# Chapter 3: Alternatives Development

## 3.0 Chapter Summary

With an understanding of the existing conditions at Wellington Circle and its role in the local and regional transportation network, potential improvement concepts, and eventually alternatives, were developed for the Circle. This chapter describes the process used to refine the spectrum of possible improvements to a select number of viable alternatives to be analyzed and compared in greater detail.

This process included the investigation and definition of design constraints, building on existing opportunities and input from Working Group members, and the iteration of potential design concepts to provide preliminary feasibility analyses of possible intersection alternatives for Wellington Circle. Ultimately, four alternatives were selected for further analysis, as discussed at the end of this chapter. Chapter 4 discusses the comparative analysis of the selected alternatives.

## 3.1 Alternatives Development Context

The Alternatives Development process was guided by findings from the existing conditions analysis, described in Chapter 2, and sought to assess the feasibility of various concepts to create an improved multimodal transportation network through Wellington Circle. The issues and opportunities, described below, provided a framework to understand the problems that need to be addressed by any concept. Stakeholder feedback also helped set goals and priorities for the project to ensure that alternatives aligned with community needs.

### 3.1.1 Issues and Opportunities

The existing Circle is characterized by deficiencies that make it difficult to navigate for all modes. Vehicles experience confusing geometry and multiple lanes for each movement, leading to a high number of crashes. Pedestrians and bicycles also experience uncomfortable conditions. Many people choose to drive short distances to cross the Circle rather than walk across the intersection, and there are no existing bicycle facilities. Issues, constraints, and considerations include:

- Safety – crashes involving pedestrians have occurred at most Circle intersections
- Multimodal connectivity – limited by wide roadways and multiple lanes of traffic
- Multimodal Infrastructure – lack of pedestrian and bicycle infrastructure is a barrier to local destinations, including Wellington Station
- Vehicular congestion – congestion causes delay for both private vehicles and buses, particularly east of the Circle

There are also physical roadway constraints that must be accounted for in the development of alternatives. Primary design constraints include:

- Designing within the existing right-of-way

- Consideration that the four roadways comprising Wellington Circle are parkways under historic designation
- Consideration of impacts to natural elements such as mature trees and waterways
- Providing access to existing driveways and properties, including the State Police Station A-4
- Designing for large vehicles and their required turning movements
- Existing and proposed traffic patterns and how to manage desire lines for all modes
- Existing facilities when tying into project limits

In contrast to the constraints, the Wellington Circle area offers several opportunities for an improved design, including:

- Right-of-way – Wide roadways, buffers, and sidewalks may provide space for multimodal facilities.
- Changing land use – Increasing transit-oriented and mixed-used development around Wellington Station could increase opportunities for short trips taken by walking and biking.
- Access to Open Space – The proximity of state parks and multiuse paths presents opportunities to improve access to open space and recreation.

The ability for safety and connectivity improvements to increase walking and biking trips has secondary benefits as well. These may include reduced vehicle trips, and therefore a reduction in congestion, which in turn benefits factors such as public health, air quality, and quality of life.

### 3.1.2 Working Group Feedback

Issues related to how Wellington Circle operates and serves its users and the potential for improvement were informed by input from the stakeholder Working Group made up of representatives from elected officials, government agencies, municipal officials, and community members. Themes from stakeholder input included the need to:

- Improve safety in Wellington Circle for all users
- Reduce vehicular travel delays and congestion
- Expand facilities for pedestrians, bicyclists, and transit users
- Improve connectivity to Wellington Station
- Reduce confusion regarding circulation patterns for all users
- Expand green space
- Promote redevelopment in the parcels surrounding Wellington Circle to provide a more active, mixed-use environment
- Improve community connectivity between neighborhoods surrounding Wellington Circle

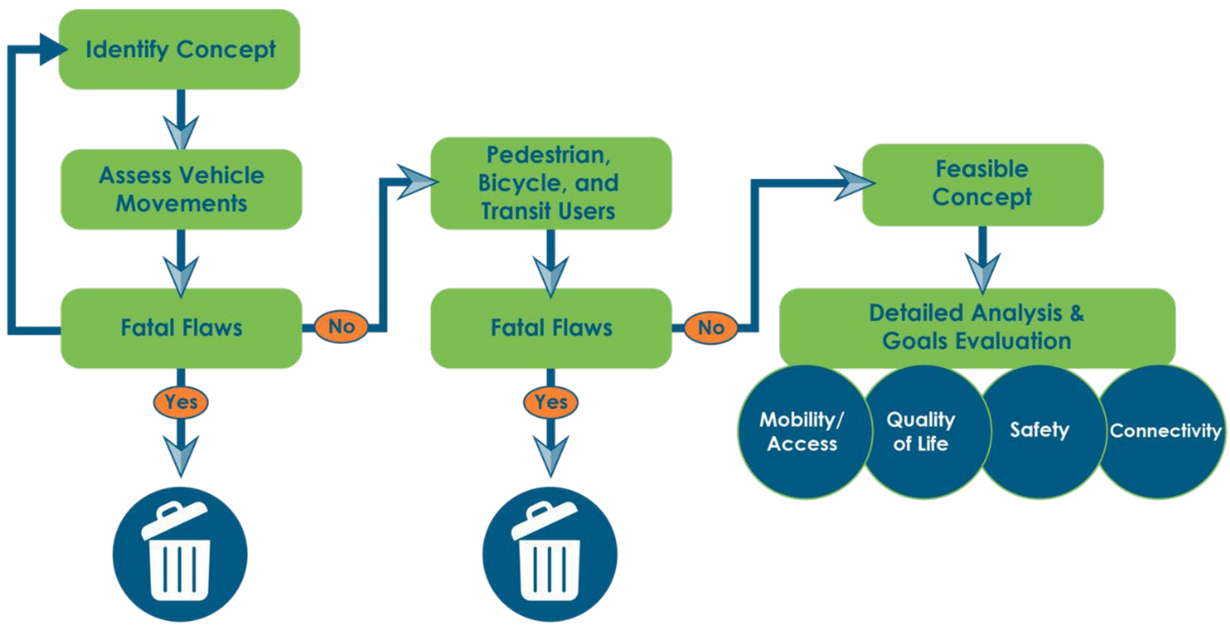
Many of the identified issues reinforce one another to help meet project goals. A design for Wellington Circle that improves multimodal access, connectivity, and safety, and facilitates mixed-use development, could enable shorter trips to be taken by walking and biking, which in turn could help reduce vehicular congestion and greenhouse gas emissions. While improving vehicular operations and congestion were not primary goals of the study, the significant role that Wellington Circle currently plays in the regional vehicle network was considered important to maintain. Wellington Circle serves as a primary regional connection point between local communities such as Malden and Medford to job centers in Boston and Cambridge (see Chapter 2 Section 2.7). The documentation of the key concerns and priorities of the Working Group was an essential component in identifying key issues and opportunities for the Study to address. This local feedback was used in the development of feasible concepts, and then alternatives, for Wellington Circle.

## 3.2 Concept Development

### 3.2.1 Process and Methodology

The Alternatives Development process started with identifying potential roadway configuration concepts and evaluating each starting with the most basic to the most advanced concepts. Each initial concept analyzed access for each mode to identify potential "fatal flaws" and was eliminated from consideration if deemed infeasible. A diagram of the alternatives development process methodology is shown in Figure 3.2-1.

*Figure 3.2-1: Alternatives Development Process*




A fatal flaw analysis focuses on quickly finding the weak link in each concept and determining if that one factor on its own makes the concept infeasible. For Wellington Circle, the fatal flaw analysis consisted of two stages:

1. Vehicle Capacity: The concept is unable to provide sufficient capacity for the existing vehicle volumes within the Circle.

