NH Route 25 Corridor Study

APRIL 2008

**Prepared by the Lakes Region Planning Commission of Meredith, NH,
with assistance provided by Fay, Spofford, and Thorndike, of Bedford, NH.**

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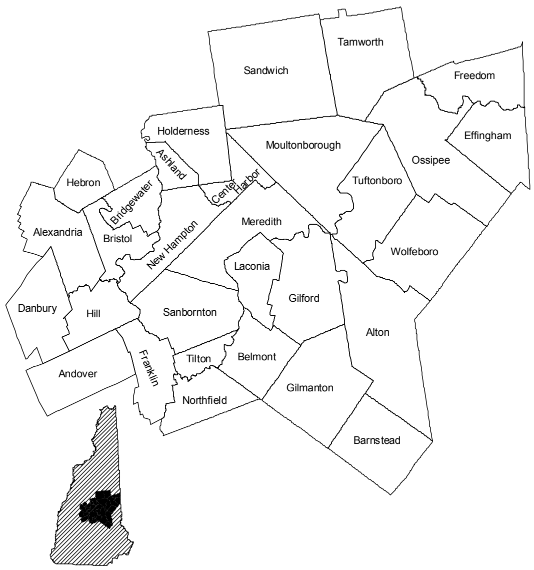

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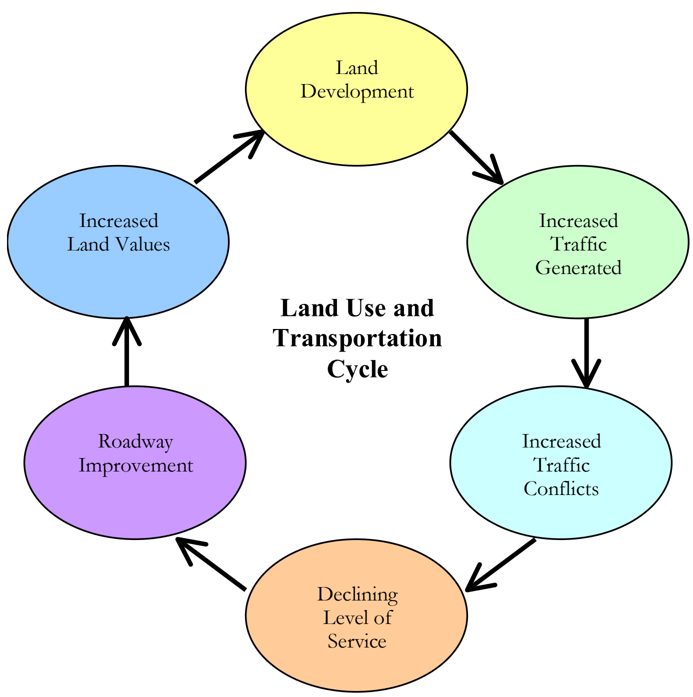
1. INTRODUCTION

In 2006, the Lakes Region Planning Commission (LRPC) identified the NH Route 25 corridor as a regional priority for study based on existing traffic volume, development potential, and regional importance. In consultation with Center Harbor and Moultonborough, the LRPC applied for and received funding from the New Hampshire Department of Transportation (NH DOT) to conduct this study. NH DOT encourages the use of corridor studies to generate more involvement and greater insight of community values and views relating to the maintenance and improvement of state transportation routes. This cooperative approach requires consideration for the multitude of users; local residents, business owners, seasonal visitors to the area, and through traffic.

Identified in the regional transportation plan as a lifeline corridor, NH Route 25 serves as a primary east-west connection for trucking between Maine and central New Hampshire, and is a significant connection between Interstate 93 and eastern Lakes Region communities. Other related planning efforts include the recently completed NH Route 104 Corridor Study and the Meredith US Route 3 – NH Route 25 Improvements Transportation Study. Combined, these studies encompass a contiguous corridor spanning more than 20 miles from the Bristol-New Hampton town line on NH Route 104 easterly through Meredith on US Route 3/NH Route 25, to NH Route 109 south in Moultonborough. Additionally, the NH Office of Energy and Planning study entitled *Managing Growth in New Hampshire: Change and Challenges* (2000) highlighted New Hampton-Meredith-Moultonborough as one of four case studies to examine statewide growth indicators and the impacts of growth on communities and regions.

Land use has an impact on the transportation system. As depicted in the *Land Use and Transportation Cycle* diagram, roadway improvements and the construction of new roads both make land more accessible, resulting in new development. As development occurs, increased demand is placed on the transportation network, increasing traffic and opportunities for conflict. This, in turn, leads to the need for system improvements, which begin the cycle again by increasing land values and development potential.[1] A leading focus for the NH DOT is roadway capacity preservation as opposed to expanding or reconstructing roads to accommodate increased demand. A key to success in doing more with the existing road network is careful land use planning that optimizes traffic efficiency and minimizes potential conflicts.



The intent of the NH Route 25 Corridor Study is to assess the current conditions, identify potential safety improvements, assess potential future traffic demand based on development potential, and outline practical land use

[1] Source: Strafford Regional Planning Commission, *How to…Link Land Use and Transportation,* 2003.

and access management strategies that can be implemented at the local level and in coordination with appropriate agencies.

The services of Fay, Spofford, and Thorndike (FST) were used in the development of conceptual and pre-engineering safety improvements. FST staff provided assistance in the prioritization of safety concerns, identification of near-term and long-term improvements, the production of project specific graphics, and the development of preliminary safety improvement cost estimates. While the graphics are suitable for planning purposes and not intended to represent final solutions, the potential projects could be considered for future implementation, and the cost estimates will be useful in budgeting discussions.

In addition to safety improvements, this study explores the link between land use and transportation. While the NH DOT approves driveway permits for access on state transportation routes based on safety, transportation design and connectivity have an impact on community character, which can be influenced with supporting land use regulations at the local level. The Center Harbor and Moultonborough master plans acknowledge the importance of future development on NH Route 25 as it relates to the maintenance of rural character. Existing land use regulations and zoning ordinances from both towns were reviewed for key transportation principles, strategies, and policy statements designed to coordinate the local land use approval process with the state permitting process. The result of this review is a series of recommendations.

The Boards of Selectmen in both communities were asked by LRPC to appoint representatives to a Local Advisory Work Group (LAWG). The LAWG consisted of a broad base of local representatives with planning experience or a working knowledge of the NH Route 25 corridor. Press releases were used to notify the public was informed about the LAWG meetings. A NH Route 25 Corridor Study web page was created to facilitate the exchange of information including, meeting notes, drafts of the plan and maps, data collection results, and general information regarding the purpose of the study.[2] The LWAG meeting dates and topics of discussion are listed below.

July 31, 2007

- ❑ Identification of corridor-wide safety issues.

August 15, 2007

- ❑ Prioritization of safety concerns based on police chief input.

September 25, 2007

- ❑ Review data collection results.
- ❑ Discuss engineering firm status.
- ❑ Review Route 16 access management video.
- ❑ Discuss preliminary draft build-out analysis.

[2] http://www.lakesrpc.org/transportation/route25/index.htm

December 4, 2007

- Presentation of build-out analysis results.
- Presentation of preliminary recommendations for safety improvements.

February 12, 2008

- Discussion of access management and land use study recommendations.
- Develop approach for public informational meeting.

March 2008

- Presentation of draft corridor study to the public.

April 2008

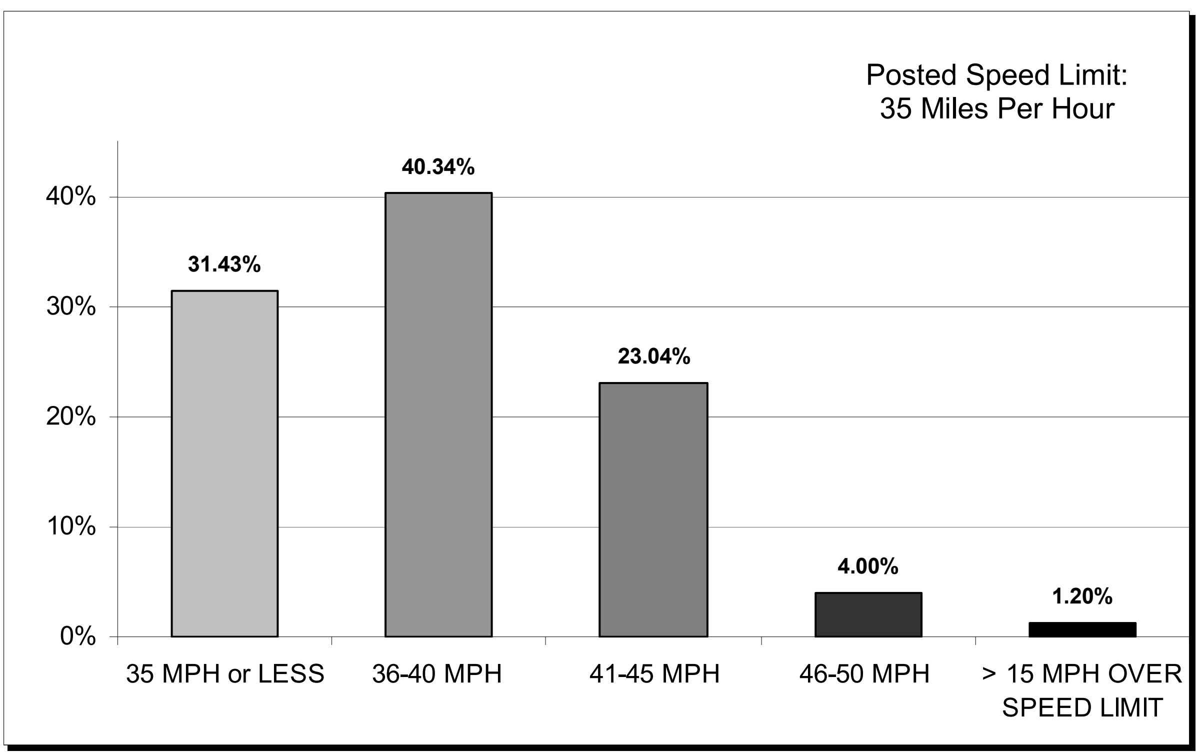
- Presentation of draft corridor study to the Center Harbor and Moultonborough Boards of Selectmen.
- Final study report submitted to NH DOT.

2. EXISTING CONDITIONS

The kick-off meeting held on July 31, 2007 was attended by more than 20 people, including both committee members and the public. Each person in attendance was provided an opportunity to express their opinions about safety and road improvements within the corridor study area. The results of this meeting are displayed in Appendix A. General themes included site distance and road alignment; walkability, especially in the village centers; seasonal traffic congestion; turning movement conflicts; and vehicle speed. The list of concerns was further refined in a meeting between LRPC staff and the police chiefs of Center Harbor and Moultonborough. These discussions were supported by a wide variety of information collected to assess current conditions along the NH Route 25 corridor. Combined, the data and local knowledge highlight a growing corridor with several safety and access issues. Absent corrective measures and the application of sound planning practices, these issues are sure to intensify as local and regional traffic increases at the same time that additional commercial and residential development occurs in the study area.

Speed data were collected at two locations to further assess safe travel patterns at posted speed limits. Automatic traffic recorders were used to clock vehicle speeds in the proximity of Sutton House Bed and Breakfast and near the intersection of Playground Drive and NH Route 25. The speed counts were conducted over the course of one week from August 20 through August 28, 2007. During this period, speed was recorded for a total of 202,349 vehicles; 105,020 vehicles at Sutton House and 97,349 vehicles at Playground Road. Figures 2.1 and 2.2 summarize the results of the study.

