ROAD SAFETY AUDIT
For
Chestnut Street/Hancock Street Intersection
Abington, MA

December 2014

Prepared by:

Old Colony Planning Council
70 School Street
Brockton, MA. 02301
(508) 583-1833
www.ocpcrpa.org

MassDOT Contract # 69649

Acknowledgements and Title VI Notice of Protection

The preparation of this report has been financed in part through grant[s] from the Federal Highway Administration, U.S. Department of Transportation, under the State Planning and Research Program, Section 505 [or Metropolitan Planning Program, Section 104(f)] of Title 23, U.S. Code.

This report was funded in part through grant[s] from the Federal Highway Administration [and Federal Transit Administration], U.S. Department of Transportation. The views and opinions of the Old Colony Planning Council expressed herein do not necessarily state or reflect those of the U. S. Department of Transportation.

Notice of Nondiscrimination Rights and Protections to Beneficiaries

<u>Federal "Title VI/Nondiscrimination" Protections</u>

The Old Colony Metropolitan Planning Organization (MPO) operates its programs, services, and activities in compliance with federal nondiscrimination laws including Title VI of the Civil Rights Act of 1964 (Title VI), the Civil Rights Restoration Act of 1987, and related statutes and regulations. Title VI prohibits discrimination in federally assisted programs and requires that no person in the United States of America shall, on the grounds of race, color, or national origin (including limited English proficiency), be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity receiving federal assistance. Related federal nondiscrimination laws administrated by the Federal Highway Administration, the Federal Transit Administration, or both prohibit discrimination on the basis of age, sex, and disability. These protected categories are contemplated within the Old Colony MPO's Title VI Programs consistent with federal interpretation and administration. Additionally, the Old Colony MPO provides meaningful access to its programs, services, and activities to individuals with limited English proficiency, in compliance with US Department of Transportation policy and guidance on federal Executive Order 13166.

<u>State Nondiscrimination Protections</u>

The Old Colony MPO also complies with the Massachusetts Public Accommodation Law, M.G.L. c 272 §§ 92a, 98, 98a, prohibiting making any distinction, discrimination, or restriction in admission to or treatment in a place of public accommodation based on race, color, religious creed, national origin, sex, sexual orientation, disability, or ancestry. Likewise, the Old Colony MPO complies with the Governor's Executive Order 526, section 4 requiring all programs, activities, and services provided, performed, licensed, chartered, funded, regulated, or contracted for by the state shall be conducted without unlawful discrimination based on race, color, age, gender, ethnicity, sexual orientation, gender identity or expression, religion, creed, ancestry, national origin, disability, veteran's status (including Vietnam-era veterans), or background.

<u>Additional Information</u>

To request additional information regarding Title VI and related federal and state nondiscrimination obligations, please contact:

Old Colony Planning Council
Title VI/ Nondiscrimination Coordinator
Pat Ciaramella
70 School Street
Brockton, MA 02301
508-583-1833 Extension 202
pciaramella@ocpcrpa.org

Title VI Specialist
MassDOT, Office of Diversity and Civil Rights
10 Park Plaza
Boston, MA 02116
857-368-8580
TTY: 857-368-0603
MASSDOT.CivilRights@state.ma.us

<u>Complaint Filing</u>

To file a complaint alleging a violation of Title VI or related federal nondiscrimination law, contact the Title VI Specialist (above) within 180 days of the alleged discriminatory conduct.

To file a complaint alleging a violation of the state's Public Accommodation Law, contact the Massachusetts Commission against Discrimination within 300 days of the alleged discriminatory conduct at:

Massachusetts Commission Against Discrimination (MCAD)
One Ashburton Place, 6th Floor
Boston, MA 02109
617-994-6000
TTY: 617-994-6196

Translation

English: If this information is needed in another language, please contact Pat Ciaramella at 508-583-1833 Extension 202.

Portuguese: Se esta informação é necessária em outro idioma, entre em contato com Pat Ciaramella em 508-583-1833 Ramal 202.

Spanish: Si se necesita esta información en otro idioma, por favor póngase en contacto con Pat Ciaramella al 508-583-1833 extensión 202.

Chinese Simplified: (mainland & Singapore): 如果这个信息是需要用另一种语言，请联系帕特Ciaramella在508-583-1833分机202。

Chinese Traditional: (Hong Kong & Taiwan): 如果這個信息是需要用另一種語言，請聯繫帕特Ciaramella在508-583-1833分機202。

Russian: Если эта информация необходима на другом языке, пожалуйста, свяжитесь с Пэт Сиарамелла на 508-583-1833 Extension 202.

Haitian Creole: Si ou bezwen enfòmasyon sa a nan yon lòt lang, tanpri kontakte breve Ciaramella nan 508-583-1833 Ekstansyon 202.

Vietnamese: Nếu thông tin này là cần thiết trong một ngôn ngữ khác, xin vui lòng liên hệ với Pat Ciaramella tại 508-583-1833 mở rộng 202.

French: Si cette information est nécessaire dans une autre langue, s'il vous plaît communiquer avec Pat Ciaramella au 508-583-1833 extension 202.

Italian: Se questa informazione è necessaria in un'altra lingua, si prega di contattare Pat Ciaramella al 508-583-1833 Extension 202.

Khmer: ប្រសិនបើព័ត៌មាននេះត្រូវបានត្រូវការនៅក្នុងភាសាមួយផ្សេងទៀតសូមទាក់ទងប៉ាត់ Ciaramella នៅផ្នែកបន្ថែម 508-583-1833 202 ។

Arabic: إذا كانت هناك حاجة هذه المعلومات في لغة أخرى، يرجى الاتصال باتCiaramella.202 امتداد 1833-583-508 في

Report Preparation

Ray Guarino, Senior Transportation Planner
rguarino@ocpcrpa.org

Traffic Data Collection and Analysis

William McNulty, Senior Transportation Planner
wmnulty@ocpcrpa.org

Kyle Mowatt, Transportation Planner
kmowatt@ocpcrpa.org

Mapping and Graphics

Andrew Vidal, GIS Manager/Communications and IT Specialist
avidal@ocpcrpa.org

Old Colony Metropolitan Planning Organization

The Honorable William Carpenter	Mayor, City of Brockton
Kenneth Tavares	Chairman, Board of Selectmen, Plymouth
Daniel Salvucci	Vice Chairman, Board of Selectmen, Whitman
Eldon Moreira	Chairman, Board of Selectmen, West Bridgewater
Frank DePaolo, P.E.	Acting Secretary and CEO, MassDOT
Frank DePaolo, P.E.	Highway Administrator, MassDOT
Reinald Ledoux, Jr.	Administrator, BAT
Lee Hartmann, AICP	President, OCPC

Joint Transportation Committee
JTC Officers

JTC Chairman	Noreen O'Toole
JTC Vice Chairman	Sid Kashi, P.E.

