideas were developed and vetted into a series of alternatives to be screened by the Study Team and the Working Group. The range of alternatives identified were organized into four categories:

- Bicycle Improvements
- Multimodal Improvements
- Transit Options
- Vehicle Options

The specific alternatives considered in each category are discussed in the following sections. The alternatives were screened against the established goals and objectives.

Alternatives Screening

Bicycle Improvements

A series of alternatives were developed to improve bicycle connectivity within the study area. The alternatives either address east-west bicycle mobility east of School Street or cross connectivity to adjacent pathways /facilities. As discussed in Chapter 3, bicycle accommodations west of School Street either already exist, are under construction, or are planned by Watertown. Therefore, the alternatives developed for this study focus on improving bicycle accommodations east of School Street.

Alternative 1 – Bike Lanes East of School Street

Alternative 1 would provide a five-foot bike lane in each direction of Arsenal Street east of School Street. To accomplish this, travel lanes would be narrowed to 11-feet to provide a variable-width (but less than five-foot) bike lane in each direction. The resulting curb-to-curb width would be 54-feet (exclusive of turn lanes).

Alternative 1 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 1 may reduce auto dependency, leading to a potential decrease in traffic congestion.
- **Safety Improvements:** Alternative 1 does not result in a targeted safety improvement but often provide a higher level of comfort for the less experienced biker.
- **Accessibility and Connectivity Benefits:** May reduce auto dependency, improve connectivity, and support active transportation initiatives.
- **Economic Development Impacts:** Smaller impact to private property than other east-west bicycle alternatives considered. The provision of formal bike lanes may encourage patronization of local businesses from adjacent residential neighborhoods.
- **Environmental Impacts:** Alternative 1 is not anticipated to have a significant benefit to or impact on the environment.

Recommendation: Retain Alternative 1 for further refinement and analysis. Analysis of this alternative will identify property impacts and develop typical cross-sections.

Current roadway changes proposed by athenahealth includes the provision of on-road bicycle lanes from School Street to Arsenal Court. Similar to this alternative, these bike lanes are of varying width, averaging 4.5 feet.

Alternative 2 - Off-road, Parallel Connections to Charles River

Alternative 2 would provide an east-west bicycle connection, north of Arsenal Street between the Watertown Greenway and the facilities along Greenough Boulevard. As shown in Figure 4-1[26], the western segment of the path could travel from the Watertown Greenway through Filippello Playground. The eastern segment of the path would utilize Grove Street and/or an undefined off-road alignment.

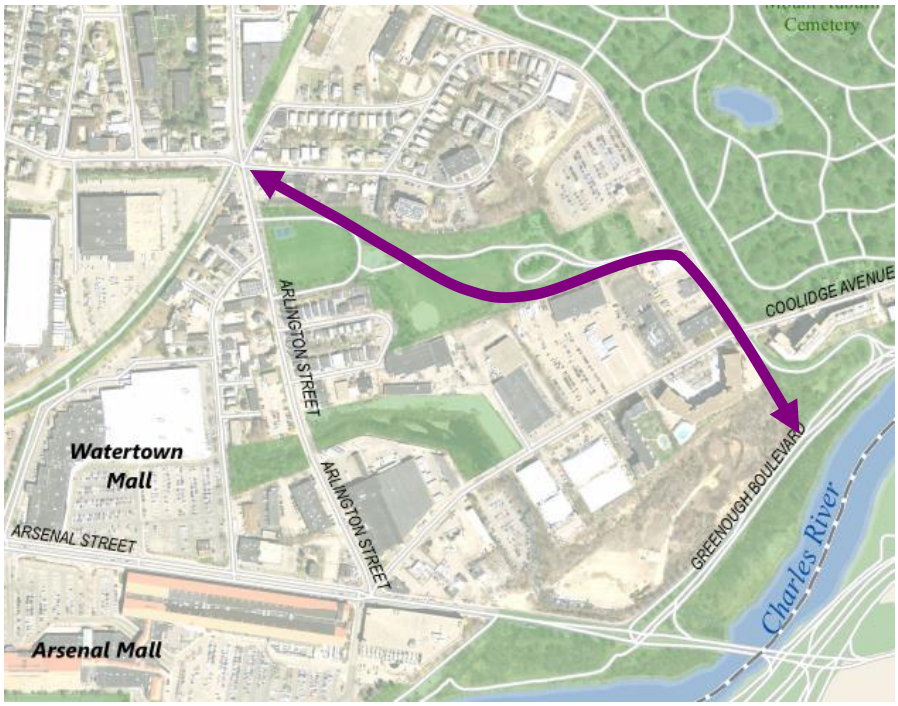


Figure 4-1 Alternative 2 - Off-road, Parallel Connections to Charles River

Alternative 2 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 2 may reduce auto dependency, leading to a potential decrease in traffic congestion.

[26] Unless noted, aerial map images in Chapters 4 and 5 are sourced from MassGIS.

- **Safety Improvements:** Alternative 2 does not result in a targeted safety improvement.
- **Accessibility and Connectivity Benefits:** May reduce auto dependency, improve connectivity, and support active transportation initiatives
- **Economic Development Impacts:** Better connection to the regional bicycle network allows for a potential increase in patrons accessing local businesses.
- **Environmental Impacts:** Alternative 2 is not anticipated to have a significant benefit to or impact on the environment.

Two constructability concerns were noted during the screening process. There is a significant grade differential for the segment of Alternative 2 from Coolidge Avenue to Greenough Boulevard. Additionally, the existing curb-to-curb width of Grove Street along this segment would preclude on-road accommodations without roadway widening.

Recommendation: Discard Alternative 2 from consideration due to constructability concerns. Advance an option that provides connections to the Charles River path system the south (Alternative 3). Alternative 2 could be pursued separately by the Town and/or DCR.

