New Hampshire Route 9 at New Hampshire Route 63

Road Safety Audit
Chesterfield, NH

RSA Conducted:	**August 1st, 2014**
Draft Report:	**January 9, 2015**
Final Report	**October 14, 2016**
Strategy Updates:	

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1. Introduction

1.1. Objectives of Study

The objective of this study was to complete a road safety audit (RSA) for the New Hampshire Department of Transportation (NHDOT) in the Town of Chesterfield, NH. The study area includes the intersection of NH Route 9 (Franklin Pierce Highway / NH 9) at NH Route 63 (NH 63) as shown in Figure 1.

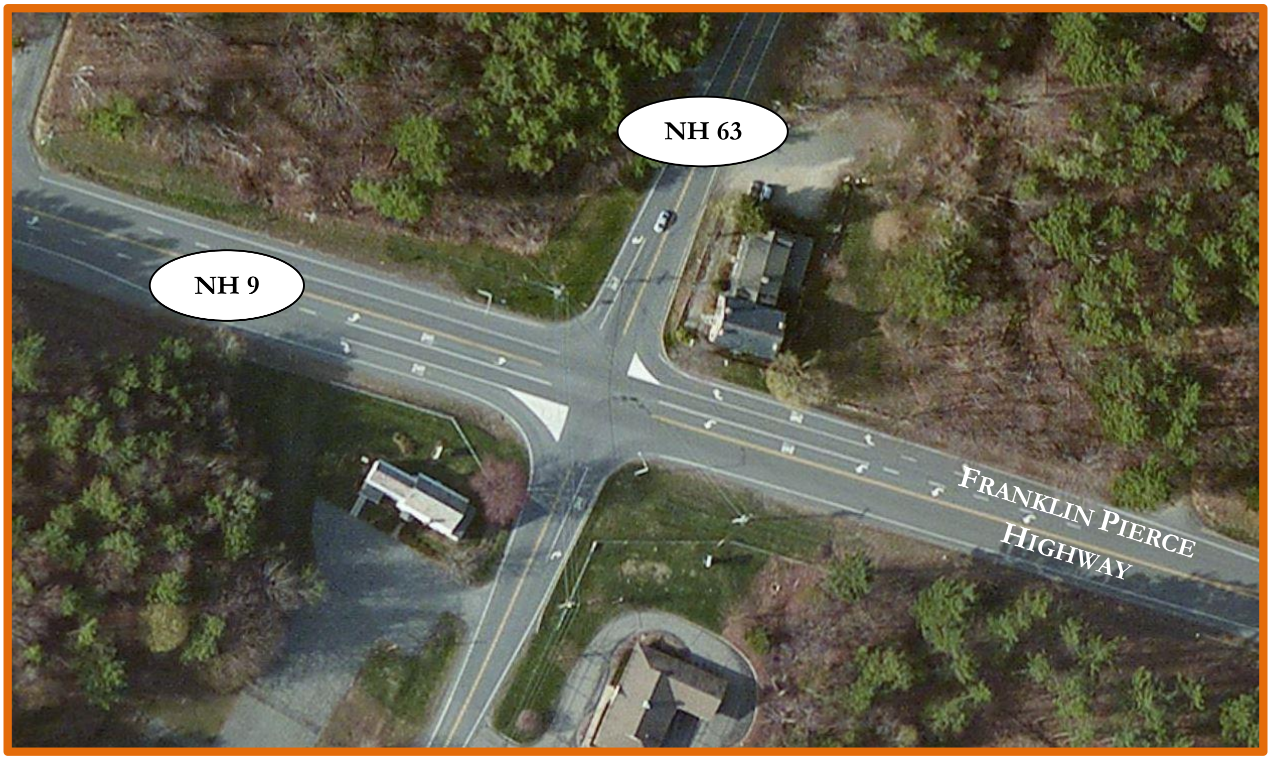

Figure 1: Study Intersection

1.2. Background

NH 9 is a two-lane, arterial highway that runs east-west from Brattleboro, VT, at the border along the Connecticut River through Chesterfield to Berwick, ME. NH 63 provides the north-south route in western New Hampshire between the communities of Winchester, Hinsdale, Chesterfield, and Westmoreland. There is a high percentage of commuting traffic along these routes as NH 9 provides access for nearby bedroom communities to the economic centers of Brattleboro, VT to the west and Keene, NH to the east.

The study intersection is an unsignalized, four-legged intersection located one mile north of the town center of Chesterfield. NH 9 is the mainline and is uncontrolled. NH 63 is stop-controlled from both approaches.

The Southwest Region Planning Commission (SWRPC), in coordination with the Town of Chesterfield, identified the intersection of NH 9 and NH 63 for further analysis and submitted an application to the NHDOT to conduct an RSA. Two fatalities have occurred at the intersection within the past 10 years. As part of the RSA application, a collision diagram was provided for the intersection of NH 9 and NH 63 that includes crashes from August 2003 to August 2013. The purpose of this RSA was to identify safety issues that may be contributing to the reported crashes, identify safety issues that could result in future crashes, and identify potential measures to mitigate these issues.

The RSA was conducted by a team represented by members with expertise in planning, design, operations, and safety. The RSA team consisted of the following members:

Name	Organization	Name	Organization
Michelle Marshall	NHDOT – Highway Design	Duane Chickering	Town of Chesterfield, Police
Michael Dugas	NHDOT – Highway Design	Jeffrey Chickering	Town of Chesterfield, Fire
Bill Lambert	NHDOT – Traffic	Bart Bevis	Town of Chesterfield, Highway
John Kallfelz	NHDOT – District 4	Frank Gross	Vanasse Hangen Brustlin, Inc.
J.B. Mack	Southwest Region Planning Commission	Frank Koczalka	Vanasse Hangen Brustlin, Inc.
Jim Larkin	Town of Chesterfield, Selectman	Evan Drew	Vanasse Hangen Brustlin, Inc.
Jon McKeon	Town of Chesterfield, Selectman		

1.3. RSA Framework

The eight-step RSA process detailed in the Federal Highway Administration's (FHWA's) *Roadway Safety Audit Guidelines* (FHWA, 2006) was utilized for conducting this RSA. This included a kickoff meeting with the RSA team to review existing information and identify concerns, followed by a field review to verify concerns and identify other potential safety issues. Based on the field review and crash analysis, the team has suggested improvements to address the identified safety issues. The suggestions have been categorized as near-term, intermediate, long-term, and proactive improvements. Near-term improvements can typically be implemented through maintenance forces, while intermediate and long-term improvements often require additional planning, design, and funding. Proactive improvements were identified to address potential safety issues that have not manifested in crashes. Conceptual drawings were developed for the study intersection, and a benefit-cost analysis was conducted for each alternative. Construction costs were estimated from the NHDOT Weighted Average Unit Prices (NHDOT, 2013) and national averages. Expected benefits were based on crash modification factors (CMFs) obtained from the Highway Safety Manual (AASHTO, 2010), FHWA CMF Clearinghouse (www.cmfclearinghouse.org), and other related resources. Crash costs were based on the NHDOT 2013 Highway Safety Improvement Program Guidelines and FHWA Crash Cost Estimates by Maximum Police-Reported Injury Severity within Selected Crash Geometries (Council et al., 2005).

The following is a list of possible funding sources to complete the identified improvements. Note that factors considered in determining potential funding sources and levels include: ownership of roadway, magnitude of cost, anticipated safety benefits, and priorities of the program.

Highway Safety Improvement Program (HSIP)

- Eligible projects [§1109; 23 USC 504(e)]:
  - A highway safety improvement project is any strategy, activity or project on a public road that is consistent with the data-driven State Strategic Highway Safety Plan (SHSP) and corrects or improves a hazardous road location or feature or addresses a highway safety problem. MAP-21 provides an example list of eligible activities, but HSIP projects are not limited to those on the list.
  - Workforce development, training, and education activities are also an eligible use of HSIP funds.
- Factors in determining if HSIP funds can be used to support improvements:
  - Benefit-cost ratio must exceed 1.0 for all project costs, including PE, right-of-way, and construction costs.
  - Demands on the funds for other safety improvements being considered in other locations around the State.

Statewide Transportation Improvement Program (STIP)

- The Ten Year Plan is developed through the cooperative efforts of: Local Governments, Regional Planning Commissions (RPC's) and Metropolitan Planning Organizations (MPOs), New Hampshire Department of Transportation (NHDOT), Governor's Advisory Commission on Intermodal Transportation (GACIT), the Governor, and the New Hampshire Legislature. Throughout the Ten Year Plan development there are also numerous opportunities for public involvement and input.

Transportation Alternatives Program (TAP)

- Funding limitations include:
  - Minimum project limit is $200,000 (total) - $160,000 (federal funds).
  - Maximum project limit is $800,000 (total) - $640,000 (federal funds).
  - Project will require at least a 20% match provided by the applicant.
  - Note that projects can exceed the $800,000 cap if other funding sources are added to the project. Projects can also request less than the minimum cap as long as other funding sources are added to keep a minimum of $200,000 for the total project cost.
- Eligible activities include:
  - Construction, planning and design of on-road and off-road trail facilities for pedestrians, bicyclists, and other non-motorized forms of transportation.
  - Construction, planning and design of infrastructure-related projects and systems that will provide safe routes for non-drivers, including children, older adults, and individuals with disabilities to access daily needs.
  - Conversion and use of abandoned railroad corridors for trails for pedestrians, bicyclists, or other non-motorized transportation users.
  - Eligible Safe Routes to School program infrastructure activities under Sections 1404 of SAFETEA-LU (20% match required).

Governors Highway Safety Association (GHSA) Section 402 State and Community Highway Safety Grant Program

- This program can help to implement education and enforcement strategies such as public service announcements and high visibility enforcement.
- Agencies can spend the 402 funds in accordance with national guidelines for programs to:
    - Reduce impaired driving.
    - Reduce speeding.
    - Encourage the use of occupant protection.
    - Improve motorcycle safety.
    - Improve pedestrian and bicycle safety.
    - Reduce school bus deaths and injuries.
    - Reduce crashes from unsafe driving behavior.
    - Improve enforcement of traffic safety laws.
    - Improve driver performance.
    - Improve traffic records.
    - Enhance emergency services.

2. Existing Conditions

2.1. Geometric Conditions

NH 9 is a two-lane, undivided road with a posted speed limit of 50 mph in the RSA study area. The pavement width in the vicinity of NH 63 is approximately 50 feet, including 12-foot lanes (left-turn, through, and right-turn lanes) and variable shoulders. Pavement markings along NH 9 are in good condition and included a centerline, edge lines, turning lane lines, and turn arrows. Right-turn traffic from NH 63 southbound onto NH 9 westbound has an acceleration lane that merges with the through traffic at Pinnacle Springs Road, approximately 450 feet west. There is a steady 6 percent downgrade along NH 9, starting approximately 550 feet west of the intersection, transitioning to a 3 percent downgrade at the intersection, and continuing to a low point in the vertical alignment approximately 1000 feet east of the intersection. The horizontal alignment is relatively straight along NH 9 in the vicinity of the intersection.

NH 63 is a two-lane, undivided road with a posted speed limit of 35 mph. The pavement width on the northbound approach is approximately 48 feet at the intersection, including a 12-foot right lane, 11-foot left-through lane, and 2-foot shoulders. The pavement width on the southbound approach is approximately 50 feet at the intersection, including a 12-foot right-turn lane, 13-foot through-left turn lane, and 2.5-foot shoulders. Pavement markings are in good condition, including a centerline, edge lines, turning lane lines, and turn arrows. NH 63 on either approach of NH 9 has a rolling vertical alignment and relatively straight horizontal alignment.

Adjacent land use includes commercial properties on three of the four corners of the study intersection: People's United Bank at the southeast, Old Stone Millhouse at the northeast, and medical offices at the southwest corners. The Old Stone Millhouse is a historical landmark.

2.2. Traffic Data

Average daily traffic (ADT) estimates were provided by the SWRPC based on counts collected in September 2013. The ADT was 12,250 vehicles per day on NH 9 West, 13,400 vehicles per day on NH 9 East, 1,640 vehicles per day on NH 63 North, and 2,320 vehicles per day on NH 63 South. The detailed 24-hr traffic counts are provided in Appendix A.1. Detailed turning movements were also provided for the intersection by SWRPC and are provided in Appendix A.2. The Donahue Condo Development is a proposed housing development of 11 to 13 condos north of the identified intersection, which would add additional volumes for the turning movements from NH 9 and approach volumes on NH 63 northbound.

2.3. Crash Analysis

Crash data were provided by the SWRPC. The SWRPC developed a collision diagram (see Appendix B) for the intersection of NH 9 and NH 63 based on crash data from August 2003 to August 2013. There were a total of 31 reported crashes at the intersection during the study period. Based on the ten years of data, there are approximately three crashes per year on average. This section presents the results of the crash analysis by crash type, crash severity, year, month, day of week, and time of day.

Figure 2 shows the distribution of reported crashes by type. There were 18 crashes that involved turning movements (right angle, left turn, and sideswipes) that account for 58 percent of crashes at this location. Ten rear end crashes (32 percent) and three other/unknown crashes account for the remaining crashes over the ten year period.

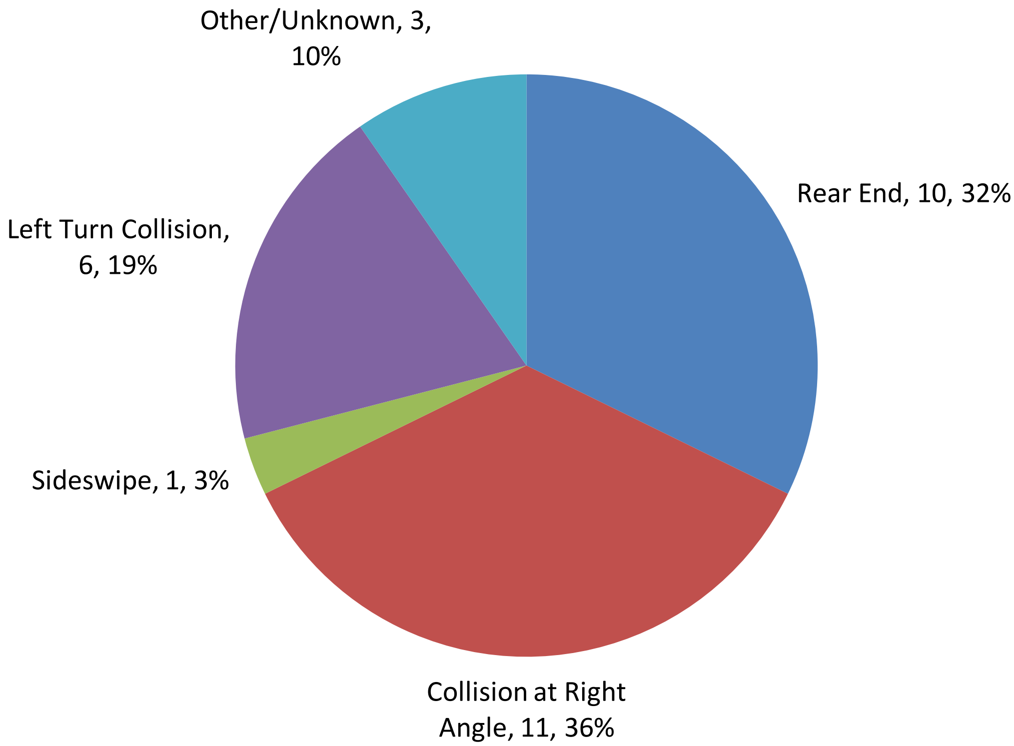

Figure 2: Summary of Crashes by Type

Figure 3 shows the distribution of reported crashes by severity. There were 20 crashes, nearly 2/3, that resulted in property damage only. There were nine crashes (29 percent) that resulted in injury, and there were two fatalities at this intersection: one in June of 2004 and one in June of 2013. Both of the fatalities involved a westbound vehicle on NH 9 and a southbound vehicle on NH 63.

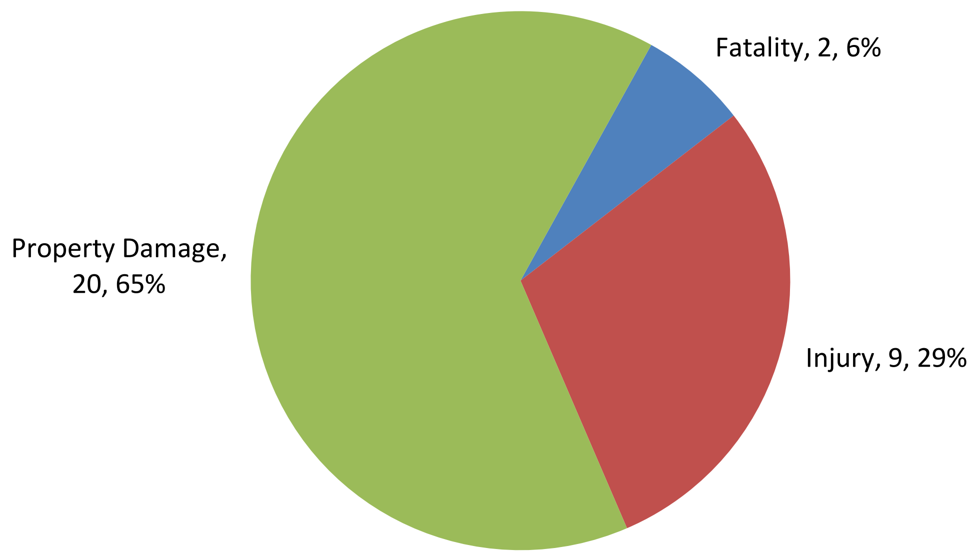

Figure 3: Summary of Crashes by Severity

Figure 4 shows the distribution of crashes by year. There is an average of approximately three crashes per year, but considerable year-to-year variation with a high of six crashes in 2007 and a low of one crash in 2005. The remaining years reflect the average of three crashes per year plus or minus.

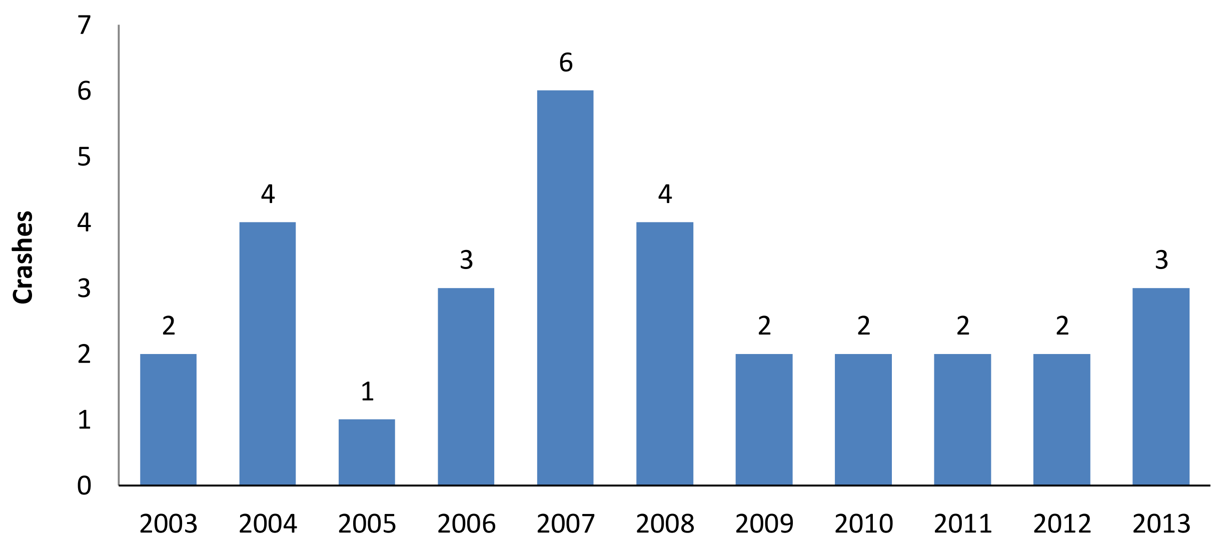

Figure 4: Summary of Crashes by Year

Figure 5 shows the distribution of crashes by month. There appears to be a peak in the summer and fall months (June – November), which may coincide with tourism, vacations, and the new school year.

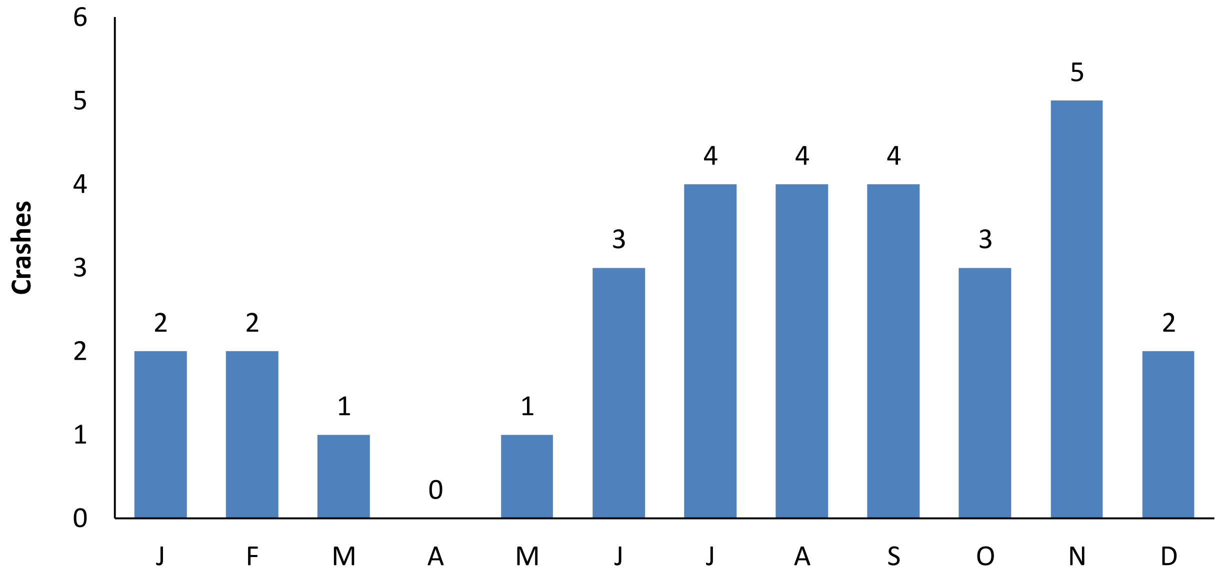

Figure 5: Summary of Crashes by Month

Figure 6 shows the distribution of reported crashes by the day of the week. There appears to be a peak on Thursdays and the RSA team did not have an explanation for this trend.