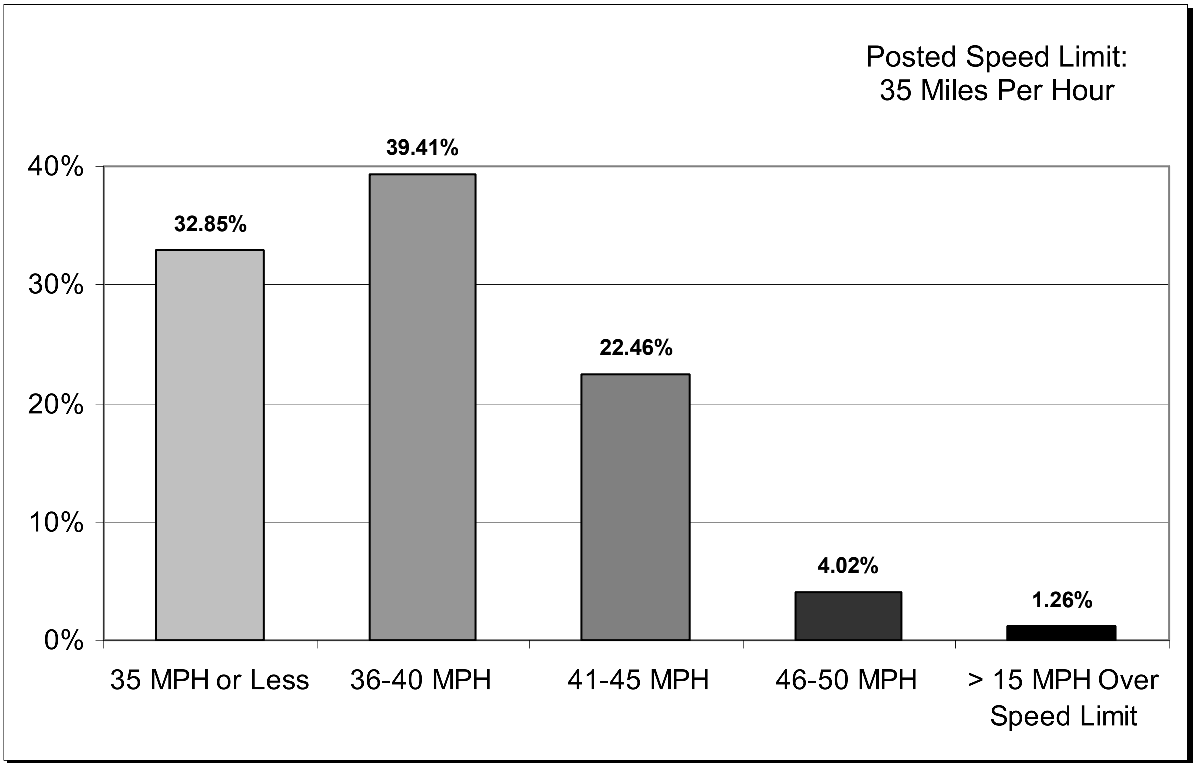
Figure 2.1: NH Route 25 Vehicle Speed Counts – Sutton House



Source: LRPC, Summer 2007

Generally, most vehicles (more than 70 percent) exhibited speeds consistent with the posted speed limits (+/- 5 miles per hour over the speed limit) at both locations. Excessive speed, more than 15 miles per hour over the posted speed limit, was recorded in approximately 1.2 percent of the vehicles at both locations. It was noted that the data displayed an increased number of vehicles traveling at excessive speeds during both the AM and PM peak traffic hours in comparison to off-peak periods throughout the day.

Figure 2.2: NH Route 25 Vehicle Speed Counts – Playground Drive

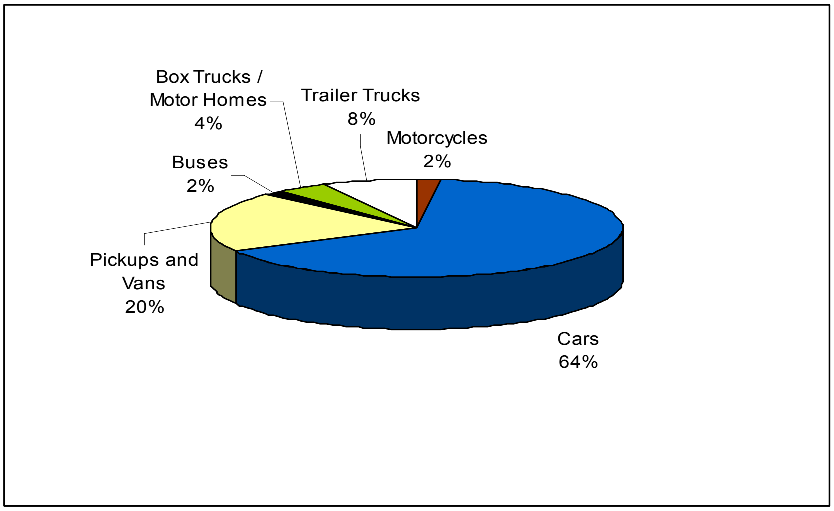


Source: LRPC, Summer 2007

Posted speed limits vary throughout the corridor, changing 10 times in the eight mile study area and varying from 55 miles per hour to 30 miles per hour in the villages, and 20 miles per hour in a school zone. A concern was expressed by committee members that this much variation leads to confusion and difficulty for motorists attempting to travel at the posted speed. Fay, Spofford, and Thorndike shared information from the Institute of Transportation Engineers (ITE) on speed zone guidelines with the corridor committee regarding careful consideration of speed limit changes (see Appendix B). According to engineers at FST, speed limits on state roads are dictated by measurements of actual free flowing speeds, horizontal and vertical geometry, the density of development and its proximity to the roadway, available shoulders and clear zones, presence of pedestrian activity, curbs, and free flow 85th percentile driver speeds. Detailed speed studies are required to alter speed limits, which should not be arbitrarily determined. Further, speed limit changes alone often do not alter driver behavior.

The volume of traffic in the corridor has increased over time. NH Department of Transportation records indicate the annual average daily traffic (AADT) recorded on NH Route 25 at a location west of Moultonborough Neck Road increased by approximately 17 percent, from 12,000 vehicles in 2002 to 14,000 vehicles in 2005. Figure 2.3 summarizes the vehicle classification data collected in Center Harbor and Moultonborough in the summer 2007. The data indicate the vast majority of the corridor traffic (64 percent) was cars. Combined with pickup trucks and vans, passenger vehicles accounted for 84 percent of the traffic. Approximately eight percent of the traffic was tractor-trailer trucks. Other large vehicles included buses (two percent), and motor homes and box trucks (four percent).

Figure 2.3: NH Route 25 Vehicle Classifications

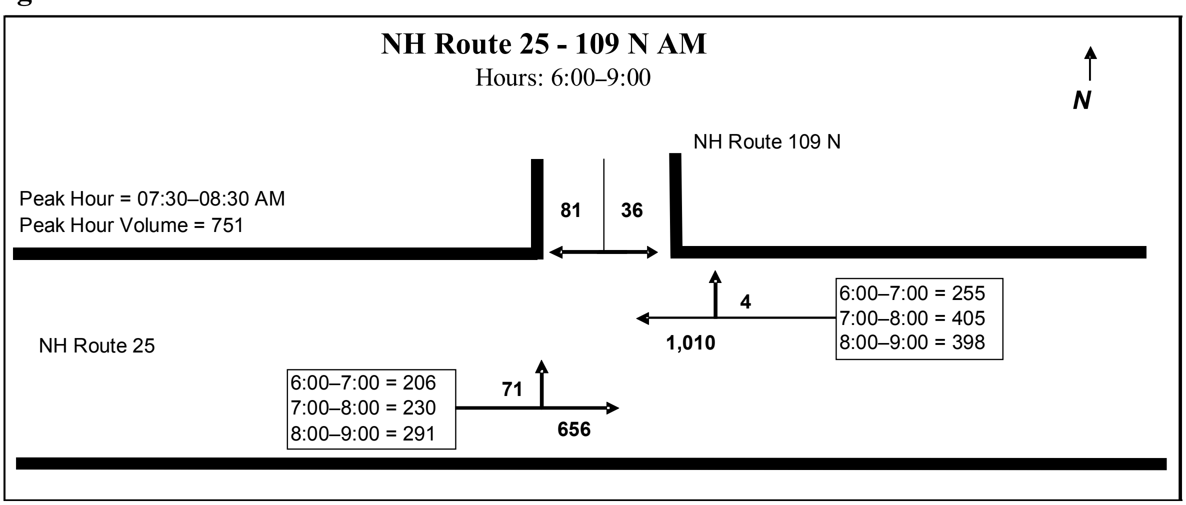


Source: LRPC, Summer 2007

Turning movement counts were conducted at eight key locations in the corridor study area during peak AM and PM traffic periods during the day. The turning counts detail vehicle movements through intersections and the volume of traffic in all directions over one-hour intervals. Figure 2.4 shows the results of the morning turning movements of vehicles traveling through the intersection of NH Route 25 and NH Route 109 N between the hours of 6:00 and 9:00 AM. During this time, the greatest amount of traffic (peak hour) through the intersection was 751 vehicles between the hours of 7:30 and 8:30 AM. Diagrams for all eight turning movement locations are located in Appendix C.

Turning movements can show potential conflicts and provide clues for potential safety improvements and intersection enhancements. The turning movement data were summarized and provided to the consulting engineers from Fay, Spofford, and Thorndike for their use in the assessment of potential safety improvement recommendations.

Figure 2.4: NH Route 25 Vehicle Classifications



Source: LRPC, Summer 2007

3. BUILD-OUT ANALYSIS

One useful tool in assessing future potential growth in the community is the build-out analysis. This tool calculates the total development that *could* occur under existing zoning and other land use regulations. Taking environmental constraints into consideration, this analysis provides valuable information to support planning board decisions by detailing potential future land use, development capabilities, and the amount of additional traffic that could be generated if the corridor was developed to its full potential. A build out is a tool that shows the potential development consequences of existing land-use regulations. This may result in a call to action; in any case, it helps officials make better decisions in planning the future.

The following is a description of the build-out data development and analysis process. The outcome is an estimate of future development expressed in terms of the number of potential housing units and the square feet of commercial building space that could be built if full development capacity were reached. Based on these results, a final estimate was produced on the assumption that future development will generate a specified amount of traffic. Both the development potential and associated traffic generation estimates are compared to existing conditions in tabular and map formats.

Data Development

The mapping component of the build-out analysis required parcel information in Geographic Information Systems (GIS) format. For the town of Moultonborough, this information was readily available. The information provided by Center Harbor required LRPC conversion from parcel images to GIS format. Community-provided tax assessor data was imported to improve the accuracy of the parcel acreage information and provide additional parcel detail. Attributes not contained in the assessor databases were added through the use of GIS overlays, aerial photograph interpretation, and field collection. This information included zoning districts, minimum lot size requirements, water and sewer service availability, current land use type, total land area currently being used, and existing residential and commercial development. Various sources were used to assess environmental constraints including New Hampshire Hydrography Dataset, National Wetlands Inventory, steep slopes and conservation lands from The Society for the Protection of New Hampshire Forests, Natural Resources Conservation Service soils, and 2003 USDA National Agriculture Imagery Program (NAIP) digital orthoquad (DOQ) color photographs.

Build-Out Process

For the purpose of this study the corridor was defined as all parcels within 1,000 feet of NH Route 25 between the Meredith/Center Harbor town line and NH Route 109 S in Moultonborough. Through committee discussion it was established that a more accurate representation of traffic generation would be achieved by including the Moultonborough residential areas south of NH Route 25 in the analysis. The areas discussed for inclusion, because of their location, require the use of NH Route 25 as a “sole access” to jobs and services; alternative routes do not exist. The sole access area that was added is nearly three times (9,027 acres) larger than the corridor (3,168 acres) area and represents an area with great potential for future residential development. Roads with sole access on NH Route 25 included in the build-out were Birch Lane, Redding Lane, Moultonborough

Neck Road, and Fox Hollow Road. A simplified build-out analysis was conducted for these sole access areas. A description of the assumptions used during the preparation of the build-out analysis can be found in Appendix D.

