

MAIN STREET CORRIDOR STUDY

DRAFT

Main Street
Groton, Massachusetts

Prepared for:

Town of Groton, MA

September 2026

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Prepared for:
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September 2026

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EXECUTIVE SUMMARY

This corridor study is commissioned as part of the Town of Groton Master Plan. MDM Transportation Consultants, Inc. (MDM) has conducted the Main Street corridor study for geographic limits established with concurrence by the Town which include all intersections between Boston Road at Old Ayer Road and Main Street at Legion Road/Elm Street. The area roadways and intersections along Main Street that are included in this study are depicted in **Figure 1**. This approximately one-mile section of Main Street is under local jurisdiction with the exception of the Old Ayer Road intersections with Boston Road and Main Street, which are under MassDOT jurisdiction. Within the study area Main Street is classified as an urban minor arterial roadway by MassDOT.

E.1 OVERVIEW

This report documents existing (baseline) conditions in the transportation study area including an inventory of roadway geometry, observed traffic volumes, safety characteristics, public transportation services and pedestrian infrastructure; projects future-year (10-year horizon) traffic volumes based on traffic growth trends and traffic from planned, approved and potential long-range area development; and identifies transportation infrastructure and management initiatives to accommodate future year growth projections that include moderate growth and high growth corridor development scenarios. Consideration is given to ongoing Town studies and relevant transportation initiatives that include the Town of Groton 2025 Master Plan and Groton Mobility Study, which informs potential parcel buildout assumptions and corridor operating conditions. The resulting corridor improvement plans provide a framework for planning access and infrastructure improvements for individual parcel development along Main Street and the vicinity and associated mitigative actions, as well as the basis for pursuing state and/or federal funding for multi-modal corridor improvements to support future economic growth along the corridor.

Study Area

This Corridor Study evaluates transportation characteristics of roadways and intersections that provide a primary means of access to properties along the corridor, and that are likely to sustain a measurable level of traffic impact from the development within the Town of Groton. The study area includes the following intersections:

- ❑ Main Street at Elm Street and Legion Road
- ❑ Main Street at Pleasant Street (North)
- ❑ Main Street at Pleasant Street (South)
- ❑ Main Street at Court Street/Hollis Street
- ❑ Main Street at Station Avenue
- ❑ Main Street at Community Center Exit Driveway
- ❑ Main Street at Community Center/Ace Hardware
- ❑ Main Street at Blacksmith Row/Ace Hardware
- ❑ Main Street at 125-137 Plaza Dwy's (2)
- ❑ Main Street at Groton Inn Driveway
- ❑ Main Street at Lowell Road/ Broadmeadow Road
- ❑ Main Street at Powderhouse Road (Northern)
- ❑ Main Street at Playground Road
- ❑ Main Street at Lawrence Academy Crosswalks (2)
- ❑ Main Street at Shumway Fields Driveway
- ❑ Main Street at Powderhouse Road (Southern)
- ❑ Main Street at Old Ayer Road

Baseline Corridor Plans

The baseline/existing conditions corridor plans for Main Street between Old Ayer Road and Elm Street have been prepared based on available MassGIS aerial mapping, Town GIS data, assessors mapping, available road layout plans as provided by the Town. The baseline/existing conditions corridor plan was augmented by limited field tape measure/field inventory to ensure existing driveways and other major features (sidewalks, crossings, posts/poles, above-grade appurtenances) are accounted for. The baseline corridor plan provides a conceptual basis for the concept corridor improvement plans for both the moderate-growth and high-growth development scenarios.

Future Conditions Scenarios

Evaluation of the proposed development impacts requires the establishment of a future analysis condition. As part of this master plan, a ten-year planning horizon was selected using two growth scenarios; moderate growth and high growth as follows:

- a) *“Moderate Growth” Scenario.* This scenario assumes the occupancy of known development projects and general area growth rate of 0.5 percent based on historic trends; and
- b) *“High Growth” Scenario.* The “High Growth” corridor buildout scenario builds upon the moderate growth scenario including likely known development scenarios, assumes additional buildout of future speculative development along Station Avenue, and applies a conservative 1.0 percent annual growth rate applied to Existing traffic volumes over a 10-year period.

The resulting effective growth rate along Main Street in Downtown Groton (between Lowell Road and Hollis Street) is 1.34 percent per year under the moderate growth scenario and 1.80 percent per year under the high growth scenario. Therefore, growth rates used under both moderate and high growth scenarios represent conservative growth assumptions for the corridor which respect to the observed 0.13% per year growth rate during the weekday morning peak hour and to 0.49% growth rate during the weekday evening peak hour along Main Street over the last 15 years.

E.2 CORRIDOR IMPROVEMENT RECOMMENDATIONS

A set of improvements aimed at enhancing safety and operations along the Main Street corridor have been prepared to accommodate multi-modal travel under the existing and future conditions as shown in the Conceptual Roadway Improvement Plans. The improvements have been organized based on highest priority ranging based on a review of the ongoing Town studies and relevant transportation initiatives that include the Town of Groton 2025 Master Plan and Groton Mobility Study, discussion with Town staff, and analysis provided herein based on four (4) key criteria: Safety, Operations, Mobility, and Public Sentiments. Key elements of the improvements are as follows:

1. Main Street at Lowell Road Improvements (\$2,000,000)

Recommended intersection improvements at the Main Street intersection with Lowell Road include realignment and signalization of the intersection. The recommended intersection improvements include the following:

- Signalize the Lowell Road intersection with Main Street with minor adjustment of the existing alignment of the westbound Lowell Street approach. Parking along Lowell Road is maintained but slightly shifted from current southerly curbline.
- Minor widening of Main Street to provide an exclusive southbound left-turn lane; single through travel lanes are provided.

- Relocation of the existing crosswalks to the north and south of the intersection to be located within the intersection; these crossings will be placed under signal control with a push button activated pedestrian phase. ADA-compliant ramps, push buttons, and pedestrian indicators will concentrate and control pedestrian crossings to enhance safety and minimize conflicts with Main Street travel.
- Dedicated bicycle lanes along Main Street through the intersection which will be incorporated into the signal operation/phasing. We note that these bike lanes will accommodate/facilitate a connection to the nearby Nashua River Rail Trail via Broadmeadow Road. This connection is further enhanced by consolidating pedestrian crossings at the Lowell Street intersection and placing them under signal control.

Alternative improvements were considered for the Lowell Road intersection that includes a roundabout option for which a conceptual design is presented in the **Appendix**. Operational assessment of this roundabout option indicates that it would not provide sufficient operational capacity as a single-lane roundabout; the roundabout operation as a single-lane option exhibits long delays and extensive vehicle queuing due to highly directional and significantly higher volume of trips along Main Street during the peak hours. Likewise, the construction of a roundabout is constrained by available property, requiring land takings from a private land owner at the northeast quadrant of the intersection. The design is further constrained by significant grade/topographic features along Lowell Road that would result in extensive grade impacts to adjacent properties at both the northeast and southeast quadrants of the intersection, significant roadway regrading and retaining wall features, significant mature tree impacts, multiple uncontrolled pedestrian crossing conflict points and lack of separated bicycle accommodations at the intersection. Accordingly, this design option was deemed infeasible.

2. Downtown Mobility (\$750,000)

Recommended improvements that apply corridor-wide include the following key design principles:

- *Typical Cross Section, Corridor Widening.* Widen Main Street between Lowell Street and Pleasant Street to provide a typical cross section of 11-foot travel lanes in each direction, a 7-foot wide parking lane, and 5-foot bike lane with 2-foot buffer to parking. This typical cross-section will provide sufficient through-traffic capacity with dedicated turn lanes at the highest volume intersections while also meeting a “Complete Streets” design philosophy to promote alternative travel modes including pedestrians and bicycles along the corridor. The majority of the corridor can achieve this recommended cross-section without widening; there are several areas however that will require minor widening and/or adjustment of existing sidewalk features. However, these corridor and intersection modifications can be achieved within the existing available public right-of-way of Main Street without the need for land acquisition or takings.

- *Pedestrian Accommodations.* Consolidate and relocate existing crosswalks where appropriate with rectangular rapid flashing beacons (RRFB) at several key locations along the Main Street corridor and provide bump-outs to shorten the crossing length and to enhance safety at the crossings. Where applicable, existing crossings near intersections to be re-aligned and/or signalized should be eliminated and placed within the reconfigured intersections where the crossings can operate under actuated signal controls, thereby concentrating and better controlling pedestrian movements along the corridor.
- *Pavement Markings.* Updated Pavement markings are recommended along Main Street to accommodate the recommended roadway cross-section and lane arrangements, including a dedicated bike lane along the majority of the Main Street corridor. “Sharrow” bike marking are identified along those portions of Main Street that provide a “transition zone” to recommended dedicated bicycle lanes where ample public right-of-way is available.

3. Main Street at Hollis Street Improvements and Main Street at Pleasant (\$2,500,000)

Recommended intersection improvements at the Main Street intersection with Hollis Street include realignment and signalization of the intersection. The recommended intersection improvements include the following:

- Signalize the Hollis Street intersection with minor adjustments to the existing alignment of the Hollis Street approach to Main Street to reduce corner turning speeds and minimize pedestrian crossing lengths.
- Minor widening of Main Street to add exclusive northbound right-turn lane to accommodate high right-turn volume.
- Relocate and modify existing pedestrian crossing with curb bump-outs to reduce crossing length and place crossings under signal control to enhance safety.
- Separated bike lane transitions to “sharrow” shared use lane markings north of Hollis Street.

Intersection improvements at the Main Street intersection with Pleasant Street include realignment of the Pleasant Street approach to the intersection and the closure of the northern roadway connection through the Filho’s Cucina parking area. The recommended improvements include the following:

- Realignment of the eastbound Pleasant Street approach to Main Street to provide perpendicular alignment to Main Street, thereby eliminating expansive surplus paved area at the intersection and creating traditional perpendicular alignment that improves driver sight lines. The realignment also provides opportunity for additional curbside parking along the west side of Main Street.

- Eliminate the northern intersection alignment through the Filho's Cucina parking area; driveways serving this use are modified to reduce "cut-through" between Main Street and Pleasant Street.
- Relocate and improve the existing Main Street crossing and equip with RRFB crossing controls.

4. Main Street at Old Ayer Road Improvements (\$3,000,000)

Recommended intersection improvements at the Main Street/Boston Road intersection with Old Ayer Road include realignment and signalization of the intersection. Different alignment options and lane configurations were reviewed. The recommended improvements were chosen to minimize construction needed to implement improvements, reduce impact to the adjacent properties, maximize options to retain and relocate/enhance existing monumentation and memorials within the intersection. All improvements can be made within existing right-of-way. The recommended intersection improvements include the following:

- Realignment and signalization of the southern Old Ayer Road approach to Main Street/Boston Road.
- Widening of Main Street for an exclusive northbound left-turn lane.
- Separate right- and left-turn lanes for the Old Ayer Road approach to minimize vehicle delays/queues and signal cycle length requirements.
- Convert the northerly intersection leg to southbound travel only, thereby retaining access to adjacent residential properties while also eliminating a poorly aligned/skewed roadway movement onto Main Street.
- Modify existing pedestrian accommodations to provide a crosswalk on the Old Ayer Road approach to Main Street within the intersection with a push button activated pedestrian phase implemented into a traffic signal system along with ADA compliant ramps, push buttons, and pedestrian indicators.

Additional alternative design options for this intersection were also developed for consideration, including a roundabout option and a variation that consolidates the Old Ayer Road roadway intersection legs to a single intersection leg. Alternative improvement plans are provided in the **Appendix**. The roundabout at the intersection was reviewed and was not deemed appropriate at the intersection due to the right-of-way and grading within the right-of-way.

E.3 TRAFFIC SIGNAL WARRANT

Based on the existing roadway geometry and volume conditions a traffic signal warrants are met at the recommended locations (Old Ayer Road, Lowell Road and Hollis Road) for Warrant 1 (8-hour Volumes).

The roadway improvements along the Main Street at Lowell Road, Hollis Street, and Old Ayer Road will adequately accommodate the operations needs for the corridor at these critical locations under both the moderate and high growth scenarios while also providing multi-modal design features which will promote alternative transportation opportunities. The proposed installation of traffic signals would also provide some level of benefit to area intersections and driveways by introducing gaps in the traffic stream along Main Street.

E.4 NEXT STEPS

The Town will facilitate a public engagement meeting to review corridor inventories, safety/operational analyses and to solicit input on potential corridor improvements as summarized in this corridor study. The finalized corridor study and public input will provide a basis for formalizing a funding and implementation strategy for improvements; the implementation process will entail prioritizing which improvement “packages” may advance to formal funding requests/applications from a variety of potential funding sources as the state and/or local level based on input from the Board of Selectmen as informed by departmental and public input.

1.0 INTRODUCTION

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1.1 PROJECT DESCRIPTION

This report documents existing (baseline) conditions in the transportation study area including an inventory of roadway geometry, observed traffic volumes, safety characteristics, public transportation services and pedestrian infrastructure; projects future-year (10-year horizon) traffic volumes based on traffic growth trends and traffic from planned, approved and potential long-range area development; and identifies transportation infrastructure and management initiatives to accommodate future year growth projections that include moderate growth and high growth corridor development scenarios. Consideration is given to ongoing Town studies and relevant transportation initiatives that include the Town of Groton 2025 Master Plan and Groton Mobility Study, which informs potential parcel buildout assumptions and corridor operating conditions. The resulting corridor improvement plans provide a framework for planning access and infrastructure improvements for individual parcel development along Main Street and the vicinity and associated mitigative actions, as well as the basis for pursuing state and/or federal funding for multi-modal corridor improvements to support future economic growth along the corridor.

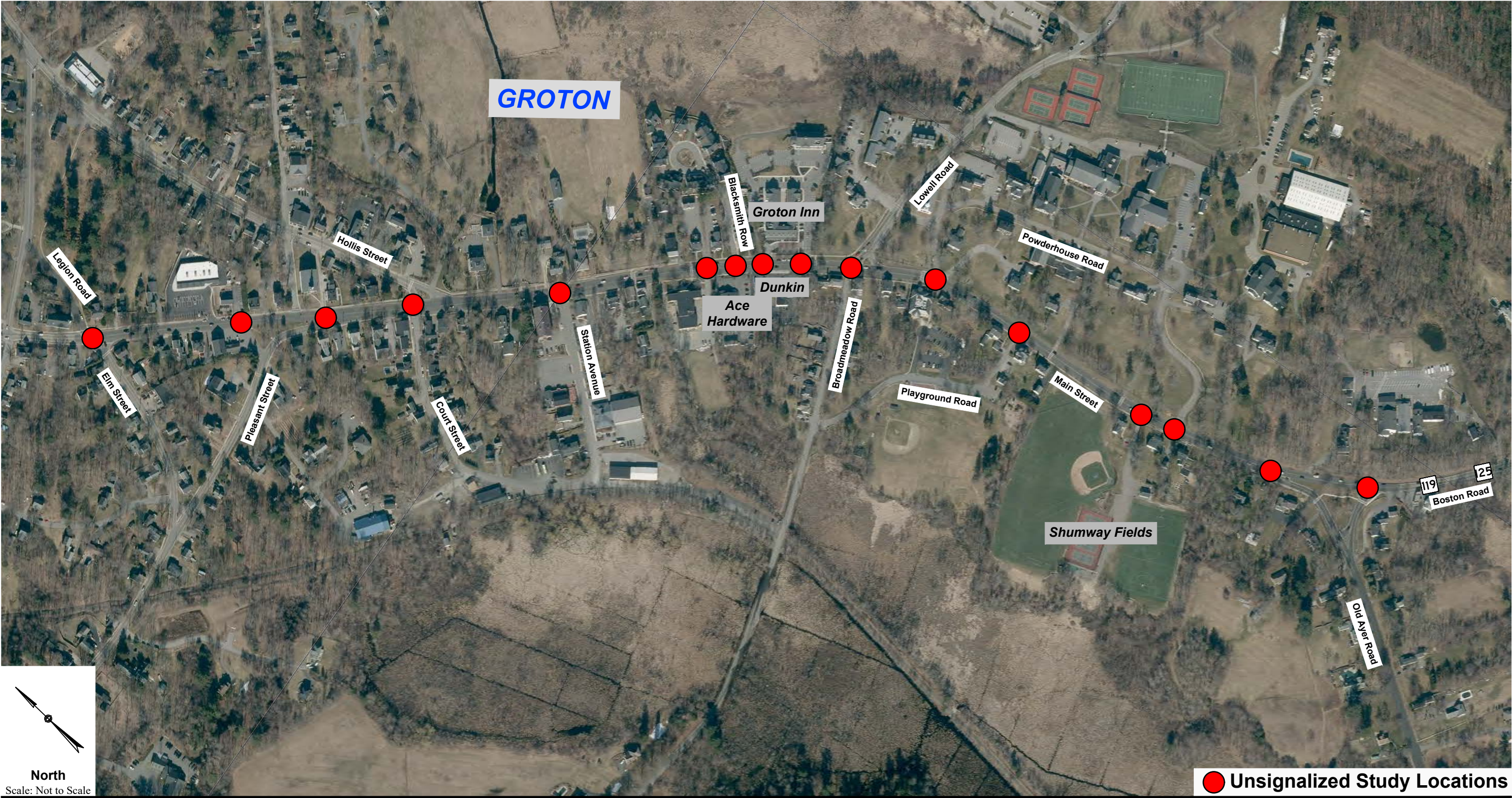


Figure 1

Site Location

1.2 STUDY AREA

This Corridor Study evaluates transportation characteristics of roadways and intersections that provide a primary means of access to properties along the corridor, and that are likely to sustain a measurable level of traffic impact from the development within the Town of Groton. The study area includes the following intersections as shown in **Figure 1**:

- Main Street at Elm Street and Legion Road
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- Main Street at Pleasant Street (South)
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- Main Street at Blacksmith Row/Ace Hardware
- Main Street at 125-137 Plaza Dwy's (2)
- Main Street at Groton Inn Driveway
- Main Street at Lowell Road/ Broadmeadow Road
- Main Street at Powderhouse Road (Northern)
- Main Street at Playground Road
- Main Street at Lawrence Academy Crosswalks (2)
- Main Street at Shumway Fields Driveway
- Main Street at Powderhouse Road (Southern)
- Main Street at Old Ayer Road

2.0 EXISTING CONDITIONS

The existing roadway system and the existing traffic operations of study area roadways were reviewed. This section describes the existing traffic characteristics and operations of roadways and intersections within the study area. Specifically, this section presents an overview of the traffic data collection program, existing traffic volumes, an inventory of existing transportation services and infrastructure serving the area and safety data.

2.1 STUDY AREA ROADWAY NETWORK

The study area roadways and intersections are described briefly in this section. A general description of the physical roadway and intersection features is provided. The study area includes roadways under local (Town) jurisdiction.

2.1.1 ROADWAY

Main Street

Main Street (Route 111 and 119) is generally a north-south roadway under local jurisdiction within the study area and State (MassDOT) jurisdiction to the south of Old Ayer Road and to north of Elm Street. Main Street is classified as a principle arterial roadway, and it provides a connection between South Road in the north and Boston Road in the south. Main Street provides one travel lane in each direction separated by a double yellow centerline. Within the study area, bicycle accommodations include “sharrow” bike pavement markings along Main Street. A sidewalk is provided along the west side of Main Street for the length of the study area, and sidewalks are provided on both sides of the road in the downtown portion of Main Street between Lowell Road/Broadmeadow Road and Legion Road/Elm Street. The regulatory speed limit within the study area is 30 mph; however, as noted in the Groton Mobility Study, excessive lane widths and unmarked shoulders along Main Street are appropriate for 45 mph+ arterials per MassDOT (see **Appendix**). Land uses along Main Street include a mixture of land uses including but not limited to residential, institutional, historical, and commercial/retail. Main Street through Downtown Groton was observed to have a high number of curb cuts which are often excessive in length resulting in long pedestrian crossings.