Vehicular infrastructure is more limited than other modes in its requirements for space and throughput capacity, which is a major factor in why many cities, towns, and regions are working towards reducing travel dependence on cars and providing a balanced multimodal network. However, these same factors mean that for Wellington Circle to carry the desired volume of traffic, providing sufficient vehicle capacity becomes a critical step in determining the feasibility of a potential alternative.

Improving vehicular operations beyond the existing condition is not a goal of this study, and given the nature of Wellington Circle, any additional vehicle capacity provided would likely result in increased demand and congestion rather than decreased congestion, also known as “induced demand”. Nonetheless, maintaining Wellington Circle as a regional connection point by providing sufficient capacity for existing vehicle volumes was considered necessary. Vehicle capacity goals for this project are to process the vehicle traffic demand in a safer manner without substantially reducing vehicle operations.

2. Multimodal Considerations: The concept is unable to sufficiently accommodate pedestrian, bicycle, and/or transit access to meet the goals of the project (described in Table 3.2-1).

***Table 3.2-1: Multimodal Considerations***

| Mode | Considerations and Goals |
|---|---|
| *Pedestrian* | - Reduce crossing distances where possible<br>- Separate signal phases for pedestrians and conflicting high vehicle volumes |
| *Bicycle* | - Provide physical separation from vehicles, including vertical separation<br>- Provide separate facilities for bicycle and pedestrians if possible<br>- Provide-high quality bicycle infrastructure at intersections |
| *Transit* | - Consider the feasibility of bus lanes and/or bus queue jump lanes to reduce delay for transit users and increase reliability of bus schedules |

Concepts were considered to be fatally flawed when it was apparent that the concept would have major negative impacts on pedestrian or bicyclist safety or would be unable to carry the existing vehicle volumes, even if a reasonable decrease in those volumes under the design conditions were to occur. Concepts that passed both fatal flaws screenings were further developed to determine if they could be considered viable alternatives for more advanced analysis. Concepts were categorized as basic concepts, circular concepts, and advanced concepts.

Analysis of vehicle capacity for the different concepts was done using Synchro analysis software, which is based on the *Highway Capacity Manual, 6$^{th}$ Edition* published by the Transportation Research Board. Concepts were modeled in Synchro based on the existing condition weekday morning and afternoon peak hour vehicle volumes through Wellington Circle. Rather than modeling a predetermined number and arrangement of vehicle lanes and analyzing the resulting vehicle capacity outputs, the number and arrangement of lanes was instead adjusted based on review of traffic simulations of the projected vehicle operations. The geometry was adjusted for each concept until all movements were projected to have a volume-to- capacity ratio of 1.20 or less, and until not more than half of the movements were projected to be over capacity. These criteria comply with the intention to process vehicle traffic without substantial degradation to vehicle operations, recognizing that the existing vehicle operations in the area are poor. The resulting geometry required was then used to determine whether a concept could provide the targeted level of vehicle capacity while also meeting the multimodal considerations of the alternatives development process.

Design Criteria:
The alternatives development process focused largely on the overall layout of the Circle; at that level of detail and given the scale of the existing intersection, there were few instances where geometric limitations came into play. To align the concepts developed with traffic engineering standards and the goals of the project, the following design criteria were used:

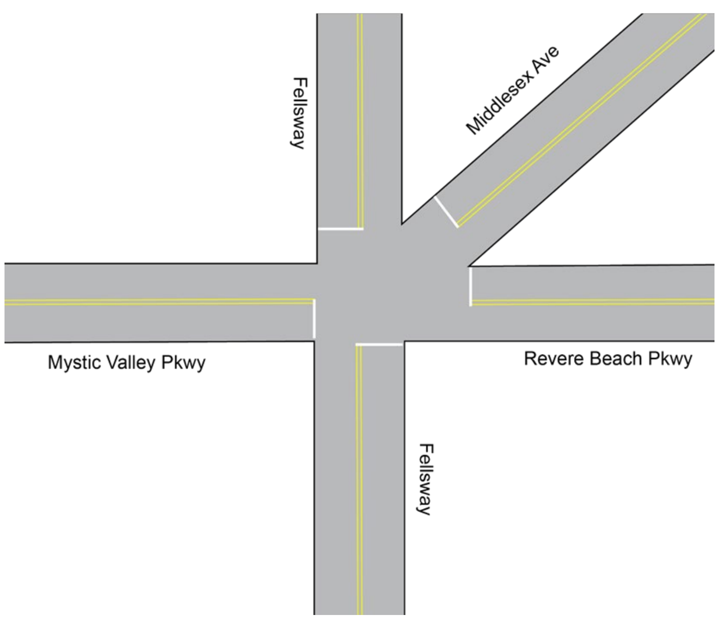
- Standard vehicle lane widths of 11 feet
- Sidewalks not less than six feet wide on both sides of all roadway segments (or within open space as applicable)
- Separated bicycle lanes not less than six feet wide on both sides of all roadway segments where feasible (or within open space as applicable)
- One- to two-foot shoulders on either side of the roadway, intended to provide some buffer between moving vehicles and curbs rather than to act as a breakdown lane

### 3.2.2 Basic Concepts

The concept development process started with basic concepts to determine if they could offer improvements over the existing roadway configuration. Four basic concepts were considered:

1. Five (5)-leg intersection (Figure 3.2-2): All five of the major Wellington Circle approaches meet at one signalized intersection

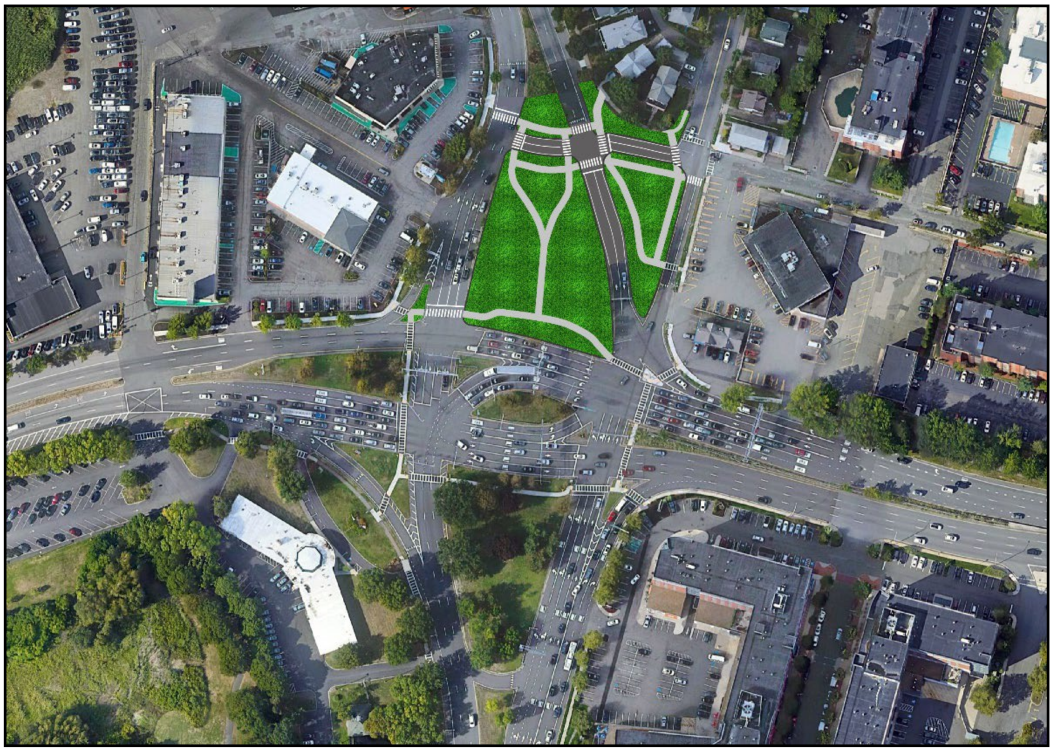
*Figure 3.2-2: Five-leg Intersection*



This concept was eliminated from consideration as it would add conflicts, increase delays, require too many lanes, and result in worsened conditions for all modes.