COMMUNITY	DELEGATE / ALTERNATE
Abington - *Delegate*	John Caine
Abington - *Alternate*	Bruce Hughes
Avon	William Fitzgerald
Bridgewater	Robert Wood
Brockton - *Delegate*	Larry Rowley
Brockton - *Alternate*	Elaine Czaja
Duxbury - *Delegate*	Peter Buttkus
East Bridgewater - *Delegate*	John Haines
East Bridgewater - *Alternate*	Richard O'Flaherty
Easton - *Delegate*	David Field, P.E.
Easton - *Alternate*	Maurice Goulet
Halifax	Robert Badore
Hanson	Donald Howard
Kingston	Paul Basler
Pembroke	Gene Fulmine
Plymouth	Sid Kashi, P.E.
Plympton	Jim Mulcahy
Stoughton - *Delegate*	Noreen O'Toole
Stoughton - *Alternate*	Marc Tisdelle
West Bridgewater	Leonard Graf, III
Whitman	Daniel Salvucci
Delegate-at-Large	Troy E. Garron

Agency Representation

MassDOT	David Mohler, AICP
MassDOT	Clinton Bench
MassDOT	Sreelatha Allam
MassDOT District 5	Mary-Joe Perry
MassDOT District 5	Pamela Haznar, P.E.
MassDOT District 5	Timothy Kochan
BAT	Reinald Ledoux, Jr.
BAT	Kathy Riddell
DEP	Christine Kirby
EPA	Donald Cook
FHWA	Pamela Stephenson
FHWA	Michael Chong
FTA	Mary Beth Mello
FTA	Noah Berger
FTA	Nicolas Garcia
Brockton Traffic Commission	Captain Robert Dibari

OCPC Transportation Staff

Charles Kilmer, AICP	Assistant Director/ Transportation Program Manager
Eric Arbeene	Community Planner
Shawn Bailey	Temporary Transportation Technician
Joshua Callahan	Temporary Transportation Technician
Paul Chenard	Transportation Planner
Jed Cornock	Senior Transportation Planner
Ray Guarino	Senior Transportation Planner
William McNulty	Senior Transportation Planner
Kyle Mowatt	Transportation Planner
Jimmy Pereira	Community/Transportation Planner
Andrew Vidal	GIS Manager/ Communications and IT Specialist

Old Colony Planning Council (OCPC)

OCPC Officers

President	Lee Hartmann, AICP
Treasurer	Fred Gilmetti
Secretary	Frank P. Staffier

COMMUNITY	DELEGATE	ALTERNATE
Abington	Christopher Aiello	David Klein
Avon	Frank P. Staffier	Charles Marinelli
Bridgewater	Anthony P. Anacki	
Brockton	Robert G. Moran, Jr.	Preston Huckabee, P.E.
Duxbury	Thomas Broadrick, AICP	George D. Wadsworth
East Bridgewater	Richard O'Flaherty	
Easton	Jeanmarie Kent Joyce	Stephen Donahue
Halifax	John G. Mather	
Hanson	Robert Overholtzer	Phillip Lindquist
Kingston	Justin Anderson	
Pembroke	Gerard W. Dempsey	Daniel Trabucco
Plymouth	Lee Hartmann, AICP	
Plympton	John Rantuccio	James Mulcahy
Stoughton	Robert E. Kuver	Forrest Lindwall
West Bridgewater	Eldon F. Moreira	Nancy Bresciani
Whitman	Fred L. Gilmetti	Daniel L. Salvucci
Delegate-at-Large	Troy E. Garron	

OCPC Staff

Pat Ciaramella	Executive Director
Janet McGinty	Fiscal Officer
Jane Linhares	Grants Monitor/ Secretary
Patrick Hamilton	AAA Administrator
Lila Burgess	Ombudsman Program Director
Anne Nicholas	Ombudsman Program Assistant
Jim Watson, AICP	Comprehensive Planning Supervisor
Eric Arbeene	Community Planner
Bruce Hughes	Economic Development/ Community Planner
Andrew Vidal	GIS Manager/ Communications and IT Specialist
Charles Kilmer, AICP	Assistant Director/ Transportation Program Manager
Jed Cornock	Senior Transportation Planner
Ray Guarino	Senior Transportation Planner
William McNulty	Senior Transportation Planner
Paul Chenard	Transportation Planner
Kyle Mowatt	Transportation Planner
Jimmy Pereira	Community/Transportation Planner
Shawn Bailey	Temporary Transportation Technician
Joshua Callahan	Temporary Transportation Technician
Shauna Diersch	Planning Intern

Table of Contents

1.0 Introduction 1
2.0 The Road Safety Audit 1
2.1 Choosing the Road Safety Audit Team 3
2.2 The RSA Procedure 4
3.0 Background Data 4
3.1 Physical Attributes 4
3.2 Average Daily Traffic, 85th Percentile Speeds, and Heavy Vehicles 5
3.3 Intersection Volumes and Levels-of-Service 6
3.4 Crash Data and Analyses 8
4.0 Safety Challenges and Observed Deficiencies 9
4.1.1 Pre-Audit Meeting and Discussion 9
4.2 Recommendations and Countermeasures for Consideration 11
4.2.1 Build Level-of-Service Analyses 13
4.2.2 Field Audit Findings 14
4.2.3 Alternative Recommendation Analysis 14
5.0 Conclusions and Next Steps 16
5.1 Next Steps 16
6.0 Appendix 16
6.1 Audit Meeting Agenda 16
6.2 Safety Audit and Meeting Sign-up Sheet 16
6.3 Morning and Afternoon Intersection Peak Hour Turning Movement Data 16
6.4 Automatic Traffic Recorder Vehicle Volumes, Speeds, and Vehicle Classifications 16
6.5 AM and PM Intersection Peak Hour Levels-of-Service 16
6.6 Signal Warrant and Multi-Way Stop Analyses Summaries 16
6.7 Crash Rate Work Sheets and Collision Diagrams 16
6.8 Profile of the Hancock Street Grade on the Northbound Approach 16

1.0 Introduction

This Road Safety Audit (RSA) was conducted for the intersection of Chestnut Street at Hancock Street by the Old Colony Planning Council (OCPC) at the request of the Town of Abington. The request was made due to correspondence from the public to the town regarding safety at the intersection. The location of the intersection is shown in Figure 1. The town's request for assistance from OCPC is included in the appendix to this report.