2.1.2 INTERSECTIONS

Main Street/ Boston Road at Old Ayer Road

Boston Road meets Old Ayer Road to form a three-legged unsignalized intersection. Boston Road provides a single travel lane in the northbound direction while Main Street and southbound directions. Old Ayer Road provided a single approach lane with flared right turn onto Main Street/Boston Road. Land uses at the intersection include residential homes and Lawrence Academy. Boston Road is under MassDOT jurisdiction while Main Street is under local jurisdiction.

Main Street at Old Ayer Road

Main Street meets Old Ayer Road to form a three-legged unsignalized intersection. Main Street provides a single travel lane in the northbound and southbound directions. Old Ayer Road provided a single skewed approach lane to Main Street. Land uses at the intersection include residential homes and Lawrence Academy.

Main Street at Powderhouse Road (Southern)

Main Street meets Powderhouse Road to form a three-legged unsignalized intersection. Main Street provides a single travel lane in the northbound and southbound directions. The Powderhouse Road approach to Main Street provides a single lane under “STOP” sign control. Land uses at the intersection include residential uses and Lawrence Academy.

Main Street at Shumway Fields Driveway

Main Street meets the Shumway Fields Driveway to form a three-legged unsignalized intersection. Main Street provides a single travel lane in the northbound and southbound directions. The Shumway Fields Driveway approach to Main Street provides a single lane under “STOP” sign control. Land uses at the intersection include residential uses and Lawrence Academy.

Main Street at Lawrence Academy Crosswalks (2)

Main Street provides two crosswalks with RRFBs connecting walkways from Lawrence Academy to the sidewalk on the western side of Main Street between Shumway Fields and Playground Road.

Main Street at Playground Road

Main Street meets Playground Road to form a three-legged unsignalized intersection. Main Street provides a single travel lane in the northbound and southbound directions. The Playground Road approach to Main Street provides a one-way single lane under “STOP” sign control. Land uses at the intersection include residential uses and Lawrence Academy.

Main Street at Powderhouse Road (Northern)

Main Street meets Powderhouse Road to form a three-legged unsignalized intersection. Main Street provides a single travel lane in the northbound and southbound directions. The Powderhouse Road approach to Main Street provides a single lane under “STOP” sign control. A crosswalk with rectangular rapid flashing beacons is provided across the northern Main Street approach to the intersection. Land uses at the intersection include residential uses, the Groton Public Library and Lawrence Academy.

Main Street at Lowell Road/Broadmeadow Road

Main Street meets Lowell Road and Broadmeadow Road to form a four-legged unsignalized intersection. Main Street provides a single travel lane in the northbound and southbound directions. The Lowell Street approach to Main Street provides a through/left-turn lane and a right-turn lane under “STOP” sign control. Broadmeadow Road provides a single one-way travel lane away from Main Street. Land uses at the intersection includes residential uses and the First Parish Church of Groton.

Main Street at Groton Inn Driveways/125-137 Plaza Driveways

Main Street meets the Groton Inn Driveways/125-137 Plaza Driveways to form two joined four-legged unsignalized intersections. Main Street provides a single travel lane in the northbound and southbound directions. The southern Groton Inn and plaza driveway approaches to Main Street provide single lane approaches under “STOP” sign control, while the northern intersection is in-only for both uses. Land uses at the intersection include the Groton Inn and 125-137 plaza.

Main Street at Blacksmith Row/Ace Hardware Driveway

Main Street meets the Blacksmith Row/Ace Hardware to form a four-legged unsignalized intersection. Main Street provides a single lane in the northbound and southbound directions. The Blacksmith Row and Ace Hardware driveway approaches to Main Street provide single lane approaches under “STOP” sign control. Land uses at the intersection include the Ace Hardware, retail, and residential.

Main Street at Ace Hardware/Community Center Driveway

Main Street meets the Ace Hardware driveway and Community Center to form a three-legged unsignalized intersection. Main Street provides a single lane in the northbound and southbound directions. The Ace Hardware driveway and Community Center driveway approaches to Main Street provide single lane approaches under “STOP” sign control. The Ace Hardware and Community Center driveways are separated by approximately 13± feet. A marked crosswalk and rectangular rapid flashing beacon is provided across the northern Main Street leg of the intersection. Land uses at the intersection include the Ace Hardware and Community Center.

Main Street at Community Center Exit Driveway

Main Street meets the Community Center exit driveway to form a three-legged unsignalized intersection. Main Street provides a single lane in the northbound and southbound directions. The one-way community center exit driveway approach to Main Street provides a single lane under “STOP” sign control. A marked crosswalk and rectangular rapid flashing beacon is provided across the northern Main Street leg of the intersection approximately 100 feet north of the community center driveway. Land uses at the intersection include the Prescott Community Center, retail and office uses.

Main Street at Station Avenue

Main Street meets Station Avenue to form a three-legged unsignalized intersection. Main Street provides a single lane in the northbound and southbound directions. The Station Avenue approach to Main Street provide a single lane under “STOP” sign control. A marked crosswalk and rectangular rapid flashing beacon is provided across the northern Main Street leg of the intersection and a marked crosswalk is provided across the eastbound Station Avenue approach to Main Street. Land uses at the intersection include Groton Town Hall, Groton Historical Society, a bank, and residential uses.

Main Street at Court Street and Hollis Street

Main Street meets Hollis Street and Court Street to form a four-legged unsignalized intersection. Main Street provides a single lane in the northbound and southbound directions. Hollis Street approach to Main Street provides a single travel lane under “STOP” sign control. Court Street provides a single one-way travel lane away from Main Street. A marked crosswalk and rectangular rapid flashing beacon is provided across the northern Main Street leg of the intersection and a marked crosswalk is provided across the westbound Hollis Street approach to Main Street. Land uses at the intersection include a restaurant, retail, and residential.

Main Street at Pleasant Street (South)

Main Street meets Pleasant Street to form a three-legged unsignalized intersection. Main Street provides a single lane in the northbound and southbound directions. The westbound Pleasant Street approach to Main Street provides a single approach lane under “YIELD” sign control. Pleasant Street provides a single one-way travel lane away from Main Street. A marked crosswalk is provided approximately 300 feet from the intersection across Pleasant Street. Land uses at the intersection include a market, restaurant, church, and residential.

Main Street at Pleasant Street (North)

Main Street meets Pleasant Street to form a three-legged unsignalized intersection attached to a parking lot just north of the primary intersection. Main Street provides a single lane in the northbound and southbound directions. The westbound Pleasant Street approach to Main Street provides a single approach lane with no signage, though is assumed to be under “STOP” control.

Pleasant Street provides a single one-way travel lane away from Main Street. Marked crosswalks are provided at the intersection across Main Street and Pleasant Street. Land uses at the intersection include a market, restaurant, commercial, and residential.

Main Street at Elm Street/Legion Road

Main Street meets Elm Street and Legion Road to form a four-legged, unsignalized intersection. Main Street provides a single lane in the northbound and southbound directions. The westbound Elm Street approaches to Main Street provides a single approach lanes under “STOP” sign control. Legion Road provides a single one-way travel lane away from Main Street. A marked crosswalk and rectangular rapid flashing beacon is provided across the northern Main Street leg of the intersection and a marked crosswalk is provided across the eastbound Elm Street approach to the Main Street. Land uses at the intersection include primarily single-family residential uses.

2.1.3 PEDESTRIAN & BICYCLE FACILITIES

The existing pedestrian and bicycle system serving the study area has been documented. A comprehensive network of sidewalks and crosswalks are provided in the study area as shown in **Figure 2**. Within the study area, “sharrow” bike pavement symbols are provided, separated bike lanes are not provided along Main Street. The Nashua River Rail Trail runs to the west and parallel to Main Street through the study area.

2.2 BASELINE TRAFFIC, PEDESTIAN & BICYCLE VOLUMES

Traffic-volume data used in this study were obtained by mechanical methods in April 2026. Automatic traffic recorder counts (ATRs) were conducted along Main Street at Powderhouse Road (South) and the Groton Community Center. Turning movement counts (TMCs) were conducted at the study intersections during the weekday morning (7:00 to 9:00 AM) and weekday evening (4:00 to 6:00 PM) peak periods. Likewise, hourly pedestrian counts were conducted at the Main Street mid-block crosswalks over a 24-hour period within the study area in April 2026 with a daily summary of crossings provided in the **Appendix**. These peak hour traffic counts represent the combination of busiest activity for the commuter traffic periods. Traffic count data is included in the **Appendix**.

2.2.1 DAILY TRAFFIC

Daily traffic volumes along Main Street at Powderhouse Road (South) and at the Groton Community Center were collected in April 2026. The results of the counts are summarized in **Table 1**. Time versus volume graphs of the daily traffic volumes collected along Main Street have been prepared for weekday conditions and are included in the **Appendix**. A review of Groton Mobility Study data indicates that approximately 60% of trips along Main Street pass through Groton without starting or ending in the community (see **Appendix**).

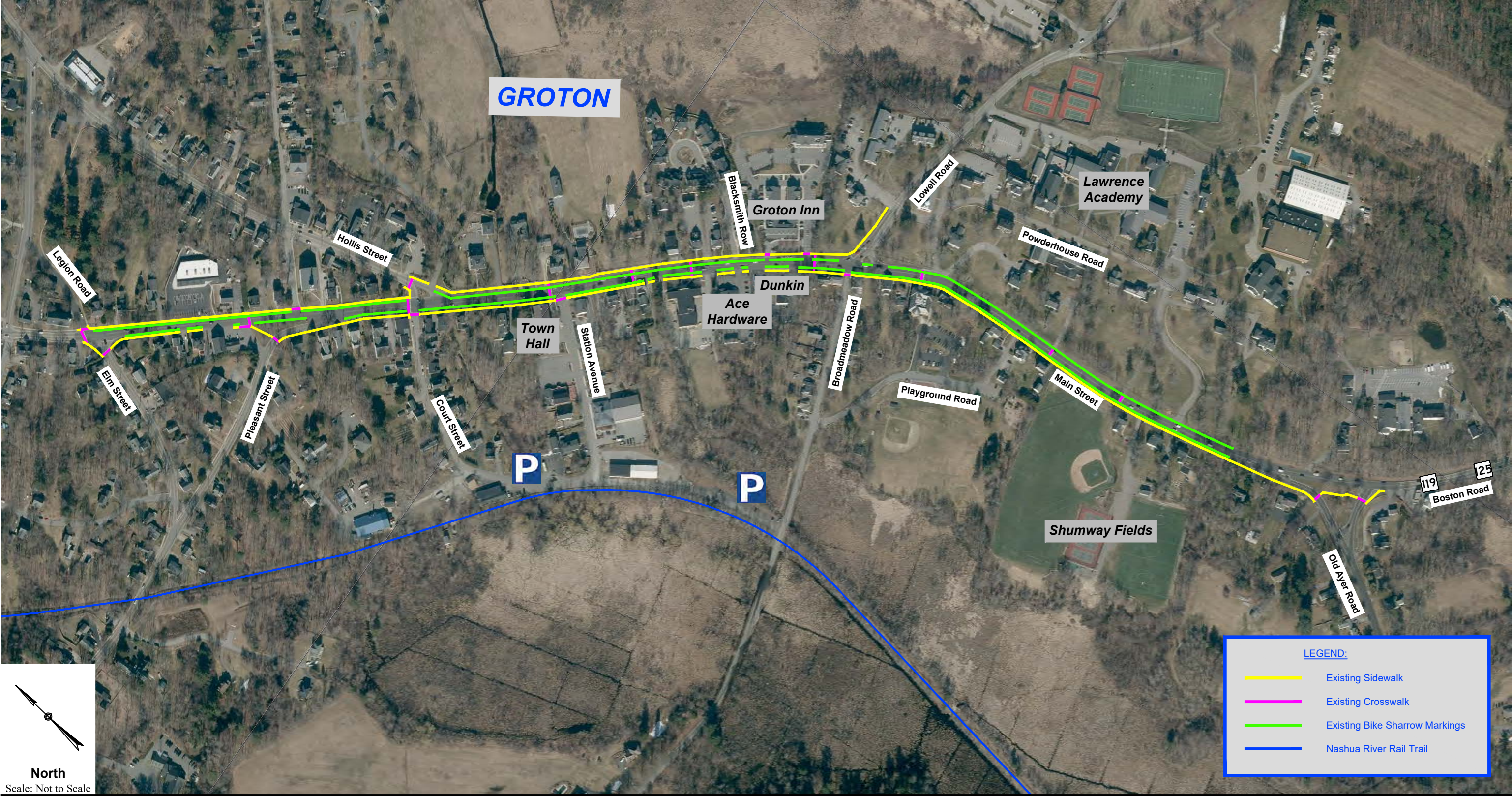


Figure 2

Existing Pedestrian & Bicycle Facilities

TABLE 1
BASELINE TRAFFIC VOLUME SUMMARY – MAIN STREET

Time Period	Daily Volume (vpd) ¹	Percent Daily Traffic ²	Peak Hour Volume (vph) ³	Peak Flow Direction ⁴	Peak Hour Directional Volume (vph)
<i>Main Street at Powderhouse Road (South of Lowell Road))</i>					
Weekday Morning Peak Hour	18,290	7%	1,361	75% SB	1,016
Weekday Evening Peak Hour	18,290	8%	1,409	61% NB	865
Saturday Midday Peak Hour	15,510	9%	1,333	53% NB	712
<i>Main Street at Community Center (between Lowell Road and Hollis Street)</i>					
Weekday Morning Peak Hour	21,870	7%	1,617	71% SB	1,150
Weekday Evening Peak Hour	21,870	9%	1,881	63% NB	1,185
Saturday Midday Peak Hour	17,880	9%	1,551	52% NB	738

¹Two-way daily traffic expressed in vehicles per day without seasonal adjustment.

²The percent of daily traffic that occurs during the peak hour.

³Two-way peak-hour volume expressed in vehicles per hour.

⁴NB = Northbound, SB = Southbound

As summarized in **Table 1**:

- *Main Street at Powderhouse Road (South of Lowell Road).* The weekday daily traffic volume on Main Street at Powderhouse Road (South) is approximately 18,290 vehicles per day (vpd) on a weekday and 15,510 vpd on a Saturday. Peak hour traffic flow on Main Street ranges from approximately 1,350 to 1,410 vehicles per hour (vph) representing approximately 7 to 9 percent of daily traffic flow. During peak hours, vehicle flow is skewed towards the southbound direction during the weekday morning, skewed towards the northbound direction during the weekday evening, and split evenly during the Saturday midday.
- *Main Street at Prescott Community Center (between Lowell Road and Hollis Street).* The weekday daily traffic volume on Main Street at the Prescott Community Center is approximately 21,870 vehicles per day (vpd) on a weekday and 17,880 vpd on a Saturday. Peak hour traffic flow on Main Street ranges from approximately 1,550 to 1,880 vehicles per hour (vph) representing approximately 7 to 9 percent of daily traffic flow. During peak hours, vehicle flow is skewed towards the southbound direction during the weekday morning, skewed towards the northbound direction during the weekday evening, and split evenly during the Saturday midday.

In summary, traffic volumes on Main Street through the Downtown Groton, between Lowell Road and Hollis Street, were observed at approximately 22,000 vpd. The peak hour traffic is generally heavily skewed in the southbound direction during the weekday morning peak hour and heavily skewed in the northbound direction during the weekday evening peak hour which is consistent with commuter travel pattern with respect to the major highway systems to the south.

2.2.2 PEAK-HOUR TRAFFIC VOLUMES

Review of MassDOT permanent count station data in the area indicates that April represents an average traffic month. Therefore, no adjustment was applied to the observed April 2026 traffic volumes to represent average conditions. Permanent count station data is provided in the **Appendix**.

The resulting Baseline weekday morning and weekday evening peak-hour traffic volumes for study intersections are depicted in **Figures 3** and **Figure 4**. The observed peak hour pedestrian volumes are depicted in **Figure 5** and **Figure 6**. Bicycle activity traveling along Main Street was limited with detailed count sheets included in the **Appendix**.

2.3 MEASURED TRAVEL SPEEDS

Vehicle speeds were obtained for Main Street at two locations for the northbound and southbound travel directions. The data was collected using radar-equipped ATRs in April 2026 at Powderhouse Road (South) and at the Groton Community Center. **Table 2** summarizes the average and 85th percentile speeds for Main Street. The speed data is provided in the **Appendix**.

TABLE 2
SPEED STUDY RESULTS – MAIN STREET

Travel Direction	Travel Speeds		
	Posted ¹	Mean ²	85 th Percentile ³
<i>Main Street at Powderhouse Road (South)</i>			
Northbound	30	30	34
Southbound	30	32	37
<i>Main Street at Community Center</i>			
Northbound	30	25	31
Southbound	30	26	32

¹Regulatory Speed Limit (mph)

²Arithmetic mean (mph)

³The speed at or below which 85 percent of the vehicles are traveling

As summarized in **Table 2**,

- *At Powderhouse Road (South).* The mean (average) travel speed on Main Street in this section traveling northbound is 30 mph and the 85th percentile travel speed is 34 mph. In the southbound direction, the mean travel speed is 32 mph and the 85th percentile travel speed is 37 mph.
- *At Community Center.* The mean (average) travel speed on Main Street in this section traveling northbound is 25 mph and the 85th percentile travel speed is 31 mph. In the southbound direction, the mean travel speed is 26 mph and the 85th percentile travel speed is 32 mph.

