TRAFFIC IMPACT AND ACCESS STUDY

PROPOSED RESIDENTIAL DEVELOPMENT

4 Hillside Avenue
Newburyport, Massachusetts

Prepared for:
Hall and Moskow Corporation
Newburyport, Massachusetts

Prepared by:
MDM Transportation Consultants, Inc.
28 Lord Road, Suite 280
Marlborough, Massachusetts 01752
Phone: (508) 303-0370
Fax: (508) 303-0371

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MDM

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EXECUTIVE SUMMARY

MDM Transportation Consultants, Inc. (MDM) has prepared this Traffic Impact and Access Study (TIAS) for a proposed residential development to be located at 4 Hillside Avenue in Newburyport, Massachusetts. This report documents existing operational and safety-related characteristics of roadways serving the development site, estimates future year operating characteristics of these roadways independent of the development, estimates development-related trip generation, and identifies incremental impacts of site-related traffic.

This TIAS has been prepared in accordance with requirements and standards for the preparation of traffic studies as jointly issued by the Commonwealth of Massachusetts Executive Office of Energy & Environmental Affairs/Massachusetts Department of Transportation (EEA/MassDOT).

E.1 PROJECT DESCRIPTION

The Site comprises approximately 4.55 acres located at 4 Hillside Avenue and 12-14 Cottage Court in Newburyport, Massachusetts. The Site includes a duplex home and an undeveloped parcel adjacent to the Highland Cemetery and single family homes on Cottage Court and Hillside Avenue. Access/egress to the Site is currently provided via Cottage Court and Hillside Avenue.

Under the proposed plan, the property will developed to include 58 new residential apartment units (48 apartments and the long range build-out of a 10 room residence for the YWCA) and an existing duplex home for a total of 60 on-site rental apartment units. Access/egress to the Site under proposed conditions will be provided via a right-in/right-out unsignalized driveway along Newburyport Turnpike (Route 1) and via roadway extensions of Cottage Court and Hillside Avenue.

E.2 STUDY AREA

This TIAS evaluates transportation characteristics of roadways and intersections that provide a primary means of access to the Site, and that are likely to sustain a measurable level of traffic impact from the development. The study area includes the following intersections:

- Route 1 at Low Street/ Pond Street (Signalized)
- Route 1 at Proposed Site Driveway (Unsignalized)
- Pond Street/Cottage Court/Auburn Street (Unsignalized)
- Pond Street/Hillside Avenue (Unsignalized)

E.3 SUMMARY OF ANALYSIS AND FINDINGS

Capacity analyses were conducted for each study area intersection to quantify existing and future year traffic operations with and without the development for the weekday morning and weekday evening peak hours. These time periods represent the highest activity periods of the proposed project and the adjacent roadway system.

Under existing and future No-Build conditions:

- The signalized intersection of Route 1 and Low Street/ Pond Street will operate below capacity at an overall level of service LOS D or better during the peak hours.

- The intersections of Cottage Court and Hillside Avenue with Pond Street will operate below capacity at LOS B or better during the peak hours with minimal delay.

The analyses presented in this TIAS are based on industry-standard trip rates published by the Institute of Transportation Engineers (ITE). On this basis, the proposed apartment development is estimated to generate approximately 30 vehicle-trips during the weekday morning peak hour and 36 vehicle-trips during the weekday evening peak hour. On a daily basis, the development is estimated to generate approximately 386 vehicle trips on a weekday.

Under Build Conditions, the incremental changes in traffic at the study intersections due to the proposed development do not result in any significant change in intersection operations at the study intersections compared to No-Build conditions. Under Build conditions, the site driveway intersection with Route 1 and nearby signalized intersection will continue to operate under capacity during the peak hours with no material change in delay.

E.4 RECOMMENDATIONS

MDM finds that travel conditions in the site vicinity along Route 1 and Pond are generally unconstrained. Trip generation for the development is estimated at approximately 30 vehicle-trips during the weekday morning peak hour and 36 vehicle-trips during the weekday evening peak hour. Traffic impacts associated with the proposed apartment development are not expected to notably affect travel or safety conditions in the site vicinity. MDM recommends the following access-related improvements:

Route 1 at Proposed Site Driveway

MDM recommends the following access-related improvements which are subject to MassDOT permitting and approval, as shown in **Figure 8:**

- A "STOP" sign (R1-1) and STOP line pavement marking are recommended on the driveway approach to Route 1. A "no left turn" sign (R3-2) should be installed opposite the Site in the median of Route 1 to enhance the right turn only restriction. The signs and pavement markings shall be compliant with the Manual on Uniform Traffic Control Devices (MUTCD).

- The existing "traffic signal ahead" sign (W3-3) will need to be relocated given the conflict with the location of the proposed site driveway.

- The driveway alignment, widths and curb radii should been designed to achieve approximate perpendicular orientation with Route 1. The final curb radii should also be designed to accommodate the largest anticipated design vehicle.

- The driveway has been designed to restrict vehicle movements to right-in/ right-out only operation. To enhance the turn restriction, the driveway will incorporate pavement markings, a raised channelized right turn island and MUTCD compliant signage.

- Plantings (shrubs, bushes) and structures (walls, fences, etc.) shall be maintained at a height of 2 feet or less within the sight lines in vicinity of the Site driveways to provide unobstructed sight lines. Furthermore, the existing vegetation and structures within the sight lines shall be selectively cleared when the Site driveway is constructed and the terrain shall be graded as required to ensure minimum recommended sight line requirements are met or exceeded.

Pond Street at Cottage Court

- A "STOP" sign (R1-1) is recommended on the Cottage Court approach to Pond Street. The sign shall be compliant with the MUTCD.

- The existing dead-end sign (W14-1) should be removed when the Cottage Court is extended through the Site to Route 1.

- Given the close proximity (less than 100 feet) to the traffic signal control at the Route 1/Pond Street intersection, a "Do Not Block Intersection" sign and markings are recommended at the Pond Street/Auburn Street/Cottage Court intersection to enhance operations for left-turn movements at the intersection. All signs and marking shall be in conformance with the MUTCD.

Pond Street at Hillside Avenue

- A "STOP" sign (R1-1) is recommended on the Hillside Avenue approach to Pond Street. The sign shall be compliant with the MUTCD.

E.5 CONCLUSIONS

While the project will increase traffic in the immediate study area, adequate capacity is available under future Build conditions along Route 1, Pond Street, Low Street and at the study intersections to accommodate the trip increases associated with the proposed apartment development. The project is not projected to significantly change any reported operating levels compared to future No-Build conditions, thus no off-site mitigation is recommended. Proposed access improvements will provide ample capacity to accommodate site-generated traffic while also enhancing safety and capacity. In addition, proposed access/egress will be designed to enhance vehicular connections to the site and to ensure that adequate sight lines are provided in accordance with AASHTO criteria based on ambient travel speeds.

1.0 INTRODUCTION

This report presents a transportation impact and access evaluation for a proposed residential development to be located at 4 Hillside Avenue in Newburyport, Massachusetts. This report documents existing operational and safety-related characteristics of roadways serving the development site, estimates future year operating characteristics of these roadways independent of the development, estimates development-related trip generation, and identifies incremental impacts of site-related traffic.

This TIAS has been prepared in accordance with requirements and standards for the preparation of traffic studies as jointly issued by the Commonwealth of Massachusetts Executive Office of Energy & Environmental Affairs/Massachusetts Department of Transportation (EEA/MassDOT).

1.1 PROPOSED DEVELOPMENT

The Site comprises approximately 4.55 acres located at 4 Hillside Avenue and 12-14 Cottage Court in Newburyport, Massachusetts. The Site includes a duplex home and an undeveloped parcel adjacent to the Highland Cemetery and single family homes on Cottage Court and Hillside Avenue. Access/egress to the Site is currently provided via Cottage Court and Hillside Avenue. The proximity of the site in relation to the regional transportation system is shown in **Figure 1**.

Under the proposed plan, the property will developed to include 58 new residential apartment units (48 apartments and the long range build-out of a 10 room residence for the YWCA) and an existing duplex home for a total of 60 on-site rental apartment units. Access/egress to the Site under proposed conditions will be provided via a right-in/right-out unsignalized driveway along Newburyport Turnpike (Route 1) and via roadway extensions of Cottage Court and Hillside Avenue. The preliminary Site layout sketch plan prepared by Westcott Site Services is presented in **Figure 2**.

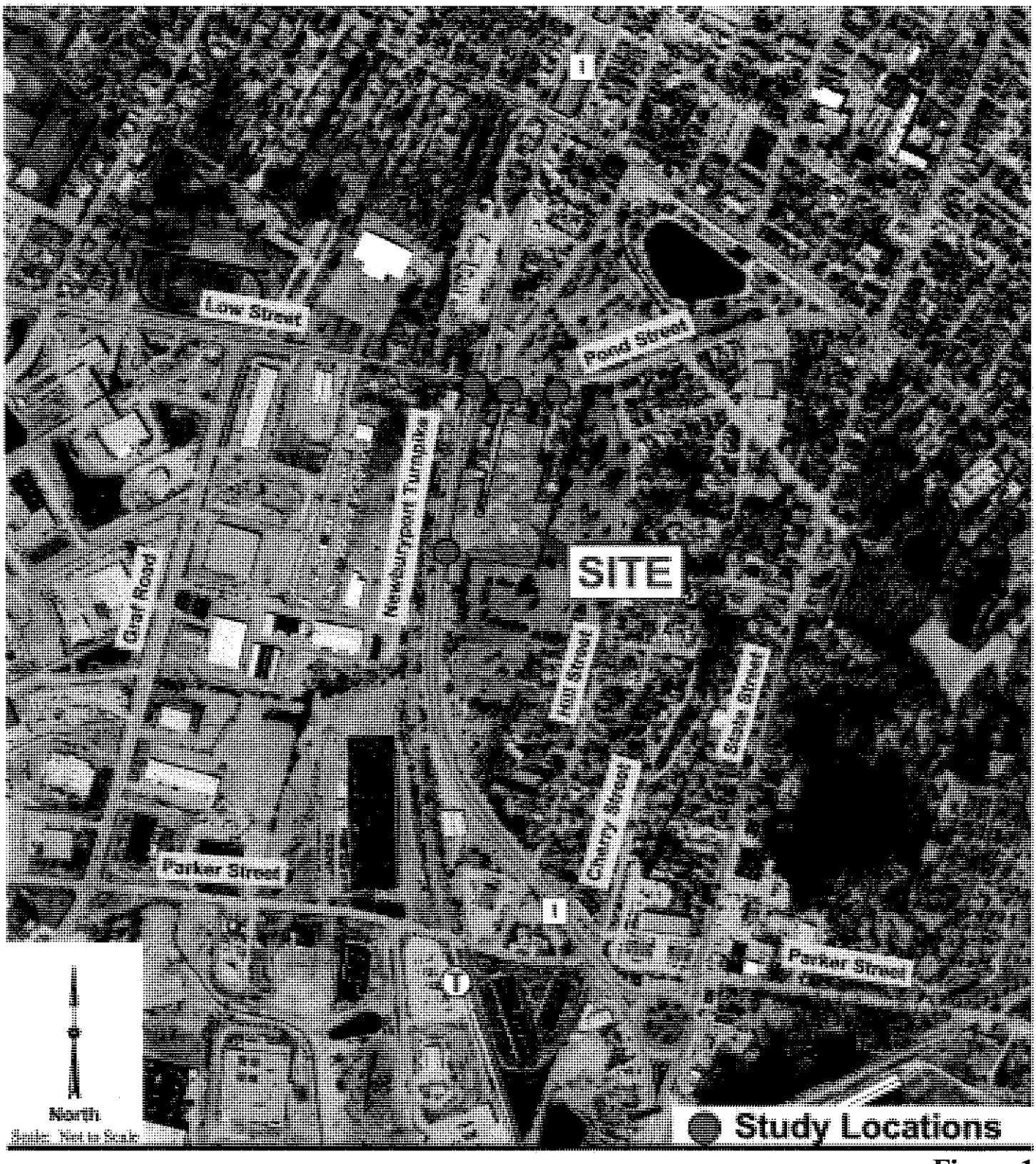

Figure 1

Site Location

MDM TRANSPORTATION CONSULTANTS, INC.
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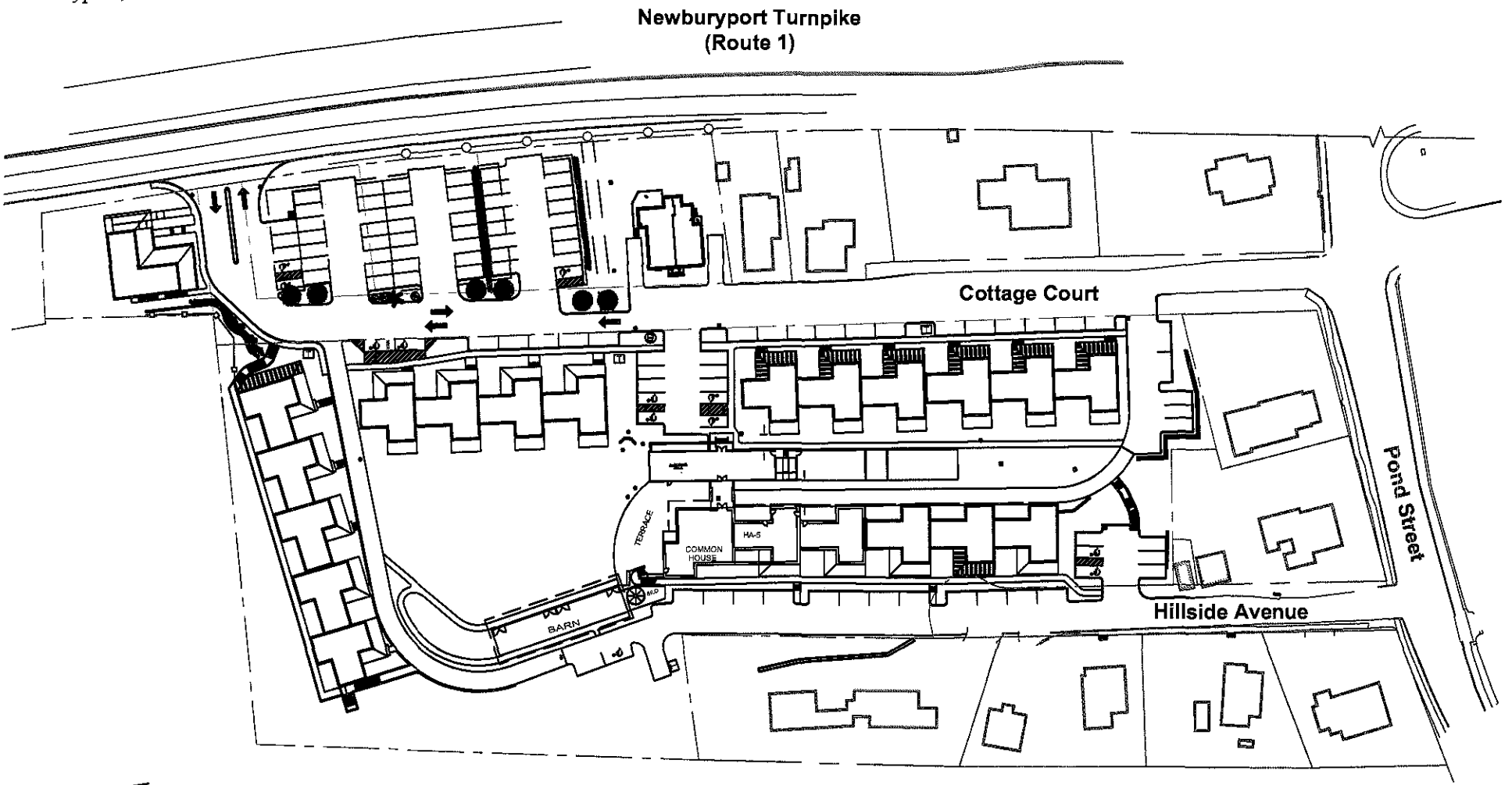

Scale: Not to Scale

Site Plan Source: Westcott Site Services

MDM TRANSPORTATION CONSULTANTS, INC.
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Figure 2

Preliminary Site Layout

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1.2 STUDY METHODOLOGY

This transportation impact and access evaluation is conducted in accordance with EEA/MassDOT guidelines, and consists of several steps. The first step documents existing conditions in the transportation study area including an inventory of roadway geometry, observed traffic volumes, public transportation, and safety characteristics. Next, future year traffic conditions are forecast that account for other planned area developments, normal area growth, and development-related traffic increases. The third step quantifies operating characteristics of the study intersection. Specific attention is given to the incremental impacts of the proposed development. Finally, improvements are identified to address specific development-related requirements as needed.

1.3 STUDY AREA

This TIAS evaluates transportation characteristics of roadways and intersections that provide a primary means of access to the Site, and that are likely to sustain a measurable level of traffic impact from the development. The study area includes the following intersections:

- Route 1 at Low Street/ Pond Street (Signalized)
- Route 1 at Proposed Site Driveway (Unsignalized)
- Pond Street/Cottage Court/Auburn Street (Unsignalized)
- Pond Street/Hillside Avenue (Unsignalized)

2.0 EXISTING CONDITIONS

In order to provide a basis for quantifying the transportation impacts of the development, 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 intersection within the study area. Specifically, this section presents an overview of the traffic data collection program, existing traffic volumes, safety issues and public transportation systems serving the area.

2.1 STUDY AREA ROADWAY NETWORK

The study area roadways and intersection are described briefly in this section. A general description of the physical roadway and intersection features is provided. The study area includes roadways under State and local jurisdiction. The study area and intersection are depicted in **Figure 1**.

2.1.1 Roadways

Route 1

Route 1 is classified by the MassDOT as an urban other principal arterial roadway in the area which generally runs in a north – south direction and is under MassDOT jurisdiction. In the area, Route 1 generally runs parallel to I-95 and provides a connection to several major roadways including Route 1A, Route 110, Route 113, and Route 133. Within the study area, Route 1 provides two travel lanes in each travel direction separated by a median and additional travel lanes are provided at its major intersections. Pavement markings include single yellow edge lines, white lane line and marked white edge lines. The posted speed limit in the project vicinity ranges between 40 and 45 miles per hour. Land uses along Route 1 in the immediate project area primarily consist of residential uses with several industrial and commercial establishments.

Pond Street

Pond Street is classified by the MassDOT as an Urban Minor Arterial under the City of Newburyport jurisdiction. Pond Street is an east-west roadway in the project area which connects Route 1/ Low Street to the west and High Street (Route 1A) to the east. The roadway generally provides one lane of travel in each direction with a total pavement width varying between 24 to 28 feet in the study area. A sidewalk is provided along both sides of the roadway within the study area and appears to have been recently enhanced with new wheelchair ramps and crosswalk markings. The posted speed limit along Pond Street in the study area is 30 miles per hour. Land use along Pond Street is generally residential with the exception of the Old Hill Burying Ground located along the northerly side of Pond Street.