2.0 The Road Safety Audit

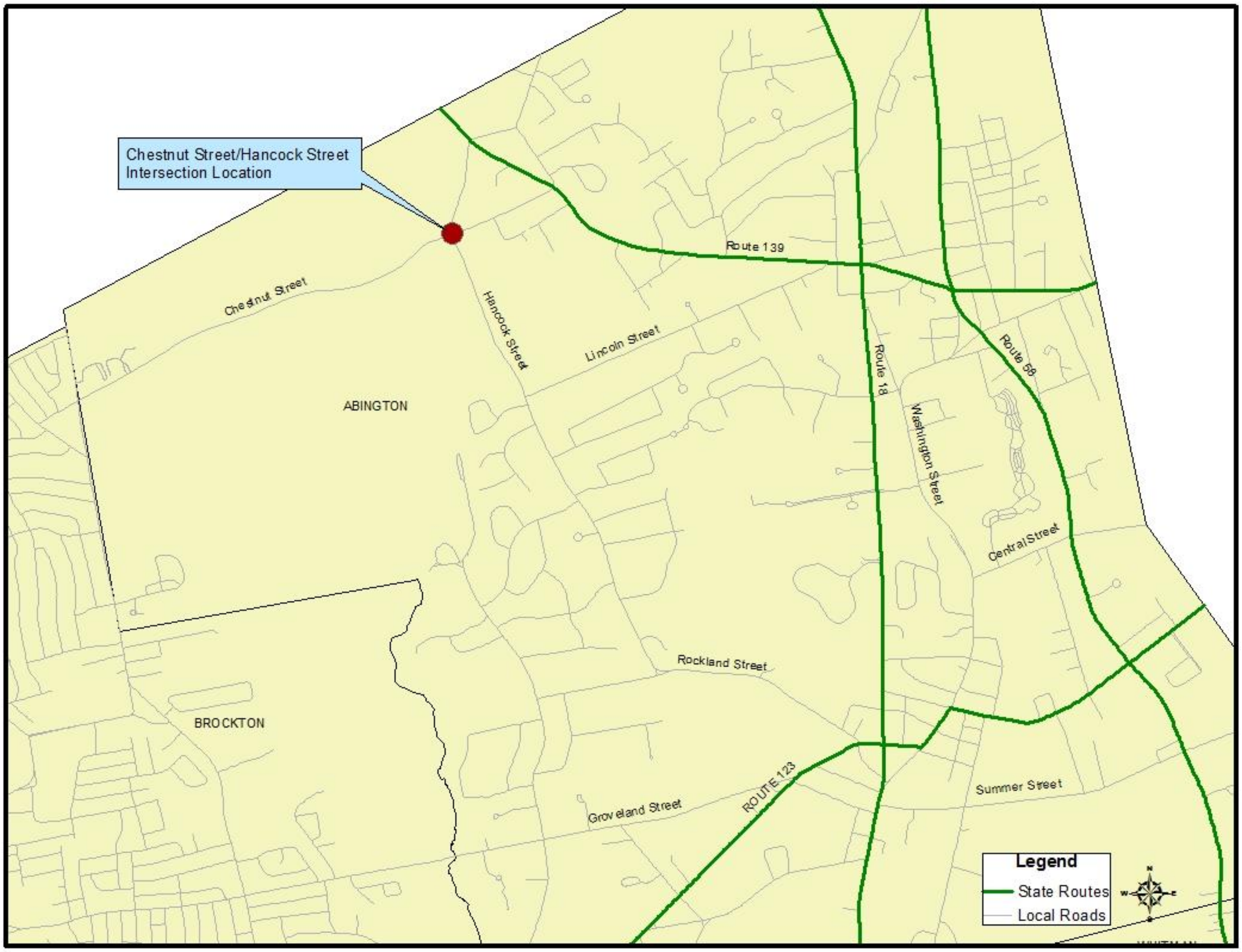
A Road Safety Audit (RSA) is defined by the Federal Highway Administration (FHWA) *Road Safety Audits Guidelines* as; "A formal safety performance examination of an existing or future road or intersection by an independent audit team." The RSA qualitatively estimates and reports on potential road safety issues and identifies opportunities for improvements in safety for all road users. It is conducted by an independent multi-disciplinary team. The RSA includes the following elements:

- The RSA is performed by an independent team
- The RSA is performed by a multi-disciplined team
- The RSA considers all potential road users
- The RSA accounts for road user capabilities and limitations
- The RSA generates a formal report
- The RSA requires a response from the project owner (in this case the Town of Abington)

In summary, the RSA is a proactive, formal examination that focuses on road safety, which is conducted by a multi-disciplinary team independent of the project owner (or the requester of the study). The audit team must be adequately qualified individually and as a team. The RSA is qualitative in nature, although crash data, traffic data, and analyses are necessary, and the safety of all road users and facilities are considered. This report includes average daily traffic volume counts, manual turning movement counts and level-of-service analysis, crash data compilation and analyses, and intersection warrant analyses for traffic signal and multi-way stop control implementation.

It is important for participants to understand the roles and responsibilities of organizations involved in the RSA. OCPC is the manager and facilitator of the process, responsible for data collection and compilation, analysis, grant and funding support, and facilitator of the meetings and field visit. The Town of Abington is charged with taking the initiative for action and implementation of the proposed alternative recommendations made by the support team. The recommendations will consist of a number of alternatives (or combination of actions) including short term, less expensive actions and long term, more costly alternatives. OCPC is available to assist with acquiring state and federal grants and funding for projects, as projects can draw on a combination of funding sources.

Figure 1- Intersection Location



2.1 Choosing the Road Safety Audit Team

The main objective in selecting an RSA team, according to the Federal Highway Administration's (FHWA) *Road Safety Audit Guidelines* is to choose an independent, qualified, and multi-disciplinary team of experts. The guidelines recommended including individuals with the following backgrounds:

- Road Safety Specialist - With expertise in causal factors that lead to crashes and effective treatments that address the occurrence of such crashes.
- Traffic Operations Engineer – Qualified in the field of traffic operations and understand the principles of traffic flow, the causes of congestion, and the proper placement and uses of signs, pavement markings, and traffic signal operations.
- Road Design Engineer – With extensive road design experience and familiarity with federal, state, and local standards.
- Local Contact Person – With familiarity with the area under review and the traffic safety issues experienced there.
- Other Areas of Specialties – These include specialists in human factors, maintenance, law enforcement, first response, pedestrian and bicycle use, and transit use.