Alternative 3 - Cross Connectivity between the Greenway and Charles River

Alternative 3 would provide cross connections between the Watertown Greenway/ Arsenal Street and the Charles River to the south through both public and private property. As shown in Figure 4-2, a variety of connections could be considered, including:

- Irving Street
- Beechwood Avenue
- Wooley Avenue (presently being advanced by athenahealth)
- Talcott Avenue
- Arsenal Court (being advanced by Boylston Properties, anticipated to include shared-use path)
- Arlington Street extension

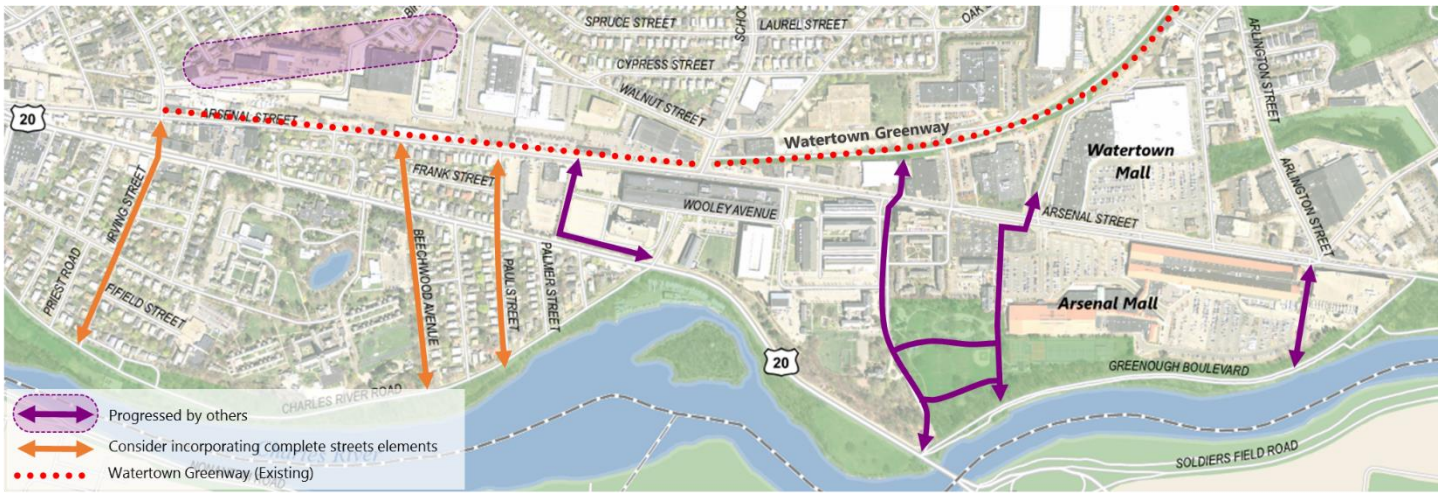


Figure 4-2 Alternative 3 - Cross Connectivity between the Greenway and Charles River

Alternative 3 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 3 may reduce auto dependency, leading to a potential decrease in traffic congestion.
- **Safety Improvements:** Alternative 3 does not result in a targeted safety improvement.
- **Accessibility and Connectivity Benefits:** May reduce auto dependency, improve connectivity, and support active transportation initiatives
- **Economic Development Impacts:** Better connection to the regional bicycle network allows for a potential increase in patrons accessing local businesses.
- **Environmental Impacts:** Alternative 3 could impact environmental resources at connections to the pathways along Charles River Road/Greenough Boulevard.

Recommendation: Retain Alternative 3 for further refinement and analysis. Analysis of this alternative will identify potential cross-connections and impacted property owners and develop typical cross-sections.

Both athenahealth and Boylston Properties are pursuing cross-connectivity opportunities as part of project development at the Arsenal on the Charles and Arsenal Mall.

Alternative 4 - Separated Bike Lanes East of School Street

Alternative 4 would provide a separated bike lane in each direction of Arsenal Street east of School Street. A separated bike lane is an exclusive space for bicyclists along or within a roadway that is physically separated from motor vehicles and pedestrians by

vertical and horizontal elements[27]. For the preliminary screening exercise, three alignments were reviewed for Alternative 4: widening to the north only, widening to the north and south (holding the existing centerline), and widening to the south only. All alignments considered a 69-foot cross-section which included two 11-foot travel lanes, a two-foot buffer, a five-foot bicycle lane, and a 5.5-foot sidewalk in each direction. Where turn lanes are provided, this cross-section would be wider.

Alternative 4 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 4 may reduce auto dependency, leading to a potential decrease in traffic congestion.
- **Safety Improvements:** Alternative 4 could improve safety for bicyclists along roadway segments between intersections, where they are no longer on the roadway. Alternative 4 may create safety concerns at intersections, where right-turning vehicles and bicycle conflicts are high and sight lines are diminished.
- **Accessibility and Connectivity Benefits:** May reduce auto dependency, improve connectivity, and support active transportation initiatives.
- **Economic Development Impacts:** Impacts to adjacent parcel frontage and/or buildings that negatively affect tax base, particularly on the north-side. A sample of the impact analysis (Figure 4-3) identifies impacts to buildings on both sides of Arsenal Street when widening to both the north and the south. The preliminary impact analysis is included in the Appendix for all alignments.
- **Environmental Impacts:** Alternative 4 is not anticipated to have a significant benefit to or impact on the environment.

[27] MassDOT Separated Bike Lane Planning and Design Guide; MassDOT, 2015.