Cottage Court

Cottage Court is classified by the MassDOT as a Local roadway under the City of Newburyport jurisdiction. Cottage Court is approximately 450 feet in length and terminates at the Site. The roadway currently provides access to six homes and ranges is approximately 20 feet wide with no sidewalks. Streetlights are provided along Cottage Court.

Hillside Avenue

Hillside Avenue is classified by the MassDOT as a Local roadway under the City of Newburyport jurisdiction. Hillside Avenue is approximately 275 feet in length and terminates at the Site. The roadway currently provides access to five homes and is approximately 20 feet wide with a sidewalk provided along the eastern side. Streetlights are provided along Hillside Avenue.

2.1.2 Intersections

Route 1 at Low Street/ Pond Street

Route 1 meets Low Street/ Pond Street to form a four-way, signalized intersection. The northbound and southbound Route 1 approaches both provide a protected left-turn lane, a through travel lane and a shared through/ right turn lane. The Low Street eastbound approach provides a shared left/ through travel lane and an excusive right turn lane. The Pond Street westbound approach provides a single left/ through/ right turn lane. Traffic signal operation provides protected left turns from Route 1 with overlapping right turns from Low Street as well as split phasing between Low Street and Pond Street movements and an exclusive pedestrian crossing phase. Land uses at the intersection include several residential homes and a commercial property.

2.2 EXISTING TRAFFIC VOLUMES

Traffic-volume data used in this study were obtained by mechanical and manual methods in October 2014 and August 2015. Automatic traffic recorder counts (ATRs) were conducted along Route 1 while manual turning movement counts (TMCs) were conducted at the study intersections. Traffic data were collected during the weekday morning (7:00 to 9:00 AM) and weekday evening (4:00 to 6:00 PM) peak periods. These hours represent the combination of busiest activity periods of the Site and adjacent roadway network. The traffic count data is included in the **Appendix**.

2.2.1 Daily Traffic

Daily traffic volumes along Route 1 in the site vicinity were obtained by mechanical methods using an automatic traffic recorder. The results of the counts are summarized in **Table 1**, and are discussed below.

TABLE 1
EXISTING TRAFFIC VOLUME SUMMARY
ROUTE 1 NORTH OF HILL 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)
Weekday Morning Peak Hour	11,660	8%	933	61% SB	569
Weekday Evening Peak Hour	11,660	9%	1,090	55% NB	595

[1]Two-way daily traffic expressed in vehicles per day without seasonal adjustment.
[2]The percent of daily traffic that occurs during the peak hour.
[3]Two-way peak-hour volume expressed in vehicles per hour.
[4]NB = Northbound, SB = Southbound

As summarized in **Table 1**, the weekday daily traffic volume on Route 1 in the site vicinity is approximately 11,660 vehicles per day (vpd) on a weekday. Peak hour traffic flow on Route 1 ranges from approximately 933 vehicles per hour (vph) during the morning peak hour to 1,090 vph during the evening peak hour representing 8 to 9 percent of daily traffic flow. Vehicle flow is skewed towards the southbound direction during the weekday morning peak hour and in the northbound direction during the weekday evening peak hour.

2.2.2 Peak-Hour Traffic

Manual turning movement counts (TMCs) were conducted during the weekday morning (7:00 AM - 9:00 AM) and weekday evening (4:00 PM – 6:00 PM) peak periods. Traffic data used in this evaluation was collected in August 2015. These data reflect above-average traffic conditions based on review of MassDOT permanent count station data for the area. In order to provide a conservative analysis, no seasonal adjustment (reduction) of the data was made to the August traffic volume counts. Permanent count station data is provided in the **Appendix**. The resulting existing weekday morning and weekday evening peak hour traffic volumes for study intersections are depicted in **Figure 3**.

2.3 MEASURED TRAVEL SPEEDS

Vehicle speeds were obtained for the Route 1 northbound travel direction by timing vehicles over a known distance and then converting the travel times to speeds. **Table 2** summarizes the average and 85th percentile speeds for Route 1 adjacent to the Site. These speed data provide a basis for determining appropriate sight lines for the proposed driveway along Route 1. Field data are provided in the **Appendix**.

TABLE 2
SPEED STUDY RESULTS – ROUTE 1

Travel Direction	Travel Speeds		
	Posted	Mean[1]	85th Percentile[2]
Northbound	45	42	48

[1] Advisory/ Posted Speed (mph)
[2] Arithmetic mean (mph)
[2] The speed at or below which 85 percent of the vehicles are traveling

As summarized in **Table 2**, the mean (average) travel speed on Route 1 traveling northbound is 42 mph and the 85th percentile travel speed is 48 mph. The observed average and 85th percentile travel speeds are highly consistent with the regulatory speed limit on Route 1 in the northbound direction.

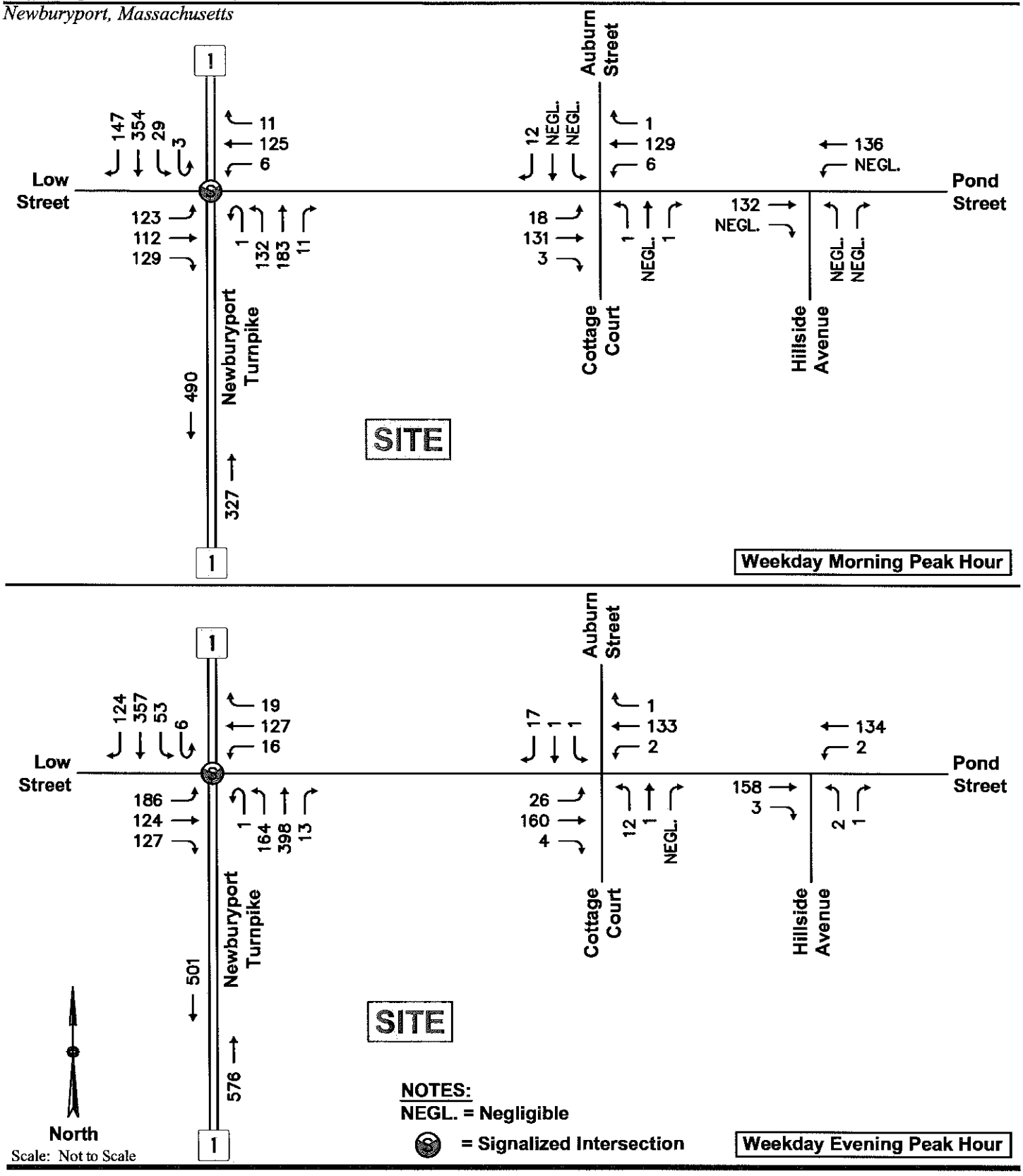

Figure 3

MDM TRANSPORTATION CONSULTANTS, INC.
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2015 Existing (Baseline) Condition
Weekday Peak Hour Volumes

Date: November 2015
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2.4 SAFETY

In order to identify crash trends and safety characteristics for study area intersections, crash data were obtained from MassDOT for the City of Newburyport for the three-year period covering 2011 through 2013 (the most recent data currently available). A summary of the crash data with crash rates for each study area intersection is detailed in **Table 3** with detailed data provided in the **Appendix**.

Crash rates were determined for each study area intersection. These rates quantify the number of crashes per million entering vehicles. MassDOT has determined the crash rates within the District 4 area (which includes the City of Newburyport) to be 0.58 for unsignalized intersections and 0.77 for signalized intersections. These rates represent MassDOT's "average" crash experience for District 4 communities and serves as a basis for comparing reported crash rates for study area intersections which are located within the district.

TABLE 3
INTERSECTION CRASH SUMMARY
2011 THROUGH 2013[1]

Data Category	INTERSECTION Route 1 at Low Street/ Pond Street
Traffic Control	Signalized
Crash Rate[2]	**0.19**
MHD District 4 Avg.[3]	0.77
Year:	
2011	2
2012	1
2013	1
Total	4
Type:	
Angle	2
Rear-End	1
Head-On	0
Sideswipe	1
Single Vehicle	0
Unknown/Other	0
Severity:	
P. Damage Only	1
Personal Injury	3
Fatality	0
Unknown	0
Conditions:	
Dry	3
Wet	1
Snow	0
Other/Unknown	0
Time:	
7:00 to 9:00 AM	0
4:00 to 6:00 PM	0
Rest of Day	4

[1] Source: MassDOT Crash Database.
[2] Crashes per million entering vehicles (MEV)
[3] District 4 Average Crash Rate

As summarized in **Table 3**:

- *Route 1 at Low Street/ Pond Street*: A total of four (4) crashes were reported for the Route 1 and Low Street signalized intersection – approximately 1 per year - resulting in a crash rate of 0.19 which is well below the District 4 average. The majority of reported crashes at the intersection included angle/ sideswipe type collisions (75%). All of the crashes occurred outside the normal peak commuter traffic periods and seventy-five percent (75%) of the crashes were personal injury type crashes. There were no pedestrian-related incidents or fatalities reported at the intersection during the 3-year study period.

- *Pond Street at Cottage Court/Auburn Street:* There were no reported crashes at this intersection during the three year study period.

- *Pond Street at Hillside Avenue:* There were no reported crashes at this intersection during the three year study period.

In summary, the study intersections all experienced crash rates well below the District 4 average and no immediate safety countermeasures are warranted based on the crash history at the study intersections.

2.5 PUBLIC TRANSPORTATION FACILITIES

The Massachusetts Bay Transit Authority operates the Newburyport commuter rail service in the study area which is located less than 1 mile away on Parker Street. The Merrimack Valley Regional Transit Authority provides bus service immediately adjacent to the Site along Pond Street. Specifically, Bus Route 54 provides service for destinations in Amesbury, Newburyport and Salisbury including the Newburyport Commuter Rail Station. Bus Route 53 (Newburyport Summer Shuttle) also runs immediately adjacent to the Site along Pond Street and generally operates between June and September with service destinations including the Newburyport Commuter Rail Station and Plum Island. Specific route and schedule information is provided in the **Appendix**.

2.6 SIGHT LINE ANALYSIS

An evaluation of sight lines was conducted at the proposed site egress driveway location along Route 1 to ensure that minimum recommended sight lines will be available at the proposed site driveway intersection with Route 1. The evaluation documents sight lines under proposed conditions for vehicles as they relate to Route 1 with comparison to recommended guidelines.

The American Association of State Highway and Transportation Officials' (AASHTO) standards[1] reference two types of sight distance which are relevant at the proposed site egress driveway intersection along Route 1: stopping sight distance (SSD) and intersection sight distance (ISD). Sight lines for critical vehicle movements at the proposed site driveway intersection with Route 1 were compared to minimum SSD and ISD recommendations for the regulatory speed limit posted in the area as well as ambient travel speeds recorded along Route 1 northbound near the site.

Stopping Sight Distance

Sight distance is the length of roadway visible to the motorist to a fixed object. The minimum sight distance available on a roadway should be sufficiently long enough to enable a below-average operator, traveling at or near the design speed, to stop safely before reaching a stationary object in its path, in this case, a vehicle exiting onto Route 1. The SSD criteria are defined by AASHTO based on design and operating speeds, anticipated driver behavior and vehicle performance, as well as physical roadway conditions. SSD includes the length of roadway traveled during the perception and reaction time of a driver to an object, and the distance traveled during brake application on wet level pavement. Adjustment factors are applied to account for roadway grades when applicable.

SSD was estimated in the field using AASHTO standards for driver's eye (3.5 feet) and object height equivalent to the taillight height of a passenger car (2.0 feet) for the northbound Route 1 approach to the proposed site driveway. **Table 4** presents a summary of the available SSD as they relate to Route 1 and AASHTO's recommended SSD based on posted and observed ambient travel speeds along Route 1. Speed study data is provided in the **Attachments.**

TABLE 4
STOPPING SIGHT DISTANCE SUMMARY
ROUTE 1 NB APPROACH TO PROPOSED SITE DRIVEWAY

		AASHTO Recommended[1]		
Approach/ Travel Direction	**Available SSD**	**Posted Speed (45 mph)**	**Average Observed Speed[2]**	**85th Percentile Observed Speed[3]**
Northbound	430± Feet	360 Feet	325 Feet	400 Feet

[1]Recommended sight distance based on AASHTO, A Policy on Geometric Design of Highways and Streets based on driver height of eye of 3.5 feet to object height of 2 feet
[2]Average travel speed of 42 MPH northbound
[3]85th percentile travel speed of 48 MPH northbound

[1] *A policy on Geometric Design of Highways and Streets,* American Association of State Highway and Transportation Officials (AASHTO), 2011.

As summarized in **Table 4**, the existing available sight lines exceed AASHTO's recommended SSD criteria for the regulatory speed limit as well as for the higher observed 85th percentile travel speed along Route 1. Stopping sight distance calculations are provided in the **Attachments.**

Intersection Sight Distance

Clear sight lines provide sufficient sight distance for a stopped driver on a minor-road approach to depart from the intersection and enter or cross the major road. AASHTO's ISD criteria are defined into several "cases". In this case, the proposed site egress driveway approach to the intersection is proposed to be under STOP signal control and the ISD in question relates to the ability to turn right onto Route 1.

Available ISD was estimated in the field using AASHTO standards for driver's eye (3.5 feet), object height (3.5 feet) for the northbound direction along Route 1. **Table 5** presents a summary of the available ISD for the departure from the proposed site driveway and AASHTO's ideal ISD.

TABLE 5
INTERSECTION SIGHT DISTANCE SUMMARY
PROPOSED SITE DRIVEWAY DEPARTURE TO ROUTE 1 NB

		AASHTO Minimum[1]		AASHTO Ideal[1]
Approach/ Travel Direction	Available ISD[2]	Posted Speed Limit (45 mph)	85th Percentile Observed Speed[2]	Posted Speed Limit (45 mph)
Looking South	430± Feet[3]	360 Feet	400 Feet	430 Feet

[1]Recommended sight distance based on AASHTO, A Policy on Geometric Design of Highways and Streets. Based on driver height of eye of 3.5 feet and an object height of 3.5 feet and adjustments for roadway grade if required. Minimum value as noted represents SSD per AASHTO guidance.
[2]85th percentile travel speed of 48 MPH northbound
[3]Assumes selective clearing of existing on-site vegetation and obstructions (i.e., retaining wall) and on-site re-grading.

The results of the ISD analysis presented in **Table 4** indicate that minimum ISD criteria would be exceeded from the proposed site egress driveway looking south onto Route 1 and ideal ISD criteria would be met or nearly met. The results assume selective clearing of existing on-site vegetation and obstructions (i.e., retaining wall) along the site frontage and on-site re-grading conducted during driveway construction. The specific limits of on-site regrading should be further reviewed as the site design progresses.

3.0 FUTURE CONDITIONS

Evaluation of the proposed development impacts requires the establishment of a future baseline analysis condition. This section estimates future roadway and traffic conditions with and without the proposed development. To be consistent with EEA/MassDOT guidelines, a seven year planning horizon was selected.

To determine the impact of site-generated traffic volumes on the roadway network under future conditions, baseline traffic volumes in the study area were projected to a future year condition. Traffic volumes on the roadway network at that time, in the absence of the development (that is, the No-Build condition), would include existing traffic, new traffic due to general background traffic growth, and traffic related to specific development by others that is currently under review at the local and/or state level. Consideration of these factors resulted in the development of No-Build traffic volumes. Anticipated site-generated traffic volumes were then superimposed upon these No-Build traffic-flow networks to develop future Build conditions.

The following sections provide an overview of future No-Build traffic volumes and projected Build traffic volumes.

3.1 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.

3.1.1 Historical Area Growth

Nearby permanent count station data published by MassDOT indicates a 0.4 percent annual growth rate. For planning purposes, a 0.5 percent annual growth rate is used. This correlated to an approximate 3.6 percent increase over a 7-year horizon. This growth rate is slightly higher than historic rates, and, as such, is also expected to account for any small fluctuation in hourly traffic as may occur from time to time in the study area and small background developments or vacancies in the area. MassDOT permanent count station data and background growth calculations are provided in the **Appendix.**

3.1.2 Background Development-Related Growth

Development of future No-Build traffic volumes considers traffic generated through the study area from other specific area developments. Review of Massachusetts Environmental Policy Act (MEPA) files and a review of the project area indicate that there is one planned development project in the area:

- ***Residential Development***: The development is an approximate 1.5-acre tract of land located along Newburyport Turnpike (Route 1) north of Hill Street in Newburyport, Massachusetts. Under the proposed development plan, eight residential townhouse/condominium units will be constructed. Information provided in the Traffic Impact Assessment[2] for the development indicates that the projected would generate 5 peak hour trips; a level that is accounted for in the general background traffic growth rate. The site-specific trip tracings are provided in the **Appendix**.