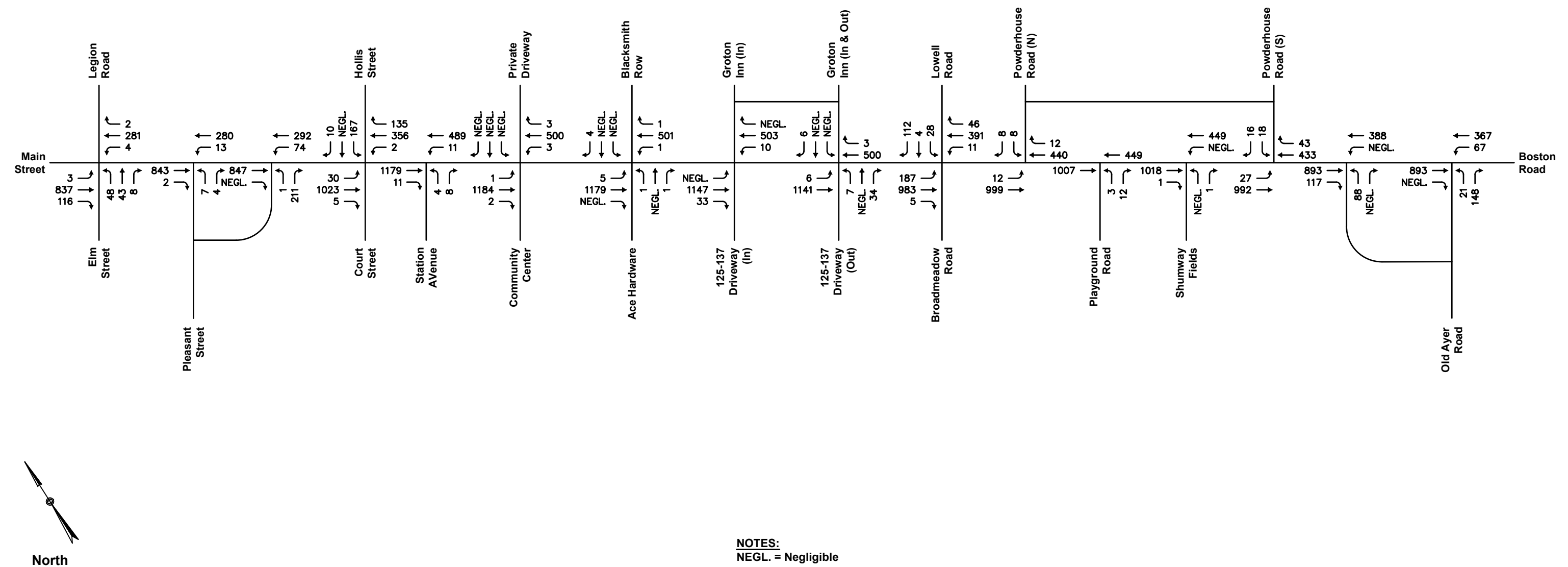


Figure 3
2026 Baseline Condition
Weekday Morning Peak Hour
Traffic Volumes

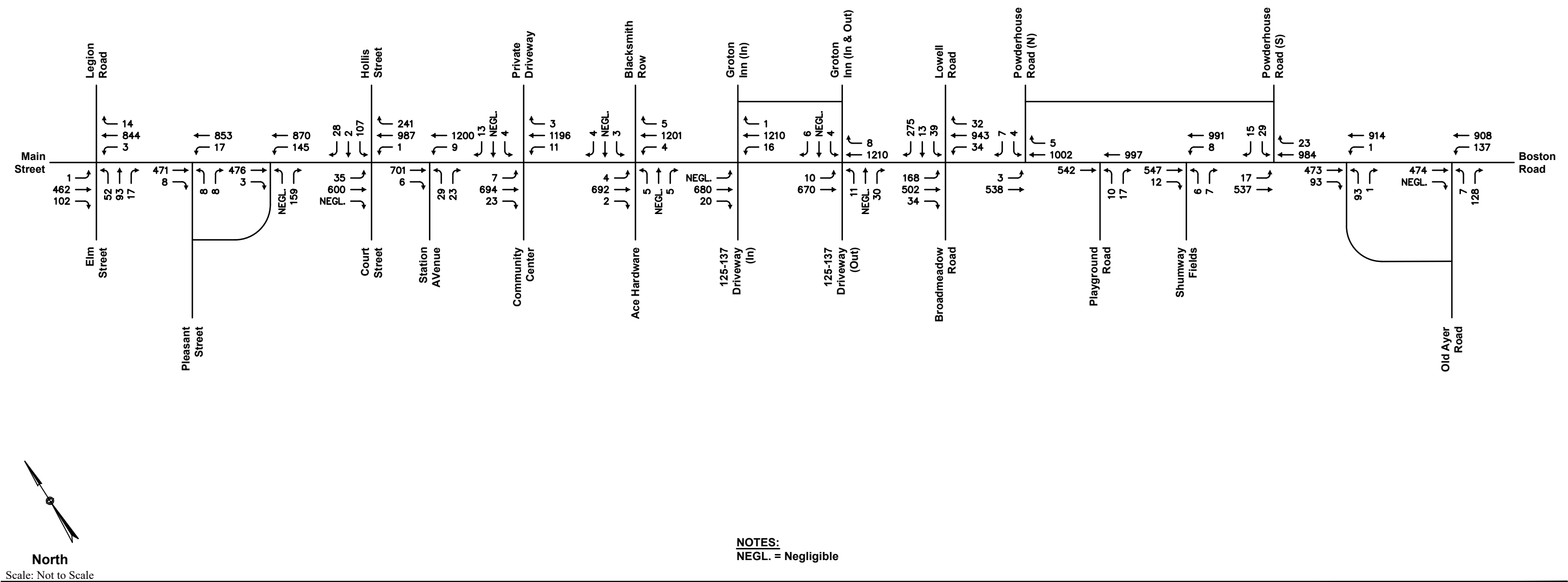


Figure 4
2026 Baseline Condition
Weekday Evening Peak Hour
Traffic Volumes

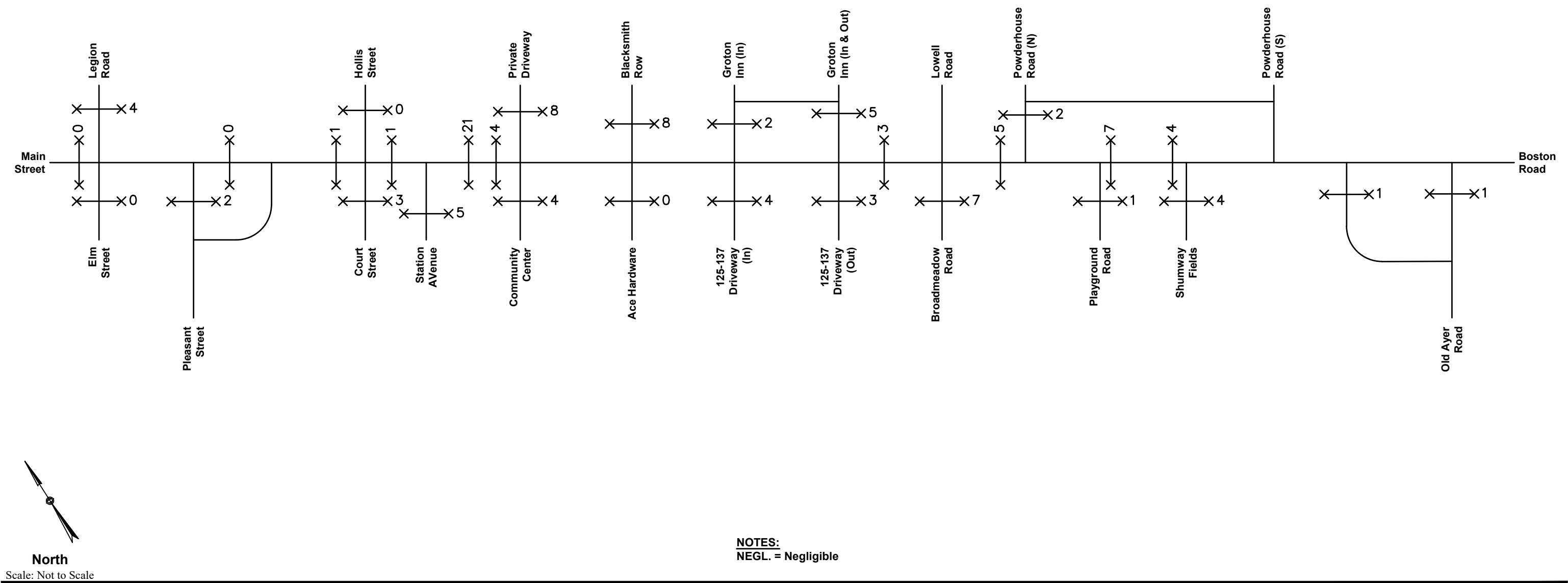


Figure 5
2026 Baseline Condition
Weekday Morning Peak Hour
Pedestrian Volumes

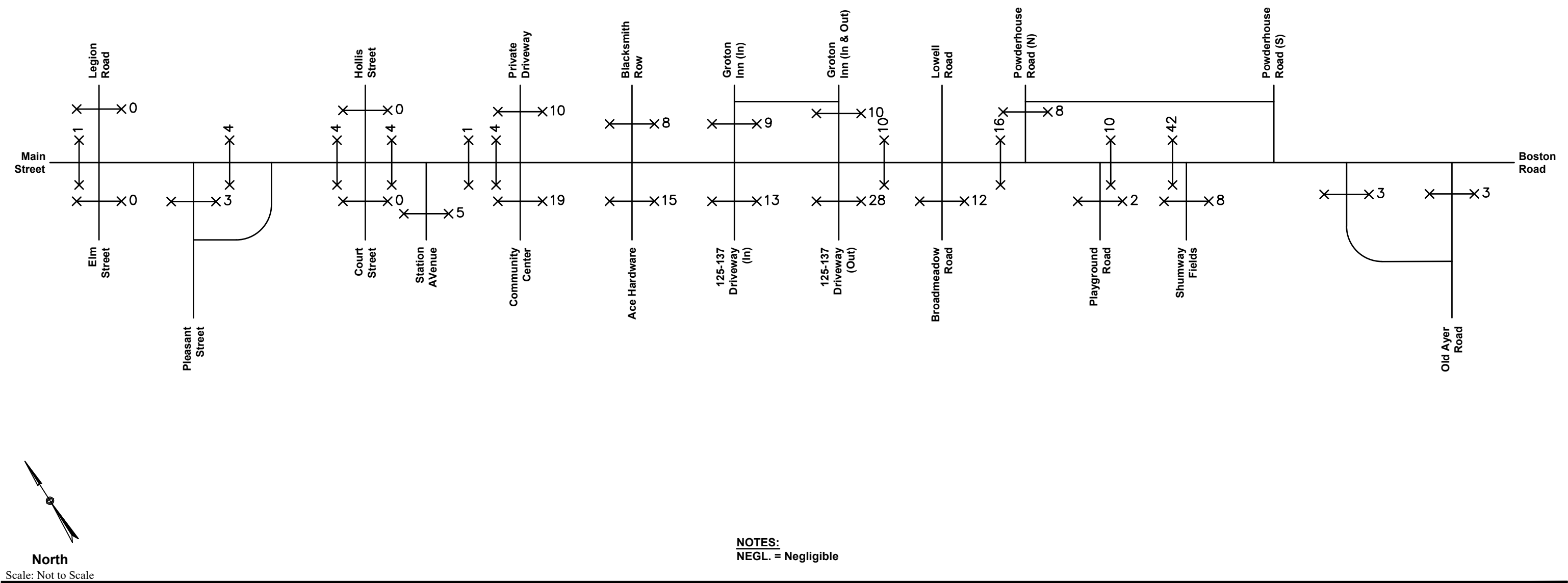


Figure 6
2026 Baseline Condition
Weekday Evening Peak Hour
Pedestrian Volumes

In summary, the observed 85th percentile travel speeds are consistent with the 30-mph regulatory speed limit on Main Street both travel directions. A comparison between the posted speed limit and observed 85th percentile travel speeds indicate higher speeds to the south of Powderhouse Road which has less development density as you move away from the downtown area.

2.4 SAFETY

In order to identify crash trends and safety characteristics for study area intersections, crash data were obtained from MassDOT for the seven-year period covering 2019 through 2025. A summary of the crash data with crash rates for the study intersections with reported crashes is provided in **Table 3** with detailed data provided in the **Appendix**.

Crash rates were calculated for the study intersections as reported in **Table 3**. These rates quantify the number of crashes per million entering vehicles. MassDOT has determined the official District 3 (which includes the Town of Groton) crash rate to be 0.61 for unsignalized intersections and 0.89 for signalized intersections. This rate represents MassDOT's "average" crash experience for District 3 communities and serves as a basis for comparing reported crash rates for the study intersections. Where calculated crash rates notably exceed the district average, some form of safety countermeasures may be warranted.

In addition to MassDOT crash data, local crash records were obtained from the Groton Police Department to further identify crash trends and safety characteristics within the Main Street corridor and corroborate the state crash data. The local crash reports are provided in the **Appendix**.

TABLE 3
INTERSECTION CRASH SUMMARY – 2019 THROUGH 2025¹

Data Category	INTERSECTIONS										
	Boston Road at Old Ayer Road	Main Street at Old Ayer Road	Main Street at Powderhouse Road South	Main Street at Playground Road	Main Street at Powderhouse Road North	Main Street at Lowell Road/ Broadmeadow Road	Main Street at Blacksmith Row/ Ace Hardware	Main Street at Station Avenue	Main Street at Hollis Street/Court Street	Main Street at Pleasant Street South	Main Street at Legion Road/ Elm Street
Traffic Control	Unsignalized	Unsignalized	Unsignalized	Unsignalized	Unsignalized	Unsignalized	Unsignalized	Unsignalized	Unsignalized	Unsignalized	Unsignalized
Crash Rate ²	0.16	0.17	0.02	0.05	0.02	0.83	0.02	0.04	0.22	0.29	0.09
MHD Dist. 3 Avg ³	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61
Year:											
2019	0	2	1	0	0	7	0	0	2	1	1
2020	1	0	0	0	0	6	0	0	2	0	1
2021	0	2	0	0	0	4	0	0	4	3	1
2022	0	0	0	0	0	6	0	1	1	2	0
2023	1	1	0	1	0	4	0	0	0	3	0
2024	3	1	0	1	1	6	0	1	0	2	0
2025	2	1	0	0	0	13	1	0	3	2	1
Total	7	7	1	2	1	46	1	2	12	13	4
Type:											
Angle	3	3	0	1	1	22	1	1	4	0	1
Rear-End	2	0	0	1	0	13	0	0	4	11	0
Head-On	0	0	0	0	0	0	0	0	0	1	0
Sideswipe	1	1	1	0	0	8	0	1	1	1	1
Single Vehicle	1	3	0	0	0	2	0	0	3	0	2
Unknown/Other	0	0	0	0	0	1	0	0	0	0	0
Severity:											
P. Damage Only	5	4	1	2	0	40	1	0	11	12	3
Personal Injury	2	2	0	0	1	6	0	2	1	1	1
Fatality	0	0	0	0	0	0	0	0	0	0	0
Not Reported	0	1	0	0	0	1	0	0	0	0	0
Conditions:											
Dry	5	4	0	2	1	41	1	2	9	13	4
Wet	1	2	1	0	0	6	0	0	0	0	0
Snow	1	0	0	0	0	0	0	0	3	0	0
Unknown	0	1	0	0	0	0	0	0	0	0	0
Time:											
7:00 to 9:00 AM	1	2	0	0	0	3	0	0	1	3	0
4:00 to 6:00 PM	1	0	0	1	0	13	0	0	5	1	1
Rest of Day	5	5	1	1	1	30	1	2	6	9	3

¹Source: Town of Groton

²Crashes per million entering vehicles (MEV)

³District 3 Average Crash Rate

As summarized in **Table 3**:

- *Boston Road at Old Ayer Road*: Seven (7) crashes were reported at or near the Boston Road unsignalized intersection with Old Ayer Road over the seven-year study period resulting in a crash rate of 0.16, which is below the District 3 average of 0.61. The reported crashes include three (3) angle type collisions (43%). The majority of crashes (71%) resulted in property damage type collisions under dry (71%) roadway conditions during off-peak travel periods (71%). No fatalities or pedestrian-related incidents were reported during the study period.
- *Main Street at Old Ayer Road*: Seven (7) crashes were reported at or near the Main Street unsignalized intersection with Old Ayer Road over the seven-year study period resulting in a crash rate of 0.17, which is below the District 3 average of 0.61. The reported crashes include three (3) angle type collisions (43%) and three (3) single-vehicle crashes (43%). The majority of crashes (57%) resulted in property damage type collisions under dry (57%) roadway conditions during off-peak travel periods (71%). No fatalities or pedestrian-related incidents were reported during the study period.
- *Main Street at Powderhouse Road (South)*: One (1) crash was reported at or near the Main Street unsignalized intersection with Powderhouse Road S over the seven-year study period resulting in a crash rate of 0.02, which is below the District 3 average of 0.61. The reported crash was a sideswipe type collision. The crash resulted in property damage type collision under wet roadway conditions during off-peak travel periods. No fatalities or pedestrian-related incidents were reported during the study period.
- *Main Street at Playground Road*: Two (2) crashes were reported at or near the Main Street unsignalized intersection with Playground Road over the seven-year study period resulting in a crash rate of 0.05, which is below the District 3 average of 0.61. The reported crashes including an angle type collision (50%) and a sideswipe type collision (50%). The two (2) crashes resulted in property damage type collisions under dry roadway conditions, one (1) during peak travel periods (50%) and one (1) during off-peak travel periods (50%). No fatalities or pedestrian-related incidents were reported during the study period.
- *Main Street at Powderhouse Road (North)*: One (1) crash was reported at or near the Main Street unsignalized intersection with Powderhouse Road N over the seven-year study period resulting in a crash rate of 0.02, which is below the District 3 average of 0.61. The reported crash was an angle type collision. The crash resulted in personal injury type collision under dry roadway conditions during off-peak travel periods. No fatalities or pedestrian-related incidents were reported during the study period.

- *Main Street at Lowell Road/Broadmeadow Road:* Forty-six (46) crashes were reported at or near the Main Street unsignalized intersection with Lowell Road/Broadmeadow Road over the seven-year study period resulting in a crash rate of 0.83, which is above the District 3 average of 0.61. The reported crashes include twenty-two (22) angle type collisions (48%). Forty (40) of the crashes resulted in property damage type collisions (87%) and forty-one (41) occurred under dry roadway conditions (89%) during off-peak travel periods (65%). No fatalities or pedestrian-related incidents were reported during the study period. Despite the high crash rate, the intersection is not an HSIP high-crash location. A review of local police data indicates a problem with southbound through traffic bypassing left turn vehicles in the wide shoulder, resulting in collisions with traffic entering Main Street from Lowell Road. Safety countermeasures such as adding a signal with dedicated turn lanes will be explored in the following sections.
- *Main Street at Blacksmith Row/Ace Hardware:* One (1) crash was reported at or near the Main Street unsignalized intersection with Blacksmith Row/Ace Hardware over the seven-year study period resulting in a crash rate of 0.02, which is below the District 3 average of 0.61. The reported crash was an angle type collision. The crash resulted in property damage type collision under dry roadway conditions during off-peak travel periods. No fatalities or pedestrian-related incidents were reported during the study period.
- *Main Street at Station Avenue:* Two (2) crashes were reported at or near the Main Street unsignalized intersection with Station Avenue over the seven-year study period resulting in a crash rate of 0.04, which is below the District 3 average of 0.61. The reported crashes including an angle type collision (50%) and a sideswipe type collision (50%). The two (2) crashes resulted in personal injury type collisions under dry roadway conditions during off-peak travel periods. No fatalities or pedestrian-related incidents were reported during the study period.
- *Main Street at Hollis Street/Court Street:* Twelve (12) crashes were reported at or near the Main Street unsignalized intersection with Hollis Street/Court Street over the seven-year study period resulting in a crash rate of 0.22, which is below the District 3 average of 0.61. The reported crashes include four (4) angle type collisions (33%) and four (4) rear-end type collisions (33%). Eleven (11) of the crashes resulted in property damage type collisions (92%) and all occurred under dry roadway conditions during off-peak travel periods (69%). No fatalities or pedestrian-related incidents were reported during the study period.
- *Main Street at Pleasant Street (South):* Thirteen (13) crashes were reported at or near the Main Street unsignalized intersection with Pleasant Street over the seven-year study period resulting in a crash rate of 0.29, which is below the District 3 average of 0.61. The reported crashes include eleven (11) rear-end type collisions (85%). Twelve (12) of the crashes resulted in property damage type collisions (92%) and nine (9) occurred under dry roadway conditions (75%) during off-peak travel periods (50%). No fatalities or pedestrian-related incidents were reported during the study period.

- *Main Street at Legion Road/Elm Street:* Four (4) crashes were reported at or near the Main Street unsignalized intersection with Legion Road/Elm Street over the seven-year study period resulting in a crash rate of 0.09, which is below the District 3 average of 0.61. The reported crashes include two (2) single-vehicle crashes (50%). The majority of crashes (75%) resulted in property damage type collisions and all occurred under dry roadway conditions during off-peak travel periods (75%). No fatalities or pedestrian-related incidents were reported during the study period.

In summary, based on local crash records the study intersections away from the Main Street at Lowell Road intersection generally experienced crash rates below the District 3 averages. That said, the intersection of Main Street at Old Ayer Road and the cluster of intersections of Main Street at Hollis Street and Pleasant Street were observed to have a moderate number of crashes which primarily resulted in property damage type collisions. While no immediate safety countermeasures are warranted based on an isolated review of crash history in the area, recommended intersection mobility and operational recommendations and safety countermeasures such as adding a signal and complete street design accommodations will be explored in the following sections.