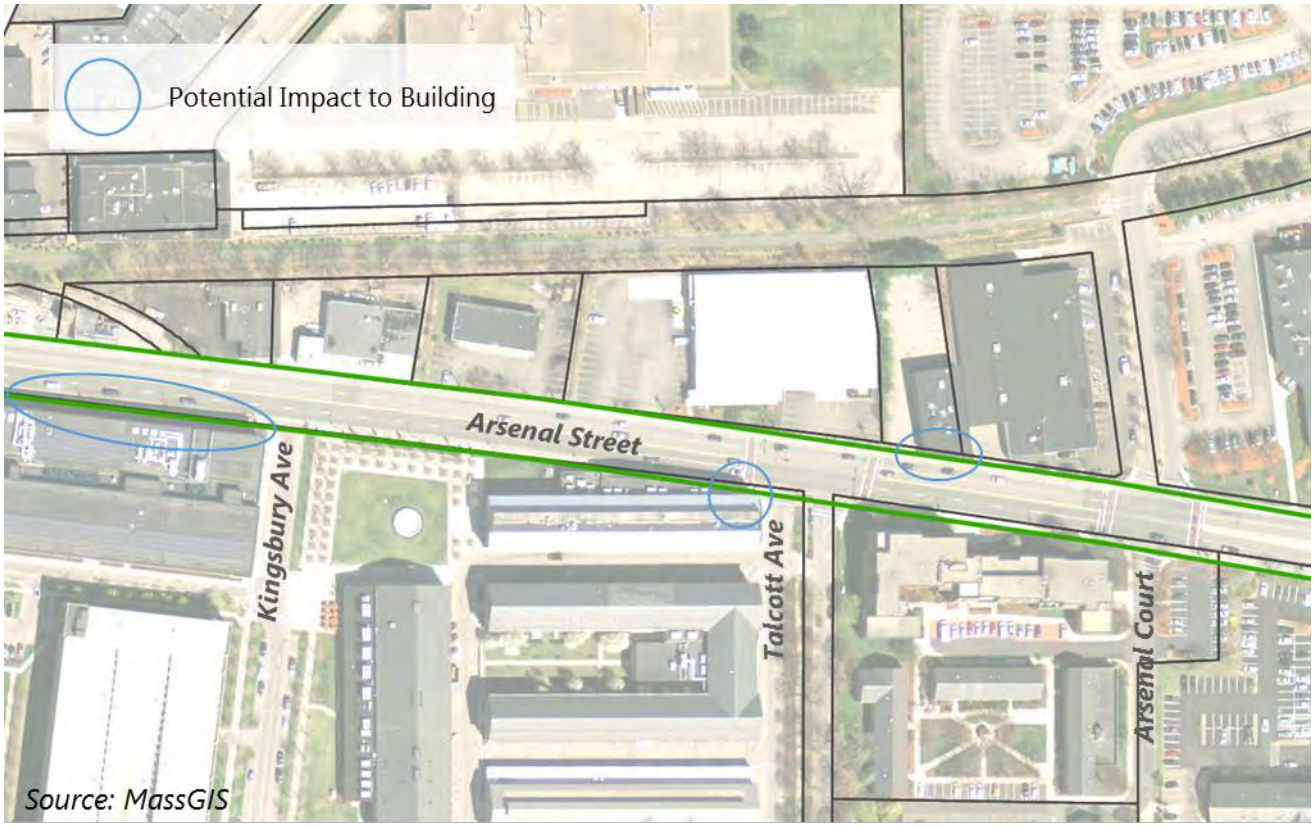


Figure 4-3 Alternative 4: Separated Bike Lanes (Widening to North and South) Preliminary Impact Analysis Example

If the Alternative 4 cross-section were carried to the eastern end of the study area, the bridge over the Charles River and Soldiers Field Road would be impacted for all three alignments considered. The bridge would need to be replaced in order to accommodate 4 vehicular travel lanes, bike lanes, and sidewalks. Reducing the number of vehicle lanes can be considered, but would have significant operational implications.

Recommendation: Discard Alternative 4 from consideration due to impacts to private property. Advance an on-road bicycle accommodation option (Alternative 1). There may be an opportunity to incorporate separated bike lanes along Arsenal Street where right-of-way allows.

Multimodal Improvements

Five multimodal alternatives were developed to take a holistic approach to improving access and mobility for all users within the study area including pedestrians, bicycles, transit riders, and vehicles.

Alternative 5: Road Diet East of School Street

Alternative 5 considers a road diet for the four-lane section, east of School Street. The road diet would reduce the number of general travel lanes to one in each direction and allow for a shared bus-bike lane in each direction on Arsenal Street. The National Association of City Transportation Officials (NACTO) notes that:

The shared bus-bike lane is not a high-comfort bike facility, nor is it appropriate at very high bus volumes… Shared bus-bike lanes can accommodate both modes at low speeds and moderate bus headways, where buses are discouraged from passing, and bicyclists pass buses only at stops.[28]

An example shared bus-bike lane for the Silver Line on Washington Street in Boston's South End is illustrated in Figure 4-4.

Figure 4-4 Example Shared Bus-Bike Lane, Washington Street, Boston

Alternative 5 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 5 would improve mobility for transit vehicles but would have an operational impact to general traffic and may impact parallel routes by diverting general traffic from Arsenal Street.
- **Safety Improvements:** Alternative 5 does not result in a targeted safety improvement. While there are many examples of successful installation of

[28] NACTO Transit Street Design Guide; NACTO, April 2016.

bus-bike lanes, care must be taken in designing such a facility to ensure adequate sight lines and the ability for bikes and buses to appropriately share space.

- **Accessibility and Connectivity Benefits:** Generally improves public health and quality of life by prioritizing transit and bicycle mobility.
- **Economic Development Impacts:** A reduction in traffic along the corridor may diminish pass by patronage of local businesses.
- **Environmental Impacts:** Alternative 5 may increase localized greenhouse gas emissions by increasing congestion for general traffic. On a regional scale these impacts would be negligible because there is not expected to be a substantive shift in mode share.

Recommendation: Retain Alternative 5 for further refinement and analysis due potential multimodal benefits. Analysis of this alternative will include a roadway capacity threshold evaluation and identification of potentially impacted parallel routes.

Alternative 6: Soldiers Field Road Gateway Improvement

Alternative 6 considers improvements to the eastern end of the Arsenal Street study area from Birmingham Parkway/Soldiers Field Road to Arlington Street/Coolidge Avenue. Potential improvements include signal timing/phasing modifications, intersection geometry changes, incorporation of pedestrian accommodations, restriping to improve lane alignment between Arlington Street and Greenough Boulevard, and/or the potential to relocate Coolidge Avenue as shown in Figure 4-5.