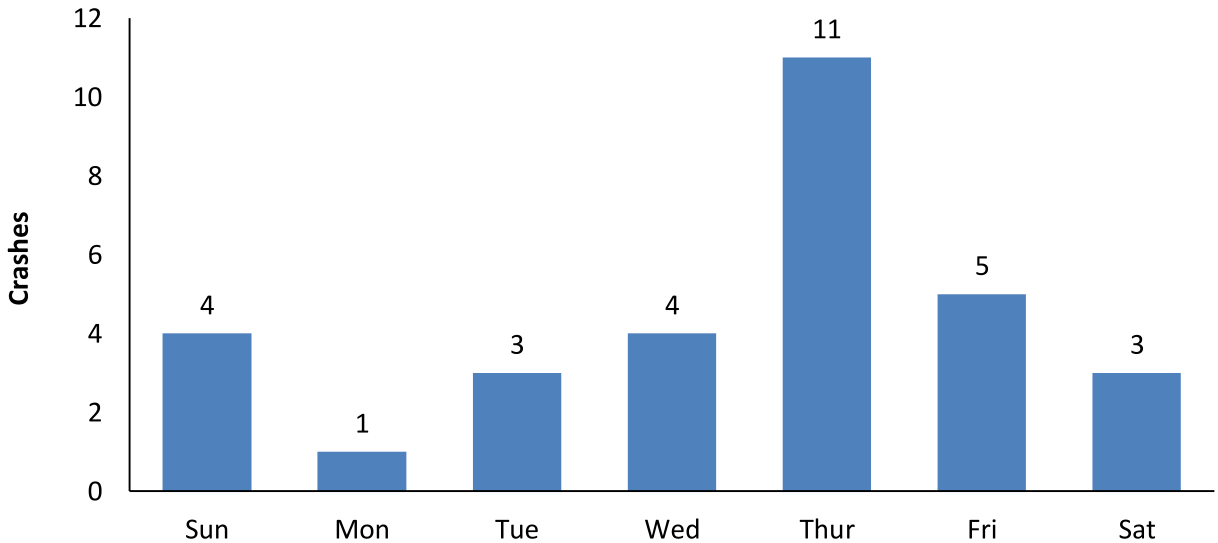

Figure 6: Summary of Crashes by Day of Week

Figure 7 shows the crash distribution by time of day. There is an AM peak from 7AM – 10AM, but more than half of the reported crashes (52 percent) occurred during evening commute hours (3PM – 6PM).

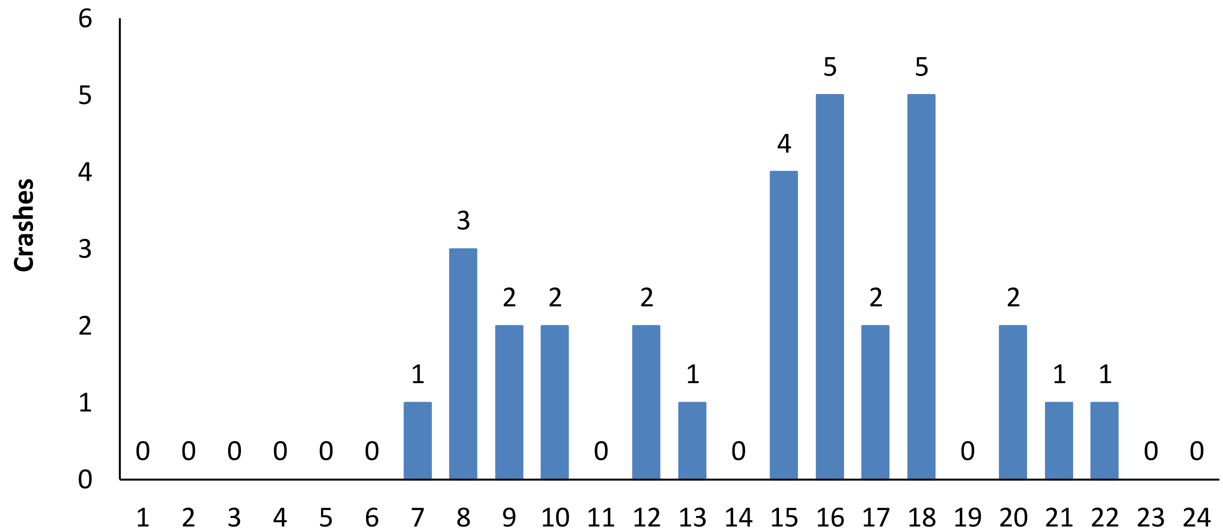

Figure 7: Summary of Crashes by Time of Day (24 HR Clock)

3. Assessment Findings

3.1. Safety Benefits of Existing Roadway Features

There are notable benefits provided by existing roadway features that are described below:

- **Positive Attitude and Multi-Agency Collaboration:** Throughout the course of the RSA process, the Town of Chesterfield, Chesterfield Highway, Chesterfield Police, Chesterfield Fire, Southwest Region Planning Commission (SWRPC), and NHDOT provided support and were open to suggestions to enhance safety and improve communication and collaboration. This attitude will help to maintain a long-term commitment to improving safety for residents and guests of the Town.
- **Turn Lanes:** There are left- and right-turn lanes installed on both approaches of NH 9. This helps to separate turning movements from through traffic.
- **Pavement Markings:** Centerline and edgeline markings are provided on all approaches. Stop bars are also provided on all of the approaches. Pavement markings define the appropriate path for vehicles and help drivers to navigate, particularly at night.
- **Advance Warning Sign on NH 9:** An advance intersection warning sign with 40 mph advisory speed plaque is provided on the eastbound approach of NH 9. This sign helps to alert drivers on NH 9 of the presence of the intersection, particularly with limited sight distance due to the crest vertical curve prior to the junction with NH 63.
- **Advance Guide Signs on NH 9:** Advance guide signs are installed on both approaches of NH 9. These signs help unfamiliar drivers to identify the upcoming junction with NH 63.
- **Guide Signs and Sign Enhancements on NH 63:** There are guide signs installed on NH 63 to notify drivers of the junction with NH 9. There are also lane use signs to notify drivers of the shared left/through lane and separate right-turn lane. Sign enhancements on NH 63 include STOP AHEAD warning signs and over-sized STOP signs.
- **Lighting:** Intersection lighting is provided at the intersection of NH 9 and NH 63. This helps to define the intersection at night.
- **Pavement Condition:** The pavement appears to be in good structural condition. Surface condition and the related friction are critical for vehicle stopping and maneuvering capabilities.

3.2. Identified Safety Issues and Suggestions for Improvement

Despite the existing safety measures to improve road safety at the intersection, the RSA team identified five general issues at the intersection of NH 9 and NH 63. The RSA team prioritized the issues based upon their perceived importance in the study area. The prioritized list of issues is summarized in Table 3.1 with a qualitative risk assessment. The qualitative assessment is based on the expected crash frequency and severity. Expected crash frequency is qualitatively estimated on the basis of expected exposure and probability. Exposure is related to how many road users will likely be exposed to the identified safety issue. Probability conveys how likely it is that a collision will result from the identified issue. Expected crash severity is qualitatively estimated on the basis of factors such as anticipated speeds, expected collision types, and the likelihood that vulnerable road users will be exposed. The two risk elements, frequency and severity, are then combined to obtain a qualitative risk assessment on the basis of the matrix shown in Table 3.2.

Table 3.1 Summary of Potential Safety Issues

Identified Issues	Expected Crash Frequency	Expected Crash Severity	Qualitative Risk Assessment
Limited Sight Distance	Frequent	Serious	Highest
Driver Behavior Issues	Frequent	Moderate	High
Signing and Pavement Marking Issues	Occasional	Moderate	Moderate-High
Pedestrian/Bicycle Safety Issues	Rare	Serious/Fatal	Moderate-High
Access Management Issues	Unknown	Unknown	Unknown

Table 3.2 Crash Risk Assessment Matrix

Frequency Rating	Severity Rating			
	Minor	**Moderate**	**Serious**	**Fatal**
Frequent	Moderate-High	High	Highest	Highest
Occasional	Moderate	Moderate-High	High	Highest
Infrequent	Low	Moderate	Moderate-High	High
Rare	Lowest	Low	Moderate	Moderate-High

The remainder of this section provides a detailed discussion of the issues along with the RSA Team's suggestions to correct or mitigate the identified issues. Conceptual drawings are provided in Appendix C and cost estimates for those alternatives are provided in Appendix D. Appendix E provides a benefit-cost analysis for suggested intermediate and long-term improvements that are associated with crashes during the study period. Appendix F provides a complete summary of suggested improvements.

ISSUE 1: LIMITED SIGHT DISTANCE

The RSA team identified the following factors that limit sight distance to and from the intersection.

- **Crest vertical curve on NH 9**: There is a crest vertical curve to the west of the intersection along the eastbound NH 9 approach. This limits sight distance to and from the intersection.
- **Crest vertical curve on NH 63**: There is a slight crest vertical curve to the south of the intersection along the northbound NH 63 approach. This limits sight distance to the intersection. Note that a STOP AHEAD warning sign and oversized STOP sign have been installed on both minor road approaches to help draw attention to the presence of an intersection.
- **Vegetation along north edge of NH 9:** There is a tree on the northeast corner of the intersection that obstructs sight distance for drivers on the southbound NH 63 approach (limits sight distance from the intersection). There are also several trees with low-hanging branches along the north side of NH 9 to the east of the intersection. The low-hanging branches limit sight distance to and from the intersection.
- **Fence and vegetation along south edge of NH 9:** There is a fence and vegetation along the south side of NH 9 to the west of the intersection, which limit sight distance from the intersection. The RSA team observed numerous drivers stopping beyond the stop bar to gain better sight distance around the fence and vegetation.
- **Vehicles in Right-Turn Lanes on NH 9:** While the right-turn lanes on NH 9 help to separate turning vehicles from the through traffic, they also create a potential safety issue when the vehicle in the turn lane obstructs the view of drivers on NH 63. Specifically, a vehicle in the right-turn lane can hide an adjacent vehicle in the through lane.
- **Adjacent Vehicles on NH 63:** The right-turn lanes on NH 63 help to improve traffic operations, but create a potential safety issue when two vehicles are side-by-side on the same approach. Specifically, each vehicle obstructs the view of the adjacent driver.

Sight distance *to* the intersection is important for drivers on both the mainline and the minor road. On the mainline, sight distance to the intersection allows drivers to identify the minor road and potential conflicts with turning vehicles. On the minor road, sight distance to the intersection allows drivers to identify and react to the STOP sign. With limited sight distance to the intersection, drivers may not have time to identify and react to conflicting movements or the traffic control and, as such, fail to respond appropriately.

Sight distance *from* the intersection is important primarily for drivers on the minor road as it allows them to detect conflicting vehicles and identify appropriate gaps.

The following table compares the approximate available intersection sight distance and available stopping sight distance with the AASHTO Green Book minimum design sight distances for the posted speed and 85^{th} to 95^{th} percentile speed (AASHTO, 2011). Note the 85^{th} to 95^{th} percentile speed on NH 9 is approximately 55 to 60 mph, and 60 mph is selected as the representative speed. All available sight distances, except one, exceed the minimum sight distances from the AASHTO Green Book based on the 35 mph posted speed limit on NH 63 and the 50 mph posted speed on

NH 9, which is also the design speed for NH 9. Considering the 85^{th} to 95^{th} percentile speeds on NH 9, the eastbound intersection sight distance does not meet the minimum design sight distance from the the AASHTO Green Book.

Type of Sight Distance	**Approach**	**Approach Grade at Intersection**	**Available Sight Distance (ft.)**	**Required Design Sight Distance[1] (ft.) [based on posted speed and grades]**	**Required Design Sight Distance[1] (ft.) [based on 85^{th} – 95^{th} percentile speed]**
Intersection Sight Distance[2]	NB	0%	750+	390	85th – 95th percentile speed not available
	SB	0%	~375[3]	390	85th – 95th percentile speed not available
	EB	-6%	750+	670[4]	800[4]
	WB	3%	750+	555[5]	665[5]
Stopping Sight Distance[6]	NB	0%	700+	250	85th – 95th percentile speed not available
	SB	0%	700+	250	85th – 95th percentile speed not available
	EB	-6%	1000+	474	638
	WB	3%	1000+	405	538

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[1] Based on AASHTO Green Book 6^{th} Edition, 2011.

[2] Based on Table 9-6. Design Intersection Sight Distance – Case B1, Left Turn from Stop in AASHTO Green Book 6^{th} Edition, 2011. The available intersection sight distance is measured from the advanced position, looking around the obstructions (i.e., fence and vegetation).

[3] Estimated that sight distance would exceed minimum with removal of vegetation (trees and low-hanging branches) on northeast corner of intersection.

[4] Intersection sight distance factored for 6% downgrade heading eastbound in Table 9-4. Adjustment factors for sight distance based on approach grade in AASHTO Green Book 6^{th} Edition, 2011.

[5] Adjustment factor not used as identified in note for Table 9-6 in AASHTO Green Book 6^{th} Edition, 2011.

[6]Based on Tables 3-1 and 3-2. Stopping Sight Distance tables in AASHTO Green Book 6^{th} Edition, 2011.

The following is a brief summary of crashes by approach that involved a vehicle on NH 9 and a vehicle on NH 63 during the 10-year study period.

- Northbound / Eastbound: There was one property damage only (PDO) crash.
- Northbound / Westbound: There were two crashes, including one injury crash and one PDO crash.
- Southbound / Eastbound: There were two PDO crashes.
- Southbound / Westbound: There were nine crashes, including one fatal crash, eight injury crashes, and one PDO crash.

In addition to the reported crashes, members of the RSA team and local residents noted several near misses at the intersection.

View looking west along NH 9 from the northbound approach of NH 63. The photo shows the crest curve, fence, and vegetation to the west of the study intersection. The crest curve limits sight distance to and from the intersection, while the fence and vegetation limit sight distance from the intersection.

View looking east along NH 9 from the southbound approach of NH 63. The photo shows the tree and low-hanging branches to the east of the study intersection, which limit sight distance from the intersection.

View looking north along NH 63 toward the intersection of NH 9. The photo shows the slight crest curve on the northbound approach of NH 63, which limits sight distance to the intersection.

The following is a list of potential mitigation measures related to these issues:

Near-Term

1.1 Consider installing centerline and lane line rumble strips on NH 9 to encourage drivers to follow the intended vehicle path. Centerline rumble strips will help to discourage left-turns from cutting the corner. Lane line rumble strips will help to discourage drivers from bypassing turning vehicles outside their lane designation.

1.2 Consider removing and/or trimming trees as appropriate on the northeast corner of the intersection to improve sight distance to and from the intersection. This will require coordination and outreach to property owners to explain the issue/benefit. As-Built plans were used to identify the approximate existing ROW lines. It appears the prominent tree and overhanging branches east of the intersection are within the ROW; this will need to be verified before any clearing takes place.

Note: Another suggestion considered by the RSA team was relocating the stop bar on the northbound approach of NH 63 closer to NH 9; however, advanced placement of the stop bar would conflict with the westbound WB-62 left-turn movements from NH 9. See Appendix G for details on the WB-62 design vehicle and turning movements.

Intermediate

1.3 Consider installing an intersection conflict warning system (ICWS) on the major and/or minor road to improve driver expectancy and assist with gap decisions. An ICWS on the major road would warn drivers on NH 9 of vehicles entering from NH 63. An ICWS on the minor road would warn drivers on NH 63 of vehicles approaching on NH 9. There is also the potential to incorporate detection of pedestrians and bicyclists to alert drivers on NH 9 of pedestrians and bicyclists crossing NH 9. This option would require a broader policy decision in order to implement.

Long-Term

1.4 Consider reducing the crest vertical curve on NH 9 to the west of the intersection. This is a high-cost alternative and would require an analysis of crashes and the potential impacts at other nearby intersections.

ISSUE 2: DRIVER BEHAVIOR ISSUES

The RSA team identified driver behavior issues that may be contributing to crashes, including:

- **Speeding:** Members of the RSA team, including the Chesterfield Police, indicated that speeds along NH 9 are higher than the posted speed limit of 50 mph. This concern was based on anecdotal evidence, but confirmed by data from a formal speed study. The results of the speed study are presented in Appendix H and summarized below. Note that the 85th percentile speeds are higher than the posted speed of 50 mph at all four data collection locations.
  - NH 9 Eastbound (toward NH 63): 85th percentile = 56.8 mph
  - NH 9 Eastbound (away from NH 63): 85th percentile = 54.4 mph
  - NH 9 Westbound (toward NH 63): 85th percentile = 58.2 mph
  - NH 9 Westbound (away from NH 63): 85th percentile = 58.6 mph
- **Distraction/Inattention:** Driver distraction and inattention are potential contributing factors to the reported crashes. Specifically, the RSA team observed several drivers using a cell phone while driving, which detracts from the driving task. While limited sight distance to and from the intersection is likely a primary contributing factor in many of the crashes, other distractions reduce the amount of information that a driver can process.
- **Rolling Stops:** The RSA team observed drivers performing "rolling stops" as they entered the intersection, particularly from the right-turn lanes on northbound and southbound NH 63. This can lead to safety issues if the driver on NH 63 does not properly assess gaps in traffic along NH 9. This can also result in rear-end crashes if the driver is rolling and then decides to stop. There were six rear-end crashes on the northbound approach and two rear-end crashes on the southbound approach during the 10-year study period.
- **Accepting Short Gaps:** The RSA team observed drivers on NH 63 accepting short gaps in traffic on NH 9. Members of the RSA team noted that this is likely due to driver frustration and impatience when traffic on NH 9 is steady and there are relatively few acceptable gaps. A gap study was conducted in September 2013. The results of the gap study are presented in Appendix I and summarized below. Note the following are the shortest average gaps by direction, which occur in the afternoon between 2pm and 4pm.
  - NH 9 Eastbound (toward NH 63): shortest gap = 5.8 seconds at 4pm
  - NH 9 Eastbound (away from NH 63): shortest gap = 6.1 seconds at 3pm
  - NH 9 Westbound (toward NH 63): shortest gap = 6.8 seconds at 4pm
  - NH 9 Westbound (away from NH 63): shortest gap = 8.1 seconds at 2pm
- **Following Too Closely:** Related to short gaps is the tendency of drivers on NH 9 to follow other vehicles closely (and sometimes too closely). Again, the results of the gap study are presented in Appendix I and there were two rear-end crashes on the westbound approach of NH 9 during the 10-year study period.
- **Inappropriate Passing and Lane Use:** The RSA team observed drivers using the left-turn lane on NH 9 to provide further separation when passing vehicles in the right-turn lane. There are also acceleration lanes on NH 9 to assist drivers turning right from northbound

and southbound NH 63. The RSA team observed drivers using the acceleration lanes as passing lanes. Drivers are also crossing the centerline to cut the corner while turning from westbound NH 9 onto southbound NH 63.

Left photo is looking west from NH 9 toward the intersection of NH 63. The photo shows a small platoon of cars closely spaced. Right photo is looking east from NH 9 toward the intersection of NH 63. The photo illustrates the undesirable gap acceptance behavior where a vehicle is turning left from northbound NH 63 onto westbound NH 9 in front of several closely spaced vehicles.

View looking east from NH 9 toward the intersection of NH 63. The photo shows tire tracks from the westbound approach crossing the centerline and cutting the corner onto southbound NH 63.

The following is a list of potential mitigation measures related to these issues:

Near-Term

2.1 A speed study was conducted to identify the relative magnitude of the “speeding” issue and evaluate the appropriateness of the current speed limit (50 mph) and potential speed mitigation measures. The 85th percentile speeds were between 54.4 and 58.6 mph on NH 9 near the study intersection. Consider one or more of the following speed mitigation measures:

- Speed feedback signs.
- Transverse rumble strips.
- High-visibility enforcement through the Governors Highway Safety Association (GHSA) Section 402 State and Community Highway Safety Grant Program.

Note that down-posting the speed limit alone will not likely be effective at reducing speeds without other measures such as changing the cross-section or sustained enforcement. There is, however, the potential to work with adjudication to explain the existing safety issues, the need to enforce the posted speed limit more closely (i.e., ticketing and adjudicating speeds more than 7 – 10 mph over the posted speed), and the benefits of high-visibility enforcement.

2.2 Consider opportunities for additional public service announcements (PSAs), media messages, and billboards with targeted messages to address driver behavior issues such as speeding, distracted driving, and aggressive driving. Note the State Highway Safety Office can fund these efforts through the GHSA Section 402 State and Community Highway Safety Grant Program.

2.3 Designate this section of NH 9 (limits to be determined) as a "Safety Corridor." States typically define safety corridors based on several factors, including crash data where safety corridors have higher-than-expected crash rates and crash severity. As shown in the image, the limits of a safety corridor are typically defined by signs indicating the designation as a "Highway Safety Corridor" and the associated fine.

This will require multi-agency coordination to determine who is responsible for each component of the program and ensuring there is support for all elements, including targeted enforcement. Again, the GHSA Section 402 State and Community Highway Safety Grant Program is a potential funding source.

See the following links for other State policies for designating highway safety corridors:
Oregon: http://www.oregon.gov/ODOT/TS/pages/roadwaysafety.aspx
Pennsylvania: http://www.pacode.com/secure/data/067/chapter214/chap214toc.html
Virginia: http://www.virginiadot.org/programs/ct-highway-safety-corridor-criteria.asp

Note: Another suggestion considered by the RSA team was relocating the stop bar on the northbound approach of NH 63 closer to NH 9; however, the stop bar cannot be relocated closer to the intersection because it will conflict with the westbound WB-62 left-turn movements from NH 9 (see Issue 1).

Intermediate

2.4 Consider installing a right-turn slip lane from northbound NH 63 to eastbound NH 9.

2.5 Consider installing a right-turn slip lane from southbound NH 63 to westbound NH 9.

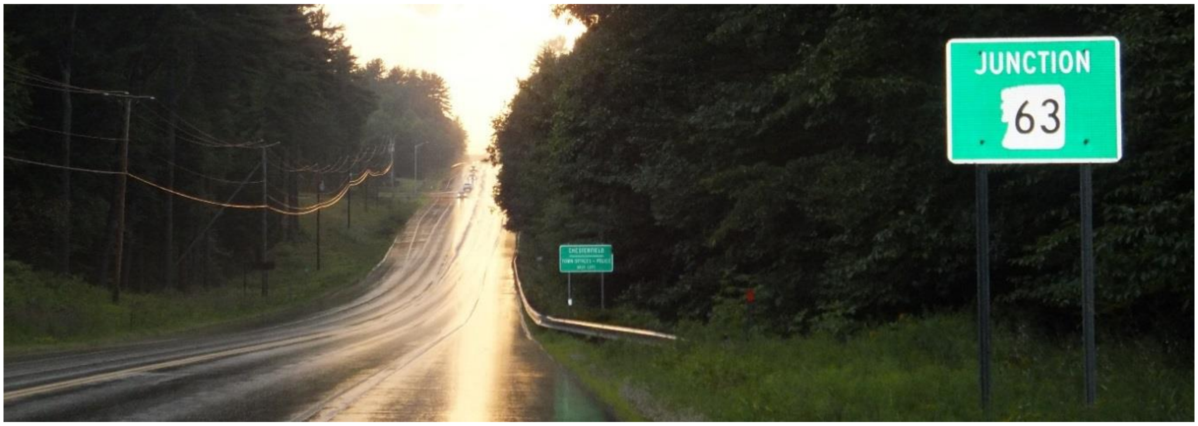
2.6 Consider installing a raised channelizing island to better define the eastbound and westbound right-turn lanes on NH 9. Note that the RSA team identified potential concerns with this measure, including motorcycles, plowing, and vaulting if vehicles hit the raised island. While a raised channelizing island may also help to define the westbound right-turn lane and address some driver behavior issues, it is not feasible as the island would restrict the turning path of large trucks from westbound NH 9 onto northbound NH 63.

