TECHNICAL MEMORANDUM

DATE: **January 22, 2015**
TO: **Boston Region MPO**
FROM: **Chen-Yuan Wang, MPO Staff**
RE: **Washington Street Subregional Priority Roadway Study in Newton**

The roadway segment of Washington Street between Chestnut Street and Church Street in Newton was selected for analysis in a project funded by the Boston Region MPO for federal fiscal year (FFY) 2014, "Addressing Safety, Mobility, and Access on Subregional Priority Roadways." The work program for this corridor study was approved on September 12, 2013, and the selection was approved on December 19, 2013.

1 INTRODUCTION

This memorandum summarizes the existing conditions and issues, roadway operations and safety analyses, and proposed short- and long-term improvements for the entire study corridor and for specific locations. It contains the following sections:

1. Introduction
2. Existing Conditions and Issues
3. Crash Data Analysis
4. Roadway Operations Analysis
5. Proposed Improvements
6. Summary and Recommendations

This memorandum also includes technical appendices that contain the data and methods that were applied in the study.

1.1 Study Background

During the MPO's outreach for the development of the Unified Planning Work Program (UPWP) and the Long-Range Transportation Plan (LRTP), Metropolitan Area Planning Council (MAPC) subregional groups and other entities submit comments and identify transportation problems and issues that concern them. These issues are related to some or all of the following: bicycle, pedestrian, and

freight accommodation; bottlenecks; safety; and lack of safe or convenient access for abutters along roadway corridors. They can affect not only mobility and safety along a roadway and its side streets, but also quality of life, including economic development and air quality.

This study was undertaken to identify roadway corridors in the MPO region that are of concern to Boston Region MPO subregional groups but that have not been identified in the LRTP regional Needs Assessment. It focused on the issues that were identified by relevant subregional groups, and developing improvement recommendations to address those issues. In addition to mobility, safety, and access, the study considered transit feasibility, truck issues, bicycle and pedestrian transportation, and other topics.

1.2 Selection Procedure

The Washington Street corridor was selected through a comprehensive process. First, MPO staff identified potential study locations using various sources: soliciting suggestions during the outreach process for the FFY 2014 UPWP; reviewing meeting records from the UPWP outreach process for the past five years; and appraising potential locations from the list of monitored roadways in the MPO's Congestion Management Process (CMP) program.

MPO staff identified 29 roadway corridors in the MPO region as potential study locations. The staff then assembled detailed data on the identified roadways and evaluated them according to five selection criteria:

- *Safety*: The location has a high crash rate for its functional class,[1] or contains areas with a high number of crashes or with a significant number of pedestrian-bicycle collisions.
- *Multimodal Significance*: The location supports transit, bicycle, or pedestrian activity, or has an implementation project to support one or more of these activities.
- *Subregional Significance*: The location carries a significant proportion of subregional vehicle, bicycle, or pedestrian traffic.
- *Subregional Priority*: The location is endorsed by a subregion and is a priority for the subregion.
- *Implementation Potential*: The location was proposed by the roadway agency or related agencies that have identified prospective funding sources for design and implementation.

[1] The location has a segment crash rate (crashes per million vehicle-miles traveled) higher than the statewide average for its functional class.

The selected corridor is a four-lane roadway that serves residents, commuters, and local businesses, and supports transit—Massachusetts Bay Transit Authority (MBTA) bus service and access to commuter rail stations on the Framingham/Worcester Line. The City of Newton expressed interest in this corridor study, which focused on 1) urban design and multiuse roadways that have pedestrian and bicycle facilities; 2) improved transportation access and mobility; and 3) safety enhancements.

1.3 Study Objectives

The objectives of this study were to:

- Identify the safety, mobility, access, and other transportation-related problems in the corridor.
- Develop and evaluate potential multimodal transportation solutions to the problems, including pedestrian, bicycle, truck, and transit modes.

1.4 Study Area and Data Collection

This study focused on a two-mile corridor of Washington Street between Chestnut Street in West Newton and Church Street near Newton Corner. The selected roadway segment is under the jurisdiction of the City of Newton, but the Massachusetts Department of Transportation (MassDOT) Highway Division District 6 Office oversees the area's roadway improvement projects.

With the assistance of MassDOT and the City, MPO staff collected extensive roadway traffic and speed data; intersection turning-movement counts, including pedestrian and bicycle movements and the percentages of heavy vehicles (trucks and buses); information about on-street parking regulations and adjacent developments; and multiple-year crash reports.

1.5 Input from City Staff and Public Involvement

During the course of the study, MPO staff worked closely with the City's transportation team. Three major meetings were conducted to support the study.

The purpose of the first meeting, hosted by the City on February 26, 2014, was to introduce the study and to get input on the issues and concerns about the study corridor from members of the public, including the area's residents, business owners, and citizen groups. The second meeting, conducted by MPO staff on July 31, 2014, focused on reviewing the findings and preliminary improvement proposals with the City's transportation team and MassDOT District 6 staff. At the last meeting, which was held on November 19, 2014, and was open to the public, MPO staff presented the study findings and improvement proposals to the

City's Public Facilities Committee and Public Safety and Transportation Committee.

2 EXISTING CONDITIONS AND ISSUES

This section examines the corridor's location; roadway configurations; adjacent developments; public transportation facilities; parking regulations; and observed traffic, pedestrian, and bicycle conditions. It also summarizes the issues and concerns raised in the first public meeting and issues identified from observations of the existing conditions.

2.1 Study Corridor and Major Transportation Facilities in the Area

Washington Street is a major regional roadway for Newton and the adjacent communities. It begins at the Wellesley-Natick border as part of state Route 16, continuing northeast through Wellesley into Newton Lower Falls, where it intersects Interstate 95/Route 128 at Exit 21. It connects with Interstate 90 at Exit 16 in Auburndale before turning east, running parallel with I-90 into Newton Corner. After crossing I-90 again at Exit 17, it turns southeast into Brighton and Brookline, ending at state Route 9 in Brookline Village.

The study corridor, between Chestnut Street and Church Street, contains most of Washington Street that is parallel to I-90 and carries a high proportion of commuting traffic. In addition, it functions like a service road for I-90 between Exit 16 (West Newton) and Exit 17 (Newton Corner), providing access to the neighborhoods in Newton, Waltham, and Watertown on both sides of I-90. Locally, the corridor links three major Newton villages (neighborhoods): West Newton, Newtonville, and Newton Corner.

Figure 1 shows the location of the study corridor and major transportation facilities in the area. Located on the north side of I-90, the entire corridor is classified as a minor urban arterial. It is a four-lane roadway with on-street parking allowed on both sides for most of its length. There are sidewalks on both sides of the roadway. The roadway, which currently contains no separate bicycle lanes, is designated as a bicycle route for advanced (experienced) cyclists (see Appendix A: Newton Bicycle Map).

The adjacent land uses are mainly multifamily residential and business, with some institutional and parkland use. The land uses in the area between Chestnut Street and Lowell Avenue are mainly residential, except the area near West Newton (business and office). Land use in the area adjacent to Newtonville (between Lowell Avenue and Harvard Street) is mainly business. Land use in the area between Harvard Street and Church Street) is mixed, with businesses,

offices, apartments and condos, schools, institutions, and parkland (see Appendix B, Newton Zoning Map).

The study area contains a dense roadway network. The selected Washington Street corridor intersects three other minor arterials—Chestnut Street, Walnut Street, and Crafts Street—and a few collector roadways: Lowell Avenue, Lewis Terrace, Adams Street, and Jackson Road. In total, there were seven signalized intersections and a few major unsignalized intersections that had stop controls on side streets. The corridor also contains a high number of driveways from adjacent business developments.

2.2 MBTA Transit Services in the Area

In the study area, there are various transit services provided by the MBTA, including several express and local buses and the Framingham/Worcester commuter rail line. The bus routes run mainly along arterials and major collector roadways. The commuter rail line runs along the north side of I-90 just south of the study corridor. Figure 2 shows these services in the study area.

Transit services in the study corridor consist of four express bus routes (Routes 553, 554, 556, and 558) that run to and from Downtown Boston, and two commuter rail stations, Newtonville and West Newton, on the Framingham/Worcester Line. The four bus routes mainly serve commuters and local travelers in Newton and Waltham. Routes 553 (Brandeis/Roberts–Downtown Boston) and 554 (Waverley Square–Downtown Boston) traverse the entire corridor, with about 10 stops in each direction. Routes 556 (Waltham Highlands–Downtown Boston) and 558 (Auburndale–Downtown Boston), traversing only part of the corridor, divert from the corridor at Walnut Street and Adams Street, respectively.

The MBTA 2014 bus ridership and service statistics indicate that the four bus routes together serve about 1,400 riders (about 2,600 inbound and outbound boardings) per weekday. According to the 2008–09 MBTA Systemwide Passenger Survey, 56.9 percent of the total trips on the four bus routes are regional (Newton/Waltham–Boston), 19.1 percent are local (Newton–Newton, Waltham–Waltham, or Newton–Waltham), and 24 percent are trips to and from other communities.

For commuter rail service, the survey focused on inbound riders, whose purpose is predominantly commuting (which is referred to as a “home-based work” trip purpose in the MPO’s regional travel demand model) from Newton to Downtown Boston. The survey data indicate that there were 240 riders boarding the line at Newtonville Station, and 230 riders at West Newton Station. Walking and driving-

parking are two major means of access. At Newtonville, about 20 percent of the riders parked their cars near the station.

Further analyses of the ridership and trip characteristics of the four bus routes and the two commuter rail stations are presented in Appendix C.

In the study area, there are also a number of bus connections at various locations along Washington Street. At Newton Corner, the bus routes that connect are Route 52 (Watertown–Dedham), Route 57 (Watertown–Kenmore Square), and two other express buses: Route 502 (Watertown–Copley Square) and Route 504 (Watertown–Downtown Boston). At Newtonville Station, the connecting bus route is Route 59, which runs between Needham and Watertown. At West Newton Station, the connecting bus is Route 170, which travels to Downtown Boston from Waltham. Among these bus connections, Newton Corner is especially attractive because of high number of express bus routes to Downtown Boston.

2.3 Traffic, Pedestrian, and Bicycle Volumes

The study corridor carries both local and regional traffic from residents and businesses in the study area and vicinity. It is also an alternative to I-90 for people commuting to Boston, Brookline, Newton, and adjacent communities. Based on the traffic counts conducted in April 2014 by MassDOT for this study, the corridor carried about 14,000 to 26,000 vehicles per weekday.

Figure 3 shows traffic volumes on Washington Street and at major intersections in the study corridor. The volumes represent recently observed traffic flows in the morning and evening peak hours of a typical weekday. As a reference, average daily traffic (ADT) volumes at eight locations in the corridor are also cited in Figure 3. Generally the daily volumes in the westbound direction are about 3 to 4 percent higher than in the eastbound direction at almost all of the count locations.

The traffic volumes increase gradually from the western to the eastern segments of the corridor. In the morning, traffic gradually feeds into the corridor from local streets—Lowell Avenue, Walnut Street, Harvard Street, Crafts Street, Adams Street, and Jackson Road—mainly in the eastbound direction. Some traffic leaves the corridor, but most of the traffic continues to Newton Corner. In the evening, the corridor has a reverse traffic pattern, with traffic peaking in the westbound direction and gradually leaving the corridor.

Turning movements at major intersections in the corridor were also collected for the study, in 15-minute intervals between 7:00 to 9:00 AM and 4:00 to 6:00 PM. Traffic movements in the morning and evening peak hours were then identified

and summarized for operational analyses. In general, each of the signalized intersections carries a total volume of entering vehicles ranging from 1,450 (at Chestnut Street) to 2,650 vehicles (at Jackson Road) per peak hour, and each of the unsignalized intersections carries a total volume ranging from 1,150 (at Armory Street) to 1,650 vehicles (at Harvard Street) per peak hour.

It is essential to examine the proportion of heavy-vehicle traffic in a corridor, since an unusually high share of heavy vehicles may seriously affect roadway and intersection operations. The recent counts indicate that the study corridor carries a heavy-vehicle percentage that is lower than the average for urban minor arterials, with about 2 percent to 3 percent of the daily traffic and 1 percent to 2 percent of the peak-hour traffic.

The intersection turning-movement counts also included pedestrian crossings and bicycle counts. The pedestrian crossing counts indicate that pedestrians are active in the study corridor, especially in the business districts in Newtonville. The intersection of Washington Street at Walnut Street experiences about 100 to 150 pedestrian crossings per peak hour.

The bicycle counts at major intersections indicate that on average 5 to 10 bicycles traveled on or crossed the corridor per peak hour on a spring weekday. Intersections on major bicycle routes, such as Jackson Road, Adams Street, and Walnut Street, carried higher bicycle volumes (about 11 to 14 bicycles per peak hour). It should be noted that these observations were performed on April 9, 2014, which was a relatively cold early spring day. The volumes are assumed to be higher in the late spring, summer, and early fall, when the weather is warmer.

2.4 On-Street Parking Conditions

There is on-street parking on both sides of the roadway in most segments of the corridor. In total, there are 558 parking spaces, under varying regulations depending on their locations. They comprise 357 spaces on the south side and 201 spaces on the north side.[2]

Table 1 summarizes the parking regulations for these spaces. For some of the spaces, the number of spaces was estimated by using 22 feet per space length, since those spaces are not metered and have no space delineation.

[2] Off-street parking is limited in the corridor. They are mainly associated with three major commercial developments: Whole Foods Market, Marty's, and Trader Joe's.

TABLE 1
Summary of Parking Spaces by Regulation

Parking Regulation	South Side	North Side	Both Sides
Meter: 1-hour limit	0	60	60
Meter: 2-hour limit	19	21	40
Meter: 12-hour limit	107	0	107
Free: 1-hour limit	4	12	16
Free: 2-hour limit	50	25	75
No regulation	177	83	260
Total	**357**	**201**	**558**

Tables 2 and 3 further summarize the parking spaces, by the street segment, by the associated land use, and by regulation, for the south and north side, respectively. In general, the spaces are metered, with a 1-, 2-, or 12-hour limit in the business areas, or free, with a 1-hour limit, 2-hour limit, or no limit, in the residential and other areas. The 12-hour metered parking spaces, 107 in total, are distributed around Newtonville Station and are mainly intended for commuter rail riders.

TABLE 2
Summary of South Side Parking Spaces by Location and Regulation

Street Segment	Land Use	Regulation	Number of Spaces
Chestnut Street - Armory Street	Commercial	No regulation	30
	N/A	No regulation	24
Armory Street - Lowell Avenue	N/A	No regulation	100
Lowell Avenue - Walnut Street	N/A	Meter: 2-hour limit	7
	N/A	Meter: 12-hour limit	17
Walnut Street - Harvard Street	N/A	Meter: 2-hour limit	12
	N/A	Meter: 12-hour limit	69
Harvard Street - Crafts Street	N/A	Meter: 12-hour limit	21
	Commercial	Free: 1-hour limit	4
Crafts Street - Jackson Road	Commercial/office/ residential	No regulation	23
Jackson Road - Church Street	N/A	Free: 2-hour limit	50
Total			**357**

N/A = not applicable (vacant or adjacent to commuter rail tracks)

TABLE 3
Summary of North Side Parking Spaces by Location and Regulation

Street Segment	Land Use	Regulation	Number of Spaces
Church Street - Jackson Road	Residential/office	Free: 1-hour limit	12
	School/office/residential	Free: 2-hour limit	25
Jackson Road - Crafts Street	Institutional	Prohibited	0
Jackson Road - Crafts Street	Residential	No regulation	7
Crafts Street - Harvard Street	Commercial	Prohibited	0
	Commercial	Meter: 2-hour limit	9
Harvard Street - Walnut Street	Commercial	Meter: 1-hour limit	30
	Commercial	Meter: 2-hour limit	12
Walnut Street - Lowell Avenue	Commercial	Meter: 1-hour limit	20
Lowell Avenue - Armory Street	Residential/commercial/office	No regulation	52
Armory Street - Chestnut Street	Commercial/office/residential	No regulation	24
	Commercial	Meter:1-hour limit	10
Total			**201**

The corridor has a wide range of land use activities, including commercial, office, residential, institutional (school and others), and recreational (parkland). Most of the land use activities are on the north side, since land use on the south side is limited because the area is adjacent to commuter rail tracks and I-90. The corridor has about 150 more parking spaces on the south side than on the north side. To reach the developments on the north side of Washington Street, people parking on the south side of the street have to cross four lanes of fast-moving traffic and that are busy during the peak hours.

Field observations indicate that parking utilization varies widely along the corridor. The metered and free parking spaces in the commercial areas between Chestnut Street and Armory Street are generally utilized during daylight business hours (about 70 percent to 80 percent of the spaces are occupied then). The free parking spaces in the residential areas between Cross Street and Lowell Avenue are sparsely occupied, except the section adjacent to Lowell Avenue, where the

south side's free spaces are usually fully occupied during daylight business hours.[3]

The short-term (1-hour and 2-hour) metered spaces in Newtonville are frequently utilized (about 80 percent or more of the spaces are occupied), especially in the area adjacent to Walnut Street. The 12-hour parking spaces distributed between Lowell Avenue and Crafts Street are generally underutilized (about only half of the spaces are occupied).
Between Crafts Street and Jackson Road, the free and metered parking spaces for adjacent businesses, offices, and residences are generally utilized during business hours. Between Jackson Road and Church Street, the free short-term parking spaces are generally fully occupied during the day. They are intended for visitors of the adjacent schools, institutions, offices, Newton Veterans Memorial Park, and the residences and offices near Church Street. However, some of the spaces might be used by Boston-bound commuters and visitors who are transferring to buses at Newton Corner.

2.5 Issues and Concerns

In the February 2014 study-scoping meeting, which was also a listening session, residents and business owners raised a number of issues and concerns related to the safety and operations of the corridor. Their comments, summarized by location and issue category, are in Appendix D.

The issues and concerns related to the corridor in general, based on comments from the meeting and the above existing-conditions analyses, are summarized below:

- High travel speeds and unsafe conditions for all users due to multiple-lane traffic operations
- Difficult and unsafe pedestrian crossings, including access to bus stops
- Lack of bicycle accommodations
- High number of pedestrian and bicycle crashes
- Inconvenient and unsafe access from Washington Street to adjacent businesses and residences
- Limited sight distances to Washington Street from side streets due to roadway geometry and parking at street corners

[3] These approximate parking occupancy data were derived from quick observations during a number of site visits between April and July, not from actual counting in a continuous period or at different periods of a day.

- Parking management and enforcement issues
- Noise from I-90
- Insufficient lighting

3 CRASH DATA ANALYSIS

Crash data are an essential source for identifying safety and operational problems in a study area. Analyses of crash locations, collision types, time-of-day, roadway conditions, and other factors also assist in developing improvement strategies. MPO staff collected two sets of data for the analyses. The two datasets are:

- 2007–11 MassDOT Registry of Motor Vehicles Division Crash Data
- Recent three-plus-years (January 2011 through February 2014) crash reports from the Newton Police Department

The five-year MassDOT data were used to examine the crash locations and crash rates. The Newton police reports were used to construct collision diagrams for further analysis of safety and operational problems at major intersections and in different segments.

3.1 Crash Locations and Crash Rates

Figure 4 shows the crash locations and crash rates at major intersections and in different segments of the corridor during the five-year period 2007–11. Among the 434 crashes that occurred in the corridor during that time period, 267 were identified as having occurred at the nine major intersections, and 167 in the segments between those intersections.

The crash rates at the intersections and in the roadway segments were calculated. Among the seven signalized intersections, the crash rates at Chestnut Street (0.96), Adams Street/Lewis Terrace (1.05), and Church Street (0.90) are higher than the MassDOT District 6 average of 0.76 crashes per million entering vehicles. The crash rate at the Walnut Street intersection is calculated as 0.69 crashes per million entering vehicles, which is slightly lower than the District 6 average.

For unsignalized intersections, the crash rate at Armory Street (1.04) is higher than the MassDOT District 6 average of 0.58 crashes per million entering vehicles, and the crash rate at Harvard Street is 0.49 crashes per million entering vehicles, which is slightly lower than the District 6 average.

The segment crash analysis indicated that the crash rates in the segments that have primarily business uses—Chestnut Street–Armory Street (5.13), Lowell Avenue–Walnut Street (5.87), Walnut Street–Harvard Street (4.80), and Harvard Street–Crafts Street (6.70)—are all higher than the state average for urban minor arterials of 3.63 crashes per million miles traveled. The crash rates in the segments with mostly institutional and office land uses— Crafts Street–Adams Street (2.21) and Jackson Road–Church Street (2.02)—are lower than the state average. The crash rate in the segment that is mostly residential—Armory Street–Lowell Avenue (1.60)—is much lower than the state average.

3.2 Pedestrian and Bicycle Crashes

Figure 4 also shows the pedestrian and bicycle crash locations in the corridor that were identified from both of the datasets in the recent period of slightly more than seven years. In total, 21 pedestrian crashes and 16 bicycle crashes were identified at various locations in the corridor.[4]

On average, about five crashes involved at least one pedestrian or cyclist per year in this corridor. The locations with a high rate of pedestrian and bicycle crashes are:

- Adams Street/Lewis Terrace Intersection: five bicycle crashes (2010–12) and three pedestrian crashes (2007–09)
- Segment adjacent to Newtonville Station: three pedestrian crashes (2010–2013) and one bicycle crash (2010)
- Segment between Walnut Street and Lowell Avenue: three pedestrian crashes (one in 2010 and two in 2012)
- Harvard Street Intersection: three pedestrian crashes (2007–2012)
- Walnut Street Intersection: two pedestrian crashes (2007 and 2008) and one bicycle crash (2012)
- Lowell Avenue Intersection: two bicycle crashes (2008 and 2013) and one pedestrian crash (2010)
- Chestnut Street Intersection: three pedestrian crashes (2011–13)

[4] In this study, the term “pedestrian crashes” refers to the crashes that involve at least one vehicle and one pedestrian, and the term “bicycle crashes” refers to crashes involving at least one vehicle and one bicycle. No crashes involving at least one bicycle or one pedestrian were identified from the available data.

- Crafts Street Intersection: two pedestrian crashes (2007 and 2009) and one bicycle crash (2012)[5]

3.4 Intersection Crash Analyses

To further investigate safety and operational problems, MPO staff summarized the crash data for the study intersections according to crash severity (property damage only, non-fatal injury, fatality, unknown), collision type (single-vehicle, rear-end, angle, sideswipe, head-on, rear-to-rear, unknown), pedestrian or bicycle involvement, time of day, pavement conditions, and light conditions.

Crash statistics for the intersections in each dataset are summarized in Table E-1 and Table E-2 in Appendix E, respectively. The data show that the number of crashes in the three recent years at Chestnut Street, Armory Street, Lowell Avenue, Harvard Street, and Church Street has been decreasing slightly, while the number of crashes at Walnut Street Intersection has increased slightly. The other intersections remain about the same.

The collision diagrams for the intersections, which cover more than three years, were constructed by using recent crash reports provided by the Newton Police Department. The crash reports contain detailed information about how and where those crashes occurred. The collision diagrams for the intersections, in order from west to east, are in Appendix F. The date and time, severity, collision type, road conditions, and contributing factors for each of the crashes used in the analysis are also summarized in tables, which follow their respective collision diagrams, in Appendix F.

Major factors affecting intersection operations and findings from the collision diagrams for each of the intersections are summarized below:

Washington Street at Chestnut Street (Figure F-1 and Table F-1)

- High westbound left-turn traffic volume during peak hours
- Most crashes involved a westbound left-turning vehicle
- Two pedestrian crashes in the last two years

Washington Street at Armory Street (Figure F-2 and Table F-2)

- The low-volume Armory Street traffic, under a stop control, increasing primarily in the PM peak hour and weekend midday hours.
- Most Trader Joe's traffic exits from its driveway east of the intersection, not from Armory Street.

[5] The intersection was reconstructed in 2012; countdown pedestrian signals were installed at that time.

- Three crashes at the Trader Joe's driveway.

Washington Street at Lowell Avenue (Figure F-3 and Table F-3)

- Located in the path to Newton North High School
- No noticeable patterns of crashes
- One bicycle crash in 2013
- One pedestrian crash in 2012

Washington Street at Walnut Street (Figure F-4 and Table F-4)

- High number of crashes in recent years
- High number of left-turn crashes
- Four crashes possibly related to the parking maneuvers near the intersection
- One pedestrian crash and one bicycle crash in 2012

Washington Street at Harvard Street (Figure F-5 and Table F-5)

- Unsignalized intersection adjacent to the stairs from Harvard Street to the Newtonville Station commuter rail platform
- Recently installed pedestrian crossing warning beacon (rectangular rapid flashing beacon)
- One pedestrian crash at the intersection in 2012
- One bicycle crash involving a parked car near the intersection

Washington Street at Crafts Street (Figure F-6 and Table F-6)

- Recently reconstructed intersection (2012) with pedestrian countdown signals
- High number of crashes related to parking at, and exiting from, the adjacent Tedeschi Food Shops, which appears to be in decline after the intersection was reconstructed
- One bicycle crash in 2011

Washington Street at Adams Street/Lewis Terrace (Figure F-7 and Table F-7)

- High traffic volumes on all approaches during peak hours
- High number of crashes in recent years
- High number of left-turn crashes
- Four bicycle crashes in 2011 and 2012

Washington Street at Jackson Road (Figure F-8 and Table F-8)

- Traffic signals under the same controller as at Adams Street/Lewis Terrace
- High traffic volumes on Washington Street during peak hours
- Mostly rear-end collisions on Washington Street
- No pedestrian or bicycle crashes

Washington Street at Church Street (Figure F-9 and Table F-9)

- High traffic volumes on Washington Street during peak hours
- Limited space between on-street parking and travel lanes
- High number of rear-end and sideswipe collisions on Washington Street
- No pedestrian or bicycle crashes

3.5 Segment Crash Analyses

Based on the Newton Police crash reports, MPO staff constructed collision diagrams for the segments between major intersections. The collision diagrams for these segments, in order from west to east, are included in Appendix G. The date and time, severity, collision type, road conditions, and contributing factors for each of the crashes used in the analysis are summarized in tables that follow their respective segments, in Appendix G.

In general, the segments that have commercial developments experience many more crashes than those with residences, offices, and institutions. The major findings from the analyses of all of the segment collision diagrams are summarized below:

- Nearly 25 percent of the total crashes involved a parked or parking vehicle, mainly in the commercial segments
- About 20 percent of the total crashes were related to vehicles' going to and from these commercial developments[6]
- Two midblock-crossing pedestrian crashes, one near the post office and one near Newtonville Station
- Three bicycle crashes, two involving a turning vehicle and one a rear-end crash

[6] This percentage does not include some rear-end collisions that might have been caused by a vehicle on Washington Street waiting to turn into adjacent developments.

4 ROADWAY OPERATIONS ANALYSIS

To address issues and concerns related to roadway operations, this section examines the roadway's prevailing travel speeds, existing roadway cross-sections, and operations at major intersections, and explores an alternative roadway design for accommodating pedestrians and bicycles and improving access to and from adjacent developments. It also examines the roadway's operations under various projected future-year traffic conditions.

4.1 Roadway Travel Speeds

High travel speeds in the corridor are a major concern of the area's residents. In order to understand how fast drivers travel in the corridor, MPO staff requested MassDOT's assistance in collecting spot speeds during the period when automatic traffic counts were being conducted, in April 2014. The speed counts were collected at five selected locations in the corridor from April 7 to April 9. Appendix H summarizes the average and 85th percentile speeds for each location.

The "85th percentile" is the principal value used for establishing speed controls. It is the speed at or below which 85 percent of vehicles passing a given point are traveling. Currently most segments in the corridor are posted with a 35 mph (miles per hour) speed limit, except for the segments west of Davis Court and east of Jewett Street, where the speed limits are 25 mph.

Table 4 shows the observed 85th percentile speeds and the posted speed limits at the five selected locations in the corridor.[7] In general, the eastbound speeds gradually decrease from west to east and the westbound speeds gradually increase from east to west. The 85th percentile speeds indicate that most vehicles in the corridor travel within a range of plus or minus 5 mph of the 35-mph speed limit. Note that there was roadside construction work on water supplies in the corridor at the time of the observations, and most of the speed counts were performed only on the curb lane in both directions (except the last location). Because of these factors, the actual travel speeds should be assumed to be somewhat higher than those shown in Table 4.

[7] Data shown in Table 4 are the average of three weekdays' observations from April 7 to 9 in 2014. The 85th percentile speeds were derived from spot speed data collected from automatic traffic recorders. To establish or modify speed controls, MassDOT requires that data be collected using radar or laser guns at critical locations for an area not to exceed 0.25 miles, in addition to vehicle trial runs in the study area.