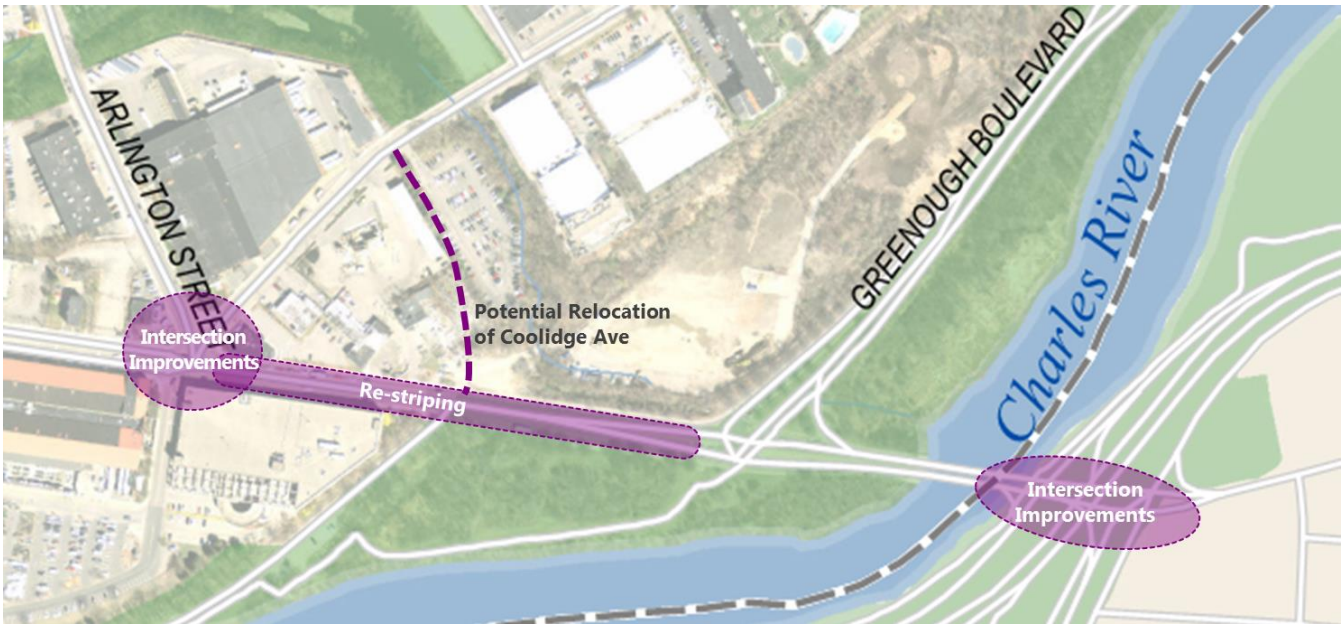


Figure 4-5 Potential Soldiers Field Road Gateway Improvements

Alternative 6 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 6 could improve traffic operations and system reliability by reducing signal delays at critical intersections. Restriping a portion of Arsenal Street could reduce driver confusion and enhance mobility. Relocating Coolidge Avenue opposite Greenough Boulevard (south) may require installation of a traffic signal, potentially increasing delays for the Arsenal Street mainline.
- **Safety Improvements:** Alternative 6 could work to address safety deficiencies at Greenough Boulevard (south) and Birmingham Parkway/Soldiers Field Road.
- **Accessibility and Connectivity Benefits:** Alternative 6 could improve multimodal access and connectivity and generally supports active transportation initiatives.
- **Economic Development Impacts:** Improving traffic flow at the corridor gateways can stimulate economic development. However, the relocation of Coolidge Avenue could have potential impacts to the Mount Auburn Health Club parking lot and/or Aggregate Industries operations.
- **Environmental Impacts:** Alternative 6 could impact environmental resources and require coordination with MassDEP, particularly if relocation of Coolidge Avenue is considered.

Recommendation: Retain Alternative 6 for further refinement and analysis. Analysis of this alternative will evaluate signal timing/phasing modifications, intersection geometry changes, incorporation of pedestrian accommodations, restriping to improve lane alignment between Arlington Street and Greenough Boulevard, and/or the potential to relocate Coolidge Avenue.

Alternative 7: Watertown Square Gateway Improvement

Alternative 7 considers improvements to the western end of the Arsenal Street study area at the intersections of Mount Auburn Street at Main Street/Arsenal Street/Charles River Road (Watertown Square); and Watertown Street/Nonantum Road at Galen Street. Potential improvements include signal timing/phasing modifications, improved coordination between the two intersections, lane use changes, pedestrian accommodation enhancements, and/or the potential to relocate Charles River Road as shown in Figure 4-6.