2.5 PUBLIC TRANSPORTATION FACILITIES

The Massachusetts Bay Transportation Authority (MBTA) currently operates commuter rail service within 10 minutes of the Groton downtown area. Specific public transportation services currently operated in the immediate area as follows:

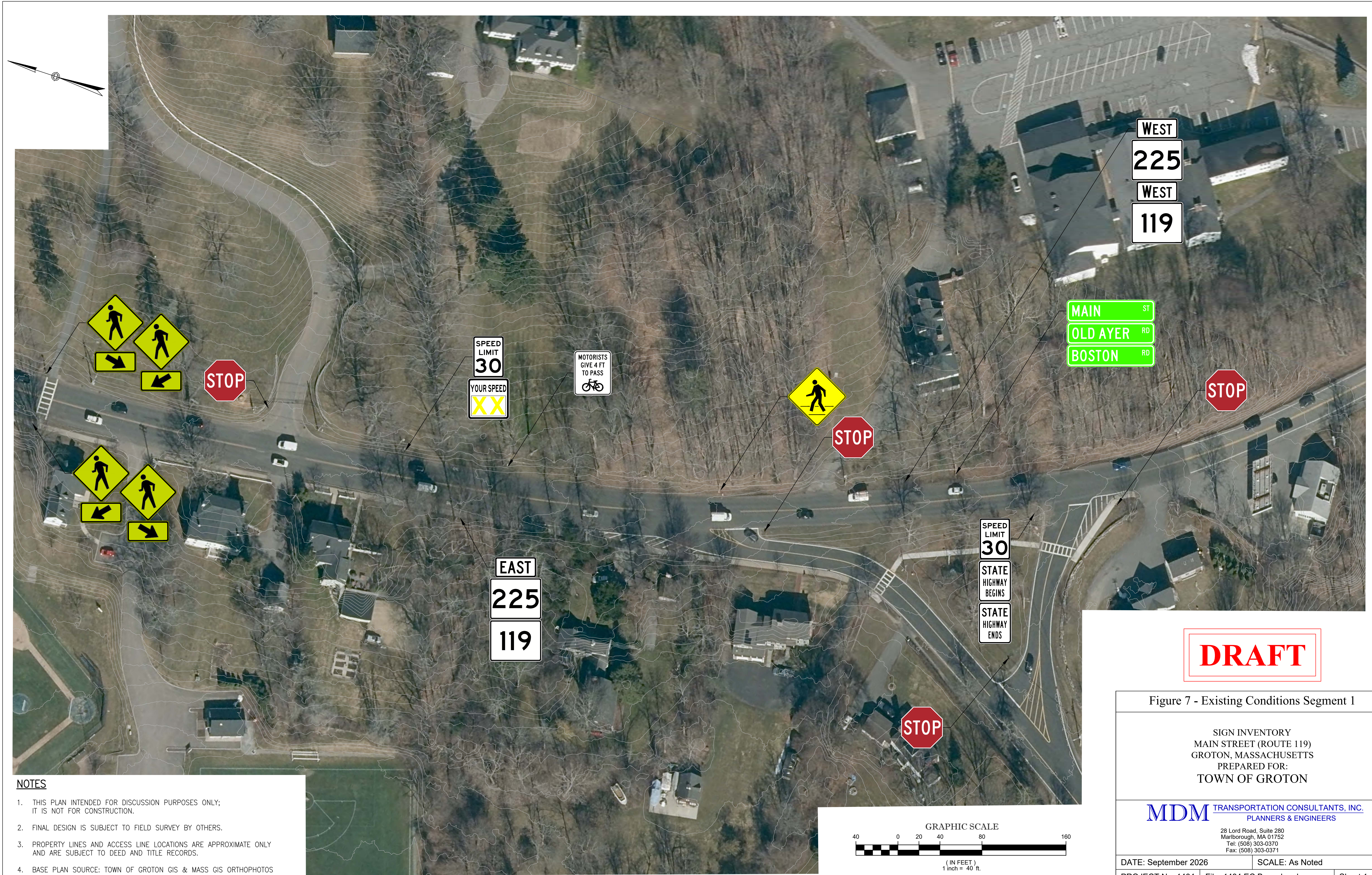
- ***MBTA Commuter Rail:*** The Fitchburg Commuter Rail line runs from Wachusett to North Station in Boston with a stop at Ayer Station, approximately 10 minutes from the Groton downtown area. Service generally runs M-F 4:25 am to 12:30 am on weekdays and 5:00 am to 10:30 am on weekends with headways of approximately 60-70 minutes on weekdays and 120-180 minutes on weekends.

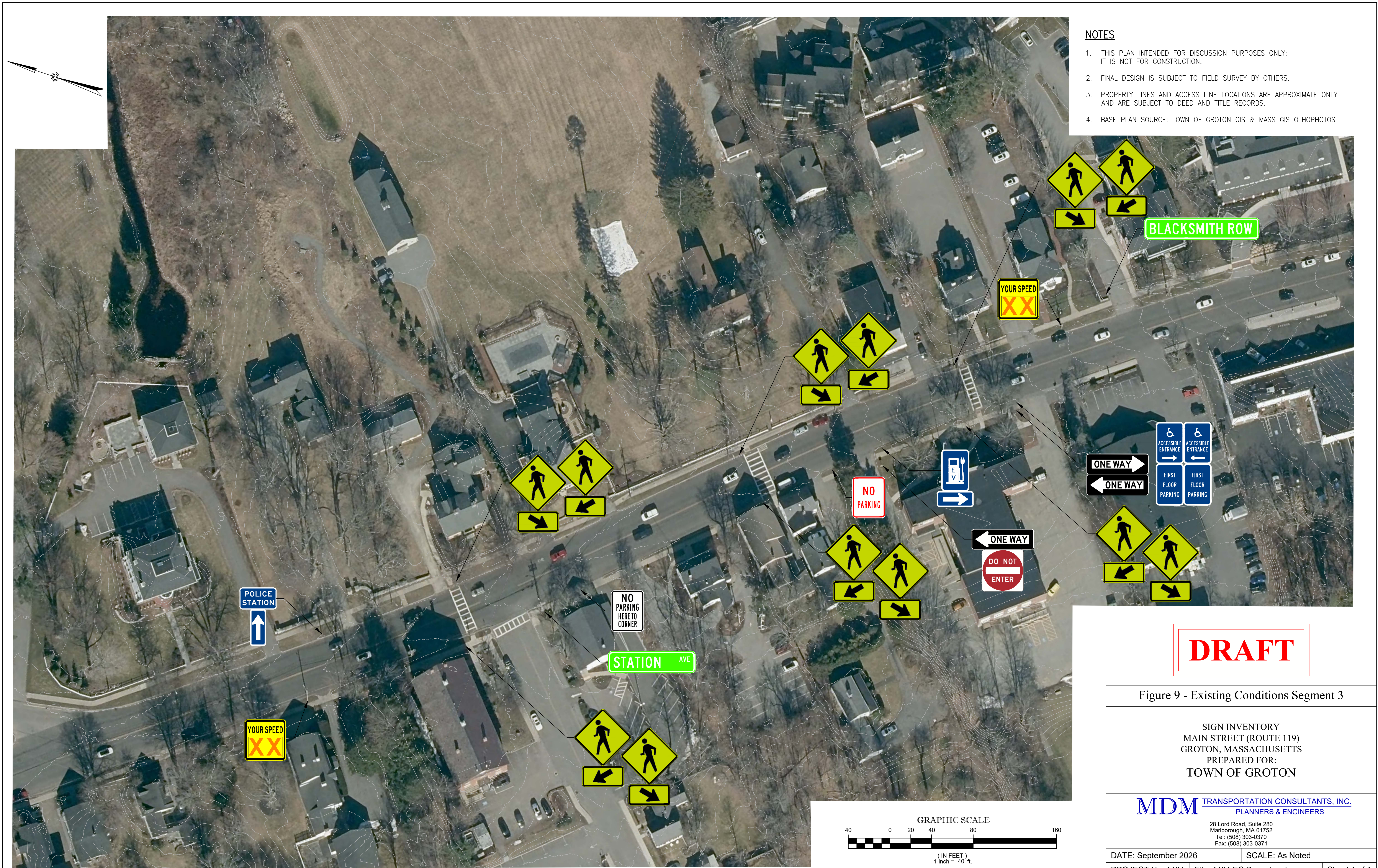
2.6 EXISTING TRANSPORTATION INFRASTRUCTURE

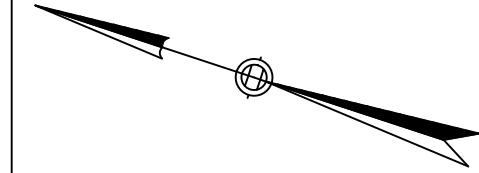
The existing transportation infrastructure in the study area is described in this section. The inventory is based on available MassGIS aerial mapping, the Town GIS data, and a field inventory of the existing transportation infrastructure along Main Street was conducted in April 2026 including roadway geometry, existing signage, pavement markings, and a review of pedestrian/bicycle accommodations.

2.6.1 SIGNAGE AND PAVEMENT MARKINGS

The existing signage and pavement markings along Main Street were inventoried and broken down into individual scaled sheets starting at the intersection of Main Street at Old Ayer Road and moving to the north to the intersection Main Street at Legion Road/Elm Street are presented in **Figures 7** through **Figure 11**.

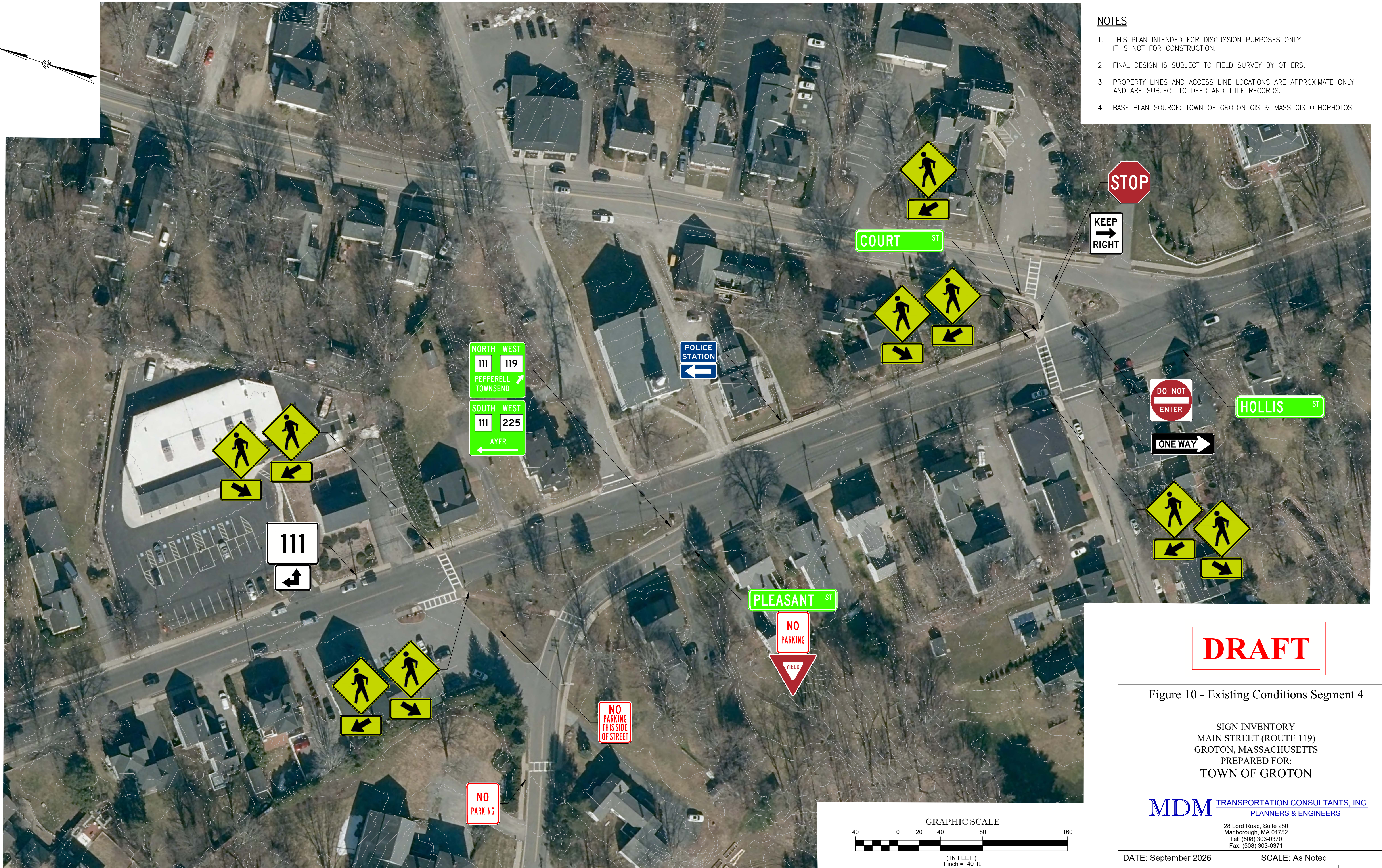






NOTES

1. THIS PLAN INTENDED FOR DISCUSSION PURPOSES ONLY;
IT IS NOT FOR CONSTRUCTION.
2. FINAL DESIGN IS SUBJECT TO FIELD SURVEY BY OTHERS.
3. PROPERTY LINES AND ACCESS LINE LOCATIONS ARE APPROXIMATE ONLY
AND ARE SUBJECT TO DEED AND TITLE RECORDS.
4. BASE PLAN SOURCE: TOWN OF GROTON GIS & MASS GIS OTHOPHOTOS



DRAFT

Figure 10 - Existing Conditions Segment 4

SIGN INVENTORY
MAIN STREET (ROUTE 119)
GROTON, MASSACHUSETTS
PREPARED FOR:
TOWN OF GROTON

MDM TRANSPORTATION CONSULTANTS, INC.
PLANNERS & ENGINEERS

28 Lord Road, Suite 280
Marlborough, MA 01752
Tel: (508) 303-0370
Fax: (508) 303-0371

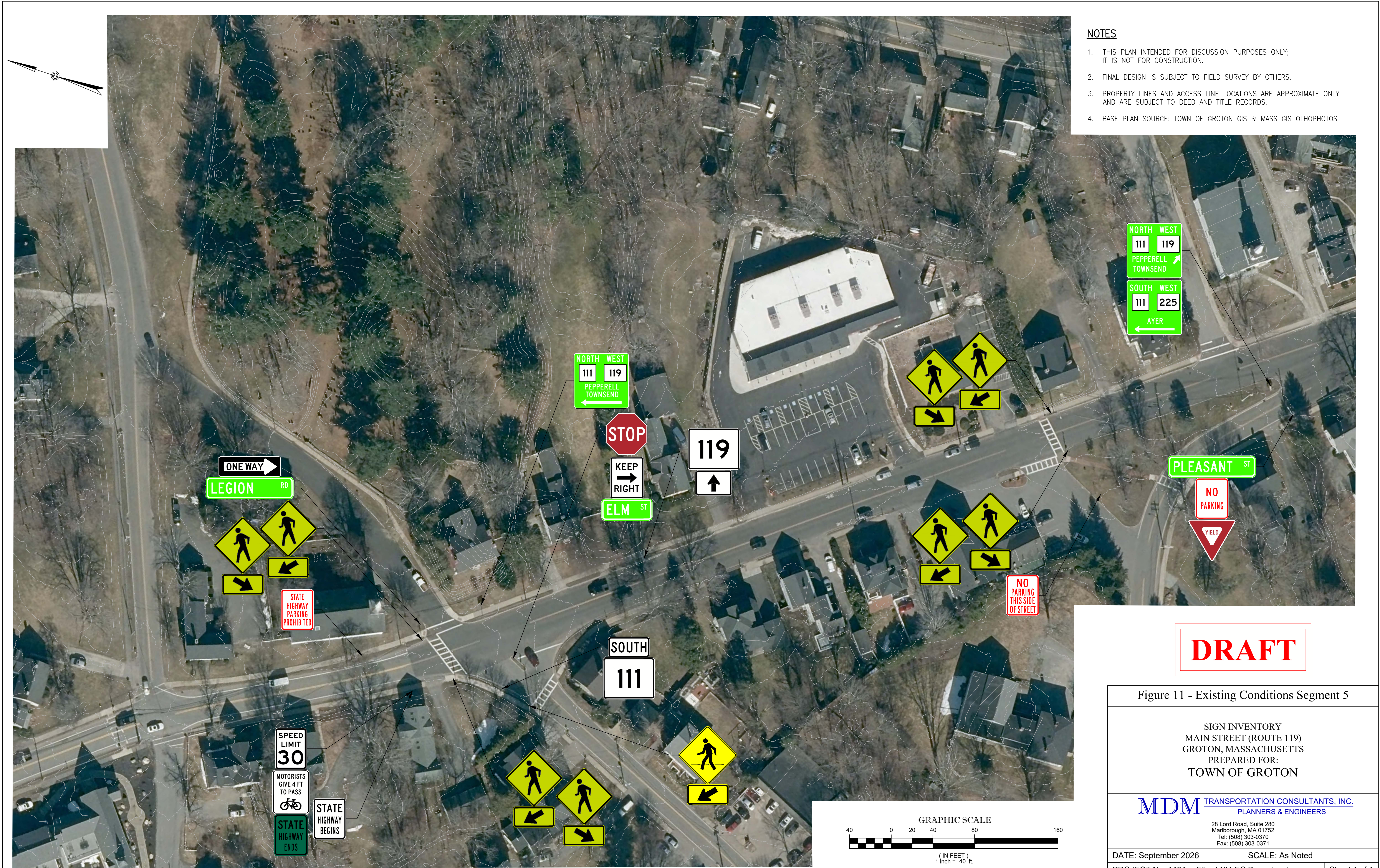
DATE: September 2026

SCALE: As Noted

PROJECT No. 1484

File: 1484 EC Baseplan.dwg

Sheet 1 of 1



3.0 EXISTING TRAFFIC OPERATIONS ANALYSIS

Intersection capacity analyses for the study intersections are presented in this section for the Existing traffic-volume conditions. Capacity analyses, conducted in accordance with EEA/MassDOT guidelines, provide an index of how well the roadway facilities serve the traffic demands placed upon them. The operational results provide the basis for recommended access and roadway improvements in the following section.

3.1 CAPACITY ANALYSIS PROCEDURES

Capacity analysis of intersections is developed using the Synchro® computer software, which implements the methods of the Highway Capacity Manual (HCM) 7th Edition. The resulting analysis presents a level-of-service (LOS) designation for individual intersection movements. The LOS is a letter designation that provides a qualitative measure of operating conditions based on several factors including roadway geometry, speeds, ambient traffic volumes, traffic controls, and driver characteristics. Since the LOS of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of LOS, depending on the time of day, day of week, or period of year. A range of six levels of service are defined on the basis of average delay, ranging from LOS A (the least delay) to LOS F (delays greater than 50 seconds for unsignalized movements and 80 seconds for signalized movements). The specific control delays and associated LOS designations are presented in the **Appendix**.

3.2 INTERSECTION CAPACITY ANALYSIS RESULTS

The capacity analysis results for the intersections in the study area are summarized in **Table 4** for the weekday morning and weekday evening peak hours. Detailed analysis results are presented in the **Appendix**.