TABLE 4
Observed 85th Percentile Speeds in the Corridor

Speed Study Location	Eastbound Speed	Westbound Speed	Posted Speed Limit
1. Washington Street west of Armory Street	37.2 mph	35.3 mph	35 mph
2. Washington Street west of Cross Street	38.9 mph	33.9 mph	35 mph
3. Washington Street west of Walker Street	37.6 mph	35.1 mph	35 mph
4. Washington Street west of Harvard Street	34.0 mph	33.7 mph	35 mph
5. Washington Street west of Adams Street	29.4 mph	33.9 mph	35 mph

The nearly 40 mph travel speeds observed at various locations in the corridor are not considered unusual for roadways with a speed limit of 35 mph. The current speed regulations in the corridor generally comply with the MassDOT speed zoning requirements.[8]

Operating speeds on roadways generally conform to design conditions. Lowering the posted speed limit without related design reconfigurations is unlikely to meaningfully reduce travel speeds.

4.2 Existing Roadway Cross-Sections

The top graphic in Figure 5 shows a roadway cross-section that is typical of most segments of the study corridor, presenting the street view of an eastbound driver. The four-lane roadway generally has two travel lanes, each of them about 11.5 feet wide and on-street parking (about seven feet wide) in each direction. There are no separate bicycle lanes. Cyclists have to ride with the outside-lane traffic and close to the parked (or parking) vehicles.

There are sidewalks on both sides of the roadway. On the north side, they are eight feet wide in most of the corridor segments. Some sidewalks in the commercial districts have a width of 10 to 12 feet, mainly in the area west of Armory Street. On the south side, the sidewalks are generally located next to the commuter rail fence, and have a width of five feet or less. Some are unpaved in the areas that are far from the commercial districts.

[8] MassDOT procedures for speed zoning require that at speed observation locations, the established safe speed shall not be more than 7 mph below the 85th percentile speed, and not higher than the 95th percentile speed. See *Procedures for Speed Zoning on State and Municipal Roadways*, MassDOT Highway Division, May 2012.

Most of the segments in the corridor have a roadway surface width (curb to curb) of about 60 feet. Some segments in the residential districts, from Armory Street to Lowell Avenue, have a surface width of 58 feet or less. The segment adjacent to Newtonville Station has a roadway surface that is wider than the other segments in the corridor, of about 80 to 85 feet.

The bottom graphic in Figure 5 shows that the segment adjacent to Newtonville Station has a roadway width of about 80 to 85 feet. It contains four 12-foot travel lanes, 7-foot parallel parking on the north side, and 60-degree angle parking on the south side that takes about 25 to 30 feet of roadway width. There are sidewalks on both sides of the roadway. There are no bicycle lanes. Although on the south side bicycles have a wider space between the angle parking and the outside-lane traffic, it is difficult for drivers who are backing out from the angle parking to see them, making this an unsafe area for cyclists.

Some of the major issues and concerns related to the existing roadway include:

- Lack of separate or safe bicycle accommodations
- Residents disfavor high travel speeds that are encouraged by roadway design
- Unsafe pedestrian crossings due to large roadway surface widths and high travel speeds
- Lack of a dedicated turning lane for accessing adjacent developments
- On-street parking and outside-lane traffic encroaching on each other
- Narrow and unpaved sidewalks along the south side of the street
- Closely spaced curb cuts in some commercial districts

4.3 Potential Roadway Cross-Sections (Designs)

The recent counts indicate that most segments of the corridor (about 70 percent) carry an average daily traffic of fewer than 20,000 vehicles. These segments have the potential for a “road diet” application, which would involve reducing the number of travel lanes from four to three in order to accommodate bicycles and to improve safety for pedestrians crossing the roadway and for vehicles accessing adjacent developments.

The top graphic in Figure 6-1 shows the potential three-lane roadway cross-section that could be applied to most of the existing four-lane roadway. The cross-section contains a 12-foot center median or left-turn-only lane, two 11-foot travel lanes (one in each direction), two 6-foot bicycle lanes (one in each direction), and a 7-foot parking lane on both sides.[9]

[9] The use of a three-lane cross-section such as this is not limited to roadways with a daily traffic volume of fewer than 20,000 vehicles. Its application depends on a number of factors, including traffic flow patterns, the spacing of major intersections, adjacent land uses, and consideration of modes other than motor vehicles. A recent MassDOT project for improving

The 6-foot bicycle lane would provide a slightly wider buffer zone separating bicycles from the parking lane and from adjacent traffic than a standard 5-foot bicycle lane. In this cross-section, pedestrians could stop at the center median and cross only one lane of traffic at a time. Meanwhile, vehicles could stay in the center left-turn lane to access the adjacent developments. It would be much safer for both the turning and through vehicles than under the existing conditions.

For the roadway segments that are not suitable for the “road diet” application, the bicycle accommodations could be accomplished by slightly reducing the width of travel lanes and removing on-street parking from one side of the roadway (mainly the south side). As shown in the bottom graphic in Figure 6-1, the proposed cross-section contains four 10.5-foot travel lanes (two in each direction), two 6-foot bicycle lanes (one in each direction), and a 7-foot parking lane on one side of the roadway.

The analysis in Section 2.4 indicates that many on-street parking spaces are currently not fully utilized, especially on the south side, but removing parking in these segments would likely impact adjacent developments. However, it would provide a safe separate accommodation for bicycles and would reduce unsafe pedestrian crossings. The goal of this study was to preserve as many of the parking spaces in the business districts of the corridor as possible.

Taking into consideration the variations in roadway configurations, adjacent land uses, and pedestrian and bicycle activities, MPO staff proposed two alternative three-lane cross-sections. Figure 6-2 shows the two alternative cross-sections—one for business districts with closely spaced driveways and one for residential districts with limited roadway surface width.

The top graphic in Figure 6-2 shows the potential three-lane roadway cross-section for business districts with closely spaced driveways. The cross-section contains a 12-foot two-way left-turn (TWLT) lane or center median (striped or concrete-stamped), two 15-foot shared lanes for motor vehicles and bicycles (one in each direction), and a 7-foot parking lane with a 2-foot buffer from the shared lane, on both sides of the roadway.

This cross-section could potentially be applied to the business district near West Newton between Chestnut Street and Kempton Place. The TWLT lane would provide access to the dense business developments on both sides of the roadway. The wide shared lane would be more practical than separate bicycle

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Needham Street in Newton, which carries about 25,000 vehicles per weekday, had proposed a similar three-lane cross-section.

lanes, which would be discontinuous and would have frequent intrusion by turning vehicles.

The bottom graphic in Figure 6-2 shows the potential three-lane roadway cross-section for residential districts that have limited roadway width. The cross-section contains a 12-foot center median (raised) or left-turn-only lane: two 11-foot travel lanes (one in each direction), two 6-foot bicycle lanes (one in each direction), and a 7-foot parking lane on the north side of the roadway.

This cross-section could potentially be applied to the residential districts between Cross Street and Walker Street, where the roadway surface width (about 58 feet or less) is narrower than in other segments of the corridor and most of the on-street parking areas on the south side are rarely utilized. The proposed roadway surface would be about 53 feet wide. The remaining space, which is 5 feet or less, could be used to increase the sidewalk space on the south side so that pedestrians would have more buffer space from the adjacent commuter rail tracks.

4.4 Existing Conditions at Major Intersections

The corridor contains seven signalized intersections and two major unsignalized intersections. These are the major locations that could affect traffic flow and pedestrian and bicycle movements in the corridor.

Based on the recently collected turning-movement data, MPO staff constructed AM and PM peak-hour traffic models for the entire corridor by using the Synchro traffic capacity and simulation program.[10] Table 5 summarizes the capacity analyses for six of the seven signalized intersections. The intersection of Washington Street at Chestnut Street is not included in the table, as its traffic signal is part of a coordinated system of a series of signals in the West Newton Square area. The signal system is currently being reviewed by the City.

[10] Synchro Version 8.0 was used for the analyses. This software is developed and distributed by Trafficware Ltd. It can perform capacity analysis and traffic simulation (when combined with SimTraffic) for an individual intersection or a series of intersections in a roadway network.

TABLE 5
Intersection Capacity Analyses
Existing (2014) Conditions

	AM Peak Hour					PM Peak Hour				
Name of Cross Street	**LOS[1]**	**Avg. Delay[2]**	**50th PQ[3]**	**95th PQ[4]**	**Cong. App.[5]**	**LOS**	**Avg. Delay**	**50th PQ**	**95th PQ**	**Cong. App.**
Lowell Avenue	C	21.8	100	260	None	C	25.7	145	300	None
Walnut Street	D	38.3	300	435	None	D	36.7	160	570	None
Crafts Street	E	73.9	370	495	SB	D	50.9	295	380	SB
Adams Street/ Lewis Terrace	D	37.1	250	325	SB	D	35.7	30	120	SB
Jackson Road	D	48.9	100	150	None	C	25.4	375	470	None
Church Street	C	21.3	190	570	None	C	20.5	160	535	None

[1] Level of service: A to F, based on 2010 Highway Capacity Manual criteria. LOS F is considered undesirable in urban areas.

[2] Average delay at the intersection: estimated in seconds per entering vehicle.

[3] 50th percentile queue: length estimated in feet on Washington Street in the peak direction (AM: eastbound, PM: westbound).

[4] 95th percentile queue: length estimated in feet on Washington Street in the peak direction (AM: eastbound, PM: westbound).

[5] Congested approach: any approach of the intersection evaluated as operating at LOS F.

In general, the existing lane assignments and timing settings for the six intersections all appear to be appropriate. They were evaluated as operating at an acceptable level of service (LOS) E or better. However, Synchro signal timing optimization tests indicated that the signal timings of three of the intersections could be adjusted slightly in order to improve pedestrian safety or traffic operations.

The three intersections are:

- Washington Street at Lowell Avenue: Currently it has an exclusive pedestrian signal phase of 21 seconds, which is not sufficient for pedestrians to cross at some of the approaches (nearly 60 feet wide). It should be increased to at least 27 seconds, the same duration as the timing at the Walnut Street intersection.
- Washington Street at Crafts Street: Synchro analyses indicated that the Crafts Street approach is operating at an undesirable LOS of F, and it could be somewhat improved by appropriating five seconds of green time from the Washington Street approach, which would operate at the same level of service after the timing change.
- Washington Street at Adams Street/Lewis Terrace: Currently the Adams Street approach has a high left-turn volume, with the existing layout of a left-turn/through shared lane and a right-turn-only lane. It could be rearranged as one left-turn-only lane and one right-turn/through shared

lane using the same signal timing settings. Although the Lewis Terrace approach's LOS would deteriorate slightly, the Adams Street LOS would significantly improve.

Table 6 summarizes the capacity analyses for the three intersections with the proposed signal timing adjustments under existing traffic conditions.

TABLE 6
Intersection Capacity Analyses
Existing Conditions with Signal Timing Adjustments

	AM Peak Hour					PM Peak Hour				
Name of Cross Street	**LOS[1]**	**Avg. Delay[2]**	**50th PQ[3]**	**95th PQ[4]**	**Cong. App.[5]**	**LOS**	**Avg. Delay**	**50th PQ**	**95th PQ**	**Cong. App.**
Adams Street./ Lewis Terrace	C	27.4	250	325	NB	C	23.3	30	120	NB
Crafts Street	E	66.0	215	280	SB	D	45.3	325	410	None
Lowell Avenue	C	25.5	115	260	None	C	25.9	145	300	None

[1] Level of service: A to F based on 2010 Highway Capacity Manual criteria. LOS F is considered undesirable in urban areas.

[2] Average delay at the intersection: estimated in seconds per entering vehicle.

[3] 50th percentile queue: length estimated in feet on Washington Street in the peak direction (AM: eastbound, PM: westbound).

[4.] 95th percentile queue: length estimated in feet on Washington Street in the peak direction (AM: eastbound, PM: westbound).

[5.] Congested approach: any approach of an intersection evaluated as operating at LOS F.

4.5 Future-Year Conditions

MPO staff also conducted future-year analyses based on projected traffic conditions for an approximately 10-year period for the horizon year 2025. One major concern about future-year conditions is the MassDOT's plan to reinstate tolls at I-90 Exits 16 and 17.[11]

Taking this recent development into consideration, the staff developed two sets of future-year projections for this study. The first set is a trend-extending projection that assumes that the toll reinstatement would have a minimal impact on future-year conditions. It predicts that the study corridor would have 0.3 percent annual traffic growth in the AM peak hour and 0.4 percent annual growth in the PM peak hour.[12]

[11] In June 2014, MassDOT announced a comprehensive tolling plan for additional Interstate and controlled-access state highways. The plan includes applying AET (All-Electronic Tolling) at the two I-90 exits, potentially within the next two years. AET is a form of toll collection that allows drivers to pay their toll without stopping or slowing down.

[12] The projection was derived from the Boston Region MPO's most recent 2035 regional travel demand model. MPO staff reviewed the growth at all of the major intersections in the corridor and calculated the average annual growth rate for the study corridor.

The second set assumes that toll reinstatement would have a significant impact on the study corridor. Based on a previous MPO study of an adjacent area, the staff estimated that toll reinstatement would cause an increase in total traffic during the peak hours of approximately 5 percent in 2025.[13]

Table 7 summarizes the total percentage of traffic growth from 2014 to 2025 for each of the peak-hour models.

TABLE 7
Future-Year (2025) Traffic Growth Projections

2014–25 Total Growth	AM Peak Hour	PM Peak Hour
Moderate traffic growth	3%	5%
Significant traffic growth	8%	10%

Based on the projections, the staff analyzed three different future-year scenarios:

1) Existing corridor layouts with moderate traffic growth
2) Existing corridor layouts with significant traffic growth
3) Proposed “road diet” layouts with significant traffic growth

Table 8 summarizes capacity analyses of six major intersections in these scenarios. For the scenarios that use existing layouts, signal timings were adjusted within reasonable ranges to accommodate future traffic conditions. In general, traffic would deteriorate from the existing conditions but would still operate at an acceptable LOS (of E or better) at all locations.

[13] The estimation was derived from the modeling data in the Boston Region MPO’s study, *Newton Corner Rotary Study, Phase II*, January 8, 2009.

TABLE 8
Future-Year (2025) Capacity Analyses

Scenario 1: Existing Corridor Layout with Moderate Traffic Growth

Name of Cross Street	AM Peak Hour					PM Peak Hour				
	LOS[1]	Avg. Delay[2]	50th PQ[3]	95th PQ[4]	Cong. App.[5]	LOS	Avg. Delay	50th PQ	95th PQ	Cong. App.
Lowell Avenue	C	26.5	130	270	None	C	27	155	350	None
Walnut Street	D	39.8	325	460	None	D	41.1	170	620	None
Crafts Street	E	70.1	410	540	SB	D	50.7	350	440	SB
Adams Street/ Lewis Terrace	C	33.6	265	345	NB	C	28	100	130	NB
Jackson Road	D	50.2	100	150	None	C	28.5	405	505	None
Church Street	C	22.5	210	600	None	C	23.6	190	585	None

Scenario 2: Existing Corridor Layout with Significant Traffic Growth

Name of Cross Street	AM Peak Hour					PM Peak Hour				
	LOS	Avg. Delay	50th PQ	95th PQ	Cong. App.	LOS	Avg. Delay	50th PQ	95th PQ	Cong. App.
Lowell Avenue	C	27.9	145	285	None	C	28.8	170	385	None
Walnut Street	D	42.9	390	500	None	D	48.3	195	660	None
Crafts Street	E	71.4	460	595	SB	E	56.8	375	470	SB
Adams Street/ Lewis Terrace	D	46.8	290	380	NB	D	39.4	120	150	NB
Jackson Road	D	53.2	100	150	None	D	35.6	435	580	None
Church Street	C	24.9	240	650	None	C	30.8	225	635	None

Scenario 3: Proposed "Road Diet" Layouts with Significant Traffic Growth

Name of Cross Street	AM Peak Hour					PM Peak Hour				
	LOS	Avg. Delay	50th PQ	95th PQ	Cong. App.	LOS	Avg. Delay	50th PQ	95th PQ	Cong. App.
Lowell Avenue	D	48.6	425	900	None	D	45.5	295	635	None
Walnut Street	E	61.1	420	880	SB	D	45.2	230	600	None
Crafts Street	E	71.4	460	595	SB	E	56.5	375	470	SB
Adams Street/ Lewis Terrace	D	46.8	290	380	NB	D	39.4	120	150	NB
Jackson Road	D	53.2	100	150	None	D	35.6	435	580	None
Church Street	C	24.9	240	650	None	C	30.8	225	635	None

[1] Level of service: A to F based on 2010 Highway Capacity Manual criteria.

[2] Average delay at the intersection: estimated in seconds per entering vehicle.

[3] 50th percentile queue: length estimated in feet on Washington Street in the peak direction (AM: eastbound, PM: westbound).

[4] 95th percentile queue: length estimated in feet on Washington Street in the peak direction (AM: eastbound, PM: westbound).

[5] Congested approach: any approach of an intersection evaluated as operating a LOS F.

The proposed "road diet" layouts include two major modifications:

- Roadway configuration between Chestnut Street and Court Street: converting from four lanes (two lanes in each direction) to three lanes (one lane in each direction with a center lane for left turns or medians)
- Intersection layout at Lowell Avenue and at Walnut Street: converting the inside lane of both of the Washington Street approaches from a left-turn/through shared lane to a left-turn-only lane.

As shown in Table 8, the "road-diet" scenario would maintain the same levels of service at all of the locations except the Walnut Street intersection. However, the Walnut Street intersection would operate at an acceptable LOS of E during peak hours.[14] Most significantly, the safety and operations of pedestrians, cyclists, and vehicles in the entire corridor would be greatly improved under the "road diet" scenario.

5 PROPOSED IMPROVEMENTS

Based on the above analyses, MPO staff developed a series of short- and long-term improvements to address the identified safety and operational problems. The short-term improvements could be implemented within a year, at relatively low cost. The long-term improvements are generally more complicated and cover large areas, which would require extensive planning and design efforts, as well as sufficient funding.

5.1 Short-Term Improvements

In the short term, a number of improvements could be considered for the corridor in order to enhance safety for pedestrians and cyclists and to moderately improve traffic operations. These improvements are:

- Install traffic signal backplates with reflective borders (yellow stripes).
- Repair street lights as needed.[15]
- Repaint faded crosswalk markings at intersections. Currently most of the intersections' crosswalks are marked by a series of white longitudinal lines

[14] The intersection appears to have room for some layout modifications if that is necessitated by further unexpected traffic growth from the toll reinstatement or an adjacent Austin Street project. Further engineering studies could also examine the feasibility of adding concurrent pedestrian signal phasing at the functional design stage.

[15] On July 26, 2014, MPO staff drove along the corridor to survey nighttime roadway conditions and observed about four to five street lights were not working.

parallel to traffic.[16] At the intersections of Washington Street at Adams Street/Lewis Terrace and at Jackson Road, the crosswalk markings have almost totally disappeared.

- Adjust signal timing or lane assignments at the following intersections:
    - Washington Street at Lowell Avenue: Increase the exclusive pedestrian signal phase from 21 to 27 seconds.
    - Washington Street at Crafts Street: Consider relocating 5 seconds of green time from Washington Street to Crafts Streets.
    - Washington Street at Adams Street/Lewis Terrace: Consider rearranging the southbound approach so it has one left-turn-only lane and one through/right-turn shared lane.
- Enforce the no-parking regulations at the corners of Washington Street westbound near the following streets:
    - Jackson Road
    - Walnut Street (MBTA bus stop location)
    - Walker Street
    - Armory Street
    - Trader Joe's driveway

5.2 Long-Term Improvements

Figures 7-1 to 7-7 show the locations and layouts of the proposed long-term improvements in a series of conceptual plans from west to east within the study corridor. The conceptual plans were not created to scale, but in approximate proportion, in order to show how the proposed improvements would relate to their surroundings. For the roadway cross-sections related to these conceptual plans, please refer to Figures 6-1 and 6-2.

Major proposed improvements include:

- Convert the corridor's travel lanes from four to three from Chestnut Street to Court Street (see the top graphic in Figure 6-1), which constitutes about 70 percent of the study corridor.

[16] *Manual on Uniform Traffic Control Devices*, Section 3B.18: Crosswalk Markings, 2009 Edition with Revisions 1 and 2, Federal Highway Administration, US Department of Transportation, May 2012.

- Maintain four travel lanes between Court Street and Church Street but slightly reduce the lane width and remove on-street parking from one side (mainly the south side) of the roadway (see the bottom graphic in Figure 6-1).[17]
- Provide bicycle accommodations on both sides of the corridor. They would in slightly different forms, but their paths would be continuous (Figures 6-1 and 6-2).
    - 6-foot separate bicycle lanes on both sides (in the majority of the proposed three-lane sections)
    - 6-foot separate bicycle lane on the north side and 5-foot separate bicycle lane on the south side (in the proposed four-lane sections that currently have a limited right-of-way)
    - 15-foot shared lane in the business districts that have closely spaced driveways between Chestnut Street and Kempton Place
- Provide the center lane (in the proposed three-lane sections) as a median, a left-turn-only lane, or a two-way left-turn lane for accessing adjacent businesses and other developments.[18] It would significantly improve the safety and mobility of travel to and from these developments, not only for vehicles but also for pedestrians and cyclists.
- Reduce the curb turning radii in order to slow down turning vehicles and reduce pedestrian crossing distances. Potential locations for such improvements include:
    - Washington Street at Eddy Street
    - Washington Street at Walker Street
    - Washington Street at Lowell Avenue
    - Washington Street at Court Street
    - Washington Street at Jewett Street
- Add sidewalk extensions (pedestrian bulb-outs) to provide staging areas for pedestrians, enhance their view of traffic, and shorten their crossing distances. Potential locations for such improvement include:
    - Washington Street at Armory Street
    - Washington Street at Eddy Street

[17] The parking removal would provide space for continuous dedicated bicycle lanes in the corridor. Meanwhile, most of the on-street parking in the business districts would be preserved.

[18] The traffic median would be concrete-stamped or striped in the business districts and would be raised in the residential districts of the corridor.

  - Washington Street at Walker Street
  - Washington Street at Lowell Avenue (north side)
- Install crosswalks at locations that have a significant number of pedestrian crossings or are adjacent to MBTA bus stops. Suitable locations for such improvements are:
  - Washington Street at Armory Street
  - Washington Street at Cross Street
  - Washington Street at Eddy Street
  - Washington Street at Walker Street
- Install midblock crosswalks at locations in business districts that have a significant number of pedestrian crossings. Proposed locations for such improvements are:
  - Washington Street at the post office in Newtonville
  - Washington Street at Newtonville Station
- Consider combining some adjacent MBTA bus stops in the corridor in order to increase the efficiency of bus travel. A potential case would be combining the existing stops at Armory Street and Cross Street.
- Increase the sidewalk width on the south side wherever adequate right-of-way is available.
- Change the corridor's posted speed limit from 35 mph to 30 mph, after the above proposed roadway modifications are in place. The travel-speed analysis (Section 4.1) supports these potential modifications. At the design stage, this would have to be further examined by applying the MassDOT speed zoning procedures.

In addition, the following items should be considered at the design stage:

- Further evaluate parking conditions, locations, and pricing strategies, and develop a comprehensive parking and business access management plan for the entire corridor.
- Further examine design alternatives to the existing angle parking at Newtonville Station.[19]

[19] The existing angle parking is substandard, with insufficient vehicle backing space. A number of crashes, including one involving a pedestrian, occurred in that parking area in the past three years. Staff performed a preliminarily examination of two options in this study. The first is to convert the angle parking to parallel parking. It would eliminate about half of the existing spaces but would provide more room for wider sidewalks on both sides of Washington Street. The second option is to convert it to "reverse angle parking, which is a type of angle parking

- Review the existing lighting facilities and conditions. If resources are available, consider installing a new lighting system powered by renewable energy for the entire corridor and adding pedestrian-scale lighting in the Newtonville business districts.
- Further examine the potential of replacing the existing fences adjacent to MBTA commuter rail and I-90 with well-designed concrete walls or other features that are more effective in blocking noise.

6 SUMMARY AND RECOMMENDATIONS

For this study, MPO staff performed a series of safety and operations analyses, identified safety and operational problems, and proposed a number of short- and long-term improvements to address the identified problems in the study corridor.

The recommended short-term improvements include:

- Install traffic signal-backplates with reflective borders.
- Repair street lights as needed.
- Repaint faded crosswalk markings at intersections.
- Adjust signal timing or lane assignments at applicable intersections.
- Enforce the no-parking regulations at corners of major intersections.

These improvements are generally low-cost and could enhance safety for pedestrians and cyclists and improve traffic operations. They should be implemented as soon as funding resources can be allocated.

The conceptual plan for long-term improvements provides a vision that would accommodate all users and would significantly enhance their safety, mobility, and access in the corridor. The expected benefits from some of the major proposed long-term improvements include:

- The “road diet” (from four-lane to three-lane) modification of majority (70 percent) of the corridor would slow down traffic and reduce pedestrian crossing distances and risks.
- A center lane in the modified sections, functioning as a median, left-turn-only, or two-way left-turn lane, would significantly improve safety and

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that requires vehicles to back into parking spots instead of pulling into them. It allows drivers to make eye contact with pedestrians and cyclists when they exit their spots and is thus considered safer than the usual angle parking. The conversion would not eliminate any of the existing parking spaces. However, it would require educating the public about its operations, as it is not widely used in this country and many drivers may not be familiar with and skilled in its operations.

mobility for users traveling to and from adjacent developments, not only for vehicles but also for the pedestrians and cyclists.

- Bicycle accommodation on both sides of Washington Street would improve cyclists' safety and mobility.
- Redesign of intersections with tighter curb radii and sidewalk extensions would slow down turning vehicles and enhance safety for pedestrians and cyclists.
- Crosswalk installations would enhance pedestrian-crossing safety in business districts and at MBTA bus stops.
- Speed-limit reduction from 35 to 30 mph would make traffic speeds more compatible with the adjacent land-use activities, thus improving safety for all users in the corridor.

In addition, the corridor would benefit from a comprehensive parking and access management program. Lighting and noise conditions should also be further examined during the design stage.

The entire corridor is under the City of Newton's jurisdiction. The MPO staff recommends the following implementation stages for consideration based on input from the community:

1) West Section: Chestnut Street to the west of Lowell Avenue
2) Middle Section: Lowell Avenue to Harvard Street
3) East Section: the east of Harvard Street to Church Street

Implementing the proposed long-term improvements would require sufficient resources. Reconstruction of the entire corridor would cost approximately $12,000,000 to $15,000,000.[20] Table 9 shows the approximate costs of the three implementation stages.

This study shows that the corridor has great potential to operate safely and efficiently for all users in various transportation modes and provides a vision for the corridor's long-term development. The City was advised to conduct community meetings, build consensus among stakeholders, and advance this planning study to the design stage. It will require significant effort and collaboration on the part of all stakeholders, including residents and owners of adjacent developments, the MBTA, and MassDOT, to achieve the vision.

[20] At this preliminary planning stage, the cost was approximated from the general expenses of similar projects. The estimation is only for design and construction; it does not include right-of-way, utility relocation, or other contingency costs.

TABLE 9
Corridor Construction Cost Estimation

Implementation Stages	Approximate Length	Major Improvement Items	Approximate Cost
West Section	0.7 miles	Roadway reconstruction and restriping, median and turning-lane installation, sidewalk widening, curb extension and crosswalk installation, street lighting upgrade, parking meter upgrade, roadside landscaping	$4,000,000 –- $5,000,000
Middle Section	0.5 miles	Roadway reconstruction and restriping, median and turning lane installation, intersection geometry modification and traffic signal upgrade (3 locations), sidewalk widening, curb extension and crosswalk installation, street lighting upgrade, parking meter upgrade, roadside landscaping	$5,000,000 – $6,000,000
East Section	0.6 miles	Roadway reconstruction and restriping, intersection traffic signal upgrade (3 locations), sidewalk paving, street lighting upgrade, parking meter upgrade, roadside landscaping	$3,000,000 –- $4,000,000
All Sections	1.8 miles	All the above items	$12,000,000 – 15,000,000

The implementation process must ensure that all parties have consensus about how the recommendations can be realized in a resourceful manner. The City has to work with MassDOT Highway Division District 6 to initiate the project, obtain favorable review from MassDOT's Project Review Committee, and identify potential funding resources through MassDOT and the Boston Region MPO.

Appendix I details the actions that are required in various steps of MassDOT's project development process, including a schematic timetable of the steps. Information regarding the project development process can also be found on MassDOT's website, at www.massdot.state.ma.us/planning/Main/PlanningProcess/ProjectDevelopmentProcess.aspx and at www.massdot.state.ma.us/Portals/8/docs/designGuide/CH_2_a.pdf.