3.2 NO-BUILD TRAFFIC VOLUMES

To account for future traffic growth in the study area, the half (0.5) percent annual growth rate was applied to the existing (baseline) traffic volumes compounded annually over 7 years. Future No-Build traffic volumes are displayed in **Figure 4**.

[2]*Memorandum, Re: Proposed Residential Development, Route 1 (Newburyport Turnpike) – Newburyport, MA;* by MDM Transportation Consultants, Inc (MDM); December 17, 2014.

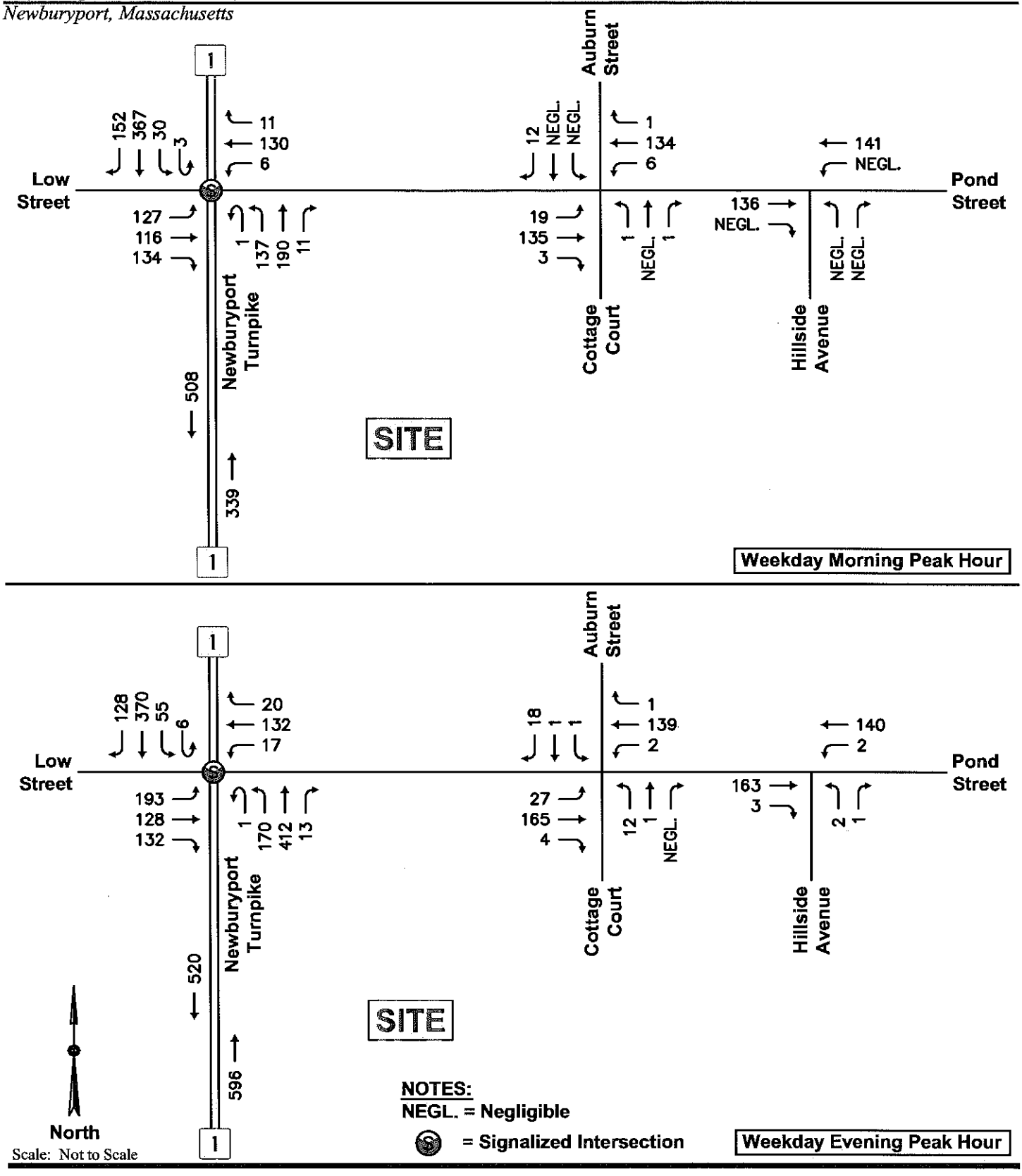

Figure 4

MDM TRANSPORTATION CONSULTANTS, INC.
Planners & Engineers

2022 No-Build Condition
Weekday Peak Hour Volumes

Date: November 2015
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3.3 SITE-GENERATED TRAFFIC – ITE BASIS

Future Build condition traffic volumes were developed by estimating the number of peak-hour trips expected to be generated by the proposed development, and distributing this additional traffic onto the local roadway network. These future development-related trips were added to future No-Build traffic volumes to evaluate future traffic operations with the proposed residential development in place. The methodology utilized to estimate the future trip-generation characteristics of the proposed development are summarized below. In accordance with EEA/MassDOT guidelines, the traffic generated by the proposed development was estimated using trip rates published in ITE's *Trip Generation* for the Land Use Code (LUC) based on trip rates for Apartments (LUC 220). The trip generation calculation worksheet is provided in the **Appendix.**

Table 6 presents the trip-generation estimates for the proposed development (including the long range build-out of the 10 bedroom YWCA building) based on ITE methodology and EEA/MassDOT guidelines.

TABLE 6
TRIP-GENERATION SUMMARY

Peak Hour/Direction	Apartments (58 Units)[2]
Weekday Morning Peak Hour:	
Entering	6
Exiting	24
Total	30
Weekday Evening Peak Hour:	
Entering	23
Exiting	13
Total	36
Weekday Daily:	386

[1]ITE LUC 220 – Apartment applied to 58 units.

As summarized in **Table 6**, based on industry-standard trip rates, the proposed development is estimated to generate approximately 30 vehicle trips during the weekday morning peak hour (6 entering and 24 exiting) and 36 vehicle trips during the weekday evening peak hour (23 entering and 13 exiting). On a daily basis, the development is estimated to generate approximately 386 vehicle trips on a weekday.

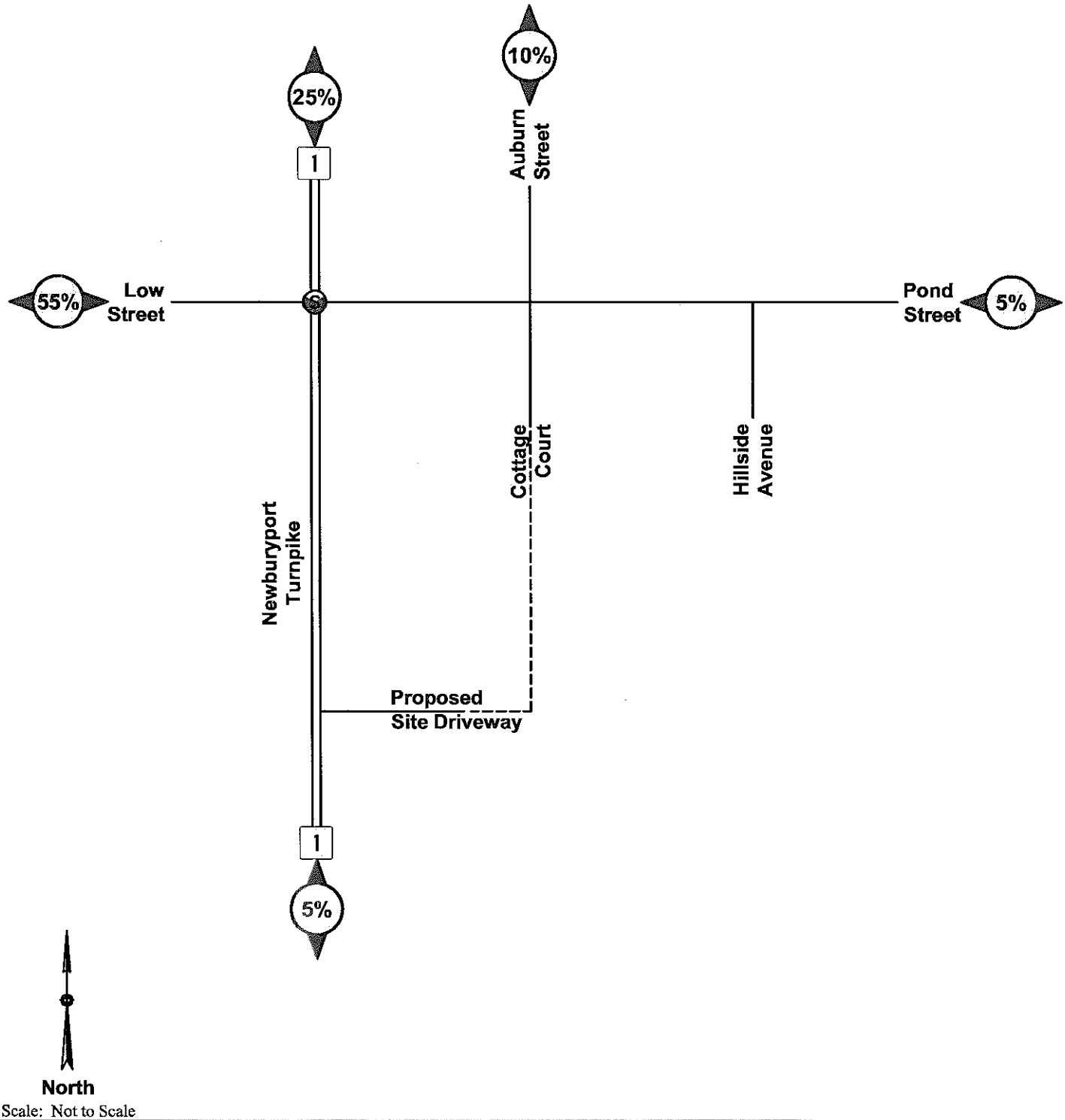
3.4 TRIP DISTRIBUTION AND ASSIGNMENT

The distribution for projected traffic for the proposed residential development is based primarily on Journey to Work data published by the US Census and the efficiency of the roadways serving the site. The resulting trip distribution for new trips is presented in **Figure 5**. Trip distribution calculations are provided in the **Appendix**.

Development-related trips for the Site were assigned to the roadway network using the ITE trip-generation estimates shown in **Table 6** and the distribution patterns presented in **Figure 5**. New development-related trips at each intersection during the peak hours are quantified in **Figure 6**.

3.5 BUILD TRAFFIC VOLUMES

Future Build condition traffic volumes were arrived at by adding development-specific traffic volumes to the 2022 No-Build conditions. The 2022 Build condition traffic-volume networks for the peak hours are displayed in **Figure 7**.



Scale: Not to Scale

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Figure 5

Trip Distribution

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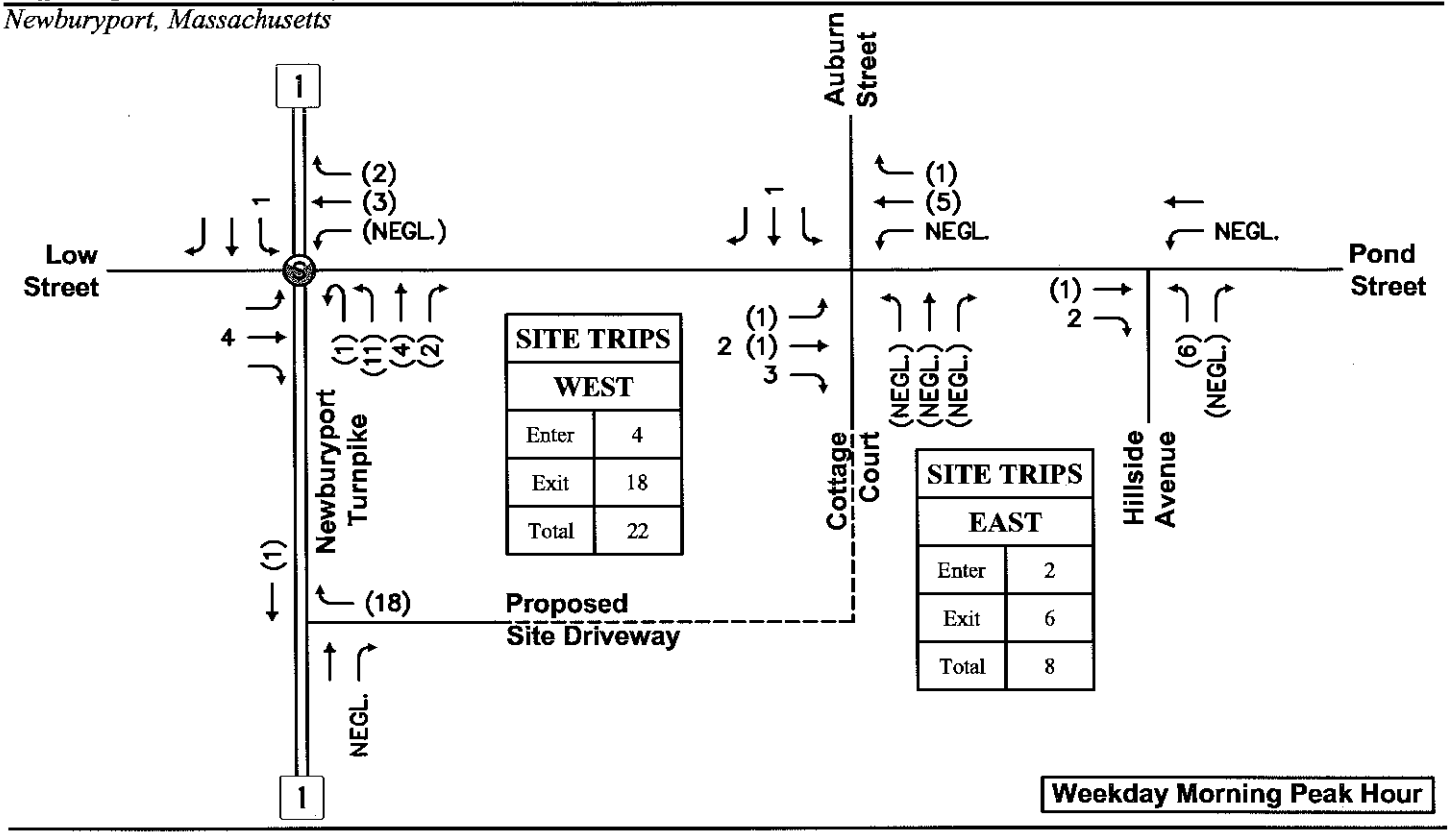