Building Constraints

In order to estimate future development potential, several calculations were made to assess developable land. Slightly different calculations were required for residential and commercial/industrial land uses; however the starting point for all land use types was the removal of environmentally constrained acres of land from the total acreage in the corridor study area. An environmental constraints GIS layer was created (see Map 1: Environmental Constraints). This layer represents all the areas that were considered unbuildable according to a variety of town land use regulations including wetlands, hydric soils, slope, conservation lands, and water body setbacks. Soils-based lot sizing was also calculated for each parcel in Moultonborough. Based on discussion with community representatives, soils-based lot sizing was omitted for Center Harbor lot calculations due to the lack of High Intensity Soil Survey data.

Existing zoning that defines the types of land uses allowed was applied to the corridor. The applicable zones are displayed in Map 2: Current Corridor Zoning. To define existing land use, assessor data and field research were required. The assessor databases contain general land use information for each parcel, but it was necessary to conduct field research to determine the exact number of residential units and commercial uses in the corridor. Existing land use is displayed in Map 3. Due to the number of lots and predominantly residential land use in the sole access areas, only assessor data was used to determine existing units. Existing land use for sole access areas is displayed in Map 4.

Residential Development Potential

To determine the existing residential development potential, the minimum lot size for the applicable zone or the soils-based lot size was subtracted from the total area of each parcel for each residential unit that exists. After all building constraints were calculated, the remaining land was defined as the parcel's buildable area. The buildable area was subdivided into 'potential lots' that met the existing minimum lot size requirements. Potential lots were defined as the number of lots a parcel could be subdivided into, not including the parcel's existing lot. Parcels with existing residential units that could not be further subdivided were considered 'built-out.' The term 'total lots' includes potential and existing lots.

The number of potential residential units was calculated based on potential residential lots and uses permitted by the zoning ordinances. Potential residential units were only calculated in zones that are dedicated to residential development, i.e., Agricultural and Rural Zone (Center Harbor), Residential Zone (Center Harbor and Moultonborough). The Residential Zone in Moultonborough permits duplexes (two-family units), but at the same minimum lot size per unit as a single family home. The number of potential units was calculated at the rate of one unit for each potential residential lot.

Non-Residential (Commercial/Industrial) Development Potential

The assessor databases, field review, and aerial photograph interpretation were used to assess existing commercial and industrial development. In addition to buildings, parking lots were identified and considered unbuildable. Parcels not likely to be developed due to their ownership status, such as conservation lands and town or utility company land, and non-conforming or landlocked parcels were also considered unbuildable.

To accurately estimate the development potential for commercial/industrial buildings and associated built areas, zoning maximum lot coverage requirements were applied as displayed in Figure 3.1.

Figure 3.1: Permitted Non-Residential Uses and Maximum Allowable Lot Coverage

Center Harbor			Moultonborough		
Zoning District	**Permitted Residence Type**	**Commercial Maximum Lot Coverage**	**Zoning District**	**Permitted Residence Type**	**Commercial Maximum Lot Coverage**
Agricultural (AR)	Single-family	NA	Comm - Zone A (COM-A)	Multi-family	50%
Commercial - Village (CV)	Single-family	100%	Comm - Zone B (COM-B)	Multi-family	50%
Residential (R)	Single-family	30%	Comm - Zone C (COM-C)	Multi-family	50%
			Residential (R)	Two-Family	NA

Source: Local Zoning Ordinances

Two calculations were made to determine developable square footage. The first calculation multiplied lot area by maximum lot coverage and a percentage to account for parking, driveway, and landscaping, resulting in the estimated, development potential for square footage of commercial/industrial buildings. A second calculation was made as a cross check. This calculation considered environmentally constrained areas and a factor to account for a driveway. The more conservative of the two calculations was applied for each parcel to determine development potential. This value was also used to calculate traffic generation estimates.

Build-Out Refinement Process

Following the completion of the initial estimates of development potential, the NH Route 25 Study Committee reviewed the results at a public meeting. LRPC staff also met with town representatives, who were asked to provide further information about each parcel, so that the estimates could be refined. This review provided detailed information about built-out lots, current and future uses, new subdivision plans, and ownership. Map 5 displays the development status of the corridor based on LRPC research and the community input and refinement process.

The build out was further refined and expanded to include the information displayed in Map 6, which summarizes development potential in terms of potential residential lots and non-residential square footage. Figure 3.2 compares the corridor development potential with existing conditions so that conclusions may be drawn about the magnitude and characteristics of potential future development. The final step in the build-out process was the addition of traffic generation estimates, as discussed in the next section.

Figure 3.2: Existing and Potential Corridor Development

Center Harbor	Acreage			Residential Lots				Residential Units				Commercial / Industrial	
Zone	Total Acreage	Non-constrained Acres	Buildable Acres	Existing Lots	Potential Lots	Total Lots	Existing Lots as % of Total Lots	Existing Units	Potential Units	Total Units	Existing Units as % of Total Units	Total Potential Non-Residential Square Footage	Zone
AR	612.92	479.24	435.16	18	77	95	19%	10	83	93	11%	0	**AR**
CV	18.85	14.87	3.81	19	2	21	90%	43	0	43	100%	50,858	**CV**
RES	164.88	143.61	99.75	86	101	187	46%	116	110	226	51%	0	**RES**
TOTAL	796.65	637.72	538.72	123	180	303	**41%**	169	193	362	**47%**	**50,858**	**TOTAL**

Center Harbor Key: AR = Agricultural and Rural, CV = Commercial Village, RES = Residential

Moulton-borough	Acreage			Residential Lots				Residential Units				Commercial / Industrial	
Zone	Total Acreage	Non-constrained Acres	Buildable Acres	Existing Lots	Potential Lots	Total Lots	Existing Lots as % of Total Lots	Existing Units	Potential Residential Units	Total Units	Existing Units as % of Total Units	Total Potential Non-Residential Square Footage	Zone
COM-A	545.80	368.96	187.09	250	83	333	75%	279	83	362	77%	2,100,125	**COM-A**
COM-B	13.43	8.98	6.25	4	3	7	57%	2	5	7	29%	66,194	**COM-B**
COM-C	120.77	65.34	28.46	46	15	61	75%	81	11	92	88%	278,549	**COM-C**
RA	1,692.21	819.44	657.70	229	326	555	41%	196	365	561	35%	0	**RA**
TOTAL	2,372.21	1,262.72	879.50	529	427	956	**55%**	558	464	1,022	**55%**	**2,444,868**	**TOTAL**
RA *	9,026.57	6,856.69	4,877.90	3,279	2,328	5,607	**58%**	NA	NA	NA	**NA**	**NA**	**RA ***

Moultonborough Key: COM-A = Commercial Zone A, COM-B = Commercial Zone B, COM-C = Commercial Zone C, RA = Residential/Agricultural, RA * = Areas with sole access in corridor

Source: LRPC, 2007

Daily Trip Generation

The Institute of Transportation Engineers publishes a manual containing the average vehicle trips generated for many land uses.[3] This manual was referenced and an average daily trip generation value was applied to the corresponding existing use of each parcel. This required a high level of detail when identifying existing land uses and non-residential building sizes to meet the manual's level of specificity. For example, some commercial trip generation values are based on 1,000 square feet of gross floor area or number of pumps at a gas station. This process led to the calculation of total existing residential and non-residential trip values as displayed in Map 7. Total potential trips generated at build out were also calculated as displayed in Map 8. These calculations were based on assumptions developed by each town and the report's authors from LRPC. Figure 3.3 allows a side by side comparison of the estimated existing and potential future trip generation data.

Figure 3.3: Trip Generation Totals

	Existing			Potential Additional			Total
	Trips Generated from Existing Residential Units	Trips Generated from Existing Non-Residential Facilities	Total Existing Trips Generated	Trips Generated from Potential Residential Units	Trips Generated from Potential Non-Residential Facilities	Total Potential Trips Generated	Total Existing and Potential Trips Generated
Center Harbor	770	7,187	7,957	1,847	2,880	4,727	12,684
Moultonborough	3,131	21,541	24,671	3,493	138,783	142,277	166,948
Sub-Total	**3,901**	**28,728**	**32,628**	**5,340**	**141,664**	**147,004**	**179,632**
Sole Access Roads South of Corridor	Not Calculated	Not Calculated	24,853	Not Calculated	Not Calculated	22,279	47,132
Total	**3,901**	**28,728**	**57,481**	**5,340**	**141,664**	**169,283**	**226,763**

	Existing			Potential Additional			Total
Trip Generation Totals By Zone	Trips Generated from Existing Residential Units	Trips Generated from Existing Non-Residential Facilities	Total Existing Trips Generated	Trips Generated from Potential Residential Units	Trips Generated from Potential Non-Residential Facilities	Total Potential Trips Generated	Total Existing and Potential Trips Generated
Center Harbor							
AR	96	0	96	794	0	794	890
CV	29	6,422	6,451	0	2,880	2,880	9,331
RES	645	765	1,410	1,053	0	1,053	2,463
Center Harbor Total	**770**	**7,187**	**7,957**	**1,847**	**2,880**	**4,727**	**12,684**
Moultonborough							
COM-A	1,364	12,069	13,433	0	118,930	118,930	132,363
COM-B	0	441	441	0	3,749	3,749	4,189
COM-C	249	7,214	7,463	0	15,774	15,774	23,237
RA (in corridor)	1,518	1,817	3,335	3,493	331	3,824	7,159
Sub-Total	**3,131**	**21,541**	**24,671**	**3,493**	**138,783**	**142,277**	**166,948**
RA (sole access areas)			24,853			22,279	47,132
Moultonborough Total	**3,131**	**21,541**	**49,524**	**3,493**	**138,783**	**164,556**	**214,080**
Corridor Total	**3,901**	**28,728**	**57,481**	**5,340**	**141,664**	**169,283**	**226,763**

Center Harbor Key: AR = Agricultural and Rural, CV = Commercial Village, RES = Residential

Moultonborough Key: COM-A = Commercial Zone A, COM-B = Commercial Zone B, COM-C = Commercial Zone C, RA = Residential/Agricultural, RA * = Areas w/sole access in corridor

Source: LRPC, 2007

[3] Institute of Transportation Engineers, *Trip Generation, 6th Edition*, Washington DC: Institute of Transportation Engineers, 1997.

Build-out Analysis Conclusions

The results of the build-out analysis provide an insightful look at parcels in each community along this important east-west corridor in the Lakes Region. This 8-mile corridor and the sole access areas together encompass over 12,000 acres. In the corridor, Center Harbor has the potential to create 180 more lots and Moultonborough 427, while sole access areas could add 2,328 more lots. Both towns have the combined potential to develop approximately 2.5 million square feet of non-residential land, the majority of which is in Moultonborough.

Total existing daily trips generated in the corridor equal 7,957 in Center Harbor, 24,671 in Moultonborough, and 24,853 in sole access areas. The sheer size and the number of residential units in the sole access areas accounts for such a large number of trips. At build-out, total existing and potential trips increase to 12,684 in Center Harbor, 166,948 in Moultonborough, and 47,134 in sole access areas. The large increase (660 percent) in trips generated in the corridor in Moultonborough can be attributed to the development potential in Commercial Zone A. Of the total daily existing and potential trips (166,948) in the Moultonborough corridor, approximately 73 percent (118,930) are potential trips generated in Commercial Zone A. In contrast, the sole access areas, which are in the Residential zone and account for 74 percent (9,026 acres) of the total area studied, have the capacity to generate 47,132 existing and potential trips at build out. This stark difference highlights the vital role that land use regulations play in development potential and traffic generation.

At build-out, as defined in this study, total daily trips for the corridor would increase dramatically from 54,364 to 226,763. Seasonal variations and additional traffic generators outside of the corridor would significantly impact the corridor, if considered.

4. SAFETY CONCERNS

In consultation with the Lakes Region Planning Commission, engineers from Fay, Spofford, and Thorndike prepared recommendations for safety improvements for five locations along the NH Route 25 corridor study area. Background information included the traffic data previously discussed in the Existing Conditions section, and the following additional guidance materials:

- Corridor-wide accident information from the NH Department of Transportation, January 1997 through December 2006.
- Summary reports from road safety audits performed by the University of New Hampshire, Transfer Technology Center (UNH T ^{2}).
- August 15, 2007, NH Route 25 meeting notes with Moultonborough Police Chief Scott Kinmond and Center Harbor Police Chief Mark Chase.