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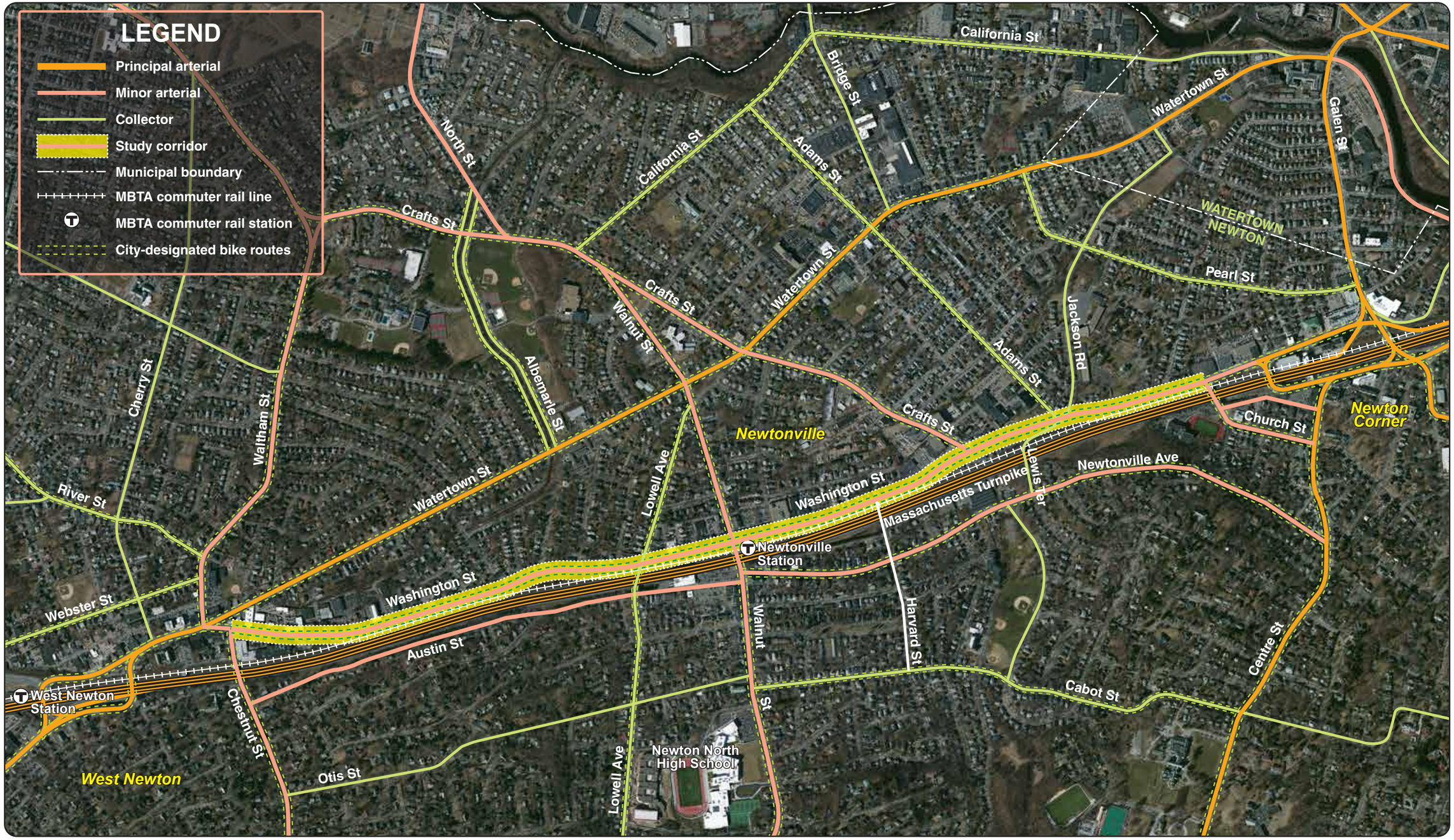

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FIGURE 1
Study Area
Washington Street, Newton

Addressing Safety,
Mobility, and Access on
Subregional Priority Roadways

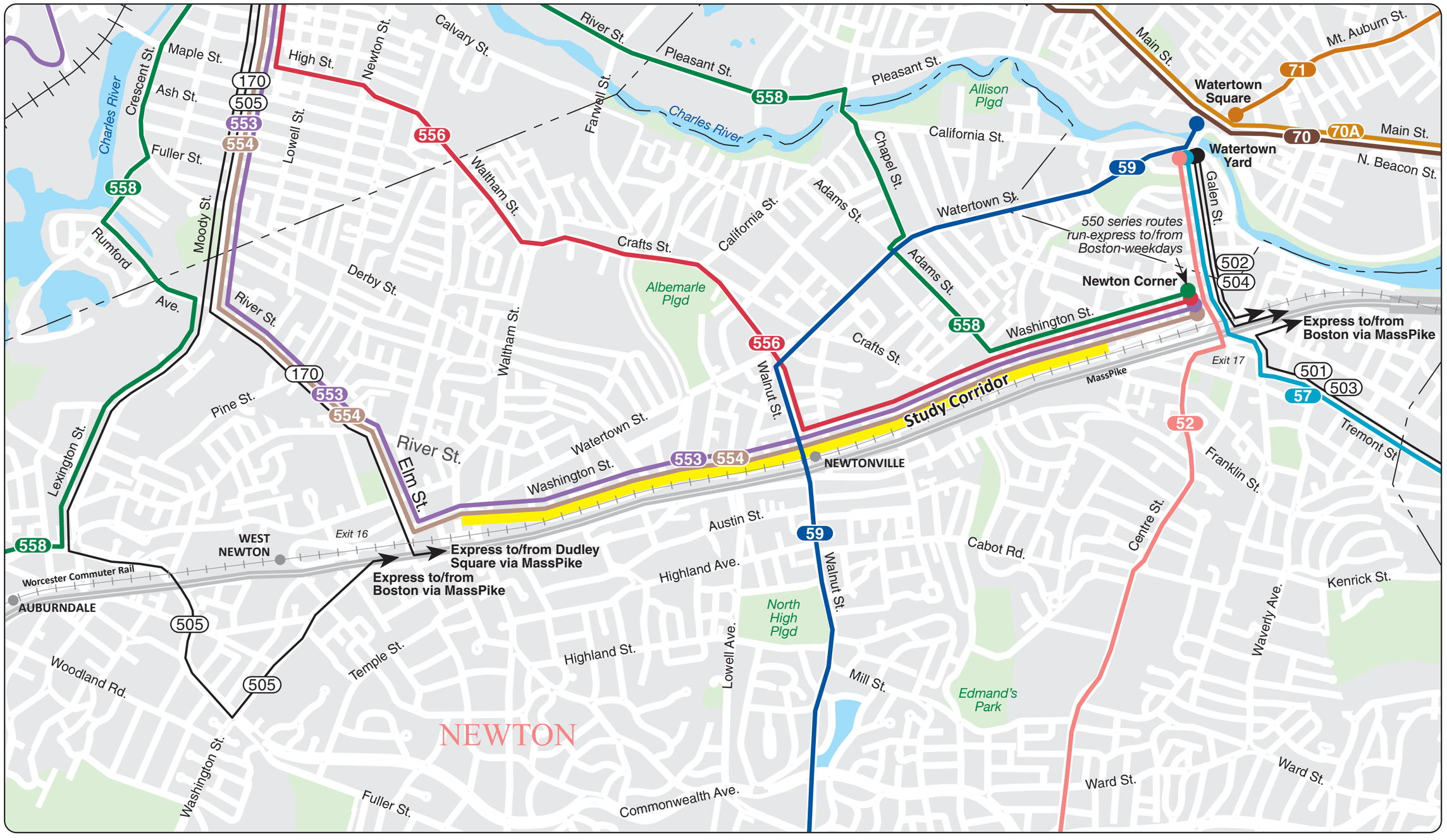

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FIGURE 2
MBTA Transit Services in the Study Area
Washington Street, Newton

Addressing Safety, Mobility, and Access on Subregional Priority Roadways

Corridor Average Daily Traffic (ADT) Summary

Count Location	❶	❷	❸	❹	❺	❻	❼	❽
Eastbound Volume	6,839	6,811	7,372	6,651	7,924	8,644	11,309	12,164
Westbound Volume	7,021	6,977	6,990	7,305	8,262	9,369	12,392	13,635
Eastbound Split	49%	49%	51%	48%	49%	48%	48%	47%
Westbound Split	51%	51%	49%	52%	51%	52%	52%	53%
Combined ADT	13,860	13,788	14,362	13,956	16,186	18,033	23,701	25,799
Seasonally Adjusted ADT	12,500	12,400	12,900	12,600	14,600	16,300	21,800	23,300

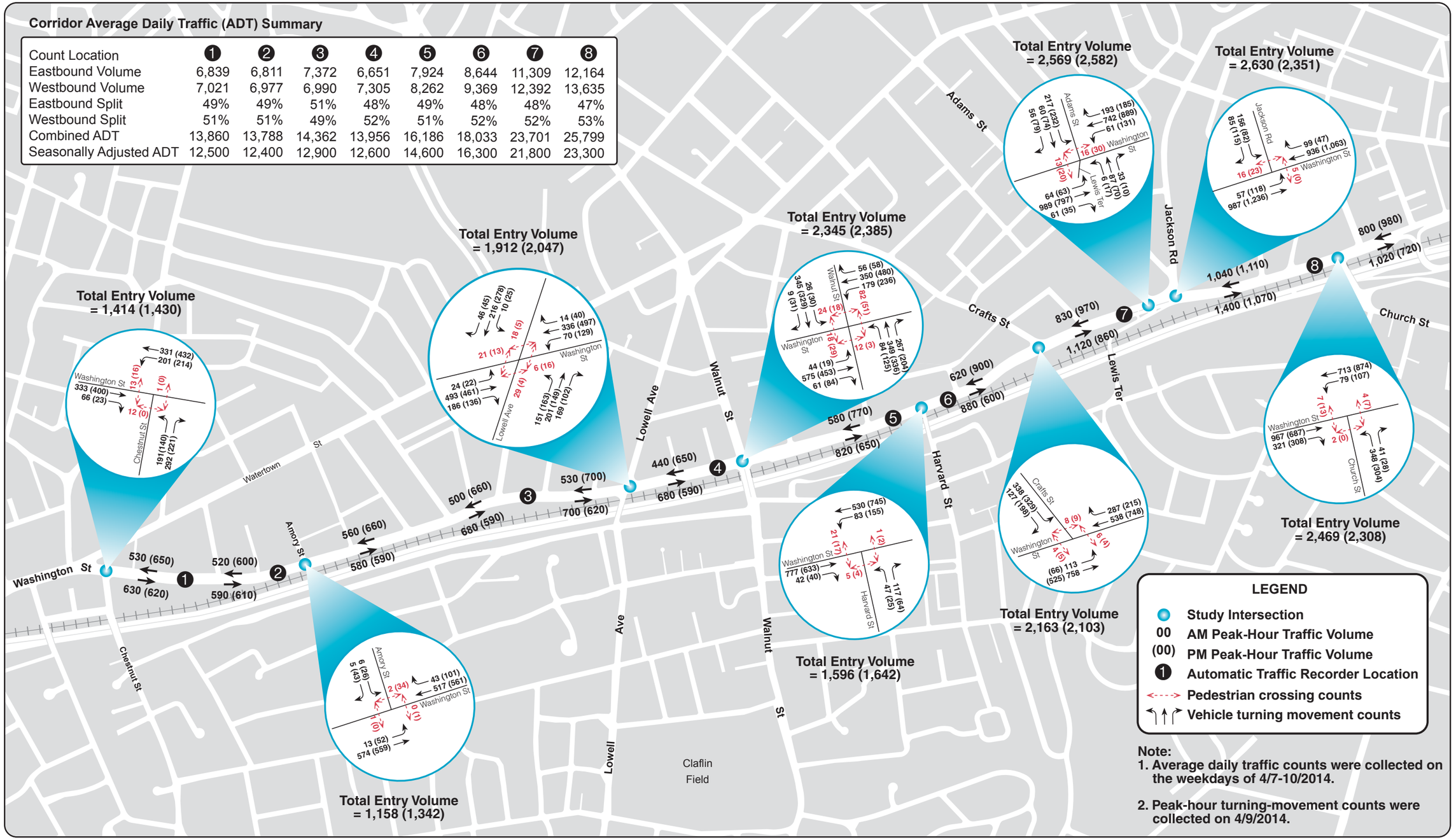

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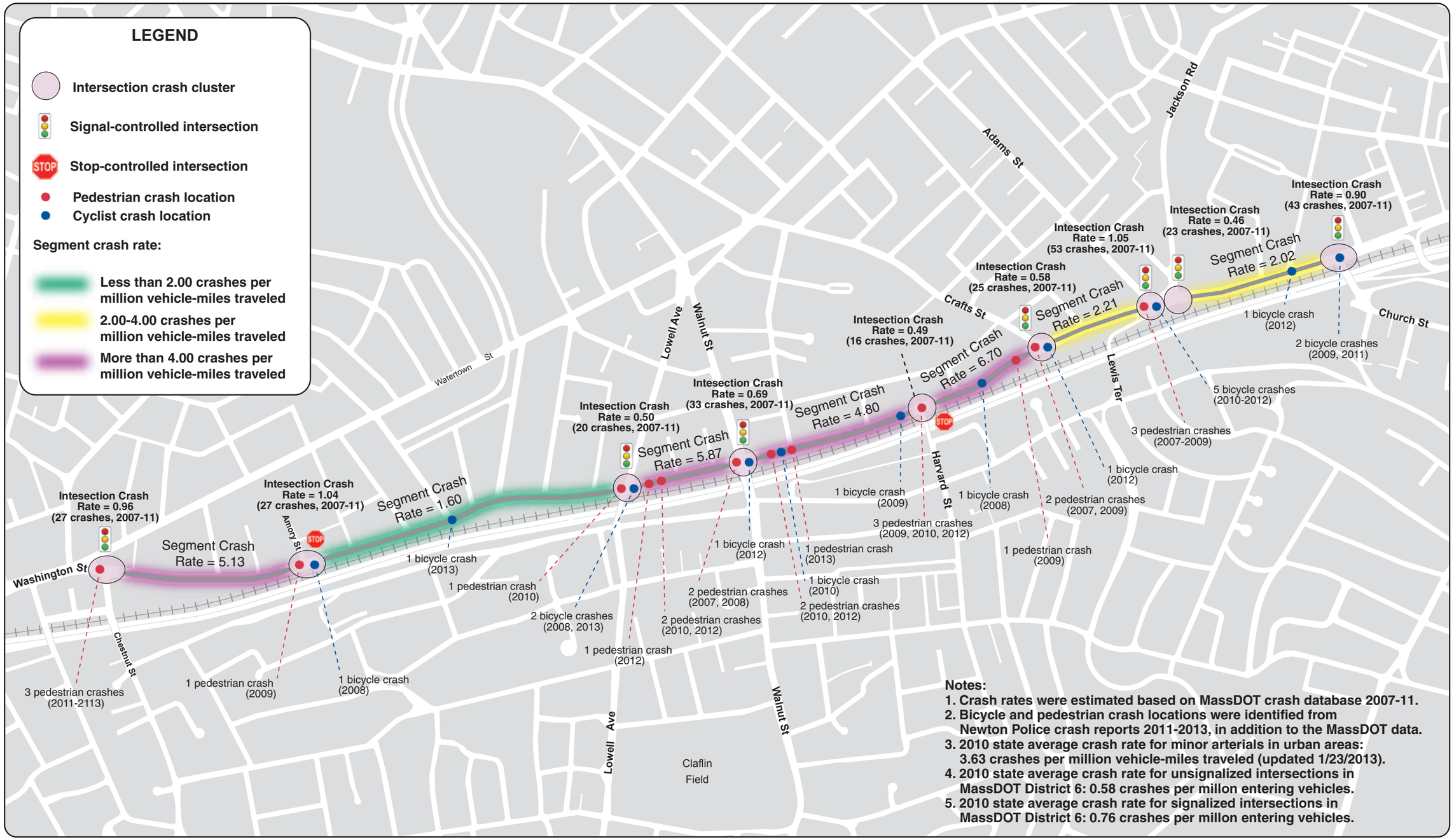
FIGURE 3
Traffic Volumes in the Corridor and at Major Intersections
Washington Street, Newton

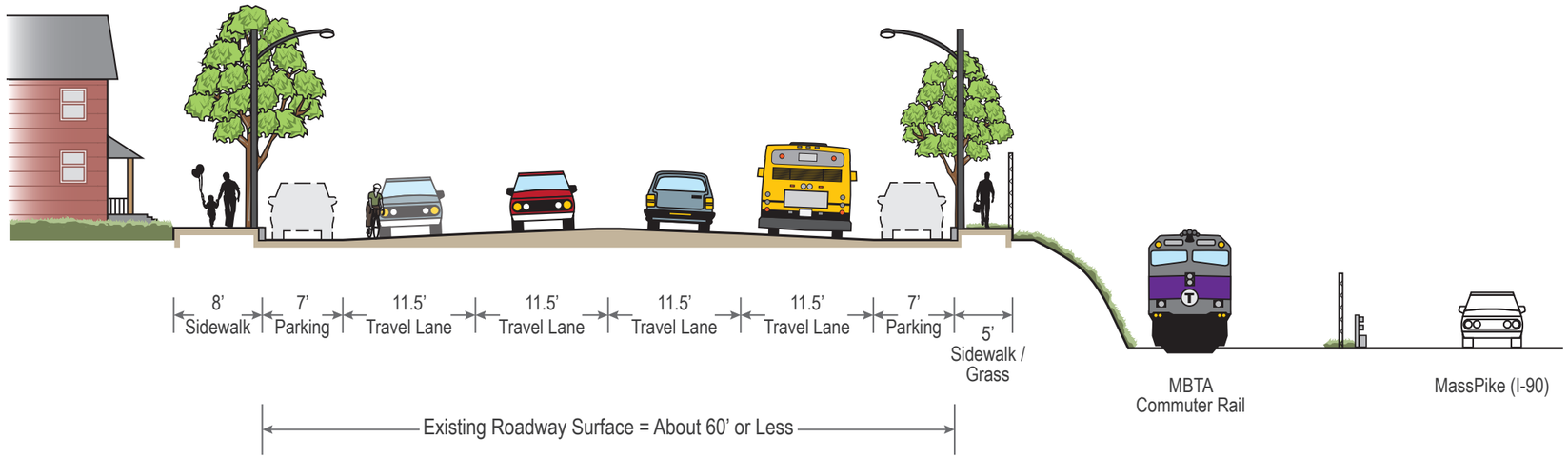
Addressing Safety, Mobility, and Access on Subregional Priority Roadways



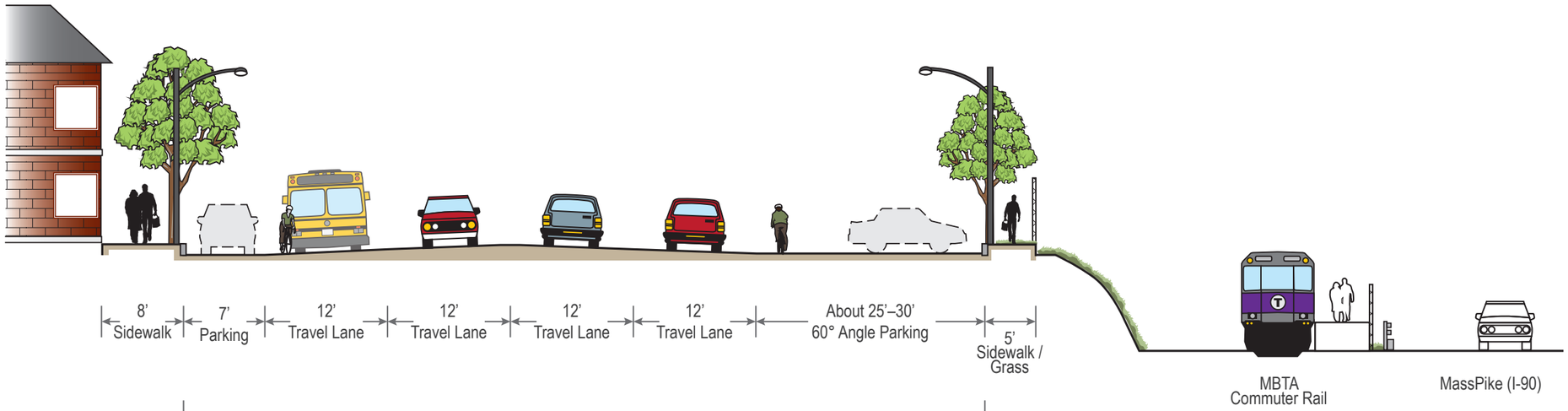
BOSTON REGION MPO

FIGURE 4
Crash Locations and Crash Rates
Washington Street, Newton

Addressing Safety, Mobility, and Access on Subregional Priority Roadways



Typical Roadway Cross-Section in the Study Corridor



Roadway Cross-Section in the Newtonville Station Area

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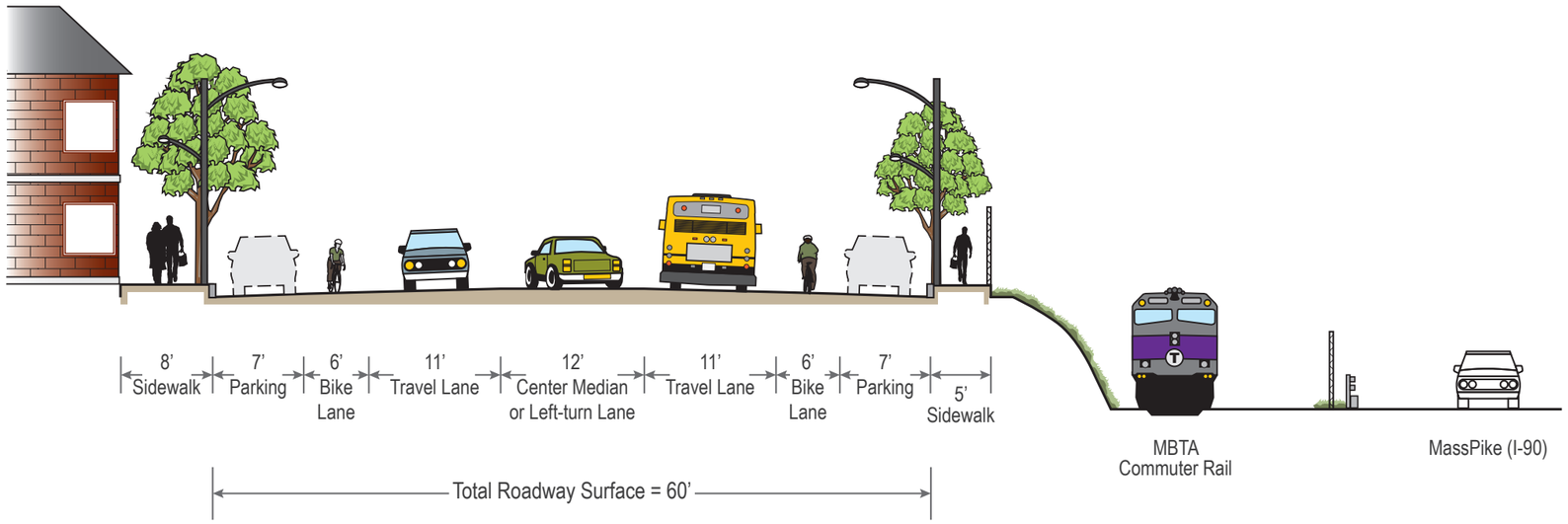
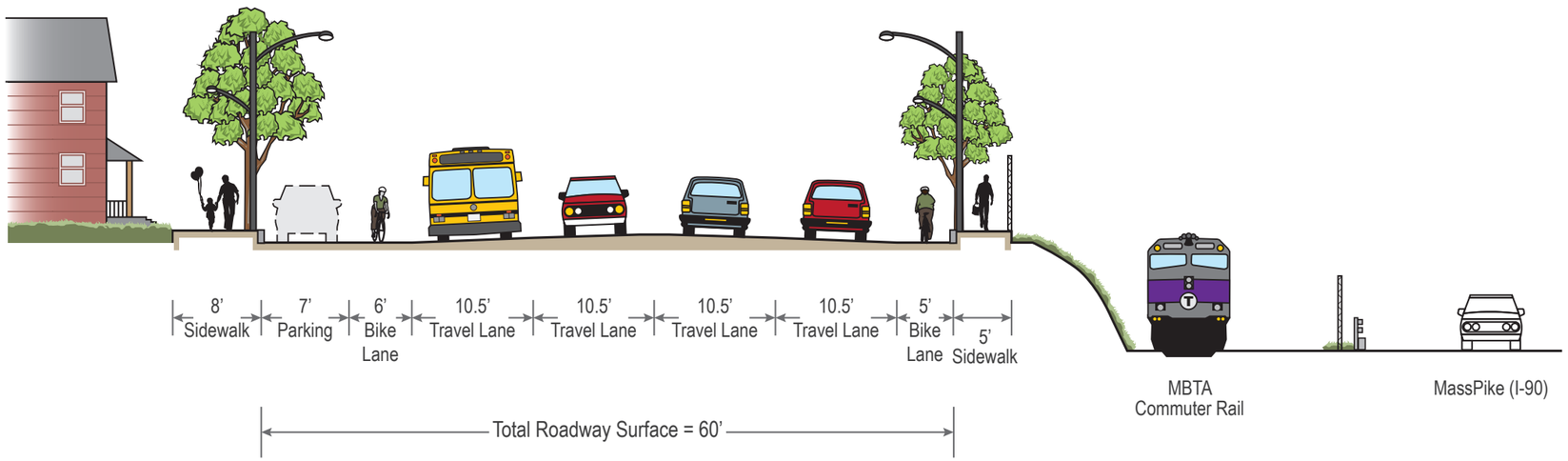
FIGURE 5
Existing Roadway Cross-Sections
Washington Street, Newton

Addressing Safety,
Mobility, and Access on
Subregional Priority Roadways



Proposed Three-Lane Cross-Section



Proposed Four-Lane Cross-Section

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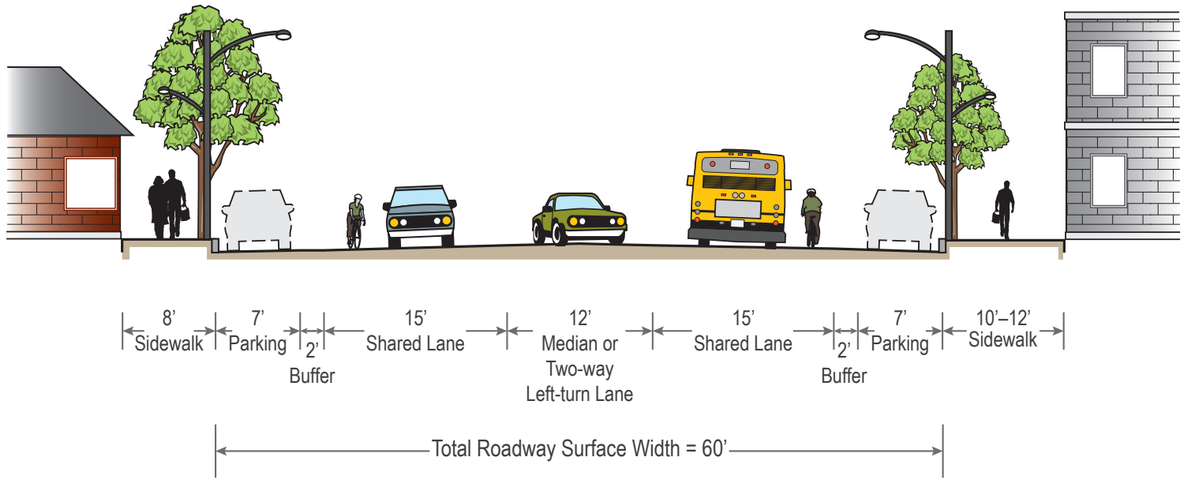
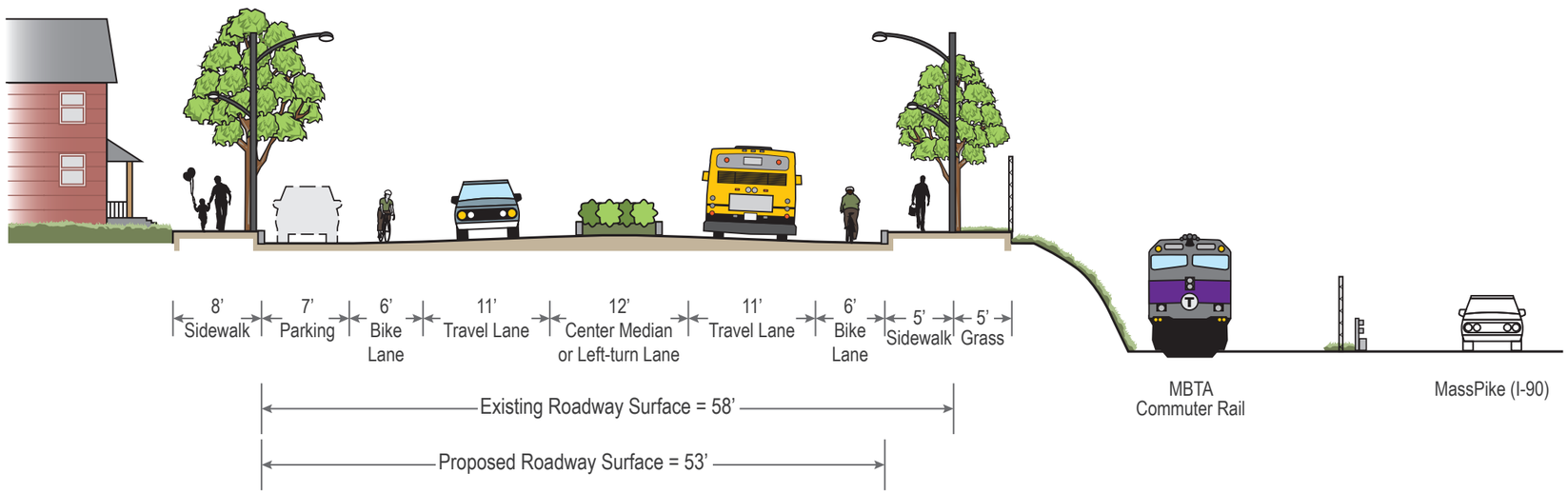
FIGURE 6-1
Proposed Roadway Cross-Sections (I)
Washington Street, Newton