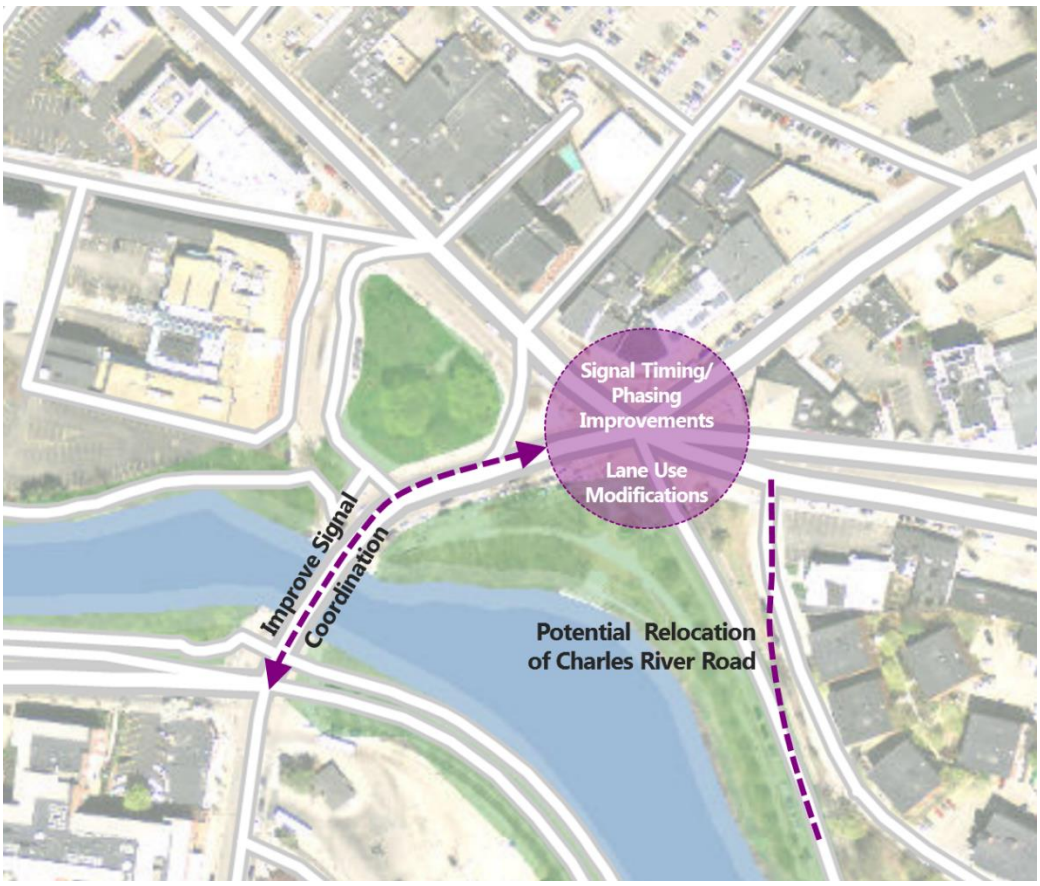


Figure 4-6 Potential Watertown Square Gateway Improvements

Alternative 7 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 7 could improve traffic operations and system reliability by reducing signal delays. Lane use modifications and signal phasing adjustments could reduce driver confusion and enhance mobility through Watertown Square.
- **Safety Improvements:** Alternative 7 could work to address safety deficiencies at both intersections.
- **Accessibility and Connectivity Benefits:** Alternative 7 could improve multimodal access and connectivity and generally supports active transportation initiatives.
- **Economic Development Impacts:** Similar to Alternative 6, improvements to traffic flow at the corridor gateways can stimulate economic development.
- **Environmental Impacts:** Alternative 7 would require coordination with DCR and the Office of Energy and Environmental Affairs (EEA) through the Article 97 process. Alternative 7 may also require coordination with MassDEP for impacts to environmental resources.

Recommendation: Retain Alternative 7 for further refinement and analysis. Analysis of this alternative will evaluate signal timing/phasing modifications, improved coordination between the two intersections, lane use changes, pedestrian accommodation enhancements, and/or the potential to relocate Charles River Road.

Alternative 8: Traffic Signal Optimization

Alternative 8 involves optimizing the timings at existing signals within the study area. Signal optimization is a cost-effective measure that can reduce congestion and improve traffic flow. Retiming can also allow for improved pedestrian crossings at locations with pedestrian signal accommodations.

It should be noted that signal timing optimization is being progressed independently as part of on-going development projects within the study area. These projects, as discussed previously in Chapter 3, include a hotel (which has since been opened), and redevelopment of several properties in the center of the corridor from industrial to mixed use.

Alternative 8 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 8 could improve traffic operations and system reliability by reducing signal delays at critical intersections.
- **Safety Improvements:** Alternative 8 does not result in a targeted safety improvement.
- **Accessibility and Connectivity Benefits:** Improvements may enhance pedestrian crossing times at isolated locations. Overall Alternative 8 does not address corridor access/connectivity or public health goals.
- **Economic Development Impacts:** Alternative 8 would not affect economic development along the corridor.
- **Environmental Impacts:** Alternative 8 is not anticipated to have a significant benefit to or impact on the environment.

Recommendation: Discard Alternative 8 from consideration as retiming is being progressed as part of on-going development projects within the study area. Advance corridor-wide signal coordination option, which may include adaptive signal control (Alternative 17).

Alternative 9: Wayfinding

Alternative 9 considers pedestrian and bicycle-scale wayfinding signage along the Arsenal Street corridor to guide non-motorized users to key destinations and connecting pathways.

Alternative 9 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 9 would not result in mobility benefits.
- **Safety Improvements:** Alternative 9 does not result in a targeted safety improvement.
- **Accessibility and Connectivity Benefits:** Installation of wayfinding signage could enhance pedestrian and bicycle awareness of available facilities, particularly off-road accommodations. As a stand along improvement, Alternative 9 does not address corridor access/connectivity or public health goals.
- **Economic Development Impacts:** Alternative 9 would not affect economic development along the corridor.
- **Environmental Impacts:** Alternative 9 is not anticipated to have a significant benefit to or impact on the environment.

Recommendation: Discard Alternative 9 from consideration as a stand-alone improvement. Consider incorporating wayfinding signage into preferred bicycle alternative and/or gateway alternatives (Alternatives 6 and 7).

Transit Options

A primary focus of the study is to improve bus service along Arsenal Street and locations where the bus service ties into other crossing bus routes. Seven transit alternatives were developed to consider improvements to transit operations, amenities, and/or connectivity.

Alternative 10: Express Bus Service along North Beacon Street

Alternative 10 considers supplementing the existing MBTA Route 70/70A service with bus service along North Beacon Street. Multiple routes were considered during the alternative development phase including Watertown Square to MBTA Commuter Rail (Boston Landing), Green Line, and/or Red Line services.

This alternative originally considered bus rapid transit (BRT) service. While BRT-style elements could be incorporated, a dedicated right-of-way would not be feasible for

the entire length of the route. As an alternate, express bus service with limited stops was considered.

Alternative 10 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 10 may reduce auto dependency, leading to a potential decrease in traffic congestion.
- **Safety Improvements:** Alternative 10 does not result in a targeted safety improvement.
- **Accessibility and Connectivity Benefits:** Alternative 10 could improve connections to existing regional transit services and generally supports active transportation initiatives.
- **Economic Development Impacts:** If this alternative were to draw pedestrian traffic away from the Arsenal Street corridor, it could affect local businesses.
- **Environmental Impacts:** The ability to shift from auto to transit mode share may benefit the environment.

Recommendation: Retain Alternative 10 for further refinement and analysis. Analysis of this alternative will evaluate whether the service could draw sufficient ridership to warrant full study.

Alternative 11: Transit Signal Priority (TSP)

Alternative 11 considers implementation of Transit Signal Priority (TSP) along Arsenal Street. TSP is a strategy that facilitates the movement of buses through signalized intersections. For example, TSP could detect a bus approaching a signal and either extend the green time or shorten the red time to allow the bus to process through the intersection. Implementation of TSP can improve transit quality of service by enhancing schedule adherence and reducing transit travel times. Impacts to non-transit traffic operations are generally minimal.

Alternative 11 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 11 may reduce auto dependency, leading to a potential decrease in traffic congestion. Implementation of TSP may result in a minor increase to cross street traffic delay.
- **Safety Improvements:** Alternative 11 does not result in a targeted safety improvement.
- **Accessibility and Connectivity Benefits:** Alternative 11 could improve the quality of existing bus services by enhancing schedule adherence and reducing transit travel times.