TABLE 4
INTERSECTION CAPACITY ANALYSIS RESULTS
2026 EXISTING CONDITIONS

Intersection	Approach	Weekday Morning Peak Hour			Weekday Evening Peak Hour		
		v/c ¹	Delay ²	LOS ³	v/c	Delay	LOS
<i>Boston Road at Old Ayer Road</i>	Old Ayer Rd EB	0.18	28	D	0.23	16	C
	Northbound	0.10	<5	A	0.13	<5	A
	Southbound	0.00	<5	A	0.00	<5	A
<i>Main Street at Old Ayer Road</i>	Old Ayer Rd EB	0.59	>50	F	0.69	>50	F
	Northbound	0.00	<5	A	0.00	<5	A
	Southbound	0.00	<5	A	0.00	<5	A
<i>Main Street at Powderhouse Road (S)</i>	Powderhouse Rd WB	0.20	30	D	0.32	42	E
	Northbound	0.00	<5	A	0.00	<5	A
	Southbound	0.03	<5	A	0.03	<5	A
<i>Main Street at Shumway Fields</i>	EB Exit	0.00	19	C	0.07	25	C
	Northbound	0.00	<5	A	0.01	<5	A
	Southbound	0.00	<5	A	0.00	<5	A
<i>Main Street at Playground Road</i>	EB Exit	0.08	23	C	0.12	22	C
	Northbound	0.00	<5	A	0.00	<5	A
	Southbound	0.00	<5	A	0.00	<5	A
<i>Main Street at Powderhouse Road (N)</i>	Powderhouse Rd WB	0.09	25	D	0.06	25	C
	Northbound	0.00	<5	A	0.00	<5	A
	Southbound	0.01	<5	A	0.00	<5	A
<i>Main Street at Lowell Road/ Broadmeadow Road</i>	Lowell Rd WB	>1.0	>50	F	>1.0	>50	F
	Northbound	0.02	<5	A	0.04	<5	A
	Southbound	0.18	<5	A	0.25	<5	A
<i>Main Street at Groton Inn/ 125-137 Driveway</i>	EB Exit	0.30	39	E	0.36	>50	F
	Groton Inn WB	0.01	12	B	0.14	>50	F
	Northbound	0.00	<5	A	0.00	<5	A
	Southbound	0.01	<5	A	0.02	<5	A
<i>Main Street at Blackstone Row/ Ace Hardware</i>	Ace Dwy EB	0.02	42	E	0.13	>50	F
	Blackstone Row WB	0.01	12	B	0.10	>50	F
	Northbound	0.00	<5	A	0.01	<5	A
	Southbound	0.01	<5	A	0.01	<5	A
<i>Main Street at Ace Hardware/ Community Center</i>	Dwy EB	0.00	<5	A	0.18	48	E
	Northbound	0.01	<5	A	0.01	<5	A
	Southbound	0.00	<5	A	0.01	<5	A

¹ Volume-to-capacity ratio

² Average control delay per vehicle (in seconds)

³ Level of service

⁴ n/a = not applicable

TABLE 4 (Cont.)
INTERSECTION CAPACITY ANALYSIS RESULTS
2026 EXISTING CONDITIONS

Intersection	Approach	Weekday Morning Peak Hour			Weekday Evening Peak Hour		
		v/c ¹	Delay ²	LOS ³	v/c	Delay	LOS
<i>Main Street at Station Avenue</i>	Station Ave EB	0.08	32	D	0.48	>50	F
	Northbound	0.02	<5	A	0.01	<5	A
	Southbound	0.00	<5	A	0.00	<5	A
<i>Main Street at Hollis Street/Court Street</i>	Hollis St WB	>1.0	>50	F	>1.0	>50	F
	Northbound	0.00	<5	A	0.00	<5	A
	Southbound	0.03	<5	A	0.06	<5	A
<i>Main Street at Pleasant Street (S)</i>	Pleasant St EB	0.32	13	B	0.19	10	A
	Northbound	0.11	<5	A	0.14	<5	A
	Southbound	0.00	<5	A	0.00	<5	A
<i>Main Street at Pleasant Street (N)</i>	Pleasant St EB	0.05	21	C	0.07	21	C
	Northbound	0.02	<5	A	0.02	<5	A
	Southbound	0.00	<5	A	0.00	<5	A
<i>Main Street at Legion Road/Elm Street</i>	Elm St EB	0.36	24	C	0.57	33	D
	Northbound	0.01	<5	A	0.00	<5	A
	Southbound	0.00	<5	A	0.00	<5	A

¹ Volume-to-capacity ratio

² Average control delay per vehicle (in seconds)

³ Level of service

⁴ n/a = not applicable

As summarized in **Table 4**:

- *Boston Road at Old Ayer Road*: Under existing conditions, capacity analyses indicate that the mainline vehicular movements along Boston Road operate unimpeded at LOS A during the weekday morning and weekday evening peak hours. The Old Ayer Road approach to Boston Road operates at LOS E or better during the weekday morning and weekday evening peak hours.
- *Main Street at Old Ayer Road*: Under existing conditions, capacity analyses indicate that the mainline vehicular movements along Main Street operate unimpeded at LOS A during the weekday morning and weekday evening peak hours. The Old Ayer Road approach to Main Street operates with long delays at LOS F during the weekday morning and weekday evening peak hours.
- *Main Street at Powderhouse Road (S)*: Under existing conditions, capacity analyses indicate that the mainline vehicular movements along Main Street operate unimpeded at LOS A during the weekday morning and weekday evening peak hours. The Powderhouse Road approach to Main Street operates at LOS E or better during the weekday morning and weekday evening peak hours.

- *Main Street at Shumway Fields:* Under existing conditions, capacity analyses indicate that the mainline vehicular movements along Main Street operate unimpeded at LOS A during the weekday morning and weekday evening peak hours. The Shumway Fields driveway approach to Main Street operates at LOS D or better during the weekday morning and weekday evening peak hours.
- *Main Street at Playground Road:* Under existing conditions, capacity analyses indicate that the mainline vehicular movements along Main Street operate unimpeded at LOS A during the weekday morning and weekday evening peak hours. The Playground Road approach to Main Street operates at LOS C or better during the weekday morning and weekday evening peak hours.
- *Main Street at Powderhouse Road (N):* Under existing conditions, capacity analyses indicate that the mainline vehicular movements along Main Street operate unimpeded at LOS A during the weekday morning and weekday evening peak hours. The Powderhouse Road approach to Main Street operates at LOS D or better during the weekday morning and weekday evening peak hours.
- *Main Street at Lowell Road/Broadmeadow Road:* Under existing conditions, capacity analyses indicate that the mainline vehicular movements along Main Street operate unimpeded at LOS A during the weekday morning and weekday evening peak hours. The Lowell Road approach to Main Street operates with long delays at LOS F or better during the weekday morning and weekday evening peak hours.
- *Main Street at Groton Inn/125-137 Driveway:* Under existing conditions, capacity analyses indicate that the mainline vehicular movements along Main Street operate unimpeded at LOS A during the weekday morning and weekday evening peak hours. The 125-137 Driveway and Groton Inn Driveway approaches to Main Street operates at LOS E or better during the weekday morning peak hour and operate with long delays at LOS F during the weekday evening peak hours.
- *Main Street at Blackstone Row/Ace Hardware:* Under existing conditions, capacity analyses indicate that the mainline vehicular movements along Main Street operate unimpeded at LOS A during the weekday morning and weekday evening peak hours. The Blackstone Row and Ace Hardware Driveway approaches to Main Street operates at LOS E or better during the weekday morning peak hour and operate with long delays at LOS F during the weekday evening peak hours.
- *Main Street at Ace Hardware/Community Center:* Under existing conditions, capacity analyses indicate that the mainline vehicular movements along Main Street operate unimpeded at LOS A during the weekday morning and weekday evening peak hours. The Ace Hardware approach to Main Street operates at LOS E or better during the weekday morning and weekday evening peak hours.

- *Main Street at Station Avenue:* Under existing conditions, capacity analyses indicate that the mainline vehicular movements along Main Street operate unimpeded at LOS A during the weekday morning and weekday evening peak hours. The Station Avenue approach to Main Street operates at LOS D or better during the weekday morning peak hour and with long delays at LOS F or better during the weekday evening peak hour.
- *Main Street at Hollis Street/Court Street:* Under existing conditions, capacity analyses indicate that the mainline vehicular movements along Main Street operate unimpeded at LOS A during the weekday morning and weekday evening peak hours. The Hollis Street approach to Main Street operates with long delays at LOS F or better during the weekday morning and weekday evening peak hours.
- *Main Street at Pleasant Street (S):* Under existing conditions, capacity analyses indicate that the mainline vehicular movements along Main Street operate unimpeded at LOS A during the weekday morning and weekday evening peak hours. The Pleasant Street approach to Main Street operates at LOS B or better during the weekday morning and weekday evening peak hours.
- *Main Street at Pleasant Street (N):* Under existing conditions, capacity analyses indicate that the mainline vehicular movements along Main Street operate unimpeded at LOS A during the weekday morning and weekday evening peak hours. The Pleasant Street approach to Main Street operates at LOS C or better during the weekday morning and weekday evening peak hours.
- *Main Street at Legion Road/Elm Street:* Under existing conditions, capacity analyses indicate that the mainline vehicular movements along Main Street operate unimpeded at LOS A during the weekday morning and weekday evening peak hours. The Elm Street approach to Main Street operates at LOS E or better during the weekday morning and weekday evening peak hours.

4.0 FUTURE CONDITIONS

Evaluation of the proposed development impacts requires the establishment of a future analysis condition. As part of this master plan, a ten-year planning horizon was selected using two growth scenarios; moderate growth and high growth.

The following sections provide an overview of future moderate growth and high growth traffic volume conditions.

4.1 BACKGROUND TRAFFIC GROWTH

Background traffic includes demand generated by other planned developments in the area as well as demand increases caused by external factors. External factors are general increases in traffic not attributable to a specific development and are determined using historical data.

4.1.1 HISTORICAL AREA GROWTH

Nearby permanent count station data published by MassDOT indicates a 0.4 percent per year growth rate while a review of historical daily traffic volumes collected in May 2011 along Main Street north of Lowell Road indicates an average yearly growth rate of approximately 0.13% per year. Likewise, the peak hour traffic volumes indicate no change in weekday morning peak hour traffic volumes and an increase of approximately 0.49% per year in weekday evening peak hour traffic volumes. For purposes of this evaluation, a 0.5 percent compounded annual growth rate was used (5.1 percent increase over a 10-year horizon) under a “Moderate Growth” scenario. This growth rate is consistent with historic rates and is also expected to account for any small fluctuation in hourly traffic as may occur from time to time in the study area and traffic associated with other potential small developments or vacancies in the area. A conservative 1.0 percent compounded annual growth rate was used (10.5 percent increase over a 10-year horizon) was used under a “High Growth” scenario. MassDOT permanent count station data, historical data, and background growth calculations are provided in the **Appendix**.

4.1.2 BACKGROUND DEVELOPMENT RELATED GROWTH

Development of future moderate and high growth scenarios consider traffic generated through the study area from specific area developments based on input from the Town Planning Department. Where specific approved development programming is available, the corridor study relies on published trip rates from prior studies; otherwise general land use categories are employed to develop trip estimates for specific parcels as described below:

- *500 Main Street.* 500 Main Street is a 24.4-acre approved/permitted residential development comprising approximately 176 apartments units and 24 townhome units. The development is supported by approximately 392 surface parking spaces. Access/egress to the site is provided via a single full access driveway along Main Street. Based on consultation with the Town Planning Department, the residential development is assumed to be fully occupied for planning purposes under both the “moderate growth” and “high growth” scenarios.
- *Gratuity Brook Farms Estates.* The proposed Gratuity Brook Farms Estates is a 36.38-acre property located at 63 Gratuity Road. The proposed development includes 24 age restricted units in 12 duplexes with cul-de-sacs proposed along Gratuity Road and Jenkins Road. Based on consultation with the Town Planning Department, the residential development is assumed to be fully occupied for planning purposes under both the “moderate growth” and “high growth” scenarios.
- *Nashoba Satellite Emergency Facility.* The proposed development includes an 18,500 sqft satellite emergency facility and a 15,700 sqft medical office building located on an approximately 7-acre property at 490 Main Street. and includes a single-family home with driveway access along Otis Street. Under the future scenarios the property was assumed to be fully operational based on consultation with the Town Planning Department for both the “moderate growth” and “high growth” scenarios.
- *Station Avenue.* The Groton 2036 – A Ten-Year Vision report identified approximately 125k square feet of future commercial space that could be supported by Groton and identified areas with potential for future development. Within the downtown area of Groton, approximately 10ksf of commercial space, 25ksf of retail space and 50 units of residential space were identified with primary access to Main Street through Station Avenue. Based on consultation with the Town Planning Department, these land uses are assumed to be in place for planning purposes under the “high growth” scenario.

4.2 MODERATE GROWTH SCENARIO

The “Moderate Growth” corridor buildout scenario results in total background development traffic volumes for weekday morning and weekday evening peak-hours for study intersections as depicted in **Figure 12** and **Figure 13**. These conditions represent likely known development scenarios and include a 0.5 percent annual growth rate applied to Existing traffic volumes over a 10-year period.

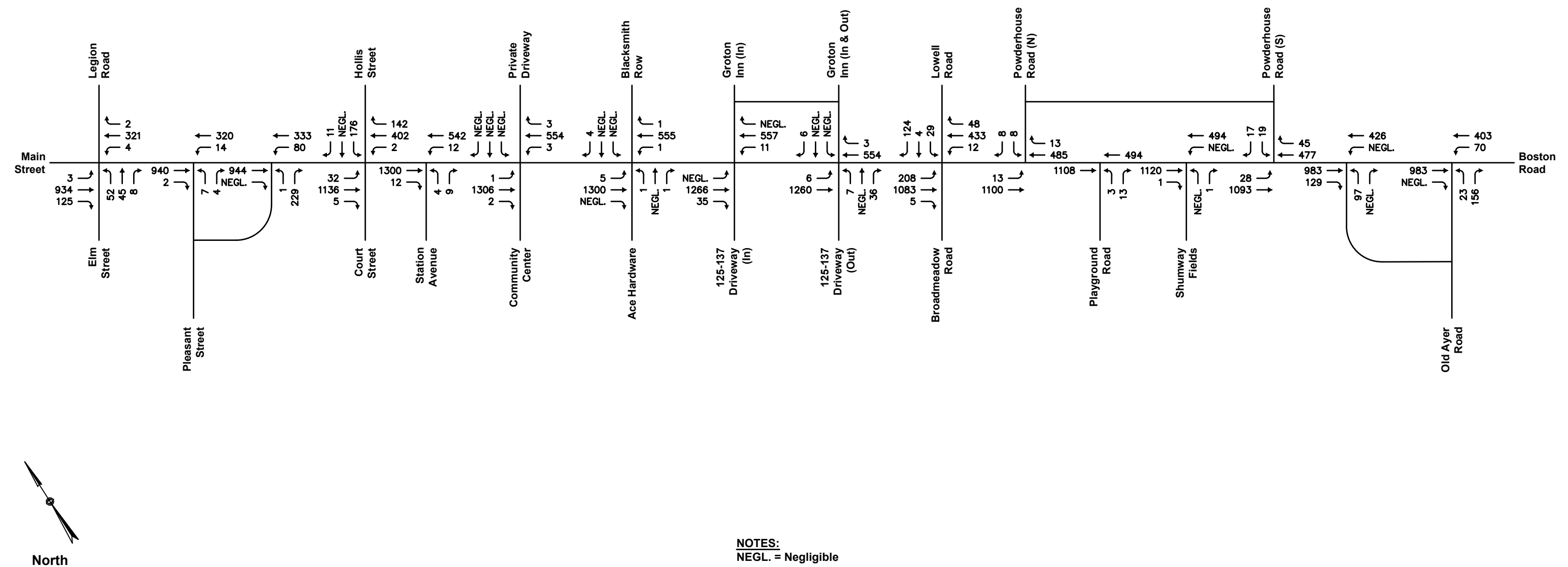


Figure 12
2036 Moderate Growth Condition
Weekday Morning Peak Hour
Traffic Volumes

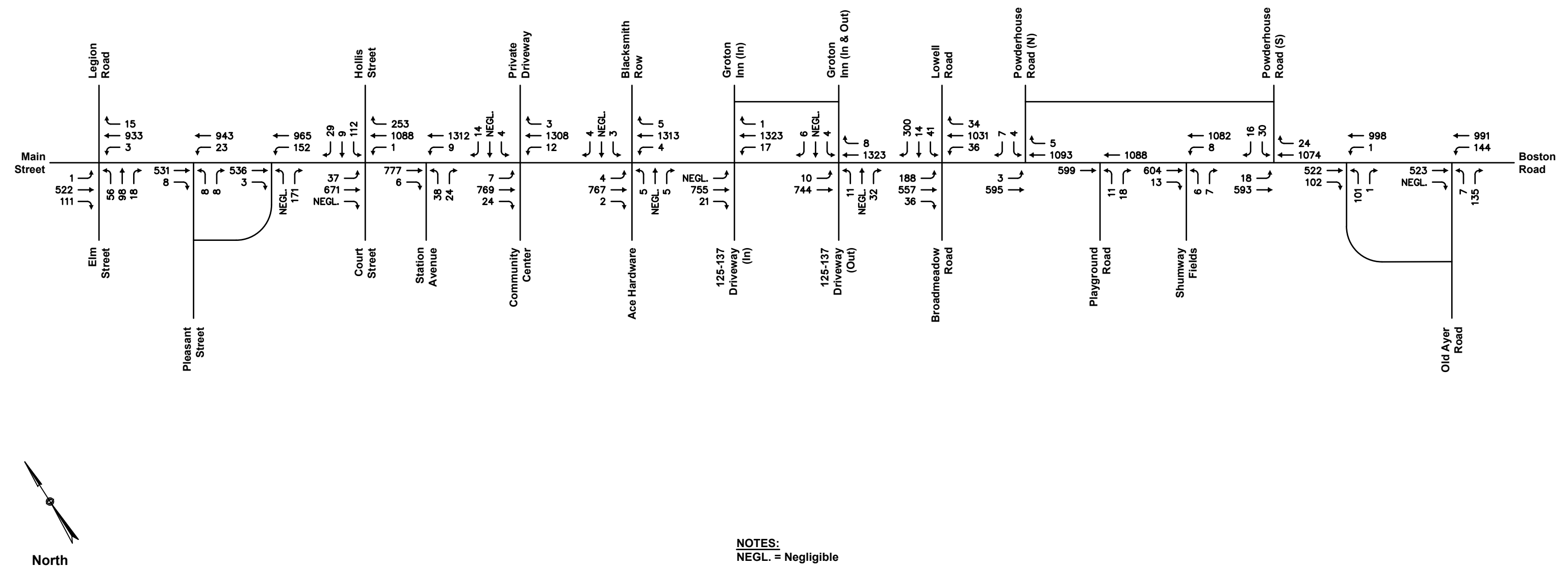


Figure 13
2036 Moderate Growth Condition
Weekday Evening Peak Hour
Traffic Volumes

4.3 HIGH GROWTH SCENARIO

The “High Growth” corridor buildout scenario builds upon the moderate growth scenario including likely known development scenarios, assumes additional buildout of future speculative development along Station Avenue, and applies a conservative 1.0 percent annual growth rate applied to Existing traffic volumes over a 10-year period. The resulting total background development traffic volumes for weekday morning and weekday evening peak-hours for study intersections are depicted in **Figure 14** and **Figure 15**.

4.4 FUTURE TRAFFIC VOLUMES

To account for future traffic growth along the corridor, the 0.5 percent annual growth rate and 1.0 percent annual growth rate was applied to Existing traffic volumes over a 10-year period to represent the future “moderate growth” and “high growth” scenarios, respectfully. Additionally, traffic associated with background developments were applied to both the moderate growth” and “high growth” scenarios. The total entering volume at the primary “gateway” intersections that provide access to the Main Street corridor under the baseline, “moderate growth” and “high growth” scenarios during the weekday morning peak hour and weekday evening peak hour, are summarized in **Table 5**.