ISSUE 3: SIGNING AND PAVEMENT MARKING ISSUES

The RSA team identified the following safety issues related to signs and pavement markings:

- **Layout of Pavement Markings:** The current layout of pavement markings is leading to undesirable driver behaviors. Specifically, the eastbound receiving lane on NH 9 is too wide, and drivers are using the extra space for passing and as an acceleration lane when turning right from northbound NH 63 onto eastbound NH 9. This issue is that the acceleration lane is not formally delineated and there is inconsistent driver behavior. Another potential issue is the set-back of the stop bar on the northbound approach of NH 63. The RSA team observed drivers pulling beyond the stop bar to gain better sight distance to the west.
- **Limited Intersection Warning:** While there are guide signs on both approaches of NH 9 and an advance intersection warning sign on the eastbound approach of NH 9, there is not a similar advance intersection warning sign on the westbound approach. The crash data suggest that conflicts between the westbound and southbound approaches is the primary issue. There were nine crashes involving vehicles on the westbound and southbound approach, seven of which were injury crashes and one was a fatal crash.

View looking east from NH 9 toward the intersection of NH 63. The photo shows the layout of the pavement markings at the intersection. Specifically, the photo shows the wide, undefined receiving lane on eastbound NH 9 and the setback of the stop bar on northbound NH 63 (the stop bar is located so far from the edge of NH 9 that it is not visible in the right of the photo).



View looking west from NH 9 toward the intersection of NH 63. Photo shows the advance guide sign for NH 63, but only the northbound approach is visible from this view; it appears that the junction may be a 3-legged intersection as the other approach of NH 63 is hidden by trees along the north edge of the roadway.

View of the intersection looking west from NH 9 toward NH 63. Photo shows the setback of the stop bar on the northbound approach of NH 63 and a driver stopping well beyond the stop bar for better sight distance.

The following is a list of potential mitigation measures related to these issues:

Near-Term

3.1 Delineate the eastbound receiving lane on NH 9 without narrowing the pavement. Delineation should include pavement markings and may include rumble strips (see Issue 1).

3.2 Install an advance intersection warning sign on the westbound approach of NH 9.

Note: Another suggestion considered by the RSA team was relocating the stop bar on the northbound approach of NH 63 closer to NH 9; however, the stop bar cannot be relocated closer to the intersection because it will conflict with the westbound WB-62 left-turn movements from NH 9 (see Issue 1).

Intermediate

3.3 Consider installing a right-turn slip lane from northbound NH 63 to eastbound NH 9 (see Issue 2).

ISSUE 4: PEDESTRIAN/BICYCLE SAFETY ISSUES

The RSA team identified several factors that may increase crash risk for pedestrians. The primary issues are the lack of pedestrian facilities and lack of driver awareness/expectancy of pedestrians and bicyclists. Pedestrian generators include a nearby residential area and walking trail around Spofford Lake. Specific issues include:

- **Vehicle Speeds on NH 9**: Members of the RSA team noted that vehicle speeds on NH 9 may be higher than the 50 mph posted speed limit, and this was confirmed by data from a speed study conducted in September 2013 (see Issue 2 and Appendix H). Speed is a significant risk factor in pedestrian safety. As speeds increase, the likelihood of a pedestrian surviving a crash is greatly reduced. Based on a review of the literature, one study showed that there is an 85% probability of pedestrian death after being struck by a car at 40 mph.[5] Another study showed similar results where the probability of death is 83% at 40 mph.[6] This trend is depicted in Figure 3-1 [Note that the speeds are shown in km/h; 50 mph is approximately 80 km/h].

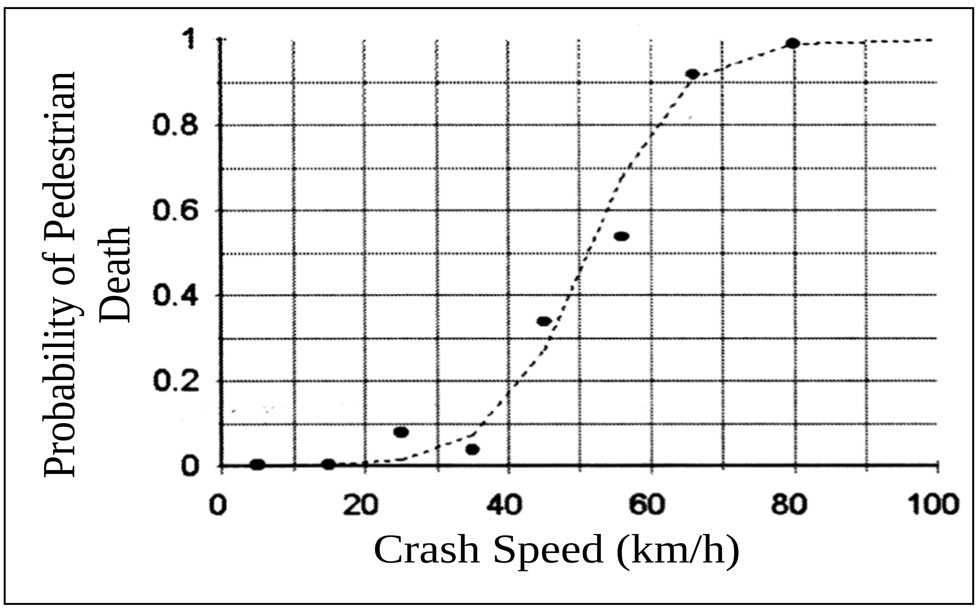


Figure 3-1: Probability of Pedestrian Fatality by Vehicle Speed

- **Lack of Designated Pedestrian Facilities:** While most of the recreational walking occurs to the north of NH 9 (i.e., along NH 63 and around Spofford Lake), the walking trails connect to NH 9. The RSA team observed pedestrians using the north shoulder of NH 9 to connect from the walking trails back to NH 63. The pedestrians were walking with traffic, which is not a desirable behavior, but it would be less desirable to have the pedestrians

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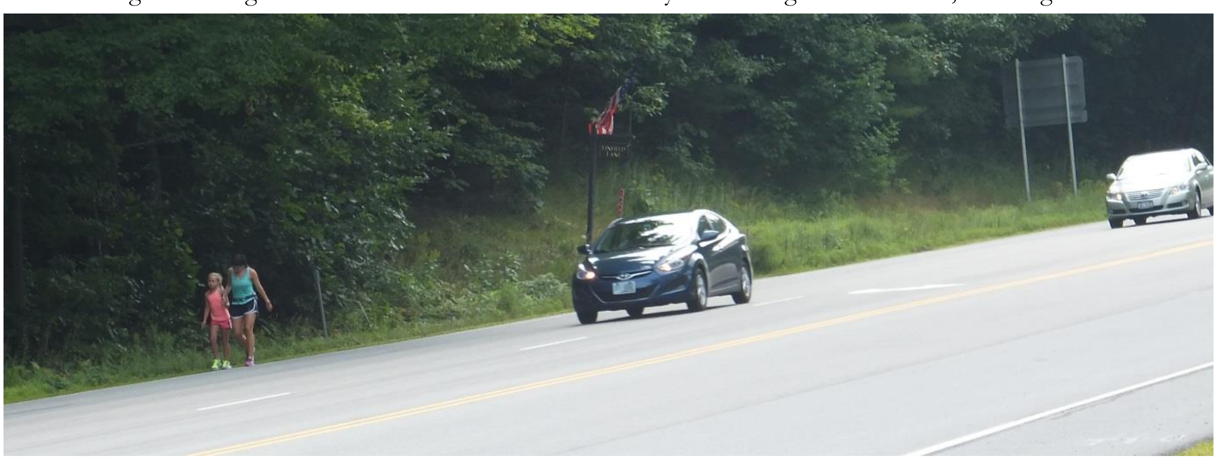
5 [Source 1: *Killing Speed and Saving Lives*, UK Dept. of Transportation, London, England. See also Limpert, Rudolph. Motor Vehicle Accident Reconstruction and Cause Analysis. Fourth Edition. Charlottesville, VA. The Michie Company, 1994, p. 663.]

6 [Source 2: *Vehicle Speeds and the Incidence of Fatal Pedestrian Collisions* prepared by the Australian Federal Office of Road Safety, Report CR 146, October 1994, by McLean AJ, Anderson RW, Farmer MJB, Lee BH, Brooks CG.]

crossing NH 9 without appropriate mitigation measures. Further, there are no pedestrian warning signs on NH 9 to alert drivers to the potential pedestrian activity.

- **Designated Bike Route**: NH 9 and NH 63 are both "recommended bicycle routes" as noted on the Monadnock Region Bicycle Routes map posted on the NHDOT Bicycle and Pedestrian Program website[7]. The RSA team observed bicyclists using these routes and crossing NH 9 traveling north on NH 63. Coupled with the slow acceleration, relatively high vehicle speeds, and limited sight distance, the lack of driver awareness of bicyclists is a major concern.

View looking west along NH 9 from NH 63. Photo shows a bicyclist waiting to cross NH 9, traveling north on NH 63.



View looking east along NH 9 from NH 63. Photo shows two pedestrians walking along the north shoulder of NH 9 from the trails around Spofford Lake to NH 63.

[7] http://www.nh.gov/dot/programs/bikeped/index.htm

The following is a list of potential mitigation measures related to these issues:

Near-Term

4.1 Consider installing pedestrian and bicycle warning signs to alert drivers on NH 9 of the potential presence of these road users. Note the NHDOT typically reserves these types of warning signs for special conditions such as a bike path entering the highway or a regular pedestrian crossing (e.g., beach to ice cream shop).

Intermediate

4.2 Further investigate the need for additional or enhanced pedestrian and bicycle facilities. Based on the vehicle speeds and other existing conditions, the level of need would be grade separation for any pedestrian crossing facilities at the intersection. This is a high-cost improvement and would not likely qualify for HSIP funds. Other funding sources include the Transportation Alternatives Program (TAP) or local fund raising.

4.3 Consider installing a raised median refuge on NH 9 to facilitate pedestrian and bicycle crossings. Members of the RSA team expressed concern with a crossing at the intersection, but noted that a crossing further to the east may be appropriate if there is adequate sight distance and additional enhancements to alert drivers to the presence of crossing pedestrians and bicyclists. If the ICWS is installed (see Issue 1), there may be a potential to incorporate pedestrian and bicycle detection.

ISSUE 5: ACCESS MANAGEMENT ISSUES

The RSA team identified the following safety issues related to access management:

- **Proximity of Pinnacle Springs Road to NH 63:** Pinnacle Springs Road is the next intersection to the west of NH 63. These two intersections are located approximately 450 feet apart. When access points are closely spaced, it increases the complexity of the driving environment as drivers have more information to observe and process. Further, when adjacent access points are located within the functional area of the intersection (e.g., along the turn lanes), it can create conflicting movements. In this case, Pinnacle Springs Road is located at the beginning of the eastbound left-turn lane and near the end of the westbound acceleration lane on NH 9. Conflicts occur when drivers stop at the beginning of the left-turn lane, waiting to turn left onto Pinnacle Springs Road, while other drivers are entering the left-turn lane to turn left at NH 63. Conflicts also occur when drivers use the acceleration lane as a right-turn lane onto Pinnacle Springs Road while other drivers are using the acceleration lane to accelerate from NH 63 or (inappropriately) using the acceleration lane as a passing lane.

Aerial view of the study intersection from Bing Maps. Aerial shows the relative proximity of Pinnacle Springs Road to the study intersection.

The following is a list of potential mitigation measures related to these issues:

Intermediate

5.1 Improve access management by converting the access at Pinnacle Springs Road from full movement to right-in-right-out only. This would eliminate left-turns to and from Pinnacle Springs Road.

4. Conclusions

There were five primary safety issues identified during the RSA, including:

- Limited Sight Distance
- Driver Behavior Issues
- Signing and Pavement Marking Issues
- Pedestrian/Bicycle Safety Issues
- Access Management Issues

Suggestions for improvements have been identified and are described in the report. The suggestions have been categorized as near-term, intermediate, and long-term improvements. Four alternatives were prepared based on the suggested improvements. Conceptual drawings for those alternatives are provided in Appendix C and corresponding cost estimates are provided in Appendix D. Appendix E provides a benefit-cost analysis for suggested intermediate and long-term improvements that are associated with crashes during the study period. Appendix F provides a complete summary of suggested improvements.

5. References

1. American Association of State Highway and Transportation Officials (AASHTO). *A Policy on the Geometric Design of Highways and Streets*, 6th Edition, Washington, DC, 2011.
2. American Association of State Highway and Transportation Officials (AASHTO). *Highway Safety Manual, 1st* Edition, Washington, DC, 2010.
3. Council, F., Zaloshnja, E., Miller, T., and Persaud, B. *Crash Cost Estimates by Maximum Police-Reported Injury Severity within Selected Crash Geometries*. Publication FHWA-HRT-05- 051, Federal Highway Administration, McLean, VA, 2005. Available online at: http://www.fhwa.dot.gov/publications/ research/safety/05051/.
4. Crash Modification Factors (CMF) Clearinghouse. Federal Highway Administration. Available online at: www.cmfclearinghouse.org
5. Federal Highway Administration, *Road Safety Audit Guidelines*, Report No. FHWA-SA-06-06, Washington, DC, 2006.
6. New Hampshire Department of Transportation (NHDOT). *Highway Safety Improvement Program Guidelines*, 2013.
7. New Hampshire Department of Transportation (NHDOT). *Weighted Average Unit Prices*, 2013.

Appendix A: Traffic Volume Data

A.1 24-hr Traffic Counts

CHESTERFIELD, NH

Traffic Counts
NH 63 South of NH 9
Week of September 16, 2013

Hour	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Averages 1 - 5	Averages 1 - 7
0000-0100	6.5	6.0	5.0	6.0	3.0	5.0	13.0	5.2	6.3
0100-0200	1.0	2.0	1.0	4.0	6.0	9.5	2.0	2.8	3.6
0200-0300	1.0	0.0	2.0	0.0	2.0	12.5	3.0	1.0	2.9
0300-0400	6.0	3.0	4.0	3.0	3.0	2.0	6.0	3.8	3.9
0400-0500	22.5	13.0	11.0	13.0	13.5	11.0	6.0	14.4	12.7
0500-0600	32.0	28.5	32.5	33.0	21.0	12.5	5.0	29.2	23.3
0600-0700	100.0	102.0	87.0	105.5	102.0	28.0	23.0	99.2	78.1
0700-0800	184.0	172.5	186.5	170.0	178.0	68.5	38.5	178.0	142.3
0800-0900	279.0	**210.5**	**223.5**	**228.5**	**235.0**	99.0	50.0	**235.0**	**189.1**
0900-1000	*	122.0	117.5	112.0	114.5	162.0	106.5	116.3	122.2
1000-1100	*	118.5	106.0	113.0	119.0	207.5	121.5	114.0	130.7
1100-1200	50.5	99.0	141.5	129.0	144.0	**209.0**	**134.5**	112.6	129.4
1200-1300	50.0	126.0	137.5	143.0	132.0	**153.0**	**179.0**	117.6	131.4
1300-1400	135.5	136.0	114.0	145.0	188.0	141.0	130.5	143.6	141.3
1400-1500	173.5	176.5	168.5	197.5	206.0	150.0	118.0	184.0	169.7
1500-1600	211.5	221.5	**214.0**	**243.5**	**250.5**	139.5	124.0	**227.8**	**200.3**
1600-1700	**229.5**	**249.0**	189.0	192.5	200.0	138.0	100.5	211.8	185.3
1700-1800	174.5	193.5	194.5	207.5	170.5	97.0	115.5	187.6	164.3
1800-1900	110.0	129.5	105.5	147.5	118.5	74.5	90.5	121.8	110.4
1900-2000	75.5	69.0	81.5	87.0	65.0	51.0	65.0	75.4	70.4
2000-2100	38.0	53.0	65.0	71.0	66.0	47.0	47.5	58.6	55.3
2100-2200	22.0	50.5	39.0	40.0	55.5	40.5	31.5	41.2	39.6
2200-2300	11.0	25.5	22.5	23.5	26.0	25.0	12.0	21.4	20.6
2300-2400	15.0	13.5	16.0	29.0	17.0	17.0	8.0	18.0	16.4
Totals									
0700-1900	*	1954.5	1898.0	2029.0	2056.0	1639.0	1309.0	1950.1	1816.4
0600-2200	*	2229.0	2170.5	2332.5	2344.5	1805.5	1476.0	2224.4	2059.8
0600-0000	*	2268.0	2209.0	2385.0	2387.5	1847.5	1496.0	2263.8	2096.8
0000-0000	*	2320.5	2264.5	2444.0	2436.0	1900.0	1531.0	2320.2	2149.4
AM Peak	*	0800	0800	0800	0800	1100	1100		
	*	210.5	223.5	228.5	235.0	209.0	134.5		
PM Peak	1600	1600	1500	1500	1500	1200	1200		
	229.5	249.0	214.0	243.5	250.5	153.0	179.0		

*** - No data.**

CHESTERFIELD, NH

Traffic Counts
NH 63 North of NH 9
Week of September 16, 2013

Hour	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Averages 1 - 5	Averages 1 - 7
0000-0100	11.0	4.5	3.0	6.0	8.5	8.0	7.0	6.4	6.7
0100-0200	2.0	8.0	4.0	2.0	6.0	4.0	7.5	4.4	4.7
0200-0300	0.0	8.5	7.5	5.0	10.0	3.0	3.0	6.0	5.1
0300-0400	8.0	11.0	10.5	9.0	5.0	2.0	2.0	8.6	6.7
0400-0500	4.0	9.0	13.0	9.0	8.0	8.5	3.0	8.6	7.7
0500-0600	19.5	22.5	23.5	18.5	25.0	3.0	9.0	21.4	17.0
0600-0700	64.0	74.5	75.5	76.5	74.0	37.0	24.0	72.6	60.6
0700-0800	113.5	105.5	**125.0**	**114.0**	114.5	49.5	35.0	**114.2**	93.6
0800-0900	96.5	**110.5**	114.5	109.5	119.5	84.5	43.0	109.6	96.4
0900-1000	*	83.0	96.5	70.5	98.5	136.0	92.0	86.8	95.8
1000-1100	*	80.0	71.0	87.0	107.5	150.5	105.5	86.3	100.0
1100-1200	47.5	85.0	99.5	100.5	**137.0**	**157.5**	**115.5**	93.6	**105.7**
1200-1300	36.0	109.5	115.0	141.0	145.5	139.5	**151.5**	109.2	119.4
1300-1400	87.5	116.0	134.5	132.5	126.0	**184.0**	140.0	119.0	131.3
1400-1500	115.5	114.5	136.0	114.5	147.0	182.0	127.0	125.2	133.6
1500-1600	124.0	137.0	**149.0**	124.0	146.0	150.0	143.5	136.0	**139.0**
1600-1700	**134.5**	**160.0**	139.0	**143.0**	**151.5**	146.0	98.0	**145.4**	138.7
1700-1800	91.0	121.5	143.5	131.0	132.0	73.0	87.5	123.6	111.1
1800-1900	75.5	107.5	92.5	103.5	110.0	85.0	73.0	97.4	92.1
1900-2000	40.0	57.0	57.5	70.0	82.0	62.5	63.5	61.2	61.6
2000-2100	27.5	46.5	42.5	46.5	58.5	51.5	32.5	43.8	43.1
2100-2200	24.5	23.0	32.0	34.0	51.5	46.0	19.5	32.8	32.7
2200-2300	11.0	14.5	18.5	23.0	35.0	24.0	12.5	20.2	19.6
2300-2400	16.5	9.0	14.0	22.5	15.0	30.5	10.5	15.2	16.6
Totals									
0700-1900	*	1330.0	1416.0	1371.0	1535.0	1537.5	1211.5	1346.2	1356.8
0600-2200	*	1531.0	1623.5	1598.0	1801.0	1734.5	1351.0	1556.6	1554.8
0600-0000	*	1554.5	1656.0	1643.5	1851.0	1789.0	1374.0	1592.0	1591.0
0000-0000	*	1618.0	1717.5	1693.0	1913.5	1817.5	1405.5	1647.4	1639.0
AM Peak	*	0800	0700	0700	1100	1100	1100		
	*	110.5	125.0	114.0	137.0	157.5	115.5		
PM Peak	1600	1600	1500	1600	1600	1300	1200		
	134.5	160.0	149.0	143.0	151.5	184.0	151.5		

*** - No data.**

CHESTERFIELD, NH

Traffic Counts
NH 9 (WB) West of NH 63
Week of September 16, 2013

Hour	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Averages 1 - 5	Averages 1 - 7
0000-0100	24.0	26.0	22.0	29.0	26.0	31.0	41.0	25.4	28.4
0100-0200	26.0	29.0	30.0	26.0	29.0	28.0	32.0	28.0	28.6
0200-0300	22.0	30.0	28.0	29.0	48.0	27.0	22.0	31.4	29.4
0300-0400	47.0	49.0	42.0	44.0	47.0	25.0	15.0	45.8	38.4
0400-0500	67.0	65.0	69.0	84.0	61.0	46.0	24.0	69.2	59.4
0500-0600	117.0	127.0	111.0	120.0	103.0	47.0	34.0	115.6	94.1
0600-0700	358.0	360.0	340.0	344.0	284.0	127.0	68.0	337.2	268.7
0700-0800	555.0	**539.0**	**551.0**	**533.0**	**502.0**	202.0	86.0	**536.0**	**424.0**
0800-0900	482.0	465.0	455.0	444.0	448.0	303.0	157.0	458.8	393.4
0900-1000	*	300.0	323.0	280.0	347.0	354.0	259.0	312.5	310.5
1000-1100	*	289.0	332.0	278.0	385.0	471.0	350.0	321.0	350.8
1100-1200	*	287.0	358.0	393.0	401.0	**483.0**	**438.0**	359.8	393.3
1200-1300	382.0	337.0	333.0	367.0	444.0	**502.0**	**560.0**	372.6	417.9
1300-1400	324.0	349.0	340.0	345.0	442.0	457.0	489.0	360.0	392.3
1400-1500	396.0	367.0	411.0	402.0	492.0	476.0	499.0	413.6	434.7
1500-1600	397.0	398.0	403.0	399.0	498.0	442.0	499.0	419.0	433.7
1600-1700	**432.0**	**421.0**	431.0	433.0	**538.0**	459.0	479.0	**451.0**	**456.1**
1700-1800	405.0	406.0	**451.0**	**455.0**	506.0	409.0	401.0	444.6	433.3
1800-1900	279.0	300.0	283.0	302.0	413.0	333.0	383.0	315.4	327.6
1900-2000	197.0	186.0	182.0	241.0	308.0	283.0	442.0	222.8	262.7
2000-2100	139.0	181.0	161.0	177.0	220.0	249.0	370.0	175.6	213.9
2100-2200	84.0	121.0	103.0	107.0	190.0	196.0	192.0	121.0	141.9
2200-2300	73.0	59.0	59.0	63.0	134.0	120.0	129.0	77.6	91.0
2300-2400	33.0	37.0	41.0	46.0	66.0	68.0	56.0	44.6	49.6
Totals									
0700-1900	*	4458.0	4671.0	4631.0	5416.0	4891.0	4600.0	4764.3	4767.7
0600-2200	*	5306.0	5457.0	5500.0	6418.0	5746.0	5672.0	5620.9	5654.8
0600-0000	*	5402.0	5557.0	5609.0	6618.0	5934.0	5857.0	5743.1	5795.4
0000-0000	*	5728.0	5859.0	5941.0	6932.0	6138.0	6025.0	6058.5	6073.8
AM Peak	*	0700	0700	0700	0700	1100	1100		
	*	539.0	551.0	533.0	502.0	483.0	438.0		
PM Peak	1600	1600	1700	1700	1600	1200	1200		
	432.0	421.0	451.0	455.0	538.0	502.0	560.0		