- **Economic Development Impacts:** Alternative 11 would not affect economic development along the corridor. Benefits could be gained by improving transit along the corridor, thereby encouraging use.
- **Environmental Impacts:** Alternative 11 is not anticipated to have a significant benefit to or impact on the environment.

Recommendation: Retain Alternative 11 for further refinement and analysis. Analysis of this alternative will include queue bypass lanes, traffic signal timing/phasing options, and the need to relocate or consolidate bus stops.

Alternative 12: Watertown Square Bus Alternative

The inbound Route 70/70A currently stops on Main Street at Cross Street. Passengers transferring to Route 59 or Route 71 are required to walk approximately 450 feet to the Watertown Square Delta. In 2008, Traffic Solutions, LLC was retained by the Town to evaluate options to relocate the Route 70/70A stop closer to the Watertown Square Delta[29]. The study recommended relocating the stop to within the Watertown Square Delta, requiring the Route 70/70A to travel through the Watertown Square signal twice. Alternative 12 considers the alternatives and recommendation of the previous study and other potential opportunities to improve transit quality of service within Watertown Square.

Alternative 12 was screened against the study goals and objectives:

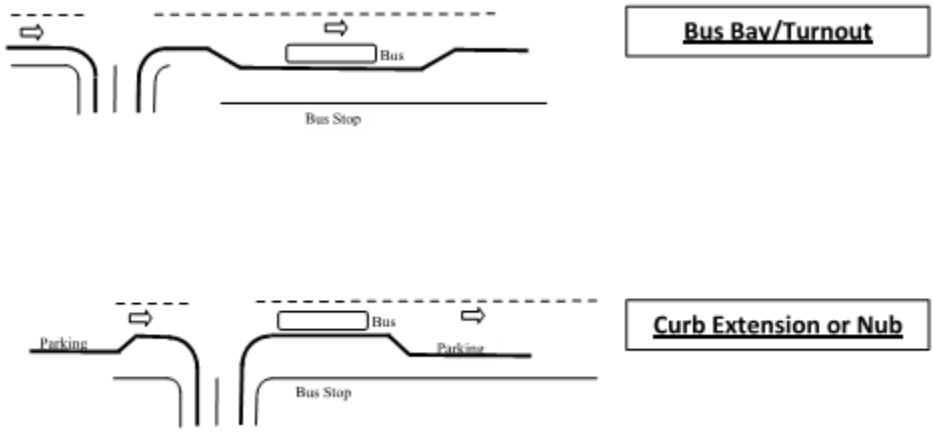
- **Mobility Benefits:** If combined with other measures, Alternative 12 may reduce auto dependency, leading to a potential decrease in traffic congestion.
- **Safety Improvements:** Alternative 12 allows bus transfers to occur within better proximity of the two bus routes and improves sight lines between bus drivers. This may indirectly improve pedestrian safety because it is likely to reduce the number of pedestrian running to meet a connecting bus.
- **Accessibility and Connectivity Benefits:** Alternative 12 could improve the quality of existing bus services by reducing passenger transfer time.
- **Economic Development Impacts:** Alternative 12 would not affect economic development along the corridor.
- **Environmental Impacts:** Alternative 12 is not anticipated to have a significant benefit to or impact on the environment.

[29] Watertown – MBTA Bus Study memorandum; Traffic Solutions, LLC. July 30, 2008.

Recommendation: Discard Alternative 12 from consideration as a stand-alone improvement. Incorporate bus operations improvements into the Watertown Square gateway alternative (Alternative 7).

Alternative 13: Transit Stop Turnouts/Curb Extensions

Alternative 13 considers improving the existing transit stops along Arsenal Street by incorporating bus bays/turnouts or curb extensions. Bus bays create a space for the bus to exit the travel lanes completely for passenger boarding and alighting. These types of stops minimize impacts to through traffic, but require buses to merge back into the travel lanes. Curb extensions to create an in-lane stop, reducing lost time for buses merging in and out of traffic. These types of stops may block the travel lane, impacting general traffic. Figure 4-7 illustrates an example of bus stop turnouts and curb extensions.



Source: Draft MBTA Bus Stop Planning and Design Guideline, Oct 2013

Figure 4-7 Bus Stop Turnouts and Curb Extensions

Alternative 13 was screened against the study goals and objectives:

- **Mobility Benefits:** If combined with other measures, Alternative 13 may reduce auto dependency, leading to a potential decrease in traffic congestion.
- **Safety Improvements:** Alternative 13 does not result in a targeted safety improvement.
- **Accessibility and Connectivity Benefits:** Alternative 13 could improve the quality of existing bus services by providing transit passenger amenities.
- **Economic Development Impacts:** Alternative 13 would not adversely affect economic development along the corridor.

- **Environmental Impacts:** Alternative 13 is not anticipated to have a significant benefit to or impact on the environment.

Recommendation: Retain Alternative 13 for further refinement and analysis. Analysis of this alterative will consider spatial constraints with respect to ADA guidelines and qualitatively assess the benefits with respect to on-time performance and travel time improvements for bus bays versus curb extensions.

Alternative 14: Transit Shelters

Alternative 14 considers installation of shelters at existing bus stops to increase passenger comfort and facilitate improved bus stop identification. The MBTA provides guidance for the placement of bus shelters, primarily based on passenger utilization (i.e. boardings) but also considering other factors[30]. According to MBTA policies, a site must receive a total of 70 points to be considered eligible for a shelter. Existing bus stops along Arsenal Street were screened according to the MBTA criteria and based on the evaluation eight stops along Arsenal Street are eligible for shelters:

- Stop 1435: at Louise St
- Stop 1436: Arsenal opposite School St
- Stop 1437: at Arsenal Court
- Stop 1438: 500 Arsenal Watertown + Arsenal Mall
- Stop 1441: opposite Elm St
- Stop 1442: opposite Arlington St
- Stop 1445: Watertown + Arsenal Mall
- Stop 1447: opposite Arsenal Court Drive

The results of this evaluation are presented in the Appendix.