TABLE 5
GATEWAY INTERSECTION TOTAL ENTERING VOLUME

	Peak Hour	2026 Baseline Entering Volume ¹	“Moderate Growth”		“High Growth”	
			Entering Volume	%Δ	Entering Volume	%Δ
<i>Main Street at</i>	Weekday AM	1,342	1,528	13.9%	1,600	19.2%
<i>Elm Street and</i>	Weekday PM	1,588	1,809	13.9%	1,892	19.1%
<i>Legion Road</i>						
<i>Main Street at</i>	Weekday AM	1,728	1,956	13.2%	2,047	18.5%
<i>Court Street and</i>	Weekday PM	2,001	2,272	13.5%	2,380	18.9%
<i>Hollis Street</i>						
<i>Main Street at</i>	Weekday AM	1,767	2,015	14.0%	2,110	19.4%
<i>Lowell Road and</i>	Weekday PM	2,040	2,341	14.8%	2,449	20.0%
<i>Broadmeadow Road</i>						
<i>Main Street at</i>	Weekday AM	1,722	1,942	12.8%	2,032	18.0%
<i>Old Ayer Road</i>	Weekday PM	1,847	2,096	13.5%	2,194	18.8%

¹ Volumes based on traffic peak hour turning movements conducted in April 2026.

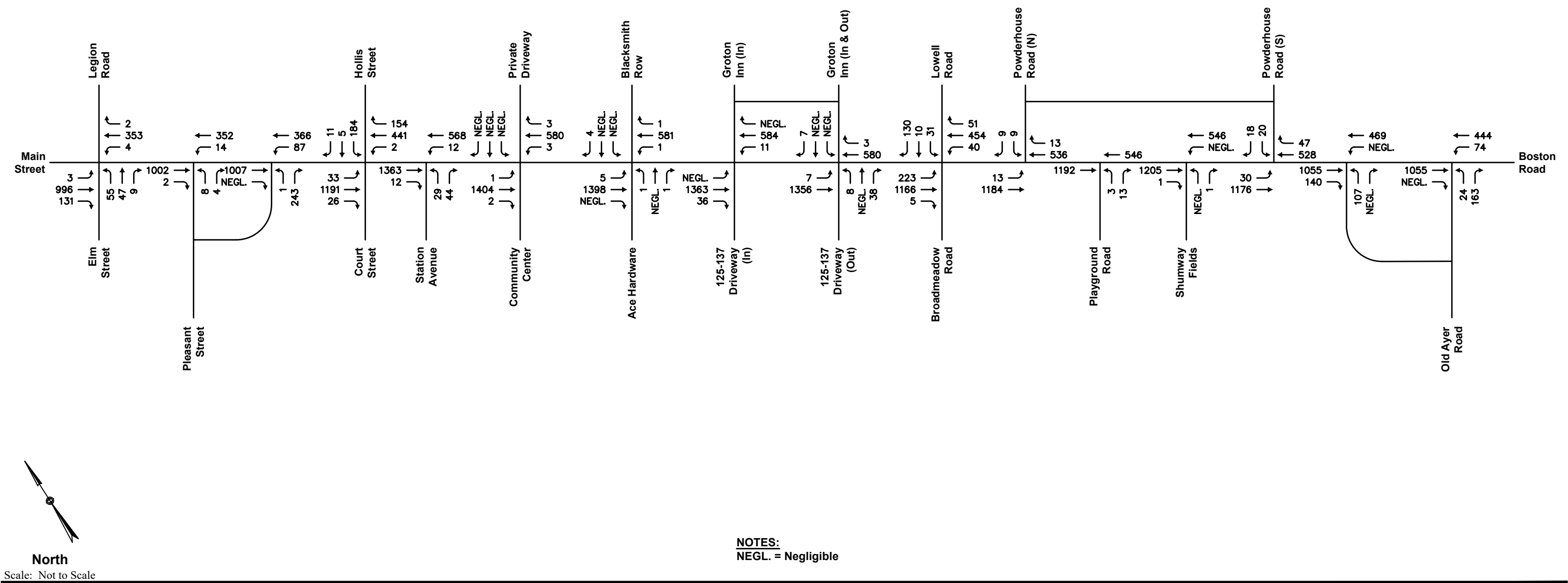


Figure 14
2036 High Growth Condition
Weekday Morning Peak Hour
Traffic Volumes

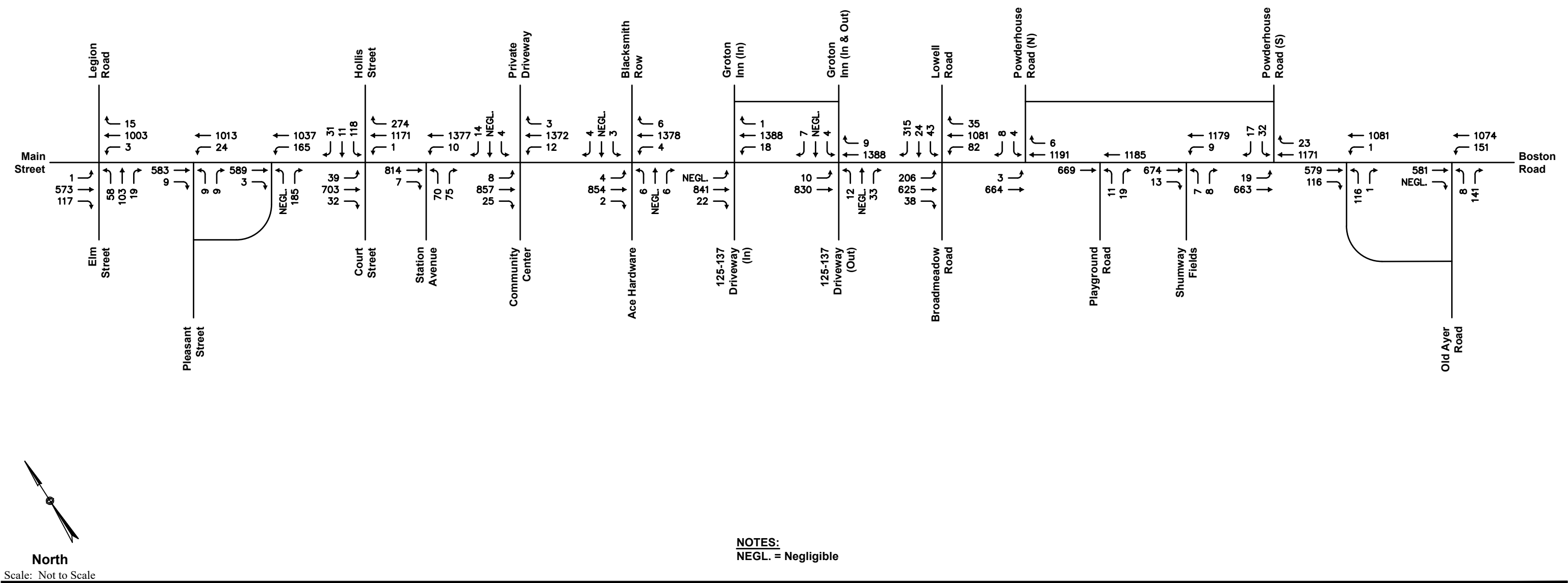


Figure 15
2036 High Growth Condition
Weekday Evening Peak Hour
Traffic Volumes

As summarized in **Table 5**, the “Moderate Growth” and “High Growth” scenarios represent an effective growth of between 10 to 20 percent at the unsignalized Main Street at Elm Street/Legion Road intersection, 10 to 19 percent at the unsignalized Main Street at Hollis Street/Court Street intersection, 10 to 20 percent at the Main Street at Lowell Road/Broadmeadow Road intersection, and 8 to 19 percent at the Main Street at Old Ayer Road intersection. The resulting effective growth rate along Main Street in Downtown Groton (between Lowell Road and Hollis Street) is 1.34 percent per year under the moderate growth scenario and 1.80 percent per year under the high growth scenario. Therefore, growth rates used under both moderate and high growth scenarios represent conservative growth assumptions for the corridor which respect to the observed 0.13% per year growth rate during the weekday morning peak hour and to 0.49% growth rate during the weekday evening peak hour along Main Street over the last 15 years.

4.4.1 FUTURE TRAFFIC VOLUME NETWORKS

Future 2036 Moderate Growth traffic volumes are displayed in **Figure 12** and **Figure 13** and future 2036 High Growth traffic volumes are displayed in **Figure 14** and **Figure 15**.

5.0 FUTURE TRAFFIC OPERATIONS ANALYSIS

Intersection capacity analyses for the study intersections are presented in this section for the Future traffic-volume conditions. Capacity analyses, conducted in accordance with EEA/MassDOT guidelines, provide an index of how well the roadway facilities serve the traffic demands placed upon them.

5.1 CAPACITY ANALYSIS PROCEDURES

Capacity analysis of intersections is developed using the Synchro® computer software, which implements the methods of the Highway Capacity Manual (HCM) 6th Edition. The resulting analysis presents a level-of-service (LOS) designation for individual intersection movements. The LOS is a letter designation that provides a qualitative measure of operating conditions based on several factors including roadway geometry, speeds, ambient traffic volumes, traffic controls, and driver characteristics. Since the LOS of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of LOS, depending on the time of day, day of week, or period of year. A range of six levels of service are defined on the basis of average delay, ranging from LOS A (the least delay) to LOS F (delays greater than 50 seconds for unsignalized movements and 80 seconds for signalized movements). The specific control delays and associated LOS designations are presented in the **Appendix**.

5.2 INTERSECTION CAPACITY ANALYSIS RESULTS

Capacity analysis results for the weekday morning and weekday evening peak hours for the study intersections are described below, with detailed analysis results presented in the **Appendix**.

5.2.1 Level of Service Analysis – Moderate Growth

The capacity analysis results for the intersections in the study area under the moderate growth assumptions are summarized in **Table 6** for the weekday morning and weekday evening peak hours, respectively.

TABLE 6
INTERSECTION CAPACITY ANALYSIS RESULTS
2036 MODERATE GROWTH CONDITIONS

Intersection	Approach	Weekday Morning Peak Hour			Weekday Evening Peak Hour		
		v/c ¹	Delay ²	LOS ³	v/c	Delay	LOS
Boston Road at Old Ayer Road	Old Ayer Rd EB	0.57	28	E	0.26	18	C
	Northbound	0.11	<5	A	0.15	<5	A
	Southbound	0.00	<5	A	0.00	<5	A
Main Street at Old Ayer Road	Old Ayer Rd EB	0.79	>50	F	0.92	>50	F
	Northbound	0.00	<5	A	0.00	<5	A
	Southbound	0.00	<5	A	0.00	<5	A
Main Street at Powderhouse Road (S)	Powderhouse Rd WB	0.26	39	E	0.41	>50	F
	Northbound	0.00	<5	A	0.00	<5	A
	Southbound	0.03	<5	A	0.03	<5	A
Main Street at Shumway Fields	EB Exit	0.01	21	C	0.09	30	D
	Northbound	0.00	<5	A	0.01	<5	A
	Southbound	0.00	<5	A	0.00	<5	A
Main Street at Playground Road	EB Exit	0.10	27	D	0.16	27	D
	Northbound	0.00	<5	A	0.00	<5	A
	Southbound	0.00	<5	A	0.00	<5	A
Main Street at Powderhouse Road (N)	Powderhouse Rd WB	0.11	30	D	0.07	29	D
	Northbound	0.00	<5	A	0.00	<5	A
	Southbound	0.01	<5	A	0.01	<5	A
Main Street at Lowell Road/ Broadmeadow Road	Lowell Rd WB	>1.0	>50	F	>1.0	>50	F
	Northbound	0.02	<5	A	0.04	<5	A
	Southbound	0.21	<5	A	0.31	<5	A
Main Street at Groton Inn/ 125-137 Driveway	EB Exit	0.39	>50	F	0.49	>50	F
	Groton Inn WB	0.01	12	B	0.19	>50	F
	Northbound	0.00	<5	A	0.00	<5	A
	Southbound	0.01	<5	A	0.02	<5	A
Main Street at Blackstone Row/ Ace Hardware	Ace Dwy EB	0.03	>50	F	0.18	>50	F
	Blackstone Row WB	0.01	12	B	0.13	>50	F
	Northbound	0.00	<5	A	0.01	<5	A
	Southbound	0.01	<5	A	0.01	<5	A
Main Street at Ace Hardware/ Community Center	Dwy EB	0.00	<5	A	0.24	>50	F
	Northbound	0.01	<5	A	0.02	<5	A
	Southbound	0.00	<5	A	0.02	<5	A

¹ Volume-to-capacity ratio

² Average control delay per vehicle (in seconds)

³ Level of service

⁴ n/a = not applicable

TABLE 6 (Cont.)
INTERSECTION CAPACITY ANALYSIS RESULTS
2036 MODERATE GROWTH CONDITIONS

Intersection	Approach	Weekday Morning Peak Hour			Weekday Evening Peak Hour		
		v/c ¹	Delay ²	LOS ³	v/c	Delay	LOS
Main Street at Station Avenue	Station Ave EB	0.11	38	E	0.81	>50	F
	Northbound	0.03	<5	A	0.01	<5	A
	Southbound	0.00	<5	A	0.00	<5	A
Main Street at Hollis Street/Court Street	Hollis St WB	>1.0	>50	F	>1.0	>50	F
	Northbound	0.00	<5	A	0.00	<5	A
	Southbound	0.03	<5	A	0.08	<5	A
Main Street at Pleasant Street (S)	Pleasant St EB	0.37	14	B	0.21	10	A
	Northbound	0.13	<5	A	0.16	<5	A
	Southbound	0.00	<5	A	0.00	<5	A
Main Street at Pleasant Street (N)	Pleasant St EB	0.06	25	C	0.09	26	D
	Northbound	0.02	<5	A	0.02	<5	A
	Southbound	0.00	<5	A	0.00	<5	A
Main Street at Legion Road/Elm Street	Elm St EB	0.45	30	D	0.70	47	E
	Northbound	0.01	<5	A	0.00	<5	A
	Southbound	0.00	<5	A	0.00	<5	A

¹ Volume-to-capacity ratio

² Average control delay per vehicle (in seconds)

³ Level of service

⁴ n/a = not applicable

As summarized in **Table 6**:

- *Boston Road at Old Ayer Road*: The northbound Old Ayer Road approach will operate at LOS F or better during the weekday morning peak hours and at LOS C during the weekday evening peak hours. The Boston Road mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.
- *Main Street at Old Ayer Road*: The northbound Old Ayer Road approach will operate at LOS F or better during the weekday morning and weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.
- *Main Street at Powderhouse Road (S)*: The southbound Powderhouse Road approach will operate at LOS E or better during the weekday morning peak hours and at LOS F during the weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.
- *Main Street at Shumway Fields*: The northbound Shumway Fields approach will operate at LOS C or better during the weekday morning peak hours and at LOS D during the weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.

- *Main Street at Playground Road:* The northbound Playground Road approach will operate at LOS D or better during the weekday morning and weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.
- *Main Street at Powderhouse Road (N):* The southbound Powderhouse Road approach will operate at LOS D or better during the weekday morning and weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.
- *Main Street at Lowell Road/Broadmeadow Road:* The southbound Lowell Road approach will operate at LOS F or better during the weekday morning and weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.
- *Main Street at Groton Inn/125-137 Driveway:* The northbound 125-137 Driveway approach will operate at LOS F or better during the weekday morning and weekday evening peak hours. The southbound Groton Inn Driveway approach will operate at LOS B or better during the weekday morning peak hours and at LOS F during the weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.
- *Main Street at Blackstone Row/Ace Hardware:* The northbound Ace Hardware Driveway approach will operate at LOS F or better during the weekday morning and weekday evening peak hours. The southbound Blackstone Row approach will operate at LOS B or better during the weekday morning peak hours and at LOS F during the weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.
- *Main Street at Ace Hardware/Community Center:* The southbound approach will operate at LOS A or better during the weekday morning peak hours and at LOS F during the weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.
- *Main Street at Station Avenue:* The northbound Station Avenue approach will operate at LOS F or better during the weekday morning and weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.
- *Main Street at Hollis Street/Court Street:* The southbound Hollis Street approach will operate at LOS F or better during the weekday morning and weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.

- *Main Street at Pleasant Street (S):* The northbound Pleasant Street approach will operate at LOS F or better during the weekday morning peak hours and at LOS B during the weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.
- *Main Street at Pleasant Street (N):* The northbound Pleasant Street approach will operate at LOS D or better during the weekday morning and weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.
- *Main Street at Legion Road/Elm Street:* The northbound Elm Street approach will operate at LOS E or better during the weekday morning and weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.

In summary, under a moderate growth scenario the study intersections, specifically the side street approaches, would incur additional delay. The intersections of Main Street with Old Ayer Road (north), Lowell Road, and Hollis Street would all continue to operate with long (LOS F) delays during the peak commuter periods. Recommended improvements to the corridor are outlined under *Roadway Improvement Recommendations* to enhance operation and provide multimodal enhancements to the corridor.

5.2.3 Level of Service Analysis – High Growth

The capacity analysis results for the intersections in the study area under the high growth assumptions are summarized in **Table 7** for the weekday morning and weekday evening peak hours, respectively.

TABLE 7
INTERSECTION CAPACITY ANALYSIS RESULTS
2036 HIGH GROWTH CONDITIONS

Intersection	Approach	Weekday Morning Peak Hour			Weekday Evening Peak Hour		
		v/c ¹	Delay ²	LOS ³	v/c	Delay	LOS
Boston Road at Old Ayer Road	Old Ayer Rd EB	0.65	45	E	0.30	21	C
	Northbound	0.12	<5	A	0.15	<5	A
	Southbound	0.00	<5	A	0.00	<5	A
Main Street at Old Ayer Road	Old Ayer Rd EB	>1.0	>50	F	>1.0	>50	F
	Northbound	0.00	<5	A	0.00	<5	A
	Southbound	0.00	<5	A	0.00	<5	A
Main Street at Powderhouse Road (S)	Powderhouse Rd WB	0.35	>50	F	0.56	>50	F
	Northbound	0.00	<5	A	0.00	<5	A
	Southbound	0.03	<5	A	0.04	<5	A
Main Street at Shumway Fields	EB Exit	0.01	23	C	0.13	38	E
	Northbound	0.00	<5	A	0.01	<5	A
	Southbound	0.00	<5	A	0.00	<5	A
Main Street at Playground Road	EB Exit	0.11	31	D	0.19	33	D
	Northbound	0.00	<5	A	0.00	<5	A
	Southbound	0.00	<5	A	0.00	<5	A
Main Street at Powderhouse Road (N)	Powderhouse Rd WB	0.15	37	E	0.07	34	D
	Northbound	0.00	<5	A	0.00	<5	A
	Southbound	0.02	<5	A	0.01	<5	A
Main Street at Lowell Road/ Broadmeadow Road	Lowell Rd WB	>1.0	>50	F	>1.0	>50	F
	Northbound	0.08	<5	A	0.09	<5	A
	Southbound	0.23	<5	A	0.35	<5	A
Main Street at Groton Inn/ 125-137 Driveway	EB Exit	>1.0	>50	F	0.68	>50	F
	Groton Inn WB	0.02	13	B	0.26	>50	F
	Northbound	0.00	<5	A	0.00	<5	A
	Southbound	0.01	<5	A	0.02	<5	A
Main Street at Blackstone Row/ Ace Hardware	Ace Dwy EB	0.03	>50	F	0.28	>50	F
	Blackstone Row WB	0.01	12	B	0.17	>50	F
	Northbound	0.00	<5	A	0.01	<5	A
	Southbound	0.01	<5	A	0.01	<5	A
Main Street at Ace Hardware/ Community Center	Dwy EB	0.00	<5	A	0.31	>50	F
	Northbound	0.01	<5	A	0.02	<5	A
	Southbound	0.00	<5	A	0.02	<5	A

¹ Volume-to-capacity ratio

² Average control delay per vehicle (in seconds)

³ Level of service

⁴ n/a = not applicable

TABLE 7 (Cont.)
INTERSECTION CAPACITY ANALYSIS RESULTS
2036 HIGH GROWTH CONDITIONS

Intersection	Approach	Weekday Morning Peak Hour			Weekday Evening Peak Hour		
		v/c ¹	Delay ²	LOS ³	v/c	Delay	LOS
Main Street at Station Avenue	Station Ave EB	0.78	>50	F	>1.0	>50	F
	Northbound	0.03	<5	A	0.01	<5	A
	Southbound	0.00	<5	A	0.00	<5	A
Main Street at Hollis Street/Court Street	Hollis St WB	>1.0	>50	F	>1.0	>50	F
	Northbound	0.00	<5	A	0.00	<5	A
	Southbound	0.04	<5	A	0.09	<5	A
Main Street at Pleasant Street (S)	Pleasant St EB	0.41	15	B	0.24	11	B
	Northbound	0.15	<5	A	0.18	<5	A
	Southbound	0.00	<5	A	0.00	<5	A
Main Street at Pleasant Street (N)	Pleasant St EB	0.07	28	D	0.12	30	D
	Northbound	0.02	<5	A	0.03	<5	A
	Southbound	0.00	<5	A	0.00	<5	A
Main Street at Legion Road/Elm Street	Elm St EB	0.53	37	E	0.82	>50	F
	Northbound	0.01	<5	A	0.00	<5	A
	Southbound	0.00	<5	A	0.00	<5	A

¹ Volume-to-capacity ratio

² Average control delay per vehicle (in seconds)

³ Level of service

⁴ n/a = not applicable

As summarized in **Table 7**:

- *Boston Road at Old Ayer Road*: The northbound Old Ayer Road approach will operate at LOS F or better during the weekday morning peak hours and at LOS D during the weekday evening peak hours. The Boston Road mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.
- *Main Street at Old Ayer Road*: The northbound Old Ayer Road approach will operate at LOS F or better during the weekday morning and weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.
- *Main Street at Powderhouse Road (S)*: The southbound Powderhouse Road approach will operate at LOS F or better during the weekday morning and weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.