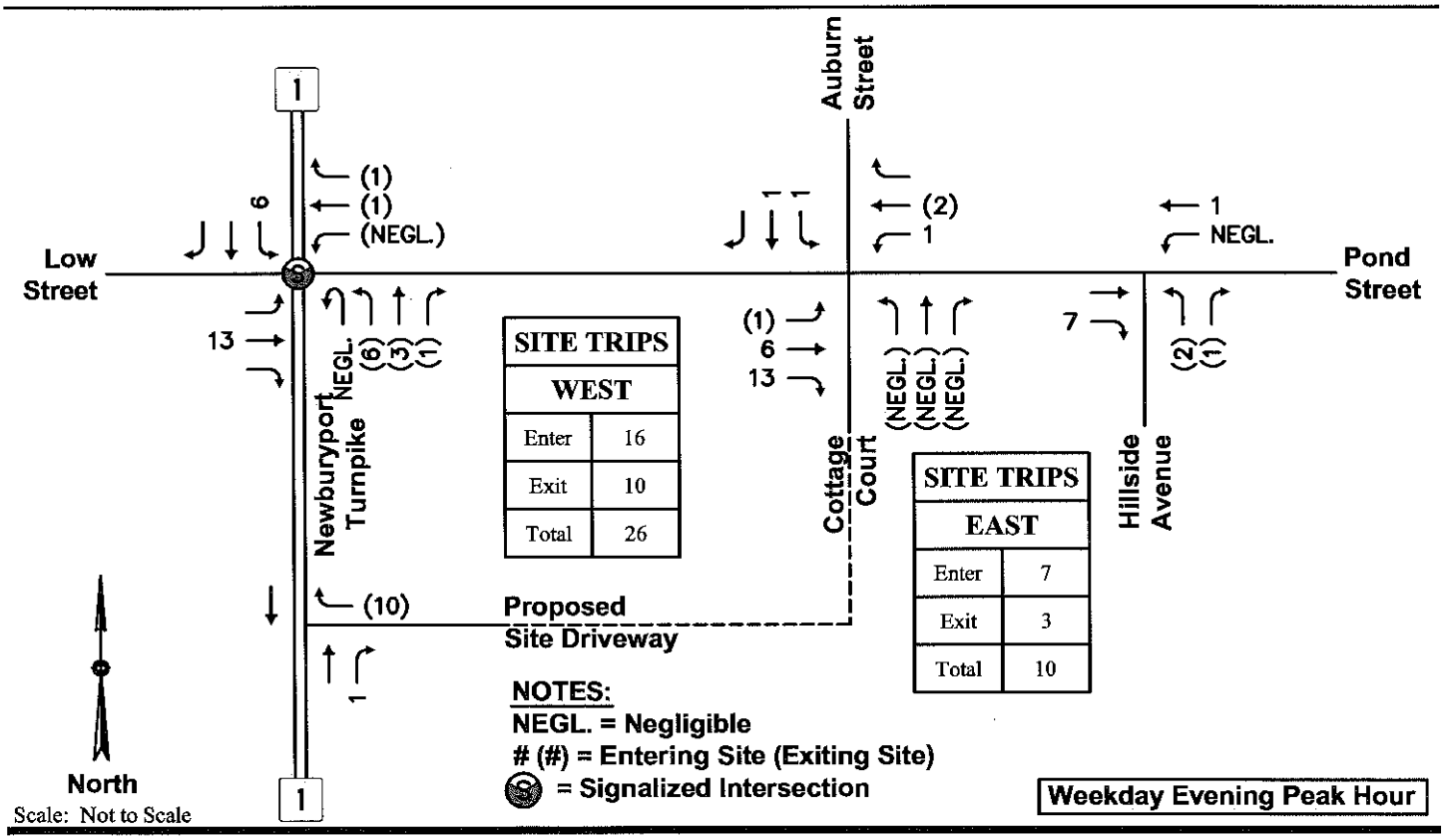

Figure 6

Site Generated Trips

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Date: November 2015
Dwg No. 848 TIAS02.dwg
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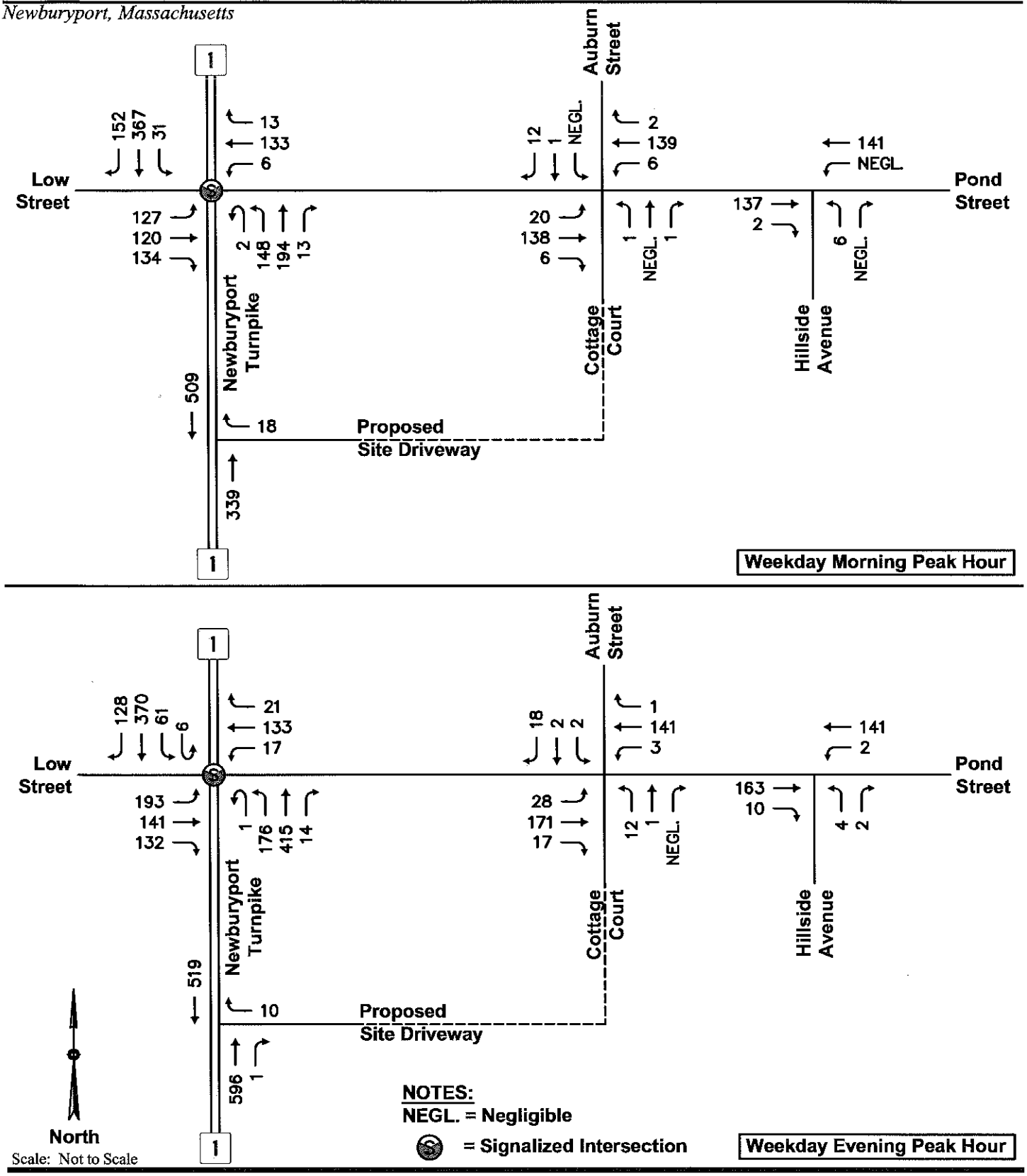

Figure 7

MDM TRANSPORTATION CONSULTANTS, INC.
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2022 Build Condition
Weekday Peak Hour Volumes

Date: November 2015
Dwg No. 848 TIAS02.dwg
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Intersection capacity analyses are presented in this section for the Existing, No-Build, and Build 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.

4.1 CAPACITY ANALYSIS PROCEDURES

Capacity analysis of intersections is developed using the Synchro® computer software, which implements the methods of the 2010 Highway Capacity Manual (HCM). 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**.

4.2 INTERSECTION CAPACITY ANALYSIS RESULTS

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

4.2.1 Level of Service Analysis

The capacity analysis results for the intersections in the study area are summarized in **Table 7** and **Table 8** for the weekday morning and weekday evening peak hours, respectively. Detailed analysis results are presented in the **Appendix**.

TABLE 7
INTERSECTION CAPACITY ANALYSIS RESULTS - WEEKDAY MORNING PEAK HOUR

Intersection	Approach	2015 Existing			2022 No-Build			2022 Build		
		v/c[1]	Delay[2]	LOS[3]	v/c	Delay	LOS	v/c	Delay	LOS
Route 1 at	Eastbound	0.74	36	D	0.76	37	D	0.78	38	D
Low Street/	Westbound	0.50	41	D	0.52	42	D	0.54	42	D
Pond Street	Northbound	0.58	30	C	0.60	31	C	0.63	32	C
	Southbound	0.62	33	C	0.64	33	C	0.64	34	C
	Overall	**0.74**	**34**	C	**0.76**	34	C	**0.78**	**35**	D
Pond Street at	Eastbound	0.02	<5	A	0.02	<5	A	0.02	<5	A
Cottage Court/	Westbound	0.01	<5	A	0.01	<5	A	0.01	<5	A
Auburn Street	NB Exit	0.00	10	A	0.00	10	A	0.00	10	A
	SB Exit	0.02	9	A	0.02	9	A	0.02	9	A
Pond Street at	Eastbound	0.00	<5	A	0.00	<5	A	0.00	<5	A
Hillside Avenue	Westbound	0.00	<5	A	0.00	<5	A	0.00	<5	A
	NB Exit	0.00	<5	A	0.00	<5	A	0.01	10	A
Route 1 at	WB R Exit	n/a[4]	n/a	n/a	n/a	n/a	n/a	0.00	9	A
Proposed	Northbound	n/a	n/a	n/a	n/a	n/a	n/a	0.02	<5	A
Site Driveway										

[1]Volume-to-capacity ratio
[2]Average control delay per vehicle (in seconds)
[3]Level of service
[4]Not Applicable

TABLE 8
INTERSECTION CAPACITY ANALYSIS RESULTS - WEEKDAY EVENING PEAK HOUR

Intersection	Approach	2015 Existing			2022 No-Build			2022 Build		
		v/c[1]	Delay[2]	LOS[3]	v/c	Delay	LOS	v/c	Delay	LOS
Route 1 at	Eastbound	0.81	39	D	0.85	43	D	0.88	46	D
Low Street/	Westbound	0.51	39	D	0.53	40	D	0.53	40	D
Pond Street	Northbound	0.62	30	C	0.63	30	C	0.65	30	C
	Southbound	0.57	33	C	0.58	34	C	0.58	34	C
	Overall	**0.81**	**34**	C	**0.85**	**35**	**D**	**0.88**	**37**	**D**
Pond Street at	Eastbound	0.02	<5	A	0.02	<5	A	0.02	<5	A
Cottage Court/	Westbound	0.00	<5	A	0.00	<5	A	0.00	<5	A
Auburn Street	NB Exit	0.03	12	B	0.03	12	B	0.03	12	B
	SB Exit	0.02	9	A	0.03	9	A	0.03	10	A
Pond Street at	Eastbound	0.00	<5	A	0.00	<5	A	0.00	<5	A
Hillside Avenue	Westbound	0.00	<5	A	0.00	<5	A	0.00	<5	A
	NB Exit	0.00	10	A	0.00	10	A	0.01	10	A
Route 1 at	WB R Exit	n/a[4]	n/a	n/a	n/a	n/a	n/a	0.00	10	A
Proposed	Northbound	n/a	n/a	n/a	n/a	n/a	n/a	0.01	<5	A
Site Driveway										

[1]Volume-to-capacity ratio
[2]Average control delay per vehicle (in seconds)
[3]Level of service
[4]Not Applicable

As summarized in **Table 7** and **Table 8**:

- *Route 1 at Low Street/ Pond Street*: Under existing and future No-Build conditions, the signalized intersection of Route 1 and Low Street will operate at an overall level of service (LOS) D or better during the peak hours. With the addition of the project, the intersection will continue to operate at an overall LOS D or better with no material increases in delay.

- *Pond Street at Cottage Court/Auburn Street*: Under Build conditions, the minor street approaches to the intersection will continue operate at LOS B or better during the peak hours with no material increases in delay compared to No-Build conditions.

- *Pond Street at Hillside Avenue*: Under Build conditions, the minor street approaches to the intersection will continue operate at LOS A during the peak hours with no material increases in delay compared to No-Build conditions.

- *Route 1 at Proposed Site Driveway*: Under future Build conditions with the proposed development in place, the Route 1 intersection with the right-in/right-out proposed site driveway will operate well under capacity at LOS A with minimal delay during the peak hours.

In summary, the incremental changes in traffic at the study intersections due to the proposed development do not result in any significant change in intersection operations at the study intersections compared to No-Build conditions. Under Build conditions, the site driveway intersection with Route 1 and nearby signalized intersection will continue to operate under capacity during the peak hours with no material change in delay.

4.2.3 Vehicle Queue Analysis

Vehicle queue results are presented for the signalized study intersection. These vehicle queues are compared to available storage lengths, which are defined as lengths of exclusive turn lanes or the distance to the nearest major intersection for through lanes. Vehicle queue results from the capacity analysis are summarized in **Table 9** for the signalized study intersection of Route 1 at Low Street/Pond Street. Detailed worksheets of the queuing analysis are provided in the **Appendix**.

TABLE 9
VEHICLE QUEUE ANALYSIS SUMMARY
ROUTE 1 AT LOW STREET/ POND STREET

Approach	Storage Length (feet)	2022 No-Build		2022 Build	
		Average Queue Length	95th Percentile Queue Length	Average Queue Length	95th Percentile Queue Length
Weekday Morning Peak Hour					
Eastbound L/T	>1000	149	318	156	325
Eastbound R	150±	33	68	33	68
Westbound L/T/R	>1000	89	164	93	168
Northbound L	165±	86	160	95	173
Northbound T, T/R	>1500	47	79	49	81
Southbound L	165±	19	52	20	53
Southbound T, T/R	>1500	158	283	161	283
Weekday Evening Peak Hour					
Eastbound L/T	>1000	179	422	189	445
Eastbound R	150±	26	59	26	59
Westbound L/T/R	>1000	88	174	89	175
Northbound L	165±	93	184	97	190
Northbound T, T/R	>1500	98	160	100	162
Southbound L	165±	31	78	34	83
Southbound T, T/R	>1500	133	214	134	214

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

As presented in **Table 9,** average and 95th percentile vehicle queues at the signalized study intersections are generally contained within available storage areas during the peak hours. Incremental impacts due to the proposed project are minor, generally representing an increase of one additional vehicle queue length or less for impacted movements and in many cases no increase at all.

5.0 RECOMMENDATIONS AND CONCLUSIONS

5.1 RECOMMENDATIONS

MDM finds that travel conditions in the site vicinity along Route 1 and Pond Street are generally unconstrained. Trip generation for the development is estimated at approximately 30 vehicle-trips during the weekday morning peak hour and 36 vehicle-trips during the weekday evening peak hour. Traffic impacts associated with the proposed apartment development are not expected to notably affect travel or safety conditions in the site vicinity. MDM recommends the following access-related improvements:

Route 1 at Proposed Site Driveway

MDM recommends the following access-related improvements which are subject to MassDOT permitting and approval, as shown in **Figure 8:**

- A "STOP" sign (R1-1) and STOP line pavement marking are recommended on the driveway approach to Route 1. A "no left turn" sign (R3-2) should be installed opposite the Site in the median of Route 1 to enhance the right turn only restriction. The signs and pavement markings shall be compliant with the Manual on Uniform Traffic Control Devices (MUTCD).

- The existing "traffic signal ahead" sign (W3-3) will need to be relocated given the conflict with the location of the proposed site driveway.

- The driveway alignment, widths and curb radii should been designed to achieve approximate perpendicular orientation with Route 1. The final curb radii should also be designed to accommodate the largest anticipated design vehicle.

NOTES

1. THIS PLAN INTENDED FOR DISCUSSION PURPOSES ONLY; IT IS NOT FOR CONSTRUCTION.
2. FINAL DESIGN IS SUBJECT TO ADDITIONAL FIELD SURVEY BY OTHERS.
3. PROPERTY LINES AND ACCESS LINE LOCATIONS ARE APPROXIMATE ONLY.
4. BASE PLAN PROVIDED BY DGT SURVEY GROUP.

SCALE
0 10 20 40 80 FEET

LEGEND

SL	STOP LINE
SWEL	SOLID WHITE EDGE LINE
SYEL	SOLID YELLOW EDGE LINE

PROPOSED SIGNS

R1-1


R3-2

Figure 4

Conceptual Access/Egress Plan

NEWBURYPORT TURNPIKE (ROUTE 1)
NEWBURYPORT, MASSACHUSETTS
PREPARED FOR:
HALL AND MOSKOW CORP.
2 FEDERAL STREET
NEWBURYPORT, MA 01950

MDM TRANSPORTATION CONSULTANTS, INC.
PLANNERS & ENGINEERS
28 Lord Road, Suite 280
Marlborough, MA 01752
Tel: (508) 303-0370
Fax: (508) 303-0371

Date: August 17, 2015	Scale: As Noted	
Project No. 848	File: 848 Concept Plan.dwg	Sheet 1 of 1

- The driveway has been designed restrict the driveway movements to right-in/ right-out movements. To enhance the turn restriction, the driveway will incorporate pavement markings, a raised channelized right turn island and MUTCD compliant signage.

- Plantings (shrubs, bushes) and structures (walls, fences, etc.) shall be maintained at a height of 2 feet or less within the sight lines in vicinity of the Site driveways to provide unobstructed sight lines. Furthermore, the existing vegetation and structures within the sight lines shall be selectively cleared when the Site driveway is constructed and the terrain shall be graded as required to ensure minimum recommended sight line requirements are met or exceeded.

Pond Street at Cottage Court

- A "STOP" sign (R1-1) is recommended on the Cottage Court approach to Pond Street. The sign shall be compliant with the MUTCD.

- The existing dead-end sign (W14-1) should be removed when the Cottage Court is extended through the Site to Route 1.

- Given the close proximity (less than 100 feet) to the traffic signal control at the Route 1/Pond Street intersection, a "Do Not Block Intersection" sign and markings are recommended at the Pond Street/Auburn Street/Cottage Court intersection to enhance operations for left-turn movements at the intersection. All signs and marking shall be in conformance with the MUTCD.

Pond Street at Hillside Avenue

- A "STOP" sign (R1-1) is recommended on the Hillside Avenue approach to Pond Street. The sign shall be compliant with the MUTCD.

5.2 CONCLUSIONS

While the project will increase traffic in the immediate study area, adequate capacity is available under future Build conditions along Route 1, Pond Street, Low Street and at the study intersections to accommodate the trip increases associated with the proposed apartment development. The project is not projected to significantly change any reported operating levels compared to future No-Build conditions, thus no off-site mitigation is recommended. Proposed access improvements will provide ample capacity to accommodate site-generated traffic while also enhancing safety and capacity. In addition, proposed access/egress will be designed to enhance vehicular connections to the site and to ensure that adequate sight lines are provided in accordance with AASHTO criteria based on ambient travel speeds.

APPENDIX

- Traffic Volume Data
- Seasonal/ Yearly Growth Data
- Speed Data
- Crash Data
- Public Transportation
- Sight Distance Calculations
- Background Growth
- Trip Generation Calculations
- Trip Distribution Calculations
- Capacity Analyses

□ Traffic Volume Data

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Marlborough, MA 01752
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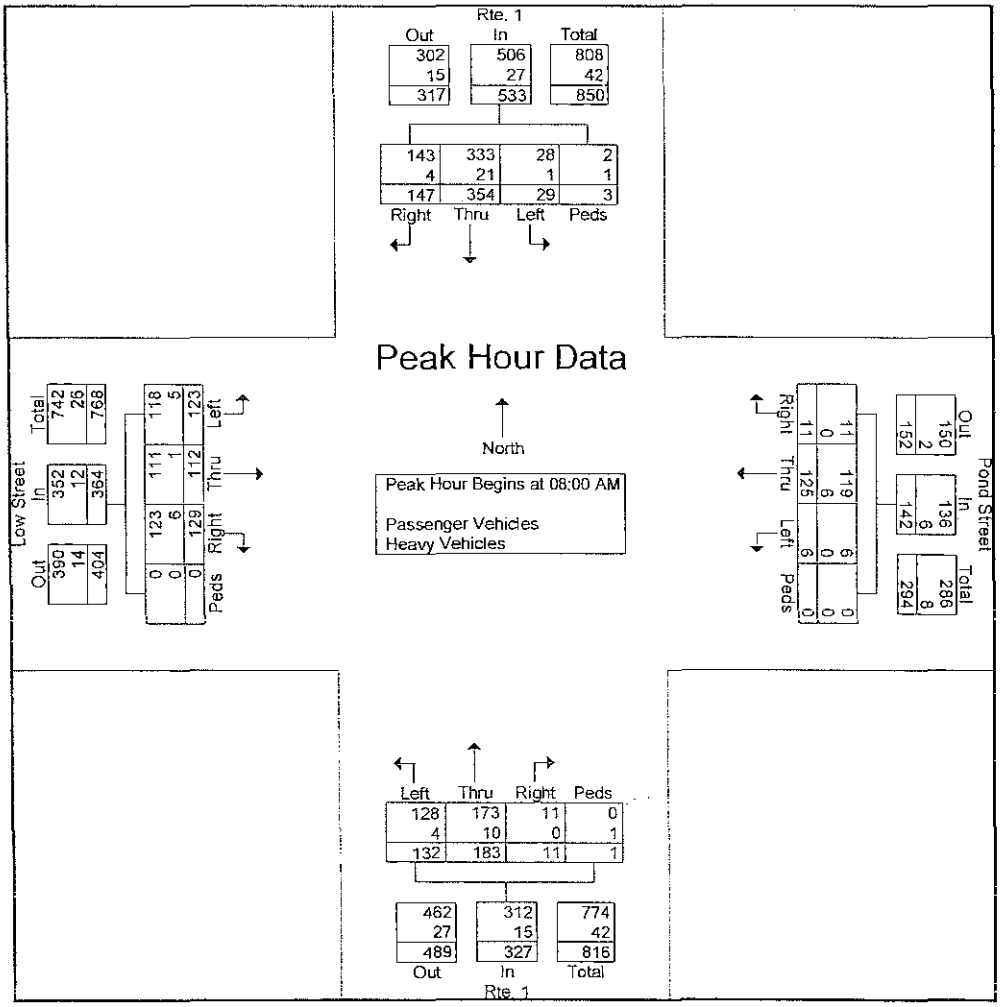
N/S: Rte. 1
/W: Pond St./Low St.
.lewburyport, MA