2. Four-leg Intersection with Middlesex Avenue at Fellsway Intersection (Figure 3.2-3): Reconfigures the Middlesex Avenue intersection to remove it from the Wellington Circle intersection and create a new, separate intersection with the Fellsway north of Wellington Circle; the other major approaches meet at a signalized four-leg intersection.

*Figure 3.2-3: Middlesex Avenue at Fellsway Intersection*



Removing the Middlesex Avenue at Fellsway intersection from Wellington Circle could provide benefits, including:

- Improvements to overall vehicle operations, particularly for the critical west-bound left-turn movement
- Use of additional time in the signal cycle to mitigate impacts of removing channelization for eastbound right turns
- Creation of a more typical roadway geometry. The concept results in simpler, shorter pedestrian crossings and potential reduction in overall pedestrian delay
- Creation of additional open space in the center of the intersection

There are also considerations with this concept, including:

- Potential queueing spillback between new signal and existing intersections
- Conversion of Middlesex Avenue to one-way away from Wellington Circle (determined not to provide substantial benefits over relocating the intersection)

While the concept would reduce conflicts along Route 16, it would require more travel lanes than the existing configuration, negatively impacting pedestrians and bicycles due to the increased pavement widths and crossing distances. For these reasons, the four-leg intersection as a stand-alone alternative was eliminated from further consideration. However, because the relocation of Middlesex Avenue to a new intersection location would provide some benefits, this aspect of the alternative moved forward for consideration as part of a short-/medium-term alternative to be used in conjunction with other improvements.

3. Removal of Right-Turn Channelization (Figure 3.2-4)

*Figure 3.2-4: Removal of Right-Turn Channelization*


Channelized right turn lanes are those which are physically separated from the rest of a roadway approach by a raised island. Removing these channelized turns would mean removing the raised island and shifting the right-turn lane to approach the signal at the same stop line as the rest of the lanes for that approach.

Removing right-turn channelization could result in several benefits, including:

- Potential improvement to pedestrians' and bicyclists' comfort and safety
- Reduced speed of turning vehicles
- Closer alignment with current MassDOT standards, as yield- controlled channelized turns are no longer acceptable by MassDOT
- Potential addition of space for partial bicycle infrastructure in Wellington Circle

There are also considerations, including:

- A likely increase in vehicle delays at currently unsignalized turns (southbound and eastbound)
- Added complexity to signal phasing to avoid re-introducing conflicts between pedestrians and vehicles
- Lengthened pedestrian crossing distances across primary crossings

While the removal of right-turn channelization is not a stand-alone solution, drawbacks of this concept can be mitigated with other interventions. Consideration of removing right-turn channelization moved forward as an option as part of the development of short-/medium-term alternatives.

4. Prohibition of Left Turn Movements (Figure 3.3-5)

*Figure 3.2-5: Prohibition of Left Turn Movements*

Left-turn movements at intersections often require dedicated time during a traffic signal cycle, due to their conflicts with other vehicle and pedestrian movements. For this reason, one common measure for improving traffic flow at busy intersections is to restrict left turn movements.

Prohibiting left turn movements could result in benefits including:

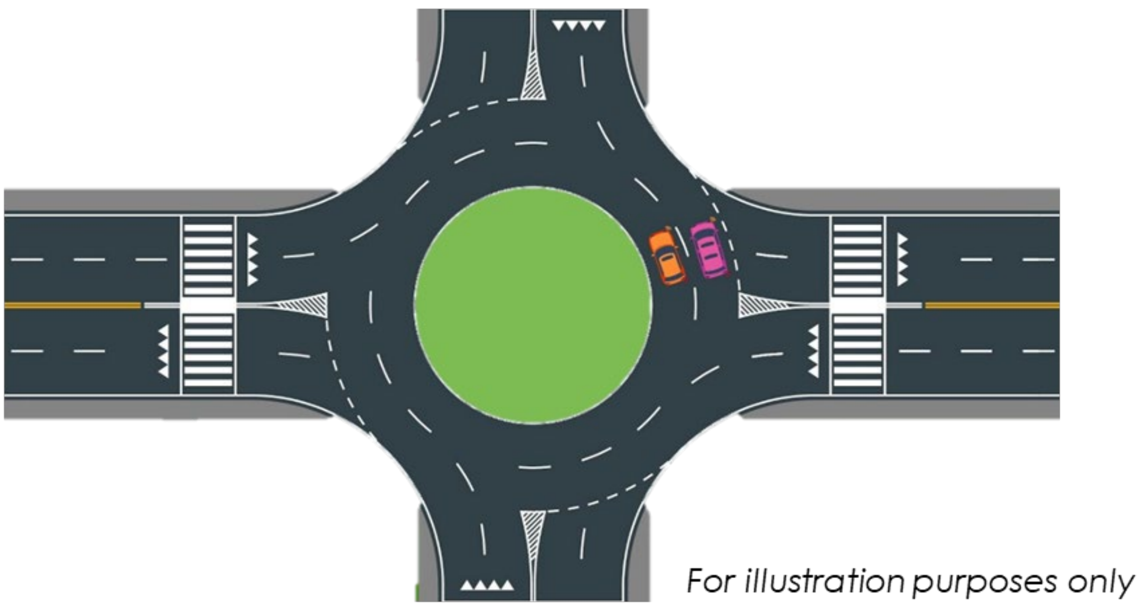
- Improvement of overall vehicle operations, particularly for westbound and northbound movements
- Additional open space in center of intersection

The main drawback to this option is that there would be limited direct benefit to pedestrian and bicycle conditions. Prohibiting left-turn movements moved forward as an option to consider as part of short-/medium-term alternative where other elements could be used to improve multimodal conditions in combination with the prohibition of left turns.