- *Main Street at Shumway Fields:* The northbound Shumway Fields approach will operate at LOS C or better during the weekday morning peak hours and at LOS E during the weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.
- *Main Street at Playground Road:* The northbound Playground Road approach will operate at LOS D or better during the weekday morning and weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.
- *Main Street at Powderhouse Road (N):* The southbound Powderhouse Road approach will operate at LOS D or better during the weekday morning and at LOS E during the weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.
- *Main Street at Lowell Road/Broadmeadow Road:* The southbound Lowell Road approach will operate at LOS F or better during the weekday morning and weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.
- *Main Street at Groton Inn/125-137 Driveway:* The northbound 125-137 Driveway approach will operate at LOS F or better during the weekday morning and weekday evening peak hours. The southbound Groton Inn Driveway approach will operate at LOS B or better during the weekday morning peak hours and at LOS F during the weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.
- *Main Street at Blackstone Row/Ace Hardware:* The northbound Ace Hardware Driveway approach will operate at LOS F or better during the weekday morning and weekday evening peak hours. The southbound Blackstone Row approach will operate at LOS B or better during the weekday morning peak hours and at LOS F during the weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.
- *Main Street at Ace Hardware/Community Center:* The southbound approach will operate at LOS A or better during the weekday morning peak hours and at LOS F during the weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.
- *Main Street at Station Avenue:* The northbound Station Avenue approach will operate at LOS F or better during the weekday morning and weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.

- *Main Street at Hollis Street/Court Street:* The southbound Hollis Street approach will operate at LOS F or better during the weekday morning and weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.
- *Main Street at Pleasant Street (S):* The northbound Pleasant Street approach will operate at LOS F or better during the weekday morning peak hours and at LOS B during the weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.
- *Main Street at Pleasant Street (N):* The northbound Pleasant Street approach will operate at LOS D or better during the weekday morning and weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.
- *Main Street at Legion Road/Elm Street:* The northbound Elm Street approach will operate at LOS F or better during the weekday morning and weekday evening peak hours. The Main Street mainline will continue to operate at LOS A during the weekday morning and weekday evening peak hours.

In summary, under a high growth scenario the study intersections, specifically the side street approaches, would incur pretty significant increases in delay. The intersections of Main Street with Old Ayer Road (north), Lowell Road, and Hollis Street would all continue to operate with long (LOS F) delays during the peak commuter periods. Recommended improvements to the corridor are outlined under *Roadway Improvement Recommendations* to enhance operation and provide multimodal enhancements to the corridor. The proposed installation of traffic signals would also provide some level of benefit to area intersections and driveways by introducing gaps in the traffic stream along Main Street.

6.0 ROADWAY IMPROVEMENT RECOMMENDATIONS

Roadway improvements that support existing and projected traffic increases along the Main Street corridor are identified that minimize/offset traffic impacts and address access needs for the corridor including multi-modal design features to address the needs of the corridor independent of the growth scenario (moderate and high growth). The following sections provide an overview of recommended multi-modal improvements including corridor-wide pedestrian and bicycle initiatives as well as intersection enhancements aimed at improving safety and operation of traffic including consideration for intersection realignment and signal controls where warranted.

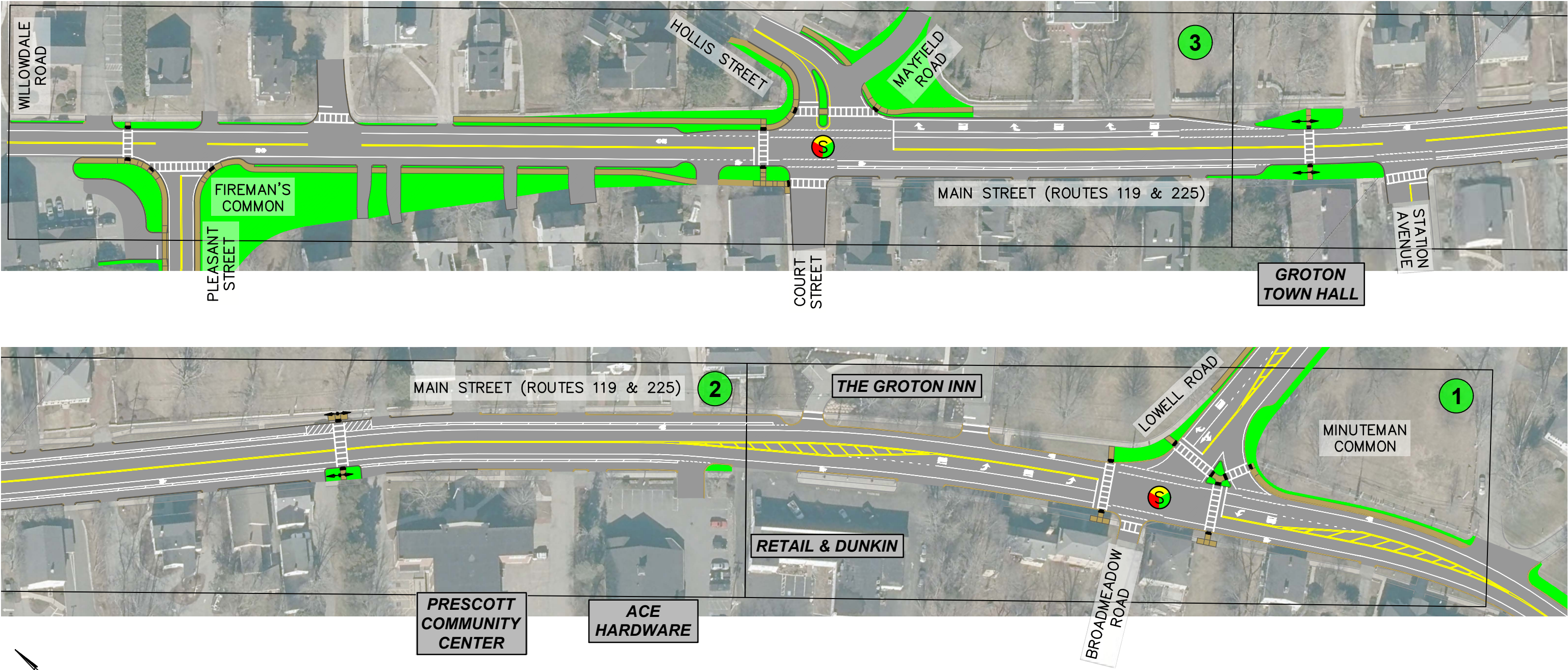
6.1 CORRIDOR IMPROVEMENT RECOMMENDATIONS

A set of improvements aimed at enhancing safety and operations along the Main Street corridor have been prepared to accommodate multi-modal travel under the existing and future conditions as shown in the Conceptual Roadway Improvement Plans (see **Figure 16** for a key index sheet of improvement locations). The improvements have been organized based on highest priority ranging based on a review of the ongoing Town studies and relevant transportation initiatives that include the Town of Groton 2025 Master Plan and Groton Mobility Study, discussion with Town staff, and analysis provided herein based on four (4) key criteria: Safety, Operations, Mobility, and Public Sentiments. Key elements of the improvements are as follows:

5. Main Street at Lowell Road Improvements (\$2,000,000)

Recommended intersection improvements at the Main Street intersection with Lowell Road include realignment and signalization of the intersection as shown in **Figure 17**. The recommended intersection improvements include the following:

- Signalize the Lowell Road intersection with Main Street with minor adjustment of the existing alignment of the westbound Lowell Street approach. Parking along Lowell Road is maintained but slightly shifted from current southerly curblin.



North

Scale: Not to Scale

Figure 16

RECOMMENDED IMPROVEMENTS - INDEX SHEET
MAIN STREET CORRIDOR STUDY

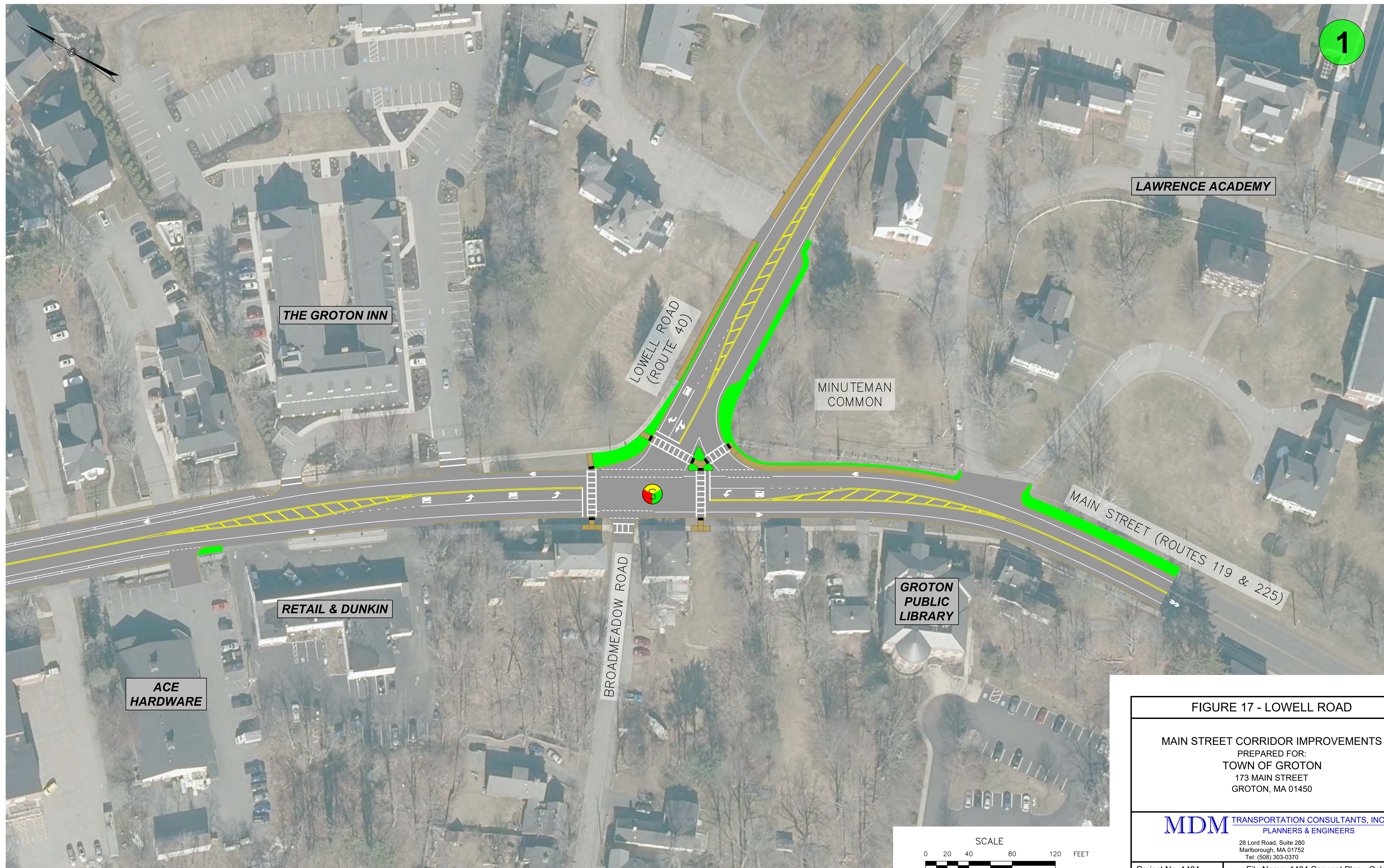


FIGURE 17 - LOWELL ROAD

MAIN STREET CORRIDOR IMPROVEMENTS
 PREPARED FOR:
 TOWN OF GROTON
 173 MAIN STREET
 GROTON, MA 01450

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28 Lord Road, Suite 280
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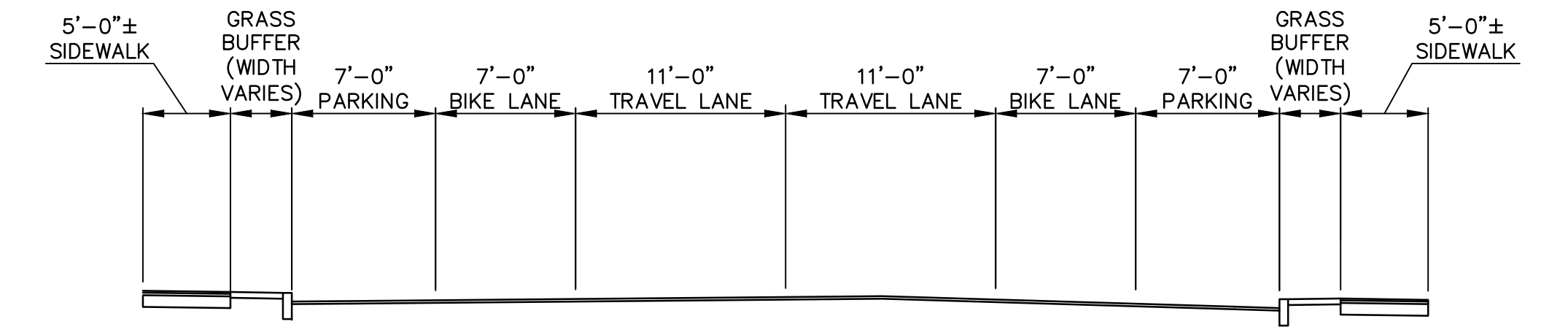
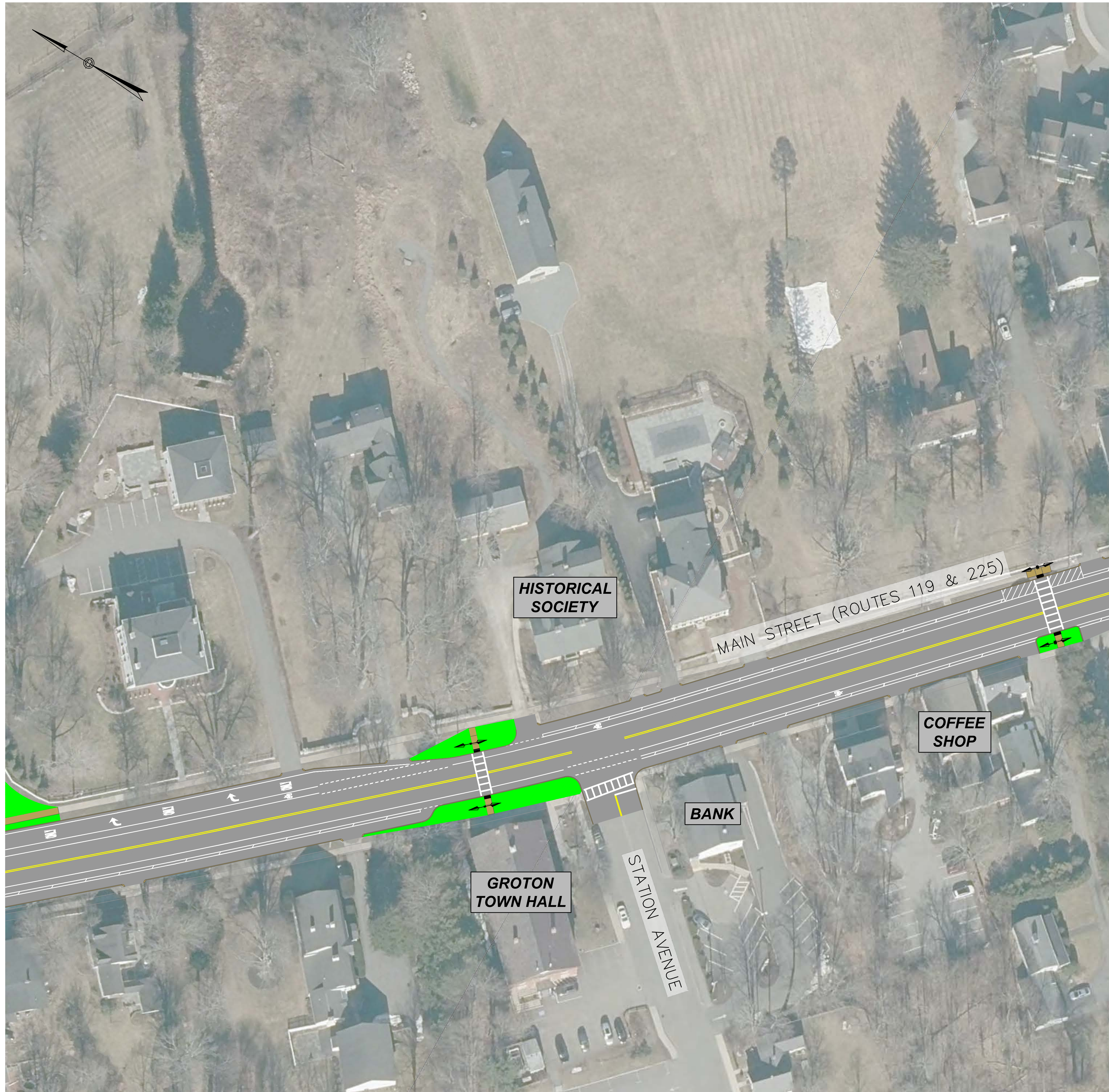
- Minor widening of Main Street to provide an exclusive southbound left-turn lane; single through travel lanes are provided.
- Relocation of the existing crosswalks to the north and south of the intersection to be located within the intersection; these crossings will be placed under signal control with a push button activated pedestrian phase. ADA-compliant ramps, push buttons, and pedestrian indicators will concentrate and control pedestrian crossings to enhance safety and minimize conflicts with Main Street travel.
- Dedicated bicycle lanes along Main Street through the intersection which will be incorporated into the signal operation/phasing. We note that these bike lanes will accommodate/facilitate a connection to the nearby Nashua River Rail Trail via Broadmeadow Road. This connection is further enhanced by consolidating pedestrian crossings at the Lowell Street intersection and placing them under signal control.