*** - No data.**

CHESTERFIELD, NH

Traffic Counts
NH 9 (WB) East of NH 63
Week of September 16, 2013

Hour	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Averages 1 - 5	Averages 1 - 7
0000-0100	25.0	30.0	24.0	32.0	22.0	33.0	50.0	26.6	30.9
0100-0200	25.0	25.0	29.0	26.0	30.0	33.0	34.0	27.0	28.9
0200-0300	22.0	28.0	26.0	28.0	47.0	26.0	22.0	30.2	28.4
0300-0400	44.0	41.0	36.0	37.0	43.0	25.0	19.0	40.2	35.0
0400-0500	65.0	58.0	63.0	76.0	60.0	42.0	26.0	64.4	55.7
0500-0600	114.0	125.0	111.0	119.0	97.0	48.0	31.0	113.2	92.1
0600-0700	356.0	342.0	327.0	336.0	285.0	120.0	65.0	329.2	261.6
0700-0800	576.0	**571.0**	**576.0**	**553.0**	**511.0**	200.0	84.0	**557.4**	**438.7**
0800-0900	520.0	474.0	487.0	475.0	466.0	303.0	166.0	484.4	413.0
0900-1000	432.0	323.0	347.0	305.0	377.0	364.0	292.0	356.8	348.6
1000-1100	*	309.0	367.0	314.0	408.0	477.0	360.0	349.5	372.5
1100-1200	*	289.0	378.0	424.0	441.0	**517.0**	**479.0**	383.0	421.3
1200-1300	175.0	372.0	360.0	395.0	457.0	**532.0**	**606.0**	351.8	413.9
1300-1400	356.0	356.0	370.0	371.0	473.0	501.0	523.0	385.2	421.4
1400-1500	457.0	404.0	466.0	436.0	577.0	510.0	532.0	468.0	483.1
1500-1600	445.0	448.0	464.0	451.0	543.0	483.0	547.0	470.2	483.0
1600-1700	**513.0**	**505.0**	509.0	509.0	**597.0**	495.0	510.0	526.6	**519.7**
1700-1800	490.0	495.0	**549.0**	**570.0**	587.0	427.0	456.0	**538.2**	510.6
1800-1900	320.0	344.0	326.0	359.0	444.0	359.0	406.0	358.6	365.4
1900-2000	242.0	216.0	223.0	290.0	334.0	314.0	469.0	261.0	298.3
2000-2100	170.0	207.0	194.0	206.0	274.0	271.0	384.0	210.2	243.7
2100-2200	100.0	151.0	126.0	126.0	226.0	213.0	202.0	145.8	163.4
2200-2300	81.0	73.0	70.0	75.0	129.0	131.0	136.0	85.6	99.3
2300-2400	40.0	42.0	43.0	59.0	74.0	70.0	59.0	51.6	55.3
Totals									
0700-1900	*	4890.0	5199.0	5162.0	5881.0	5168.0	4961.0	5229.7	5191.3
0600-2200	*	5806.0	6069.0	6120.0	7000.0	6086.0	6081.0	6175.9	6158.3
0600-0000	*	5921.0	6182.0	6254.0	7203.0	6287.0	6276.0	6313.1	6312.8
0000-0000	*	6228.0	6471.0	6572.0	7502.0	6494.0	6458.0	6614.7	6583.8
AM Peak	*	0700	0700	0700	0700	1100	1100		
	*	571.0	576.0	553.0	511.0	517.0	479.0		
PM Peak	1600	1600	1700	1700	1600	1200	1200		
	513.0	505.0	549.0	570.0	597.0	532.0	606.0		

*** - No data.**

CHESTERFIELD, NH

Traffic Counts
NH 9 (EB) West of NH 63
Week of September 16, 2013

Hour	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Averages 1 - 5	Averages 1 - 7
0000-0100	49.0	20.0	23.0	33.0	27.0	57.0	36.0	30.4	35.0
0100-0200	16.0	25.0	39.0	30.0	54.0	30.0	22.0	32.8	30.9
0200-0300	15.0	45.0	30.0	20.0	32.0	17.0	8.0	28.4	23.9
0300-0400	34.0	39.0	28.0	29.0	34.0	27.0	8.0	32.8	28.4
0400-0500	29.0	44.0	31.0	33.0	31.0	34.0	24.0	33.6	32.3
0500-0600	75.0	88.0	77.0	79.0	87.0	42.0	44.0	81.2	70.3
0600-0700	215.0	210.0	194.0	227.0	207.0	99.0	145.0	210.6	185.3
0700-0800	331.0	337.0	**374.0**	354.0	357.0	173.0	225.0	350.6	307.3
0800-0900	343.0	**399.0**	339.0	**354.0**	376.0	300.0	292.0	**362.2**	343.3
0900-1000	*	309.0	332.0	316.0	346.0	416.0	397.0	325.8	352.7
1000-1100	*	285.0	299.0	338.0	389.0	**516.0**	479.0	327.8	**384.3**
1100-1200	137.0	327.0	340.0	338.0	**416.0**	490.0	**497.0**	311.6	363.6
1200-1300	361.0	322.0	342.0	333.0	536.0	527.0	**478.0**	378.8	414.1
1300-1400	376.0	394.0	385.0	407.0	511.0	509.0	455.0	414.6	433.9
1400-1500	358.0	373.0	412.0	450.0	530.0	522.0	455.0	424.6	442.9
1500-1600	501.0	507.0	494.0	505.0	616.0	**549.0**	459.0	524.6	518.7
1600-1700	**610.0**	**653.0**	**632.0**	627.0	**750.0**	526.0	437.0	**654.4**	**605.0**
1700-1800	566.0	584.0	605.0	**654.0**	713.0	415.0	376.0	624.4	559.0
1800-1900	306.0	376.0	352.0	358.0	518.0	340.0	297.0	382.0	363.9
1900-2000	146.0	195.0	200.0	235.0	358.0	213.0	241.0	226.8	226.9
2000-2100	108.0	137.0	150.0	186.0	291.0	189.0	144.0	174.4	172.1
2100-2200	94.0	104.0	103.0	121.0	206.0	159.0	105.0	125.6	127.4
2200-2300	41.0	68.0	76.0	108.0	121.0	116.0	79.0	82.8	87.0
2300-2400	63.0	47.0	64.0	65.0	94.0	91.0	43.0	66.6	66.7
Totals									
0700-1900	*	4866.0	4906.0	5034.0	6058.0	5283.0	4847.0	5081.3	5088.6
0600-2200	*	5512.0	5553.0	5803.0	7120.0	5943.0	5482.0	5818.7	5800.3
0600-0000	*	5627.0	5693.0	5976.0	7335.0	6150.0	5604.0	5968.1	5954.0
0000-0000	*	5888.0	5921.0	6200.0	7600.0	6357.0	5746.0	6207.3	6174.7
AM Peak	*	0800	0700	0800	1100	1000	1100		
	*	399.0	374.0	354.0	416.0	516.0	497.0		
PM Peak	1600	1600	1600	1700	1600	1500	1200		
	610.0	653.0	632.0	654.0	750.0	549.0	478.0		

*** - No data.**

CHESTERFIELD, NH

Traffic Counts
NH 9 (EB) East of NH 63
Week of September 16, 2013

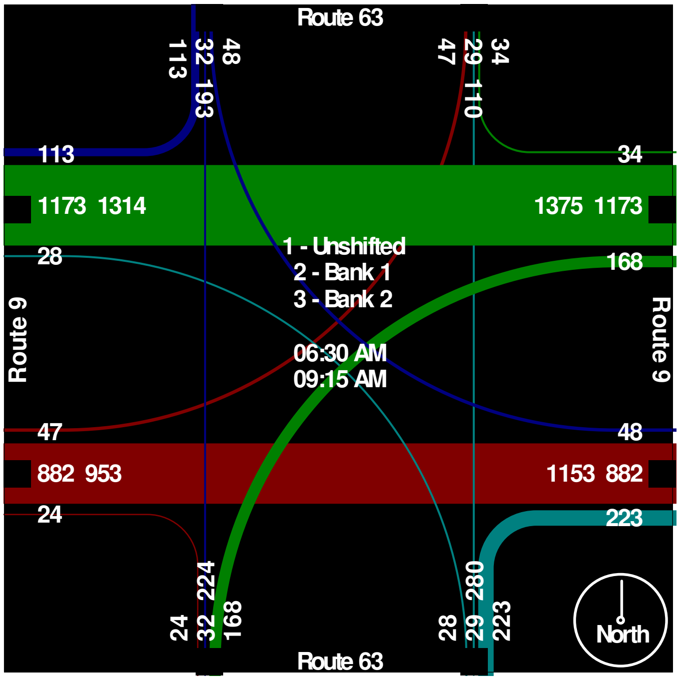
Hour	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Averages 1 - 5	Averages 1 - 7
0000-0100	48.0	22.0	24.0	33.0	25.0	55.0	36.0	30.4	34.7
0100-0200	16.0	22.0	37.0	28.0	50.0	29.0	23.0	30.6	29.3
0200-0300	15.0	39.0	27.0	19.0	26.0	17.0	13.0	25.2	22.3
0300-0400	32.0	36.0	27.0	28.0	33.0	28.0	13.0	31.2	28.1
0400-0500	35.0	53.0	38.0	41.0	39.0	38.0	27.0	41.2	38.7
0500-0600	97.0	99.0	95.0	95.0	101.0	49.0	48.0	97.4	83.4
0600-0700	266.0	270.0	237.0	277.0	253.0	119.0	155.0	260.6	225.3
0700-0800	406.0	433.0	452.0	423.0	426.0	214.0	258.0	428.0	373.1
0800-0900	436.0	**487.0**	**454.0**	**462.0**	**474.0**	332.0	322.0	**462.6**	423.9
0900-1000	310.0	345.0	369.0	354.0	390.0	445.0	459.0	353.6	381.7
1000-1100	*	307.0	331.0	379.0	413.0	**554.0**	**549.0**	357.5	422.2
1100-1200	*	359.0	368.0	384.0	434.0	539.0	540.0	386.3	**437.3**
1200-1300	123.0	341.0	376.0	355.0	559.0	566.0	**534.0**	350.8	407.7
1300-1400	406.0	416.0	419.0	434.0	550.0	528.0	481.0	445.0	462.0
1400-1500	403.0	401.0	459.0	497.0	560.0	539.0	501.0	464.0	480.0
1500-1600	562.0	551.0	569.0	587.0	698.0	**581.0**	477.0	593.4	575.0
1600-1700	**639.0**	**683.0**	**686.0**	**684.0**	**767.0**	545.0	450.0	**691.8**	**636.3**
1700-1800	580.0	624.0	611.0	679.0	730.0	455.0	411.0	644.8	584.3
1800-1900	332.0	410.0	380.0	386.0	540.0	366.0	327.0	409.6	391.6
1900-2000	172.0	199.0	225.0	252.0	359.0	220.0	242.0	241.4	238.4
2000-2100	108.0	137.0	160.0	205.0	293.0	195.0	156.0	180.6	179.1
2100-2200	104.0	111.0	106.0	126.0	207.0	166.0	105.0	130.8	132.1
2200-2300	40.0	69.0	80.0	104.0	123.0	116.0	77.0	83.2	87.0
2300-2400	60.0	48.0	62.0	61.0	88.0	87.0	42.0	63.8	64.0
Totals									
0700-1900	*	5357.0	5474.0	5624.0	6541.0	5664.0	5309.0	5587.4	5575.1
0600-2200	*	6074.0	6202.0	6484.0	7653.0	6364.0	5967.0	6400.8	6350.1
0600-0000	*	6191.0	6344.0	6649.0	7864.0	6567.0	6086.0	6547.8	6501.1
0000-0000	*	6462.0	6592.0	6893.0	8138.0	6783.0	6246.0	6803.8	6737.6
AM Peak	*	0800	0800	0800	0800	1000	1000		
	*	487.0	454.0	462.0	474.0	554.0	549.0		
PM Peak	1600	1600	1600	1600	1600	1500	1200		
	639.0	683.0	686.0	684.0	767.0	581.0	534.0		

*** - No data.**

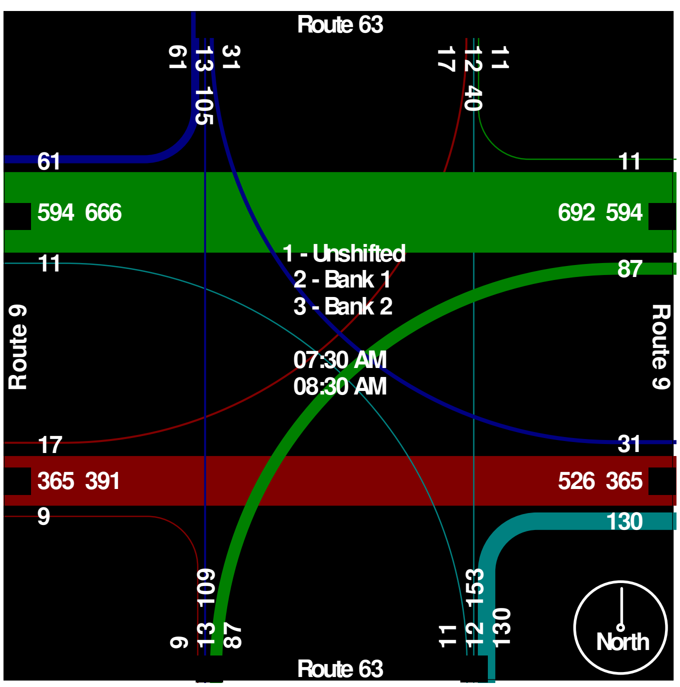
A.2 Turning Movements

Turning Movement Counts
Location: NH 9 at NH 63, Chesterfield, NH
Date: Wednesday, 10/02/13
Data Collection by: Southwest Region Planning Commission, (603) 357-0557

630-930 AM

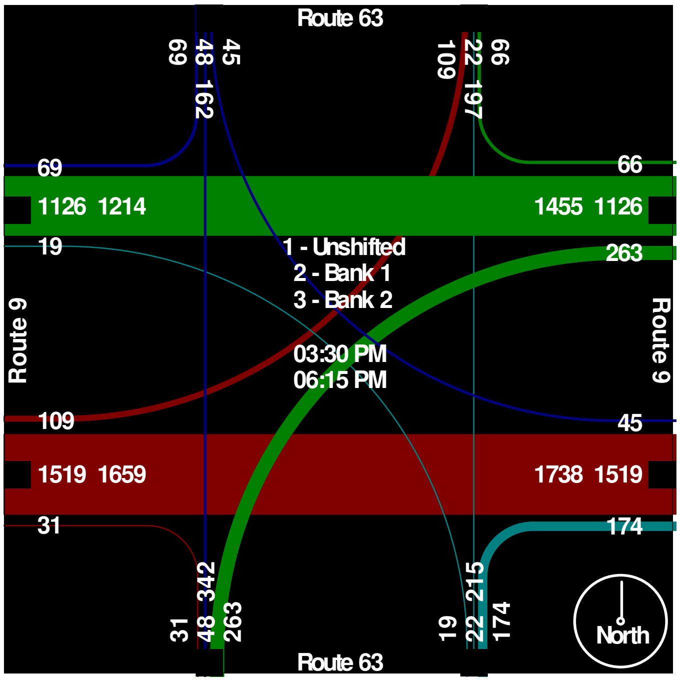


730-830 AM (Peak Hour)

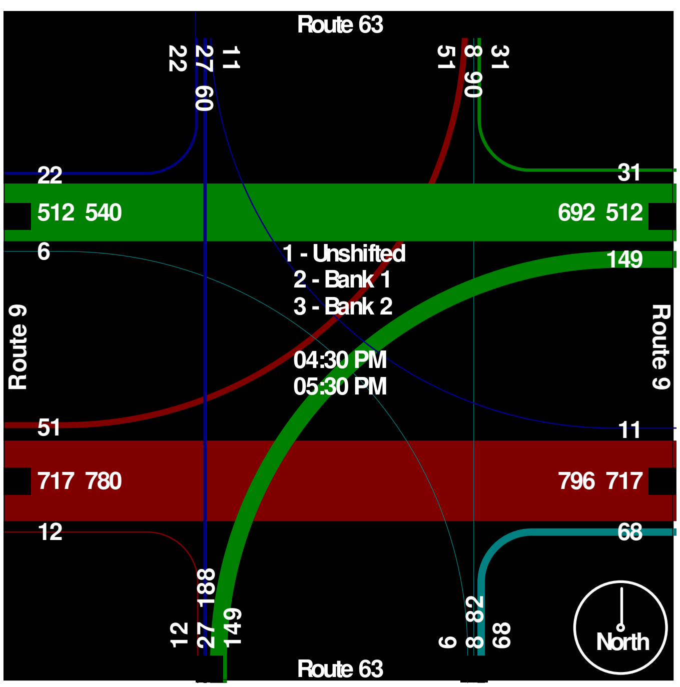


Turning Movement Counts
Location: NH 9 at NH 63, Chesterfield, NH
Date: Wednesday, 10/02/13
Data Collection by: Southwest Region Planning Commission, (603) 357-0557

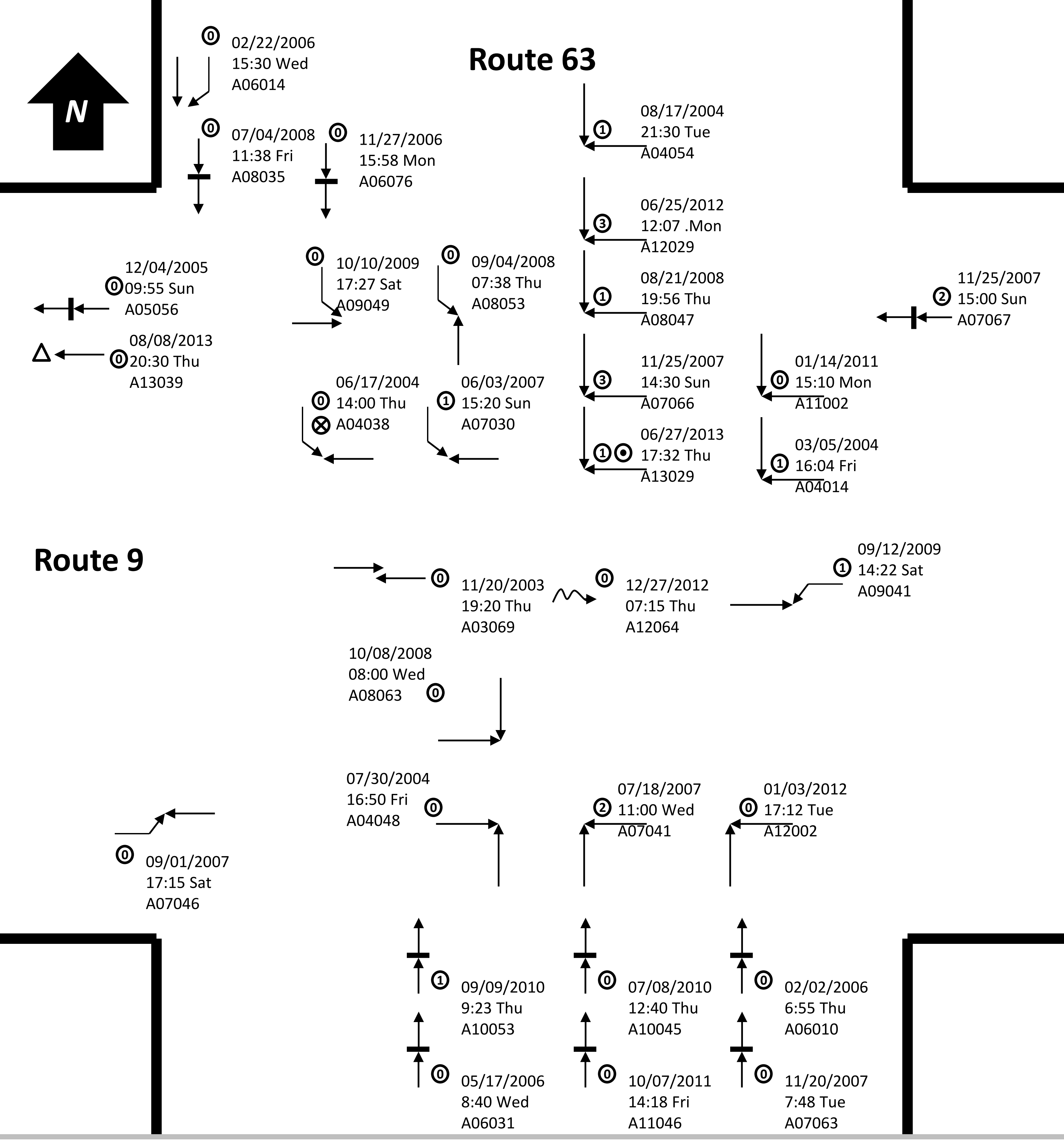
330-630 PM



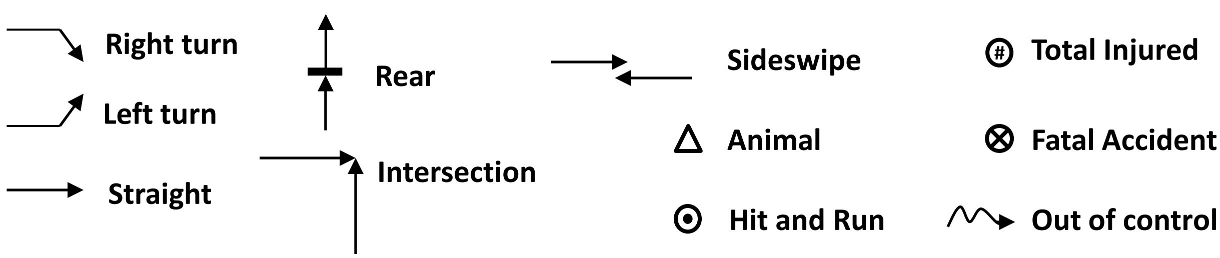
430-530 PM (Peak Hour)



Appendix B: Crash Diagram



Note: symbols do not indicate position of the collision



Appendix C: Conceptual Drawings

Conceptual drawings are included in Appendix C to help determine the feasibility of the RSA Team's suggestions, and to estimate potential impacts and construction costs. Section 3: Assessment Findings provides a detailed discussion of the safety issues identified by the RSA team and potential mitigation strategies for each issue. The concepts can aid in visualizing these suggestions as well as the potential benefits and impacts.