### 3.2.3 Roundabout Concepts

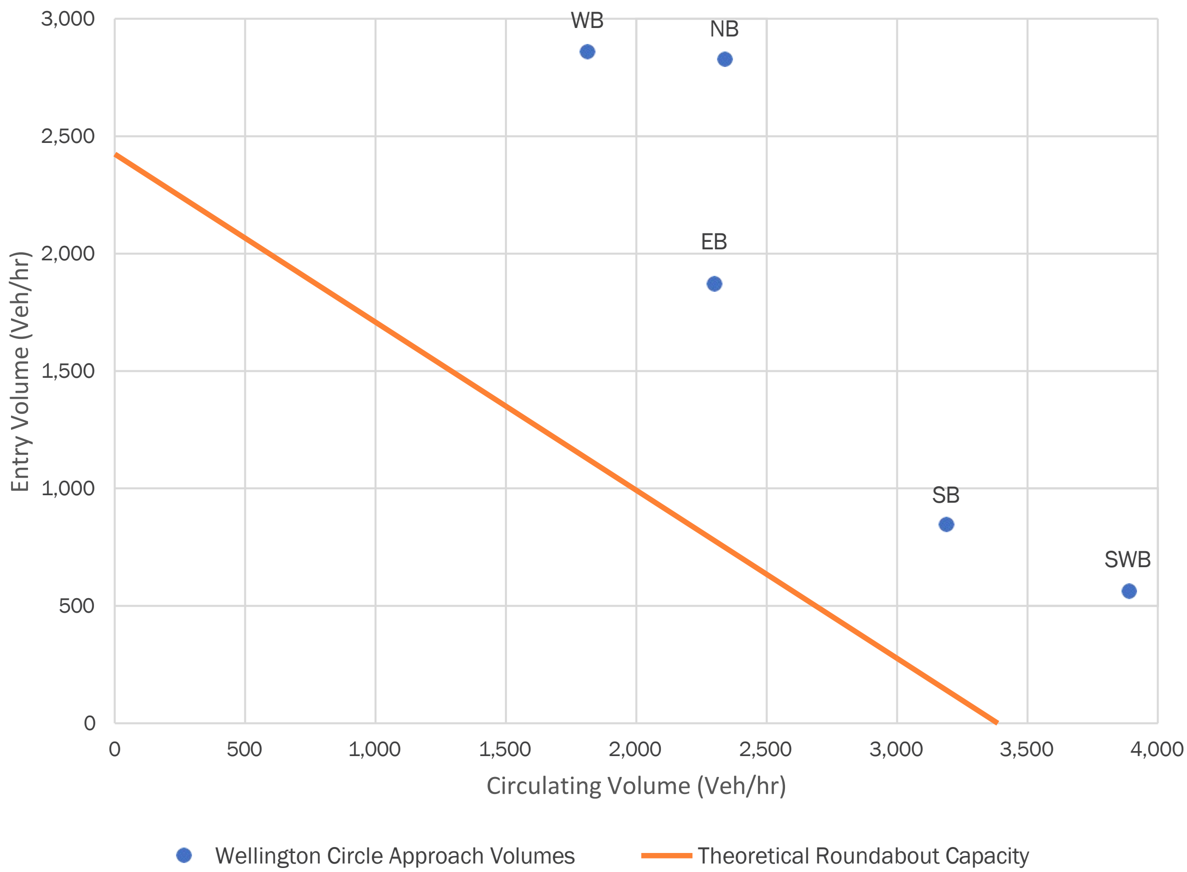
Various roundabout configurations were considered, including multi-lane and turbo roundabouts and multiple-roundabout concepts. A multi-lane roundabout concept considered is shown in Figure 3.2-6. This layout typically includes two circulatory lanes and up to two lanes per approach. Lane usages are assigned lane choices on each approach in order to minimize potential conflicts between vehicles. A specific form of multi-lane roundabout, called a turbo roundabout, removes one of the approach lanes on the side street approaches in order to further reduce potential conflicts for traffic within the roundabout, resulting in lower vehicle capacity but potentially higher safety.

*Figure 3.2-6: Roundabout Concept*




The FHWA publication *Roundabouts: An Informational Guide* provides the approximate theoretical capacity of a multi-lane roundabout based on entering and circulating volumes at each approach. Figure 3.2-7 below shows this theoretical capacity plotted on a chart along with the entering and circulating volumes during the weekday afternoon peak hour for each approach into Wellington Circle.

*Figure 3.2-7: Roundabout Capacity*



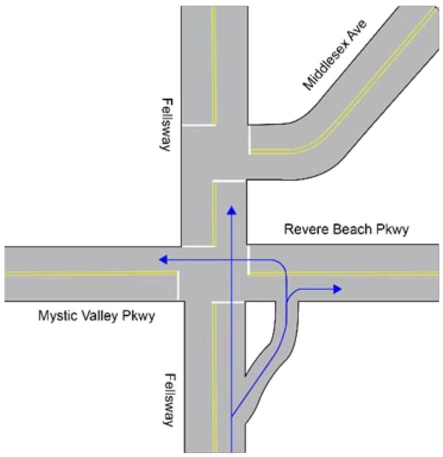
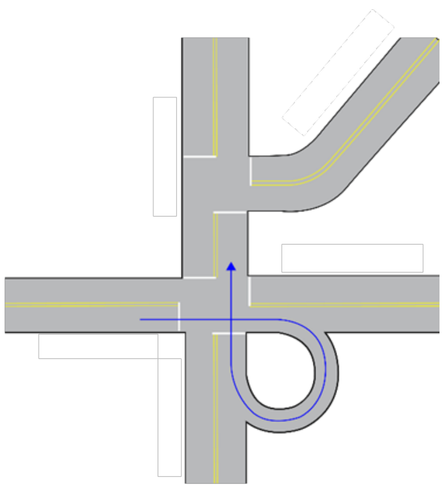
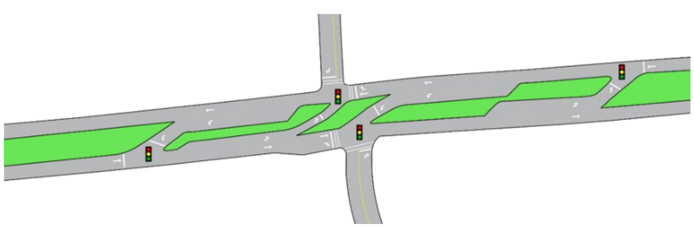

As shown in Figure 3.2-7, all approaches to Wellington Circle are shown to significantly exceed the theoretical capacity for a multi-lane roundabout – with two of the approaches exceeding the theoretical capacity with zero circulating volumes. On this basis, single multi-lane and turbo roundabouts were not considered feasible.

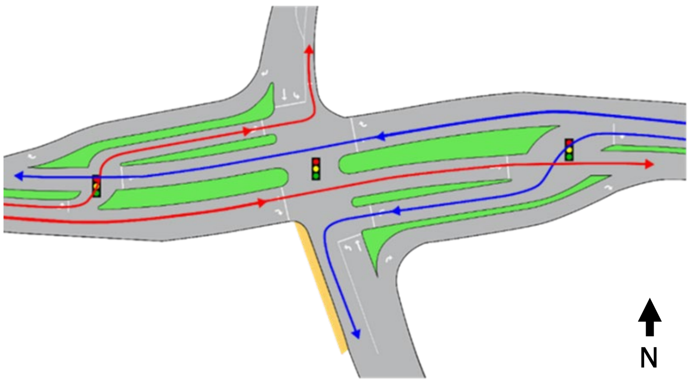
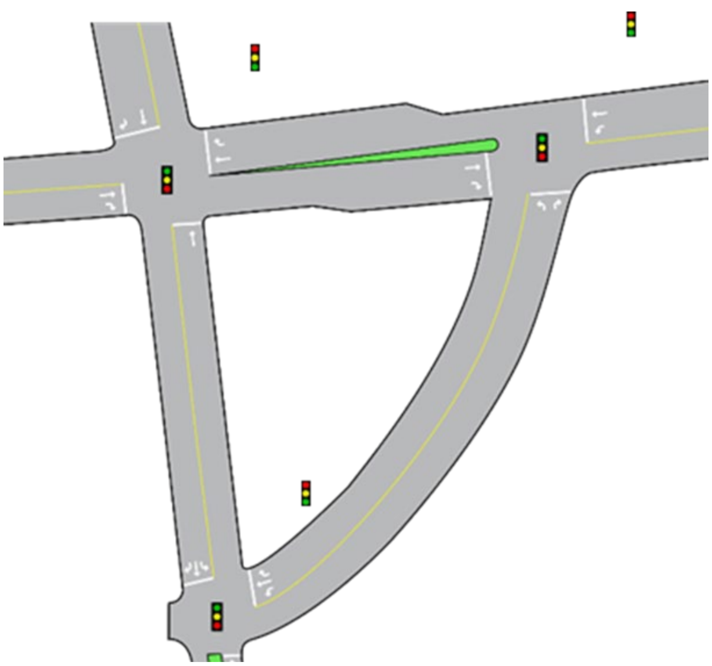
Concepts which involved the use of multiple roundabouts in concert with each other or with signalized intersections were also considered, including ones which would only serve the Middlesex Avenue at Fellsway intersection or other specific areas with lower traffic volumes. These encountered the same fundamental issue of providing insufficient vehicle capacity, even to carry only a portion of the total Circle traffic. Additionally, roundabouts are susceptible to queue spillback gridlocking the intersection, preventing all traffic from proceeding. Clusters of roundabouts can exacerbate this issue.