Addressing Safety, Mobility, and Access on Subregional Priority Roadways



Proposed Alternative Three-Lane Cross-Section for Business Districts with Intensive Driveways



Proposed Alternative Three-Lane Cross-Section for Residential Districts with Limited Right-of-Way

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FIGURE 6-2
Proposed Roadway Cross-Sections (II)
Washington Street, Newton

Addressing Safety,
Mobility, and Access on
Subregional Priority Roadways

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N

FIGURE 7-1
Conceptual Plan of Proposed Long-Term Improvements (Section 1)
Washington Street, Newton

Addressing Safety, Mobility, and Access on Subregional Priority Roadways

BOSTON REGION MPO

N

FIGURE 7-2
Conceptual Plan of Proposed Long-Term Improvements (Section 2)
Washington Street, Newton

Addressing Safety, Mobility, and Access on Subregional Priority Roadways

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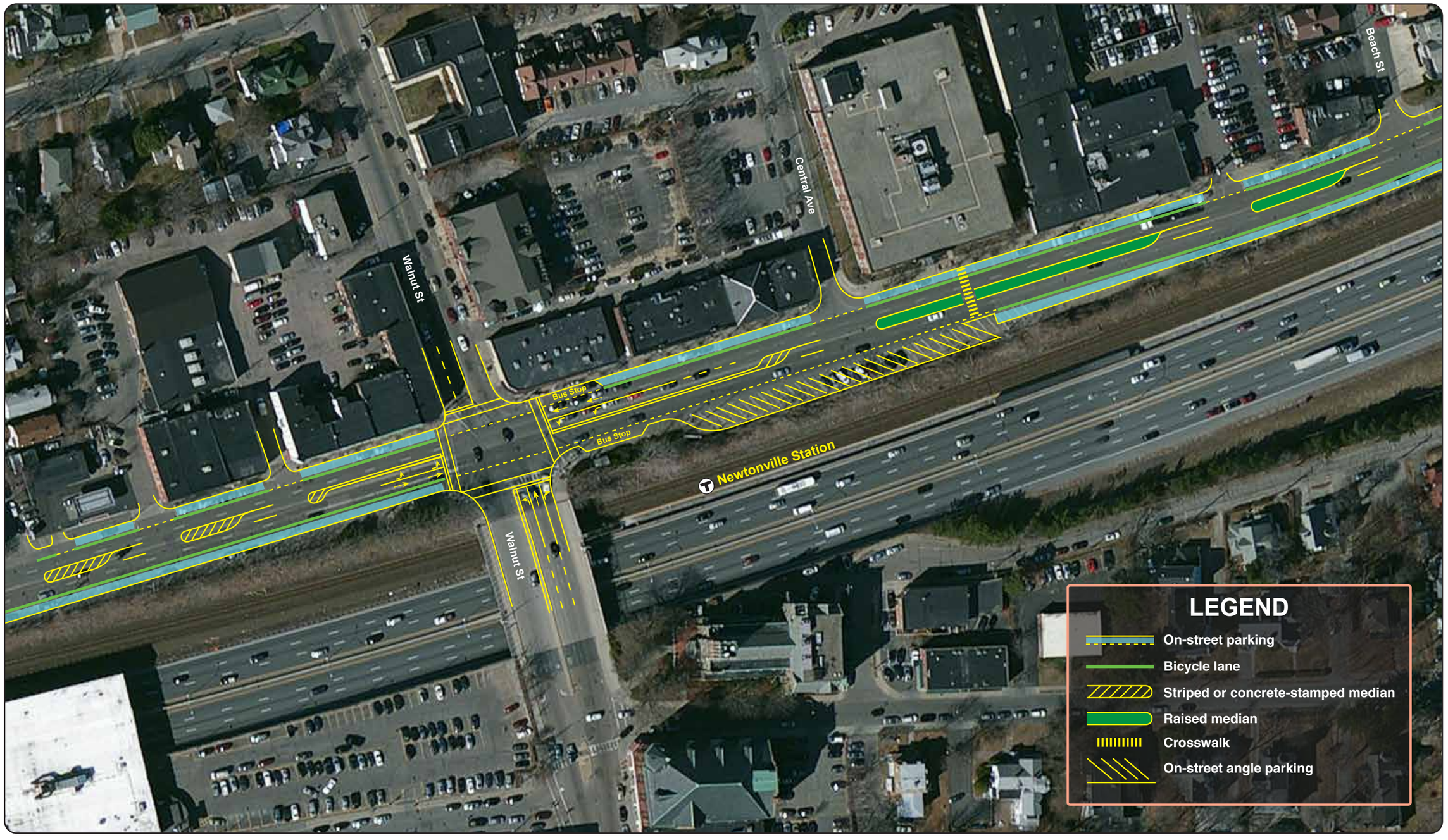
N

FIGURE 7-3
Conceptual Plan of Proposed Long-Term Improvements (Section 3)
Washington Street, Newton

Addressing Safety, Mobility, and Access on Subregional Priority Roadways



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N

FIGURE 7-4
Conceptual Plan of Proposed Long-Term Improvements (Section 4)
Washington Street, Newton

Addressing Safety, Mobility, and Access on Subregional Priority Roadways

BOSTON REGION MPO

N

FIGURE 7-5
Conceptual Plan of Proposed Long-Term Improvements (Section 5)
Washington Street, Newton

Addressing Safety, Mobility, and Access on Subregional Priority Roadways

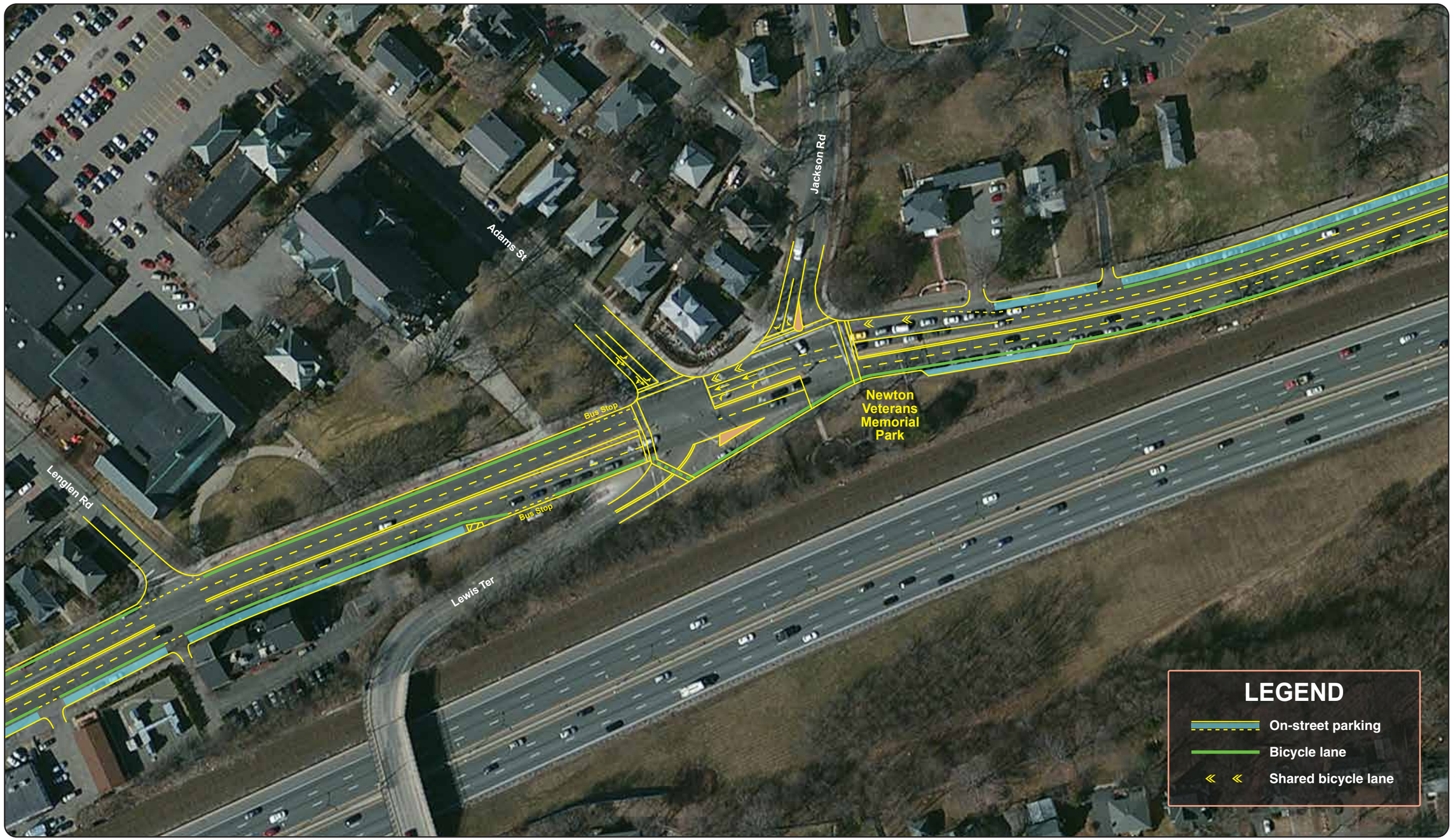

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FIGURE 7-6
Conceptual Plan of Proposed Long-Term Improvements (Section 6)
Washington Street, Newton

Addressing Safety, Mobility, and Access on Subregional Priority Roadways

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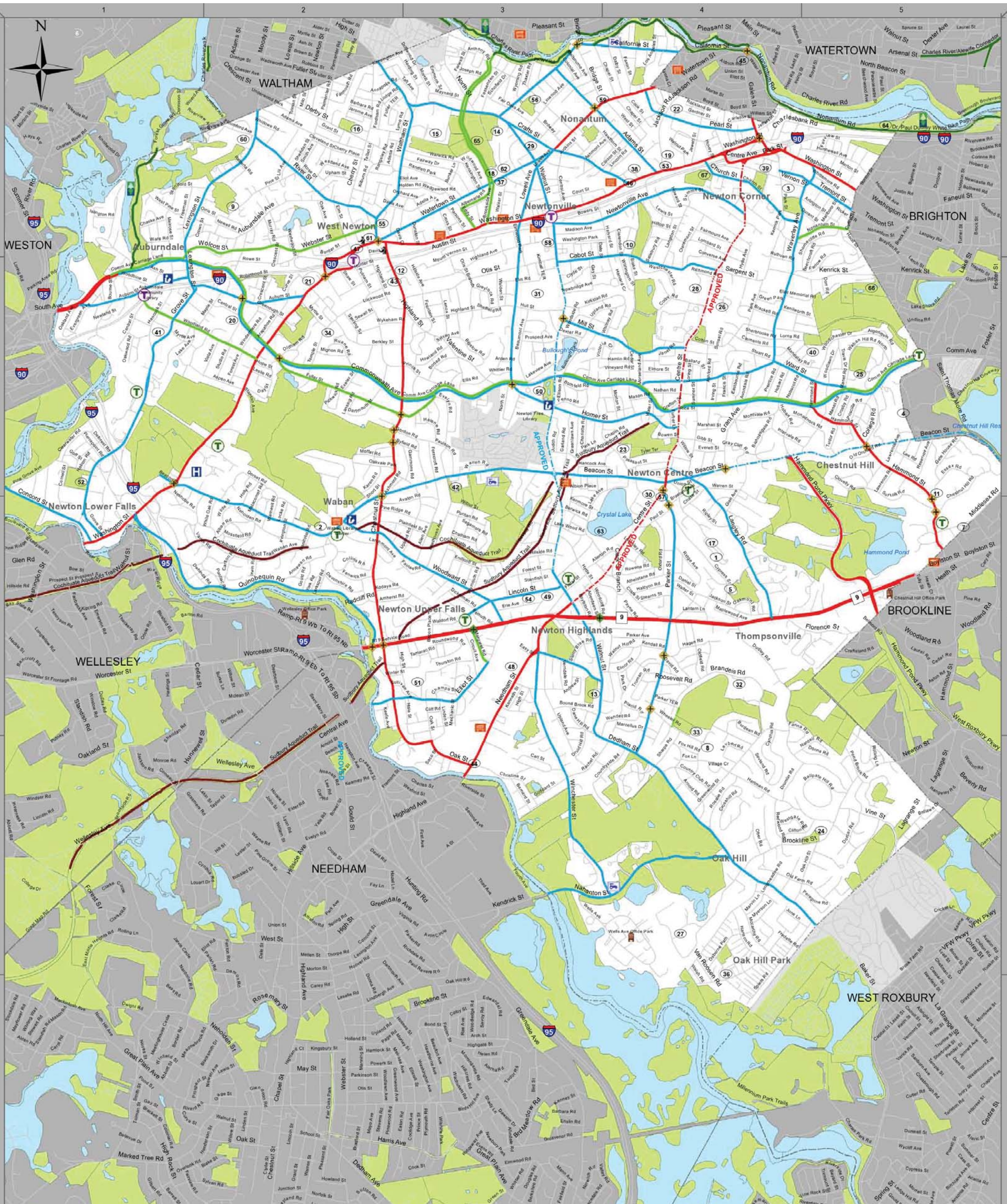
FIGURE 7-7
Conceptual Plan of Proposed Long-Term Improvements (Section 7)
Washington Street, Newton

Addressing Safety, Mobility, and Access on Subregional Priority Roadways

APPENDIX A

Newton Bike Map: 2012



LEGEND

- Commuter Rail
- Green Line
- Grocery Store
- Farmers Market
- Hospital
- Office Park
- Police
- Library

INTERSECTIONS

- Dangerous Intersection
- Safe Crossing

SHARED-USE PATHS

- Unpaved
- Paved

STREETS

- Easy Bike Lane
- Easy
- Intermediate Bike Lane
- Intermediate
- Advanced

NEWTONBIKEMAP

Minutes: 3, 6, 9, 12

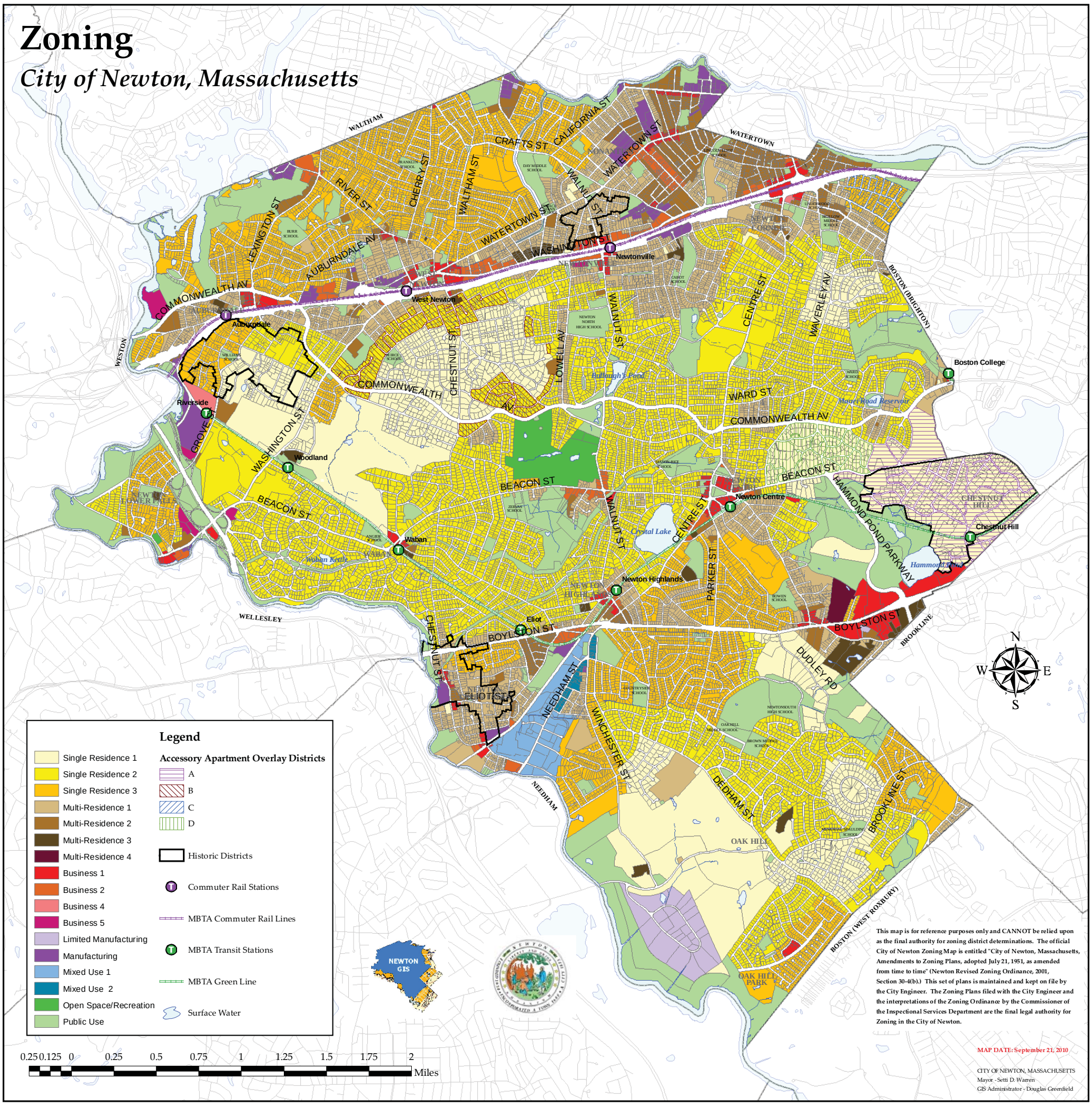
Miles: 0, 0.25, 0.5, 1, 1.5, 2

APPENDIX B

Newton Zoning Map: 2010

Zoning

City of Newton, Massachusetts



Legend

- Single Residence 1
- Single Residence 2
- Single Residence 3
- Multi-Residence 1
- Multi-Residence 2
- Multi-Residence 3
- Multi-Residence 4
- Business 1
- Business 2
- Business 4
- Business 5
- Limited Manufacturing
- Manufacturing
- Mixed Use 1
- Mixed Use 2
- Open Space/Recreation
- Public Use

Accessory Apartment Overlay Districts

- A
- B
- C
- D

- Historic Districts
- Commuter Rail Stations
- MBTA Commuter Rail Lines
- MBTA Transit Stations
- MBTA Green Line
- Surface Water

0.25 0.125 0 0.25 0.5 0.75 1 1.25 1.5 1.75 2 Miles

NEWTON GIS

This map is for reference purposes only and CANNOT be relied upon as the final authority for zoning district determinations. The official City of Newton Zoning Map is entitled "City of Newton, Massachusetts, Amendments to Zoning Plans, adopted July 21, 1951, as amended from time to time" (Newton Revised Zoning Ordinance, 2001, Section 30-4(b).) This set of plans is maintained and kept on file by the City Engineer. The Zoning Plans filed with the City Engineer and the interpretations of the Zoning Ordinance by the Commissioner of the Inspectional Services Department are the final legal authority for Zoning in the City of Newton.

MAP DATE: September 21, 2010

CITY OF NEWTON, MASSACHUSETTS
Mayor - Setti D. Warren
GIS Administrator - Douglas Greenfield

APPENDIX C

Summary of Ridership and Trip Characteristics: MBTA Services in the Study Area

General Summary

The public transit options along the Washington Street study corridor are the four express bus routes (553, 554, 556, and 558) to Downtown Boston, and two commuter rail stations, Newtonville and West Newton, of the Framingham/Worcester Line. The four bus routes mainly serve the commuters and local travelers in Newton and Waltham.

The MBTA 2014 bus ridership and service statistics indicate that the four bus routes together serve about 1,400 riders (about 2,600 inbound and outbound boardings) per weekday. According to the 2008–09 MBTA Systemwide Passenger Survey, 56.9 percent of the trips on the four bus routes are regional (Newton/Waltham–Boston), 19.1 percent are local (Newton–Newton, Waltham–Waltham, or Newton–Waltham), and 24 percent are trips to and from other communities.

For the commuter rail service, the survey focused on inbound riders, whose purpose is predominantly commuting (home-based work) from Newton to Downtown Boston. There were 240 riders boarding the line at Newtonville Station, and 230 riders at West Newton station from the survey data.

The following analyses further summarize the ridership and trip characteristics of these services based on the 2008–09 survey.

Bus Routes Overview

Routes 553 & 554

Route 553 starts at Brandeis/Roberts, passes Central Square Waltham, travels along Washington Street in Newton, and expresses to Downtown Boston after stopping at Newton Corner. Route 554 starts in Watertown and follows the same route as 553 after arriving at Central Square Waltham. Both 553 and 554 have 24 stops in the Newton, and 13 of them are along the study corridor on Washington Street.

Route 556

Route 556 starts at Waltham Highlands, passes Central Square Waltham, High Street, Craft Street, Washington Street in Newton, and expresses to Downtown Boston after stopping at Newton Corner. 556 has 15 stops in the Newton, and eight of them are along the study corridor on Washington Street.

Route 558

Route 558 starts at Riverside in Newton, runs eastbound along the Charles River, passes Central Square Waltham and runs along the river again on the Watertown side. It follows the same route as Route 556 after it arrives at the intersection of Adam Street

and Washington. Route 558 has 21 stops (10 at the west side and 11 at East Newton) in the Newton, and five of them are on the study corridor.

The Downtown Boston routes and stops for all four buses are the same.

Characteristics of Bus Riders

Although the survey does not specifically describe the bus ridership along Washington Street, we can still observe important characteristics along the corridor by analyzing activities in Newton as a whole. The following discussion will be based on the survey data of Routes 553, 554, 556, and 558.

Activities at Origins or Destinations

The survey shows that 59.0% of all the bus trips have their origins and/or destinations in Newton. For the bus riders leaving from Newton, 89.9% indicate that they leave from home. These riders travel primarily to Boston (62.2%), with others to Waltham (13.2%), Newton (10.5%), and others (14.1%). While we don't know at what time in the day these trips took place, we can assume that there is a Newton to Boston, home to work morning commute pattern.

For the trips ends in Newton, the riders' destination activities in Newtown are work (58.4%), home (20.8%), or others (10.3%). These riders travel primarily from Boston (53.9%), with others from Waltham (21.6%), Newton (12.5%), and others (12.0%). There is a noticeable but less dominant pattern of evening commute from Boston to Newton, work to home. The survey also shows that a shorter trip pattern (Waltham to Newton) is relatively common.

Popular Route: Local vs. Regional

The biggest shared characteristic of all four bus routes is the point to point connection from Waltham/Newton to Downtown Boston (express regional trips), which composed of 56.9% of the bus rides. According to the survey, route 556 has the highest percentage of Newton –Boston service (78.0%), followed by 558 (57.1%), 553 (51.6%), and 554 (45.8%). It is noteworthy that route 556 has the most frequent morning inbound trips (6), that it originates in Waltham Highlands, and that it has the second least number of stops (26, after 24 for 558) between Central Square Waltham and Newton Corner, which may make 556 the more popular choice for regional commuters.

The buses also support local connection between Waltham, Riverside, Newton, and Watertown, depending on the routes. Route 553 has the highest percentage of Newton–Waltham service (22.9%), followed by 554 (18.1%), 556 (13.8%), 555 (10.4%). Route 553 and 554 has the most bus stops (30) between Newton Corner and Waltham Central Square, and 553 has more buses during peak hours than 554.

Access Mode

In general, most bus riders walk to the bus stops (79.7%). This characteristic indicates that the buses primarily serve people who live or have activities in the vicinity of the bus routes. Other access modes included drive/park (4.1%), drop-off (2.3%), and other public transit (18.6%).

Commuter Rail Line Overview

Both Newtonville and West Newton Stations are along the Framingham/Worcester Line. There are four trips in the morning peak period from 7:00 to 10:00 and four trips in the evening peak period from 3:30 to 6:30.

Characteristics of Commuter Rail Riders

Trip Purpose: Home-based Work

Over 95% of the commuter rail riders indicated that their purpose of travel is home-based work.

Access Mode

For both stations, walking and driving/parking are the two major means of access. 77.3% of the riders accessed Newtonville Station by walking and 20.5% of them by driving/parking. 55.6% of the riders accessed West Newton Station by walking and 42.2% of them by driving/parking. No riders reported access from other public transportation.

Popular Route: Newton–Boston

Since only the inbound trips were recorded, all riders from Newton who accessed from both stations indicated Boston as their destination.

APPENDIX D

Summary of Public Comments:
Washington Street Study Scoping and Listening Meeting

Newton, February 26, 2014

Location	Category	Comments
Washington @ Lowell	Design/Geometry	Difficult geometry, "improvements" not ideal
Washington @ Walker	Visibility/Lighting	Visibility is poor
Washington @ Harvard	Visibility/Lighting	Poor lighting, unsafe for pedestrians even with ped. lights
West Newton	Traffic Signals	Lights and SQ not included, should be studied later
Rt. 16 Bypass	Misc.	Air Rights
Newton Corner	Scope of Study	Not included in study, most difficult area for bikes
Washington Street	Bikes	Nice to buffer bikers on Wash.
Newtonville	Pedestrians/Crossings	Parking demand causing more risk, esp. at crossing near Cook/Paintbar
Washington @ Walnut	Pedestrians/Crossings	Lots of kids and pedestrians, young school kids crossing
Washington Street	Design/Geometry	Road Diet is good use of space
Washington Street	Parking at Corners	Backups on roads coming into Washington St./cars parking near corners
Washington Street	Design/Geometry	Use street design to restrict parking at corners, not signs
West Newton	Scope of Study	Consider impact to W. Newton SQ traffic
West Newton	Pedestrians/Crossings	Peds. Crossing Washington Street at Trader Joes and Post Office
Washington @ Lowell	Bikes	Bumpout impact on cyclists - don't push bikes into traffic
Washington Street	Pedestrians/Crossings	Bumpouts not ideal for cyclists but safe for pedestrians
Washington @ Harvard	Traffic Signals	Rapid flash is helpful
Washington Street	Bikes	Opportunity for great E/W bike route, similar to beacon street. Bike Newton is moving ahead
Washington Street	Policy	Be consistent with GreenDOT policy, inc. bike travel, keep auto traffic level
Washington Street	Bikes	Cycle track possible on portion, but currently not safe
Washington Street	Bikes	Consider cycle track
Washington Street	Transit	Bus shelters needed
Washington Street	Transit	Need to speed up transit
Washington Street	Transit	Need safe crossings to bus stops
Washington Street	Scope of Study	Consider economics of making it easier to cross Washington - people don't like to cross it now
Washington Street	Policy	Consider making safety changes quickly - don't wait for a study to make obvious improvements
Washington @ Cross	Pedestrians/Crossings	Crossing here is difficult. There are 2 express busses, very full, many commuters, need to make crossing safer
Washington Street	Misc.	So many high volume businesses (trader joes, car dealers, Walgreens, etc.) make left turns very difficult
Washington Street	Access	Residential and commercial access is difficult
Washington Street	Design/Geometry	Continuous center lane or median
Washington Street	Policy	This is complicated work and an array of comments are helpful. There is room for an educational element to this. Great potential!
Washington Street	Transit	DMU on tracks sounds awesome! Increasing housing density along corridor is good too!
Washington Street	Bikes	Difficult for cyclists to make left turns
Washington Street	Policy	Frustration due to timing, slow, many meetings, progress could be faster. Ex. Move "no parking" signs at corner via police power
Washington Street	Misc.	A lot of potential on corridor because there is little development on the S. side.