Based on this information and a day long field observation session attended by LRPC and FST staff, the following locations were prioritized as the leading safety concerns within the corridor study area:

1) Fox Hollow Road/NH Route 25 Intersection
2) Glidden Road/NH Route 25 Intersection
3) NH Route 25 in Center Harbor (Lake Street to Bean Road)
4) Sheridan Road/NH Route 25 Intersection
5) Redding Lane/NH Route 25 Intersection

For each of the priority safety locations, short-and long-term recommendations were developed. The recommendations are supplemented by photo enhanced illustrations, CAD renderings of current conditions and concept plans, and preliminary cost estimates for safety improvements. Additional corridor-wide recommendations are provided as well.

According to the non-profit, Washington, DC-based organization TRIP, “roads with poor geometry, inadequate shoulders for the posted speed limits, or poorly laid out intersections or interchanges, pose greater risks to motorists, pedestrians, and bicyclists.” The following matrix outlines the average reduction in fatal accident rates over a 20-year period, based on the type of safety improvement recommendations in this study.

Figure 4.1: Road Improvements Reduce Fatalities

Type of Improvement	Reduction in Fatal Accident Rates After Improvements
Realign Roadway	66%
Site Distance Improvements	56%
New Traffic Signals	53%
Turning Lanes and Traffic Signalization	47%
Widen or Improve Shoulders	22%

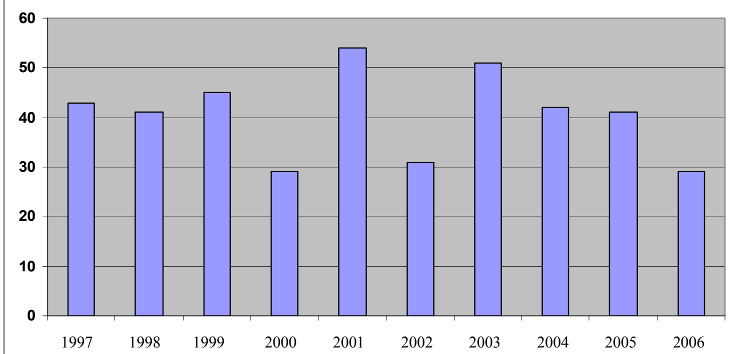
Source: TRIP, *How Road Improvements Save Lives,* February 2005.

General Corridor-Wide Safety Issues

NH Route 25 is generally a two-lane highway with variable width shoulders along its length. It has a meandering alignment with horizontal and vertical curves affecting driver operations along its length. It has a typical speed limit of 45 miles per hour, with limits varying from 30--55 miles per hour, with lower speed limits through villages. At signalized intersections and one flashing intersection, it flares out to provide turning lanes. Several roadways intersect at shallow angles.

NH DOT historical traffic volume counts along the NH Route 25 corridor indicate that traffic volumes along the corridor have remained fairly stable over the years on an average annual basis (i.e., approximately 12,000 AADT at the Center Harbor/Meredith Line and approximately 4,800 AADT at the Moultonborough/Sandwich line). Highest volumes are experienced on the west side of the corridor, and lowest volumes on the east.

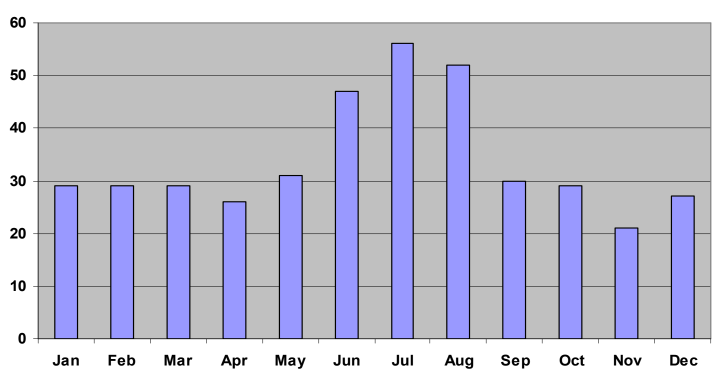
Figure 4.2: NH Route 25 Total Crashes by Year, 1997--2006



Source: NH DOT

The 1997--2006 crash data indicates that there were a total of 406 crashes, including 3 fatal crashes and 116 injury crashes over the 10-year analysis period. This equates to an average of approximately 41 crashes per year including an average of approximately 12 injury crashes and 33 property damage only crashes. Figure 4.2 shows that the total number of crashes reported on the NH Route 25 study corridor has generally trended downward from its peak in the year 2001. Figure 4.3 indicates that crash patterns on NH Route 25 are highest during the summer months and are similar to the changes in traffic volumes on a month-to-month basis; it is well known that traffic volumes peak on NH Route 25 during the summer months.

Figure 4.3: Route 25 Total Crashes by Month, 1997--2006



Source: NH DOT

Another corridor issue of importance is the treatment of pedestrian flows/crossings in village centers and other locations where pedestrian activity is greatest. Two areas of concern are the Center Harbor area between the Canoe Restaurant and the information booth at Lake Shore Drive, and Moultonborough Center approximately between Blake Road and Old NH Route 109. It is important that a pedestrian circulation/sidewalk master plan, including bicycle facilities and priority enhanced crosswalk locations, be considered for these village activity centers. This pedestrian circulation/sidewalk should be created by working in consultation with local elected officials, police/emergency officials, village residents, and business owners.

Additionally, the field review found several signs indicating school buses stop along the corridor, but the actual school bus turnouts are not clearly indicated. Well-marked school bus bays should be considered along the corridor in coordination with affected local school district needs. Along with pedestrian walking route enhancements, such bus bays may be eligible for funding under the Federal Highway Administration (FHWA) Safe Routes to School program. In village areas, school bus bays could also be used to provide public transportation stops during the peak summer season, thereby having year-round use. A typical school bus bay would be approximately 50 feet long and 12 feet wide with 25-foot-long transition lengths.

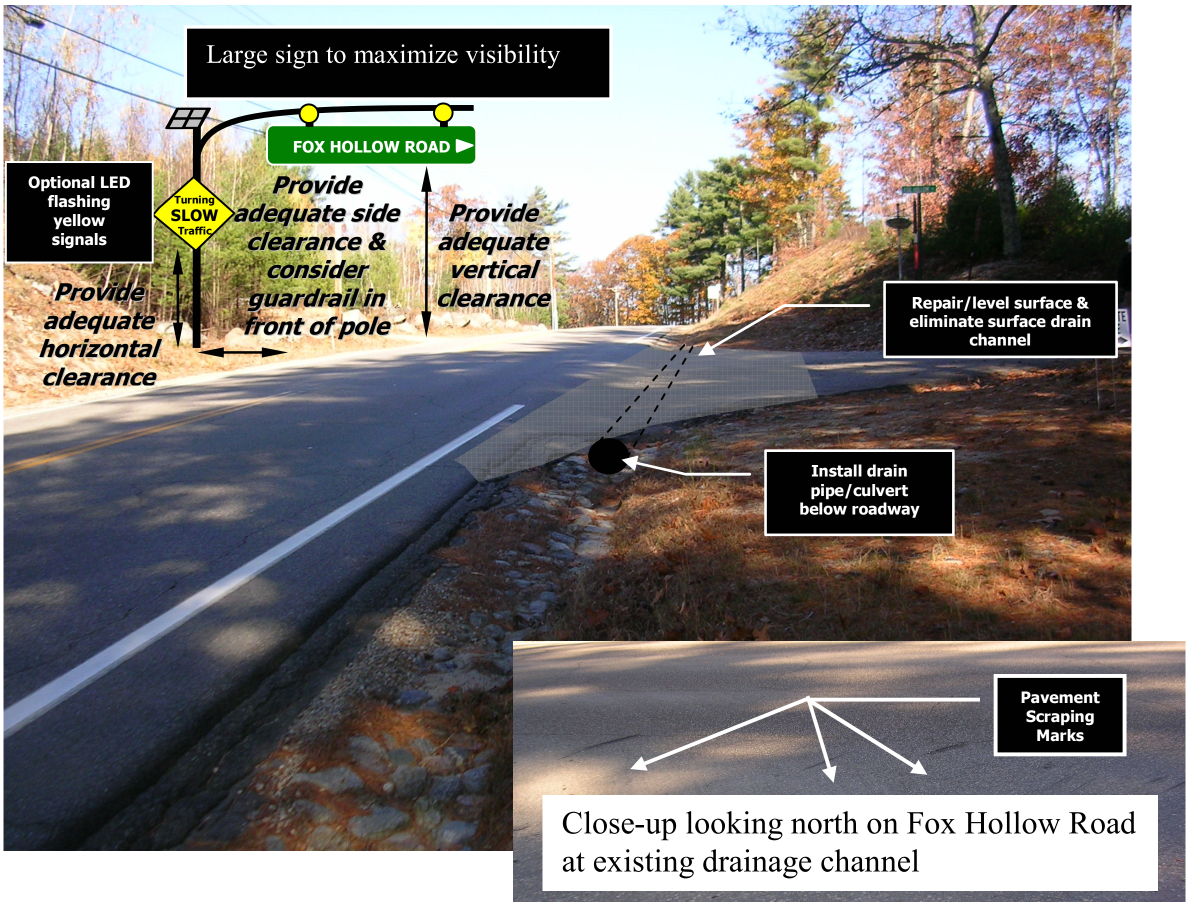
Corridor View Looking East

Fox Hollow Road at NH Route 25

Located on a segment of NH Route 25 that has a speed limit of 45 miles per hour, the Fox Hollow Road intersects NH Route 25 in a 'T' intersection. Traffic counts were unavailable for the intersection. East of the intersection, a hillcrest impairs visibility of the intersection. NH Route 25 has a drainage channel dip between the NH Route 25 roadway surface and Fox Hollow Road. The evidence of scraping along the front of the road indicates many vehicles have bottomed out making left or right turns from NH Route 25 into or out of Fox Hollow Road (see Illustration 4.1).

Recommendations include modifying the drainage channel along the south side of NH Route 25 by adding a culvert under the Fox Hollow Road to raise and level the approach. This will ease turning movements into and out of Fox Hollow Road, thereby reducing the potential for rear end collisions. A crash avoidance system (see Appendix E) could be considered in the absence of a road widening strategy. As Illustration 4.2 shows, if left turn lane warrants are met, a westbound left turn or bypass lane should also be considered for installation. An overhead sign indicating the street name should also be considered under a NH DOT test. Refer to Appendix E for an illustration of overhead signs allowed under current Manual on Uniform Traffic Control Devices (MUTCD). This technique might also be considered at other 'T' intersections along NH Route 25, particularly as a measure prior to the installation of a left turn lane, which involves costly widening, drainage modifications, taking of green space, vertical hill removal, and possible construction of walls.