Existing Conditions

The existing conditions for NH 9 and NH 63 roadways are described in Section 2 of this report.

Design Criteria/Controls

The following table presents the design criteria and controls assumed for the layout of the concepts.

Design Speed	50 mph and 35 mph posted speeds, for NH 9 and NH 63, respectively. This segment of NH 9 was rebuilt in the mid-1980s, and the plans show a design speed of 50 mph. The crest curve to the west of the intersection has a stopping sight distance almost good enough for 55 mph, while the sag curve to the east is just below current 50 mph design criteria. The NH 63 crest curve south of NH 9 provides nearly 40 mph stopping sight distance.
Typical Section	The existing typical sections will remain unchanged except for the construction of the right turn lanes and painted islands in Concept 3.
Landscaping	No landscaping review was conducted for the RSA or concept development.
Drainage & Stormwater Treatment	There is no existing drainage within the project limits. Storm water runoff is conveyed along the edge of the roadway in existing grassed ditch lines. No drainage improvements are anticipated for Concepts C1, C2, and C4. For Concept C3, the existing grassed ditches would need to be adjusted to reflect the additional pavement at the intersection.
Environment	No environmental review was conducted for the RSA or concept development.
Right-of-Way	Limited existing research was provided for the RSA and concept development. The approximate existing ROW shown on the concepts was obtained from the New Hampshire Department of Transportation. The ROW was digitized in from the as-built construction plans. During final design, the ROW will require a full review.
Traffic Control Plan (TCP)	TCP was not evaluated for the RSA or concept development. However, the concept scope includes pavement widening, pavement striping, and raised median island which will all impact existing traffic flows during construction.
Utilities	No formal existing utility review was conducted for the RSA or concept development. Aerial utilities are present within this area, and aerial utilities will conflict with the proposed improvements shown in Concept 3.
Survey	No survey was conducted for the RSA or concept development.
Lighting	Two existing street lights were found within the intersection of NH 9 and NH 63. Lighting design was not conducted for the RSA or concept development. However, the existing light pole in the southeast quadrant of the intersection will be impacted in Concept 3.
Soils	No geotechnical review was conducted for the RSA or concept development.
Crashes	See Section 2 and Appendix B for crash data.
Traffic	Traffic information was received for the purpose of the RSA; however, an in-depth analysis was not performed to establish lane usage and layout for the RSA or concept development. See Section 2 and Appendix A for traffic data.
Estimate	See Appendix D for Conceptual Construction Costs.

Funding	Highway Safety Improvement Program Funding is considered for this project.
Turning Radius	All intersections were designed to accommodate a WB-62 turning movement.

Conceptual Designs and Considerations

As noted above, the concepts provided are conceptual representations of mitigation strategies highlighted in Section 3. The concepts are two-dimensional sketches overlaid on aerial photography without horizontal and vertical alignments; therefore, actual footprints could be different if the design progresses from concept to final design. The primary focus of the concepts is to address safety issues related to roadway geometry. The four concepts are presented below in Figures C1 – C4.

C.1 Concept 1

Concept 1 involves the installation of speed feedback signs. Installation of advance intersection warning, lane control, and combination junction signs on the NH 9 westbound approach. Improved pavement marking delineation along NH 9 eastbound and selective tree and vegetation clearing within the existing ROW along the northern side of NH 9. The following table provides a summary of the proposed strategies, safety concerns, and related issues from Section 3.

Roadway	Proposed Strategies	Safety Concerns	Related Issues/Notes
NH 9	Install speed feedback signs on NH 9. Install advance intersection warning, lane control, and combination junction signs on the NH 9 westbound approach.	High speeds and limited intersection warning for approaching drivers.	2, 3
	Improve pavement marking delineation along NH 9 eastbound.	Inappropriate passing and lane use, and expansive pavement width for the eastbound receiving lane.	2, 3
	Selective tree and vegetation clearing within the existing ROW along the northern side of NH 9.	Limited sight distance	1

0 125 250 FEET

RSA CONCEPT
PLAN
SUBJECT TO CHANGE
DATE 10/6/2016

vhb

Figure C.1
Concept 1

Chesterfield, NH

C.2 Concept 2

Concept 2 involves the installation of an intersection conflict warning system (ICWS) on the major road (NH 9) with detection equipment on the minor road approaches to detect vehicles on NH 63. The following table provides a summary of the proposed strategies, safety concerns, and related issues from Section 3.

Roadway	Proposed Strategies	Safety Concerns	Related Issues/Notes
NH 9	Install "Watch for Entering Traffic" signs.	High speeds and limited intersection warning for approaching drivers.	2, 3
NH 63	Install vehicle detection on existing stop signs.	Short gaps in traffic on NH 9 result in frustration and impatience for drivers entering NH 9.	2, 3

RSA CONCEPT
PLAN
SUBJECT TO CHANGE
DATE 10/6/2016

vhb

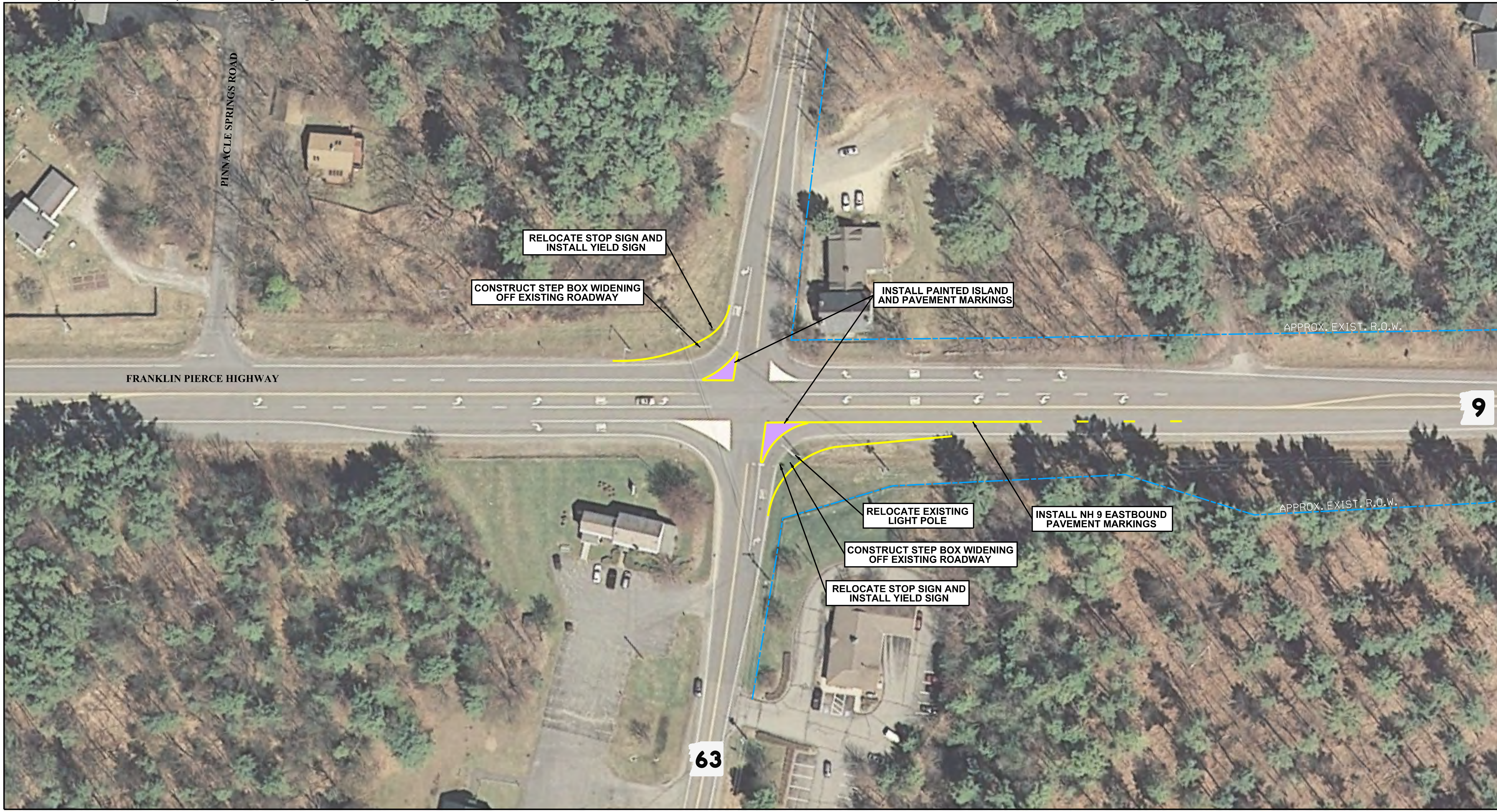
Figure C.2
Concept 2

Chesterfield, NH

C.3 Concept 3

Concept 3 involves the construction of painted medians and right turn lanes on NH 9. The STOP signs would be relocated further upstream on the minor roads, and yield signs would be installed to control the right-turn slip ramps. The following table provides a summary of the proposed strategies, safety concerns, and related issues from Section 3.

Roadway	Proposed Strategies	Safety Concerns	Related Issues/Notes
NH 9	Construct painted medians and right turn lanes.	Expansive pavement width of receiving lanes are developing undesirable merging conditions.	3



0 80 160 FEET

RSA CONCEPT
PLAN
SUBJECT TO CHANGE
DATE 10/6/2016

vhb

Figure C.3
Concept 3

Chesterfield, NH

C.4 Concept 4

Concept 4 involves the construction of a raised island on Pinnacle Spring Road to restrict intersection movements to right-in/right-out only. The following table provides a summary of the proposed strategies, safety concerns, and related issues from Section 3.

Roadway	Proposed Strategies	Safety Concerns	Related Issues/Notes
Pinnacle Spring Road	Construct raised island.	Proximity of Pinnacle Spring Road increases complexity of the driving environment.	5

RSA CONCEPT
PLAN
SUBJECT TO CHANGE
DATE 10/6/2016

vhb

Figure C.4
Concept 4

Chesterfield, NH

Appendix D: Conceptual Cost Estimates

Conceptual cost estimates are provided for each of the four concepts. NHDOT's Weighted Average Unit Costs were used to establish project unit costs and quantities calculations were performed for the major items in each concept.

The following assumptions were made in the development of cost estimates for each concept:

Concept 1:

1. Roadway improvements require no changes to the horizontal or vertical alignments.
2. Signage types and locations were based on the Manual on Uniform Traffic Control Devices.
3. Pavement marking layout was based on the NHDOT Standard Plans for Road Construction.

Concept 2:

1. No roadway improvements required.
2. Signage types and locations were based on the Design and Evaluation Guidance for Intersection Conflict Warning Systems (ICWS) document.

Concept 3:

1. Step box widening of NH 9 with full pavement structure includes 6" pavement, 8" crushed gravel, 8" gravel, and 8" sand.
2. Step box widening of NH 63 with full pavement structure includes 4" pavement, 8" crushed gravel, 8" gravel, and 8" sand.
3. No changes to the horizontal or vertical alignments are required.

Concept 4:

1. Roadway improvements are limited to the construction of the raised island on Pinnacle Spring Road. No changes to the horizontal or vertical alignments are required.

The following table provides a summary of costs, which are detailed in the following sections. Right-of-way costs were assumed to be zero. Preliminary engineering costs were estimated as 25 percent of construction costs for Concepts 1, 2, and 3, and 40 percent of construction costs for Concept 4.

Cost Components	**Concept 1**	**Concept 2**	**Concept 3**	**Concept 4**
Conceptual Construction Cost	$20,000	$30,000	$35,000	$5,000
Right-of-Way	$0	$0	$0	$0
Preliminary Engineering	$5,000	$7,500	$8,750	$2,000
Total	**$25,000**	**$37,500**	**$43,750**	**$7,000**

D.1 Concept 1: Cost Estimate

CONSTRUCTION COST ESTIMATE

PROJECT : **NH 9 / NH 63**

LOCATION : Chesterfield, NH

STATE PROJECT NO.

FEDERAL PROJECT NO.

ESTIMATE TYPE: Conceptual Cost Estimate

DATE PREPARED: 10/04/2016

ESTIMATED BY: FMK

CHECKED BY: MJB

Chesterfield RSA

NH 9 / NH 63

Concept 1

	ITEM NO	ITEM DESCRIPTION	UNIT	NOTE	UNIT PRICE	QUANTITY	TOTAL COST
		MATERIAL ITEMS (ROADWAY)					
1	201.1	CLEARING AND GRUBBING (F)	A		$8,000	0.15	$1,200
2	203.1	COMMON EXCAVATION	CY		$8	0	$0
2.1	203.2	ROCK EXCAVATION	CY	ASSUME 0% OF COMMON EXCAVATION	$30	0	$0
2.2	203.6	EMBANKMENT-IN-PLACE (F)	CY		$10	0	$0
2.4	206.1	COMMON STRUCTURE EXCAVATION					
2.5	206.19	COMMON STRUCTURE EXCAVATION EXPLORATORY	LS	ADD 15% OF TOTAL COST of COM. EXC. & ROCK EXC. COST			$0
2.6	206.2	ROCK STRUCTURE EXCAVATION					
2.7	207.3	UNCLASSIFIED CHANNEL EXCAVATION					
3	304.1	SAND	CY		$19	0	$0
3	304.2	GRAVEL (F)	CY		$23	0	$0
3	304.3	CRUSHED GRAVEL (F)	CY		$25	0	$0
4	403.11	HOT BITUMINOUS PAVEMENT,MACHINE METHOD	TON		$70	0	$0
4	403.12	HOT BITUMINOUS PAVEMENT, HAND METHOD	TON		$110	0	$0
4	403.99	TEMPORARY BITUMINOUS PAVEMENT	TON		$60	0	$0
4	411.43	PLANT MIX SURFACE TREAT- MENT (ASPHALT CEMENT 3/8")	TON		$70	0	$0
4	417	COLD PLANING BITUMINOUS SURFACES (F)	SY		$5	0	$0
6	606.14	BEAM GUARDRAIL (STANDARD SECTION- WOOD POSTS)	LF		$18	0	$0
6	606.141	BEAM GUARDRAIL (CURVED W/CRT POSTS)					
6	606.1452	BEAM GUARDRAIL (TERMINAL UNIT TYPE ELT)	LS	ADD 40% OF COST OF GUARD RAIL			$0
6	606.147	BEAM GUARDRAIL (TERMINAL UNIT TYPE G-2)					
6	606.84	ANCHOR FOR CURVED GUARD- RAIL W/CRT POSTS					
	608.12	2" BITUMINOUS SIDEWALK	SY		$13	0	$0
7	608.24	CONCRETE SIDEWALK (F)	SY		$40	0	$0
8	609.01	STRAIGHT GRANITE CURB	LF		$17	0	$0
8	609.02	CURVED GRANITE CURB	LF		$30	0	$0
8.1	609.21	STRAIGHT GRANITE SLOPE CURB	LF		$13	0	$0
8.2	609.811	BITUMINOUS CURB, TYPE B (4" REVEAL)	LF	25% OF GUARD RAIL QUANTITY	$5	0	$0
8.3	609.5	RESET GRANITE CURB	LF		$7		$0
10	214	FINE GRADING	LS	20% OF TOTAL SUB BASE COST			$0
		SUBTOTAL A					$1,200
		MISCELLANEOUS ITEMS (ROADWAY) (SAMPLE ITEMS BELOW)					
12		FILL ABANDONED PIPE	CY				
		CLEARING FOR FENCE LINES (F)	A				
12		REMOVAL OF EXISTING PIPE 0-24" DIAMETER	LF				
12		REMOVAL OF CATCH BASINS, DROP INLETS, AND MANHOLES	EA				
12		REMOVAL OF GUARDRAIL (F)	LF				
12		CRUSHED GRAVEL FOR SHOULDER LEVELING /DRIVES	CY				
		Geotextile fabrics	SY				
12		ADJUSTING CATCH BASIN DROP INLET GRATE AND FRAMES	EA				
12		ADJUSTING MANHOLE COVERS AND FRAMES	EA				
12		DROP INLET SEDIMENT TRAP OUTLET	EA				
12		CHAIN LINK FENCE WITH VINYL-COATED STEEL FABRIC 6' HIGH	LF				
12		POST ASSEMBLIES FOR CHAIN LINK FENCE, 6 FT. HIGH	EA				
12		CONCRETE STAIRS	U				
12		RETROREFLECTIVE BEAM GUARDRAIL DELINEATOR	EA	USE 40% OF SUBTOTAL "A" COST			
12		DELINEATORS WITH POST	EA				
12		STEEL WITNESS MARKERS, BOUNDS	EA				
12		SAWED PAVEMENT	LF				
12		DETECTABLE WARNING PAVERS (SIDEWALK RAMPS)					
12		THERMOPLAS. & PAINT PAVE. MARKING,	LF				
12		LOAM & HUMAS	CY				
12		FERTILIZER	TON				
12		GRASS SEED, TYPE 82	LB				
12		SLOPE STABILIZATION & CHANNEL STABILIZATION	SY				
12		TURF ESTABLISHMENT	SY				
12		BARK MULCH MATERIAL	CY				
12		ON-THE-JOB TRAINING OF UNSKILLED WORKERS	$				
12		FIELD OFFICE TYPE & LAB	MON				
		MICELLANEOUS COST SUBTOTAL					$480
		SUBTOTAL B					$1,680
		DRAINAGE COSTS (SAMPLE ITEMS BELOW)					
13		STONE FILL, CLASS B,C,D	CY				
13		PIPE	LF				
13		STEEL END SECTIONS	EA	**CONSIDER**		0%	
13		CATCH BASINS	U	1-10% MINOR IMPROVEMENTS			
13		DRAINAGE MANHOLES	U	10% RECONST NON URBAN			
13		RECONSTRUCTING CATCH BASINS & DROP INLETS	LF	15% NEW NON URBAN			
13		WATER REPELLENT FOR EXISTING CB'S AND DI'S	EA	20% FULL DEPTH RECONSTRUCT URBAN			
13		UNDERDRAIN FLUSHING BASINS	EA	20% NEW URBAN			
13		18" AGGREGATE UNDERDRAIN TYPE 2, WITH 6" PIPE	LF	25% COMPLEX URBAN			
13		24" AGGRE UND. TYPE 2, WITH OPTION PIPE	LF				
13		6" PIPE UNDERDRAIN (CON- TRACTORS OPTION)	LF				
		DRAINAGE COST SUBTOTAL					$0.00
		SUBTOTAL C					$1,680
		PERMANENT TRAFFIC CONTROL (SAMPLE ITEMS BELOW)					
13.1		OVERHEAD SIGN STRUCTURES CANTELEVER	EA	USE $600/LF	$600		$0
13.1		OVERHEAD SIGN STRUCTURES SPAN	EA	USE $800/LF	$800	0	$0
		TRAFFIC SIGN TYPE A,B,C;AA,BB,CC	SF		$40	34	$1,360
		TRAFFIC SIGN (Speed Feedback)	U		$3,000	2	$6,000
60		TRAFFIC SIGNALS	EA	USE $150K/ INTERSECTION	$150,000	0	$0
60		TRAFFIC SIGNAL COORDINATION	EA	USE $50K/ ADDITIONAL INTERSECTION	$50,000	0	$0
65		LIGHT POLES AND BASES (est 2/300 feet)	EA	USE $4500/ POLE	$4,500	0	$0
		PERMANENT TRAFFIC CONTROL COST SUBTOTAL					$7,360
		SUBTOTAL D					$9,040
		TEMPORARY TRAFFIC CONTROL (SAMPLE ITEMS BELOW)					
70		UNIFORMED OFFICERS WITH VEHICLE		USE 2.5 TIMES MAINT OF TRAFFIC COST			$2,000
71		FLAGGERS		USE 30% OF UNIFORMED OFFICER COST			$600
73		MAINTENANCE OF TRAFFIC	UNIT	USE 8% OF SUBTOTAL D	$800	1	$800
74		PORTABLE CONCRETE BARRIER FOR TRAFFIC CONTROL	LF		$20	0	$0
		MISCELLANEOUS TRAFFIC CONTROL					
75		PORTABLE CHANGEABLE MESSAGE SIGN-					
		TEMPORARY CONSTRUCTION SIGNS					
75		TRUCK-MOUNTED IMPACT ATTENUATOR, TEST LEVEL 2		USE 30% OF MAINTENANCE OF TRAFFIC			
75		IMPACT ATTENUATION DEVICE					
		MISCELLANEOUS TRAFFIC CONTROL SUBTOTAL					$240
		TEMPORARY TRAFFIC CONTROL COST SUBTOTAL					$3,640
		EROSION, SEDIMENT & POLLUTION CONTROL					
80		HAY BALES FOR TEMPORARY EROSION CONTROL	EA				
80		RYEGRASS FOR TEMPORARY EROSION CONTROL	LB				
80		SILT FENCE	LF	USE 5% OF SUBTOTAL A			
80		EROSION AND SEDIMENT CONTROL STORMWATER MGMT PLAN	U				
80		MONITORING EROSION AND SEDIMENT CONTROL	HR				
80		TEMPORARY PROJECT WATER POLLUTION CONTROL	$				$60
		EROSION, SEDIMENT & POLLUTION CONTROL SUBTOTAL					$60
		SUBTOTAL E					$12,740
		ADDITIONAL ITEMS OF CONSIDERATION					
		ITS			$0	0	$0
20		RETAINING WALLS	SF	USE $50/SF	$50	0	$0
30		SOUND WALL	SF	USE $25 /SF	$25	0	$0
		MISCELLANEOUS (fuel adjust,alterations)		USE 10% OF SUBTOTAL E			$1,274
		WATER QUALITY - STORMWATER BMPs		DRAINAGE BASINS AREAS (INCLUDED IN SITE)	$100,000	0	$0
		LANDSCAPING		ASSUME $20.65/LF	$20.65	0	$0
		UTILITY ADJUSTMENTS		ASSUME $1000/LF	$0	0	$0
		STRUCTURES			$0	0	$0
		ADDITIONAL ITEMS COST SUBTOTAL					$1,274
		SUBTOTAL F					$14,014
		MOBILIZATION		USE 8% OF SUBTOTAL F			$1,121
		CONTINGENCIES		USE 10% OF SUBTOTAL F			$1,401
		CONSTRUCTION SUBTOTAL					**$16,537**
		CONSTRUCTION ENGINEERING		USE 8% OF CONSTRUCTION TOTALS			$1,323
		CONSTRUCTION TOTAL					**$20,000**