The eight bus stops which meet MBTA criteria for a shelter were screened against the study goals and objectives:

- **Mobility Benefits:** If combined with other measures, Alternative 14 may reduce auto dependency, leading to a potential decrease in traffic congestion.
- **Safety Improvements:** Alternative 14 does not result in a targeted safety improvement.

[30] Bus Stop Planning & Design Guidelines Draft v.3; MBTA, October 2013.

- **Accessibility and Connectivity Benefits:** Alternative 14 could improve the quality of existing bus services by providing transit passenger amenities. This alternative generally supports active transportation initiatives.
- **Economic Development Impacts:** Alternative 14 would not affect economic development along the corridor. Benefits could be gained by improving transit along the corridor, thereby encouraging use.
- **Environmental Impacts:** Alternative 14 is not anticipated to have a significant benefit to or impact on the environment.

Recommendation: Retain Alternative 14 for further refinement and analysis. Analysis of this alterative will consider spatial requirements for installation of a shelter and identify existing constraints to the extent feasible.

Alternative 15: Existing Transit Service Improvements

Alternative 15 incorporates several independent alternatives that consider operational improvements to the MBTA's existing Route 70 and 70A services including:

- Terminal adjustments for some or all trips (to Watertown Square)
- Terminal adjustments for some or all trips (to Waltham Center)
- Splitting the Route 70/70A into three distinct and shorter routes
- Adding express service
- Combining segments of the Route 70A with other existing MBTA bus routes
- Service frequency adjustments
- Trip schedule adjustments

Alternative 15 was screened against the study goals and objectives:

- **Mobility Benefits:** By improving the capacity and reliability of transit service on the corridor, Alternative 15 is anticipated to encourage mode shifts to transit and reduce auto dependence, which could lead to a decrease in traffic congestion. Adding express bus service to the corridor would reduce travel times between express stop locations, resulting in improvements to transit mobility.
- **Safety Improvements:** Alternative 15 does not result in a targeted safety improvement.
- **Accessibility and Connectivity Benefits:** Alternative 15 could improve transit service reliability and generally supports active transportation initiatives.

Alternative 15 has the potential to increase transit accessibility to key attractions (such as employment, education, and shopping centers) by providing increased transit capacity and reduced trip times for passengers.

- **Economic Development Impacts:** Alternative 15 may modestly improve economic development opportunities by providing a more reliable service and potentially drawing patrons from a larger capture area.
- **Environmental Impacts:** Alternative 15 is not anticipated to have a significant negative impact on the environment and may result in environmental benefits. Alternative 15 would support smart growth initiatives by providing increased transit capacity and improved reliability to the corridor. The Alternative 15 service improvements also have the potential to reduce regional greenhouse gas emissions through mode shifts from auto to transit, which would be encouraged by improved transit reliability, travel times, capacity and comfort.

Recommendation: Retain Alternative 15 for further refinement and analysis. Analysis of this alternative will consider impacts to on-time performance, passenger crowding, and travel times for each of the potential operational improvements outlined above.

Alternative 16: Consolidated Shuttle Services

Alternative 16 considers combined shuttle service to collectively serve developments along Arsenal Street. At this time, athenahealth runs private shuttle service and several other developers along the corridor are planning or have committed to providing service to regional transportation nodes such as Harvard Square and/or off-site employee parking.

Alternative 16 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 16 may reduce auto dependency, leading to a potential decrease in traffic congestion.
- **Safety Improvements:** Alternative 16 does not result in a targeted safety improvement.
- **Accessibility and Connectivity Benefits:** Alternative 16 could improve transportation options and generally supports active transportation initiatives.
- **Economic Development Impacts:** Alternative 16 would not affect economic development along the corridor.
- **Environmental Impacts:** Alternative 16 is not anticipated to have a significant benefit to or impact on the environment.

Recommendation: Discard Alternative 16 from consideration due to limited operational services at this time. This alternative could be pursued by others such as the planned Watertown Transportation Management Association (TMA) at a later date when there are services from multiple employers operational and when robust ridership data is available to support the consolidation decision making process.

Vehicle Options

Two alternatives were developed to specifically address vehicular operations and mobility.

Alternative 17: Adaptive Signal Control

Alternative 17 considers implementing adaptive signal control (ASC) along the Arsenal Street corridor. ASC technologies are able to capture and respond to real-time traffic demands to optimize traffic flow and progression in a coordinated signal system by adjusting cycle length, phase splits, and offsets. ASC can result in reduced travel times, intersection delay, and vehicle emissions – making more efficient use of the roadway network.

Alternative 17 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 17 may decrease congestion and reduce delays and improve system reliability.
- **Safety Improvements:** Alternative 17 does not result in a targeted safety improvement.
- **Accessibility and Connectivity Benefits:** By decreasing congestion, Alternative 17 could improve transit service run-time and reliability. Overall Alternative 17 does not address multimodal corridor access/connectivity or public health goals.
- **Economic Development Impacts:** Alternative 17 would not affect economic development along the corridor but may make the movement of goods easier outside of peak hours.
- **Environmental Impacts:** Alternative 17 is not anticipated to have a significant benefit to or impact on the environment.

Recommendation: Retain Alternative 17 for further refinement and analysis. Analysis of this alterative will consider various ASC technologies and evaluate their appropriateness for the Arsenal Street corridor.

Alternative 18: Overhead Lane Indication Signage

During the existing conditions analysis and public outreach process, driver confusion regarding proper lane usage was noted particularly in Watertown Square. Alternative 18 would provide supplemental directional signage in Watertown Square.

Alternative 18 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 18 does not result in notable mobility benefits.
- **Safety Improvements:** Alternative 18 does not result in a targeted safety improvement, although it may reduce driver confusion.
- **Accessibility and Connectivity Benefits:** Alternative 18 does not address multimodal corridor access/connectivity or public health goals.
- **Economic Development Impacts:** Alternative 18 would not affect economic development along the corridor.
- **Environmental Impacts:** Alternative 18 is not anticipated to have a significant benefit to or impact on the environment.

Recommendation: Discard Alternative 18 from consideration as a stand-alone improvement. Incorporate potential supplemental lane indication signage into the Watertown Square gateway alternative (Alternative 7).

Summary

This chapter presented the range of alternatives that were identified and screened against the study goals and objectives. The results of the alternatives screening process are presented in Table 4-1.