The FHWA guidelines recommend that the best practice regarding the size of the team is to limit its size. The team should consult with other individuals if other skill sets are necessary. Those participating in the RSA on August 24, 2014 included:

John M. Nuttall, Fire Chief, Abington Fire Department
John Caine, Superintendent, Abington Highway Department
John Stone, Abington Sewer Department
Rick LaFond, Abington Town Manager
David G. Majenski, Chief of Police, Abington Police Department
Jacob Poulin, Police Officer, Abington Police Department
Bruce Hughes, OCPC Economic Development/Community Planner and Abington Planning Board Member
Wayne P. Smith, Abington Planning Board Chairman
Lisa Schletzbaum, MassDOT
Kyle Mowatt, Transportation Planner, OCPC
Ray Guarino, Senior Transportation Planner, OCPC

A copy of the attendance sheet for the pre-audit meeting and the field audit is included in the appendix to this report.

2.2 The RSA Procedure

After receiving a request from the Town of Abington, regarding safety at the Chestnut Street/Hancock Street intersection, the Road Safety Audit (RSA) was scheduled, in collaboration with the Town Manager, for October 15, 2014 at 10:00 AM at the Abington Police Department conference room. The agenda for the meeting is included in the appendix to this report. OCPC compiled background traffic for the intersection, level-of-service analysis, and crash data. The agenda, data, and analyses were distributed to the RSA participants prior to the RSA meeting on October 15th.

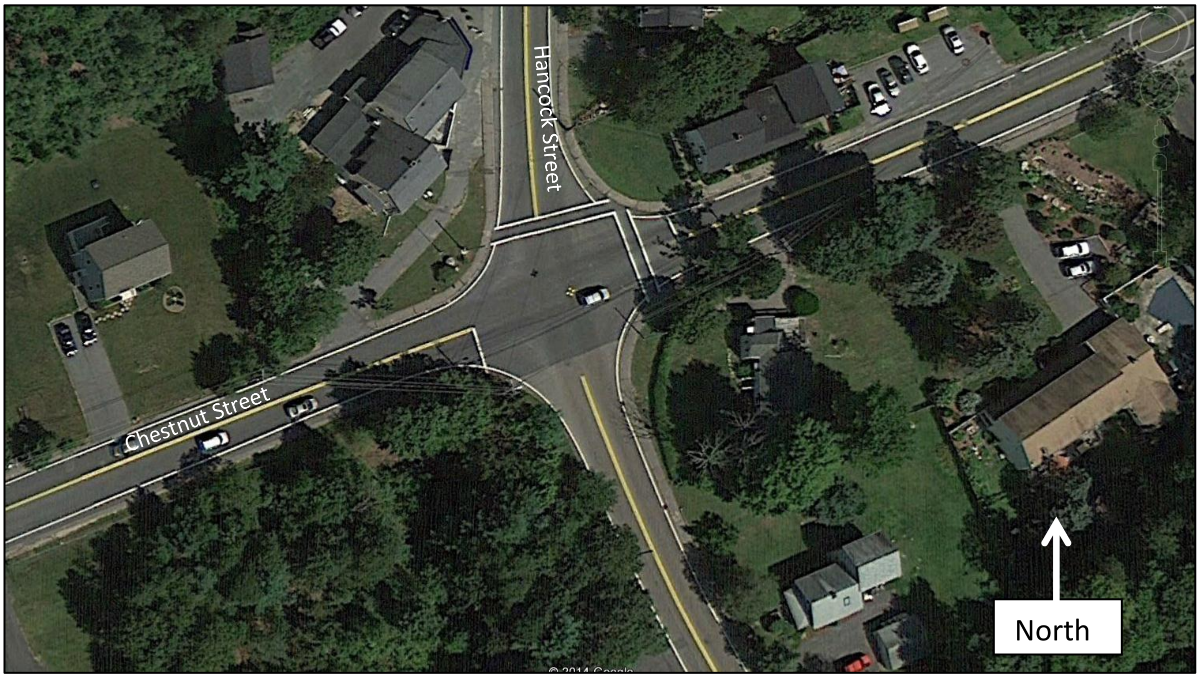
3.0 Background Data

3.1 Physical Attributes

In the Massachusetts Department of Transportation's (MassDOT) road inventory file, Chestnut Street is classified as a collector road under the jurisdiction of the Town of Abington. Chestnut Street is a two lane road that runs east-west connecting Route 139 in Abington to North Quincy Street in Brockton. The speed limit is posted at 45 miles per hour eastbound on Chestnut Street in Abington just east of North Quincy Street in Brockton. The Woodsdale Elementary School is located on Chestnut Street east of the Chestnut Street/Hancock Street intersection. There is a school zone with speed limits at 20 miles per hour on Chestnut Street in the vicinity of the Woodsdale School. Hancock Street is classified as a connector road under the jurisdiction of the Town of Abington. Hancock Street is a two lane connector road that runs north-south in Abington between Route 139 and Rockland Street. The posted speed limit southbound on Hancock Street approaching the intersection is 35 miles per hour. South of the intersection, the posted speed limit is 40 miles per hour northbound and it changes to 25 miles per hour approaching the intersection. There are intersection ahead warning signs on all four approaches to the intersection. Although the roads are under the jurisdiction of the Town of Abington, the intersection is eligible for federal funding under the Surface Transportation Program (STP).

The Chestnut Street/Hancock Street intersection in Abington is un-signalized with a stop control on the eastbound and westbound Chestnut Street approaches. All four approaches to the intersection provide a single shared right/through/left turn lane. The northbound Hancock Street approach contains a hill just as it intersects Chestnut Street, which results in a downgrade slope for vehicles entering the intersection from this approach. There is a country store located on the northwest quadrant of the intersection with a curb cut on the Hancock Street southbound approach for vehicle parking. The northbound approach also contains curb cuts for residential driveways. There is a line of hedges on the northbound approach to the intersection, on the downward slope along the southeast quadrant, which interferes with the line of sight for vehicles stopped at the stop sign on the westbound Chestnut Street approach. Figure 2 shows the aerial view of the intersection.