File Name : Rte 1 at Pond 7-9
Site Code : 00234001
Start Date : 8/5/2015
Page No : 2

	Rte. 1 From North					Pond Street From East					Rte. 1 From South					Low Street From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 08:00 AM																					
08:00 AM	42	103	6	1	152	3	19	1	0	23	2	44	33	0	79	35	23	24	0	82	336
08:15 AM	30	85	3	0	118	0	32	2	0	34	1	44	32	1	78	22	19	31	0	72	302
08:30 AM	35	80	10	0	125	5	34	0	0	39	0	39	32	0	71	29	35	25	0	89	324
08:45 AM	40	86	10	2	138	3	40	3	0	46	8	56	35	0	99	43	35	43	0	121	404
Total Volume	147	354	29	3	533	11	125	6	0	142	11	183	132	1	327	129	112	123	0	364	1366
% App. Total	27.6	66.4	5.4	0.6		7.7	88	4.2	0		3.4	56	40.4	0.3		35.4	30.8	33.8	0		
PHF	.875	.859	.725	.375	.877	.550	.781	.500	.000	.772	.344	.817	.943	.250	.826	.750	.800	.715	.000	.752	.845
Passenger Vehicles	143	333	28	2	506	11	119	6	0	136	11	173	128	0	312	123	111	118	0	352	1306
% Passenger Vehicles																					
Heavy Vehicles	4	21	1	1	27	0	6	0	0	6	0	10	4	1	15	6	1	5	0	12	60
% Heavy Vehicles	2.7	5.9	3.4	33.3	5.1	0	4.8	0	0	4.2	0	5.5	3.0	100	4.6	4.7	0.9	4.1	0	3.3	4.4



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Marlborough, MA 01752
www.mdmtrans.com

N/S: Rte. 1
E/W: Pond St./Low St.
Newburyport, MA

File Name : Rte 1 at Pond 7-9
Site Code : 00234001
Start Date : 8/5/2015
Page No : 1

Groups Printed- Bicycles

	Rte. 1 From North					Pond Street From East					Rte. 1 From South					Low Street From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
** BREAK ***																					
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apprch %	0	0	0	0		0	0	0	0		0	0	0	0		0	0	0	0		
Total %																					

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28 Lord Road, Suite 280
Marlborough, MA

N/S:Auburn St./Cottage Ct.
E/W: Pond Street
Newburyport, MA

File Name : Pond at Cottage 7-9
Site Code : 00235001
Start Date : 8/5/2015
Page No : 1

Groups Printed- Passenger Vehicles

	Auburn Street From North					Pond Street From East					Cottage Court From South					Pond Street From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:00 AM	1	0	0	0	1	1	0	6	0	7	0	0	1	0	1	1	0	6	0	7	16
07:15 AM	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	1	0	2	5
07:30 AM	2	0	0	3	5	0	0	0	0	0	0	0	0	0	0	1	0	4	0	5	10
07:45 AM	6	0	0	2	8	0	0	0	0	0	1	0	0	0	1	0	0	7	0	7	16
Total	12	0	0	5	17	1	0	6	0	7	1	0	1	0	2	3	0	18	0	21	47
08:00 AM	1	0	1	1	3	0	0	0	0	0	1	0	0	0	1	0	0	5	0	5	9
08:15 AM	3	0	0	2	5	0	0	0	0	0	1	0	0	0	1	0	0	4	0	4	10
08:30 AM	3	0	0	0	3	0	0	0	0	0	0	0	1	0	1	0	0	6	0	6	10
08:45 AM	9	1	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	8	0	8	18
Total	16	1	1	3	21	0	0	0	0	0	2	0	1	0	3	0	0	23	0	23	47
Grand Total	28	1	1	8	38	1	0	6	0	7	3	0	2	0	5	3	0	41	0	44	94
Apprch %	73.7	2.6	2.6	21.1		14.3	0	85.7	0		60	0	40	0		6.8	0	93.2	0		
Total %	29.8	1.1	1.1	8.5	40.4	1.1	0	6.4	0	7.4	3.2	0	2.1	0	5.3	3.2	0	43.6	0	46.8	

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28 Lord Road, Suite 280
Marlborough, MA 01752
www.mdmtrans.com

N/S: Hillside Ave
W/W: Pond Street
Newburyport, MA

File Name : Pond at Hillside 7-9
Site Code : 00235001
Start Date : 8/5/2015
Page No : 1

Groups Printed- Passenger Vehicles

	Pond Street From East				Hillside Avenue From South				Pond Street From West				
Start Time	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Int. Total
* BREAK ***													
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0	0
Apprch %	0	0	0		0	0	0		0	0	0		
Total %													

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N/S: Rte. 1
/W: Pond St./Low St.
Newburyport, MA

File Name : Rte 1 at Pond 4-6
Site Code : 00234002
Start Date : 8/5/2015
Page No : 1

Groups Printed- Passengeer Vehicles - Heavy Vehicles

	Rte. 1 From North					Pond Street From East					Rte. 1 From South					Low Street From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
04:00 PM	23	94	15	1	133	1	27	5	0	33	3	87	46	0	136	32	24	44	0	100	402
04:15 PM	31	89	14	0	134	3	31	3	0	37	3	102	36	0	141	35	30	46	0	111	423
04:30 PM	34	87	14	3	138	4	29	1	0	34	1	86	47	0	134	24	38	33	0	95	401
04:45 PM	15	78	11	0	104	4	30	5	0	39	5	100	42	0	147	25	31	40	0	96	386
Total	103	348	54	4	509	12	117	14	0	143	12	375	171	0	558	116	123	163	0	402	1612
05:00 PM	48	84	14	1	147	6	26	4	0	36	1	102	40	0	143	41	25	50	0	116	442
05:15 PM	36	107	14	4	161	2	37	3	0	42	1	97	44	0	142	28	37	45	0	110	455
05:30 PM	25	88	14	1	128	7	34	4	0	45	6	99	38	1	144	33	31	51	0	115	432
05:45 PM	26	87	9	1	123	0	18	3	0	21	2	50	30	1	83	19	31	33	0	83	310
Total	135	366	51	7	559	15	115	14	0	144	10	348	152	2	512	121	124	179	0	424	1639
Grand Total	238	714	105	11	1068	27	232	28	0	287	22	723	323	2	1070	237	247	342	0	826	3251
Apprch %	22.3	66.9	9.8	1		9.4	80.8	9.8	0		2.1	67.6	30.2	0.2		28.7	29.9	41.4	0		
Total %	7.3	22	3.2	0.3	32.9	0.8	7.1	0.9	0	8.8	0.7	22.2	9.9	0.1	32.9	7.3	7.6	10.5	0	25.4	
Passengeer Vehicles	229	694	104	7	1034	26	227	25	0	278	22	713	320	1	1056	236	243	338	0	817	3185
% Passengeer Vehicles	96.2	97.2	99	63.6	96.8	96.3	97.8	89.3	0	96.9	100	98.6	99.1	50	98.7	99.6	98.4	98.8	0	98.9	98
Heavy Vehicles	9	20	1	4	34	1	5	3	0	9	0	10	3	1	14	1	4	4	0	9	66
% Heavy Vehicles	3.8	2.8	1	36.4	3.2	3.7	2.2	10.7	0	3.1	0	1.4	0.9	50	1.3	0.4	1.6	1.2	0	1.1	2

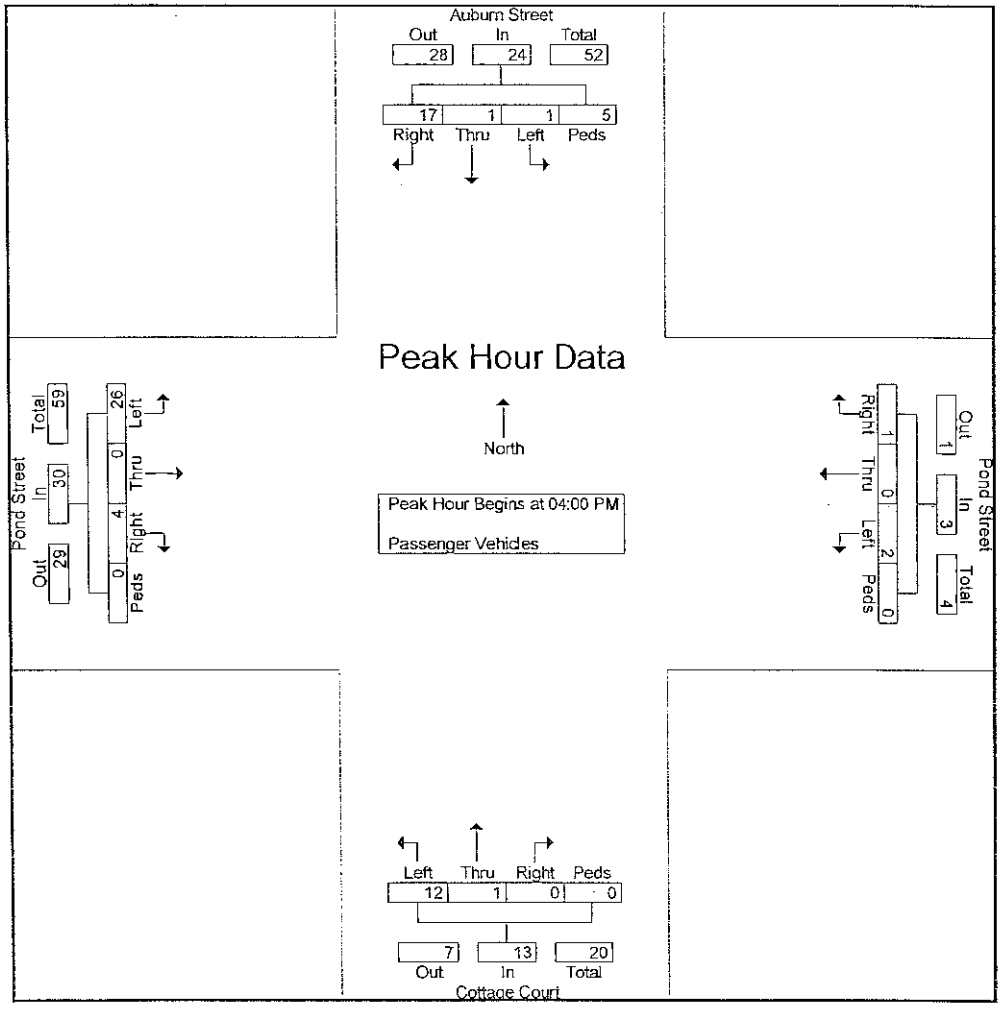
MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA 01752
www.mdmtrans.com

N/S: Cottage Ct./Auburn St.
E/W: Pond St
Newburyport,MA
Then Click the Comments Tab

File Name : Pond at Cottage 4-6
Site Code : 00235002
Start Date : 8/5/2015
Page No : 2

	Auburn Street From North					Pond Street From East					Cottage Court From South					Pond Street From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:00 PM																					
04:00 PM	7	1	0	1	9	0	0	0	0	0	0	0	3	0	3	0	0	11	0	11	23
04:15 PM	5	0	0	0	5	0	0	1	0	1	0	0	0	0	0	0	0	8	0	8	14
04:30 PM	3	0	1	4	8	1	0	1	0	2	0	1	3	0	4	2	0	5	0	7	21
04:45 PM	2	0	0	0	2	0	0	0	0	0	0	0	6	0	6	2	0	2	0	4	12
Total Volume	17	1	1	5	24	1	0	2	0	3	0	1	12	0	13	4	0	26	0	30	70
% App. Total	70.8	4.2	4.2	20.8		33.3	0	66.7	0		0	7.7	92.3	0		13.3	0	86.7	0		
PHF	.607	.250	.250	.313	.667	.250	.000	.500	.000	.375	.000	.250	.500	.000	.542	.500	.000	.591	.000	.682	.761



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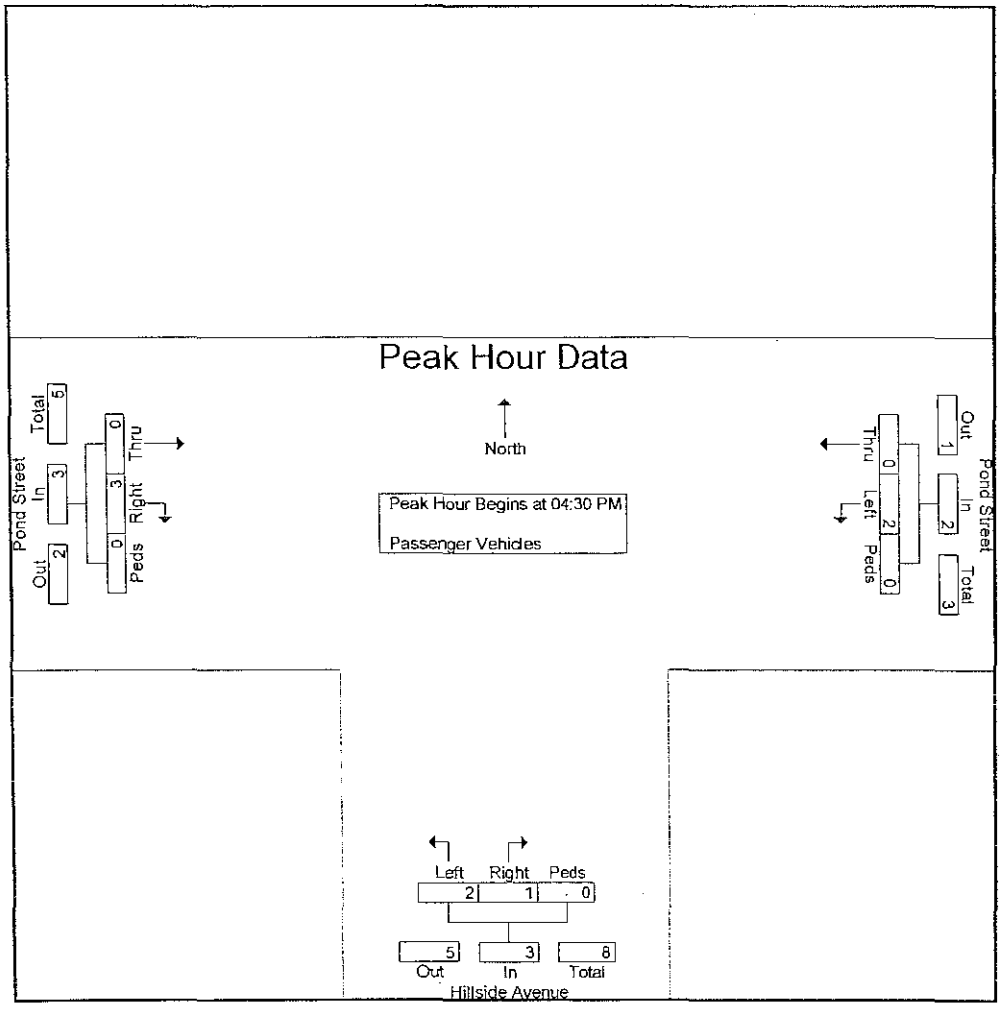
N/S: Hillside Ave
E/W: Pond St
Newburyport,MA

File Name : Pond at Hillside 4-6
Site Code : 00235002
Start Date : 8/5/2015

	Pond Street From East				Hillside Avenue From South				Pond Street From West				
Start Time	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:30 PM													
04:30 PM	0	0	0	0	0	0	0	0	2	0	0	2	2
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	2	0	2	0	0	0	0	1	0	0	1	3
05:15 PM	0	0	0	0	1	2	0	3	0	0	0	0	3
Total Volume	0	2	0	2	1	2	0	3	3	0	0	3	8
% App. Total	0	100	0		33.3	66.7	0		100	0	0		
PHF	.000	.250	.000	.250	.250	.250	.000	.250	.375	.000	.000	.375	.667



□ Seasonal Data/ Yearly Growth

SECTION I - CONTINUOUS COUNTING STATION MONTHLY AVERAGE DAILY TRAFFIC

STATION 5010 - NEWBURY - RTE.I-95 - SOUTH OF SCOTLAND RD.

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	August Adjustment to Year	
08	59,463	60,485	63,000	65,420	*68,663*	72,461	79,444	81,485	69,158	70,161	63,382	59,916	67,770	0.83	
	-5%	1%	-4%	1%	1%	1%	1%	2%	5%	-1%	0%	3%	1%		
09	56,254	60,998	60,741	65,981	*69,723*	72,870	80,271	83,498	72,755	69,281	63,516	61,523	68,118	0.82	
	2%	-1%	4%	0%	3%	3%	4%	1%	1%	1%	3%	-1%	2%		
10	57,311	60,412	62,874	66,194	*71,671*	75,291	83,447	84,636	73,300	69,965	65,132	60,888	69,260	0.82	
	-5%	-4%	-1%	-3%	-5%	-1%	0%	-5%	-1%	0%	0%	4%	-2%		
11	54,718	58,007	62,347	64,386	*68,084*	74,276	83,211	80,459	72,745	69,941	65,261	63,216	68,054	0.85	
	7%	5%	0%	2%	5%	-1%	1%	6%	-1%	-2%	0%	-1%	2%		
12	58,648	61,080	62,489	65,667	*71,204*	73,600	84,023	84,971	71,999	68,649	65,349	62,383	69,172	0.81	
	0%	-7%	-3%	0%	0%	4%	-1%	1%	2%	5%	-1%	-18%	-1%		
13	58,632	56,534	60,707	65,432	*71,158*	76,325	83,494	85,725	73,509	71,971	64,770	51,183	68,287	0.80	
													0.16%	0.82	Sub Average

STATION 5128 - NEWBURY - RTE.1 - SOUTH OF HANOVER ST.

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR		
09	7,734	7,890	8,469	8,675	9,200	9,352	9,300	9,935	9,390	9,100	8,160	8,019	8,769	0.88	
	-4%	-10%	-1%	-1%	1%	2%	3%	-3%	-1%	-1%	2%	2%	-1%		
11	7,049	6,245	8,315	8,569	9,368	9,660	9,794	9,263	9,262	8,926	8,421	8,320	8,601	0.93	
	14%	27%	2%	5%	-1%	-18%	-6%	0%	3%	1%	0%	-1%	1%		
12	8,030	7,928	8,495	8,964	9,304	7,820	9,220	*9,260*	9,578	8,997	8,442	8,203	8,687	0.94	
	-2%	-9%	-7%	-2%	3%	27%	5%	7%	-2%	1%	-2%	-4%	1%		
13	7,899	7,233	7,901	8,805	9,625	9,924	9,665	9,869	9,420	9,100	8,239	7,844	8,794	0.89	
													0.58%	0.91	Sub Average

STATION 5258 - WEST NEWBURY - RTE.I-95 - NORTH OF SCOTLAND RD.