### 3.2.4 Advanced Concepts

As the basic concepts were eliminated, more complex concepts were evaluated. Table 3.2-2 summarizes the advanced concepts considered. Of these concepts, the Quadrant Roadway demonstrated the most potential to improve access and connectivity through the Circle. This concept was carried into the development of alternatives.

*Table 3.2-2: Advanced Concepts Considered*

| Concept | Description |
|---|---|
| *Jughandle*<br><br><br>Type A Jughandle<br><br>Type C Jughandle | Jughandles shift turning traffic to separate locations to reduce conflicts and the number of signal phases. There are two types of jughandles, shown in the graphic, Type A and Type C. All types of jughandles require more space than traditional turn lanes, and Type C have significant right-of-way impacts due to their larger configuration. Jughandle concepts were eliminated because they only shift vehicle conflicts, and do not improve upon overall traffic flow, while requiring additional footprint. For this reason, all concepts identified which used jughandles still required additional vehicle lanes compared to the existing configuration. |
| *Restricted Crossing U-Turn (RCUT)*<br> | RCUT intersections relocate side-street through and left turn movements to U-turns. Side-street right turns run concurrent with main line lefts. RCUT concepts were eliminated because the volume of vehicles projected to utilize the U-turn intersections would exceed the feasible vehicular capacity of the roadways. |

| | |
|---|---|
| *Continuous Flow Intersection*<br> | Continuous Flow Intersections allow left turn traffic to cross over opposing traffic ahead of an intersection, which helps to maximize capacity. For example, westbound left and eastbound through movements could run simultaneously. Continuous Flow Intersections can be implemented approach by approach.<br><br>The main drawback is that this creates a large, complex intersection that can be challenging for pedestrians and bicyclists to navigate. It was determined that it would not offer substantial operational benefits over quadrant roadway concepts. Due to these factors, these concepts were eliminated from further consideration. |
| *Quadrant Roadway*<br> | Quadrant roadways redirect turning movements by providing a new roadway which connects two perpendicular approaches to the intersection, allowing potentially conflicting movements to move simultaneously. They are helpful for intersections with both high volumes and large turning volumes.<br><br>One drawback is the amount of physical space required to provide a new roadway. They are best used in locations where available space or right-of-way is not a constraint.<br><br>These concepts were advanced for further consideration. They demonstrated the greatest potential to accommodate existing vehicular movements of any advanced concept, as they provide a more direct connection for existing patterns between south and east of the Circle. This would separate westbound left and northbound right movements and |

| | |
|---|---|
| | enable eastbound and southbound lefts to potentially also use the quadrant roadway. The Quadrant Roadway also shows the best potential for accommodating bicycles and pedestrians, as quadrant roadways function effectively the same as any other part of the roadway network and do not involve unfamiliar forms of roadway geometry or traffic control. |

## 3.3 Alternatives Development

Preliminary Short-/Medium-Term alternatives were developed based on elements of the Basic concepts that showed potential in terms of feasibility and alignment with project goals. These preliminary alternatives were refined to develop a final set of alternatives for analysis. The Long-Term Alternatives were based on the concept of quadrant roadways and include at-grade (surface) and grade-separated alternatives.

While Short-/Medium-Term Alternatives have the potential to provide improvements to the Circle on a shorter time-horizon (within 5-7 years), the more capital-intensive Long-Term Alternatives would provide more substantial improvements that better address the desired outcomes of the project.

### 3.3.1 Short-/Medium-Term Alternatives

Short-/Medium-Term alternatives were considered to provide nearer-term improvements. These improvements satisfy some project goals and provide benefits to different types of users, while being feasible to construct sooner, at lower costs, and with less disruptions to existing travel.

The primary focus of the Short- and Medium-Term concepts was identifying potential changes to the geometry or vehicle flow through the Circle to improve pedestrian comfort and safety, provide space for bicycle infrastructure where possible, and reduce bottlenecks within the intersection for vehicular movements. A number of individual basic concept elements, described in Section 3.2, were identified which could be implemented within the existing intersection configuration and achieve some of these goals. These elements could also be combined.

1. Relocate Middlesex Avenue at Fellsway Intersection (see Figure 3.2-3): Shifts Middlesex Avenue to intersect with Fellsway to the north of Route 16.
2. Remove right-turn channelization (see Figure 3.2-4): Replaces the existing channelized right-turn lanes in the eastbound, westbound, and southbound directions with traditional right-turn lanes. Due to the high volume of northbound right-turning traffic, combined with other signal phasing considerations, eliminating the northbound channelized right-turn lane is not feasible within the existing Circle configuration.
3. Prohibit eastbound left turns (see Figure 3.2-5): Prohibits eastbound left-turn movements and removes the existing eastbound left-turn lanes from the intersection.

Each of the above elements has the potential to benefit pedestrians, bicyclists, and drivers if implemented individually. All of them combined would simplify the overall geometry of the Circle. The combination of all these elements is what formed the Short-/Medium-Term Alternative which was analyzed further.

During the Alternatives Analysis process described in Chapter 4 of this report, it was determined based on further analysis that the potential impact on vehicle capacity, which could result in longer queues and/or also increased delay, of the full removal of the channelized turns was greater than had been realized during the Alternatives Development phase. For this reason, two variations of the overall Short- and Medium-Term Alternative were developed: Option A and Option B.

#### 3.3.1.1 Option A

Short-/Medium-Term Alternative Option A consists of the full combination of each of the above elements, namely:

- Removing the channelized right-turn lanes in the eastbound, westbound, and southbound directions, and providing typical right-turn lanes in their place.
- Prohibiting the eastbound left-turn movement at the Circle and removing the existing left-turn lanes. Drivers traveling from the west of the Circle to the north would be expected to reroute via Commercial Street or by making an eastbound right turn followed by a U-turn south of Wellington Circle to then continue north.
- Relocating Middlesex Avenue southbound to connect to Fellsway north of Route 16.

Benefits and impacts:

- Minor improvements to bicycle and pedestrian access and connectivity, with shortened crossing distances and bicycle infrastructure.
- Increases open space, particularly on the north side of the Circle.
- Significantly degrades right turn operations, as right turning vehicles must wait for the pedestrian crossing phase to end, thereby reducing the time available in the cycle for the right-turning vehicles.

***Figure 3.3-1: Short-/Medium Term Alternative Option A***

### 3.3.1.2 Option B

Short-/Medium-Term Alternative Option B is identical to Option A, except for the following elements:

- Maintains channelized right turns for the eastbound and westbound directions to accommodate right turn volumes.
- Signalizes the eastbound channelized right turn lane to give pedestrians and bicyclists a protected crossing. The westbound crossing is currently signalized.

Benefits and impacts:

- Small improvements to bicycle and pedestrian access and connectivity.
- Increases open space.
- Degrades right-turn operations to a lesser degree than Option A.

***Figure 3.3-2: Short-/Medium Term Alternative Option B***

### 3.3.2 Long-Term Alternatives

The Long-Term Alternatives integrate the Quadrant Roadway concept, which showed the most potential for improving access and connectivity for Wellington Circle. Both at-grade and grade-separated concepts were considered, as described in the following sections.

#### *3.3.2.1 Dual Quadrant At-Grade Alternative*

Using the quadrant roadway concept as a framework, several at-grade alternative concepts were evaluated in more detail. Each concept is based on a dual quadrant roadway framework with a goal of reducing the existing five (5) to six (6) vehicular lanes on each approach to Wellington Circle to better accommodate cyclists and pedestrians. The dual quadrant framework would construct quadrant roadways on both the northeast and southeast corners of the primary signalized intersection. All the at-grade alternatives incorporate bicycle and pedestrian infrastructure, which are noted in light blue and tan respectively on the concept graphics. Three design concepts were developed based on the configuration of open space and roadways north of Route 16.