Figure 2



3.2 Average Daily Traffic, 85th Percentile Speeds, and Heavy Vehicles

OCPC conducted traffic counts using automatic traffic recorders in August of 2014 on the study area roads. The average daily traffic (total traffic within a 24-hour period) was determined based on these counts. In addition, the automatic traffic counters collected speed data (85th percentile speeds) as well as the percentage of truck traffic in the traffic stream. Table 1 summarizes the traffic volume data collected utilizing the automatic traffic recorders at the study area locations for an average weekday (24-hour period), as well as the prevailing speeds and percentage of heavy vehicles in the traffic flow.

Table 1 Average Daily Traffic Vehicles Per Day (VPD)

Traffic Count Location	East Bound	West Bound	Total	85th Percentile Speeds (both directions)	Percent Heavy Vehicles
1. Chestnut Street east of Hancock Street	2,827	2,888	5,715	39 miles per hour	7.5 %
2. Chestnut Street west of Hancock Street	3,983	3,819	7,802	50 miles per hour	12.0 %
3. Hancock Street north of Chestnut Street	2,950	2,753	5,703	40 miles per hour	5.2 %
4. Hancock Street south of Chestnut Street	3,024	3,103	6,127	37 miles per hour	3.0 %

As shown in Table 1, Chestnut Street west of Hancock Street has 7,802 VPD. This location was the highest traffic count location. The Hancock Street location south of Chestnut Street had 6,127 VPD, the second highest count location. Chestnut Street east of Hancock Street had 5,715 VPD and Hancock Street north of Chestnut Street had 5,703 VPD. The traffic recorders measured the 85th percentile speed, which is the speed that 85 percent of traffic is travelling at or below.

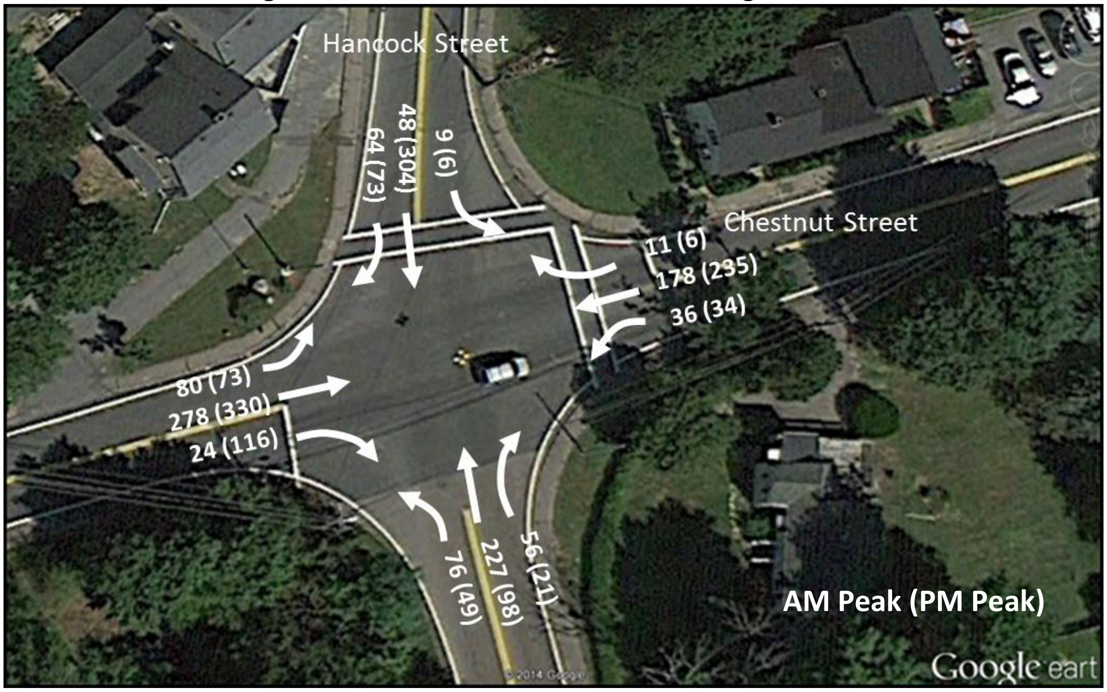
The heavy vehicle data is classified into categories based on the Federal Highway Administration (FHWA) classification system. Any vehicle with a minimum of two axles and six tires is considered a heavy vehicle. As shown in Table 1, at the count location on Chestnut Street east of Hancock Street, the percent of heavy vehicles in the traffic flow was at 7.5 percent, and the 85th percentile speed was 39 miles per hour. At the Chestnut Street location west of Hancock Street, the automatic traffic recorder recorded 12.0 percent heavy vehicles in the traffic flow and an 85th percentile speed of 50 miles per hour. This location had the highest number of trucks and highest speeds in the study area. The percentage of heavy vehicles at the Hancock Street location, north of Chestnut Street was 5.2 percent, and the 85th percentile speed was 40 miles per hour. The location on Hancock Street south of Chestnut Street had 3.0 percent trucks and an 85th Percentile speed of 37 miles per hour.

3.3 Intersection Volumes and Levels-of-Service

Manual turning movement counts were conducted in September 2013 at the Chestnut Street/Hancock Street intersection during the morning, 7:00 AM to 9:00 AM and afternoon, 4:00 PM to 6:00 PM periods to determine the morning and afternoon peak hours (the highest one-hour volumes.) Figure 3 shows the AM and PM Peak hour turning movements at the Hancock Street/Chestnut Street intersection.

The turning movement reports summarizing the morning and afternoon peak hour volumes are included in the appendix to this report. As shown in Figure 3, the heaviest volumes at the intersection occurred during the PM Peak hour with 330 vehicles headed through on the Chestnut Street eastbound approach, 304 vehicles southbound on Hancock Street, and 295 vehicles headed through on Chestnut Street westbound. There were also heavy right turn volumes on Chestnut Street eastbound during the PM Peak hour with 116 vehicles.

Figure 3 Peak Hour Intersection Turning Movements



The level-of-service helps to discern the existing traffic operating conditions at an intersection. Level-of-service analyses are a qualitative and quantitative measure based on the techniques published in the *Highway Capacity Manual* by the Transportation Research Board. Level-of-service is a general measure that summarizes the overall operation of an intersection or transportation facility. It is based upon the operational conditions of a facility including lane use, traffic control, and lane width, and takes into account such factors as operating speeds, traffic interruptions, and freedom to maneuver.