Location	Category	Comments
Washington Street	Design/Geometry	Slow traffic with geometry and engineering to make pedestrian crossing easier (slow design speed = explicit goal)
Washington Street	Design/Geometry	Drive transportation choice for high school students (major route)
Washington Street	Transit	MBTA retrofit bus get priority green signal transponders? (like fire trucks)
Washington @ Walnut	Design/Geometry	There are 3 lanes NB, need a left turn lane SB
Washington Street	Parking at Corners	Temporary asphalt curbing at "no parking" areas. Is this as easy as moving signs? Ex. Washington @Walker St.
West Newton	Scope of Study	Timeframe and process to extend study through to W. Newton? City is looking at W. Newton
Washington @ Central Ave	Visibility/Lighting	Poor visibility
Washington @ Beach Street	Visibility/Lighting	Poor visibility
Washington @ Court	Visibility/Lighting	Poor visibility
Washington Street	Bikes	How do changes to street width affect bike lanes?
Washington Street	Pedestrians/Crossings	Walking on Wash. Is unpleasant - need sound barrier for sound and pollution
Washington Street	Design/Geometry	Could it be reduced to 3 lanes? 2 lanes?
Washington @ Brookline Street	Aesthetics	Landscape buffer from Sullivan Tire to Brookline Street (CDBG proj.)
Washington Street	Aesthetics	What would it take to get state to clean up dead trees along MBTA route?
Washington Street	Bikes	What makes Wash. better for bike path than Watertown St.?
Washington Street	Policy	How does city prioritize changes? Are any intersections in CIP included in this CTPS study? Yes.

Note: Summary of public comments were prepared and provided by Newton transportation planning team.

APPENDIX E

Summary of Crash Statistics:
Major Intersections in the Study Corridor

TABLE E-1
Summary of MassDOT Crash Data 2007–11
Intersections at Washington Streetreet

Cross Streetreet Name		Chestnut Street		Armory Street		Lowell Avenue		Walnut Street		Harvard Street		Crafts Street		Adams Street		Jackson Road		Church Street		Corridor Total	
Total number of crashes/Percentage		27	100.0%	27	100.0%	20	100.0%	33	100.0%	16	100.0%	25	100.0%	53	100.0%	23	100.0%	43	100.0%	267	100.0%
Severity	Property damage only	18	66.7%	15	55.6%	13	65.0%	15	45.5%	8	50.0%	16	64.0%	30	56.6%	13	56.5%	28	65.1%	156	58.4%
	Non-fatal injury	4	14.8%	4	14.8%	4	20.0%	11	33.3%	5	31.3%	5	20.0%	19	35.8%	6	26.1%	11	25.6%	69	25.8%
	Fatality	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Not reported/unknown	5	18.5%	8	29.6%	3	15.0%	7	21.2%	3	18.8%	4	16.0%	4	7.5%	4	17.4%	4	9.3%	42	15.7%
Collision type	Single vehicle	1	3.7%	4	14.8%	2	10.0%	4	12.1%	1	6.3%	3	12.0%	5	9.4%	2	8.7%	2	4.7%	24	9.0%
	Rear-end	5	18.5%	2	7.4%	1	5.0%	7	21.2%	2	12.5%	9	36.0%	8	15.1%	11	47.8%	18	41.9%	63	23.6%
	Angle	9	33.3%	15	55.6%	9	45.0%	12	36.4%	6	37.5%	9	36.0%	30	56.6%	5	21.7%	9	20.9%	104	39.0%
	Sideswipe, same direction	6	22.2%	2	7.4%	7	35.0%	6	18.2%	4	25.0%	3	12.0%	3	5.7%	3	13.0%	8	18.6%	42	15.7%
	Sideswipe, opposite direction	1	3.7%	2	7.4%	0	0.0%	0	0.0%	1	6.3%	0	0.0%	2	3.8%	1	4.3%	1	2.3%	8	3.0%
	Head-on	0	0.0%	0	0.0%	0	0.0%	2	6.1%	1	6.3%	0	0.0%	1	1.9%	0	0.0%	0	0.0%	4	1.5%
	Rear-to-rear	2	7.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	0.7%
Involved pedeStreetrian(s)		1	3.7%	1	3.7%	1	5.0%	2	6.1%	2	12.5%	2	8.0%	3	5.7%	0	0.0%	0	0.0%	12	4.5%
Involved cycliStreet(s)		0	0.0%	1	3.7%	1	5.0%	1	3.0%	0	0.0%	1	4.0%	3	5.7%	0	0.0%	2	4.7%	9	3.4%
Occurred during weekday peak periods*		9	33.3%	5	18.5%	8	40.0%	8	24.2%	7	43.8%	10	40.0%	14	26.4%	6	26.1%	15	34.9%	82	30.7%
Wet or icy pavement conditions		7	25.9%	7	25.9%	3	15.0%	13	39.4%	5	31.3%	8	32.0%	11	20.8%	3	13.0%	9	20.9%	66	24.7%
Dark conditions (lit or unlit)		7	25.9%	5	18.5%	4	20.0%	4	12.1%	1	6.3%	4	16.0%	11	20.8%	6	26.1%	8	18.6%	50	18.7%

* Peak periods are defined as 07:00–10:00 and 15:30–18:30.

TABLE E-2
Summary of Newton Police Crash Reports January 2011–February 2014
Intersections at Washington Streetreet

Cross Streetreet Name		Chestnut Street		Armory Street		Lowell Avenue		Walnut Street		Harvard Street		Crafts Street		Adams Street		Jackson Road		Church Street		Corridor Total	
Total number of crashes/Percentage		5	100.0%	9	100.0%	8	100.0%	18	100.0%	6	100.0%	15	100.0%	21	100.0%	11	100.0%	14	100.0%	107	100.0%
Severity	Property damage only	3	60.0%	6	66.7%	6	75.0%	10	55.6%	3	50.0%	9	60.0%	14	66.7%	5	45.5%	9	64.3%	65	60.7%
	Non-fatal injury	2	40.0%	2	22.2%	2	25.0%	7	38.9%	2	33.3%	4	26.7%	6	28.6%	3	27.3%	5	35.7%	33	30.8%
	Fatality	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Not reported/unknown	0	0.0%	1	11.1%	0	0.0%	1	5.6%	1	16.7%	2	13.3%	1	4.8%	3	27.3%	0	0.0%	9	8.4%
Collision type	Single vehicle	2	40.0%	0	0.0%	2	25.0%	2	11.1%	1	16.7%	2	13.3%	4	19.0%	2	18.2%	0	0.0%	15	14.0%
	Rear-end	0	0.0%	1	11.1%	1	12.5%	5	27.8%	0	0.0%	4	26.7%	4	19.0%	6	54.5%	6	42.9%	27	25.2%
	Angle	1	20.0%	6	66.7%	4	50.0%	9	50.0%	1	16.7%	4	26.7%	8	38.1%	1	9.1%	3	21.4%	37	34.6%
	Sideswipe, same direction	1	20.0%	1	11.1%	1	12.5%	2	11.1%	4	66.7%	3	20.0%	3	14.3%	2	18.2%	5	35.7%	22	20.6%
	Sideswipe, opposite direction	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	6.7%	0	0.0%	0	0.0%	0	0.0%	1	0.9%
	Head-on	1	20.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	6.7%	0	0.0%	0	0.0%	0	0.0%	2	1.9%
	Rear-to-rear	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Involved pedeStreetrian(s)		2	40.0%	0	0.0%	1	12.5%	1	5.6%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	4	3.7%
Involved cycliStreet(s)		0	0.0%	0	0.0%	1	12.5%	1	5.6%	1	16.7%	1	6.7%	4	19.0%	0	0.0%	0	0.0%	8	7.5%
Occurred during weekday peak periods*		2	40.0%	5	55.6%	5	62.5%	5	27.8%	2	33.3%	1	6.7%	7	33.3%	3	27.3%	6	42.9%	36	33.6%
Wet or icy pavement conditions		1	20.0%	2	22.2%	4	50.0%	4	22.2%	1	16.7%	3	20.0%	5	23.8%	5	45.5%	5	35.7%	30	28.0%
Dark conditions (lit or unlit)		0	0.0%	0	0.0%	2	25.0%	3	16.7%	0	0.0%	3	20.0%	4	19.0%	4	36.4%	6	42.9%	22	20.6%

* Peak periods are defined as 07:00–10:00 and 15:30–18:30.

APPENDIX F

Collision Diagram and Summary of Crash Reports: Major Intersections in the Study Corridor

FIGURE F-1
Intersection Collision Diagram, Newton Police Reports 1/1/2011–2/28/2014
Washington Street @ Chestnut Street

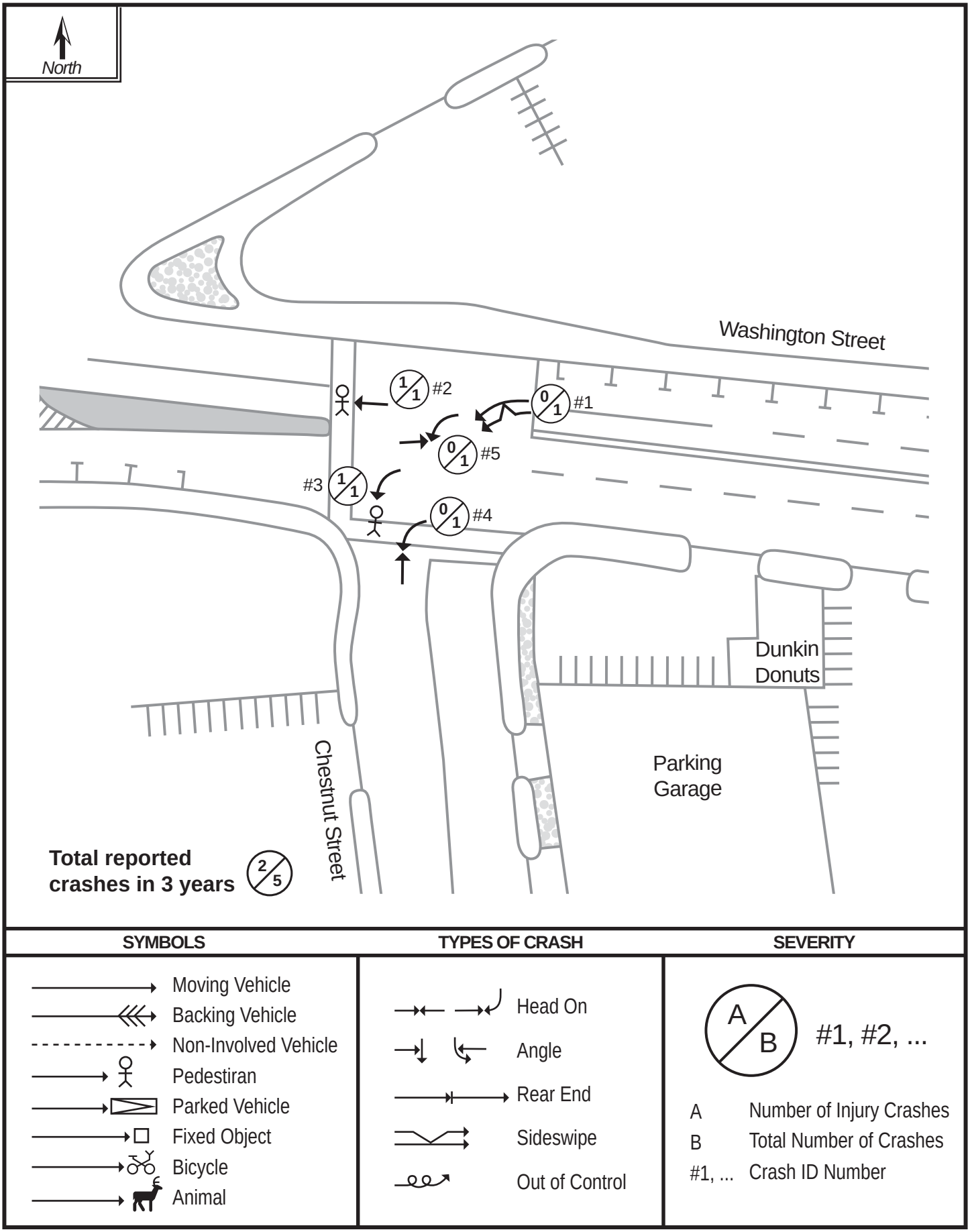
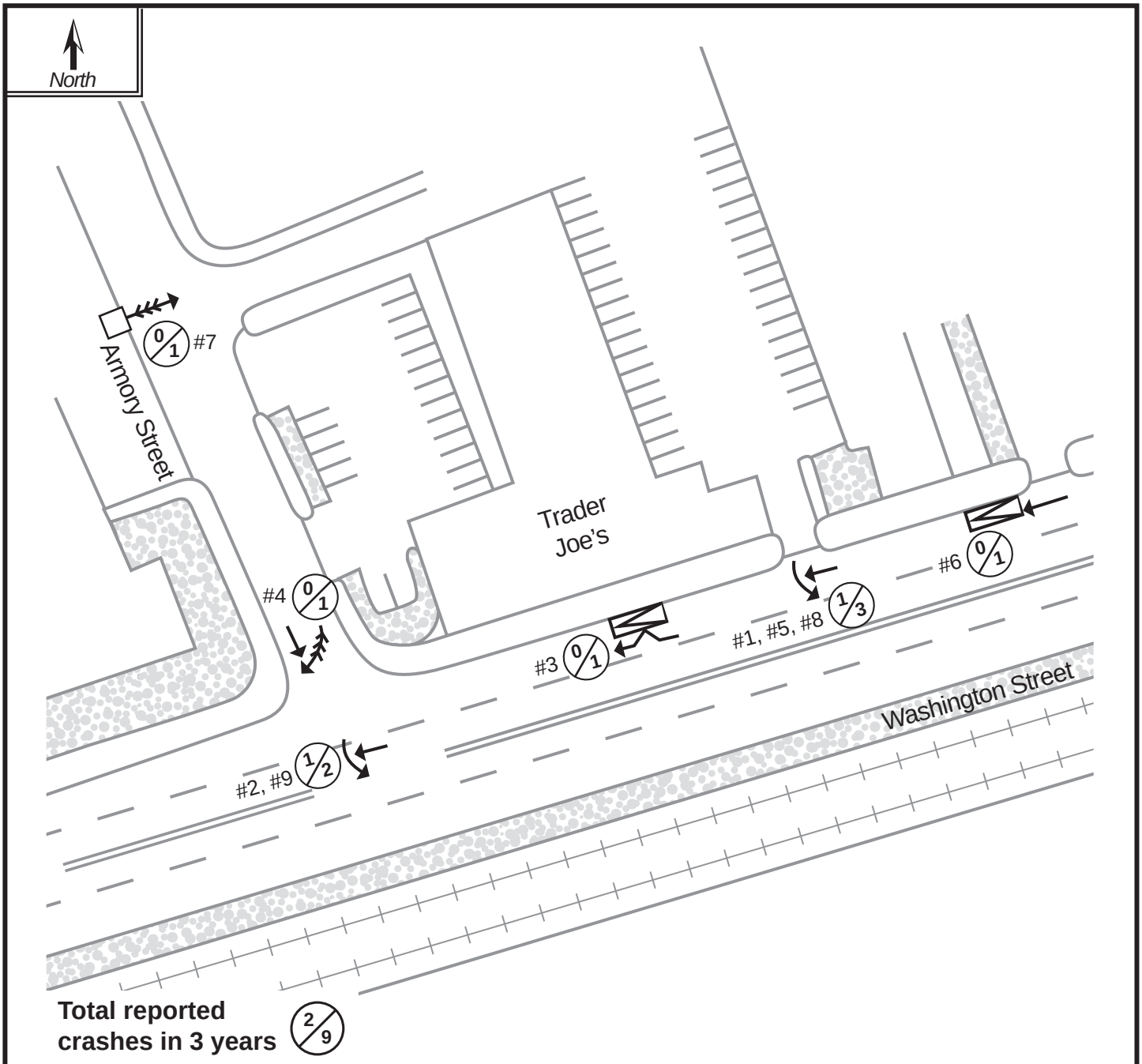


TABLE F-1
Summary of Newton Police Crash Reports, January 2011–February 2014
Washington Street at Chestnut Street

Crash Number	Crash Date	Crash Time	Crash Severity	Number of Vehicles	Manner of Collision	Road Surface	Light Conditions	Nonmotorist Type	Contributing Factor (s)
#1	23-Sep-2011	5:53 PM	Property damage only	2	Sideswipe, same dir.	Wet	Daylight	-	Failure to keep in proper lane or running off road
#2	9-Oct-2012	12:43 PM	Non-fatal injury	1	Single vehicle crash	Dry	Daylight	ped	No Improper Driving
#3	31-Jan-2013	2:58 PM	Non-fatal injury	1	Single vehicle crash	Dry	Daylight	ped	Failed to yield right of way
#4	28-Feb-2013	12:12 PM	Property damage only	2	Head-on	Dry	Daylight	-	Failed to yield right of way
#5	10-May-2013	3:55 PM	Property damage only	2	Angle	Dry	Daylight	-	Failed to yield right of way

FIGURE F-2
Intersection Collision Diagram, Newton Police Reports 1/1/2011–2/28/2014
Washington Street @ Armory Street



SYMBOLS

- Moving Vehicle
- Backing Vehicle
- Non-Involved Vehicle
- Pedestiran
- Parked Vehicle
- Fixed Object
- Bicycle
- Animal

TYPES OF CRASH

- Head On
- Angle
- Rear End
- Sideswipe
- Out of Control

SEVERITY

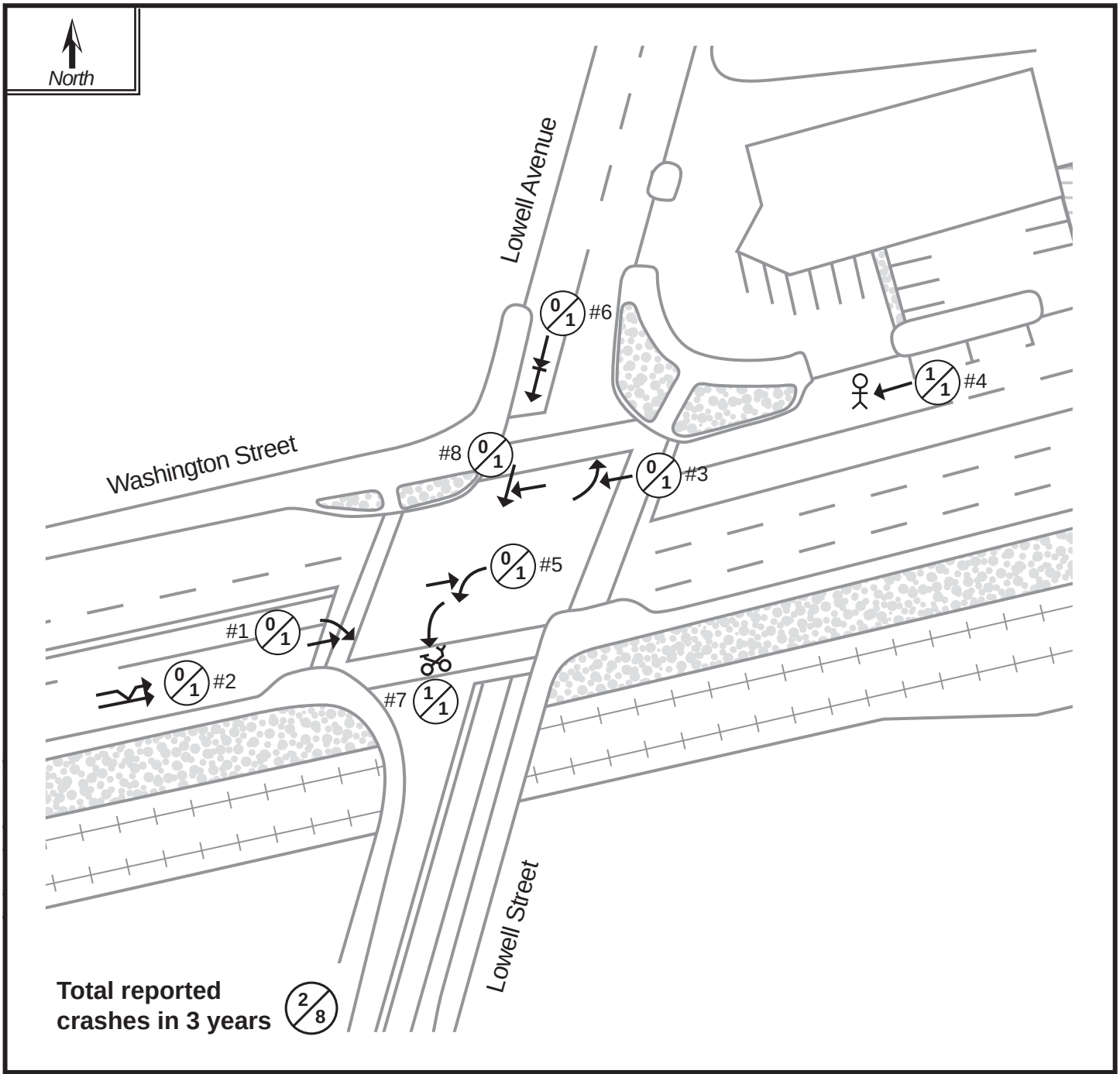
A/B #1, #2, ...

A	Number of Injury Crashes
B	Total Number of Crashes
#1, ...	Crash ID Number

TABLE F-2
Summary of Newton Police Crash Reports, January 2011–February 2014
Washington Street at Armory Street

Crash Number	Crash Date	Crash Time	Crash Severity	Number of Vehicles	Manner of Collision	Road Surface	Light Conditions	Nonmotorist Type	Contributing Factor (s)
#1	6-Sep-2011	4:12 PM	Property damage only	2	Angle	Wet	Daylight	-	Failed to yield right of way
#2	7-Mar-2012	8:45 AM	Property damage only	2	Angle	Dry	Daylight	-	Failed to yield right of way
#3	10-Apr-2012	9:38 PM	Not Reported	2	Sideswipe, same dir.	Dry	Daylight	-	No Improper Driving
#4	23-May-2012	7:02 PM	Property damage only	2	Angle	Dry	Dusk	-	Wrong side or wrong way
#5	12-Jul-2012	2:52 PM	Non-fatal injury	2	Angle	Dry	Daylight	-	Failed to yield right of way
#6	16-Aug-2012	8:02 AM	Property damage only	2	Rear-end	Wet	Daylight	-	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist in roadway, etc.
#7	4-May-2013	8:04 PM	Property damage only	1		Dry	Dusk	-	Visibility Obstructed
#8	9-Sep-2013	3:49 PM	Property damage only	2	Angle	Dry	Daylight	-	Inattention
#9	19-Sep-2013	5:27 PM	Non-fatal injury	2	Angle	Dry	Daylight	-	Visibility Obstructed

FIGURE F-3
Intersection Collision Diagram, Newton Police Reports 1/1/2011–2/28/2014
Washington Street @ Lowell Avenue



SYMBOLS	TYPES OF CRASH	SEVERITY
Moving Vehicle	Head On	A/B #1, #2, ...
Backing Vehicle	Angle	A Number of Injury Crashes
Non-Involved Vehicle	Rear End	B Total Number of Crashes
Pedestiran	Sideswipe	#1, ... Crash ID Number
Parked Vehicle	Out of Control	
Fixed Object		
Bicycle		
Animal		

TABLE F-3
Summary of Newton Police Crash Reports, January 2011–February 2014
Washington Street at Lowell Avenue

Crash Number	Crash Date	Crash Time	Crash Severity	Number of Vehicles	Manner of Collision	Road Surface	Light Conditions	Nonmotorist Type	Contributing Factor (s)
#1	1-Feb-2011	5:50 PM	Property damage only	2	Angle	Snow	Dark - lighted roadway	-	No Improper Driving
#2	26-Nov-2011	11:21 AM	Property damage only	2	Sideswipe, same dir.	Dry	Daylight	-	Failed to yield right of way
#3	20-Jan-2012	5:57 PM	Property damage only	2	Angle	Snow	Dark - lighted roadway	-	Inattention
#4	23-Jun-2012	12:41 PM	Non-fatal injury	1	Single vehicle crash	Not reported	Not reported	ped	No Improper Driving
#5	4-Oct-2012	9:57 AM	Property damage only	2	Angle	Wet	Daylight	-	No Improper Driving
#6	27-Nov-2012	3:43 PM	Property damage only	2	Rear-end	Wet	Dawn	-	Followed too closely
#7	15-Oct-2013	5:18 PM	Non-fatal injury	1	Single vehicle crash	Dry	Daylight	cyc	Glare
#8	2-Nov-2013	12:28 PM	Property damage only	2	Angle	Dry	Daylight	-	No Improper Driving

FIGURE F-4
Intersection Collision Diagram, Newton Police Reports 1/1/2011–2/28/2014
Washington Street @ Walnut Street