Illustration 4.1: Preliminary Short-Term Improvement Strategy at NH Route 25/Fox Hollow Road



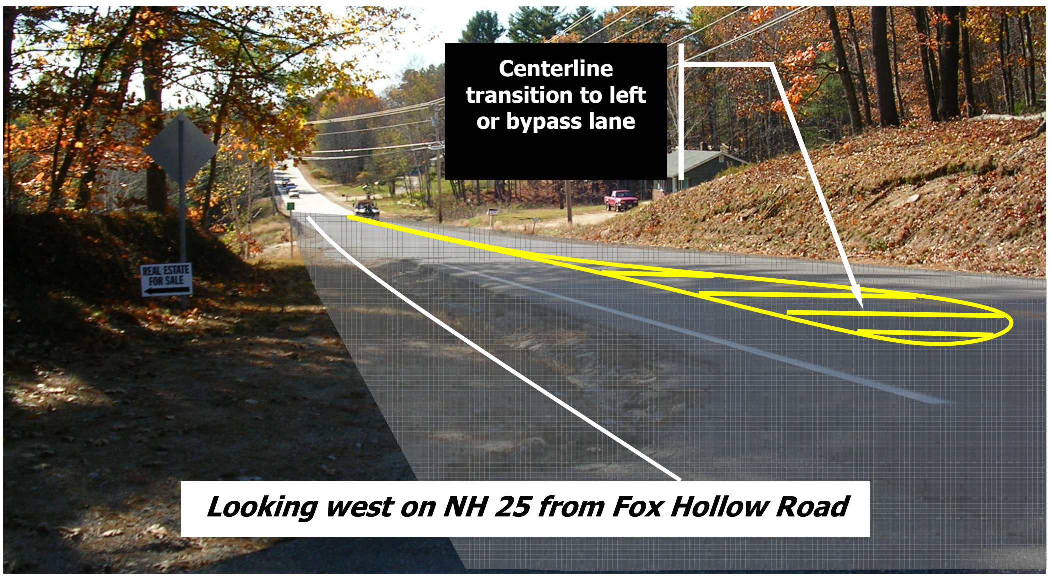
Close-up looking north on Fox Hollow Road at existing drainage channel

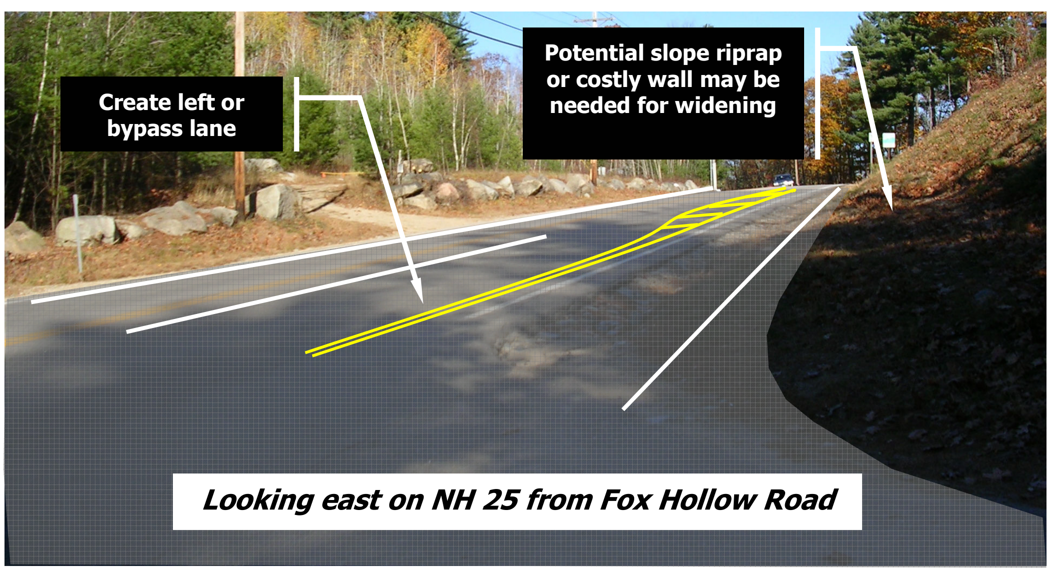
Illustration Notes:

- Advance warning signs needed in both directions – possible crash avoidance system (Illustrated in Appendix E).
- Design overhead or highly-visible street name signs in accordance with MUTCD and NH DOT requirements.
- Same signs must be visible in both directions.
- If used, place overhead street sign at the centerline of Fox Hollow Road.
- Optional alternating LED flashing signals (on pole or overhead), possibly solar powered.

Based on observations, an ideal long-term solution for the Fox Hollow Road intersection with NH Route 25 would also include the creation of a westbound bypass lane (requires less right-of-way) or, if warrants are met, the creation of an exclusive westbound left turn lane into Fox Hollow Road. As seen belowin Illustration 4.2, widening NH Route 25 is problematic in that it might involve the construction of a wall or rip-rap slope on the south side of the highway to create a 10--12 foot wide left turn or bypass lane. Refer to Appendix F for sketches of existing conditions, proposed improvement strategies, and cost estimates for safety improvements.

Illustration 4.2: Preliminary Long-Term Improvement Strategy at NH Route 25/Fox Hollow Road





Glidden Road at NH Route 25

Glidden Road intersects the north side of NH Route 25 to form a 'T' intersection. Like the Fox Road intersection, the posted speed limit of Glidden Road is 45 miles per hour. Conditions are similar to those encountered at the Fox Hollow Road intersection, but the available shoulder is much wider (see Illustration 4.3). Glidden Road is a busier intersection year round than Fox Hollow Road. The Glidden Road intersection is located just east of a hillcrest on NH Route 25 and was the subject of a site safety audit review by the University of New Hampshire's Technology Transfer Center. On the basis of the site visit and the information contained in the site safety audit, the following measures are proposed (see Illustration 4.4):

- Remove obstacles to enhance sight lines where feasible within right-of-way constraints.
- Consider similar approach to Fox Hollow Road with overhead or highly visible sign in both directions of travel. NH Route 25 has wider shoulders in this area, so less widening would be required than at Fox Hollow Road.
- Using a portion of the striped shoulders, create an eastbound exclusive left lane (assuming warrants are met) or a bypass lane involving less overall widening in the event exclusive left lane warrants are not met.

Illustration 4.3: Existing Conditions Glidden Road at NH Route 25

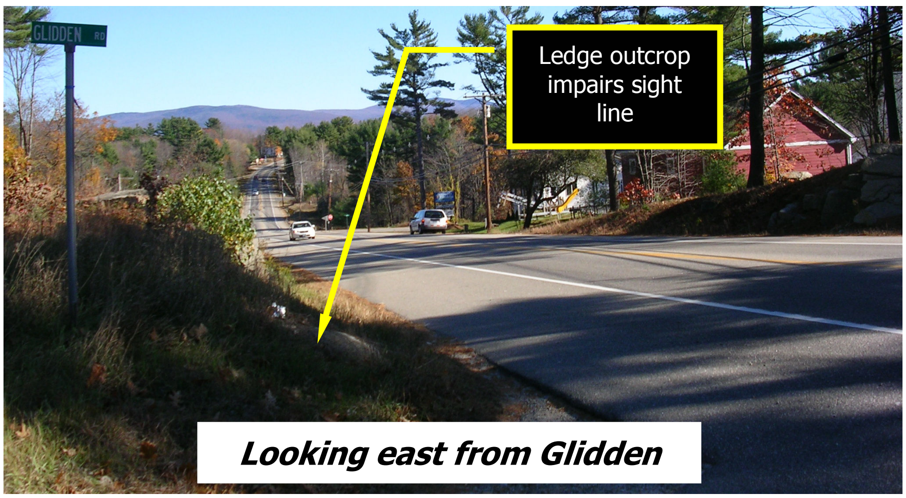


Illustration 4.4: Preliminary Improvement Strategy Glidden Road at NH Route 25

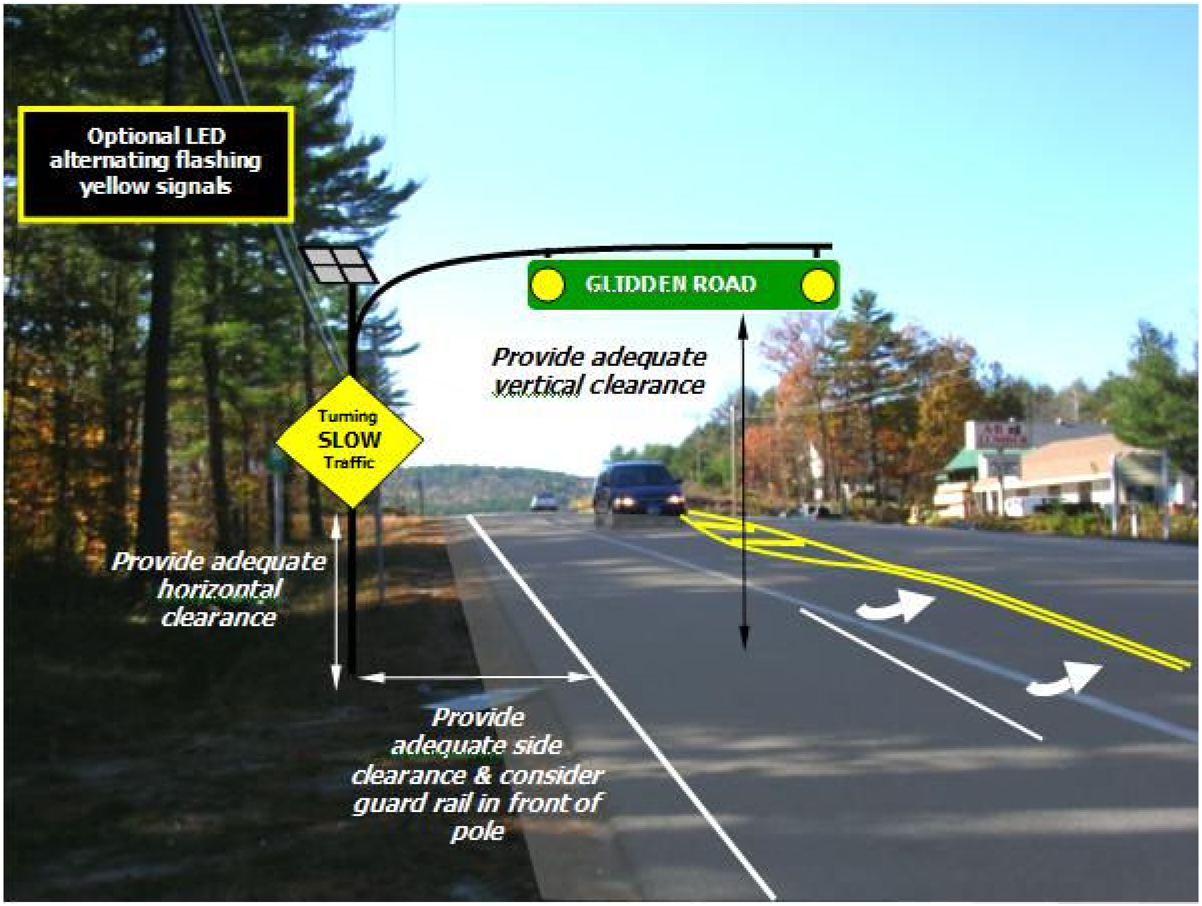


Illustration Notes:

- Advance warning signs needed in both directions.
- Design overhead or highly-visible street name signs in accordance with MUTCD and NH DOT requirements.
- Same signs must be visible in both directions at the intersection.
- If used, place overhead street sign at the centerline of Glidden Road.
- Optional alternating LED flashing signals (on pole or overhead), possibly solar powered.

As part of the potential solution, the installation of a stabilized shoulder edge in both directions might be considered optionally with a 'cape cod berm' (see Appendix E), creating a sloped edge plus drainage through the improvement area.

Refer to Appendix G for sketches of existing conditions, proposed improvement strategies, and cost estimates for safety improvements.

NH Route 25 from Lake Street to Bean Road/Wharf Road

Going from west to east, this corridor includes three intersections between Lake Street and Bean Road, over a linear distance of approximately 470 feet. The posted speed limit of NH Route 25 through this short corridor is 30 miles per hour. Two of the three intersections, NH Route 25 at Main Street and NH Route 25 at Bean Road/Wharf Road, are controlled by closely spaced traffic signals, with less than 100 feet of storage area between the traffic signals, equivalent to approximately four car lengths. These signals become congested during the summer months, inadequate left turn storage.

Illustration 4.5: Existing Conditions Lake Street at NH Route 25 (looking east)

Recent site visit observations made during the off-peak season indicate that when traffic on NH Route 25 is free flowing, it operates at speeds well in excess of 30 miles per hour.

Located approximately 850 feet east of NH Route 25's 'T' intersection with Main Street, Lake Street intersects NH Route 25 to form a four-way, unsignalized intersection with stop control on the two approaches to NH Route 25. NH Route 25 has an exclusive left turn lane on both approaches to Lake Street. Lake Street also provides direct access to Lake Winnipesaukee and has a significant amount of pedestrian activity crossing NH Route 25, particularly during the summer months. Lake Street has a painted sidewalk on the west side (see Illustration 4.5).