Level-of-service represents a range of operating conditions and is summarized with letter grades from “A” to “F”, with “A” being the most desirable. Level-of-service “E” represents the maximum flow rate or the capacity on a facility. The following describes the characteristics of each level-of-service:

- LOS "A" represents free flow. Individual users are virtually unaffected by the presence of others in the traffic stream.
- LOS "B" is in the range of stable flow, but the presence of other users in the traffic stream begins to be noticeable. Freedom to select desired speeds is still relatively unaffected.
- LOS "C" is in the range of stable flow, but marks the beginning of the range of flow in which the operation of individual users becomes significantly affected by interactions with others in the traffic stream. Occasional backups occur behind turning vehicles.

- LOS "D" represents high-density, but stable, flow. Speed and freedom to maneuver are restricted, and the driver experiences a below average level of comfort and convenience. Small increases in traffic flow will generally cause operational problems at this level.
- LOS "E" represents operating conditions at or near the capacity level. All speeds are reduced to a low, but relatively uniform level. Freedom to maneuver within the traffic stream is extremely limited, and generally requires forcing other vehicles to give way. Congestion levels and delay are very high.
- LOS "F" is representative of forced or breakdown flow. This condition exists wherever the amount of traffic approaching a point exceeds the amount that can traverse the point, resulting in lengthy queues and delay.

The LOS definitions describe conditions based on a number of operational parameters. There are certain parameters utilized as measures of effectiveness for specific facilities. In the case for intersections, two-lane highways, and arterials, which represent the physical conditions that typify the study area corridors, time delay, average stop delay, and average travel speed are used as measures of operational effectiveness to which levels of service are assigned.

The Chestnut Street/Hancock Street intersection is classified as a two-way stop controlled intersection (TWSC) as the traffic eastbound on Chestnut Street and westbound on Chestnut Street must stop to allow Hancock Street traffic the right of way. Level-of-service analysis was conducted for the intersection utilizing the turning movement volumes. The analysis showed that the traffic flow on the eastbound and westbound Chestnut Street approaches are at the LOS “F” level for both the AM and PM peak hour conditions for all turning movements, which denotes forced flow and failed operating conditions with very long delays and back-ups.

3.4 Crash Data and Analyses

The Institute of Transportation Engineers (ITE) Handbook, *Manual of Traffic Engineering Studies* recommends that three years of crash data be compiled for safety analysis. Crash data was compiled for the Chestnut Street/Hancock Street intersection based on crash reports supplied by the Abington Police Department for a three year period between June 2010 and June 2013. There were 25 crashes that occurred within the three year study period. Table 2 summarizes the intersection crash data.

Table 2 Crash Data Summary for Chestnut Street/Hancock Street Intersection

	2010	2011	2012	2013	Total
Personal Injury	0	6	0	2	9
Property Damage Only	1	3	7	3	14
Severity unknown	0	1	2	0	3
Total	1	10	9	5	25
Angle - Cross Movement	1	8	7	4	20
Side-Swipe	0	1	0	0	1
Head-On	0	0	0	1	1
Rear-End	0	0	0	0	0
Ran off road	0	0	0	0	0
Unknown	0	1	2	0	3
Total	1	10	9	5	25

Data source, Abington Police Department

Table 2 shows that nine of the 25 crashes (36 percent) within the study time period involved personal injury. The majority of crashes that occurred at the intersection were angle type crashes. There were 20 angle crashes (80 percent) that occurred at the intersection within the time period. There was one side swipe crash, one head-on crash, and three crashes with the type unknown.

The crash rate was calculated for the Chestnut Street/Hancock Street intersection. The crash rate indicates the frequency of crashes at intersections and measures the crash exposure. It is based on the number of crashes per million entering vehicles (MEV). The crash rates calculated for intersections in this study are based upon the ITE equation in the *Manual of Traffic Engineering Studies*. The crash rate per million entering vehicles is the number of accidents in a year (averaged over three years) times one million, divided by the number of vehicles entering the intersection in a year. The crash rate for the intersection was calculated to be 1.53 crashes per million entering vehicles. The average crash rate for un-signalized intersections in MassDOT District 5 is 0.58 MEV. The average crash rate for un-signalized intersections in Massachusetts is 0.60 MEV. The crash rate for this intersection is more than double both the MassDOT District 5 averages and the Massachusetts average. The crash rate calculations, as well as a collision diagram, are included in the appendix to this report.

4.0 Safety Challenges and Observed Deficiencies

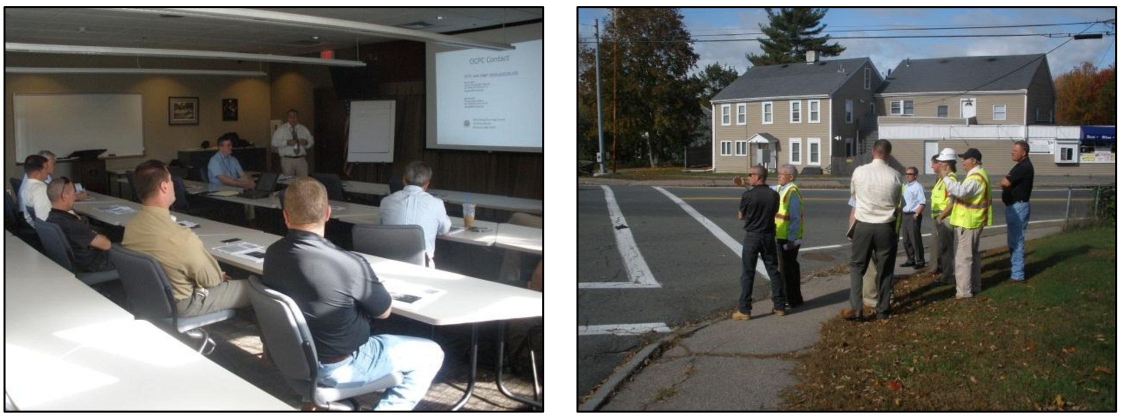
4.1.1 Pre-Audit Meeting and Discussion

OCPC held a pre-field visit meeting and discussion with the RSA team regarding traffic and safety issues on October 15, 2014 at the Abington Police Station. OCPC presented the background traffic and crash data to the team and reviewed the purpose, procedures, and timeline for the RSA.