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR		
08	56,156	55,549	58,000	60,205	63,921	67,516	74,637	76,747	65,170	*64,871*	58,424	54,893	63,007	0.82	
	-3%	1%	3%	1%	1%	1%	1%	-1%	2%	2%	0%	2%	1%		
09	54,522	56,074	60,000	60,916	64,608	68,356	75,236	76,000	66,789	*65,870*	58,560	56,041	63,598	0.84	
	-4%	-2%	-4%	0%	2%	2%	4%	4%	2%	-2%	3%	0%	1%		
10	52,451	54,781	57,350	60,787	66,226	69,857	78,218	79,290	68,013	*64,657*	60,104	55,878	63,968	0.81	
	2%	-3%	0%	-2%	-5%	-1%	0%	-5%	-1%	-1%	0%	4%	-1%		
11	53,628	53,106	57,332	59,404	62,699	69,034	78,077	75,436	67,289	*64,076*	60,090	58,319	63,208	0.84	
	1%	6%	-1%	2%	5%	2%	-1%	5%	-2%	-1%	0%	-2%	1%		
12	54,432	56,313	56,875	60,519	66,028	70,268	77,650	79,389	66,070	*63,430*	59,947	57,335	64,021	0.81	
	5%	-9%	-2%	-1%	-1%	0%	1%	1%	3%	5%	0%	-4%	0%		
13	57,356	51,519	55,611	60,141	65,643	70,600	78,055	80,033	67,988	*66,341*	59,842	55,071	64,017	0.80	
													0.32%	0.82	Sub Average

Average Adjusment Factor 0.85

Average Yearly Growth Calculated 0.4%
Yearly Growth Factor Used 0.5%

ITALICS = ESTIMATED DATA
MADT

□ Speed Data

MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA 01752
www.mdmtrans.com

Route 1
South of Pond Street
Newburyport, MA

File Name : rte 1 spot speed
Site Code : 848
Start Date : 9/2/2015
Page No : 1

#	Northbound
1	47
2	47
3	47
4	37
5	42
6	38
7	40
8	39
9	46
10	40
11	32
12	45
13	55
14	42
15	39
16	38
17	44
18	43
19	40
20	47
21	48
22	38
23	40
24	43
25	38
26	39
27	44
28	42
29	40
30	50
31	52
32	38
33	45
34	38
35	39
36	50
37	36
38	37
39	39
40	39
41	45
42	52
43	41
44	40
45	50
46	40
47	34
48	54
49	37
50	38
51	39
52	49
53	44
54	

Class	Vehicle Count	Average Speed	True Median (50th Percentile)	85 Percentile	10 MPH Pace Speed	Number in Pace	Percent in Pace	Number of Vehicles Over 45 MPH	Percent of Vehicles Over 45 MPH
Northbound	53	42	40	48	38 - 47	38	72	14	26

□ Crash Data

Moving Massachusetts Forward
massDOT Highway

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Newburyport, MA COUNT DATE : Aug-15

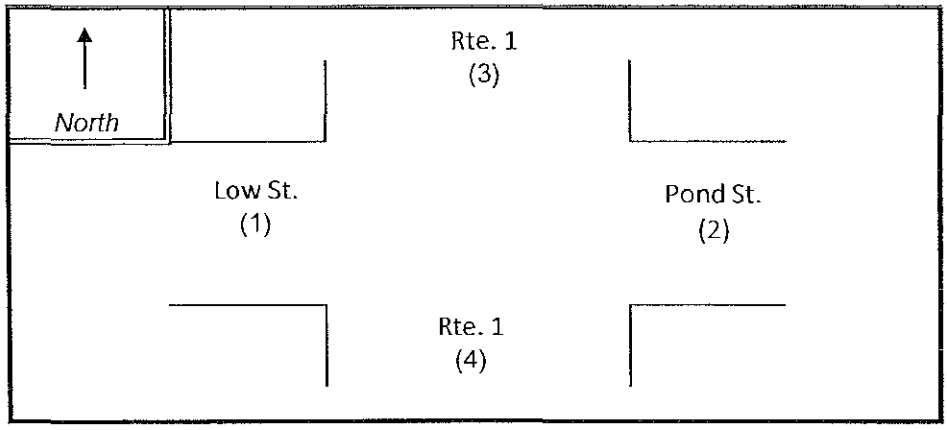
DISTRICT : 4 UNSIGNALIZED : [ ] SIGNALIZED : [X]

~ INTERSECTION DATA ~

MAJOR STREET : Rte. 1

MINOR STREET(S) : Pond St. / Low St.

INTERSECTION DIAGRAM
(Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	EB	WB	SB	NB		
PEAK HOURLY VOLUMES (PM) :	437	162	540	576		1,715

" K " FACTOR : 0.090

INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : 19,056

TOTAL # OF CRASHES : 4 # OF YEARS : 3 AVERAGE # OF CRASHES PER YEAR (**A**) : 1.33

CRASH RATE CALCULATION : 0.19 RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

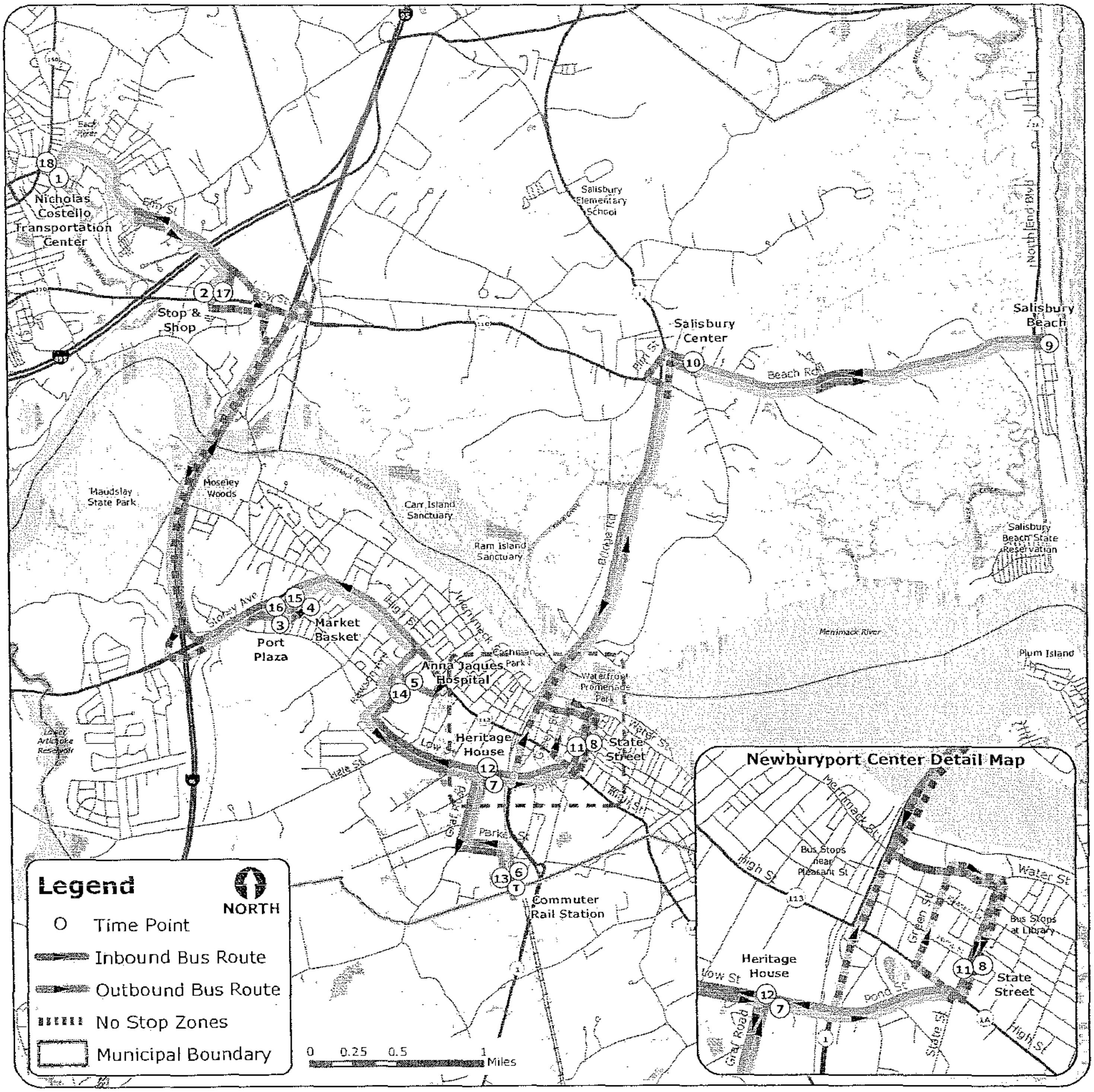
Comments : MassDOT District 4 Avg: Signalized = 0.77; Unsignalized = 0.58

Project Title & Date: 848 - Newburyport

MassDOT Crash Report for Newburyport 2012

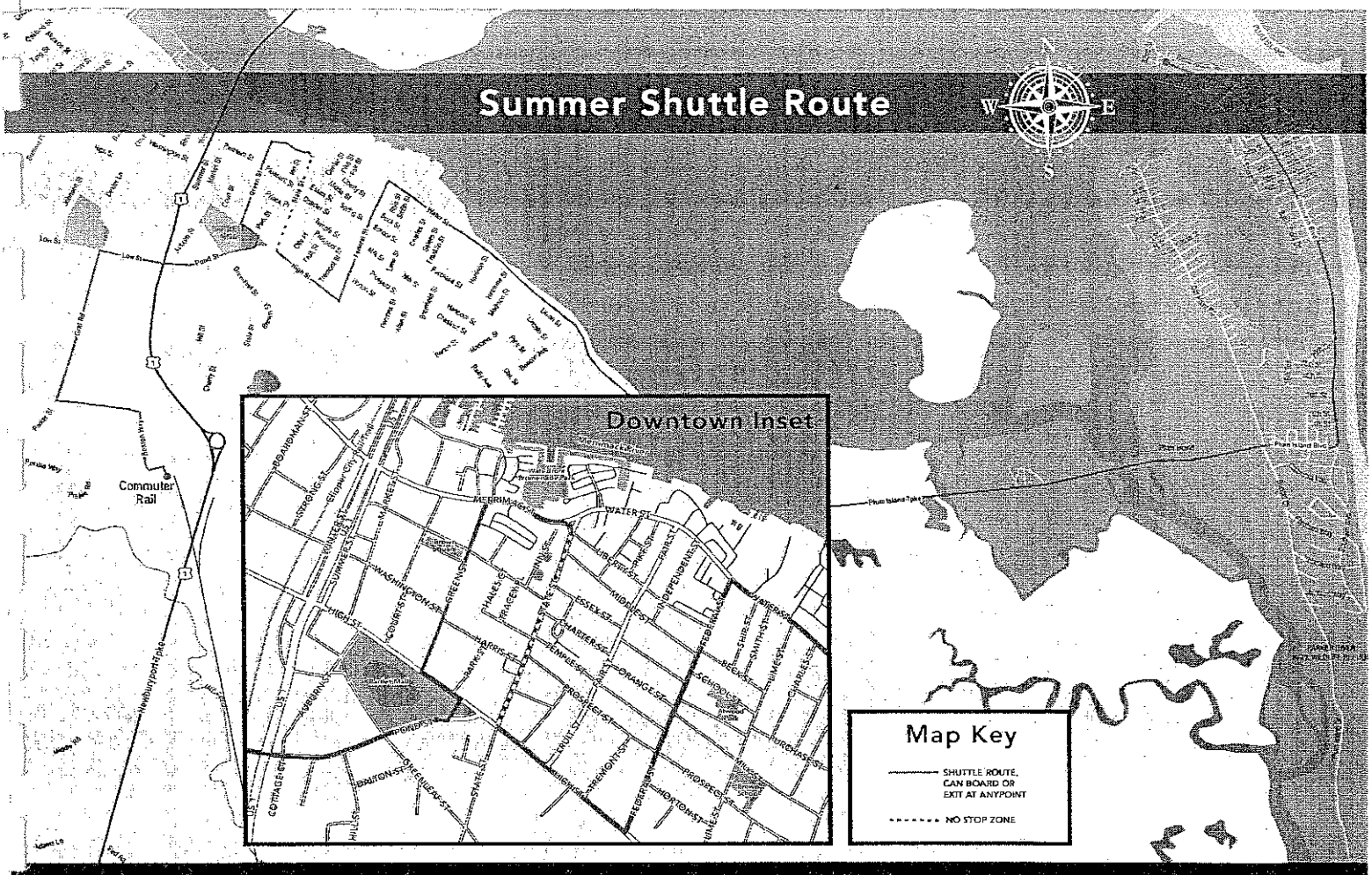
Crash Number	City/Town Name	Crash Date	Crash Time	Crash Severity	Number of Vehicles	Total Nonfatal Injuries	Total Fatal Injuries	Manner of Collision	Vehicle Action Prior to Crash	Vehicle Travel Directions	Most Harmful Events	Vehicle Configuration	Road Surface Condition	Ambient Light	Weather Condition	At Roadway Intersection	Distance from Nearest Roadway Intersection	Distance from Nearest Milemarker	Distance from Nearest Exit	Distance from Nearest Landmark	Non Motorist Type	X Coordinate	Y Coordinate
POND STREET Rte 1 / Rte 1																							
[illegible]	NEWBURYPORT	[illegible]	1:24 PM	Property damage only (none injured)	2	0	0	Sideswipe, same direction	V1: Turning left / V2:Travelling straight ahead	V1:Eastbound / V2:Southbound	V1: Collision with motor vehicle in traffic / V2: Collision with motor vehicle in traffic	V1: Passenger car / V2:Passenger car	Dry	Daylight	Clear		POND STREET Rte 1 / Rte 1					[illegible]	[illegible]

□ Public Transportation


Nicholas Costello Transportation Center
Stop & Shop
Salisbury Elementary School
Salisbury Center
Salisbury Beach
Beach Rd
Moseley Woods
Maudslay State Park
Carr Island Sanctuary
Ram Island Sanctuary
Salisbury Beach State Reservation
Merrimack River
Plum Island
Storey Ave
Market Basket
Port Plaza
Anna Jaques Hospital
Heritage House
State Street
Waterfront Promenade Park
Commuter Rail Station
Parker St
Low St
Hale St
High St
Water St
Elm St
Pine St
Bridge Rd
North End Blvd
Legend
NORTH
Time Point
Inbound Bus Route
Outbound Bus Route
No Stop Zones
Municipal Boundary
0 0.25 0.5 1 Miles
Newburyport Center Detail Map
Bus Stops near Pleasant St
Bus Stops at Library
Green St
Pond St
State St
Graf Road

	9:54	10:00	10:10	10:20	10:23	10:29	10:36	10:45	10:50	10:52	51
PM	11:04	11:10	11:20	11:30	11:33	11:39	11:46	11:55	12:00	12:02	51
	12:14	12:20	12:30	12:40	12:43	12:49	12:56	1:05	1:10	1:12	51
	1:24	1:30	1:40	1:50	1:53	1:59	2:06	2:15	2:20	2:22	51
	2:34	2:40	2:50	3:00	3:03	3:09	3:16	3:25	3:30	3:32	51
	3:44	3:50	4:00	4:10	4:13	4:19	4:26	4:35	4:40	4:42	51
	4:54	5:00	5:10	5:20	5:23	5:29	5:36	5:45	5:50	5:52	51
	6:04	6:10	6:20	6:30	6:33	6:39	6:46	6:55	7:00	7:02	51
SATURDAY/SUNDAY											
AM	7:34*	7:40*	7:50*	8:00	8:03	8:09	8:16	8:25	8:30	8:32	51
	8:44	8:50	9:00	9:10	9:13	9:19	9:26	9:35	9:40	9:42	51
	9:54	10:00	10:10	10:20	10:23	10:29	10:36	10:45	10:50	10:52	51
PM	11:04	11:10	11:20	11:30	11:33	11:39	11:46	11:55	12:00	12:02	51
	12:14	12:20	12:30	12:40	12:43	12:49	12:56	1:05	1:10	1:12	51
	1:24	1:30	1:40	1:50	1:53	1:59	2:06	2:15	2:20	2:22	51
	2:34	2:40	2:50	3:00	3:03	3:09	3:16	3:25	3:30	3:32	51
	3:44	3:50	4:00	4:10	4:13	4:19	4:26	4:35	4:40	4:42	51
	4:54	5:00	5:10	5:20	5:23	5:29	5:36	5:45	5:50	5:52	51
	6:04*	6:10*	6:20*	6:30*	6:33*	6:39*	6:46*	6:55*	7:00*	7:02*	51

Summer Shuttle Route



Summer Shuttle Schedule

Friday, Saturday & Sunday Service Only - **MAY 29 - SEPTEMBER 6, 2015**

[illegible]	16TH STREET	COMMUTER RAIL / INDUSTRIAL PARK	STATE STREET	[illegible]
[illegible]	[illegible]	[illegible]	10:50	[illegible]
[illegible]	11:30	[illegible]	[illegible]	[illegible]
[illegible]	12:00	[illegible]	[illegible]	[illegible]
[illegible]	12:30	12:40	12:50	[illegible]
[illegible]	1:00	[illegible]	[illegible]	[illegible]
[illegible]	1:30	[illegible]	[illegible]	[illegible]
[illegible]	2:00	[illegible]	[illegible]	[illegible]
[illegible]	2:30	2:40	2:50	[illegible]
[illegible]	3:00	[illegible]	[illegible]	[illegible]
[illegible]	3:30	[illegible]	[illegible]	[illegible]
[illegible]	4:00	[illegible]	[illegible]	[illegible]
[illegible]	4:30*	4:40	4:50	[illegible]
[illegible]	5:00	5:10	5:20	[illegible]

*FINAL TRAIN TO NORTH STATION - Friday 5:26 p.m. / Weekends 5:34 p.m.