On the basis of the site visit and the information provided by LRPC, the following measures are proposed:

- Encourage pedestrian crossings at the traffic signals, rather than mid-block; add count-down pedestrian signals to the recently installed traffic signal at Main Street and Bean Road.

- Determine whether abutting businesses can assist in creating a new ingress-only curb cut at Lake Street and consolidate access driveways at the Main Street signal. This would accommodate left turn exits from the south side businesses at the traffic signals and entering traffic via Lake Street.

Illustration 4.6: Existing Conditions Lake Shore Drive at NH Route 25 (looking east)

- Consider modifying the shoulders to create a raised, curbed sidewalk system for pedestrians, separated from the road by a green space, if possible. Such an approach would greatly enhance pedestrian safety in the area and may reduce travel speeds.

- Consider enhancing the existing crosswalk (see Illustration 4.5) visibility by implementing textured pavement through crosswalk (e.g., Durotherm® inlaid patterns) with wider 24" edge lines. Provide crosswalks at the two signalized intersections, if pedestrian crossing demands warrant them.

- Approximately 320 feet west of Lake Street, Main Street forms a signalized 'T' intersection with exclusive left turn lanes on the eastbound and southbound approaches to the intersection. Between Main Street and the traffic signal at Bean Street, as noted previously, the short left turn storage area overflows during the peak season when left turns increase significantly. Signal timing is apparently an issue at the intersection. Due to the close spacing of the intersections, it is difficult to keep the storage area between the two intersections clear. Adjust signal timing to minimize delays, while providing adequate clearance for left turn movements.

- Also, the Lake Shore Drive intersection with NH Route 25 could be modified near the information booth to create a single, wider opening to the immediate west of the booth (Illustrations 4.6 and 4.7). The current configuration allows motorists to speed, which can be a hazard for pedestrian crossings. This would be create green space and reduce the speed at which right turning traffic accesses Lake Shore Drive. The access change involves the creation of a short bypass lane on NH Route 25 eastbound as it approaches

Lake Shore Drive to ease left turns into the Irving gas station on the north side of NH Route 25, and allow traffic to bypass to the right and turn right onto Lake Shore Drive.

Illustration 4.7: Preliminary Improvement Strategy Lake Shore Drive (looking east)

Refer to Appendix H for sketches of existing conditions, proposed improvement strategies, and cost estimates for safety improvements.

Sheridan Road at NH Route 25

Sheridan Road intersects the north side of NH Route 25 to form a 'T' intersection. The posted speed limit of NH Route 25 at Sheridan Road is 45 miles per hour. The intersection is located between an 'S' curve on NH Route 25 and near a wetland protected by guard rail. On the basis of the site visit and the information contained in the site safety audit, the following measures are proposed (see Illustration 4.8):

- Potential improvements include the installation of a crash avoidance system (illustrated in Appendix E) with advance warning signs, an overhead or highly visible street sign facing both directions, and a slow 'turning traffic' warning similar to that proposed for Fox Hollow and Glidden Roads. This may be an interim measure before widening the shoulder on the south side of NH Route 25.

- Assuming the wetland can be bridged, create an eastbound exclusive left or bypass lane with shoulder widening as needed to provide an adequate transition for following traffic with drainage modifications as needed.

- Create new bridge rail with culvert or bridge expansion. (The term 'bridge rail' refers to treatments of guardrail across bridges or large culverts. In 2005, the Federal Highway Administration (FHWA) and the California Department of Transportation (Caltrans) published a guide for bridge rail types and uses.)

Illustration 4.8: Preliminary Improvement Strategy Sheridan Road at NH Route 25 (looking east opposite Sheridan Road)

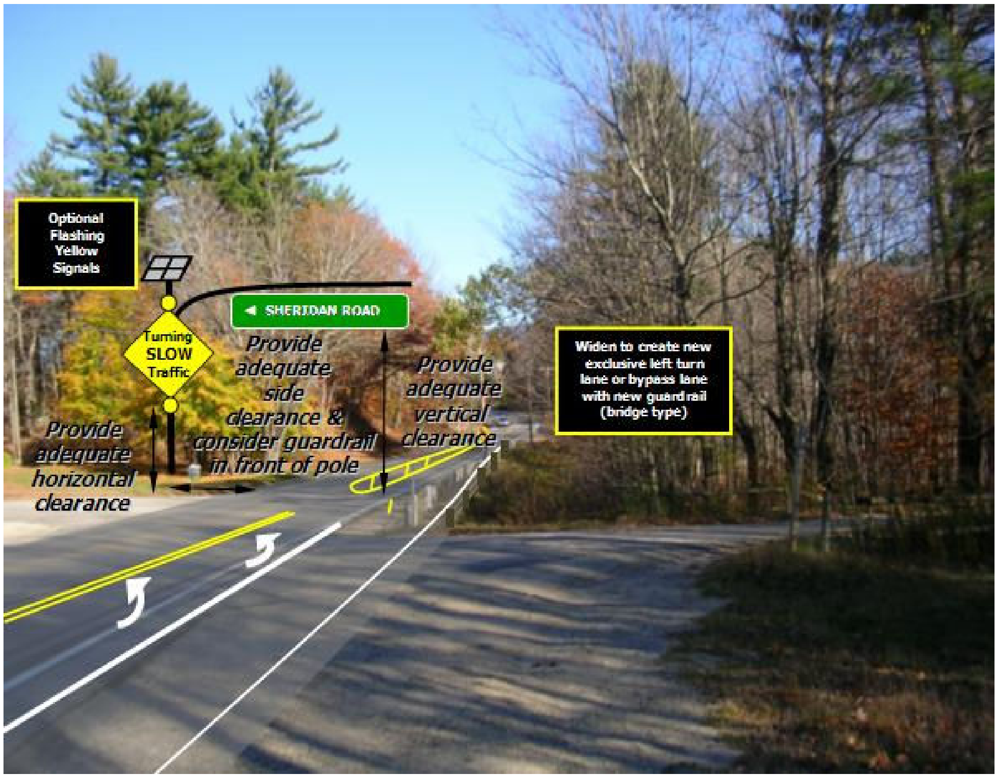


Illustration Notes:

- Advance warning signs needed in both directions – possible crash avoidance system (see Appendix E) if widening is not possible.
- Design overhead or highly-visible street name signs in accordance with MUTCD and NH DOT requirements.
- Same signs must be visible in both directions at the intersection.
- Rotate mounting to place street sign over centerline of Sheridan Road.
- Optional, alternating LED flashing signals (side or overhead), possibly solar powered.

Refer to Appendix I for sketches of existing conditions, proposed improvement strategies, and cost estimates for safety improvements.

NH Route 25 at Redding Lane

Like many segments of NH Route 25, its intersection with Redding Lane (Illustration 4.9) has narrow shoulders with evidence of vehicles using the unpaved portion of the shoulders to bypass traffic waiting to turn left.

Recommendations as shown in Illustration 4.10 for the intersection of Redding Lane and NH Route 25 include the following:

- Install overhead street sign facing both directions with a slow 'turning traffic' warning similar to that proposed for other intersections along the corridor.
- Widen the shoulders on the north side of NH Route 25 and consider adding 'cape cod berm' (illustrated in Appendix E) to reduce pavement-edge wear.

Illustration 4.9: Existing Conditions NH Route 25 (looking east opposite Redding Lane)

Illustration 4.10: Preliminary Improvement Strategy (looking west at Redding Lane)

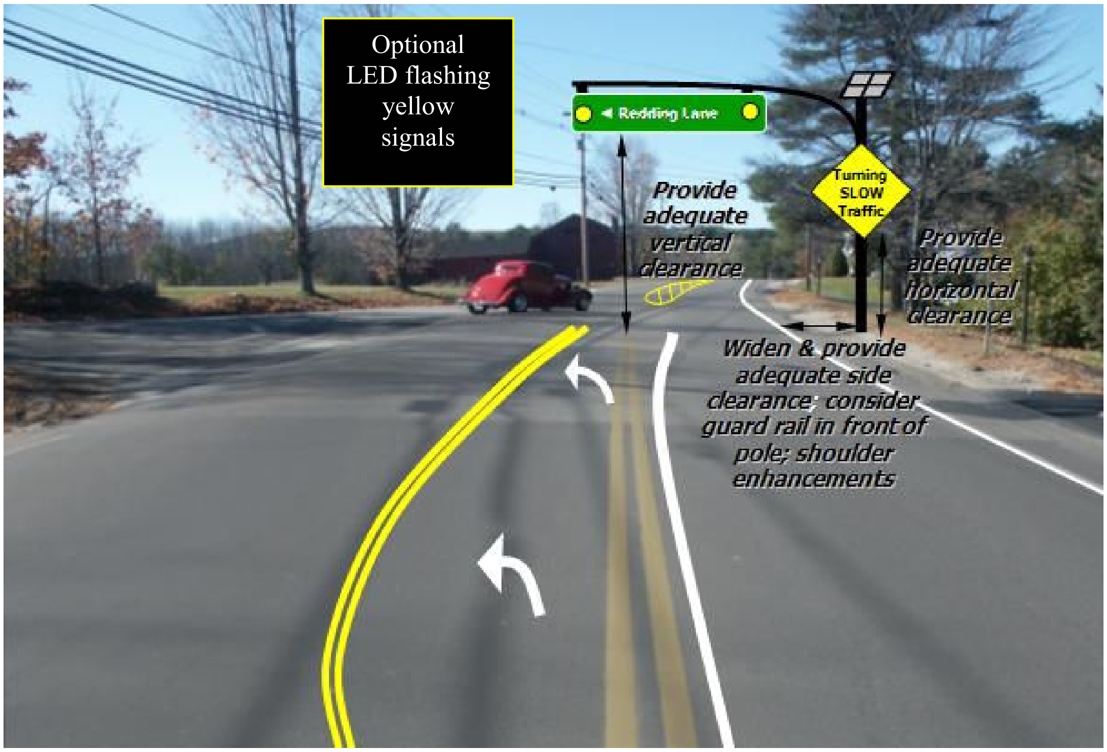


Illustration Notes:

- Design overhead or highly-visible street name signs in accordance with MUTCD and NH DOT requirements.
- Same signs must be visible in both directions.
- If used, place overhead street sign over centerline of Redding Lane.
- Optional alternating LED flashing signals (side or overhead), possibly solar powered.

Refer to Appendix J for sketches of existing conditions, proposed improvement strategies, and cost estimates for safety improvements.

NH Route 25 – Other Corridor Issues and Associated Recommendations

a) General

High hazard intersections addressed in this report require special attention. Motorists must be alerted to pedestrian crossings, motorists slowing for turns, and hazardous intersections by more than is provided with the existing conditions, markings, and signs. Overhead signs (illustrated in Appendix E) discussed in this report are not commonly employed to designate rural unsignalized intersections, so there are no specific standards for their application in NH DOT's statewide standards. Information signs, however, can be erected using the standard MUTCD reflectorized green background and white letters on standard NH DOT sign poles. Use of any other sign colors and pole configurations or the application of solar power for optional flashing signs would require an experimental application test through US DOT. The development and application of implementation standards would typically follow field operational tests. At issue is the best way to implement effective crash reduction measures within the context of the rural settings along NH Route 25. There is a need to install feasible, cost-effective measures that will not require excessive NH DOT maintenance and measures and that will be fully consistent with NH DOT/MUTCD standards.

While requiring further study, the installation of raised, plowable pavement markers (low profile reflectors) spaced progressively closer together in the centerline and on the edge line when approaching an intersection might be considered. Raised, plowable markers in the centerline or augmented on the edge lines may add emphasis to each intersection's location and the need to slow traffic down on the approaches to intersections where vehicles are likely to be turning, particularly if employed only within 500 feet in either direction of each significant intersection. The goal is to reduce the potential for severe rear-end or angle collisions.

Techniques applied to the five selected intersections could also be applied to other intersections along the corridor experiencing rear end collisions, angle collisions, or inadequate sight line issues.