Each design concept for the at-grade dual quadrant roadway alternative is described below:

***Square Concept***

The Square Concept (Figure 3.3-3) features two dual quadrant roadways, with one providing a connection between the east and the north, and the other roadway providing a connection between the east and the south. Extensions of Middlesex Avenue and 9th Street in their direction of travel would be extended into the Circle, creating a small grid within the Circle and an approximately 140-foot by 240-foot rectangular area of green space on the north side of the Circle (hence the “Square” alternative). To travel between Fellsway south of the Parkway and Middlesex Avenue, vehicles would use the proposed extension of 9th Street within Wellington Circle, turning to or from Middlesex Avenue at its existing intersection with 9th Street. As part of this alternative, eastbound left turns are prohibited and could occur at Commercial Street to access Fellsway north of the parkway. It is not feasible to provide a crosswalk directly across Revere Beach Parkway at the eastern most portion of the Circle. This is due to three high volume vehicle movements through this intersection: northbound right, southbound left, and eastbound through. Due to these high volumes, there would not be enough available signal time to allocate to a pedestrian phase for the eastern leg of the intersection. Additionally, a pedestrian phase would not be able to run concurrently with traffic due to high vehicle turning volumes that would create conflict with crossing pedestrians.

Benefits:

- Simplifies overall geometry
- Creates open spaces for multimodal considerations and greenery
- Provides mostly protected, single-phase crossings for pedestrians

Drawbacks:

- Overall geometry maintains high number of vehicle lanes
- Requires additional signalized intersection at Middlesex Avenue at 9th Street
- Concurrent or multiple-phase pedestrian crossings would be required at some locations
- Lack of crosswalk at major desire line across Revere Beach Parkway on eastern portion of intersection

*Figure 3.3-3: Square Concept*


### *Triangle Concept*

Like the Square, the Triangle Concept (Figure 3.3-4) features dual quadrant roadways allowing for connections to and from the east, and an extension of 9$^{th}$ Street closer to the Circle. Unlike the Square Concept, however, in the Triangle Concept the extension of 9$^{th}$ Street, Fellsway, and the northeast quadrant roadway would all curve north of Route 16 to meet at a single intersection. This atypical geometry has the benefit of requiring one fewer signalized intersection and in turn reducing the potential for queue spillback between intersections. Additionally, Fellsway through traffic in both directions would need to turn at the intersection on the northern point of the triangle. Eastbound left turns are still prohibited in this alternative and could occur at Commercial Street to access Fellsway north of Route 16. Similar to the Square Concept, there is no crosswalk across Revere Beach Parkway on the east side of the Circle.

Benefits:

- Better able to process existing vehicle volumes
- Creates open spaces for multimodal considerations and greenery
- Allows future bicycle connections to Fellsway and Route 16
- Provides mostly protected, single-phase crossings for pedestrians

Drawbacks:

- Overall geometry is slightly atypical and maintains high number of vehicle lanes
- Concurrent or multiple-phase pedestrian crossings would be required at some locations
- Lack of crosswalk at major desire line across Revere Beach Parkway on eastern portion of intersection

*Figure 3.3-4: Triangle Concept*

### *Transit Enhanced Concept*

The Transit Enhanced Concept (Figure 3.3-5) is identical to the Triangle Concept with the addition of dedicated transit lanes approaching the Circle to accommodate existing MBTA bus routes 100, 108, and 134 which travel from north of the Circle to Wellington Station. The proposed inbound bus lane would begin on the right side of Fellsway in the southbound direction before Wellington Circle and would continue on the southbound right side of the proposed northeast quadrant roadway. The outbound transit lane would begin as a shared bus and right-turn lane in the westbound direction on Revere Beach Parkway. The northeast quadrant roadway would then provide a bus-only lane on the northbound right side of the roadway. Dedicated bus phase signals would be provided in both directions at the intersection of Fellsway at the northeast quadrant roadway and the extension of 9$^{th}$ Street. The existing bus stops on Fellsway just north of Wellington Circle would be maintained in their same general location as floating bus stops, with separated bicycle lanes wrapping around the outside of each stop.

Benefits:

- The transit lanes could be extended along Fellsway to the north of the Circle, if desirable
- Prioritizes and best serves the existing routes between Fellsway to the north and Wellington Station with dedicated lanes for transit services

Drawbacks:

- Not practical to create an eastbound transit lane on Revere Beach Parkway due to number of turning conflicts
- Lack of crosswalk at major desire line across Revere Beach Parkway on eastern portion of intersection

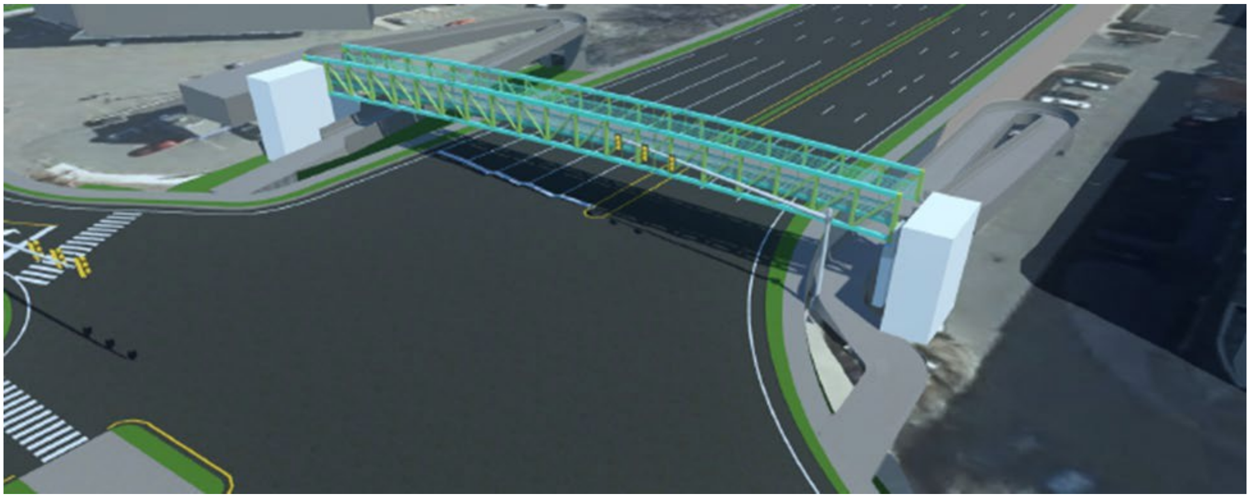
*Figure 3.3-5: Transit Enhanced Concept*


### *Pedestrian Bridge*

A pedestrian bridge (Figure 3.3-6) could address the missing crosswalk to the east of the quadrant roadways/across Revere Beach Parkway. The pedestrian bridge could be added to any of the Long-Term At-Grade Dual-Quadrant Alternative concepts.

The proposed pedestrian bridge would cross the eastern leg of Wellington Circle, connecting the Station Landing development on the south with the property occupied by the Boston Tattoo Company across Revere Beach Parkway (Route 16). A conceptual design of the bridge was developed that would provide a 14-foot wide shared-use path with pedestrian safety barriers on each side to meet the standards for a path shared by bicycle and pedestrians. The length of bridge required to span Revere Beach Parkway is 120 feet and is based on the standards in the AASHTO Guide for Planning, Design, and Operation of Pedestrian Facilities. It would provide 17 feet of vertical clearance for vehicles. The bridge ramps would provide a 10-foot wide shared-use path with pedestrian safety barriers on each side. The bridge ramps would be narrower than the path on the bridge to minimize potential property impacts. Each ramp would be 260-feet long (not including level landings) and have a maximum 7.5% grade.