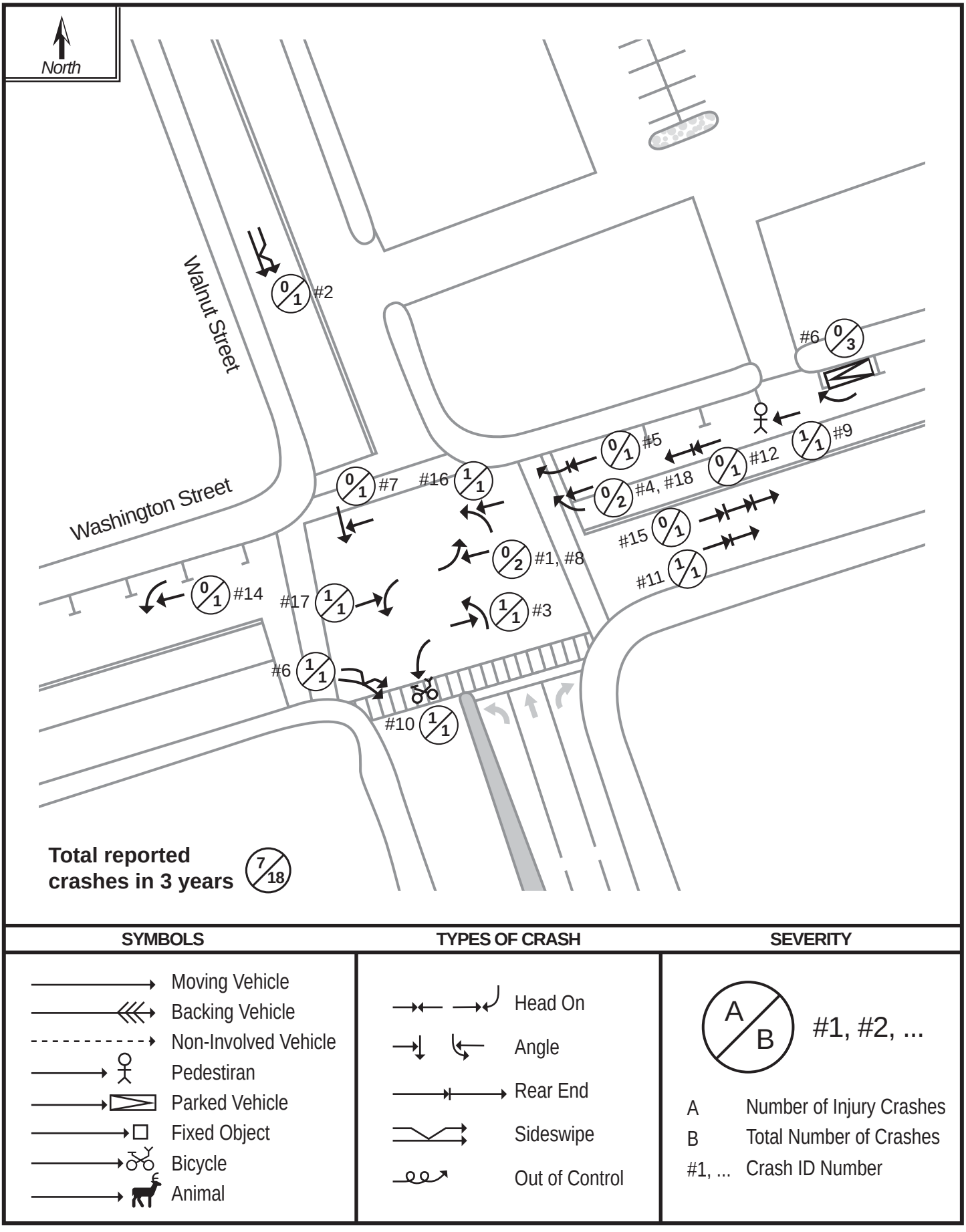
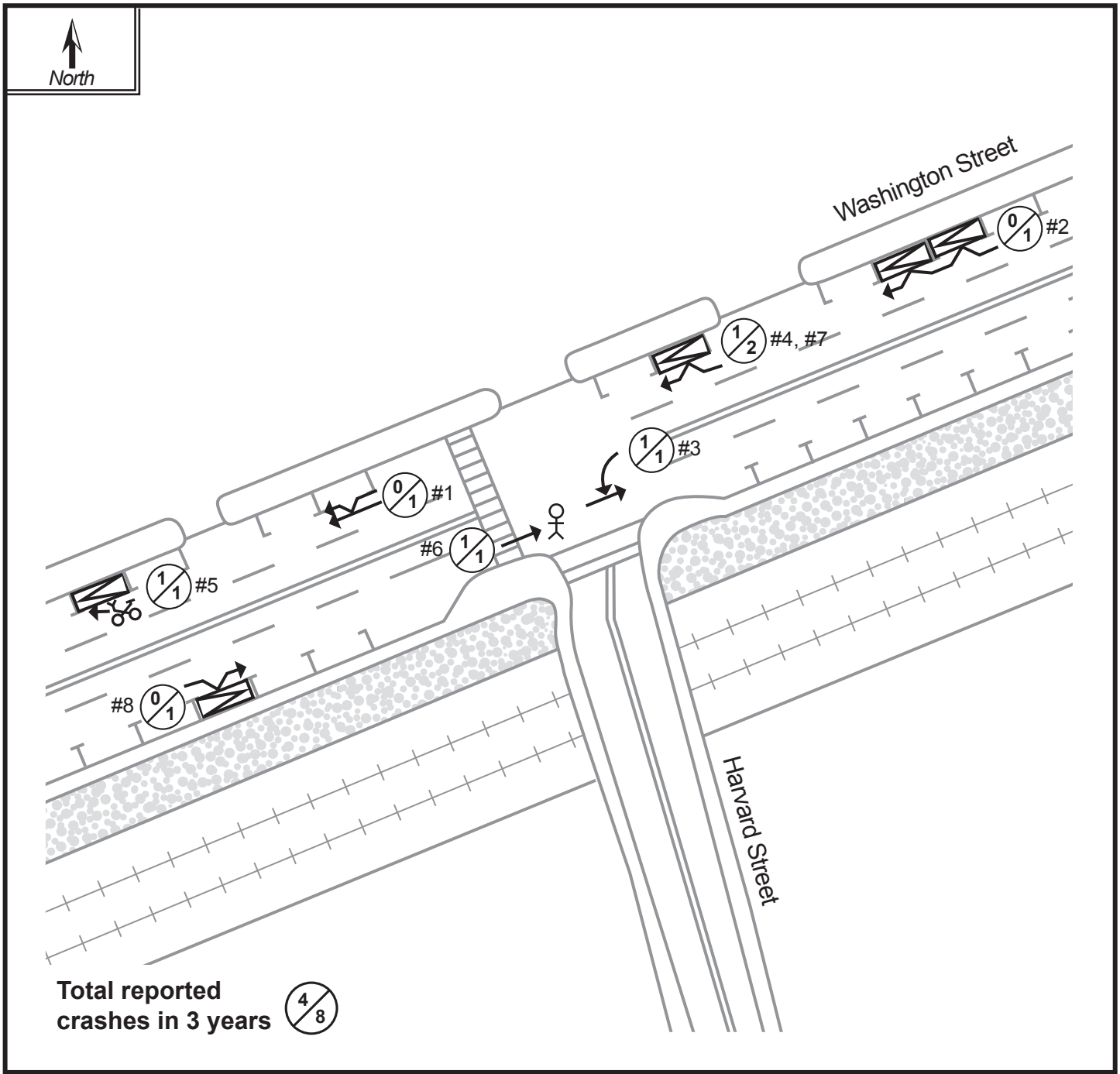


TABLE F-4
Summary of Newton Police Crash Reports, January 2011–February 2014
Washington Street at Walnut Street

Crash Number	Crash Date	Crash Time	Crash Severity	Number of Vehicles	Manner of Collision	Road Surface	Light Conditions	Nonmotorist Type	Contributing Factor (s)
#1	20-Jan-2011	2:54 PM	Property damage only	2	Angle	Wet	Daylight	-	Inattention
#2	4-Mar-2011	8:18 AM	Property damage only	2	Sideswipe, same dir.	Dry	Daylight	-	Inattention
#3	28-Apr-2011	7:15 PM	Non-fatal injury	2	Angle	Wet	Daylight	-	Failed to yield right of way
#4	8-Sep-2011	10:53 AM	Property damage only	2	Angle	Wet	Daylight	-	No Improper Driving
#5	15-Sep-2011	9:58 AM	Not Reported	2	Rear-end	Dry	Daylight	-	Inattention
#6	24-Oct-2011	10:41 AM	Non-fatal injury	2	Sideswipe, same dir.	Dry	Daylight	-	Visibility Obstructed
#7	2-Dec-2011	11:33 PM	Property damage only	2	Angle	Dry	Dark - lighted roadway	-	Operating vehicle in erratic, reckless, careless, negligent or aggressive manner
#8	25-Mar-2012	9:36 AM	Property damage only	2	Angle	Dry	Daylight	-	Failed to yield right of way
#9	24-Jun-2012	12:45 PM	Non-fatal injury	1	Single vehicle crash	Dry	Daylight	ped	Inattention
#10	2-Aug-2012	7:05 PM	Non-fatal injury	1	Single vehicle crash	Dry	Daylight	cycle	Inattention
#11	1-Oct-2012	8:14 AM	Non-fatal injury	2	Rear-end	Dry	Daylight	-	Visibility Obstructed
#12	2-Oct-2012	7:36 AM	Property damage only	2	Rear-end	Not reporte	Daylight	-	Followed too closely
#13	11-Dec-2012	8:17 PM	Property damage only	2	Angle	Dry	Dark - lighted roadway	-	Other improper action
#14	17-Jan-2013	12:55 PM	Property damage only	2	Angle	Dry	Daylight	-	Failed to yield right of way
#15	25-Jun-2013	3:26 PM	Property damage only	3	Rear-end	Not reporte	Not reported	-	Followed too closely
#16	30-Oct-2013	11:29 PM	Non-fatal injury	2	Angle	Dry	Dark - lighted roadway	-	Disregarded traffic signs, signals, road markings
#17	31-Oct-2013	4:34 PM	Non-fatal injury	2	Angle	Dry	Daylight	-	Failed to yield right of way
#18	1-Dec-2013	3:53 PM	Property damage only	2	Rear-end	Wet	Daylight	-	Inattention

FIGURE F-5
Intersection Collision Diagram, Newton Police Reports 1/1/2011–2/28/2014
Washington Street @ Harvard Street

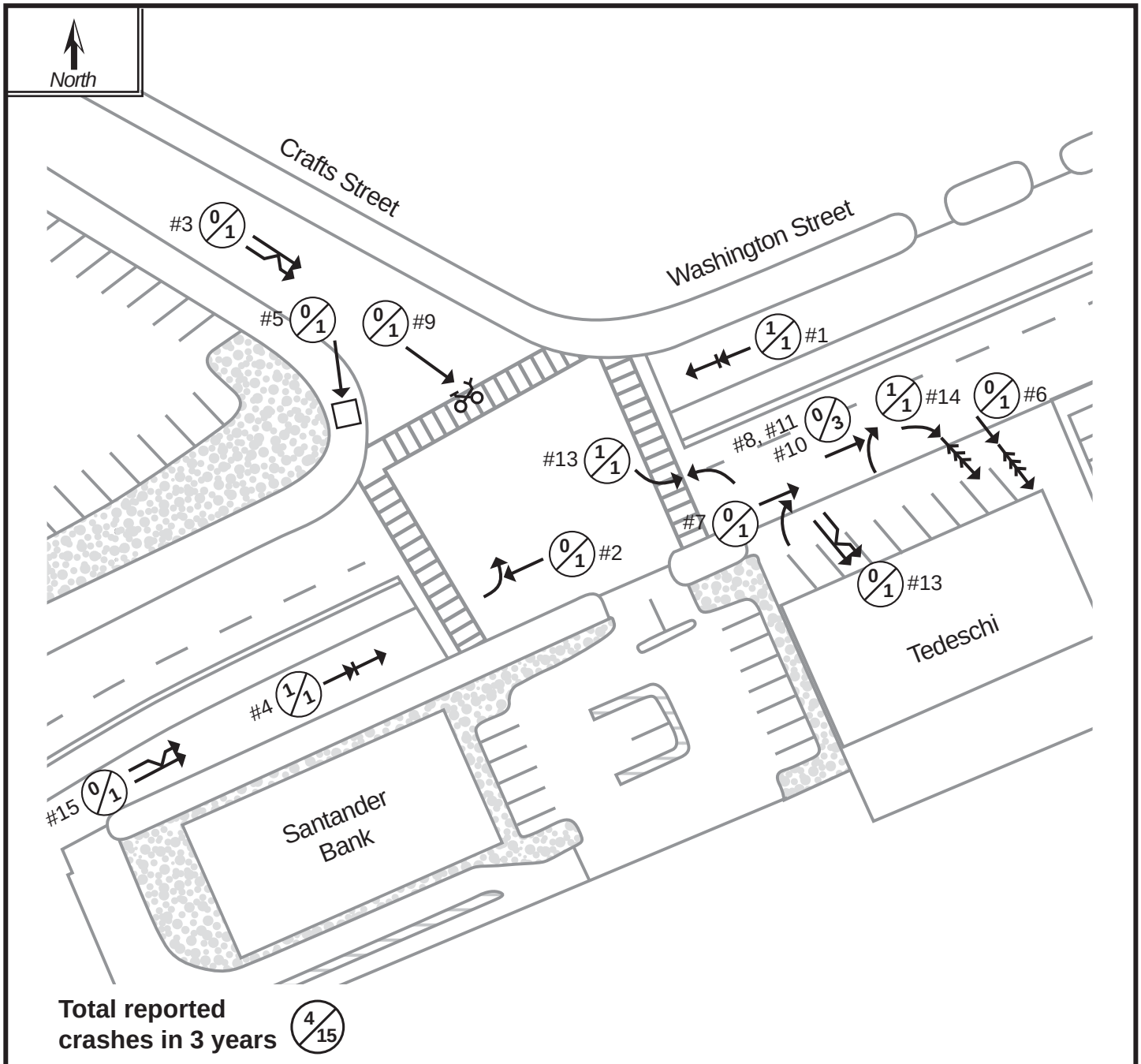


SYMBOLS	TYPES OF CRASH	SEVERITY
Moving Vehicle	Head On	A/B #1, #2, ...
Backing Vehicle	Angle	A Number of Injury Crashes
Non-Involved Vehicle	Rear End	B Total Number of Crashes
Pedestiran	Sideswipe	#1, ... Crash ID Number
Parked Vehicle	Out of Control	
Fixed Object		
Bicycle		
Animal		

TABLE F-5
Summary of Newton Police Crash Reports, January 2011–February 2014
Washington Street at Harvard Street

Crash Number	Crash Date	Crash Time	Crash Severity	Number of Vehicles	Manner of Collision	Road Surface	Light Conditions	Nonmotorist Type	Contributing Factor (s)
#1	29-Apr-2011	6:10 PM	Property damage only	2	Sideswipe, same dir.	Dry	Daylight	-	Failed to yield right of way
#2	1-Sep-2011	12:32 PM	Property damage only	3	Angle	Dry	Daylight	-	Failed to yield right of way
#3	31-Dec-2011	4:28 PM	Non-fatal injury	2	Angle	Wet	Dusk	-	Failed to yield right of way
#4	11-Jul-2012	6:08 PM	Property damage only	2	Sideswipe, same dir.	Dry	Daylight	-	No Improper Driving
#5	8-Aug-2012	10:19 AM	Non-fatal injury	1	Single vehicle crash	Dry	Daylight	cyc	Inattention
#6	23-Dec-2012	5:58 PM	Non-fatal injury	1	Single vehicle crash	Dry	Dark - lighted roadway	ped	Inattention
#7	8-Apr-2013	11:58 AM	Non-fatal injury	2	Sideswipe, same dir.	Dry	Daylight	-	Inattention
#8	18-Feb-2014	11:27 AM	Not Reported	2	Sideswipe, same dir.	Wet	Daylight	-	Inattention

FIGURE F-6
Intersection Collision Diagram, Newton Police Reports 1/1/2011–2/28/2014
Washington Street @ Crafts Street

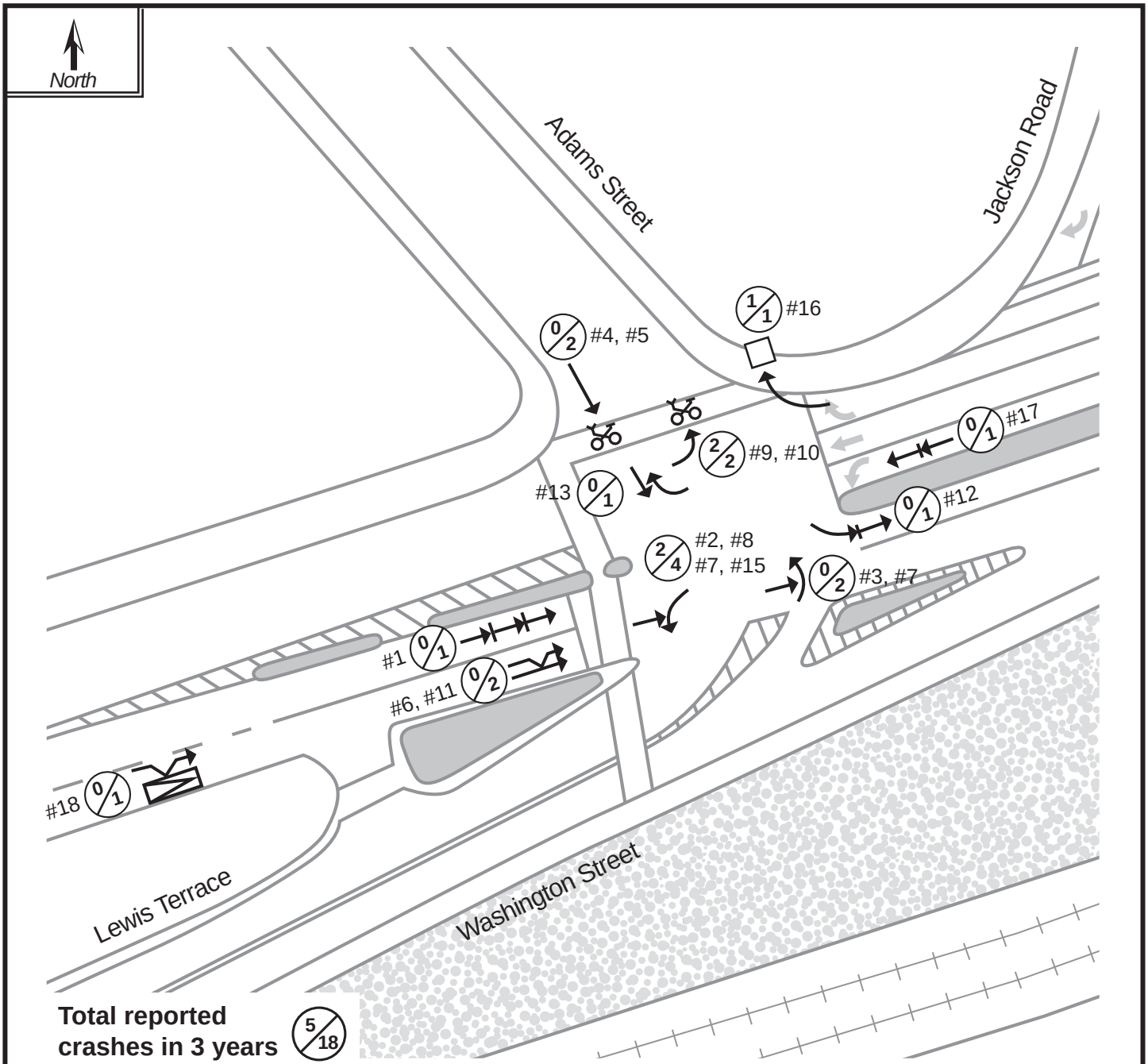


SYMBOLS	TYPES OF CRASH	SEVERITY
Moving Vehicle	Head On	A/B #1, #2, ...
Backing Vehicle	Angle	A Number of Injury Crashes
Non-Involved Vehicle	Rear End	B Total Number of Crashes
Pedestiran	Sideswipe	#1, ... Crash ID Number
Parked Vehicle	Out of Control	
Fixed Object		
Bicycle		
Animal		

TABLE F-6
Summary of Newton Police Crash Reports, January 2011–February 2014
Washington Street at Crafts Street

Crash Number	Crash Date	Crash Time	Crash Severity	Number of Vehicles	Manner of Collision	Road Surface	Light Conditions	Nonmotorist Type	Contributing Factor (s)
#1	2-Jan-2011	2:09 PM	Non-fatal injury	2	Rear-end	Wet	Daylight	-	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist in roadway, etc.
#2	4-Jan-2011	10:10 AM	Property damage only	2	Angle	Dry	Daylight	-	Failed to yield right of way
#3	26-Apr-2011	7:36 AM	Not Reported	2	Sideswipe, same dir.	Dry	Daylight	-	Failure to keep in proper lane or running off road
#4	16-May-2011	11:06 PM	Non-fatal injury	2	Rear-end	Wet	Dark - lighted roadway	-	Operating vehicle in erratic, reckless, careless, negligent or aggressive manner
#5	29-May-2011	1:02 AM	Property damage only	1	Single vehicle crash	Dry	Dark - lighted roadway	-	Failure to keep in proper lane or running off road
#6	02-Aug-2011	2:35 PM	Property damage only	2	Rear-end	Dry	Daylight	-	Other improper action
#7	30-Oct-2011	1:06 PM	Property damage only	2	Angle	Not reported	Daylight	-	Failed to yield right of way
#8	18-Dec-2011	11:10 AM	Property damage only	2	Angle	Dry	Daylight	-	Failed to yield right of way
#9	27-Dec-2011	3:27 PM	Property damage only	1	Single vehicle crash	Not reported	Not reported	cyc	No Improper Driving
#10	6-Jan-2012	2:12 PM	Property damage only	2	Sideswipe, opposite dir	Dry	Daylight	-	Failed to yield right of way
#11	13-Mar-2012	6:55 AM	Property damage only	2	Angle	Wet	Daylight	-	Failed to yield right of way
#12	28-Mar-2012	6:49 PM	Not Reported	2	Sideswipe, same dir.	Dry	Daylight	-	No Improper Driving
#13	1-Aug-2012	9:23 PM	Non-fatal injury	2	Head-on	Dry	Dark - lighted roadway	-	Failed to yield right of way
#14	14-Nov-2012	12:44 PM	Non-fatal injury	2	Rear-end	Dry	Daylight	-	Followed too closely
#15	18-May-2013	7:16 PM	Property damage only	2	Sideswipe, same dir.	Dry	Daylight	-	Visibility Obstructed

FIGURE F-7
Intersection Collision Diagram, Newton Police Reports 1/1/2011–2/28/2014
Washington Street @ Adams Street/Lewis Terrace

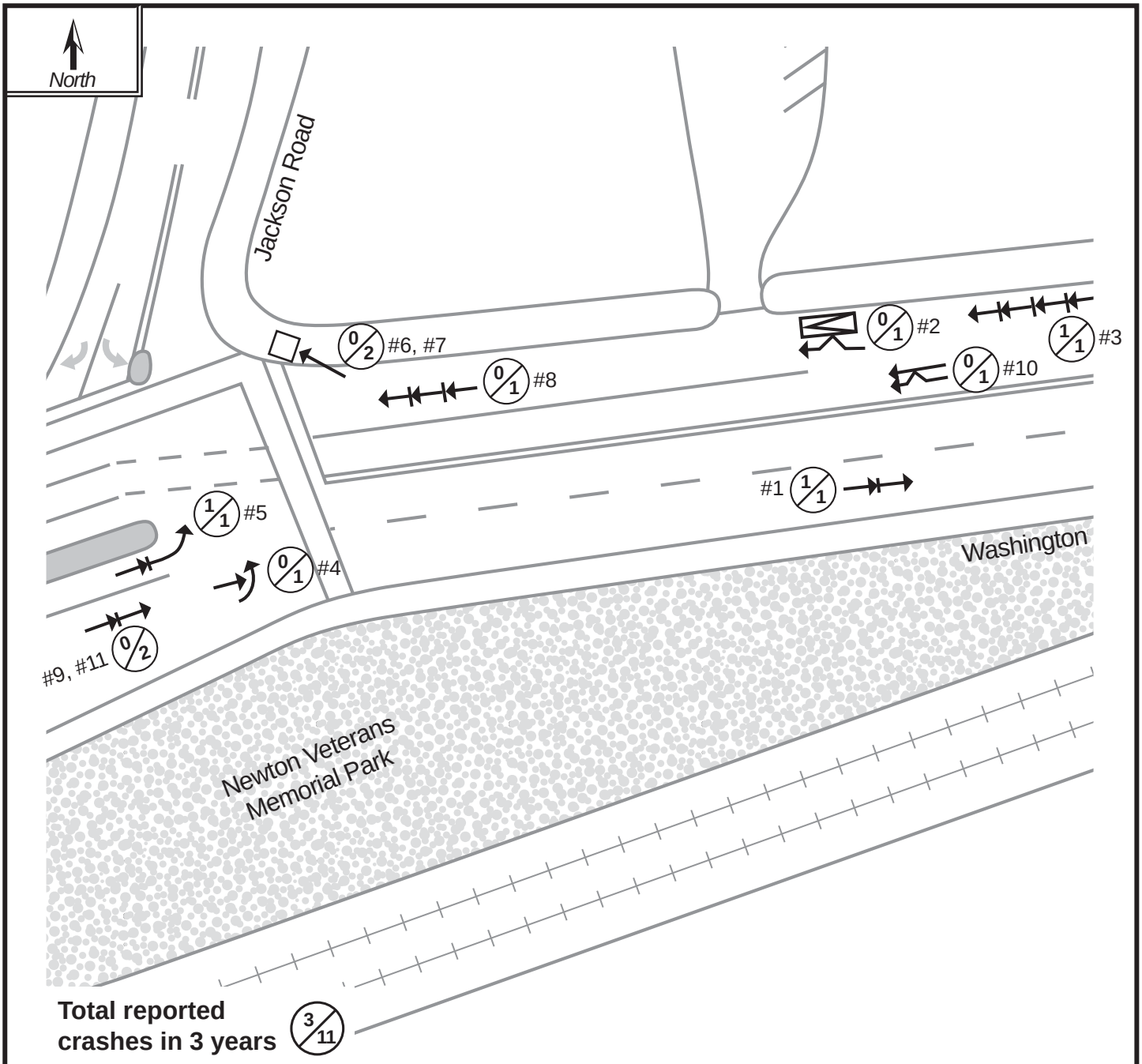


SYMBOLS	TYPES OF CRASH	SEVERITY
Moving Vehicle	Head On	A/B #1, #2, ...
Backing Vehicle	Angle	A Number of Injury Crashes
Non-Involved Vehicle	Rear End	B Total Number of Crashes
Pedestiran	Sideswipe	#1, ... Crash ID Number
Parked Vehicle	Out of Control	
Fixed Object		
Bicycle		
Animal		

TABLE F-7
Summary of Newton Police Crash Reports, January 2011–February 2014
Washington Street at Adams Street/ Lewis Terrace

Crash Number	Crash Date	Crash Time	Crash Severity	Number of Vehicles	Manner of Collision	Road Surface	Light Conditions	Nonmotorist Type	Contributing Factor (s)
#1	4-Jan-2011	5:41 PM	Property damage only	3	Rear-end	Dry	Dark - lighted roadway	-	Cellular telephone
#2	20-Jan-2011	1:29 PM	Property damage only	2	Angle	Wet	Daylight	-	Visibility Obstructed
#3	23-Jan-2011	12:45 AM	Property damage only	1	Angle	Ice	Dark - lighted roadway	-	Disregarded traffic signs, signals, road markings
#4	18-Jul-2011	8:24 AM	Property damage only	1	Single vehicle crash	Not reported	Unknown	cyc	No Improper Driving
#5	3-Sep-2011	1:36 PM	Property damage only	2	Unknown	Dry	Daylight	cyc	Failed to yield right of way
#6	26-Oct-2011	4:23 PM	Property damage only	2	Sideswipe, same dir.	Dry	Daylight	-	Made an improper turn
#7	14-Nov-2011	9:43 AM	Non-fatal injury	2	Angle	Dry	Daylight	-	Visibility Obstructed
#8	21-Jan-2012	8:57 AM	Non-fatal injury	2	Angle	Snow	Daylight	-	Failed to yield right of way
#9	20-Jun-2012	10:28 AM	Non-fatal injury	1	Angle	Dry	Daylight	cyc	No Improper Driving
#10	8-Jul-2012	8:55 PM	Non-fatal injury	1	Single vehicle crash	Dry	Dark - lighted roadway	cyc	Failed to yield right of way
#11	4-Sep-2012	8:00 AM	Property damage only	2	Sideswipe, same dir.	Wet	Daylight	-	Operating vehicle in erratic, reckless, careless, negligent or aggressive manner
#12	8-Sep-2012	12:40 PM	Property damage only	2	Rear-end	Dry	Daylight	-	Inattention
#13	4-Oct-2012	9:10 AM	Property damage only	2	Angle	Wet	Daylight	-	Made an improper turn
#14	24-Nov-2012	8:23 AM	Property damage only	2	Angle	Dry	Daylight	-	Disregarded traffic signs, signals, road markings
#15	7-Dec-2012	12:58 PM	Property damage only	2	Angle	Dry	Daylight	-	Failed to yield right of way
#16	31-Mar-2013	8:51 AM	Non-fatal injury	1	Single vehicle crash	Dry	Daylight	-	Disregarded traffic signs, signals, road markings
#17	22-Apr-2013	1:09 PM	Non-fatal injury	2	Rear-end	Dry	Daylight	-	No Improper Driving
#18	11-Dec-2013	5:42 PM	Property damage only	2	Sideswipe, same dir.	Dry	Dark - lighted roadway	-	Inattention

FIGURE F-8
Intersection Collision Diagram, Newton Police Reports 1/1/2011–2/28/2014
Washington Street @ Jackson Road