Speeding along the corridor remains a significant issue. The creation of a more uniform speed limit would be preferable, particularly as development along the corridor continues. According to engineers at Fay, Spofford, and Thorndike, ideally the maximum speed limit would be 35 miles per hour, with village speed limits of 30 miles per hour. As long as speed limit changes are based on actual 85th percentile speeds obtained during the peak travel season, a change to less variable speed limits should be considered along the corridor.

Locations of school bus stops on NH Route 25 should be more clearly demarcated, with the possible creation of paved school bus turnout areas, where available right-of-way permits.

b) Canoe Restaurant Pedestrian Activity

The Canoe Restaurant is located on the south side of NH Route 25 approximately 1,500 feet west of the Main Street traffic signal. The restaurant has a parking lot that is too small to accommodate peak parking demands during the summer months and on weekends, so the restaurant operates a shuttle service between a church parking lot located on the north side of NH Route 25 and the site. Its employees, as well as patrons during peak demand times, are requested to park in a leased Center Harbor Congregational Church parking lot located approximately 1,500 feet away at 52 Main Street.

As described by the Canoe employees, sometimes pedestrians walk rather than use the continuously running shuttle. In doing so, they must cross NH Route 25. Unfortunately, their natural walking desire lines place them at a NH Route 25 unmarked crossing location that follows a sharp horizontal curve on NH Route 25. This is particularly hazardous for pedestrian crossings from the south side to the north side of NH Route 25, as its horizontal curve and heavy vegetation limits the sight distance visibility of the pedestrians. Providing a crosswalk in this area is *not recommended* due to the observed speeds and sight distance impairment. The restaurant should continue to enhance its shuttle service and encourage its employees to cross only at locations where visibility of oncoming traffic is adequate for a safe crossing (e.g., at Lake Street).

As mentioned in the Safety Concerns section, a pedestrian circulation/sidewalk master plan should be considered for the Center Harbor area, including bicycle facilities and enhanced crosswalks where warrants for their installation are met. Such a master plan should be closely coordinated with the police and emergency providers, local elected officials, as well as residents, affected institutions, and business owners.

c) Moultonborough Center at NH Route 109

The Town of Moultonborough recently improved NH Route 25 to create a left turn lane onto NH Route 109, which intersects NH Route 25 in a 'T' alignment and with an overhead flashing signal – flashing yellow for NH Route 25 and flashing red for NH Route 109 southbound traffic. This recent modification is expected to reduce the incidence of rear end crashes and draw greater attention to the intersection's hazards, but observations indicate the added left turn lane also makes it difficult for pedestrians to cross the highway. Field observations indicate the line of sight looking east from NH Route 109 is impaired. Regrading the hillside adjacent to the east side of the intersection could conceivably improve the sight line looking to the east, particularly for motorists turning left out of NH Route 109. Creation of a sidewalk system with curbs may also help to address observed on-street parking issues. Additionally, lengthening the existing left turn lane by 200--250 feet appears to be a possible strategy to keep left turning traffic out of the through lane.

As mentioned in the Safety Concerns section, a pedestrian circulation/sidewalk master plan should be considered for the Moultonborough Center area including bicycle facilities and enhanced crosswalks where warrants for their installation are met. Such a master plan should be closely coordinated with the police and emergency providers, local elected officials, as well as residents, affected institutions, and business owners.

d) Aubuchon Hardware at Moultonborough Neck Road

The Town of Moultonborough recently improved NH Route 25 to signalize and create auxiliary turning lanes onto Moultonborough Neck Road opposite Aubuchon Hardware. These modifications are expected to reduce the incidence of rear end crashes. Field observations also indicate that the added left turn lane makes it difficult for pedestrians to cross the highway. Field observations indicate the Aubuchon Hardware approach is not located directly opposite the Moultonborough Neck Road approach. Realigning of the southbound Aubuchon Hardware approach directly opposite the Moultonborough Neck northbound approach might be considered in the future, should the offset create turning issues for left turning motorists, due to overlapping travel paths.

e) Blake Road at NH Route 25

The two schools located in this area have intermittent events requiring parking along Blake Road. The identification of the limit for on-street parking areas on Blake Road may assist in keeping parked vehicles from encroaching on neighborhood abutter sight lines. Appropriate signage and off-street parking spaces may alleviate on-street parking and standing, which blocks views from area driveways.

f) Wildlife Crossings

The committee identified animal crossings near the junction of NH Route 25 and Sheridan Road as a significant safety concern. To assess existing conditions, the New Hampshire Fish and Game's (NHFG) Wildlife Action Plan (WAP) was used in the identification and mapping of key habit and wildlife diversity in the area of concern. By adding information to the map such as topography, conservation lands, water features, wetlands, and roads, the potential for conflict is further illustrated (see Map 9: Wildlife Habitats).

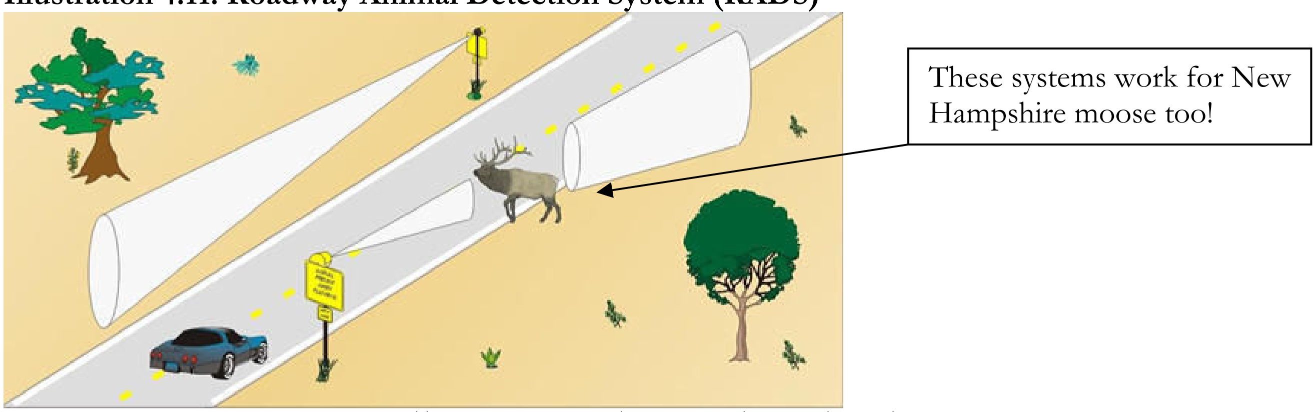
In Moultonborough, the intersection of NH Route 25 and Sheridan Road is located in a valley between Red Hill to the west and the Ossipee Mountain Range in the east. Also prevalent in this area are wetlands, conservation lands, and water bodies, including Berry Pond, Garland Pond, Lee Pond, and Lake Winnipesaukee. Garland Pond collects water from headwaters on Red Hill and points north, and funnels it under NH Route 25 at Sheridan Road into Lees Pond, which flows into Lake Winnipesaukee. This interconnected water way, surrounded by wetlands, uplands, and conservation land adjacent to Sheridan Road, creates an area that is classified as the highest ranked habitat in New Hampshire by NHFG. Habitat rankings in the WAP need to be viewed as predicted, as opposed to actual habitat locations, but with the addition of committee member wildlife sightings, it can be said with certainty that this area is conducive to wildlife habitation and movement.

The area of concern is comprised of three habitat types, with Hemlock-Hardwood-Pine dominating the area and Northern Hardwood-Conifer and Lowland Spruce-Fur as adjacent upland areas. The larger species generally associated with these habitats include: moose, black bear, white-tailed deer, coyotes, bobcat, turkeys, and bald eagles. A host of other smaller species prefer these habitats as well.

The following safety recommendations to minimize wildlife – vehicle interactions were compiled from a variety of sources:

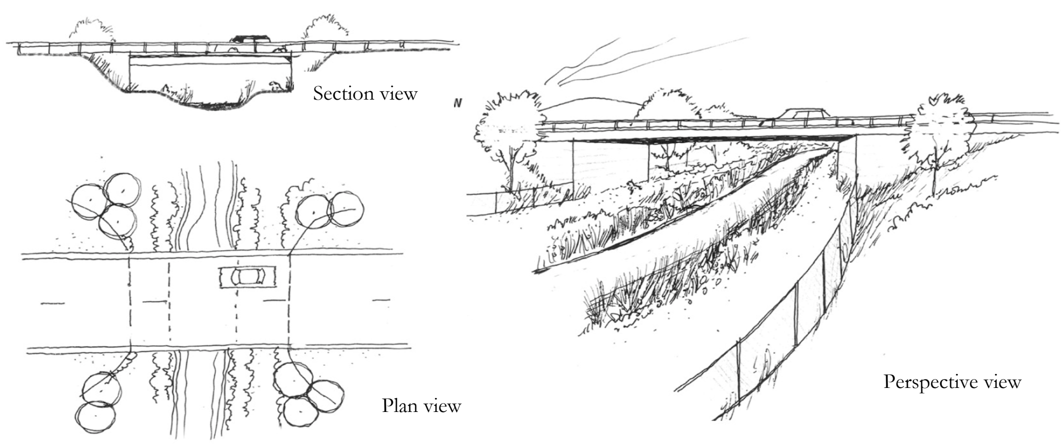
- Field research and further study of wildlife habitats and movements is recommended to better understand impacts on the NH Route 25 corridor near Sheridan Road.
- Right-of-way clearing can reduce animals' desire to graze roadside and increase motorist visibility as they approach the area of concern. Special care should be taken when removing vegetation in order to minimize impact on the environment.
- Conserve highest ranking habitat lands surrounding the area of concern. Habitat loss, reduction, and fragmentation changes could increase the likelihood that wildlife must cross road to find new habitat and foraging grounds.
- Improvements to infrastructure or structures should not restrict, degrade, or negatively impact habitat or impede wildlife movement.
- Install Roadway Animal Detection Systems (RADS) to alert motorists of the presence of large animals entering the roadway. These systems can detect any size animal from a small deer to a large moose in all weather and light conditions and operate on solar-powered warning signs. The illuminated signs are effective both during the day and at night (see Illustration 4.11)
- Retrofit the bridge to include a larger underpass to improve water flow and wildlife movement below the roadway (see Illustration 4.12).

Illustration 4.11: Roadway Animal Detection System (RADS)



Source: Sensor Technology & Systems, Inc. http://www.sensor-tech.com/sub%20pages/products/RADS/rads.html

Illustration 4.12: Wildlife Underpass



Source: Massachusetts Department of Transportation, Wildlife Accommodations, 2006

g) Alternate Routes

The promotion of alternative routes (Illustration 4.13) may help to reduce traffic congestion on NH Route 25 to Interstate 93. A possible alternative route is the use of Little Pond Road in Sandwich, which provides a connection between NH Routes 25 and 109 N. Travel over Little Pond Road to 109 N, NH Route 113, and US Route 3 provides access from NH Route 25 to Interstate 93 (Exit 24) in approximately 20 miles. Comparatively, NH Route 25 from Little Pond Road through Meredith to Interstate 93 (Exit 23) is approximately 22 miles. The use of Little Pond Road, 109 N and NH Route 113 as an alternative would require roadway improvements, but appears to provide a viable alternative route. Figure 4.4 provides a comparison of estimated miles traveled to Meredith and I-93 via Route 25 and the potential alternate route.