D.2 Concept 2: Cost Estimate

	CONSTRUCTION COST ESTIMATE						
	PROJECT : **NH 9 / NH 63** LOCATION : Chesterfield, NH STATE PROJECT NO. FEDERAL PROJECT NO. ESTIMATE TYPE: Conceptual Cost Estimate			DATE PREPARED: 10/04/2016 ESTIMATED BY: FMK CHECKED BY: MJB	**Chesterfield RSA** **NH 9 / NH 63** **Concept 2**		
	ITEM NO	**ITEM DESCRIPTION**	**UNIT**	**NOTE**	**UNIT PRICE**	**QUANTITY**	**TOTAL COST**
		MATERIAL ITEMS (ROADWAY)					
1	201.1	CLEARING AND GRUBBING (F)	A		$8,000	0.00	$0
2	203.1	COMMON EXCAVATION	CY		$8	0	$0
2.1	203.2	ROCK EXCAVATION	CY	ASSUME 0% OF COMMON EXCAVATION	$30	0	$0
2.2	203.6	EMBANKMENT-IN-PLACE (F)	CY		$10	0	$0
2.4	206.1	COMMON STRUCTURE EXCAVATION					
2.5	206.19	COMMON STRUCTURE EXCAVATION EXPLORATORY	LS	ADD 15% OF TOTAL COST of COM. EXC. & ROCK EXC. COST			$0
2.6	206.2	ROCK STRUCTURE EXCAVATION					
2.7	207.3	UNCLASSIFIED CHANNEL EXCAVATION					
3	304.1	SAND	CY		$19	0	$0
3	304.2	GRAVEL (F)	CY		$23	0	$0
3	304.3	CRUSHED GRAVEL (F)	CY		$25	0	$0
4	403.11	HOT BITUMINOUS PAVEMENT,MACHINE METHOD	TON		$70	0	$0
4	403.12	HOT BITUMINOUS PAVEMENT, HAND METHOD	TON		$110	0	$0
4	403.99	TEMPORARY BITUMINOUS PAVEMENT	TON		$60	0	$0
4	411.43	PLANT MIX SURFACE TREAT- MENT (ASPHALT CEMENT 3/8")	TON		$70	0	$0
4	417	COLD PLANING BITUMINOUS SURFACES (F)	SY		$5	0	$0
5	417.41x	RUMBLE STRIPS	LF		$5	0	$0
6	606.14	BEAM GUARDRAIL (STANDARD SECTION- WOOD POSTS)	LF		$18	0	$0
6	606.141	BEAM GUARDRAIL (CURVED W/CRT POSTS)					
6	606.1452	BEAM GUARDRAIL (TERMINAL UNIT TYPE ELT)	LS	ADD 40% OF COST OF GUARD RAIL			$0
6	606.147	BEAM GUARDRAIL (TERMINAL UNIT TYPE G-2)					
6	606.84	ANCHOR FOR CURVED GUARD- RAIL W/CRT POSTS					
	608.12	2" BITUMINOUS SIDEWALK	SY		$13	0	$0
7	608.24	CONCRETE SIDEWALK (F)	SY		$40	0	$0
8	609.01	STRAIGHT GRANITE CURB	LF		$17	0	$0
8	609.02	CURVED GRANITE CURB	LF		$30	0	$0
8.1	609.21	STRAIGHT GRANITE SLOPE CURB	LF		$13	0	$0
8.2	609.811	BITUMINOUS CURB, TYPE B (4" REVEAL)	LF	25% OF GUARD RAIL QUANTITY	$5	0	$0
8.3	609.5	RESET GRANITE CURB	LF		$7		$0
10	214	FINE GRADING	LS	20% OF TOTAL SUB BASE COST			$0
		SUBTOTAL A					$0
		MISCELLANEOUS ITEMS (ROADWAY) (SAMPLE ITEMS BELOW)					
12		FILL ABANDONED PIPE	CY				
		CLEARING FOR FENCE LINES (F)	A				
12		REMOVAL OF EXISTING PIPE 0-24" DIAMETER	LF				
12		REMOVAL OF CATCH BASINS, DROP INLETS, AND MANHOLES	EA				
12		REMOVAL OF GUARDRAIL (F)	LF				
12		CRUSHED GRAVEL FOR SHOULDER LEVELING /DRIVES	CY				
		Geotextile fabrics	SY				
12		ADJUSTING CATCH BASIN DROP INLET GRATE AND FRAMES	EA				
12		ADJUSTING MANHOLE COVERS AND FRAMES	EA				
12		DROP INLET SEDIMENT TRAP OUTLET	EA				
12		CHAIN LINK FENCE WITH VINYL-COATED STEEL FABRIC 6' HIGH	LF				
12		POST ASSEMBLIES FOR CHAIN LINK FENCE, 6 FT. HIGH	EA				
12		CONCRETE STAIRS	U				
12		RETROREFLECTIVE BEAM GUARDRAIL DELINEATOR	EA				
12		DELINEATORS WITH POST	EA	USE 40% OF SUBTOTAL "A" COST			
12		STEEL WITNESS MARKERS, BOUNDS	EA				
12		SAWED PAVEMENT	LF				
12		DETECTABLE WARNING PAVERS (SIDEWALK RAMPS)					
12		THERMOPLAS. & PAINT PAVE. MARKING,	LF				
12		LOAM & HUMAS	CY				
12		FERTILIZER	TON				
12		GRASS SEED, TYPE 82	LB				
12		SLOPE STABILIZATION & CHANNEL STABILIZATION	SY				
12		TURF ESTABLISHMENT	SY				
12		BARK MULCH MATERIAL	CY				
12		ON-THE-JOB TRAINING OF UNSKILLED WORKERS	$				
12		FIELD OFFICE TYPE & LAB	MON				
12		TRAFFIC SIGN TYPE A,B,C;AA,BB,CC	SF				
		MICELLANEOUS COST SUBTOTAL					$0
		SUBTOTAL B					$0
		DRAINAGE COSTS (SAMPLE ITEMS BELOW)					
13		STONE FILL, CLASS B,C,D	CY				
13		PIPE	LF				
13		STEEL END SECTIONS	EA	**CONSIDER** 1-10% MINOR IMPROVEMENTS 10% RECONST NON URBAN 15% NEW NON URBAN 20% FULL DEPTH RECONSTRUCT URBAN 20% NEW URBAN 25% COMPLEX URBAN		0%	
13		CATCH BASINS	U				
13		DRAINAGE MANHOLES	U				
13		RECONSTRUCTING CATCH BASINS & DROP INLETS	LF				
13		WATER REPELLENT FOR EXISTING CB'S AND DI'S	EA				
13		UNDERDRAIN FLUSHING BASINS	EA				
13		18" AGGREGATE UNDERDRAIN TYPE 2, WITH 6" PIPE	LF				
13		24" AGGRE UND. TYPE 2, WITH OPTION PIPE	LF				
13		6" PIPE UNDERDRAIN (CON- TRACTORS OPTION)	LF				
		DRAINAGE COST SUBTOTAL					$0.00
		SUBTOTAL C					$0
		PERMANENT TRAFFIC CONTROL (SAMPLE ITEMS BELOW)					
13.1		OVERHEAD SIGN STRUCTURES CANTELEVER	EA	USE $600/LF	$600		$0
13.1		OVERHEAD SIGN STRUCTURES SPAN	EA	USE $800/LF	$800	0	$0
		INTERSECTION CONFLICT WARNING SYSTEM (ICWS)	U		$20,000	1	$20,000
60		TRAFFIC SIGNALS	EA	USE $150K/ INTERSECTION	$150,000	0	$0
60		TRAFFIC SIGNAL COORDINATION	EA	USE $50K/ ADDITIONAL INTERSECTION	$50,000	0	$0
65		LIGHT POLES AND BASES (est 2/300 feet)	EA	USE $4500/ POLE	$4,500	0	$0
		PERMANENT TRAFFIC CONTROL COST SUBTOTAL					$20,000
		SUBTOTAL D					$20,000
		TEMPORARY TRAFFIC CONTROL (SAMPLE ITEMS BELOW)					
70		UNIFORMED OFFICERS WITH VEHICLE		USE 1.0 TIMES MAINT OF TRAFFIC COST			$600
71		FLAGGERS		USE 30% OF UNIFORMED OFFICER COST			$180
73		MAINTENANCE OF TRAFFIC	UNIT	USE 3% OF SUBTOTAL D	$600	1	$600
74		PORTABLE CONCRETE BARRIER FOR TRAFFIC CONTROL	LF		$20	0	$0
		MISCELLANEOUS TRAFFIC CONTROL					
75		PORTABLE CHANGEABLE MESSAGE SIGN-					
		TEMPORARY CONSTRUCTION SIGNS					
75		TRUCK-MOUNTED IMPACT ATTENUATOR, TEST LEVEL 2		USE 30% OF MAINTENANCE OF TRAFFIC			
75		IMPACT ATTENUATION DEVICE					
		MISCELLANEOUS TRAFFIC CONTROL SUBTOTAL					$180
		TEMPORARY TRAFFIC CONTROL COST SUBTOTAL					$1,560
		EROSION, SEDIMENT & POLLUTION CONTROL					
80		HAY BALES FOR TEMPORARY EROSION CONTROL	EA				
80		RYEGRASS FOR TEMPORARY EROSION CONTROL	LB				
80		SILT FENCE	LF	USE 5% OF SUBTOTAL A			
80		EROSION AND SEDIMENT CONTROL STORMWATER MGMT PLAN	U				
80		MONITORING EROSION AND SEDIMENT CONTROL	HR				
80		TEMPORARY PROJECT WATER POLLUTION CONTROL	$				$0
		EROSION, SEDIMENT & POLLUTION CONTROL SUBTOTAL					$0
		SUBTOTAL E					$21,560
		ADDITIONAL ITEMS OF CONSIDERATION					
		ITS			$0	0	$0
20		RETAINING WALLS	SF	USE $50/SF	$50	0	$0
30		SOUND WALL	SF	USE $25 /SF	$25	0	$0
		MISCELLANEOUS (fuel adjust,alterations)					$0
		WATER QUALITY - STORMWATER BMPs		DRAINAGE BASINS AREAS (INCLUDED IN SITE)	$100,000	0	$0
		LANDSCAPING		ASSUME $20.65/LF	$20.65	0	$0
		UTILITY ADJUSTMENTS		ASSUME $1000/LF	$0	0	$0
		STRUCTURES			$0	0	$0
		ADDITIONAL ITEMS COST SUBTOTAL					$0
		SUBTOTAL F					$21,560
		MOBILIZATION		USE 8% OF SUBTOTAL F			$1,725
		CONTINGENCIES		USE 10% OF SUBTOTAL F			$2,156
		CONSTRUCTION SUBTOTAL					**$25,441**
		CONSTRUCTION ENGINEERING		USE 8% OF CONSTRUCTION TOTALS			$2,035
		CONSTRUCTION TOTAL					**$30,000**

D.3 Concept 3: Cost Estimate

CONSTRUCTION COST ESTIMATE

PROJECT : **NH 9 / NH 63**

LOCATION : Chesterfield, NH

STATE PROJECT NO.

FEDERAL PROJECT NO.

ESTIMATE TYPE: Conceptual Cost Estimate

DATE PREPARED: 10/04/2016

ESTIMATED BY: FMK

CHECKED BY: MJB

Chesterfield RSA

NH 9 / NH 63

Concept 3

	ITEM NO	ITEM DESCRIPTION	UNIT	NOTE	UNIT PRICE	QUANTITY	TOTAL COST
		MATERIAL ITEMS (ROADWAY)					
1	201.1	CLEARING AND GRUBBING (F)	A		$8,000	0.00	$0
2	203.1	COMMON EXCAVATION	CY		$8	175	$1,400
2.1	203.2	ROCK EXCAVATION	CY	ASSUME 0% OF COMMON EXCAVATION	$30	0	$0
2.2	203.6	EMBANKMENT-IN-PLACE (F)	CY		$10	55	$550
2.4	206.1	COMMON STRUCTURE EXCAVATION					
2.5	206.19	COMMON STRUCTURE EXCAVATION EXPLORATORY	LS	ADD 15% OF TOTAL COST of COM. EXC. & ROCK EXC. COST			$210
2.6	206.2	ROCK STRUCTURE EXCAVATION					
2.7	207.3	UNCLASSIFIED CHANNEL EXCAVATION					
3	304.1	SAND	CY		$19	50	$950
3	304.2	GRAVEL (F)	CY		$23	50	$1,150
3	304.3	CRUSHED GRAVEL (F)	CY		$25	50	$1,250
4	403.11	HOT BITUMINOUS PAVEMENT,MACHINE METHOD	TON		$70	70	$4,900
4	403.12	HOT BITUMINOUS PAVEMENT, HAND METHOD	TON		$110	0	$0
4	403.99	TEMPORARY BITUMINOUS PAVEMENT	TON		$60	0	$0
4	411.43	PLANT MIX SURFACE TREAT- MENT (ASPHALT CEMENT 3/8")	TON		$70	0	$0
4	417	COLD PLANING BITUMINOUS SURFACES (F)	SY		$5	0	$0
5	417.41x	RUMBLE STRIPS	LF		$5	0	$0
6	606.14	BEAM GUARDRAIL (STANDARD SECTION- WOOD POSTS)	LF		$18	0	$0
6	606.141	BEAM GUARDRAIL (CURVED W/CRT POSTS)					
6	606.1452	BEAM GUARDRAIL (TERMINAL UNIT TYPE ELT)	LS	ADD 40% OF COST OF GUARD RAIL			$0
6	606.147	BEAM GUARDRAIL (TERMINAL UNIT TYPE G-2)					
6	606.84	ANCHOR FOR CURVED GUARD- RAIL W/CRT POSTS					
	608.12	2" BITUMINOUS SIDEWALK	SY		$13	0	$0
7	608.24	CONCRETE SIDEWALK (F)	SY		$40	0	$0
8	609.01	STRAIGHT GRANITE CURB	LF		$17	0	$0
8	609.02	CURVED GRANITE CURB	LF		$30	0	$0
8.1	609.21	STRAIGHT GRANITE SLOPE CURB	LF		$13	0	$0
8.2	609.811	BITUMINOUS CURB, TYPE B (4" REVEAL)	LF	25% OF GUARD RAIL QUANTITY	$5	0	$0
8.3	609.5	RESET GRANITE CURB	LF		$7		$0
10	214	FINE GRADING	LS	20% OF TOTAL SUB BASE COST			$670
		SUBTOTAL A					$11,080
		MISCELLANEOUS ITEMS (ROADWAY) (SAMPLE ITEMS BELOW)					
12		FILL ABANDONED PIPE	CY				
		CLEARING FOR FENCE LINES (F)	A				
12		REMOVAL OF EXISTING PIPE 0-24" DIAMETER	LF				
12		REMOVAL OF CATCH BASINS, DROP INLETS, AND MANHOLES	EA				
12		REMOVAL OF GUARDRAIL (F)	LF				
12		CRUSHED GRAVEL FOR SHOULDER LEVELING /DRIVES	CY				
		Geotextile fabrics	SY				
12		ADJUSTING CATCH BASIN DROP INLET GRATE AND FRAMES	EA				
12		ADJUSTING MANHOLE COVERS AND FRAMES	EA				
12		DROP INLET SEDIMENT TRAP OUTLET	EA				
12		CHAIN LINK FENCE WITH VINYL-COATED STEEL FABRIC 6' HIGH	LF				
12		POST ASSEMBLIES FOR CHAIN LINK FENCE, 6 FT. HIGH	EA				
12		CONCRETE STAIRS	U				
12		RETROREFLECTIVE BEAM GUARDRAIL DELINEATOR	EA				
12		DELINEATORS WITH POST	EA	USE 40% OF SUBTOTAL "A" COST			
12		STEEL WITNESS MARKERS, BOUNDS	EA				
12		SAWED PAVEMENT	LF				
12		DETECTABLE WARNING PAVERS (SIDEWALK RAMPS)					
12		THERMOPLAS. & PAINT PAVE. MARKING,	LF				
12		LOAM & HUMAS	CY				
12		FERTILIZER	TON				
12		GRASS SEED, TYPE 82	LB				
12		SLOPE STABILIZATION & CHANNEL STABILIZATION	SY				
12		TURF ESTABLISHMENT	SY				
12		BARK MULCH MATERIAL	CY				
12		ON-THE-JOB TRAINING OF UNSKILLED WORKERS	$				
12		FIELD OFFICE TYPE & LAB	MON				
12		TRAFFIC SIGN TYPE A,B,C;AA,BB,CC	SF				
		MICELLANEOUS COST SUBTOTAL					$4,432
		SUBTOTAL B					$15,512
		DRAINAGE COSTS (SAMPLE ITEMS BELOW)					
13		STONE FILL, CLASS B,C,D	CY				
13		PIPE	LF				
13		STEEL END SECTIONS	EA	**CONSIDER** 1-10% MINOR IMPROVEMENTS 10% RECONST NON URBAN 15% NEW NON URBAN 20% FULL DEPTH RECONSTRUCT URBAN 20% NEW URBAN 25% COMPLEX URBAN		0%	
13		CATCH BASINS	U				
13		DRAINAGE MANHOLES	U				
13		RECONSTRUCTING CATCH BASINS & DROP INLETS	LF				
13		WATER REPELLENT FOR EXISTING CB'S AND DI'S	EA				
13		UNDERDRAIN FLUSHING BASINS	EA				
13		18" AGGREGATE UNDERDRAIN TYPE 2, WITH 6" PIPE	LF				
13		24" AGGRE UND. TYPE 2, WITH OPTION PIPE	LF				
13		6" PIPE UNDERDRAIN (CON- TRACTORS OPTION)	LF				
		DRAINAGE COST SUBTOTAL					$0.00
		SUBTOTAL C					$15,512
		PERMANENT TRAFFIC CONTROL (SAMPLE ITEMS BELOW)					
13.1		OVERHEAD SIGN STRUCTURES CANTELEVER	EA	USE $600/LF	$600		$0
13.1		OVERHEAD SIGN STRUCTURES SPAN	EA	USE $800/LF	$800	0	$0
60		TRAFFIC SIGNALS	EA	USE $150K/ INTERSECTION	$150,000	0	$0
60		TRAFFIC SIGNAL COORDINATION	EA	USE $50K/ ADDITIONAL INTERSECTION	$50,000	0	$0
65		LIGHT POLES AND BASES (est 2/300 feet)	EA	USE $4500/ POLE	$4,500	0	$0
		PERMANENT TRAFFIC CONTROL COST SUBTOTAL					$0
		SUBTOTAL D					$15,512
		TEMPORARY TRAFFIC CONTROL (SAMPLE ITEMS BELOW)					
70		UNIFORMED OFFICERS WITH VEHICLE		USE 2.5 TIMES MAINT OF TRAFFIC COST			$3,250
71		FLAGGERS		USE 30% OF UNIFORMED OFFICER COST			$975
73		MAINTENANCE OF TRAFFIC	UNIT	USE 8% OF SUBTOTAL D	$1,300	1	$1,300
74		PORTABLE CONCRETE BARRIER FOR TRAFFIC CONTROL	LF		$20	0	$0
		MISCELLANEOUS TRAFFIC CONTROL					
75		PORTABLE CHANGEABLE MESSAGE SIGN-					
		TEMPORARY CONSTRUCTION SIGNS					
75		TRUCK-MOUNTED IMPACT ATTENUATOR, TEST LEVEL 2		USE 30% OF MAINTENANCE OF TRAFFIC			
75		IMPACT ATTENUATION DEVICE					
		MISCELLANEOUS TRAFFIC CONTROL SUBTOTAL					$390
		TEMPORARY TRAFFIC CONTROL COST SUBTOTAL					$5,915
		EROSION, SEDIMENT & POLLUTION CONTROL					
80		HAY BALES FOR TEMPORARY EROSION CONTROL	EA				
80		RYEGRASS FOR TEMPORARY EROSION CONTROL	LB				
80		SILT FENCE	LF	USE 5% OF SUBTOTAL A			
80		EROSION AND SEDIMENT CONTROL STORMWATER MGMT PLAN	U				
80		MONITORING EROSION AND SEDIMENT CONTROL	HR				
80		TEMPORARY PROJECT WATER POLLUTION CONTROL	$				$554
		EROSION, SEDIMENT & POLLUTION CONTROL SUBTOTAL					$554
		SUBTOTAL E					$21,981
		ADDITIONAL ITEMS OF CONSIDERATION					
		ITS			$0	0	$0
20		RETAINING WALLS	SF	USE $50/SF	$50	0	$0
30		SOUND WALL	SF	USE $25 /SF	$25	0	$0
		MISCELLANEOUS (fuel adjust,alterations)		USE 10% OF SUBTOTAL E			$2,198
		WATER QUALITY - STORMWATER BMPs		DRAINAGE BASINS AREAS (INCLUDED IN SITE)	$100,000	0	$0
		LANDSCAPING		ASSUME $20.65/LF	$20.65	0	$0
		UTILITY ADJUSTMENTS		ASSUME $1000/LF	$0	0	$0
		STRUCTURES			$0	0	$0
		ADDITIONAL ITEMS COST SUBTOTAL					$2,198
		SUBTOTAL F					$24,179
		MOBILIZATION		USE 8% OF SUBTOTAL F			$1,934
		CONTINGENCIES		USE 10% OF SUBTOTAL F			$2,418
		CONSTRUCTION SUBTOTAL					**$28,531**
		CONSTRUCTION ENGINEERING		USE 8% OF CONSTRUCTION TOTALS			$2,283
		CONSTRUCTION TOTAL					**$35,000**

D.4 Concept 4: Cost Estimate

CONSTRUCTION COST ESTIMATE

PROJECT : **NH 9 / NH 63**

LOCATION : Chesterfield, NH

STATE PROJECT NO.

FEDERAL PROJECT NO.