***Figure 3.3-6: Pedestrian Bridge***



*Description: Concept Level Shared Use Path Bridge, Ramps and Stairways*

It is important to note that the figure shown represents an early-stage, conceptual level of design for the pedestrian bridge and ramps and stairways needed to access it. Potential stairway locations are shown as polygons in this sketch and would need to be designed in future stages of project development. The conceptual level of design outlines the overall function and form of the potential infrastructure changes but does not include the required final location of the bridge, final orientation of the ramps, the preferred design materials, and the structure type. Additional design based on a detailed survey of the property that incorporates feedback from stakeholders and abutting property owners would be required to define the final design of the pedestrian bridge, ramps, and stairways. Only after this additional design is complete could the full set of benefits and impacts be understood, including those related to permanent and/or temporary use of private property.

### *3.3.2.2 Grade-Separated Alternatives*

Given the high vehicular volumes through the project area, grade-separated alternatives were also evaluated to understand if they would provide advantages over the at-grade alternatives. Grade separation for both the east-west and south-east connections was considered due to their higher through volumes. As north-south volumes are lower than east-west, they were not considered for grade separation.

The east-west grade separation moved forward as an alternative due to its simpler configuration compared to a south-east grade separated structure. While south-east serves the heaviest vehicle volumes, it would not offer any advantage over the east-west connection and would require a more complex, curved structure and result in a larger at-grade intersection.

*Figure 3.3-7: Above Grade-Separated Single Quadrant (plan view)*

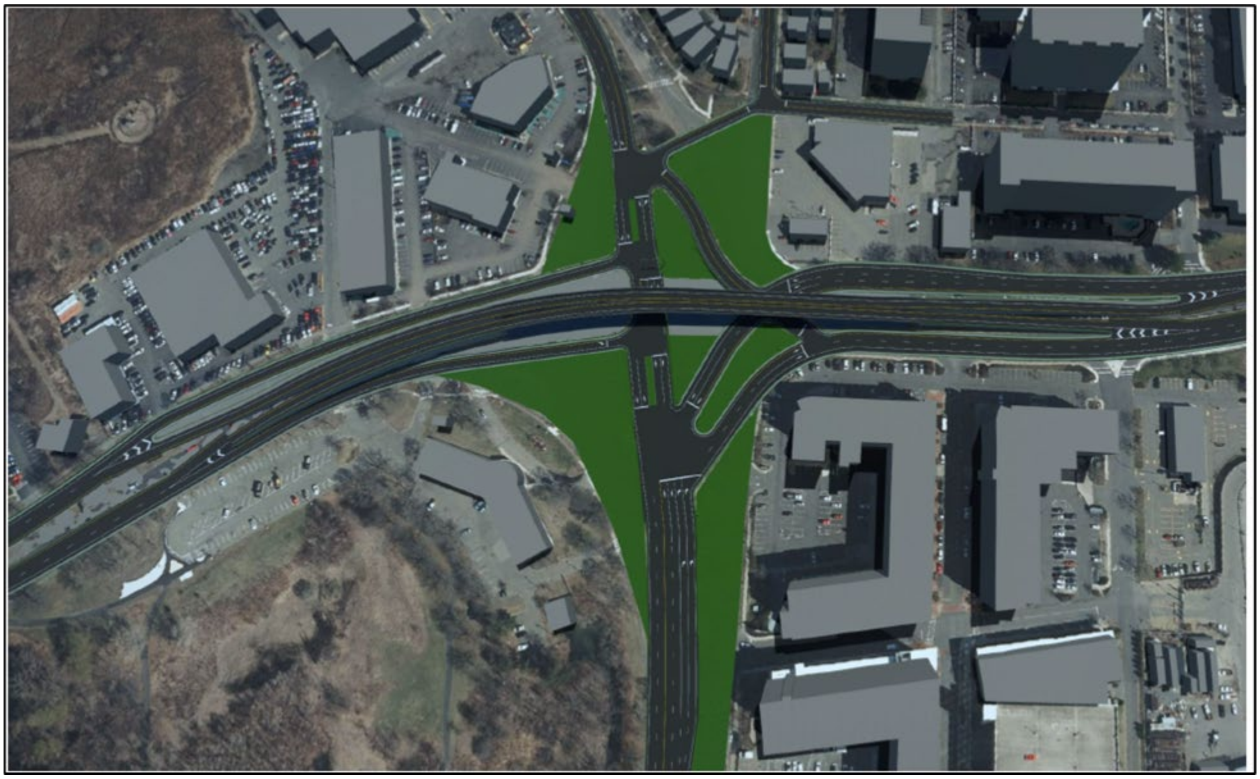
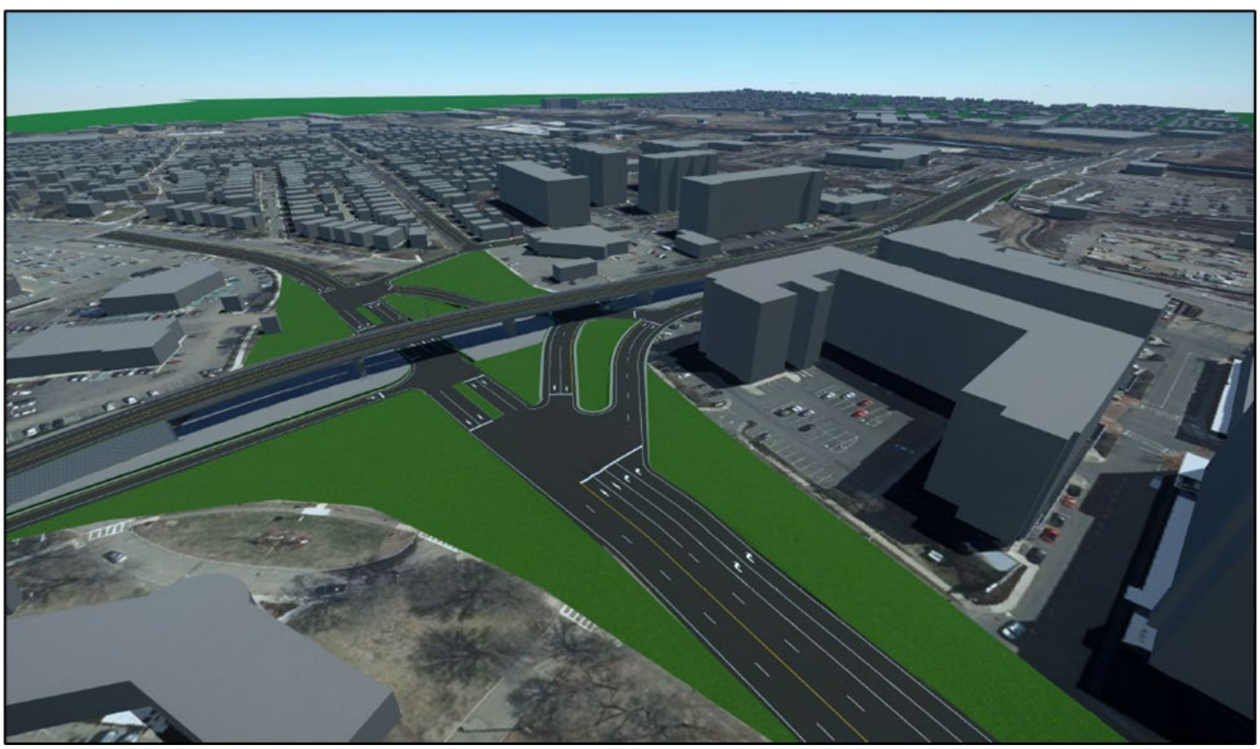