□ Sight Distance Calculations

Stopping Sight Distance

Route 1 - Posted Speed Limit

		SPEED (MPH)	BRAKE REACTION DISTANCE (FT)	BRAKING DISTANCE (FT)	CALCULATED STOPPING SIGHT DISTANCE (FT)
Direction 1	NB	45	165.375	194.4	359.7

INPUTS	Direction 1
Travel Direction	NB
Speed	45
t	2.5
a	11.2

Stopping Sight Distance (SSD) - Source: AASHTO

SSD = Reaction Distance + Brake Distance

Reaction Distance = 1.47 x t x V

Brake Distance = 1.075 x V^2 / a

Where:
t = reaction time (sec)
V = travel speed (mph)
a - deceleration rate (ft/sec^2)

Stopping Sight Distance

Route 1 - 85th Percentile Observed Travel Speeds

		SPEED (MPH)	BRAKE REACTION DISTANCE (FT)	BRAKING DISTANCE (FT)	CALCULATED STOPPING SIGHT DISTANCE (FT)
Direction 1	NB	48	176.4	221.1	397.5

INPUTS	Direction 1
Travel Direction	NB
Speed	48
t	2.5
a	11.2

Stopping Sight Distance (SSD) - Source: AASHTO

SSD = Reaction Distance + Brake Distance

Reaction Distance = 1.47 x t x V

Brake Distance = 1.075 x V^2 / a

Where:
t = reaction time (sec)
V = travel speed (mph)
a - deceleration rate (ft/sec^2)

□ Background Growth

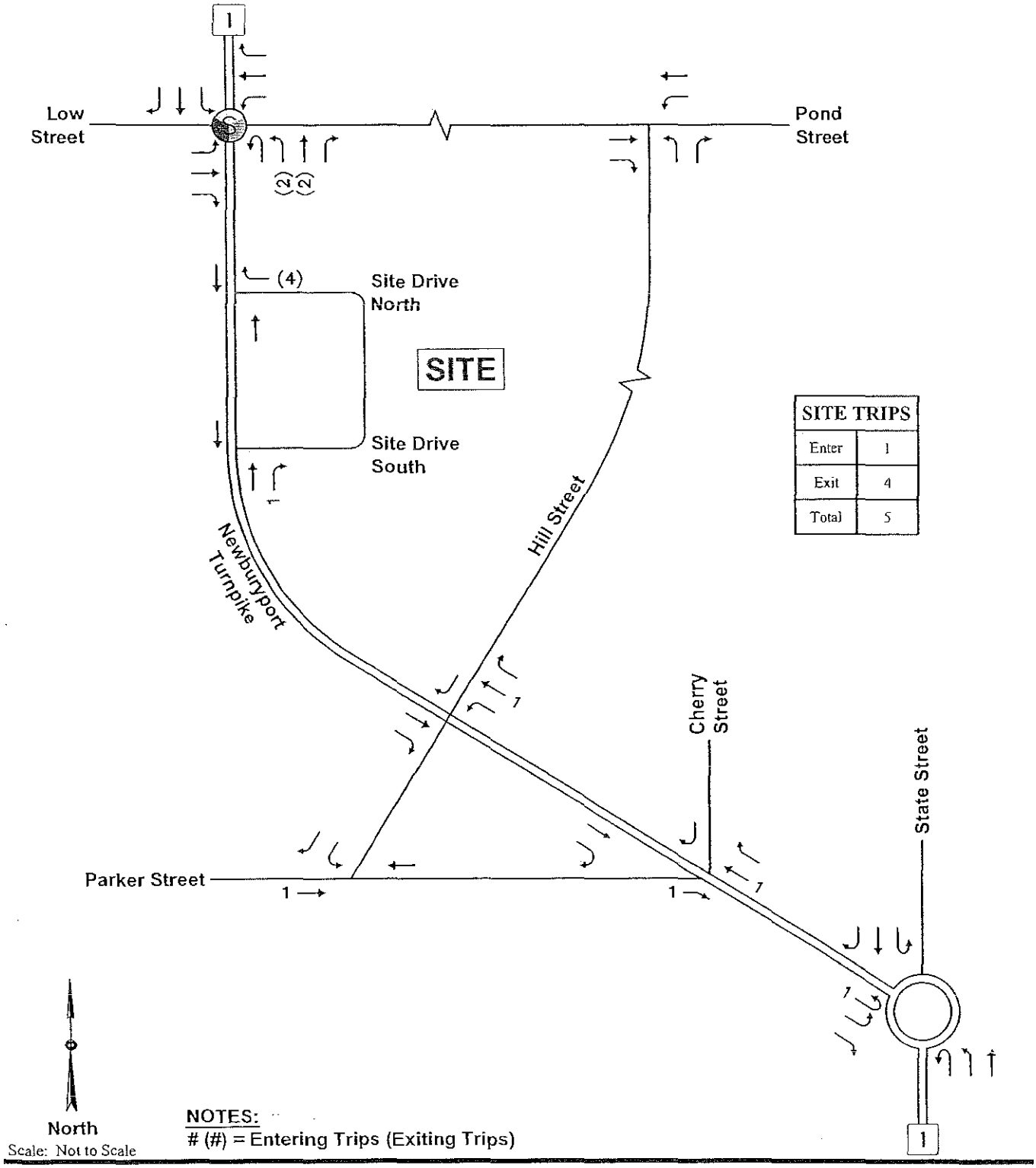


Figure 5

MDM TRANSPORTATION CONSULTANTS, INC.
Planners & Engineers

Site-Generated Trips
Weekday Morning Peak Hour

Date: December 2014
Dwg No. 801 TIAS02.dwg
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□ Trip Generation Calculations

Institute of Transportation Engineers (ITE) 9th Edition
Land Use Code (LUC) 220 - Apartment

Average Vehicle Trips Ends vs: Dwelling Units
Independent Variable (X): 58

Average Weekday Daily

T = 6.65 * X
T = 6.65 * 58
T = 385.70
T = 386 vehicle trips
with 50% (**193** vpd) entering and 50% (**193** vpd) exiting.

Weekday Morning Peak Hour Of Adjacent Street Traffic

T = 0.51 * X
T = 0.51 * 58
T = 29.58
T = 30 vehicle trips
with 20% (**6** vph) entering and 80% (**24** vph) exiting.

Weekday Evening Peak Hour Of Adjacent Street Traffic

T = 0.62 * X
T = 0.62 * 58
T = 35.96
T = 36 vehicle trips
with 65% (**23** vph) entering and 35% (13 vph) exiting.

Saturday Daily

T = 6.39 * X
T = 6.39 * 58
T = 370.62
T = 370 vehicle trips
with 50% (**185** vpd) entering and 50% (**185** vpd) exiting.

Saturday Midday Peak Hour Of Generator

T = 0.52 * X
T = 0.52 * 58
T = 30.16
T = 30 vehicle trips
with 50% (**15** vph) entering and 50% (**15** vph) exiting.

□ Trip Distribution Calculations

Journey-to-Work Distribution

Residence Town Name	Workplace Town Name	All Workers	% of Total Rounded
Newburyport, MA	Newburyport, MA	3,532	39%
Newburyport, MA	Boston, MA	709	8%
Newburyport, MA	Haverhill, MA	235	3%
Newburyport, MA	Andover, MA	234	3%
Newburyport, MA	Peabody, MA	229	3%
Newburyport, MA	Danvers, MA	192	2%
Newburyport, MA	Salisbury, MA	188	2%
Newburyport, MA	Newbury, MA	170	2%
Newburyport, MA	Portsmouth, NH	169	2%
Newburyport, MA	Amesbury, MA	155	2%
Newburyport, MA	Lawrence, MA	136	1%
Newburyport, MA	Rowley, MA	132	1%
Newburyport, MA	Medford, MA	128	1%
Newburyport, MA	Beverly, MA	124	1%
Newburyport, MA	Ipswich, MA	114	1%
Newburyport, MA	Seabrook, NH	104	1%
Newburyport, MA	Cambridge, MA	102	1%
Newburyport, MA	Georgetown, MA	87	1%
Newburyport, MA	Lynn, MA	85	1%
Newburyport, MA	West Newbury, MA	85	1%
Newburyport, MA	Gloucester, MA	82	1%
Newburyport, MA	Chelmsford, MA	75	1%
Newburyport, MA	Lowell, MA	75	1%
Newburyport, MA	North Andover, MA	73	1%
Newburyport, MA	Salem, NH	67	0.5%
Newburyport, MA	Winthrop, MA	65	0.5%
Newburyport, MA	Tewksbury, MA	64	0.5%
Newburyport, MA	Burlington, MA	61	0.5%
Newburyport, MA	Topsfield, MA	58	0.5%
Newburyport, MA	Somerville, MA	56	0.5%
Newburyport, MA	Newton, MA	54	0.5%
Newburyport, MA	Southborough, MA	50	0.5%
Newburyport, MA	Framingham, MA	45	0.5%
Newburyport, MA	Lexington, MA	44	0.5%
Newburyport, MA	Hampton, NH	43	0.5%
Newburyport, MA	Chelsea, MA	42	0.5%
Newburyport, MA	Other	1,268	14%
	Total	9,132	100%

Source: 2006-2010 US Census Journey-to-Work Data

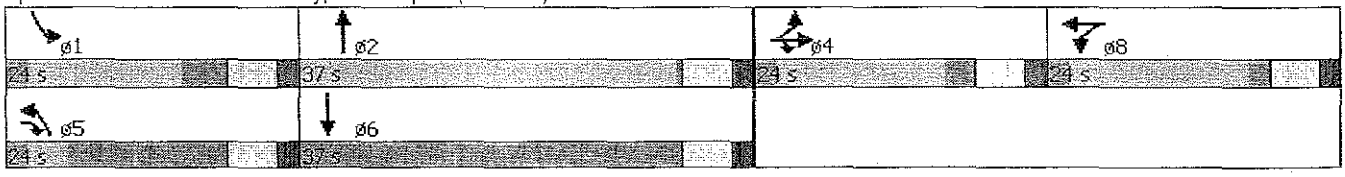
	To/From Routes									
	Route 1 (To/From North)		Route 1 (To/From South)		Pond Street (To/From East)		Pond St to Auburn St (To/From West)		Low Street (To/From West)	Total
Workplace										
Newburyport, MA	40%	15.6%		0.0%	10%	3.9%		0.0%	50% 19.5%	39.0%
Boston, MA		0.0%		0.0%		0.0%		0.0%	100% 8.0%	8.0%
Haverhill, MA	33%	1.0%		0.0%		0.0%	33.3%	1.0%	33% 1.0%	3.0%
Andover, MA		0.0%		0.0%		0.0%	50.0%	1.5%	50% 1.5%	3.0%
Peabody, MA		0.0%		0.0%		0.0%		0.0%	100% 3.0%	3.0%
Danvers, MA		0.0%	50%	1.0%		0.0%		0.0%	50% 1.0%	2.0%
Salisbury, MA	100%	2.0%		0.0%		0.0%		0.0%	0.0%	2.0%
Newbury, MA		0.0%	50%	1.0%		0.0%		0.0%	50% 1.0%	2.0%
Portsmouth, NH	50%	1.0%		0.0%		0.0%		0.0%	50% 1.0%	2.0%
Amesbury, MA	50%	1.0%		0.0%		0.0%		0.0%	50% 1.0%	2.0%
Lawrence, MA		0.0%	33%	0.3%		0.0%	33.3%	0.3%	33% 0.3%	1.0%
Rowley, MA		0.0%		0.0%	33%	0.3%	33%	0.3%	33% 0.3%	1.0%
Medford, MA		0.0%		0.0%		0.0%		0.0%	50% 0.5%	0.5%
Beverly, MA		0.0%	50%	0.5%		0.0%		0.0%	50% 0.5%	1.0%
Ipswich, MA		0.0%	50%	0.5%		0.0%		0.0%	50% 0.5%	1.0%
Seabrook, NH	33%	0.3%		0.0%		0.0%	33%	0.3%	33% 0.3%	1.0%
Cambridge, MA		0.0%	50%	0.5%		0.0%		0.0%	50% 0.5%	1.0%
Georgetown, MA		0.0%	50%	0.5%		0.0%		0.0%	50% 0.5%	1.0%
Lynn, MA		0.0%		0.0%		0.0%		0.0%	100% 1.0%	1.0%
West Newbury, MA		0.0%		0.0%		0.0%	50%	0.5%	50% 0.5%	1.0%
Gloucester, MA		0.0%	50%	0.5%		0.0%		0.0%	50% 0.5%	1.0%
Chelmsford, MA		0.0%		0.0%		0.0%	50%	0.5%	50% 0.5%	1.0%
Lowell, MA		0.0%		0.0%		0.0%	50%	0.5%	50% 0.5%	1.0%
North Andover, MA		0.0%		0.0%		0.0%	50%	0.5%	50% 0.5%	1.0%
Salem, NH		0.0%		0.0%		0.0%	100%	0.5%	0.0%	0.5%
Winthrop, MA		0.0%	50%	0.3%		0.0%		0.0%	50% 0.3%	0.5%
Tewksbury, MA		0.0%	33%	0.2%		0.0%	33%	0.2%	33% 0.2%	0.5%
Burlington, MA		0.0%		0.0%		0.0%	50%	0.3%	50% 0.3%	0.5%
Topsfield, MA		0.0%	50%	0.3%		0.0%		0.0%	50% 0.3%	0.5%
Somerville, MA		0.0%	50%	0.3%		0.0%		0.0%	50% 0.3%	0.5%
Newton, MA		0.0%	50%	0.3%		0.0%		0.0%	50% 0.3%	0.5%
Southborough, MA		0.0%		0.0%		0.0%	50%	0.3%	50% 0.3%	0.5%
Framingham, MA		0.0%		0.0%		0.0%	50%	0.3%	50% 0.3%	0.5%
Lexington, MA		0.0%		0.0%		0.0%	50%	0.3%	50% 0.3%	0.5%
Hampton, NH	50%	0.3%		0.0%		0.0%		0.0%	50% 0.3%	0.5%
Chelsea, MA		0.0%		0.0%		0.0%		0.0%	100% 0.5%	0.5%
Other										0.0%
		21.2%		6.0%		4.2%		7.2%	46.9%	85.5%
		25%		7%		5%		8%	55%	100%
SAY		25		6		5		10	55	100

□ Capacity Analyses

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	123	112	129	6	125	11	133	183	11	29	354	147
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	11	15	15	15	12	13	13	12	13	13
Storage Length (ft)	0		150	0		0	165		0	165		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt			0.850		0.989			0.991			0.956	
Flt Protected		0.974			0.998		0.950			0.950		
Satd. Flow (prot)	0	1744	1487	0	1976	0	1752	3499	0	1752	3393	0
Flt Permitted		0.974			0.998		0.950			0.950		
Satd. Flow (perm)	0	1744	1487	0	1976	0	1752	3499	0	1752	3393	0
Right Turn on Red			No			Yes			No			No
Satd. Flow (RTOR)					3							
Link Speed (mph)		30			30			45			45	
Link Distance (ft)		525			133			750			1500	
Travel Time (s)		11.9			3.0			11.4			22.7	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Heavy Vehicles (%)	4%	1%	5%	0%	5%	0%	3%	6%	0%	3%	6%	3%
Adj. Flow (vph)	145	132	152	7	147	13	156	215	13	34	416	173
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	277	152	0	167	0	156	228	0	34	589	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.04	1.04	1.04	0.88	0.88	0.88	1.00	0.96	0.96	1.00	0.96	0.96
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	1	1	1	1		1	1		1	1	
Detector Template												
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Size(ft)	50	50	50	50	50		50	50		50	50	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Turn Type	Split	NA	pt+ov	Split	NA		Prot	NA		Prot	NA	
Protected Phases	4	4	4 5	8	8		5	2		1	6	
Permitted Phases												
Detector Phase	4	4	4 5	8	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		5.0	17.0		5.0	17.0	
Minimum Split (s)	16.0	16.0		16.0	16.0		11.0	23.0		11.0	23.0	

Analysis Period (min) 15
90th %ile Actuated Cycle: 109
70th %ile Actuated Cycle: 96.2
50th %ile Actuated Cycle: 87.4
30th %ile Actuated Cycle: 78
10th %ile Actuated Cycle: 69.4
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Newburyport Turnpike (Route 1) & Low Street/Pond Street



Intersection	
Int Delay, s/veh	0

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	132	0	0	136	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	1	0	0	5	0	0
Mvmt Flow	155	0	0	160	0	0

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	155	0	315	155
Stage 1	-	-	-	-	155	-
Stage 2	-	-	-	-	160	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	1438	-	682	896
Stage 1	-	-	-	-	878	-
Stage 2	-	-	-	-	874	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1438	-	682	896
Mov Cap-2 Maneuver	-	-	-	-	682	-
Stage 1	-	-	-	-	878	-
Stage 2	-	-	-	-	874	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0	0
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	-	-	-	1438	-
HCM Lane V/C Ratio	-	-	-	-	-
HCM Control Delay (s)	0	-	-	0	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	-	-	-	0	-

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Split (s)	24.0	24.0		24.0	24.0		24.0	37.0		24.0	37.0	
Total Split (%)	22.0%	22.0%		22.0%	22.0%		22.0%	33.9%		22.0%	33.9%	
Maximum Green (s)	18.0	18.0		18.0	18.0		18.0	31.0		18.0	31.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		-2.0			-2.0		-2.0	-2.0		-2.0	-2.0	
Total Lost Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lead/Lag							Lead	Lag		Lead	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Vehicle Extension (s)	2.0	2.0		2.0	2.0		1.0	4.0		1.0	4.0	
Recall Mode	None	None		None	None		None	Min		None	Min	
Act Effct Green (s)		19.2	33.0		14.9		13.8	36.3		8.0	25.3	
Actuated g/C Ratio		0.21	0.37		0.17		0.15	0.41		0.09	0.28	
v/c Ratio		0.76	0.29		0.52		0.60	0.17		0.22	0.64	
Control Delay		50.4	12.6		41.8		47.1	19.2		46.1	32.4	
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Delay		50.4	12.6		41.8		47.1	19.2		46.1	32.4	
LOS		D	B		D		D	B		D	C	
Approach Delay		36.9			41.8			30.5			33.1	
Approach LOS		D			D			C			C	
90th %ile Green (s)	18.0	18.0		18.0	18.0		18.0	40.7		8.3	31.0	
90th %ile Term Code	Max	Max		Max	Max		Max	Hold		Gap	Max	
70th %ile Green (s)	18.0	18.0		14.9	14.9		14.8	34.9		6.5	26.6	
70th %ile Term Code	Max	Max		Gap	Gap		Gap	Hold		Gap	Gap	
50th %ile Green (s)	18.0	18.0		12.2	12.2		11.9	29.6		5.3	23.0	
50th %ile Term Code	Max	Max		Gap	Gap		Gap	Hold		Gap	Gap	
30th %ile Green (s)	17.9	17.9		10.0	10.0		9.4	35.3		0.0	19.9	
30th %ile Term Code	Gap	Gap		Min	Min		Gap	Hold		Skip	Gap	
10th %ile Green (s)	13.1	13.1		10.0	10.0		6.3	29.3		0.0	17.0	
10th %ile Term Code	Gap	Gap		Min	Min		Gap	Hold		Skip	Min	
Queue Length 50th (ft)		149	33		89		86	47		19	158	
Queue Length 95th (ft)		#318	68		164		160	79		52	233	
Internal Link Dist (ft)		445			53			670			1420	
Turn Bay Length (ft)			150				165			165		
Base Capacity (vph)		398	679		454		400	1446		400	1278	
Starvation Cap Reductn		0	0		0		0	0		0	0	
Spillback Cap Reductn		0	0		0		0	0		0	0	
Storage Cap Reductn		0	0		0		0	0		0	0	
Reduced v/c Ratio		0.72	0.23		0.38		0.41	0.16		0.09	0.48	