At the meeting, the participants discussed the existing conditions and the history of crashes. These included:

- There are poor sight distances and sight lines for vehicles approaching on the Chestnut Street eastbound and westbound approaches.
- The descending slope on the northbound Hancock Street approach adds to the poor sight lines.
- The descending slope approaching the intersection on the northbound approach makes for hazardous conditions during icy and snow conditions, especially if a stop sign or signal were added to this approach.
- The descending slope approaching the intersection on the northbound approach makes for hazardous conditions for police and fire response during icy and snow conditions.
- Twenty-four detached units are expected to be built on Chestnut Street west of the intersection and 101 apartment type units will be built on Hancock Street north of the intersection. These projects will add traffic to the intersection.
- The hedges on the southeast corner of the intersection, extending from Chestnut Street along the right side of the northbound approach, impede sight lines for vehicles stopping on the westbound approach.
- Motorists often get impatient during the AM and PM peak hours because of traffic and drive through the intersection despite the lack of sufficient gaps in the conflicting flow.
- Motorists stopping at the stop signs on the eastbound and westbound approaches pull up into the intersection beyond the stop lines in order to get a clear line of sight of conflicting traffic on the northbound and southbound Hancock Street approaches.
- The road alignment creates a difficult left turn movement for Hancock Street northbound traffic, which must also avoid vehicles stopped on Chestnut Street eastbound that have encroached on the left turn travel path because they have to pull up beyond the stop line in order to get better sight lines.
- Often times, left turning vehicles northbound from Hancock Street to Chestnut Street will yield the right of way to Chestnut Street eastbound vehicles, even though the northbound left turns have no stop control and have the right of way.
- There is heavy queuing eastbound during the AM and PM peak hours that create impatient drivers who go without sufficient gaps in the Hancock Street traffic.
- Heavy Vehicles on the eastbound and westbound Chestnut Street stop controlled approaches often do not come to a complete stop and make a "rolling stop" through the intersection.
- The positioning of the street signs is such that they are not readily visible from the northbound Hancock Street approach.

- The "Stop Ahead" warning signs on the Chestnut Street eastbound approach are located too close to the intersection so that approaching vehicles are not given timely warning of the stop sign control.
- Chestnut Street westbound traffic and eastbound traffic are stopping beyond the stop line and are in the intersection before they come to a complete stop due to limited sight lines, where they interfere with turning vehicles on the northbound and southbound Hancock Street approaches.
- There are duplicate warning signs on the Hancock Street southbound approach to the intersection.
- The warning signs on the westbound Chestnut Street approach are not MUTCD compliant.
- The intersection is very wide.
- The power lines crossing the northbound approach interfere with the view of the flashing overhead beacon.



Pre-audit meeting (at Abington Police Headquarters) and intersection field visit

4.2 Recommendations and Countermeasures for Consideration

The participants discussed a number of potential improvements and projects to improve safety, and the potential impacts, positive and negative that can result from improvements.

The recommendations and countermeasures developed by the RSA participants have been categorized as short-term, mid-term or long-term based on the definitions shown in Table 3. Additionally, a cost category has been assigned to each improvement based on the parameters in Table 3.

Table 3 Time Frame and Cost Categories

Time Frame		Costs	
Short-term	<1 year	Low	<$10,000
Mid-term	1–3 years	Medium	$10,000–$50,000
Long-term	>3 years	High	>$50,000

Table 4 summarizes the potential measures discussed and recommended by the RSA team. Included are a both the estimated time frame and costs associated with the recommended safety measures.

Table 4 RSA Recommendations

Improvement	Benefit	Potential Impacts	Time	Cost
Add Right Turn Islands - Move stop lines forward	Provides refuge for pedestrians, channels traffic reducing cross movement crashes.	Creates more work for snow removal.	Short-term	Medium cost
All-Way Stop	Mitigates cross-movement crashes.	Vehicles will be required to stop on northbound down-hill slope, which will be hazardous under ice, snow, and slippery conditions, the hill on the northbound approach should be removed.	Long-term	High Cost
Add Traffic signals to the intersection	Mitigates cross-movement crashes.	Vehicles will be required to stop on northbound down-hill slope, which will be hazardous under ice, snow, and slippery conditions, the hill on the northbound approach should be removed.	Long-term	High Cost
Construct Roundabout	Mitigates cross-movement crashes, adds traffic calming (speeds reduced to 20 MPH through the intersection).	The northbound downhill slope will impact the ability of northbound vehicles to yield or stop upon entering the intersection under slippery conditions, the hill on the northbound approach should be removed.	Long-term	High Cost
Remove the hill and descending grade on the Hancock Street northbound approach	Removes the skidding hazard for vehicles approaching northbound.	Driveways on Hancock Street will have to be re-graded to meet the lowered street; utilities beneath the street will also have to be moved.	Long-term	High Cost
Work with homeowners to remove (and replace with lower stone wall) or push back the hedge on the southeast corner of the intersection	Improves sight lines.		Short-term	Low cost
Re-assess warning sign placement on the Chestnut Street eastbound approaches	Improves motorist awareness.		Short-term	Low cost
Re-assess warning signage on all approaches	Improves motorist awareness.		Short-term	Low cost

Warrant analyses for a multi-way stop control and for signalized operations at the intersection were performed in conformance with the FHWA's *Manual on Uniform Traffic Control Devices* (MUTCD). The MUTCD Guidance for multi-way stop control includes a number of criteria, including: *"Five or more reported crashes in a 12-month period that are susceptible to correction by a multi-way stop installation. Such crashes include right-turn and left-turn collisions as well as right-angle collisions."* The crash data meets this specific crash criterion. The volumes at the intersection also satisfy the minimum volumes criteria for the multi-way stop control, Warrant 2 Four Hour Vehicular Volume, and Warrant 3, Peak Hour Volume. The warrant analyses are included in the appendix to this report. The MUTCD recommends that an engineering study be completed before the decision to install a multi-way stop or traffic signals.

4.2.1 Build Level-of-Service Analyses

Peak Hour level-of-service analyses were performed assuming that the potential improvements were in place. The Build peak hour level-of-service analyses for the intersection were performed utilizing the 2014 turning movement volumes for potential build alternatives; 1) Assuming islands and right turn lanes were added on the minor street Chestnut Street approaches. 2) Assuming an all way stop 3) Assuming the intersection was signalized, 4) Assuming that a roundabout was in place. Table 5 summarizes the Build peak hour levels-of-service.