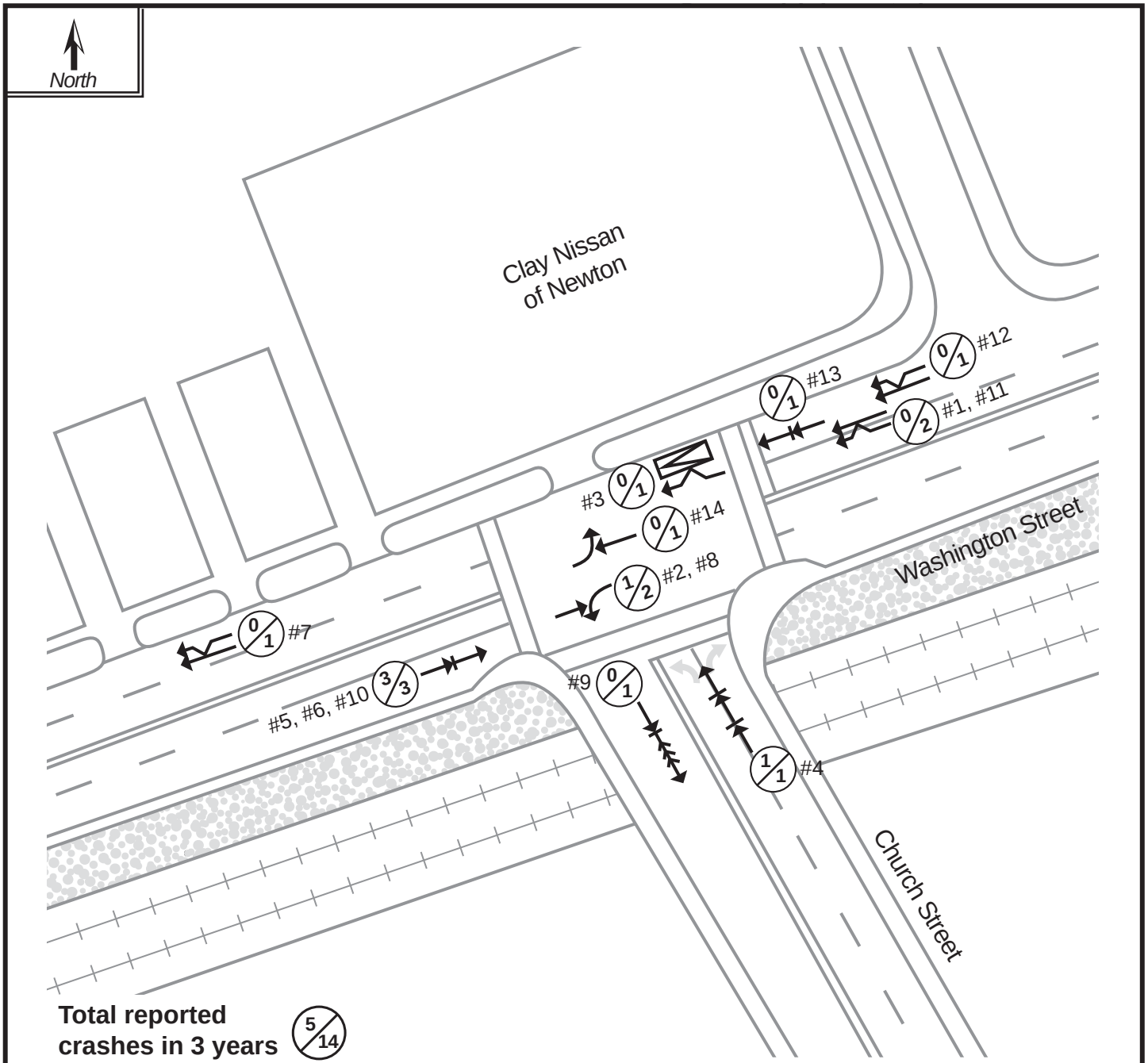


SYMBOLS	TYPES OF CRASH	SEVERITY
Moving Vehicle	Head On	A/B #1, #2, ...
Backing Vehicle	Angle	A Number of Injury Crashes
Non-Involved Vehicle	Rear End	B Total Number of Crashes
Pedestiran	Sideswipe	#1, ... Crash ID Number
Parked Vehicle	Out of Control	
Fixed Object		
Bicycle		
Animal		

TABLE F-8
Summary of Newton Police Crash Reports, January 2011–February 2014
Washington Street at Jackson Road

Crash Number	Crash Date	Crash Time	Crash Severity	Number of Vehicles	Manner of Collision	Road Surface	Light Conditions	Nonmotorist Type	Contributing Factor (s)
#1	2-Mar-2011	6:31 PM	Non-fatal injury	2	Rear-end	Ice	Dark - lighted roadway	-	No Improper Driving
#2	3-Feb-2011	6:36 PM	Property damage only	2	Sideswipe, same dir.	Ice	Dark - lighted roadway	-	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist in roadway, etc.
#3	12-Jul-2011	6:18 PM	Non-fatal injury	4	Rear-end	Dry	Daylight	-	Followed too closely
#4	20-Jan-2012	6:41 PM	Property damage only	2	Angle	Dry	Dark - lighted roadway	-	Made an improper turn
#5	2-Feb-2012	11:52 AM	Non-fatal injury	2	Rear-end	Dry	Daylight	-	Followed too closely
#6	9-Sep-2012	11:26 PM	Not Reported	1	Single vehicle crash	Dry	Dark - lighted roadway	-	Failure to keep in proper lane or running off road
#7	6-Dec-2012	8:41 AM	Not Reported	1	Single vehicle crash	Unknown	Daylight	-	Distracted
#8	1-Nov-2013	10:22 AM	Property damage only	3	Rear-end	Wet	Daylight	-	Followed too closely
#9	31-Dec-2013	3:10 PM	Property damage only	2	Rear-end	Dry	Daylight	-	Inattention
#10	1-Jan-2014	11:30 AM	Not Reported	2	Sideswipe, same dir.	Unknown	Daylight	-	Operating vehicle in erratic, reckless, careless, negligent or aggressive manner
#11	12-Feb-2014	9:42 AM	Property damage only	2	Rear-end	Dry	Daylight	-	Visibility Obstructed

FIGURE F-9
Intersection Collision Diagram, Newton Police Reports 1/1/2011–2/28/2014
Washington Street @ Church Street



SYMBOLS	TYPES OF CRASH	SEVERITY
Moving Vehicle	Head On	A/B #1, #2, ...
Backing Vehicle	Angle	A Number of Injury Crashes
Non-Involved Vehicle	Rear End	B Total Number of Crashes
Pedestiran	Sideswipe	#1, ... Crash ID Number
Parked Vehicle	Out of Control	
Fixed Object		
Bicycle		
Animal		

TABLE F-9
Summary of Newton Police Crash Reports, January 2011–February 2014
Washington Street at Church Street

Crash Number	Crash Date	Crash Time	Crash Severity	Number of Vehicles	Manner of Collision	Road Surface	Light Conditions	Nonmotorist Type	Contributing Factor (s)
#1	4-Feb-2011	12:35 PM	Property damage only	2	Sideswipe, same dir.	Snow	Daylight	-	Made an improper turn
#2	14-Mar-2011	9:07 AM	Non-fatal injury	2	Angle	Dry	Daylight	-	Inattention
#3	25-May-2011	1:23 PM	Property damage only	2	Sideswipe, same dir.	Dry	Daylight	-	Fatigued/asleep
#4	28-Oct-2011	7:33 AM	Non-fatal injury	3	Rear-end	Ice	Daylight	-	No Improper Driving
#5	16-Nov-2011	7:41 AM	Non-fatal injury	2	Rear-end	Dry	Daylight	-	Followed too closely
#6	22-Jan-2012	8:35 PM	Non-fatal injury	2	Rear-end	Wet	Dark - lighted roadway	-	Followed too closely
#7	31-May-2012	10:42 PM	Property damage only	2	Sideswipe, same dir.	Dry	Dark - lighted roadway	-	Operating vehicle in erratic, reckless, careless, negligent or aggressive manner
#8	4-Nov-2012	10:02 AM	Property damage only	2	Angle	Dry	Daylight	-	Failed to yield right of way
#9	10-Dec-2012	6:45 PM	Property damage only	2	Rear-end	Wet	Dark - lighted roadway	-	Wrong side or wrong way
#10	5-Mar-2013	6:22 PM	Non-fatal injury	2	Rear-end	Dry	Dark - roadway not lighted	-	Followed too closely
#11	26-Mar-2013	7:35 PM	Property damage only	2	Sideswipe, same dir.	Dry	Dark - lighted roadway	-	Inattention
#12	30-May-2013	2:38 PM	Property damage only	2	Sideswipe, same dir.	Dry	Daylight	-	Failure to keep in proper lane or running off road
#13	29-Jul-2013	5:12 PM	Property damage only	2	Rear-end	Wet	Daylight	-	Followed too closely
#14	7-Feb-2014	5:08 PM	Property damage only	2	Angle	Dry	Dark - lighted roadway	-	Inattention

APPENDIX G

Collision Diagram and Summary of Crash Reports: Roadway Segments between Major Intersections in the Corridor

FIGURE G-1
Segment Collision Diagram, Newton Police Reports 1/1/2011–2/28/2014
Washington Street between Chestnut Street and Armory Street

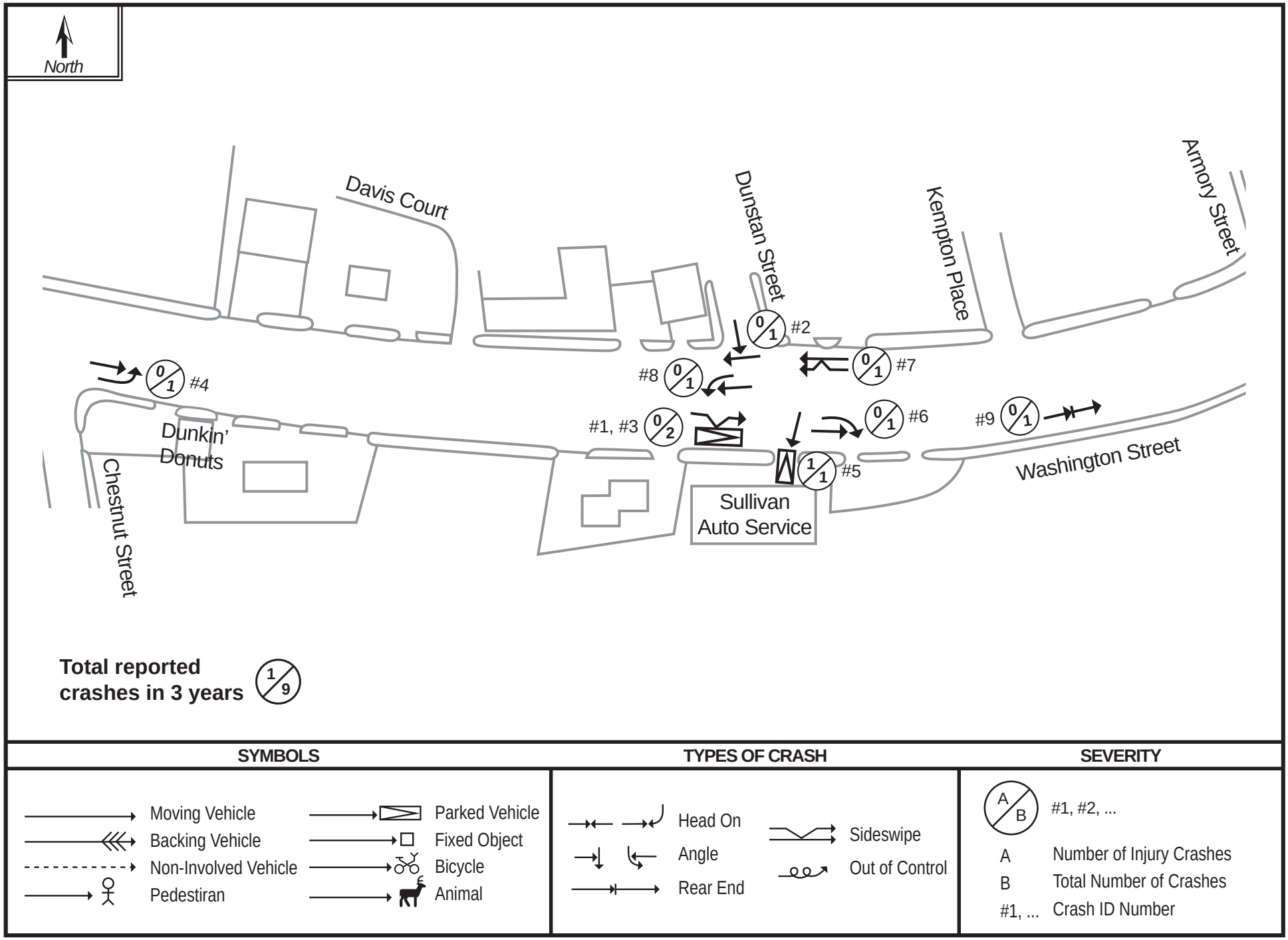


TABLE G-1
Summary of Newton Police Crash Reports January 2011–February 2014
Washington Street between Chestnut Street and Armory Street

Crash Number	Crash Date	Crash Time	Crash Severity	Number of Vehicles	Manner of Collision	Road Surface	Light Conditions	Nonmotorist Type	Contributing Factor (s)
#1	12-Oct-2011	5:30 PM	Not Reported	2	Angle	Dry	Daylight	-	Hit and run
#2	07-Dec-2011	5:07 PM	Not Reported	2	Angle	Wet	Dark - lighted roadway	-	Failed to yield right of way
#3	13-Apr-2012	10:34 AM	Property damage only	2	Sideswipe, same dir.	Dry	Daylight	-	Inattention
#4	26-Jun-2012	10:10 AM	Property damage only	2	Angle	Dry	Daylight	-	Inattention
#5	30-Aug-2012	4:06 AM	Non-fatal injury	2	Single vehicle crash	Dry	Dark - lighted roadway	-	Operating vehicle in erratic, reckless, careless, negligent or aggressive manner
#6	7-Oct-2012	10:06 AM	Property damage only	2	Sideswipe, same dir.	Dry	Daylight	-	Made an improper turn
#7	2-Nov-2012	7:00 PM	Property damage only	2	Sideswipe, same dir.	Wet	Dark - lighted roadway	-	Inattention
#8	3-Dec-2012	9:17 AM	Property damage only	2	Angle	Dry	Daylight	-	Inattention
#9	10-Nov-2013	5:33 PM	Property damage only	2	Rear-end	Wet	Dark - lighted roadway	-	Followed too closely

FIGURE G-2
Segment Collision Diagram, Newton Police Reports 1/1/2011–2/28/2014
Washington Street between Armory Street and Lowell Avenue

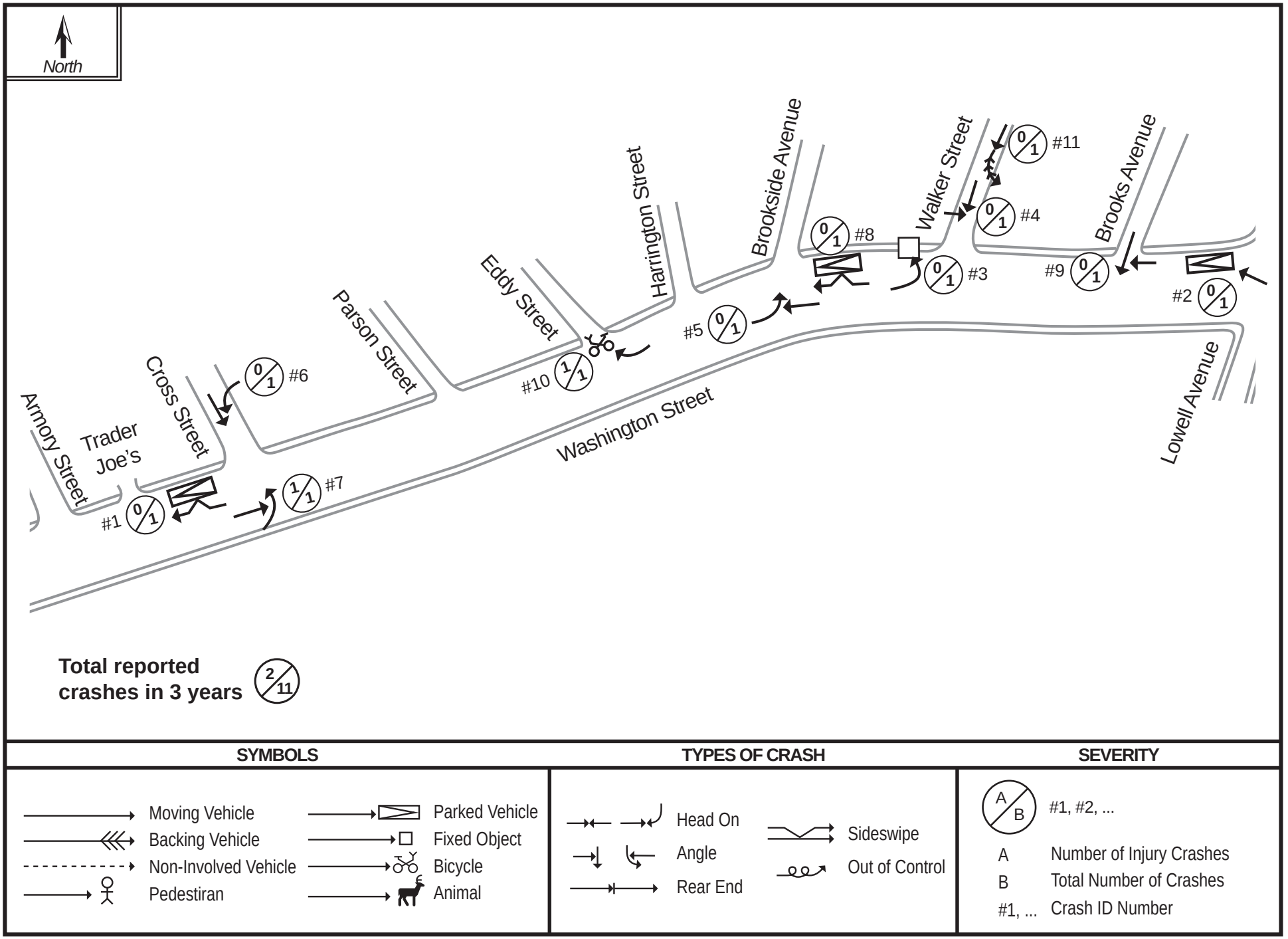
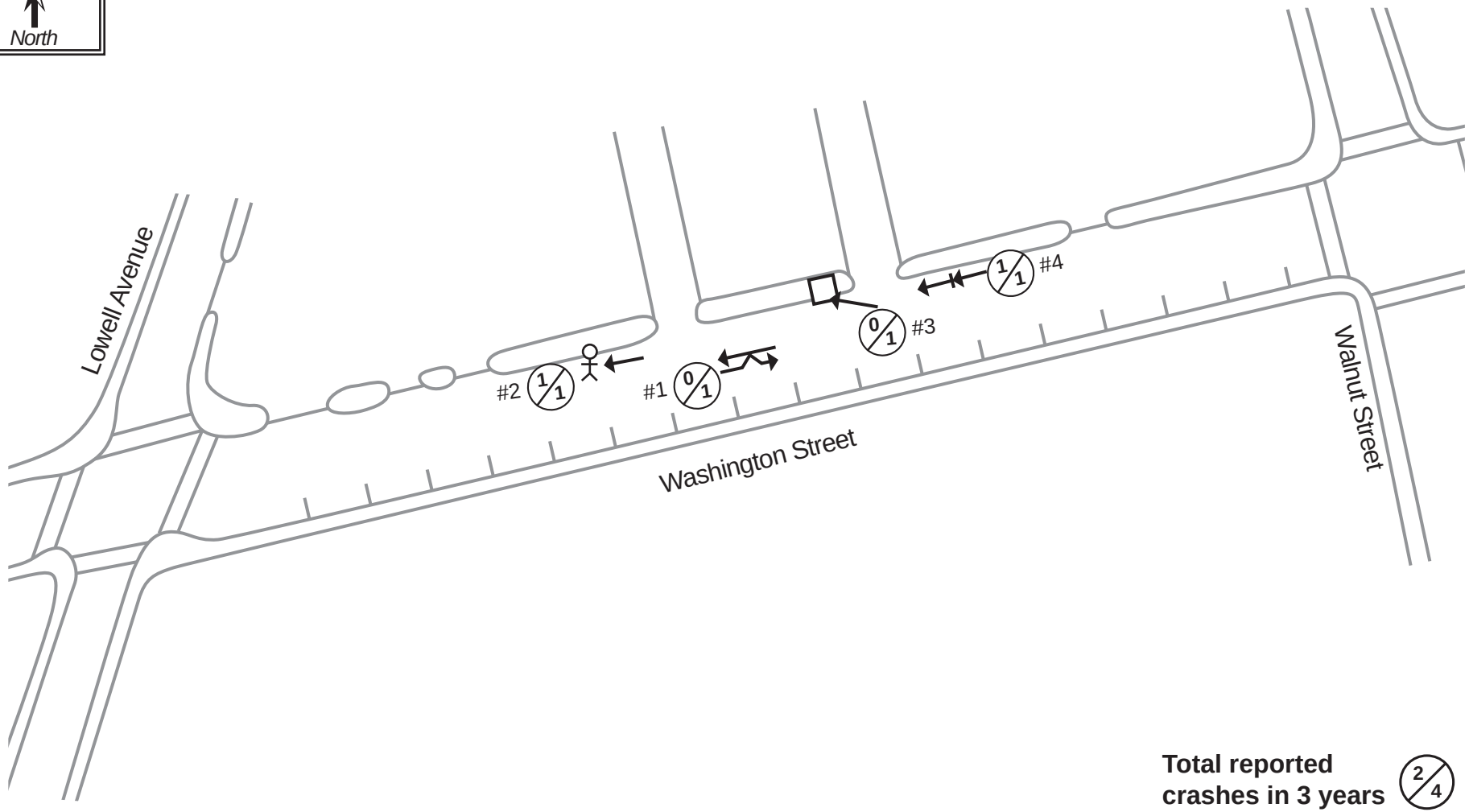


TABLE G-2
Summary of Newton Police Crash Reports, January 2011–February 2014
Washington Street between Armory Street and Lowell Avenue

Crash Number	Crash Date	Crash Time	Crash Severity	Number of Vehicles	Manner of Collision	Road Surface	Light Conditions	Nonmotorist Type	Contributing Factor (s)
#1	22-Jan-2011	4:34 PM	Not Reported	2	Sideswipe, same dir.	Dry	Daylight	-	Hit and run
#2	19-May-2011	5:04 AM	Property damage only	2	Rear-end	Wet	Dawn	-	Operating vehicle in erratic, reckless, careless, negligent or aggressive manner
#3	04-Jun-2011	8:29 AM	Property damage only	1	Single vehicle crash	Dry	Daylight	-	Made an improper turn
#4	30-Oct-2011	1:48 PM	Property damage only	2	Angle	Wet	Daylight	-	Failed to yield right of way
#5	5-Nov-2012	2:59 PM	Property damage only	2	Head on	Dry	Daylight	-	Inattention
#6	29-Nov-2013	8:16 AM	Property damage only	2	Angle	Dry	Daylight	-	Visibility Obstructed
#7	5-Dec-2012	9:08 AM	Non-fatal injury	2	Angle	Dry	Daylight	-	Made an improper turn
#8	10-May-2013	4:55 PM	Property damage only	2	Sideswipe, same dir.	Dry	Daylight	-	Inattention
#9	12-Jun-2013	9:09 AM	Property damage only	2	Angle	Dry	Daylight	-	Failed to yield right of way
#10	14-Aug-2013	3:40 PM	Non-fatal injury	1	Single vehicle crash	Dry	Daylight	cyc	No Improper Driving
#11	27-Dec-2013	9:57 AM	Property damage only	2	Angle	Wet	Daylight	-	Failed to yield right of way

FIGURE G-3
Segment Collision Diagram, Newton Police Reports 1/1/2011–2/28/2014
Washington Street between Lowell Avenue and Walnut Street



SYMBOLS

- Moving Vehicle
- Backing Vehicle
- Non-Involved Vehicle
- Pedestiran
- Parked Vehicle
- Fixed Object
- Bicycle
- Animal

TYPES OF CRASH

- Head On
- Angle
- Rear End
- Sideswipe
- Out of Control

SEVERITY

A/B #1, #2, ...

A Number of Injury Crashes

B Total Number of Crashes

#1, ... Crash ID Number

TABLE G-3
Summary of Newton Police Crash Reports, January 2011–February 2014
Washington Street between Lowell Avenue and Walnut Street

Crash Number	Crash Date	Crash Time	Crash Severity	Number of Vehicles	Manner of Collision	Road Surface	Light Conditions	Nonmotorist Type	Contributing Factor (s)
#1	17-Feb-2011	7:19 AM	Property damage only	2	Sideswipe, opposite dir.	Ice	Daylight	-	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist in roadway, etc.
#2	3-Apr-2012	10:11 AM	Non-fatal injury	1	Single vehicle crash	Dry	Daylight	ped	Inattention
#3	2-Oct-2012	11:05 AM	Property damage only	2	Single vehicle crash	Dry	Daylight	-	Inattention
#4	30-Jan-2013	4:06 PM	Non-fatal injury	2	Rear-end	Wet	Daylight	-	Inattention

FIGURE G-4
Segment Collision Diagram, Newton Police Reports 1/1/2011–2/28/2014
Washington Street between Walnut Street and Harvard Street

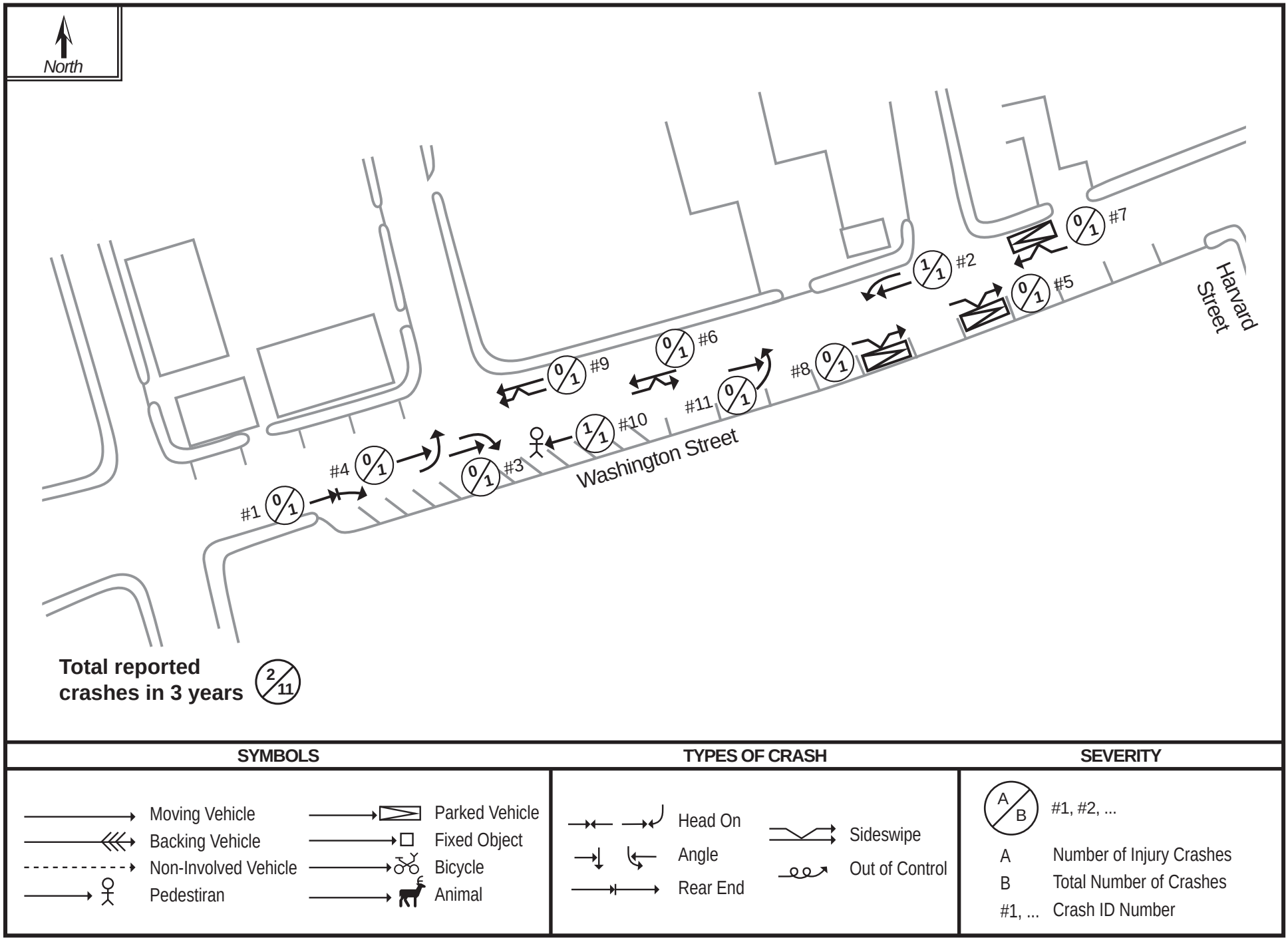


TABLE G-4
Summary of Newton Police Crash Reports January 2011–February 2014
Washington Street between Walnut Street and Harvard Street