The alternatives that were recommended for further consideration will be reevaluated and further refined in Chapter 5, Alternatives Analysis. Chapter 6 will identify potential packaging of the alternatives into short, mid, and long-term recommendations.

Table 4-1 Alternatives Screening Summary

Retained for Further Evaluation	Discarded from Consideration	Comments
Alternative 1: Bike Lanes East of School Street		Analysis will identify property impacts and develop typical cross-sections and consider planned athenahealth improvements.
	Alternative 2: Off-Road, Parallel Connections to Charles River	Discarded due to constructability concerns and in favor of Alternative 3. Alternative 2 could be pursued separately by the Town and/or DCR.
Alternative 3: Cross Connectivity between the Greenway and Charles River		Analysis will identify potential cross-connections and impacted property owners and develop typical cross-sections.
	Alternative 4: Separated Bike Lane East of School Street	Discarded due to impacts to private property. There may be an opportunity to incorporate separated bike lanes along Arsenal Street where right-of-way allows into Alternative 1.
Alternative 5: Road Diet East of School Street		Analysis will include a roadway capacity threshold evaluation and identification of potentially impacted parallel routes.
Alternative 6: Soldiers Field Road Gateway Improvement		Analysis will evaluate signal timing/phasing modifications, intersection geometry changes, incorporation of pedestrian accommodations, restriping, and/or Coolidge Avenue relocation.
Alternative 7: Watertown Square Gateway Improvement		Analysis will evaluate signal timing/phasing modifications, improved coordination, lane use changes, pedestrian accommodation enhancements, and/or Charles River Road relocation.
	Alternative 8: Traffic Signal Optimization	Discard as retiming is being progressed as part of on-going development projects within the study area.
	Alternative 9: Wayfinding	Discarded as a stand-alone improvement. Consider incorporating into preferred bicycle alternative and/or Alternatives 6 and 7.
Alternative 10: Express Bus along North Beacon Street		Analysis will evaluate whether the service could draw sufficient ridership to warrant full study.
Alternative 11: Transit Signal Priority (TSP)		Analysis will include queue bypass lanes, traffic signal timing/phasing options, and bus stop relocation/consolidation.
	Alternative 12: Watertown Square Bus Alternative	Discarded as a stand-alone improvement. Consider incorporating into Alternative 7.
Alternative 13: Transit Stop Turnouts/Curb Extensions		Analysis will consider spatial constraints (ADA guidelines) and qualitatively assess benefits to on-time performance and travel time improvements for bus bays versus curb extensions.
Alternative 14: Transit Shelters		Analysis will consider spatial requirements for installation of a shelter and identify existing constraints to the extent feasible.
Alternative 15: Existing Transit Service Improvements		Analysis will consider impacts on on-time performance, passenger crowding, and travel times of each sub-alternative.
	Alternative 16: Consolidated Shuttle Service	Discarded due to limited operational services at this time. Could be pursued by others when there are services from multiple employers operational.
Alternative 17: Adaptive Signal Control (ACS)		Analysis of this alterative will consider various ACS technologies and evaluate their appropriateness for the Arsenal Street corridor.
	Alternative 18: Overhead Lane Indication Signage	Discarded as a stand-alone improvement. Consider incorporating into Alternative 7.

Immediate (0 to 1 year) Recommendations

In addition to the alternatives screened above, a series of improvements were identified for immediate implementation by the Town. Immediate-term actions address existing safety and operational deficiencies or advance some aspects of longer-term improvement projects. For the most part, the improvements can be completed within one year and include low-cost options that do not require environmental permitting, prolonged design or approvals, or extensive community vetting.

Immediate-term recommendations fall into three categories discussed below: road safety audits (RSAs), traffic signal deficiencies/compliance, and curb ramp improvements.

Road Safety Audits (RSAs)

An RSA is a formal safety examination of a roadway or intersection conducted by an independent, experienced multidisciplinary RSA team. MassDOT requires an RSA for all HSIP-eligible locations that fall within a project area prior to submittal of 25-percent design plans. Additionally, the RSA program has recently been expanded to focus on pedestrian and bicycle hot spots.

There are five HSIP-eligible crash clusters within the Arsenal Street study area:

- Arsenal Mall (unsignalized) at Arsenal Street
- Greenough Boulevard (south) at Arsenal Street
- Mount Auburn Street/ Main Street/ Arsenal Street/ Charles River Road (bicycle)
- Arsenal Street at Soldiers Field Road and Western Ave at Birmingham Parkway (bicycle)
- Galen Street/ Nonantum/Watertown Street and Mount Auburn Street/ Main Street/ Arsenal Street/ Charles River Road (pedestrian)

Additionally, the intersection of Galen Street at Nonantum Road/ Watertown Street is ranked 178 in the 2011-2013 Statewide Top 200 Intersection Crash List. An RSA was conducted at this location in Fall 2016. The detailed RSA results are provided in the Appendix. The primary recommendations supported by the findings of this study include:

- Changes to the traffic signal phasing and the incorporation of a yellow flashing arrow (note these changes may necessitate replacement of the traffic signal controller)
- Changes to pedestrian phasing and increased clearance intervals
- Geometric changes to the Watertown Yard Driveway

For the remaining locations, it is recommended that the Town continue work with MassDOT to conduct RSA's as appropriate.

Traffic Signal Deficiency/Compliance

The traffic signal and controller equipment at the 14 signalized intersections within the study area were reviewed. A table summary with locations reviewed and recommended actions can be found in the Appendix. While issues relating to MUTCD compliance, ADA compliance, and operations/maintenance were noted at all locations, three locations had noted safety deficiencies that should be addressed as soon as possible:

- Watertown Street/Nonantum Road at Galen Street: Pedestrian phase issue
- North Beacon Street/Arsenal Street/Taylor Street at Alfred Street: Multiple pedestrian phase issues
- Arsenal Street at Soldiers Field Road/ Birmingham Parkway: Permissive left-turn against vertical green arrow

Curb Ramp Improvements

VHB inventoried 91 curb ramps within the study area in November 2015. Of the non-compliant ramps, 37 locations require only a tactile warning strip, with the other features meeting current regulations. Addition of a tactile warning strip at these locations would make the ramp fully compliant. A table summarizing all curb-ramps reviewed and the recommended actions can be found in the Appendix.