Table 5 Build Peak Hour Levels-of-Service (LOS) for the Chestnut Street/Hancock Street Intersection

Build Alternative	AM Peak	PM Peak
Right Turn Islands on the Chestnut Street Eastbound and Westbound approaches		
Chestnut Street Eastbound Left/Through	F	F
Chestnut Street Eastbound Right turns	F	F
Chestnut Street Westbound Left/Through	D	F
Chestnut Street Westbound Right turns	D	F
All-Way Stop Sign		
Chestnut Street Eastbound Left/Through/Right	C	F
Chestnut Street Westbound Left/Through/Right	B	C
Hancock Street Northbound Left/Through/Right	C	C
Hancock Street Southbound Left/Through/Right	B	E
Signalization (Overall LOS)	B	B
Roundabout (Overall LOS)	A	B

Table 5 shows that the signalization and roundabout alternatives achieve the better levels of service (LOS "A" and "B") for the AM and PM operations. The alternative that includes the right turn islands on the Chestnut Street eastbound and westbound approaches results in failed peak hour levels-of-service on these approaches except for the Chestnut Street westbound approach during the AM Peak Hour. The all-way stop alternative results in acceptable levels-of-service except on the Chestnut Street eastbound approach during the PM Peak Hour (LOS "F") and the Hancock Street southbound approach during the PM Peak Hour (LOS "E"). The traffic signal alternative results in level-of-service "B" during the AM Peak Hour and PM Peak Hour, and the roundabout alternative results in level-of-service "A" during the AM Peak Hour and level-of-service "B" during the PM Peak Hour.

4.2.2 Field Audit Findings

After reviewing the background crash data, traffic volumes, speed data, and heavy vehicle data, and discussing the issues, the participants re-convened the audit in the field at the Chestnut Street/Hancock Street intersection. The team inspected sight lines, the condition and placement of signs along the road, and the road alignment. The team noted a number of deficiencies including the grade descending toward the intersection on the northbound approach and the limited sight lines on the Chestnut Street approaches as vehicles approached eastbound and westbound. The vehicles stopped for the stop signs on these approaches encroached into the intersection in order to get a good view of oncoming traffic on Hancock Street. Vehicles on Hancock Street making left turns from the northbound approach to Chestnut Street westbound had to swerve to avoid vehicles that had encroached in the travel way that were stopped for the stop sign on the Chestnut Street eastbound approach. Some of these left turning vehicles from Hancock Street yielded the right of way to clear the intersection so they could make the turn. The participants cited the limited sight line due to the hedges located on the northeast side of the Hancock Street northbound approach. This limits the sight line for vehicles that approach the intersection from the Chestnut Street westbound approach as motorists look to the left at vehicles approaching north on Hancock Street, and it limits the view of the north approaching vehicles as they enter the intersection.

4.2.3 Alternative Recommendation Analysis

1. <u>Add Islands on the Eastbound and Westbound Chestnut Street Approaches</u> – Adding Islands on the Chestnut Street stop controlled approaches and moving the stop lines forward will help to keep vehicles from encroaching on the path of vehicles entering the intersection and making turning movements from the Hancock Street approaches. This will help to reduce cross-movement crashes, which are prevalent at the intersection. In addition, the islands will provide refuge for pedestrians crossing Chestnut Street. This treatment can be an obstacle to snow removal creating more work for snow plows. The AM and PM Peak Hour levels-of-service will remain at LOS "F", failed conditions with this alternative, except for the Chestnut Street Westbound approach during the AM Peak Hour, which will experience LOS "D" conditions.
2. <u>All-Way Stop</u> – The installation of stop signs on all four of the approaches will help to mitigate the cross-movement crashes that are prevalent at the intersection. The downside to this treatment is that vehicles will be required to stop on the Hancock Street northbound down-hill slope, which is hazardous under ice, snow, and slippery conditions. The hill on this approach should be removed if the town decides to go ahead with this alternative improvement. The level-of-service analysis for the all-way stop improvement alternative show that the intersection will operate under acceptable levels-of-service during the

morning peak hour; however, the Chestnut Street eastbound approach will operate at LOS “F” failed operations during the PM Peak Hour and the Hancock Street southbound approach will operate at LOS “E” beyond capacity with very long delays during the PM Peak Hour.

3. Install Traffic Signals – The installation of traffic signals at this location will mitigates cross-movement crashes; however, like the stop sign alternative, vehicles will be required to stop on northbound down-hill slope, which is hazardous under ice, snow, and slippery conditions. The hill on the northbound approach should be removed if the town decides to go forward with this alternative. The level-of-service analysis shows acceptable levels-of-service (LOS “B”) for this alternative during both the AM and PM Peak hours.
4. Re-construct the Intersection and Install a Modern Roundabout - Modern roundabouts significantly reduce crashes, especially crashes that cause fatalities and injuries. Roundabouts have a traffic calming effect that forces vehicles to traverse the intersection at speeds of about 20 miles per hour. Studies show that roundabouts reduce the overall crash experience at stop controlled intersections by 70 percent and by 40 percent over signalized intersections. Overall, roundabouts reduce injury related crashes by 70 percent over conventional intersections. Peak hour level-of-service analyses for the roundabout conditions show that a roundabout will operate at acceptable levels with capacity for future increases in traffic (LOS “A” during the AM Peak and LOS “B” during the PM Peak). The installation of a roundabout at this location presents layout issues due to the downslope grade on the northbound approach. This grade should be leveled to ensure safer operations especially in icy and slippery conditions.
5. Regardless of which short and long term traffic control options are selected by the town, it is recommended that immediate and strict enforcement of the posted speed limits be implemented in an effort to reduce approach speeds.
6. Provide targeted enforcement to reduce stop sign violations.

The superintendent of the Abington Sewer Department noted that the recommendations that include removal of the hill on the northbound approach to the intersection will encounter a number of obstacles, including:

- The Relocation of 8" PVC gravity sewer main and three manholes.
- The Relocation of 12" concrete drain line and four catch basins.
- The Relocation of gas and water lines.
- The Blasting of ledge.

A copy of the profile of the hill showing the ledge is included in the appendix to this report.

5.0 Conclusions and Next Steps

5.1 Next Steps

The Road Safety Audit process will conclude with a review and finalization of the findings and recommendations by the RSA participants, and a response should be prepared by the Town that includes a plan for implementation of improvements.

6.0 Appendix

6.1 Audit Meeting Agenda

6.2 Safety Audit and Meeting Sign-up Sheet

6.3 Morning and Afternoon Intersection Peak Hour Turning Movement Data

6.4 Automatic Traffic Recorder Vehicle Volumes, Speeds, and Vehicle Classifications

6.5 AM and PM Intersection Peak Hour Levels-of-Service

6.6 Signal Warrant and Multi-Way Stop Analyses Summaries

6.7 Crash Rate Work Sheets and Collision Diagrams

6.8 Profile of the Hancock Street Grade on the Northbound Approach