Crash Number	Crash Date	Crash Time	Crash Severity	Number of Vehicles	Manner of Collision	Road Surface	Light Conditions	Nonmotorist Type	Contributing Factor (s)
#1	11-Jan-2011	12:11 PM	Property damage only	2	Rear-end	Wet	Daylight	-	Followed too closely
#2	04-May-2011	7:39 PM	Non-fatal injury	2	Sideswipe, same dir.	Wet	Dusk	-	Failed to yield right of way
#3	17-Jul-2012	11:30 AM	Property damage only	2	Angle	Dry	Daylight	-	Operating vehicle in erratic, reckless, careless, negligent or aggressive manner
#4	11-Dec-2012	12:57 PM	Property damage only	2	Angle	Dry	Daylight	-	Inattention
#5	28-Dec-2012	9:30 AM	Property damage only	2	Sideswipe, same dir.	Dry	Daylight	-	Failure to keep in proper lane or running off road
#6	2-Jan-2013	5:12 PM	Property damage only	2	Sideswipe, opposite dir.	Dry	Dark - lighted roadway	-	Operating vehicle in erratic, reckless, careless, negligent or aggressive manner
#7	18-Jan-2013	6:11 PM	Not Reported	2	Sideswipe, same dir.	Dry	Dark - lighted roadway	-	Hit and run
#8	2-Feb-2013	11:09 PM	Not Reported	2	Sideswipe, same dir.	Dry	Dark - lighted roadway	-	Hit and run
#9	2-Jun-2013	2:33 PM	Property damage only	2	Sideswipe, same dir.	Dry	Daylight	-	Inattention
#10	21-Sep-2013	7:33 PM	Non-fatal injury	1	Single vehicle crash	Dry	Dark - lighted roadway	ped	Inattention
#11	26-Sep-2013	6:11 PM	Non-fatal injury	2	Angle	Dry	Dusk	-	Made an improper turn

FIGURE G-5
Segment Collision Diagram, Newton Police Reports 1/1/2011–2/28/2014
Washington Street between Harvard Street and Crafts Street

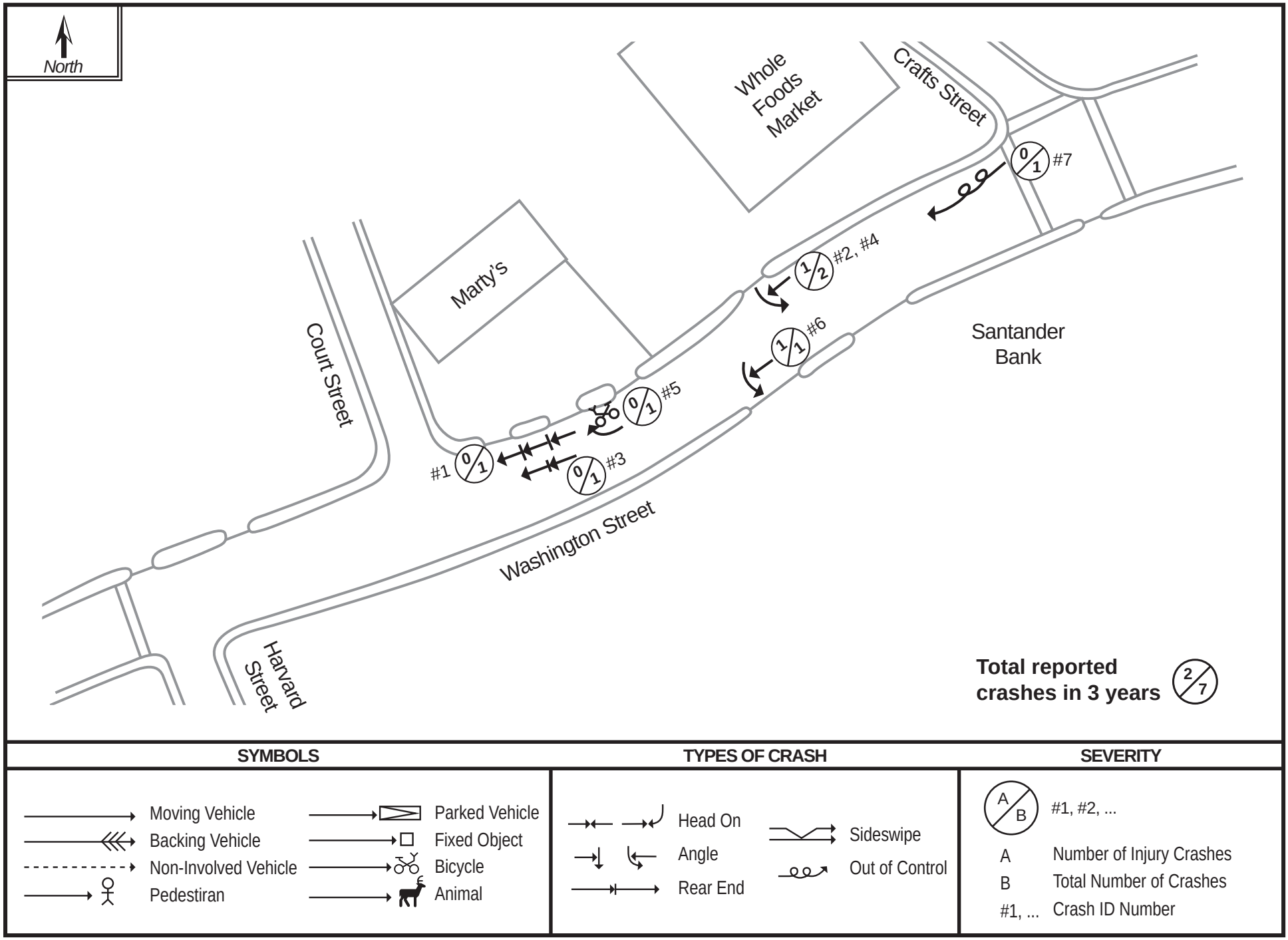


TABLE G-5
Summary of Newton Police Crash Reports, January 2011–February 2014
Washington Street between Harvard Street and Crafts Street

Crash Number	Crash Date	Crash Time	Crash Severity	Number of Vehicles	Manner of Collision	Road Surface	Light Conditions	Nonmotorist Type	Contributing Factor (s)
#1	20-Aug-2011	10:55 AM	Property damage only	3	Rear-end	Dry	Daylight	-	Driving too fast for conditions
#2	29-Apr-2012	6:25 PM	Non-fatal injury	2	Angle	Dry	Daylight	-	Visibility Obstructed
#3	9-Aug-2012	5:55 PM	Property damage only	2	Rear-end	Dry	Daylight	-	Followed too closely
#4	18-Oct-2012	8:03 PM	Property damage only	2	Angle	Dry	Dark - lighted roadway	-	Made an improper turn
#5	3-Nov-2012	6:36 PM	Not Reported	1	Single vehicle crash	Dry	Dark - lighted roadway	-	Failed to yield right of way
#6	19-May-2013	2:45 PM	Non-fatal injury	2	Angle	Dry	Daylight	-	Made an improper turn
#7	26-May-2013	2:59 PM	Property damage only	1	Single vehicle crash	Dry	Daylight	-	Operating vehicle in erratic, reckless, careless, negligent or aggressive manner

FIGURE G-6
Segment Collision Diagram, Newton Police Reports 1/1/2011–2/28/2014
Washington Street between Crafts Street and Adams Street

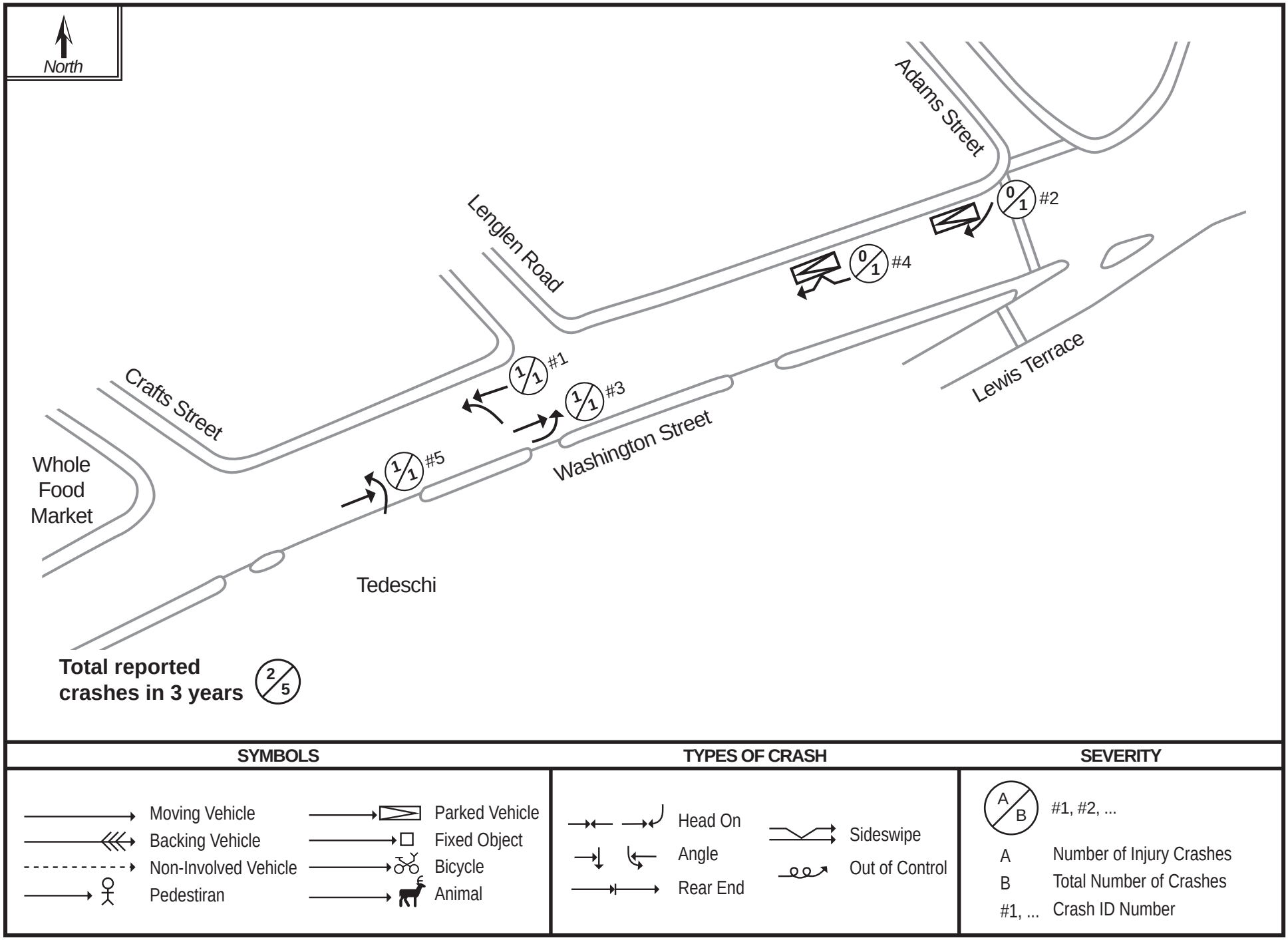


TABLE G-6
Summary of Newton Police Crash Reports, January 2011–February 2014
Washington Street between Crafts Street and Adams Street

Crash Number	Crash Date	Crash Time	Crash Severity	Number of Vehicles	Manner of Collision	Road Surface	Light Conditions	Nonmotorist Type	Contributing Factor (s)
#1	10-Jan-2011	4:02 PM	Non-fatal injury	2	Angle	Dry	Daylight	-	Failed to yield right of way
#2	02-Mar-2011	12:45 PM	Property damage only	2	Angle	Dry	Daylight	-	Inattention
#3	22-Mar-2012	7:37 AM	Non-fatal injury	2	Angle	Dry	Daylight	-	Made an improper turn
#4	7-Mar-2013	12:18 PM	Not Reported	2	Sideswipe, same dir.	Unknown	Unknown	-	Operating vehicle in erratic, reckless, careless, negligent or aggressive manner
#5	23-Oct-2013	5:33 AM	Non-fatal injury	2	Angle	Dry	Dawn	-	Made an improper turn

FIGURE G-7
Segment Collision Diagram, Newton Police Reports 1/1/2011–2/28/2014
Washington Street between Jackson Road and Church Street

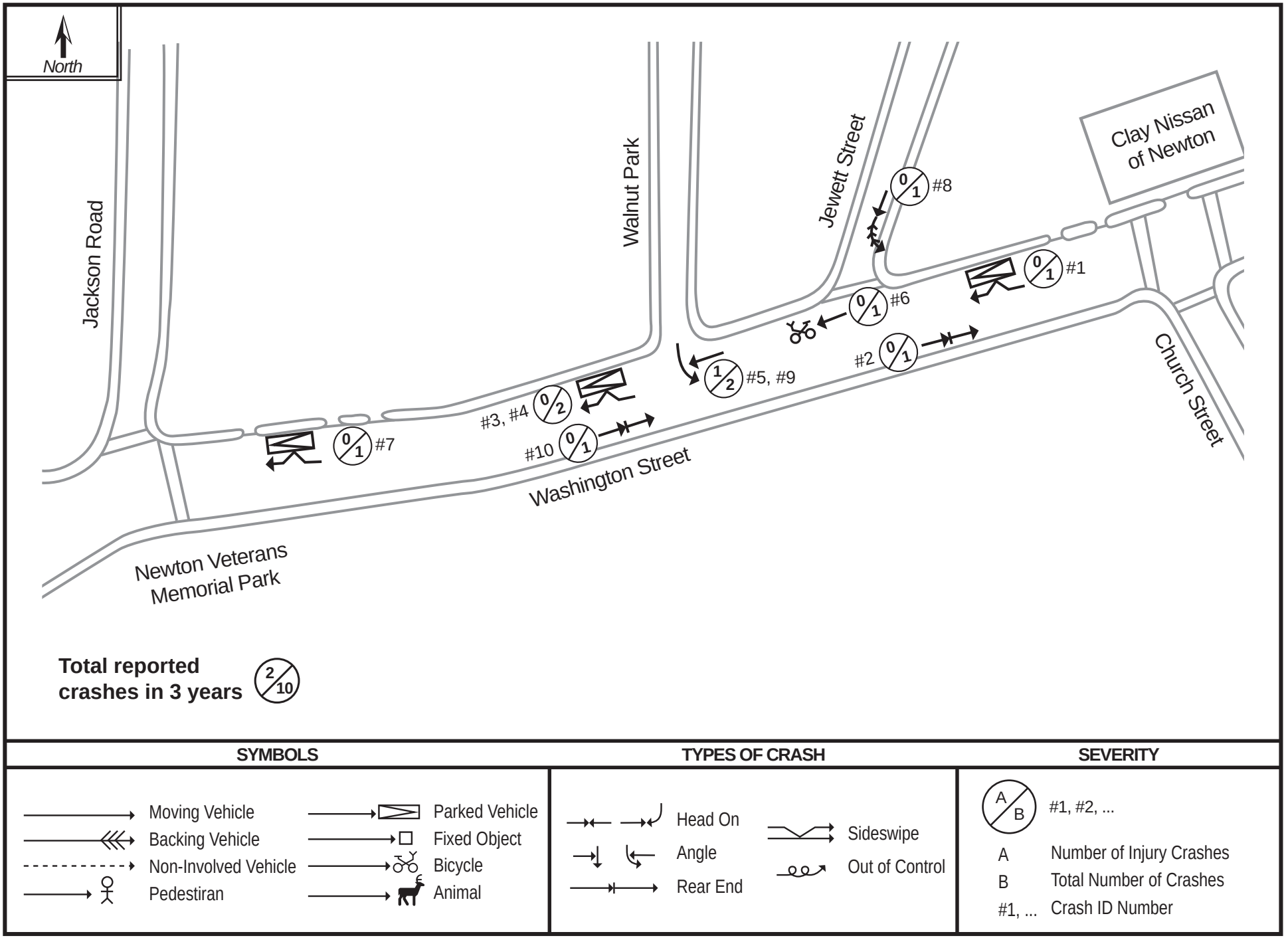


TABLE G-7
Summary of Newton Police Crash Reports, January 2011 February 2014
Washington Street between Jackson Street and Church Street

Crash Number	Crash Date	Crash Time	Crash Severity	Number of Vehicles	Manner of Collision	Road Surface	Light Conditions	Nonmotorist Type	Contributing Factor (s)
#1	09-Aug-2011	12:34 PM	Property damage only	2	Sideswipe, same dir.	Dry	Daylight	-	Inattention
#2	30-Sep-2011	8:11 AM	Property damage only	2	Rear-end	Dry	Daylight	-	Followed too closely
#3	11-Oct-2011	5:44 PM	Property damage only	2	Sideswipe, same dir.	Dry	Daylight	-	Followed too closely
#4	26-Oct-2011	1:53 PM	Not Reported	2	Sideswipe, same dir.	Wet	Daylight	-	Hit and run
#5	30-Nov-2011	8:19 AM	Property damage only	2	Angle	Dry	Daylight	-	Failed to yield right of way
#6	3-May-2012	12:59 PM	Non-fatal injury	1	Single vehicle crash	Dry	Daylight	cyc	Cellular telephone
#7	1-Nov-2012	2:01 PM	Property damage only	2	Sideswipe, same dir.	Dry	Daylight	-	Inattention
#8	11-May-2013	1:03 PM	Property damage only	2	Single vehicle crash	Wet	Daylight	-	Inattention
#9	17-Sep-2013	8:23 AM	Non-fatal injury	2	Angle	Dry	Daylight	-	Inattention
#10	6-Oct-2013	12:08 PM	Property damage only	2	Rear-end	Wet	Daylight	-	Inattention

APPENDIX H

Observed 85th Percentile and Average Speeds: MassDOT Spot Speed Studies

April 7–9, 2014

TABLE H-1
Summary of Washington Street Spot Speed Studies

Location 1: Washington Street west of Armory Street

Eastbound (curb-lane only)				
Speed Count Date	4/7 Mon	4/8 Tue	4/9 Wed	Average
85th Percentile Speed	37.0	36.9	37.8	37.2
Average Speed	30.9	31.1	31.3	31.1
Westbound (curb-lane only)				
Speed Count Date	4/7 Mon	4/8 Tue	4/9 Wed	Average
85th Percentile Speed	35.6	34.8	35.4	35.3
Average Speed	29.3	28.8	29.2	29.1

Location 2: Washington Street west of Cross Street

Eastbound (curb-lane only)				
Speed Count Date	4/7 Mon	4/8 Tue	4/9 Wed	Average
85th Percentile Speed	39.0	39.1	38.7	38.9
Average Speed	33.2	33.3	32.2	32.9
Westbound (curb-lane only)				
Speed Count Date	4/7 Mon	4/8 Tue	4/9 Wed	Average
85th Percentile Speed	33.9	33.9	33.9	33.9
Average Speed	27.7	27.8	26.6	27.4

Location 3: Washington Street west of Walker Street

Eastbound (curb-lane only)				
Speed Count Date	4/7 Mon	4/8 Tue	4/9 Wed	Average
85th Percentile Speed	37.2	37.4	38.3	37.6
Average Speed	31.9	32.2	33	32.4
Westbound (curb-lane only)				
Speed Count Date	4/7 Mon	4/8 Tue	4/9 Wed	Average
85th Percentile Speed	34.8	34.8	35.7	35.1
Average Speed	30.0	30.4	30.9	30.4

Location 4: Washington Street west of Harvard Street

Eastbound (curb-lane only)				
Speed Count Date	4/7 Mon	4/8 Tue	4/9 Wed	Average
85th Percentile Speed	34.0	33.7	34.2	34.0
Average Speed	26.6	26.5	26.6	26.6
Westbound (curb-lane only)				
Speed Count Date	4/7 Mon	4/8 Tue	4/9 Wed	Average
85th Percentile Speed	33.8	33.3	33.9	33.7
Average Speed	27.4	27.0	27.6	27.3

Location 5: Washington Street west of Adams Street

Eastbound				
Speed Count Date	4/7 Mon	4/8 Tue	4/9 Wed	Average
85th Percentile Speed	29.3	29.3	29.5	29.4
Average Speed	19.2	18.9	19.0	19.0
Westbound				
Speed Count Date	4/7 Mon	4/8 Tue	4/9 Wed	Average
85th Percentile Speed	34.1	33.6	34.1	33.9
Average Speed	28.3	27.7	28.2	28.1

APPENDIX I

MassDOT Project Development Process

Overview of the Project Development Process

Transportation decision-making is complex and can be influenced by legislative mandates, environmental regulations, financial limitations, agency programmatic commitments, and partnering opportunities. Decision-makers and reviewing agencies, when consulted early and often throughout the project development process, can ensure that all participants understand the potential impact these factors can have on project implementation. Project development is the process that takes a transportation improvement from concept through construction.

The MassDOT Highway Division has developed a comprehensive project development process which is contained in Chapter 2 of the *MassDOT Highway Division's Project Development and Design Guide*. The eight-step process covers a range of activities extending from identification of a project need, through completion of a set of finished contract plans, to construction of the project. The sequence of decisions made through the project development process progressively narrows the project focus and, ultimately, leads to a project that addresses the identified needs. The descriptions provided below are focused on the process for a highway project, but the same basic process will need to be followed for non-highway projects as well.

1. Needs Identification

For each of the locations at which an improvement is to be implemented, MassDOT leads an effort to define the problem, establishes project goals and objectives, and defines the scope of the planning needed for implementation. To that end, it has to complete a Project Need Form (PNF), which states in general terms the deficiencies or needs related to the transportation facility or location. The PNF documents the problems and explains why corrective action is needed. For this study, the information defining the need for the project will be drawn primarily, perhaps exclusively, from the present report. Also, at this point in the process, MassDOT meets with potential participants, such as the Metropolitan Planning Organization (MPO) and community members, to allow for an informal review of the project.

The PNF is reviewed by the MassDOT Highway Division district office whose jurisdiction includes the location of the proposed project. MassDOT also sends the PNF to the MPO, for informational purposes. The outcome of this step determines whether the project requires further planning, whether it is already well supported by prior planning studies, and, therefore, whether it is ready to move forward into the design phase, or whether it should be dismissed from further consideration.

2. Planning

This phase will likely not be required for the implementation of the improvements proposed in this planning study, as this planning report should constitute the outcome of this step. However, in general, the purpose of this implementation step is for the project proponent to identify issues, impacts, and approvals that may need to be obtained, so that the subsequent design and permitting processes are understood.

The level of planning needed will vary widely, based on the complexity of the project. Typical tasks include: define the existing context, confirm project need, establish goals and objectives, initiate public outreach, define the project, collect data, develop and analyze alternatives, make

recommendations, and provide documentation. Likely outcomes include consensus on the project definition to enable it to move forward into environmental documentation (if needed) and design, or a recommendation to delay the project or dismiss it from further consideration.

3. Project Initiation

At this point in the process, the proponent, MassDOT Highway Division, fills out a Project Initiation Form (PIF) for each improvement, which is reviewed by its Project Review Committee (PRC) and the MPO. The PRC is composed of the Chief Engineer, each District Highway Director, and representatives of the Project Management, Environmental, Planning, Right-of-Way, Traffic, and Bridge departments, and the MassDOT Federal Aid Program Office (FAPO). The PIF documents the project type and description, summarizes the project planning process, identifies likely funding and project management responsibility, and defines a plan for interagency and public participation. First the PRC reviews and evaluates the proposed project based on the MassDOT's statewide priorities and criteria. If the result is positive, MassDOT Highway Division moves the project forward to the design phase, and to programming review by the MPO. The PRC may provide a Project Management Plan to define roles and responsibilities for subsequent steps. The MPO review includes project evaluation based on the MPO's regional priorities and criteria. The MPO may assign project evaluation criteria score, a Transportation Improvement Program (TIP) year, a tentative project category, and a tentative funding category.

4. Environmental Permitting, Design, and Right-of-Way Process

This step has four distinct but closely integrated elements: public outreach, environmental documentation and permitting (if required), design, and right-of-way acquisition (if required). The outcome of this step is a fully designed and permitted project ready for construction. However, a project does not have to be fully designed in order for the MPO to program it in the TIP. The sections below provide more detailed information on the four elements of this step of the project development process.

Public Outreach

Continued public outreach in the design and environmental process is essential to maintain public support for the project and to seek meaningful input on the design elements. The public outreach is often in the form of required public hearings, but can also include less formal dialogues with those interested in and affected by a proposed project.

Environmental Documentation and Permitting

The project proponent, in coordination with the Environmental Services section of the MassDOT Highway Division, will be responsible for identifying and complying with all applicable federal, state, and local environmental laws and requirements. This includes determining the appropriate project category for both the Massachusetts Environmental Protection Act (MEPA) and the National Environmental Protection Act (NEPA). Environmental documentation and permitting is often completed in conjunction with the **Preliminary Design** phase described below.

Design
There are three major phases of design. The first is **Preliminary Design**, which is also referred to as the 25-percent submission. The major components of this phase include full survey of the project area, preparation of base plans, development of basic geometric layout, development of preliminary cost estimates, and submission of a functional design report. Preliminary Design, although not required to, is often completed in conjunction with the Environmental Documentation and Permitting. The next phase is **Final Design**, which is also referred to as the 75-percent and 100-percent submission. The major components of this phase include preparation of a subsurface exploratory plan (if required), coordination of utility relocations, development of traffic management plans through construction zones, development of final cost estimates, and refinement and finalization of the construction plans. Once Final Design is complete, a full set of **Plans, Specifications, and Estimates (PS&E)** is developed for the project.

Right-of-Way Acquisition
A separate set of Right-of-Way plans are required for any project that requires land acquisition or easements. The plans must identify the existing and proposed layout lines, easements, property lines, names of property owners, and the dimensions and areas of estimated takings and easements.

5. Programming (Identification of Funding)
Programming, which typically begins during the design phase, can actually occur at any time during the process, from planning to design. In this step, which is distinct from project initiation, the proponent requests that the MPO place the project in the region's Transportation Improvement Program (TIP). The proponent requesting the project's listing on the TIP can be the community or it can be one of the MPO member agencies (the Regional Planning Agency, MassDOT, and the Regional Transit Authority). The MPO then considers the project in terms of state and regional needs, evaluation criteria, and compliance with the regional Transportation Plan and decides whether to place it in the draft TIP for public review and then in the final TIP.

6. Procurement
Following project design and programming of a highway project, the MassDOT Highway Division publishes a request for proposals. It then reviews the bids and awards the contract to the qualified bidder with the lowest bid.

7. Construction
After a construction contract is awarded, MassDOT Highway Division and the contractor develop a public participation plan and a management plan for the construction process.

8. Project Assessment
The purpose of this step is to receive constituents' comments on the project development process and the project's design elements. MassDOT Highway Division can apply what is learned in this process to future projects.

Project Development Schematic Timetable

Description	Schedule Influence	Typical Duration
Step I: Problem/Need/Opportunity Identification The proponent completes a Project Need Form (PNF). This form is then reviewed by the MassDOT Highway District office which provides guidance to the proponent on the subsequent steps of the process.	The Project Need Form has been developed so that it can be prepared quickly by the proponent, including any supporting data that is readily available. The District office shall return comments to the proponent within one month of PNF submission.	1 to 3 months
Step II: Planning Project planning can range from agreement that the problem should be addressed through a clear solution to a detailed analysis of alternatives and their impacts.	For some projects, no planning beyond preparation of the Project Need Form is required. Some projects require a planning study centered on specific project issues associated with the proposed solution or a narrow family of alternatives. More complex projects will likely require a detailed alternatives analysis.	Project Planning Report: 3 to 24+ months
Step III: Project Initiation The proponent prepares and submits a Project Initiation Form (PIF) and a Transportation Evaluation Criteria (TEC) form in this step. The PIF and TEC are informally reviewed by the Metropolitan Planning Organization (MPO) and MassDOT Highway District office, and formally reviewed by the PRC.	The PIF includes refinement of the preliminary information contained in the PNF. Additional information summarizing the results of the planning process, such as the Project Planning Report, are included with the PIF and TEC. The schedule is determined by PRC staff review (dependent on project complexity) and meeting schedule.	1 to 4 months
Step IV: Design, Environmental, and Right of Way The proponent completes the project design. Concurrently, the proponent completes necessary environmental permitting analyses and files applications for permits. Any right of way needed for the project is identified and the acquisition process begins.	The schedule for this step is dependent upon the size of the project and the complexity of the design, permitting, and right-of-way issues. Design review by the MassDOT Highway district and appropriate sections is completed in this step.	3 to 48+ months
Step V: Programming The MPO considers the project in terms of its regional priorities and determines whether or not to include the project in the draft Regional Transportation Improvement Program (TIP) which is then made available for public comment. The TIP includes a project description and funding source.	The schedule for this step is subject to each MPO's programming cycle and meeting schedule. It is also possible that the MPO will not include a project in its Draft TIP based on its review and approval procedures.	3 to 12+ months
Step VI: Procurement The project is advertised for construction and a contract awarded.	Administration of competing projects can influence the advertising schedule.	1 to 12 months
Step VII: Construction The construction process is initiated including public notification and any anticipated public involvement. Construction continues to project completion.	The duration for this step is entirely dependent upon project complexity and phasing.	3 to 60+ months
Step VIII: Project Assessment The construction period is complete and project elements and processes are evaluated on a voluntary basis.	The duration for this step is dependent upon the proponent's approach to this step and any follow-up required.	1 month

Source: MassDOT Highway Division Project Development and Design Guide