*Figure 3.3-8: Above Grade-Separated Single Quadrant (isometric view)*

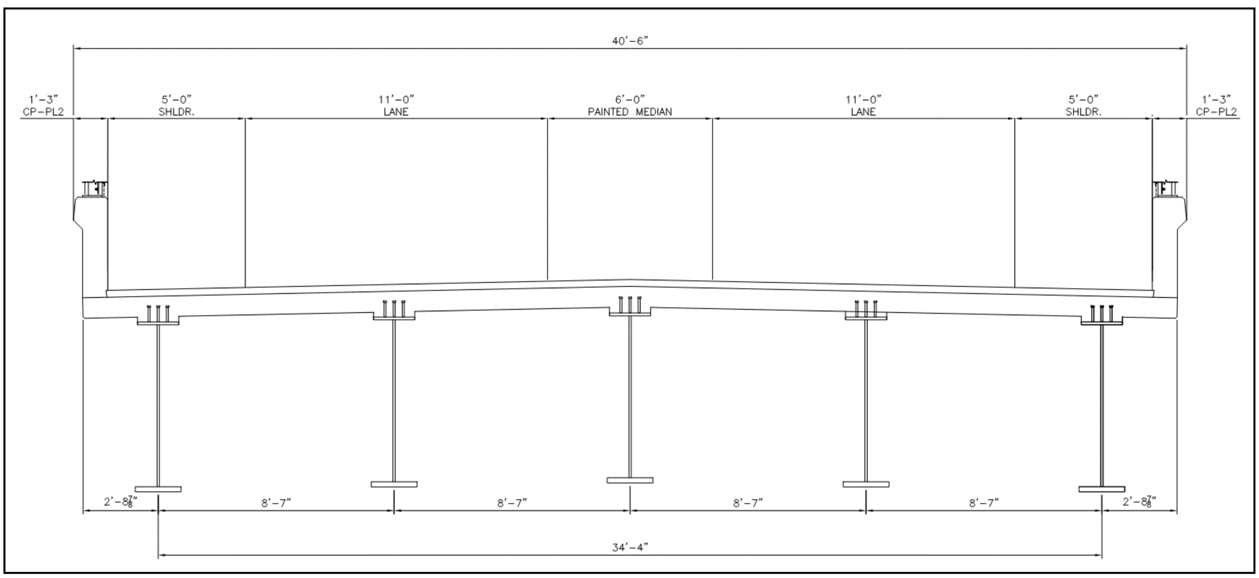


*Above-Grade Separated Single Quadrant*

A grade-separated single quadrant roadway (Figures 3.3-7 and 3.3-8) was developed as the primary grade-separated alternative. It contains an east-west bridge structure with a single lane in each direction. Surface roadways are configured to accommodate the heavy south to east connection, aligned around the bridge structure.

The Above-Grade Alternative provides an overpass carrying Route 16 as it travels east-west over the Wellington Circle Intersection. The overpass alignment was designed for 30 mph speeds and consists of a 640-foot long four-span continuous bridge. As shown in Figure 3.3-9, the total width of the bridge is 40’-6” and carries one 11-foot lane of travel in each direction with 5-foot shoulders, 6-foot mountable median for emergency vehicles, and 1’-3” wide barriers on both sides. There is no pedestrian or cyclist access on the bridge. Bicyclists could be accommodated with a wider cross-section, if desired.  Bicycle and pedestrian infrastructure would be created on the surface with the alternative as proposed.

***Figure 3.3-9: Overpass Bridge Geometry***




The bridge geometry is based on the MassDOT Bridge Manual. It maintains a 16’-6” vertical clearance above the intersection. The bridge depth is approximately 8 feet deep with 2’-8” tall barriers on top. The approach walls at the abutments are approximately 19-feet tall plus barrier on top. On the western end of the structure, the roadway descends at a 4% grade to tie into the existing roadways. For the eastern approach to the structure, a 5% grade was required to match the existing roadway before the adjacent railroad bridge. These grades and wall heights would require an approximately 475-feet long approach walls on each side of the bridge, resulting in a 1600-foot total structure length.

*Surface Roadways*

The remaining Wellington Circle roadways would remain at-grade and be reconfigured into several separate signalized intersections. The Route 28 northbound and southbound travel lanes would be realigned into a more direct north-south alignment and no longer separate at the intersections. Middlesex Avenue and Ninth Avenue would meet at a signalized intersection with a new connector road that connects both with Route 28 north of the Route 16 overpass. Ramps would be constructed to provide access from Route 16 to the surface roadways. The ramps function as an add-a-lane configuration with the Route 16 mainline beyond the bridge extents.

The new Route 16 ramps to and from the east would be constructed in a traditional diamond configuration with driveway access to adjacent properties provided from each ramp before they intersect with Route 28. The configuration for the new Route 16 ramps to and from the west would include a displaced intersection where the Route 16 westbound off-ramp traffic would intersect with a new roadway that connects Route 28 southbound traffic with the Route 16 eastbound on-ramp.

Driveway access to the adjacent properties would be provided on each ramp. Overall, Route 28 would form the major spine of travel along the surface with two lanes in each direction and the following four intersections from north to south:

- Route 28 at the Middlesex Avenue/Ninth Avenue Connector and the Route 16 Ramp Connector
- Route 28 at the Route 16 Westbound On-Ramp
- Route 28 at the Route 16 Eastbound Off-Ramp
- Route 28 at the Route 16 Eastbound On-Ramp and the Route 16 Westbound Off-Ramp

It is important to note that the figures shown represent an early-stage, conceptual level of design. The conceptual level of design outlines the overall function and form of the potential infrastructure changes but does not include the required final location of the bridge, final orientation of the ramps, surface roadway network, the preferred design materials, and the structure type. Additional design based on a detailed survey of the property that incorporates feedback from stakeholders and abutting property owners would be required to define the final design. Only after this additional design is complete could the full set of benefits and impacts be understood, including those related to permanent and/or temporary use of private property.

*Below-Grade Alternative*

A Below-Grade Alternative that would provide a tunnel carrying Route 16 below the Wellington Circle intersection was considered but not advanced through conceptual design. A preliminary review of the concept revealed several complicated issues that would make it more costly and disruptive to traffic operations than the Above-Grade Alternative. The first is that a tunnel would likely be at least 50% more expensive than a bridge of equal length and the length of the tunnel needed may require safety and fire suppression utilities. It would also require pumps to remove rainwater, with an annual operating cost. The second is the need to identify and relocate utility lines like the Massachusetts Water Resources Authority (MWRA) 48” water main following Route 28 and Middlesex Avenue that serves as an emergency back-up water supply. A tunnel would also be more difficult to stage construction and require increased support during excavation. The last reason identified is the potential for severe traffic impacts if the underpass were closed due to flooding during heavy rainstorms. The Massachusetts Coastal Flood Risk Model, created by Woods Hole Group, shows that the Wellington Circle area will be at risk for flooding due to coastal storms with a 20% annual chance of occurring by the year 2070.

*Benefits:*

- Removes major through movements from surface roadways, limiting the number of lanes required to handle existing volumes

*Drawbacks:*

- Surface roadways still require a high number of lanes in some locations
- The bridge acts as a visual barrier bisecting the Wellington Circle transit station from nearby residents and businesses

## 3.4 Final Alternatives

After developing concepts into more distinct alternatives, including both at-grade and grade-separated alternatives, four alternatives were advanced for evaluation to understand which best address the study goals. These alternatives include:

- Short-/Medium-Term (Options A and B)
- Long-Term At-Grade Dual Quadrant (Square and Triangle Concepts)
- Long-Term At-Grade Transit Enhanced Dual Quadrant
- Long-Term Grade Separated Single Quadrant

Chapter 4 describes the Alternatives Analysis process and provides a comparative evaluation of the alternatives.