ESTIMATE TYPE: Conceptual Cost Estimate

DATE PREPARED: 10/04/2016

ESTIMATED BY: FMK

CHECKED BY: MJB

Chesterfield RSA
NH 9 / NH 63

Concept 4

	ITEM NO	ITEM DESCRIPTION	UNIT	NOTE	UNIT PRICE	QUANTITY	TOTAL COST
		MATERIAL ITEMS (ROADWAY)					
1	201.1	CLEARING AND GRUBBING (F)	A		$8,000	0.00	$0
2	203.1	COMMON EXCAVATION	CY		$8	5	$40
2.1	203.2	ROCK EXCAVATION	CY	ASSUME 0% OF COMMON EXCAVATION	$30	0	$0
2.2	203.6	EMBANKMENT-IN-PLACE (F)	CY		$10	0	$0
2.4	206.1	COMMON STRUCTURE EXCAVATION					
2.5	206.19	COMMON STRUCTURE EXCAVATION EXPLORATORY	LS	ADD 15% OF TOTAL COST of COM. EXC. & ROCK EXC. COST			$6
2.6	206.2	ROCK STRUCTURE EXCAVATION					
2.7	207.3	UNCLASSIFIED CHANNEL EXCAVATION					
3	304.1	SAND	CY		$19	0	$0
3	304.2	GRAVEL (F)	CY		$23	0	$0
3	304.3	CRUSHED GRAVEL (F)	CY		$25	10	$250
4	403.11	HOT BITUMINOUS PAVEMENT,MACHINE METHOD	TON		$70	3	$210
4	403.12	HOT BITUMINOUS PAVEMENT, HAND METHOD	TON		$110	0	$0
4	403.99	TEMPORARY BITUMINOUS PAVEMENT	TON		$60	0	$0
4	411.43	PLANT MIX SURFACE TREAT- MENT (ASPHALT CEMENT 3/8")	TON		$70	0	$0
4	417	COLD PLANING BITUMINOUS SURFACES (F)	SY		$5	0	$0
5	417.41x	RUMBLE STRIPS	LF		$5	0	$0
6	606.14	BEAM GUARDRAIL (STANDARD SECTION- WOOD POSTS)	LF		$18	0	$0
6	606.141	BEAM GUARDRAIL (CURVED W/CRT POSTS)					
6	606.1452	BEAM GUARDRAIL (TERMINAL UNIT TYPE ELT)	LS	ADD 40% OF COST OF GUARD RAIL			$0
6	606.147	BEAM GUARDRAIL (TERMINAL UNIT TYPE G-2)					
6	606.84	ANCHOR FOR CURVED GUARD- RAIL W/CRT POSTS					
	608.12	2" BITUMINOUS SIDEWALK	SY		$13	0	$0
7	608.24	CONCRETE SIDEWALK (F)	SY		$40	0	$0
8	609.01	STRAIGHT GRANITE CURB	LF		$17	0	$0
8	609.02	CURVED GRANITE CURB	LF		$30	0	$0
8.1	609.21	STRAIGHT GRANITE SLOPE CURB	LF		$13	70	$910
8.2	609.811	BITUMINOUS CURB, TYPE B (4" REVEAL)	LF	25% OF GUARD RAIL QUANTITY	$5	0	$0
8.3	609.5	RESET GRANITE CURB	LF		$7		$0
10	214	FINE GRADING	LS	20% OF TOTAL SUB BASE COST			$50
		SUBTOTAL A					$1,466
		MISCELLANEOUS ITEMS (ROADWAY) (SAMPLE ITEMS BELOW)					
12		FILL ABANDONED PIPE	CY				
		CLEARING FOR FENCE LINES (F)	A				
12		REMOVAL OF EXISTING PIPE 0-24" DIAMETER	LF				
12		REMOVAL OF CATCH BASINS, DROP INLETS, AND MANHOLES	EA				
12		REMOVAL OF GUARDRAIL (F)	LF				
12		CRUSHED GRAVEL FOR SHOULDER LEVELING /DRIVES	CY				
		Geotextile fabrics	SY				
12		ADJUSTING CATCH BASIN DROP INLET GRATE AND FRAMES	EA				
12		ADJUSTING MANHOLE COVERS AND FRAMES	EA				
12		DROP INLET SEDIMENT TRAP OUTLET	EA				
12		CHAIN LINK FENCE WITH VINYL-COATED STEEL FABRIC 6' HIGH	LF				
12		POST ASSEMBLIES FOR CHAIN LINK FENCE, 6 FT. HIGH	EA				
12		CONCRETE STAIRS	U				
12		RETROREFLECTIVE BEAM GUARDRAIL DELINEATOR	EA				
12		DELINEATORS WITH POST	EA	USE 40% OF SUBTOTAL "A" COST			
12		STEEL WITNESS MARKERS, BOUNDS	EA				
12		SAWED PAVEMENT	LF				
12		DETECTABLE WARNING PAVERS (SIDEWALK RAMPS)					
12		THERMOPLAS. & PAINT PAVE. MARKING,	LF				
12		LOAM & HUMAS	CY				
12		FERTILIZER	TON				
12		GRASS SEED, TYPE 82	LB				
12		SLOPE STABILIZATION & CHANNEL STABILIZATION	SY				
12		TURF ESTABLISHMENT	SY				
12		BARK MULCH MATERIAL	CY				
12		ON-THE-JOB TRAINING OF UNSKILLED WORKERS	$				
12		FIELD OFFICE TYPE & LAB	MON				
12		TRAFFIC SIGN TYPE A,B,C;AA,BB,CC	SF				
		MICELLANEOUS COST SUBTOTAL					$586
		SUBTOTAL B					$2,052
		DRAINAGE COSTS (SAMPLE ITEMS BELOW)					
13		STONE FILL, CLASS B,C,D	CY				
13		PIPE	LF				
13		STEEL END SECTIONS	EA	**CONSIDER** 1-10% MINOR IMPROVEMENTS 10% RECONST NON URBAN 15% NEW NON URBAN 20% FULL DEPTH RECONSTRUCT URBAN 20% NEW URBAN 25% COMPLEX URBAN		0%	
13		CATCH BASINS	U				
13		DRAINAGE MANHOLES	U				
13		RECONSTRUCTING CATCH BASINS & DROP INLETS	LF				
13		WATER REPELLENT FOR EXISTING CB'S AND DI'S	EA				
13		UNDERDRAIN FLUSHING BASINS	EA				
13		18" AGGREGATE UNDERDRAIN TYPE 2, WITH 6" PIPE	LF				
13		24" AGGRE UND. TYPE 2, WITH OPTION PIPE	LF				
13		6" PIPE UNDERDRAIN (CON- TRACTORS OPTION)	LF				
		DRAINAGE COST SUBTOTAL					$0.00
		SUBTOTAL C					$2,052
		PERMANENT TRAFFIC CONTROL (SAMPLE ITEMS BELOW)					
13.1		OVERHEAD SIGN STRUCTURES CANTELEVER	EA	USE $600/LF	$600		$0
13.1		OVERHEAD SIGN STRUCTURES SPAN	EA	USE $800/LF	$800	0	$0
60		TRAFFIC SIGNALS	EA	USE $150K/ INTERSECTION	$150,000	0	$0
60		TRAFFIC SIGNAL COORDINATION	EA	USE $50K/ ADDITIONAL INTERSECTION	$50,000	0	$0
65		LIGHT POLES AND BASES (est 2/300 feet)	EA	USE $4500/ POLE	$4,500	0	$0
		PERMANENT TRAFFIC CONTROL COST SUBTOTAL					$0
		SUBTOTAL D					$2,052
		TEMPORARY TRAFFIC CONTROL (SAMPLE ITEMS BELOW)					
70		UNIFORMED OFFICERS WITH VEHICLE		USE 2.5 TIMES MAINT OF TRAFFIC COST			$500
71		FLAGGERS		USE 30% OF UNIFORMED OFFICER COST			$150
73		MAINTENANCE OF TRAFFIC	UNIT	USE 8% OF SUBTOTAL D	$200	1	$200
74		PORTABLE CONCRETE BARRIER FOR TRAFFIC CONTROL	LF		$20	0	$0
		MISCELLANEOUS TRAFFIC CONTROL					
75		PORTABLE CHANGEABLE MESSAGE SIGN-					
		TEMPORARY CONSTRUCTION SIGNS					
75		TRUCK-MOUNTED IMPACT ATTENUATOR, TEST LEVEL 2		USE 30% OF MAINTENANCE OF TRAFFIC			
75		IMPACT ATTENUATION DEVICE					
		MISCELLANEOUS TRAFFIC CONTROL SUBTOTAL					$60
		TEMPORARY TRAFFIC CONTROL COST SUBTOTAL					$910
		EROSION, SEDIMENT & POLLUTION CONTROL					
80		HAY BALES FOR TEMPORARY EROSION CONTROL	EA				
80		RYEGRASS FOR TEMPORARY EROSION CONTROL	LB				
80		SILT FENCE	LF	USE 5% OF SUBTOTAL A			
80		EROSION AND SEDIMENT CONTROL STORMWATER MGMT PLAN	U				
80		MONITORING EROSION AND SEDIMENT CONTROL	HR				
80		TEMPORARY PROJECT WATER POLLUTION CONTROL	$				$73
		EROSION, SEDIMENT & POLLUTION CONTROL SUBTOTAL					$73
		SUBTOTAL E					$3,036
		ADDITIONAL ITEMS OF CONSIDERATION					
		ITS			$0	0	$0
20		RETAINING WALLS	SF	USE $50/SF	$50	0	$0
30		SOUND WALL	SF	USE $25 /SF	$25	0	$0
		MISCELLANEOUS (fuel adjust,alterations)		USE 10% OF SUBTOTAL E			$304
		WATER QUALITY - STORMWATER BMPs		DRAINAGE BASINS AREAS (INCLUDED IN SITE)	$100,000	0	$0
		LANDSCAPING		ASSUME $20.65/LF	$20.65	0	$0
		UTILITY ADJUSTMENTS		ASSUME $1000/LF	$0	0	$0
		STRUCTURES			$0	0	$0
		ADDITIONAL ITEMS COST SUBTOTAL					$304
		SUBTOTAL F					$3,339
		MOBILIZATION		USE 8% OF SUBTOTAL F			$267
		CONTINGENCIES		USE 10% OF SUBTOTAL F			$334
		CONSTRUCTION SUBTOTAL					**$3,940**
		CONSTRUCTION ENGINEERING		USE 8% OF CONSTRUCTION TOTALS			$315
		CONSTRUCTION TOTAL					**$5,000**

Appendix E: Benefit-Cost Analysis

E.1 Near-Term Strategies

Near-term improvements are those that are lower cost and can generally be done with maintenance staff. For example, sign replacements are an inexpensive strategy and can generally be done as part of routine maintenance. As such, detailed benefit-cost analyses were not conducted for near-term improvements. Near-term strategies are summarized in Appendix F.

E.2 Proactive Strategies

The report identified proactive strategies that are not necessarily related to any crashes experienced in the 10-year study period from 2003 – 2013. Instead, these strategies are suggested based on field observations of potential safety issues. A benefit-cost analysis was not conducted for proactive measures because they are not directly related to any crashes experienced in the study period. Proactive strategies are summarized in Appendix F.

E.3 Benefit-Cost Analysis of Concepts 1 – 4

Detailed benefit-cost analyses were conducted for the four concepts related to the intersection of NH 9 and NH 63, including strategies that are associated with crashes reported during the study period. The following tables present a summary of the benefit-cost analyses by concept for Concepts 1 – 4.

Concept 1

Summary	Issue	Target Crashes	Individual Benefit	Total Benefit	Construction Cost	B/C Ratio
Improve sight distance by trimming and removing trees in NE corner.	1	Fatal/Injury	$266,869	$272,696	$25,000	10.91
		PDO	$5,827			
Install speed feedback sign.	2, 3	N/A	N/A			
Static intersection warning sign.	2, 3	N/A	N/A			
Improve delineation through pavement markings.	2, 3	N/A	N/A			

N/A: CMF is not available for this treatment, but it is expected to target reported crashes at this location.

Concept 2

Summary	Issue	Target Crashes	Individual Benefit	Total Benefit	Construction Cost	B/C Ratio
Install ICWS.	1, 2, 3	All	$208,344	$208,344	$37,500	5.56

Concept 3

Summary	Issue	Target Crashes	Individual Benefit	Total Benefit	Construction Cost	B/C Ratio
Construct right-turn slip lanes on NH 63.	2, 3	N/A	N/A	N/A	$43,750	N/A

N/A: CMF is not available for this treatment, but it is expected to target reported crashes at this location.

Concept 4

Summary	Issue	Target Crashes	Individual Benefit	Total Benefit	Construction Cost	B/C Ratio
Construct raised channelizing island on Pinnacle Spring Road.	5	PDO	$6,659	$6,659	$7,000	0.95

Appendix F: Summary of Strategies

Appendix F provides a summary of suggested strategies. This can form the basis of the formal response letter, which is Step 7 of the FHWA RSA Process. The objective of the formal response letter is to document the decisions made by the project owner/design team with respect to the RSA findings. The response identifies those strategies that will be implemented and the responsible party. The response should also note any strategies that will not be implemented and why. The following are examples of why a strategy may not be selected:

- The strategy is not within the scope of the project.
- The strategy would lead to mobility, environmental, or other non-safety related issues.
- The strategy is not cost-effective and other alternatives will be explored.

F.1 Near-Term Strategies

Issue(s)	Strategy	Responsible Stakeholder		Status / Comments
		Implementation	Maintenance	
1	1.1 Install centerline and lane line rumble strips on NH 9.	Not Applicable	Not Applicable	NHDOT installed centerline rumble strips in the summer of 2015 along NH 9. Due to local noise complaints the rumble strips were removed.
1	1.2 Remove and/or trim trees in northeast corner of intersection.	NHDOT	NHDOT	Determine if there is a historical impact before trimming or removing trees.
2	2.1 Consider one or more of the following speed mitigation measures: • Speed feedback signs. • Transverse rumble strips. • High-visibility enforcement through the Highway 101 enforcement grant.	Town	Town	Note NHDOT does not recommend transverse rumble strips due to noise; speed feedback signs are not supported by NHDOT practice.
2	2.2 Employ public service announcements (PSAs), media messages, and billboards with targeted messages to address driver behavior issues such as speeding, distracted driving, and aggressive driving.	GHSA	GHSA	The State Highway Safety Office can fund these efforts through the GHSA Section 402 State and Community Highway Safety Grant Program.
2	2.3 Designate this section of NH 9 as a "Safety Corridor."	Multiple	Multiple	The State Highway Safety Office may be able to fund enforcement components of these efforts through the GHSA Section 402 State and Community Highway Safety Grant Program.

Issue(s)	Strategy	Responsible Stakeholder		Status / Comments
		Implementation	Maintenance	
3	3.1 Delineate eastbound receiving lane on NH 9.	B/C ratio is less than 1.0		B/C ratio is less than 1.0, so HSIP funds cannot be used. Town & RPC need to find alternative funding for this improvement.
3	3.2 Install advance intersection warning sign on westbound approach of NH 9.	NHDOT	NHDOT	NHDOT Traffic would evaluate these signs.
4	4.1 Install pedestrian and bicycle warning signs on NH 9.	Not applicable	Not applicable	This is not a NHDOT standard and these types of warning signs are generally not supported for State Roads. No further action will occur for this strategy.

F.2 Intermediate and Long-Term Proactive Strategies

Issue(s)	Strategy	Responsible Stakeholder		Status / Comments
		Implementation	Maintenance	
4	4.2 Investigate the need for additional or enhanced pedestrian and bicycle facilities.	Town	Town	
4	4.3 Consider installing a raised median refuge on NH 9 to facilitate pedestrian and bicycle crossings.	Town	Town	The RSA team expressed concern with a crossing at the intersection, but noted that a crossing further to the east may be appropriate if there is adequate sight distance and additional enhancements. B/C ratio would need to be developed for this improvement. Currently no data on the cost of this improvement. If the B/C ratio is less than 1.0, then Town & RPC need to find alternative funding for this improvement.

F.3 Intermediate Strategies Associated with Crashes

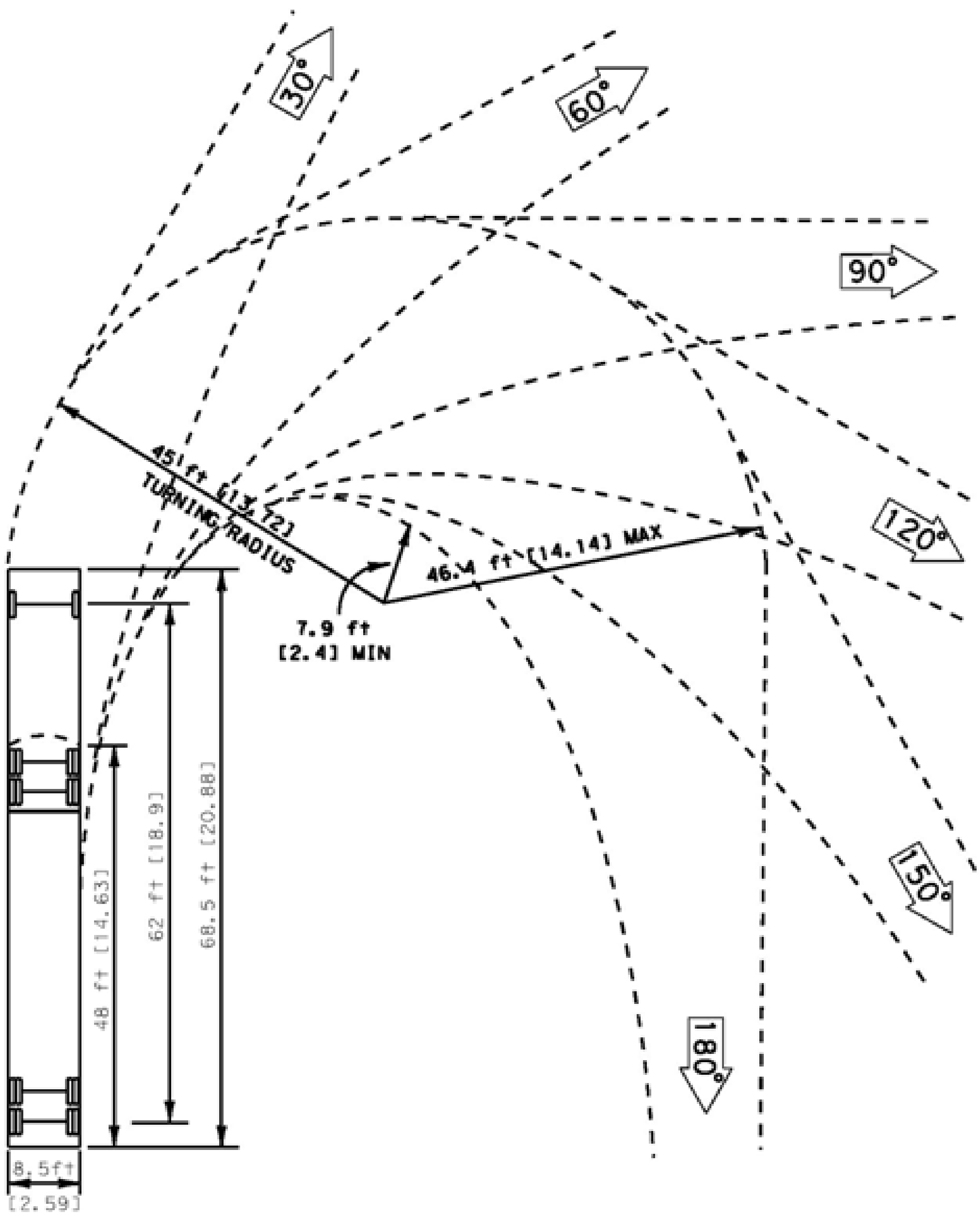
Issue(s)	Strategies	Responsible Stakeholder		Status / Comments
		Implementation	Maintenance	
1	1.3 Install an intersection conflict warning system (ICWS).	NHDOT	NHDOT	NHDOT HSIP project is approved by HSIP committee, NHDOT executive staff, & Town officials. B/C ratio is 5.56.
2, 3	2.4/3.3 Install a right-turn slip lane from northbound NH 63 to eastbound NH 9.	B/C ratio is less than 1.0		B/C ratio is less than 1.0, so HSIP funds cannot be used. Town & RPC need to find alternative funding for this improvement.
2	2.5 Install a right-turn slip lane from southbound NH 63 to westbound NH 9.	B/C ratio is less than 1.0		B/C ratio is less than 1.0, so HSIP funds cannot be used. Town & RPC need to find alternative funding for this improvement.
2	2.6 Consider installing a raised channelizing island to better define the eastbound right-turn lane on NH 9.	Not applicable	Not applicable	This alternative is not feasible as the island would restrict the turning path of large trucks.
5	5.1 Convert access at Pinnacle Springs Road from full movement to right-in-right-out only.	B/C ratio is less than 1.0		B/C ratio is less than 1.0, so HSIP funds cannot be used. Town & RPC need to find alternative funding for this improvement.

F.4 Long-Term Strategies Associated with Crashes

Issue(s)	Strategies	Responsible Stakeholder		Status / Comments
		Implementation	Maintenance	
1	1.4 Reduce crest vertical curve on NH 9 to the west of the intersection.	NHDOT	NHDOT	This is currently not shown in a concept. The construction cost and B/C ratio would need to be developed. Most likely this type of improvement would need to be funded with a 10 year plan project.