Intersection Summary

Area Type: Other
Cycle Length: 109
Actuated Cycle Length: 89.6
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.76
Intersection Signal Delay: 34.4 Intersection LOS: C
Intersection Capacity Utilization 57.5% ICU Level of Service B

Intersection

Int Delay, s/veh 1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	19	135	3	6	134	1	1	0	1	0	0	12
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	85	85	85	85	85	85	85	85	85	85	85	85
Heavy Vehicles, %	0	1	0	0	5	0	0	0	0	0	0	0
Mvmt Flow	22	159	4	7	158	1	1	0	1	0	0	14

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	159	0	0	162	0	0	384	378	161	378	379	158
Stage 1	-	-	-	-	-	-	205	205	-	172	172	-
Stage 2	-	-	-	-	-	-	179	173	-	206	207	-
Critical Hdwy	4.1	-	-	4.1	-	-	7.1	6.5	6.2	7.1	6.5	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.1	5.5	-	6.1	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.1	5.5	-	6.1	5.5	-
Follow-up Hdwy	2.2	-	-	2.2	-	-	3.5	4	3.3	3.5	4	3.3
Pot Cap-1 Maneuver	1433	-	-	1429	-	-	578	557	889	583	556	893
Stage 1	-	-	-	-	-	-	802	736	-	835	760	-
Stage 2	-	-	-	-	-	-	827	760	-	801	734	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1433	-	-	1429	-	-	559	545	889	572	544	893
Mov Cap-2 Maneuver	-	-	-	-	-	-	559	545	-	572	544	-
Stage 1	-	-	-	-	-	-	788	723	-	821	756	-
Stage 2	-	-	-	-	-	-	810	756	-	786	722	-

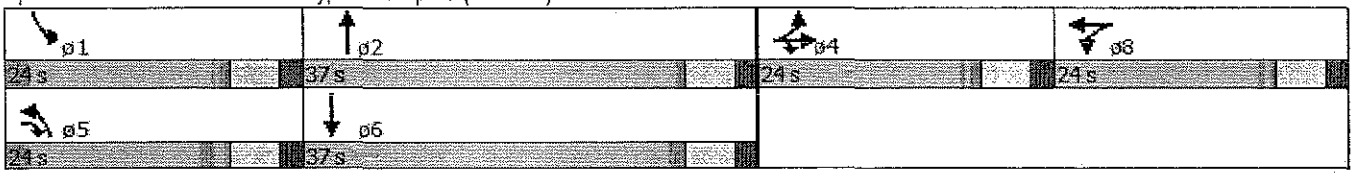
Approach	EB	WB	NB	SB
HCM Control Delay, s	0.9	0.3	10.3	9.1
HCM LOS			B	A

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	686	1433	-	-	1429	-	-	893
HCM Lane V/C Ratio	0.003	0.016	-	-	0.005	-	-	0.016
HCM Control Delay (s)	10.3	7.6	0	-	7.5	0	-	9.1
HCM Lane LOS	B	A	A	-	A	A	-	A
HCM 95th %tile Q(veh)	0	0	-	-	0	-	-	0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	127	120	134	6	133	13	150	194	13	31	367	152
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	11	15	15	15	12	13	13	12	13	13
Storage Length (ft)	0		150	0		0	165		0	165		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt			0.850		0.989			0.991			0.956	
Flt Protected		0.975			0.998		0.950			0.950		
Satd. Flow (prot)	0	1746	1487	0	1976	0	1752	3500	0	1752	3392	0
Flt Permitted		0.975			0.998		0.950			0.950		
Satd. Flow (perm)	0	1746	1487	0	1976	0	1752	3500	0	1752	3392	0
Right Turn on Red			No			Yes			No			No
Satd. Flow (RTOR)					4							
Link Speed (mph)		30			30			45			45	
Link Distance (ft)		525			133			750			1500	
Travel Time (s)		11.9			3.0			11.4			22.7	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Heavy Vehicles (%)	4%	1%	5%	0%	5%	0%	3%	6%	0%	3%	6%	3%
Adj. Flow (vph)	149	141	158	7	156	15	176	228	15	36	432	179
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	290	158	0	178	0	176	243	0	36	611	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.04	1.04	1.04	0.88	0.88	0.88	1.00	0.96	0.96	1.00	0.96	0.96
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	1	1	1	1		1	1		1	1	
Detector Template												
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Size(ft)	50	50	50	50	50		50	50		50	50	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Turn Type	Split	NA	pt+ov	Split	NA		Prot	NA		Prot	NA	
Protected Phases	4	4	4 5	8	8		5	2		1	6	
Permitted Phases												
Detector Phase	4	4	4 5	8	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		5.0	17.0		5.0	17.0	
Minimum Split (s)	16.0	16.0		16.0	16.0		11.0	23.0		11.0	23.0	

Analysis Period (min) 15
90th %ile Actuated Cycle: 109
70th %ile Actuated Cycle: 100.1
50th %ile Actuated Cycle: 90.4
30th %ile Actuated Cycle: 82.2
10th %ile Actuated Cycle: 71.7
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Newburyport Turnpike (Route 1) & Low Street/Pond Street



Intersection	
Int Delay, s/veh	0.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	137	2	0	141	6	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	1	0	0	5	0	0
Mvmt Flow	161	2	0	166	7	0

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	164	0	328	162
Stage 1	-	-	-	-	162	-
Stage 2	-	-	-	-	166	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	1427	-	671	888
Stage 1	-	-	-	-	872	-
Stage 2	-	-	-	-	868	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1427	-	671	888
Mov Cap-2 Maneuver	-	-	-	-	671	-
Stage 1	-	-	-	-	872	-
Stage 2	-	-	-	-	868	-

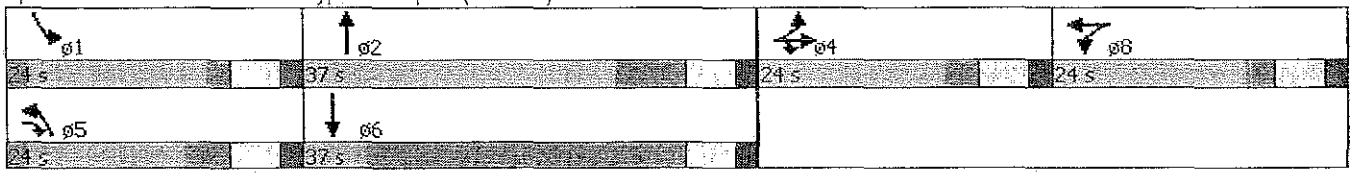
Approach	EB	WB	NB
HCM Control Delay, s	0	0	10.4
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	671	-	-	1427	-
HCM Lane V/C Ratio	0.011	-	-	-	-
HCM Control Delay (s)	10.4	-	-	0	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0	-	-	0	-

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	186	124	127	16	127	19	165	398	13	53	357	124
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	11	15	15	15	12	13	13	12	13	13
Storage Length (ft)	0		150	0		0	165		0	165		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt			0.850		0.984			0.995			0.961	
Flt Protected		0.971			0.995		0.950			0.950		
Satd. Flow (prot)	0	1759	1561	0	2003	0	1787	3676	0	1805	3513	0
Flt Permitted		0.971			0.995		0.950			0.950		
Satd. Flow (perm)	0	1759	1561	0	2003	0	1787	3676	0	1805	3513	0
Right Turn on Red			No			Yes			No			No
Satd. Flow (RTOR)					5							
Link Speed (mph)		30			30			45			45	
Link Distance (ft)		525			133			750			1500	
Travel Time (s)		11.9			3.0			11.4			22.7	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Heavy Vehicles (%)	1%	2%	0%	6%	2%	0%	1%	1%	0%	0%	1%	5%
Adj. Flow (vph)	198	132	135	17	135	20	176	423	14	56	380	132
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	330	135	0	172	0	176	437	0	56	512	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.04	1.04	1.04	0.88	0.88	0.88	1.00	0.96	0.96	1.00	0.96	0.96
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	1	1	1	1		1	1		1	1	
Detector Template												
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Size(ft)	50	50	50	50	50		50	50		50	50	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Turn Type	Split	NA	pt+ov	Split	NA		Prot	NA		Prot	NA	
Protected Phases	4	4	4 5	8	8		5	2		1	6	
Permitted Phases												
Detector Phase	4	4	4 5	8	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		5.0	17.0		5.0	17.0	
Minimum Split (s)	16.0	16.0		16.0	16.0		11.0	23.0		11.0	23.0	

Analysis Period (min) 15
90th %ile Actuated Cycle: 104.7
70th %ile Actuated Cycle: 93.6
50th %ile Actuated Cycle: 84.1
30th %ile Actuated Cycle: 78.5
10th %ile Actuated Cycle: 75.7
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Newburyport Turnpike (Route 1) & Low Street/Pond Street



Intersection

Int Delay, s/veh 0.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	158	3	2	134	2	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	0	0	2	0	0
Mvmt Flow	168	3	2	143	2	1

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	171	0	317	170
Stage 1	-	-	-	-	170	-
Stage 2	-	-	-	-	147	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	1418	-	680	879
Stage 1	-	-	-	-	865	-
Stage 2	-	-	-	-	885	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1418	-	679	879
Mov Cap-2 Maneuver	-	-	-	-	679	-
Stage 1	-	-	-	-	865	-
Stage 2	-	-	-	-	883	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.1	9.9
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	735	-	-	1418	-
HCM Lane V/C Ratio	0.004	-	-	0.002	-
HCM Control Delay (s)	9.9	-	-	7.5	0
HCM Lane LOS	A	-	-	A	A
HCM 95th %tile Q(veh)	0	-	-	0	-

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Split (s)	24.0	24.0		24.0	24.0		24.0	37.0		24.0	37.0	
Total Split (%)	22.0%	22.0%		22.0%	22.0%		22.0%	33.9%		22.0%	33.9%	
Maximum Green (s)	18.0	18.0		18.0	18.0		18.0	31.0		18.0	31.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		-2.0			-2.0		-2.0	-2.0		-2.0	-2.0	
Total Lost Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lead/Lag							Lead	Lag		Lead	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Vehicle Extension (s)	2.0	2.0		2.0	2.0		1.0	4.0		1.0	4.0	
Recall Mode	None	None		None	None		None	Min		None	Min	
Act Effct Green (s)		20.3	34.6		14.8		14.3	30.9		8.8	22.9	
Actuated g/C Ratio		0.23	0.39		0.17		0.16	0.35		0.10	0.26	
v/c Ratio		0.85	0.23		0.53		0.63	0.35		0.33	0.58	
Control Delay		55.6	10.9		40.3		46.2	23.4		45.1	32.3	
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Delay		55.6	10.9		40.3		46.2	23.4		45.1	32.3	
LOS		E	B		D		D	C		D	C	
Approach Delay		42.6			40.3			30.0			33.6	
Approach LOS		D			D			C			C	
90th %ile Green (s)	18.0	18.0		18.0	18.0		18.0	35.3		10.2	27.5	
90th %ile Term Code	Max	Max		Max	Max		Max	Hold		Gap	Gap	
70th %ile Green (s)	18.0	18.0		14.7	14.7		15.5	30.9		7.9	23.3	
70th %ile Term Code	Max	Max		Gap	Gap		Gap	Hold		Gap	Gap	
50th %ile Green (s)	18.0	18.0		12.1	12.1		12.5	26.3		6.4	20.2	
50th %ile Term Code	Max	Max		Gap	Gap		Gap	Hold		Gap	Gap	
30th %ile Green (s)	18.0	18.0		10.0	10.0		9.8	21.7		5.1	17.0	
30th %ile Term Code	Max	Max		Min	Min		Gap	Hold		Gap	Min	
10th %ile Green (s)	18.0	18.0		10.0	10.0		6.9	29.9		0.0	17.0	
10th %ile Term Code	Max	Max		Min	Min		Gap	Hold		Skip	Min	
Queue Length 50th (ft)		179	26		88		93	98		31	133	
Queue Length 95th (ft)		#422	59		174		184	160		78	214	
Internal Link Dist (ft)		445			53			670			1420	
Turn Bay Length (ft)			150				165			165		
Base Capacity (vph)		403	715		463		409	1421		414	1331	
Starvation Cap Reductn		0	0		0		0	0		0	0	
Spillback Cap Reductn		0	0		0		0	0		0	0	
Storage Cap Reductn		0	0		0		0	0		0	0	
Reduced v/c Ratio		0.85	0.20		0.39		0.44	0.32		0.14	0.40	

Intersection Summary

Area Type: Other
Cycle Length: 109
Actuated Cycle Length: 88.5
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.85
Intersection Signal Delay: 35.3 Intersection LOS: D
Intersection Capacity Utilization 63.6% ICU Level of Service B

Intersection

Int Delay, s/veh 1.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	27	165	4	2	139	1	12	1	0	1	1	18
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	94	94	94	94	94	94	94	94	94	94	94	94
Heavy Vehicles, %	0	2	0	0	2	0	0	0	0	0	0	0
Mvmt Flow	29	176	4	2	148	1	13	1	0	1	1	19

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	149	0	0	180	0	0	398	388	178	389	390	148
Stage 1	-	-	-	-	-	-	235	235	-	153	153	-
Stage 2	-	-	-	-	-	-	163	153	-	236	237	-
Critical Hdwy	4.1	-	-	4.1	-	-	7.1	6.5	6.2	7.1	6.5	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.1	5.5	-	6.1	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.1	5.5	-	6.1	5.5	-
Follow-up Hdwy	2.2	-	-	2.2	-	-	3.5	4	3.3	3.5	4	3.3
Pot Cap-1 Maneuver	1445	-	-	1408	-	-	566	550	870	574	548	904
Stage 1	-	-	-	-	-	-	773	714	-	854	775	-
Stage 2	-	-	-	-	-	-	844	775	-	772	713	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1445	-	-	1408	-	-	543	537	870	563	535	904
Mov Cap-2 Maneuver	-	-	-	-	-	-	543	537	-	563	535	-
Stage 1	-	-	-	-	-	-	756	698	-	835	773	-
Stage 2	-	-	-	-	-	-	823	773	-	754	697	-

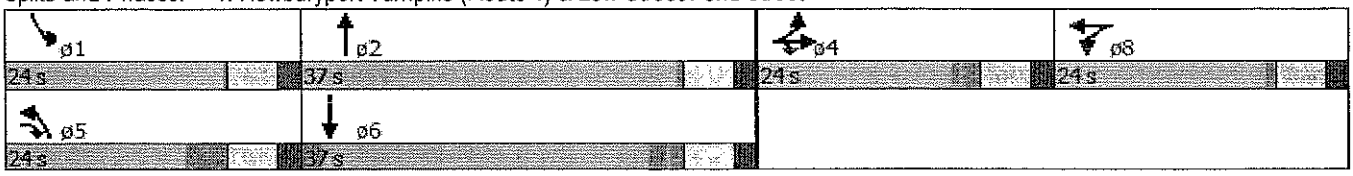
Approach	EB	WB	NB	SB
HCM Control Delay, s	1	0.1	11.8	9.3
HCM LOS			B	A

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	543	1445	-	-	1408	-	-	849
HCM Lane V/C Ratio	0.025	0.02	-	-	0.002	-	-	0.025
HCM Control Delay (s)	11.8	7.5	0	-	7.6	0	-	9.3
HCM Lane LOS	B	A	A	-	A	A	-	A
HCM 95th %tile Q(veh)	0.1	0.1	-	-	0	-	-	0.1

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	193	141	132	17	133	21	177	415	14	61	370	128
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	11	15	15	15	12	13	13	12	13	13
Storage Length (ft)	0		150	0		0	165		0	165		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt			0.850		0.984			0.995			0.962	
Flt Protected		0.972			0.995		0.950			0.950		
Satd. Flow (prot)	0	1760	1561	0	2003	0	1787	3676	0	1805	3517	0
Flt Permitted		0.972			0.995		0.950			0.950		
Satd. Flow (perm)	0	1760	1561	0	2003	0	1787	3676	0	1805	3517	0
Right Turn on Red			No			Yes			No			No
Satd. Flow (RTOR)					6							
Link Speed (mph)		30			30			45			45	
Link Distance (ft)		525			133			750			1500	
Travel Time (s)		11.9			3.0			11.4			22.7	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Heavy Vehicles (%)	1%	2%	0%	6%	2%	0%	1%	1%	0%	0%	1%	5%
Adj. Flow (vph)	205	150	140	18	141	22	188	441	15	65	394	136
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	355	140	0	181	0	188	456	0	65	530	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.04	1.04	1.04	0.88	0.88	0.88	1.00	0.96	0.96	1.00	0.96	0.96
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	1	1	1	1		1	1		1	1	
Detector Template												
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Size(ft)	50	50	50	50	50		50	50		50	50	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Turn Type	Split	NA	pt+ov	Split	NA		Prot	NA		Prot	NA	
Protected Phases	4	4	4 5	8	8		5	2		1	6	
Permitted Phases												
Detector Phase	4	4	4 5	8	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		5.0	17.0		5.0	17.0	
Minimum Split (s)	16.0	16.0		16.0	16.0		11.0	23.0		11.0	23.0	

Analysis Period (min) 15
90th %ile Actuated Cycle: 105.5
70th %ile Actuated Cycle: 96
50th %ile Actuated Cycle: 87.3
30th %ile Actuated Cycle: 79.1
10th %ile Actuated Cycle: 76.1
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Newburyport Turnpike (Route 1) & Low Street/Pond Street



Intersection

Int Delay, s/veh 0.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	163	10	2	141	4	2
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	0	0	2	0	0
Mvmt Flow	173	11	2	150	4	2

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	184	0	333	179
Stage 1	-	-	-	-	179	-
Stage 2	-	-	-	-	154	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	1403	-	666	869
Stage 1	-	-	-	-	857	-
Stage 2	-	-	-	-	879	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1403	-	665	869
Mov Cap-2 Maneuver	-	-	-	-	665	-
Stage 1	-	-	-	-	857	-
Stage 2	-	-	-	-	877	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.1	10
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	721	-	-	1403	-
HCM Lane V/C Ratio	0.009	-	-	0.002	-
HCM Control Delay (s)	10	-	-	7.6	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0	-	-	0	-

TRAFFIC IMPACT AND ACCESS STUDY

PROPOSED RESIDENTIAL DEVELOPMENT

4 Hillside Avenue
Newburyport, Massachusetts

Prepared for:
Hall and Moskow Corporation

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MDM TRANSPORTATION CONSULTANTS, INC.
Planners & Engineers

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