Alternative improvements were considered for the Lowell Road intersection that includes a roundabout option for which a conceptual design is presented in the **Appendix**. Operational assessment of this roundabout option indicates that it would not provide sufficient operational capacity as a single-lane roundabout; the roundabout operation as a single-lane option exhibits long delays and extensive vehicle queuing due to highly directional and significantly higher volume of trips along Main Street during the peak hours. Likewise, the construction of a roundabout is constrained by available property, requiring land takings from a private land owner at the northeast quadrant of the intersection. The design is further constrained by significant grade/topographic features along Lowell Road that would result in extensive grade impacts to adjacent properties at both the northeast and southeast quadrants of the intersection, significant roadway regrading and retaining wall features, significant mature tree impacts, multiple uncontrolled pedestrian crossing conflict points and lack of separated bicycle accommodations at the intersection. Accordingly, this design option was deemed infeasible.

6. Downtown Mobility (\$750,000)

Recommended improvements that apply corridor-wide include the following key design principles as shown on **Figure 18**:

- *Typical Cross Section, Corridor Widening.* Widen Main Street between Lowell Street and Pleasant Street to provide a typical cross section of 11-foot travel lanes in each direction, a 7 foot parking lane, and 5-foot bike lane with 2-foot buffer to parking. This typical cross-section will provide sufficient through-traffic capacity with dedicated turn lanes at the highest volume intersections while also meeting the “Complete Streets” design philosophy to include and promote alternative travel modes including pedestrians and bicycles along the corridor. The majority of the corridor can achieve this recommended cross-section without widening; there are several areas however that will require minor widening and/or adjustment of existing sidewalk features. However, these corridor and intersection modifications can be achieved within the existing available public right-of-way of Main Street without the need for land acquisition or takings.



TYPICAL SECTION - MAIN STREET CORRIDOR
NOT TO SCALE

2

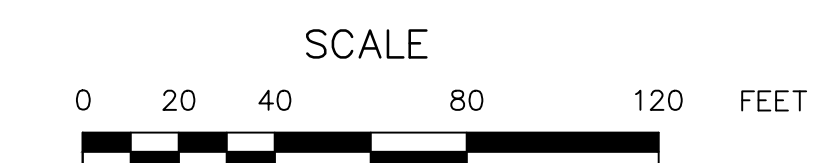


FIGURE 18 - DOWNTOWN AREA

MAIN STREET CORRIDOR IMPROVEMENTS
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- *Pedestrian Accommodations.* Consolidate and relocate existing crosswalks where appropriate with rectangular rapid flashing beacons (RRFB) at several key locations along the Main Street corridor and provide bump-outs to shorten the crossing length and to enhance safety at the crossings. Where applicable, existing crossings near intersections to be re-aligned and/or signalized should be eliminated and placed within the reconfigured intersections where the crossings can operate under actuated signal controls, thereby concentrating and better controlling pedestrian movements along the corridor.
- *Pavement Markings.* Updated Pavement markings are recommended along Main Street to accommodate the recommended roadway cross-section and lane arrangements, including a dedicated bike lane along the majority of the Main Street corridor. “Sharrow” bike marking are identified along those portions of Main Street that provide a “transition zone” to recommended dedicated bicycle lanes where ample public right-of-way is available.

7. Main Street at Hollis Street Improvements and Main Street at Pleasant (\$2,500,000)

Recommended intersection improvements at the Main Street intersection with Hollis Street include realignment and signalization of the intersection as shown in **Figure 19**. The recommended intersection improvements include the following:

- Signalize the Hollis Street intersection with minor adjustments to the existing alignment of the Hollis Street approach to Main Street to reduce corner turning speeds and minimize pedestrian crossing lengths.
- Minor widening of Main Street to add exclusive northbound right-turn lane to accommodate high right-turn volume.
- Relocate and modify existing pedestrian crossing with curb bump-outs to reduce crossing length and place crossings under signal control to enhance safety.
- Separated bike lane transitions to “sharrow” shared use lane markings north of Hollis Street.

Intersection improvements at the Main Street intersection with Pleasant Street include realignment of the Pleasant Street approach to the intersection and the closure of the northern roadway connection through the Filho’s Cucina parking area. The recommended improvements shown in **Figure 19** and include the following:

- Realignment of the eastbound Pleasant Street approach to Main Street to provide perpendicular alignment to Main Street, thereby eliminating expansive surplus paved area at the intersection and creating traditional perpendicular alignment that improves driver sight lines. The realignment also provides opportunity for additional curbside parking along the west side of Main Street.

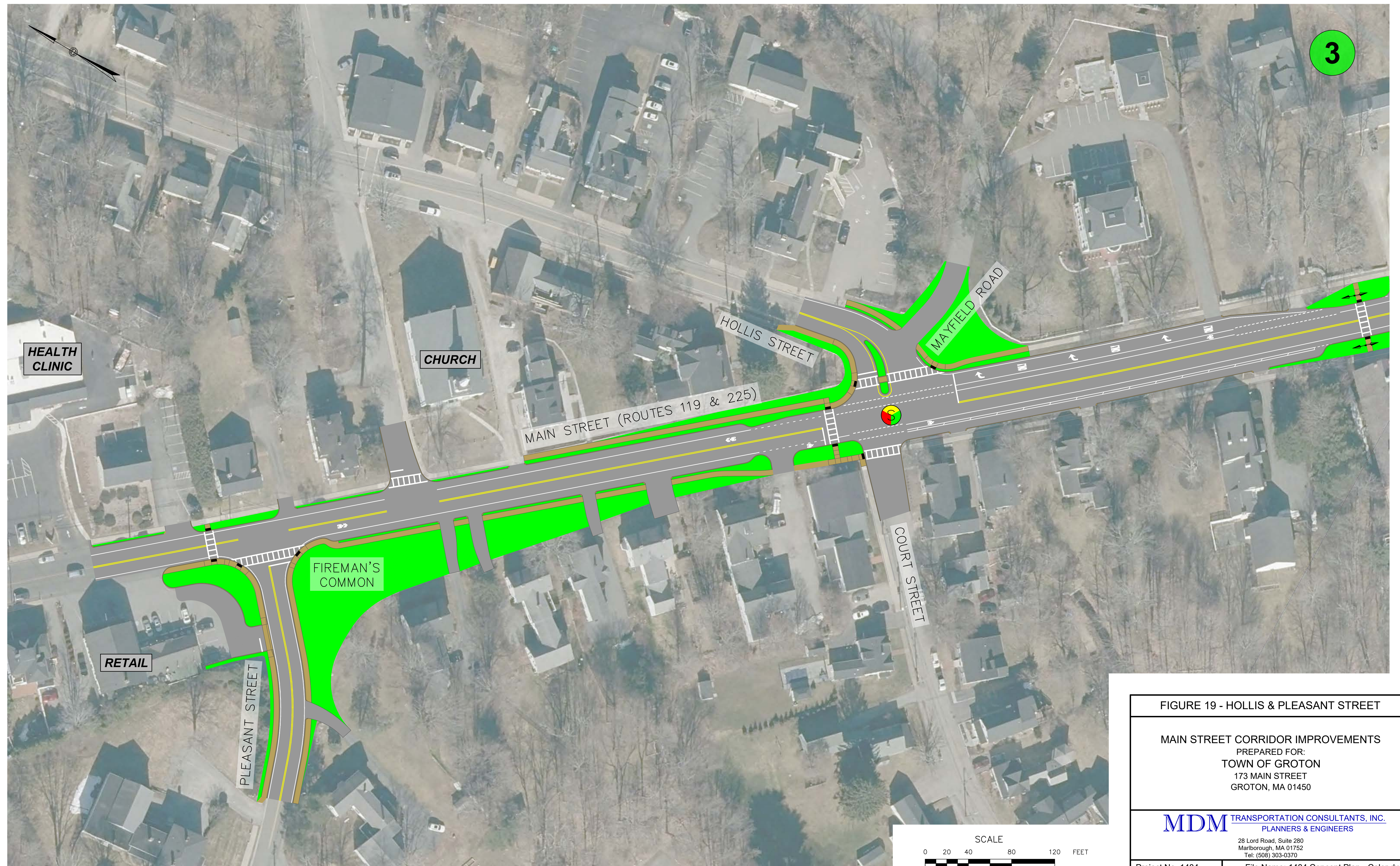


FIGURE 19 - HOLLIS & PLEASANT STREET

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- Eliminate the northern intersection alignment through the Filho's Cucina parking area; driveways serving this use are modified to reduce "cut-through" between Main Street and Pleasant Street.
- Relocate and improve the existing Main Street crossing and equip with RRFB crossing controls.

8. Main Street at Old Ayer Road Improvements (\$3,000,000)

Recommended intersection improvements at the Main Street/Boston Road intersection with Old Ayer Road include realignment and signalization of the intersection. Different alignment options and lane configurations were reviewed. The recommended improvements shown in **Figure 20** were chosen to minimize construction needed to implement improvements, reduce impact to the adjacent properties, maximize options to retain and relocate/enhance existing monumentation and memorials within the intersection. All improvements can be made within existing right-of-way. The recommended intersection improvements include the following:

- Realignment and signalization of the southern Old Ayer Road approach to Main Street/Boston Road.
- Widening of Main Street for an exclusive northbound left-turn lane.
- Separate right- and left-turn lanes for the Old Ayer Road approach to minimize vehicle delays/queues and signal cycle length requirements.
- Convert the northerly intersection leg to southbound travel only, thereby retaining access to adjacent residential properties while also eliminating a poorly aligned/skewed roadway movement onto Main Street.
- Modify existing pedestrian accommodations to provide a crosswalk on the Old Ayer Road approach to Main Street within the intersection with a push button activated pedestrian phase implemented into a traffic signal system along with ADA compliant ramps, push buttons, and pedestrian indicators.

Additional alternative design options for this intersection were also developed for consideration, including a roundabout option and a variation that consolidates the Old Ayer Road roadway intersection legs to a single intersection leg. Alternative improvement plans are provided in the **Appendix**. The roundabout at the intersection was reviewed and was not deemed appropriate at the intersection due to the right-of-way and grading within the right-of-way.



FIGURE 20 - OLD AYER ROAD

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6.2 TRAFFIC SIGNAL WARRANT

Recommended traffic signal installations along Main Street at the intersections with Old Ayer Road, Lowell Road and Hollis Street are supported by warrants analysis following procedures documented in the Manual on Uniform Traffic Control Devices (MUTCD). A brief description of applicable warrant criteria is provided in the **Appendix** and includes the following warrants:

- Warrant 1 – Eight-Hour Vehicular Volume
- Warrant 2 – Four-Hour Vehicular Volume
- Warrant 3 – Peak Hour
- Warrant 4 – Pedestrian Volume
- Warrant 5 – School Crossing
- Warrant 6 – Coordinated Signal System
- Warrant 7 – Crash Experience
- Warrant 8 – Roadway Network
- Warrant 9 – Intersection Near at Grade Crossing

Based on the existing roadway geometry, volume conditions and documented safety characteristics traffic signal warrants are met at the recommended locations (Old Ayer Road, Lowell Road and Hollis Road); specific warrants met include Warrant 1 (8-hour Volumes), Warrant 2 (4-hour Volumes) and Warrant 3 (Peak Hour Volumes); the intersection of Main Street at Lowell Road also meets warrant thresholds as outlined in MUTCD Table 4C-2 and Table 4C-3 based on angle and injury/angle type collisions. The traffic signal warrant analysis is provided in the **Appendix**.

Signalization Improvements Operational Analysis

Capacity and queue analysis for the Baseline, Moderate Growth and High Growth scenarios assuming signal implementations identified in the conceptual corridor improvement plans are presented in **Table 8** and **Table 9**.

TABLE 8
INTERSECTION CAPACITY ANALYSIS RESULTS
SIGNALIZED IMPROVEMENT

Intersection	Approach	2026 Baseline			2036 Moderate Growth			2036 High Growth		
		v/c ¹	Delay ²	LOS ³	v/c	Delay	LOS	v/c	Delay	LOS
Weekday Morning Peak Hour										
Main Street at Old Ayer Road	Old Ayer Rd EB	0.38	16	B	0.44	18	B	0.49	20	C
	Northbound	0.29	<5	A	0.32	<5	A	0.35	<5	A
	Southbound	0.78	16	B	0.87	22	C	0.92	28	C
	Overall	0.78	12	B	0.87	17	B	0.92	20	C
Main Street at Lowell Road/ Broadmeadow Road	Lowell Rd WB	0.16	8	A	0.19	9	A	0.21	11	B
	Northbound	0.41	11	B	0.42	10	A	0.49	11	B
	Southbound	0.67	7	A	0.71	7	A	0.75	8	A
	Overall	0.67	8	A	0.71	8	A	0.75	9	A
Main Street at Hollis Street/ Court Street	Hollis St WB	0.45	24	C	0.50	26	C	0.54	30	C
	Northbound	0.30	<5	A	0.33	<5	A	0.39	<5	A
	Southbound	0.82	15	B	0.88	19	B	0.96	29	C
	Overall	0.82	12	B	0.88	15	B	0.96	22	C
Weekday Evening Peak Hour										
Main Street at Old Ayer Road	Old Ayer Rd EB	0.27	12	B	0.32	14	B	0.38	15	B
	Northbound	0.67	7	A	0.71	8	A	0.83	12	B
	Southbound	0.47	12	B	0.50	12	B	0.59	13	B
	Overall	0.67	9	A	0.78	10	A	0.83	13	B
Main Street at Lowell Road/ Broadmeadow Road	Lowell Rd WB	0.44	17	B	0.52	20	C	0.56	22	C
	Northbound	0.85	20	C	0.89	24	C	0.92	26	C
	Southbound	0.53	7	A	0.63	8	A	0.70	10	A
	Overall	0.85	15	C	0.89	18	B	0.92	20	B
Main Street at Hollis Street/ Court Street	Hollis St WB	0.34	23	C	0.39	25	C	0.43	26	C
	Northbound	0.79	10	A	0.85	13	B	0.89	16	B
	Southbound	0.48	6	A	0.52	6	A	0.56	7	A
	Overall	0.79	10	A	0.85	12	B	0.89	14	B

¹ Volume-to-capacity ratio

² Average control delay per vehicle (in seconds)

³ Level of service

TABLE 9
VEHICLE QUEUE ANALYSIS SUMMARY
SIGNALIZED IMPROVEMENT

Intersection	Approach	Storage Length (feet)	2026 Baseline		2036 Moderate Growth		2036 High Growth	
			Average	95 th	Average	95 th	Average	95 th
			Queue Length ¹	Queue Length ¹	Queue Length	Queue Length	Queue Length	Queue Length
Weekday Morning Peak Hour								
Main Street at	Eastbound L	200±	47	96	52	104	57	112
Old Ayer	Eastbound R	>1000	<25	39	<25	54	<25	64
Road	Northbound L	250±	<25	<25	<25	<25	<25	<25
	Northbound T	>1000	42	69	47	77	54	87
	Southbound T	>1000	287	565	352	659	416	734
Main Street at	Westbound L/T	150±	<25	36	<25	41	<25	48
Lowell Road/	Westbound R	>1000	<25	34	<25	39	<25	39
Broadmeadow	Northbound L	140±	<25	<25	<25	<25	<25	39
Road	Northbound T/R	>1000	105	166	120	183	128	195
	Southbound L	250±	<25	34	<25	36	<25	39
	Southbound T/R	>1000	177	279	217	338	257	413
Main Street at	Westbound L/T	>1000	58	117	65	122	82	142
Hollis Street/	Northbound L/T	>1000	45	108	54	129	70	159
Court Street	Northbound R	300±	<25	<25	<25	<25	<25	<25
	Southbound L/T/R	>1000	235	701	316	845	426	957
Weekday Evening Peak Hour								
Main Street at	Eastbound L	200±	26	81	33	87	46	98
Old Ayer	Eastbound R	>1000	<25	30	<25	33	<25	35
Road	Northbound L	250±	<25	<25	<25	25	<25	26
	Northbound T	>1000	132	260	169	324	229	415
	Southbound T	>1000	105	203	136	212	183	226
Main Street at	Westbound L/T	150±	<25	57	26	59	31	68
Lowell Road/	Westbound R	>1000	55	132	82	160	95	178
Broadmeadow	Northbound L	140±	<25	<25	<25	<25	<25	38
Road	Northbound T/R	>1000	345	522	413	734	458	796
	Southbound L	250±	<25	86	39	120	51	148
	Southbound T/R	>1000	63	94	72	108	86	127
Main Street at	Westbound L/T	>1000	36	96	52	104	58	111
Hollis Street/	Northbound L/T	>1000	172	426	238	692	301	781
Court Street	Northbound R	300±	<25	<25	<25	<25	<25	<25
	Southbound L/T/R	>1000	72	166	94	196	112	228

¹ Average and 95th percentile queue lengths are reported in feet per lane.

As summarized in **Tables 4** and **Table 5**:

- *Main Street at Old Ayer Road:* With the recommended intersection improvement in place, capacity analyses indicate that the signalized intersections will operate at capacity at LOS C or better on all approaches during the peak hours. The average and 95th percentile vehicle queues at the signalized intersections will generally be contained within available storage lanes under existing, moderate and high growth scenarios.
- *Main Street at Lowell Road/Broadmeadow Road:* With the recommended intersection improvements in place, capacity analyses indicate that the signalized intersections will operate at capacity at LOS C or better on all approaches during the peak hours. The average and 95th percentile vehicle queues at the signalized intersections will generally be contained within available storage lanes under existing, moderate and high growth scenarios.
- *Main Street at Hollis Street/Court Street:* With the recommended intersection improvements in place, capacity analyses indicate that the signalized intersections will operate at capacity at LOS C or better on all approaches during the peak hours. The average and 95th percentile vehicle queues at the signalized intersections will generally be contained within available storage lanes under existing, moderate and high growth scenarios.

In summary, the roadway improvements along the Main Street at Lowell Road, Hollis Street, and Old Ayer Road will adequately accommodate the operations needs for the corridor at these critical locations under both the moderate and high growth scenarios while also providing multi-modal design features which will promote alternative transportation opportunities. The proposed installation of traffic signals would also provide some level of benefit to area intersections and driveways by introducing gaps in the traffic stream along Main Street.

7.0 NEXT STEPS/ POTENTIAL FUNDING SOURCES

The Town will facilitate a public engagement meeting to review corridor inventories, safety/operational analyses and to solicit input on potential corridor improvements as summarized in this corridor study. The finalized corridor study and public input will provide a basis for formalizing a funding and implementation strategy for improvements; the implementation process will entail prioritizing which improvement “packages” may advance to formal funding requests/applications from a variety of potential funding sources as the state and/or local level based on input from the Board of Selectmen as informed by departmental and public input.

- *Base Plan Survey.* Field instrument survey and associated right-of-way research is required along Main Street between the intersection with Old Ayer Road and Pleasant Street (north) at the Groton Market to establish more precisely the existing right-of-way, ground features and utility locations/constraints. This survey will update and supersede the GIS-based survey and limited field measurements used to develop conceptual plans for the corridor conceptual plans, allowing a definitive engineering design and tabulation of specific land acquisition or easements if required for specific parcels along the corridor to advance landowner discussions if required. Engineering design at the 25% design level would then be used to solicit funding as outlined below under potential funding sources.
- *Potential Funding Sources.* Recommended transportation initiatives, programs and improvements actions for the Main Street corridor provide a framework for the Town to evaluate potential sources of funding for implementation and associated improvement prioritization. In addition to potential state funding sources (MassWorks, Congestion Management and Air Quality/CMAQ, Transportation Improvement Program/TIP, Planning Agency Grants/Funds, Highway Safety Improvement Program/HSIP, or other state funding), the improvement scenarios described herein also provide a basis for the Town and private Applicants to consider mitigation actions as individual development proposals are evaluated under the local approval process.