Appendix G: WB-62 Turning Radius

WB-62 [WB-19] DESIGN VEHICLE
RADIUS = 45 ft [13.72 m]
SCALE =1:20 [1:200]



Turning Template for Semi-Trailer with 62 ft [18.9 m] Wheelbase (Radius=45 ft [13.72 m])

Appendix H: Speed Study Results

Chesterfield, NH
NH 9 (WB) West of NH 63
Speed Statistics by Hour

SpeedStatHour-113
Site: WB R9 West of 63.0.0EW
Description: **(WB) RT 9 West of 63**
Filter time: **12:00 Monday, September 16, 2013 => 9:40 Monday, September 23, 2013**
Scheme: Vehicle classification (Scheme F2)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12 13) Dir(NESW) Sp(6,99) Headway(>0)

Vehicles = 41610
Posted speed limit = 50 mph, Exceeding = 32737 (78.68%), Mean Exceeding = 55.69 mph
Maximum = 86.0 mph, **Minimum** = 6.4 mph, **Mean** = 53.5 mph
85% Speed = 58.6 mph, **95% Speed** = 61.5 mph, **Median** = 53.9 mph
12 mph Pace = 48 - 60, **Number in Pace** = 32473 (78.04%)
Variance = 32.22, **Standard Deviation** = 5.68 mph

Hour Bins (Partial days)

Time	Bin		Min	Max	Mean	Median	85%	95%	>PSL 50 mph	
0000	199	0.5%	13.5	66.8	53.2	54.1	58.6	61.5	153	76.9%
0100	200	0.5%	28.9	66.9	53.6	53.5	59.3	61.1	156	78.0%
0200	206	0.5%	18.8	67.6	53.4	53.5	60.8	63.5	146	70.9%
0300	269	0.6%	17.2	85.7	53.3	54.4	60.4	63.5	195	72.5%
0400	416	1.0%	23.0	73.8	56.0	56.4	61.5	64.6	351	84.4%
0500	659	1.6%	31.1	75.2	54.7	55.3	60.2	63.3	527	80.0%
0600	1877	4.5%	22.0	75.1	53.6	54.4	59.3	62.4	1454	77.5%
0700	2962	7.1%	10.7	73.3	53.6	54.1	58.4	60.8	2374	80.1%
0800	2746	6.6%	19.6	78.4	53.5	54.1	58.6	61.5	2155	78.5%
0900	2135	5.1%	12.0	72.8	53.9	54.6	58.8	61.7	1751	82.0%
1000	2094	5.0%	20.8	72.4	53.7	54.1	59.1	62.0	1630	77.8%
1100	2348	5.6%	22.6	73.4	53.7	54.1	58.8	61.7	1868	79.6%
1200	2918	7.0%	6.4	78.5	53.0	53.5	58.2	61.1	2226	76.3%
1300	2735	6.6%	19.4	72.7	53.6	53.9	58.6	61.7	2162	79.0%
1400	3029	7.3%	10.5	74.9	53.1	53.2	58.2	61.3	2335	77.1%
1500	3028	7.3%	8.0	86.0	53.2	53.7	58.2	60.6	2337	77.2%
1600	3187	7.7%	15.5	74.7	53.6	53.9	58.4	61.1	2550	80.0%
1700	3021	7.3%	13.7	76.1	54.4	54.6	58.8	61.5	2578	85.3%
1800	2287	5.5%	23.2	85.2	54.5	54.8	59.1	62.0	1939	84.8%
1900	1837	4.4%	28.7	69.9	52.9	53.0	57.7	60.4	1350	73.5%
2000	1491	3.6%	8.4	68.6	52.1	52.1	57.0	60.2	1021	68.5%
2100	989	2.4%	24.2	68.1	52.8	53.0	57.5	59.7	739	74.7%
2200	632	1.5%	24.8	83.2	53.6	53.2	58.4	61.5	502	79.4%
2300	345	0.8%	30.7	86.0	52.5	52.3	57.9	61.7	238	69.0%
----	41610	100.0%	6.4	86.0	53.5	53.9	58.6	61.5	32737	78.7%

Chesterfield, NH
NH 9 (WB) East of NH 63
Speed Statistics by Hour

SpeedStatHour-112
Site: RT 9 (WB).0.0EW
Description: **RT 9 (WB) east of RT 63**
Filter time: **12:00 Monday, September 16, 2013 => 10:04 Monday, September 23, 2013**
Scheme: Vehicle classification (Scheme F2)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12 13) Dir(NESW) Sp(6,99) Headway(>0)

Vehicles = 45199
Posted speed limit = 50 mph, Exceeding = 37542 (83.06%), Mean Exceeding = 55.29 mph
Maximum = 97.6 mph, **Minimum** = 7.3 mph, **Mean** = 53.9 mph
85% Speed = 58.2 mph, **95% Speed** = 61.1 mph, **Median** = 53.9 mph
12 mph Pace = 48 - 60, **Number in Pace** = 38190 (84.49%)
Variance = 20.40, **Standard Deviation** = 4.52 mph

Hour Bins (Partial days)

Time	Bin		Min	Max	Mean	Median	85%	95%	>PSL 50 mph	
0000	216	0.5%	36.7	71.4	53.3	53.2	57.9	60.8	168	77.8%
0100	202	0.4%	42.1	70.4	54.4	54.6	58.6	61.3	174	86.1%
0200	199	0.4%	42.0	67.0	54.5	54.4	59.5	62.0	169	84.9%
0300	245	0.5%	39.8	84.2	54.9	54.1	60.2	64.4	208	84.9%
0400	390	0.9%	40.2	72.6	56.5	56.1	60.8	63.8	361	92.6%
0500	645	1.4%	42.7	72.6	55.7	55.5	60.2	63.3	570	88.4%
0600	1827	4.0%	32.2	74.8	54.6	54.6	58.8	61.5	1592	87.1%
0700	3067	6.8%	7.3	74.7	53.8	53.7	57.7	60.2	2591	84.5%
0800	2882	6.4%	22.9	71.2	54.1	53.9	58.4	61.3	2418	83.9%
0900	2430	5.4%	37.4	69.3	54.9	54.8	59.1	61.7	2167	89.2%
1000	2249	5.0%	18.9	74.3	54.6	54.6	59.1	62.0	1924	85.5%
1100	2517	5.6%	19.1	70.8	54.4	54.4	58.6	61.7	2167	86.1%
1200	2889	6.4%	9.7	75.2	53.9	53.9	58.2	60.6	2419	83.7%
1300	2942	6.5%	23.3	69.7	54.3	54.1	58.4	61.1	2531	86.0%
1400	3372	7.5%	18.2	71.5	53.6	53.5	57.7	60.6	2750	81.6%
1500	3373	7.5%	19.5	70.9	53.4	53.5	57.5	60.2	2699	80.0%
1600	3636	8.0%	19.6	72.5	54.0	53.9	57.9	60.4	3082	84.8%
1700	3562	7.9%	16.0	70.9	53.4	53.5	57.5	60.4	2887	81.0%
1800	2553	5.6%	14.6	73.1	54.5	54.4	58.6	61.1	2212	86.6%
1900	2085	4.6%	17.5	67.9	53.0	53.0	57.3	60.4	1589	76.2%
2000	1700	3.8%	18.5	71.0	52.1	52.1	56.4	59.1	1199	70.5%
2100	1141	2.5%	21.2	97.6	52.5	52.6	56.8	59.3	829	72.7%
2200	691	1.5%	40.9	69.2	53.8	53.7	58.4	60.6	565	81.8%
2300	386	0.9%	23.2	69.6	52.8	52.6	57.9	62.0	271	70.2%
----	**45199**	**100.0%**	**7.3**	**97.6**	**53.9**	**53.9**	**58.2**	**61.1**	**37542**	**83.1%**

Chesterfield, NH
NH 9 (EB) West of NH 63
Week of September 16, 2013
Speed Statistics by Hour

SpeedStatHour-109
Site: EB RT 9.0.0EW
Description: **(EB) RT 9 West of RT 63**
Filter time: **11:00 Monday, September 16, 2013 => 9:45 Monday, September 23, 2013**
Scheme: Vehicle classification (Scheme F2)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12 13) Dir(NESW) Sp(6,99) Headway(>0)

Vehicles = 42558
Posted speed limit = 50 mph, Exceeding = 28319 (66.54%), Mean Exceeding = 54.76 mph
Maximum = 88.6 mph, **Minimum** = 8.7 mph, **Mean** = 51.9 mph
85% Speed = 56.8 mph, **95% Speed** = 60.2 mph, **Median** = 51.9 mph
12 mph Pace = 46 - 58, **Number in Pace** = 33133 (77.85%)
Variance = 29.52, **Standard Deviation** = 5.43 mph

Hour Bins (Partial days)

Time	Bin		Min	Max	Mean	Median	85%	95%	>PSL 50 mph	
0000	245	0.6%	16.9	83.3	51.5	51.7	56.8	60.6	161	65.7%
0100	216	0.5%	37.9	64.3	50.7	50.6	56.4	59.5	121	56.0%
0200	165	0.4%	17.1	65.8	49.9	50.8	56.8	60.2	95	57.6%
0300	199	0.5%	21.6	67.7	50.8	51.0	56.6	59.3	112	56.3%
0400	226	0.5%	26.5	65.7	50.5	50.1	56.8	60.4	116	51.3%
0500	491	1.2%	21.0	66.4	51.4	51.7	56.8	60.4	294	59.9%
0600	1291	3.0%	19.2	72.8	52.1	52.1	56.8	59.9	879	68.1%
0700	2147	5.0%	20.0	77.9	52.7	52.6	57.5	60.8	1549	72.1%
0800	2397	5.6%	21.4	76.5	52.3	52.3	57.5	60.6	1655	69.0%
0900	2313	5.4%	10.2	70.5	52.2	52.1	57.0	60.4	1589	68.7%
1000	2301	5.4%	13.8	72.8	51.8	51.9	57.0	60.4	1524	66.2%
1100	2535	6.0%	18.7	76.1	52.1	52.3	57.0	60.4	1716	67.7%
1200	2882	6.8%	14.2	77.0	52.0	51.9	57.0	60.2	1948	67.6%
1300	3020	7.1%	8.7	83.3	52.2	52.1	57.3	60.6	2099	69.5%
1400	3077	7.2%	19.1	71.9	52.2	52.3	57.0	60.4	2150	69.9%
1500	3618	8.5%	12.4	74.1	51.8	51.9	56.6	60.2	2420	66.9%
1600	4224	9.9%	27.2	76.1	51.6	51.7	56.4	59.7	2762	65.4%
1700	3911	9.2%	18.9	83.9	51.6	51.7	56.6	59.9	2481	63.4%
1800	2545	6.0%	30.3	76.3	52.4	52.3	57.3	60.8	1782	70.0%
1900	1585	3.7%	26.8	70.1	50.8	50.8	55.9	59.3	919	58.0%
2000	1205	2.8%	23.4	77.0	51.3	51.2	56.6	59.3	739	61.3%
2100	892	2.1%	29.7	88.6	51.3	51.2	56.4	60.6	530	59.4%
2200	607	1.4%	31.3	68.8	51.7	51.7	56.8	59.9	384	63.3%
2300	466	1.1%	28.1	71.4	51.3	51.4	56.6	59.5	294	63.1%
----	**42558**	**100.0%**	**8.7**	**88.6**	**51.9**	**51.9**	**56.8**	**60.2**	**28319**	**66.5%**

Chesterfield, NH
NH 9 (EB) East of NH 63
Week of September 16, 2013
Speed Statistics by Hour

SpeedStatHour-110
Site: rt 9 (EB) e of 63.0.0EW
Description: **(EB) RT 9 East of RT 63**
Filter time: **12:00 Monday, September 16, 2013 => 10:00 Monday, September 23, 2013**
Scheme: Vehicle classification (Scheme F2)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12 13) Dir(NESW) Sp(6,99) Headway(>0)

Vehicles = 46185
Posted speed limit = 50 mph, Exceeding = 26379 (57.12%), Mean Exceeding = 53.26 mph
Maximum = 81.6 mph, **Minimum** = 8.9 mph, **Mean** = 50.6 mph
85% Speed = 54.4 mph, **95% Speed** = 56.8 mph, **Median** = 50.6 mph
12 mph Pace = 45 - 57, **Number in Pace** = 40828 (88.40%)
Variance = 16.22, **Standard Deviation** = 4.03 mph

Hour Bins (Partial days)

Time	Bin		Min	Max	Mean	Median	85%	95%	>PSL 50 mph	
0000	243	0.5%	23.7	76.0	50.1	49.4	54.6	57.9	112	46.1%
0100	205	0.4%	32.3	62.3	50.3	50.1	54.6	56.6	107	52.2%
0200	155	0.3%	37.6	61.0	50.6	50.3	55.5	57.3	84	54.2%
0300	197	0.4%	37.8	67.0	51.4	50.8	55.5	57.7	128	65.0%
0400	271	0.6%	36.7	61.5	50.8	50.8	55.7	57.7	150	55.4%
0500	583	1.3%	35.2	64.8	50.5	50.3	54.8	57.3	334	57.3%
0600	1573	3.4%	36.1	69.4	50.6	50.6	54.4	57.0	883	56.1%
0700	2610	5.7%	22.1	71.2	50.7	50.6	54.6	57.0	1514	58.0%
0800	2963	6.4%	18.3	65.1	50.3	50.3	54.1	56.8	1583	53.4%
0900	2663	5.8%	17.0	65.0	50.7	50.8	54.6	56.8	1566	58.8%
1000	2524	5.5%	17.3	66.6	50.8	50.8	54.6	57.0	1486	58.9%
1100	2617	5.7%	18.7	64.7	50.9	50.8	54.6	57.0	1584	60.5%
1200	2841	6.2%	17.9	65.3	50.9	50.8	54.6	57.0	1663	58.5%
1300	3216	7.0%	16.5	73.7	50.9	51.0	54.8	57.3	1984	61.7%
1400	3342	7.2%	21.8	68.7	50.8	50.8	54.4	56.8	2007	60.1%
1500	4012	8.7%	19.5	68.0	50.4	50.3	54.1	56.6	2258	56.3%
1600	4447	9.6%	29.1	65.1	50.4	50.3	53.7	56.1	2471	55.6%
1700	4086	8.8%	8.9	81.6	50.6	50.6	54.1	56.8	2320	56.8%
1800	2738	5.9%	16.5	69.3	51.0	50.8	54.8	57.0	1643	60.0%
1900	1667	3.6%	36.3	64.9	49.7	49.7	53.5	55.9	766	46.0%
2000	1253	2.7%	25.0	68.2	50.1	50.1	54.1	56.4	645	51.5%
2100	925	2.0%	33.8	78.1	50.2	50.1	53.9	57.0	480	51.9%
2200	607	1.3%	37.1	77.9	50.7	50.8	54.6	56.8	360	59.3%
2300	447	1.0%	35.6	63.9	50.3	50.3	54.4	56.4	251	56.2%
----	**46185**	**100.0%**	**8.9**	**81.6**	**50.6**	**50.6**	**54.4**	**56.8**	**26379**	**57.1%**

Appendix I: Gap Study Results

Chesterfield, NH
NH 9 (WB) West of NH 63
Gap Between Vehicles Statistics by Hour

SepStatHour-118
Site: WB R9 West of 63.0.0EW
Description: **(WB) RT 9 West of 63**
Filter time: **12:00 Monday, September 16, 2013 => 9:40 Monday, September 23, 2013**
Scheme: Vehicle classification (Scheme F2)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12 13) Dir(NESW) Sp(6,99) Gap(>0)

Hour Bins (Partial days)

Time	Bin	Mean	Sep 0.0 0.5	Sep 0.5 1.0	Sep 1.0 2.0	Sep 2.0 4.0	Sep 4.0 8.0	Sep 8.0 16.0	Sep 16.0 32.0	Sep 32.0 64.0	Sep 64.0 128.0	Sep 128.0 1000.0
0000	199	127.6	1	1	6	6	3	9	15	31	53	73
0100	200	124.6	0	0	6	14	11	10	14	26	45	74
0200	206	171.9	0	0	6	9	8	13	19	27	49	74
0300	269	93.7	0	1	11	20	12	19	27	52	62	64
0400	416	61.2	0	6	23	30	30	43	61	83	86	54
0500	659	38.1	1	11	74	70	64	73	98	140	103	25
0600	1877	13.3	6	115	436	312	254	289	241	169	45	10
0700	2962	8.4	10	247	840	607	457	360	283	124	27	7
0800	2746	28.8	19	242	733	472	398	396	316	147	20	2
0900	2135	79.2	11	143	502	357	296	317	314	167	23	1
1000	2094	10.1	11	134	515	387	285	306	311	131	14	0
1100	2348	82.1	9	176	579	456	346	353	279	138	10	0
1200	2918	17.4	16	205	757	551	440	444	372	119	11	0
1300	2735	10.2	13	192	703	498	403	409	362	147	7	0
1400	3029	8.1	27	242	868	572	395	424	360	127	13	1
1500	3028	21.0	19	217	838	595	439	443	320	146	7	1
1600	3187	9.8	27	251	904	567	462	479	370	118	6	0
1700	3021	8.9	11	202	833	629	440	400	353	143	9	0
1800	2287	36.0	7	150	540	440	304	316	322	180	27	0
1900	1837	13.5	4	75	398	347	247	236	292	197	39	2
2000	1491	16.7	3	51	297	268	190	195	208	209	67	3
2100	989	25.3	4	14	155	145	122	113	148	173	105	10
2200	632	37.8	0	6	74	81	54	57	117	109	104	30
2300	345	143.9	1	4	24	20	29	25	41	57	77	66
----	41610		200	2685	10122	7453	5689	5729	5243	2960	1009	497

Chesterfield, NH
NH 9 (WB) East of NH 63
Gap Between Vehicles Statistics by Hour

SepStatHour-117
Site: RT 9 (WB).0.0EW
Description: **RT 9 (WB) east of RT 63**
Filter time: **12:00 Monday, September 16, 2013 => 10:04 Monday, September 23, 2013**
Scheme: Vehicle classification (Scheme F2)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12 13) Dir(NESW) Sp(6,99) Gap(>0)

Hour Bins (Partial days)

Time	Bin	Mean	Sep 0.0 0.5	Sep 0.5 1.0	Sep 1.0 2.0	Sep 2.0 4.0	Sep 4.0 8.0	Sep 8.0 16.0	Sep 16.0 32.0	Sep 32.0 64.0	Sep 64.0 128.0	Sep 128.0 1000.0
0000	216	2715.2	0	2	5	9	6	11	15	42	58	66
0100	202	124.8	0	2	8	11	10	11	17	28	41	74
0200	199	124.9	0	0	7	9	7	10	17	28	44	77
0300	245	104.1	0	2	14	13	10	14	22	43	58	68
0400	390	65.0	1	4	25	28	30	37	45	77	87	56
0500	645	39.0	0	11	73	71	53	77	93	137	102	28
0600	1827	13.7	4	139	434	327	217	223	254	166	51	12
0700	3067	8.1	6	287	963	629	396	313	319	120	27	7
0800	2882	8.5	3	281	905	509	339	338	343	143	19	2
0900	2430	24.8	3	179	640	447	297	326	339	180	17	1
1000	2249	9.5	3	207	562	435	268	305	319	139	11	0
1100	2517	8.4	6	215	711	491	322	330	301	130	11	0
1200	2889	8.4	2	242	846	557	377	427	316	112	9	0
1300	2942	8.4	6	298	797	557	397	369	350	158	10	0
1400	3372	7.3	8	369	1036	610	427	421	380	109	12	0
1500	3373	7.3	7	337	1033	681	411	440	313	145	6	0
1600	3636	6.8	8	388	1103	714	485	458	374	99	7	0
1700	3562	6.9	10	358	1088	713	489	417	369	114	4	0
1800	2553	9.7	4	177	666	509	329	338	333	180	17	0
1900	2085	11.8	1	85	491	424	275	265	324	194	25	1
2000	1700	14.7	1	59	389	320	224	212	231	199	63	2
2100	1141	21.8	0	27	188	197	144	136	157	185	101	6
2200	691	35.9	0	13	73	94	62	67	119	123	109	31
2300	386	64.9	0	5	35	29	26	28	40	76	80	67
----	**45199**		**73**	**3687**	**12092**	**8384**	**5601**	**5573**	**5390**	**2927**	**969**	**498**

Chesterfield, NH
NH 9 (EB) West of NH 63
Gap Between Vehicles Statistics by Hour

SepStatHour-115
Site: EB RT 9.0.0EW
Description: **(EB) RT 9 West of RT 63**
Filter time: **11:00 Monday, September 16, 2013 => 9:45 Monday, September 23, 2013**
Scheme: Vehicle classification (Scheme F2)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12 13) Dir(NESW) Sp(6,99) Gap(>0)

Hour Bins (Partial days)

Time	Bin	Mean	Sep 0.0 0.5	Sep 0.5 1.0	Sep 1.0 2.0	Sep 2.0 4.0	Sep 4.0 8.0	Sep 8.0 16.0	Sep 16.0 32.0	Sep 32.0 64.0	Sep 64.0 128.0	Sep 128.0 1000.0
0000	245	101.0	0	3	7	9	20	15	27	56	38	70
0100	216	116.7	3	0	3	6	14	15	22	41	46	66
0200	165	143.7	0	0	4	8	6	14	21	22	35	53
0300	199	132.4	0	2	1	5	12	15	18	33	54	57
0400	226	112.7	1	1	6	2	18	11	25	40	41	81
0500	491	52.5	1	7	29	27	47	41	91	120	79	49
0600	1291	64.7	3	34	127	155	215	243	256	193	57	7
0700	2147	11.6	3	118	355	369	352	428	347	150	25	0
0800	2397	10.3	16	111	467	443	406	431	364	146	13	0
0900	2313	10.2	10	141	461	424	357	403	365	139	13	0
1000	2301	9.2	8	164	461	430	404	388	332	105	9	0
1100	2535	9.9	18	183	546	474	406	436	354	107	10	0
1200	2882	8.5	23	251	645	561	419	483	378	110	12	0
1300	3020	8.1	22	225	657	585	509	541	388	91	2	0
1400	3077	8.0	14	241	656	625	522	538	380	97	4	0
1500	3618	6.8	46	336	875	773	590	579	340	71	8	0
1600	4224	5.8	45	428	1118	903	704	684	297	45	0	0
1700	3911	6.3	39	391	1056	810	631	568	345	69	2	0
1800	2545	9.7	12	152	487	513	394	486	356	133	12	0
1900	1585	15.6	5	46	243	268	230	266	283	192	51	1
2000	1205	20.9	5	27	156	159	168	167	257	171	90	5
2100	892	28.0	2	22	94	107	106	119	170	154	98	20
2200	607	41.0	0	8	43	49	55	70	109	159	83	31
2300	466	52.1	1	3	22	32	27	54	77	105	105	40
----	**42558**		**277**	**2894**	**8519**	**7737**	**6612**	**6995**	**5602**	**2549**	**887**	**480**

Chesterfield, NH
NH 9 (EB) East of NH 63
Gap Between Vehicles Statistics by Hour

SepStatHour-116
Site: rt 9 (EB) e of 63.0.0EW
Description: **(EB) RT 9 East of RT 63**
Filter time: **12:00 Monday, September 16, 2013 => 10:00 Monday, September 23, 2013**
Scheme: Vehicle classification (Scheme F2)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12 13) Dir(NESW) Sp(6,99) Gap(>0)

Hour Bins (Partial days)

Time	Bin	Mean	Sep	Sep	Sep	Sep	Sep	Sep	Sep	Sep	Sep	Sep
			0.0	0.5	1.0	2.0	4.0	8.0	16.0	32.0	64.0	128.0
			0.5	1.0	2.0	4.0	8.0	16.0	32.0	64.0	128.0	1000.0
0000	243	103.7	0	4	5	12	16	14	27	54	39	72
0100	205	121.1	0	0	7	3	13	14	18	39	39	72
0200	155	158.4	0	0	7	6	5	10	11	25	29	60
0300	197	129.8	1	1	3	5	12	10	18	33	53	60
0400	271	332.2	0	1	6	6	22	24	30	53	53	75
0500	583	44.4	0	8	31	30	56	86	121	120	90	41
0600	1573	16.0	0	38	142	225	328	318	300	181	38	3
0700	2610	9.6	3	95	399	544	618	456	362	118	15	0
0800	2963	25.7	2	88	534	645	718	536	342	92	5	0
0900	2663	9.2	1	124	506	491	553	508	356	118	6	0
1000	2524	34.9	2	121	499	510	530	455	333	66	7	0
1100	2617	8.1	1	130	540	514	586	467	296	81	2	0
1200	2841	8.2	7	168	646	540	578	494	326	76	5	0
1300	3216	7.6	3	195	638	663	692	594	354	76	1	0
1400	3342	7.4	3	170	683	725	723	620	352	65	1	0
1500	4012	6.1	4	253	959	936	931	587	297	42	3	0
1600	4447	12.4	5	306	1172	1034	1011	647	231	39	1	0
1700	4086	38.7	7	270	1051	911	876	619	303	46	1	0
1800	2738	35.6	2	125	476	561	594	524	334	112	9	0
1900	1667	14.8	0	34	234	257	297	325	302	175	41	2
2000	1253	20.0	1	23	140	163	198	191	272	191	71	3
2100	925	27.1	1	13	101	91	127	144	182	158	87	21
2200	607	66.0	0	5	39	54	48	78	104	161	82	35
2300	447	54.5	0	2	21	27	38	48	70	90	108	43
----	**46185**		**43**	**2174**	**8839**	**8953**	**9570**	**7769**	**5341**	**2211**	**786**	**487**