Illustration 4.13: NH Route 25 and Alternative Routes

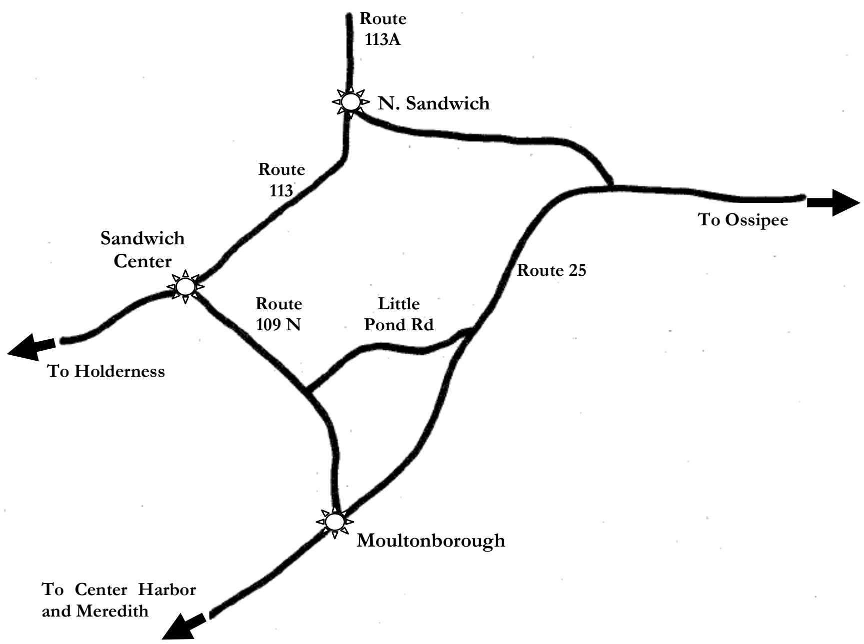


Figure 4.4: Estimate of Miles Traveled

Little Pond Road @ NH 25, 109 N, NH 113 to US Route 3	15.5
US Route 3 at NH 113 to I-93 (Exit 24)	4.5
NH 25/Little Pond Road to US Route 3	13.0
US Route 3 at NH 25 to I-93 (Exit 23) via NH 104	9.4
I-93 Exit 23 to Exit 24	6.0
NH 113 at US 3 to US 3/25 in Meredith	7.8

The use of Intelligent Transportation Systems (ITS) might also be considered. Dialing 511 from any phone provides the caller with up-to-date information on road conditions, construction, and congestion. The use of alternative route signage in conjunction with the 511 system could inform travelers about delays while the signs indicate practical alternatives.

5. ACCESS MANAGEMENT CONSIDERATIONS

Access management is a planning tool that balances property access and travel mobility, which positively impacts the safe and efficient movement of vehicles. According to the NH DOT:

> "Each driveway that intersects a roadway provides a point of potential conflict as cars turn off of the roadway, or turn on to the roadway. As a result, traffic slows down, the efficiency of the roadway is reduced and the potential for access increases."

The potential benefits of access management are great. These benefits include:

- Increased highway capacity;
- Extended functional life of existing highways;
- Reduction in tax expenditures for capacity expansion;
- Decreased energy consumption (some sources indicate savings of 35--50 percent);
- Reduction in vehicle emissions by reducing acceleration, deceleration, and stops;
- Improved bicycle and pedestrian safety;
- Increased traffic safety.

The starting point for good access management is the development of a solid foundation in the local master plan. The master plan should include goals, objectives, strategies, and policies that support good access management. The plan should establish how the community will balance mobility with access, identify the desired access management approach, and designate corridors that require special consideration.

After addressing access management in the master plan, a community should consider if the local zoning ordinance and local land use regulations are supportive of good access management techniques. Questions to ask about the zoning ordinance include:

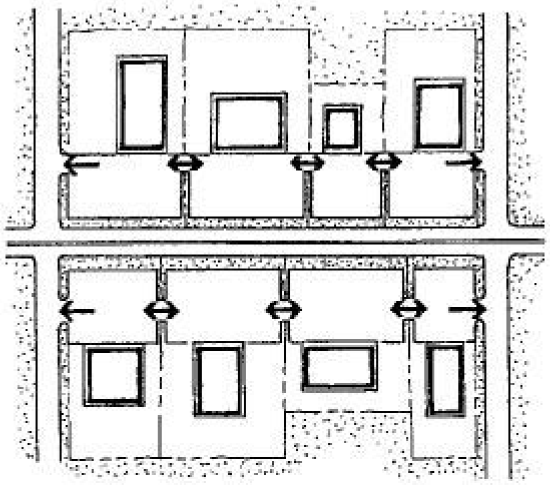
- Does current zoning promote strip development?
- Does the ordinance limit the number of access points per parcel?
- Should frontage requirements be increased on arterial roads?
- Does the ordinance promote an interconnected road network?
- Do maximum lot coverage requirements limit compact development?
- Does the ordinance promote mixed use development?

The following outlines effective access management strategies that may be considered by the towns of Center Harbor and Moultonborough.

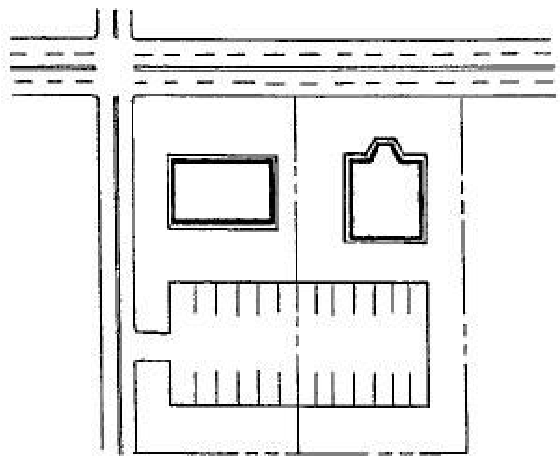
Driveways

- Locate driveways away from intersections.
- Consolidate driveways.

- Regulate the number of driveways per lot (one per lot is recommended). An incentive could be provided for reduced lot size and frontage requirement if a lot is solely accessed by a shared driveway with an adjacent lot.
- Regulate location, spacing, and design of driveways.
- Access to corner lots should be from the side street rather than from the main artery.



Interconnecting commercial sites



A single access point from a collector road for two adjacent businesses

Driveways can be regulated through Site site plan review. Recommendations for spacing from the Federal Highway Administration are based on highway speeds as follows in Figure 4.5:

Figure 4.5: Driveway Spacing Based on Road Speed

Speed (MPH)	Spacing
35	150'
40	185'
45	230'
50	275'

Parking Lots

- Provide for internal connections for parking lots, also known as "cross access drives."
- Commercial driveways should not exceed 36 feet in width. NH DOT permitting allows for up to 50 feet in width.
- Regulate location, spacing, and design of driveways.
- Where possible, encourage frontage roads.
- Throat length for commercial driveways requires traffic analysis for proper design. Poorly designed approaches lead to back-ups on arterial roads and increase potential accidents.

Other Considerations

- Regulate signage. The placement and size of signs along arterial roadways can have a significant impact on a driver's ability to locate and negotiate businesses along the traveled way.
- Bicycle and pedestrian connectivity. ADA accessible 5-feet pathways should provide connections to adjacent streets, parking areas, and existing sidewalks.
- Use roundabouts for traffic calming and maintaining a flow of traffic as an alternative to three and four way intersections.
- The planning board might consider use of a site plan checklist such as the one developed for the Route 11 Corridor study (see Appendix K). The checklist covers all aspects of access management including driveway location, access points, sight distance, parking lots, etc. In order to use the checklist, items must be consistent with local land use regulations and ordinances.
- Consider the use of impact fees or off-site exactions as a way to require developers to pay for the road improvements made necessary by their development. Impact fees as outlined in RSA 674:21, V, requires the community to have a current capital improvement plan as well an impact fee ordinance. The absence of an impact fee ordinance does not preclude the planning board from negotiating with developers and collecting exactions for off-site improvements which are necessitated by the development as outlined in RSA 674:61, V (j).
- Coordinate with NH DOT. While the NH DOT has the authority to issue access permits on state routes, the planning board maintains the responsibility for reviewing site designs and subdivision proposals. These tandem responsibilities require coordination. A possible first step would be to arrange a meeting with NH DOT to share the local access management strategies outlined in the master plan. The community could also develop a memorandum of understanding (MOU) between the municipality and NH DOT. The MOU formalizes the communications required to implement local access management in coordination with the NH DOT permitting process. A sample MOU is provided in Appendix L.

COMMUNITY ACCEPTANCE

On April 16, 2008 Lakes Region Planning Commission staff presented the draft corridor study to the Center Harbor Board of Selectmen. The Board was encouraged to acknowledge the study contents and recommendations. As stated below:

The Center Harbor Board of Selectmen has reviewed and endorses the recommendations in the NH Route 25 Corridor Study: April 2008.

4/23/08

Randy Mattson, Chairman

Date

Charlie Hanson

TOWN SEAL

Rick Drenkhaha

On April 17, 2008 Lakes Region Planning Commission staff presented the draft corridor study to the Moultonborough Board of Selectmen. The Board was encouraged to acknowledge the study contents and recommendations. As stated below:

The Moultonborough Board of Selectmen has reviewed and endorses the recommendations in the NH Route 25 Corridor Study: April 2008.

4/24/08

Karel A. Crawford - Chairman

Date

Edward J. Charest - Selectman

James F. Gray - Selectman

Joel R. Mudgett - Selectman

Betsey L. Patten - Selectman

SOURCES

Fay, Spofford, and Thorndike, *Memorandum: Preliminary Intersection Safety Improvement Concepts*, January 9, 2008.

Federal Highway Administration, *Safe Access is Good for Business*, 2006.

Lakes Region Planning Commission, *NH Route 104 Corridor Study*, April 2007.

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New Hampshire Office of Energy and Planning, *New Hampshire Planning and Land Use Regulation*, 2007-2008 Edition, RSA 236:13

Rockingham Planning Commission, *Local Access Management Manual*, (date unknown).

Strafford Regional Planning Commission, *Route 16 Corridor Protection Study: Access Management*, April 1998.

University of South Florida, Center for Urban Transportation Research, *Ten Ways to Manage Roadway Access in Your Community*, 1998.

Wilber Smith Associates, *Route 11 Access Management Study: Rochester/Farmington/New Durham, NH*, 2001.

APPENDIX A: Kick-off Meeting Identification of Corridor Issues

NH Route 25 Corridor Study

Local Advisory Work Group (LAWG) - Kick-Off Meeting
Moultonborough Town Hall, 6:30 PM
Meeting Notes of Tuesday, July 31, 2007

Committee Attendance: D. Scott Davis, Herbert Farnham, Jeff Haines, Scott Kinmond, Barbara Merrill, Joel Mudgett, William Page, Judith Ryerson, Eric Taussig, Jim Marshall, NH DOT, Absent: Mark Chase, Joanne Coppinger, and Tom Whalen.

Others Present:

Maureen Criasia, Center Harbor
Joanne M. Farnham, Moultonborough
Jerry Hopkins, Moultonborough
Alan Hunter, Sandwich
Barbara Perry, Moultonborough
Sam Perry, Moultonborough
William Wilderman, Moultonborough
Scott Weiss, Center Harbor
Kimon Koulet, Lakes Region Planning Commission
Adam Kurowski, Lakes Region Planning Commission
Michael Izard, Lakes Region Planning Commission

Purpose: Identify Safety Issues in the Corridor Study Area

Meeting Notes: Kimon Koulet, Executive Director provided background information about the project. He identified Mike Izard, Project Manager, and Adam Kurowski, Regional Planner, as the project team. M. Izard provided a draft outline of potential meeting dates and contents based on project milestones, and stated the project is scheduled for completion by April 30, 2008. A. Kurowski discussed particular data needs related to the build-out analysis portion of the study and the need to identify key contacts in the community who can aid verification of land use.

M. Izard led a discussion on corridor safety issues. Each person in attendance was provided an opportunity to share their perspective. Poster-sized maps were provided for reference and to mark particular areas of concern after the discussion. When the group had completed the list of safety issues, consensus was reached that Lakes Region Planning Commission staff will work with the Center Harbor and Moultonborough Police Chiefs to prioritize the list of safety concerns and identify appropriate data collection locations.

The following represents the list of identified corridor-wide safety issues:

Signal at Moultonborough Neck Road - timing for turns.

Animal crossings prevalent near Sheridan Road.

Curve at Rob's Roast Beef - turns into property are difficult.

Moultonborough Neck shoulders: 3-- 4 feet of additional pavement is needed to accommodate bikes/walkers and improve safety.

Wider shoulders for bikes/pedestrians on Sheridan Road, Redding Lane, and Moultonborough Neck Road.

Fox Hollow Road – realignment (access point closer to NH DOT shed), drainage "gully" is a hazard when turning onto NH Route 25, limited site distance.

Weekends 9:00 am to 1:00 pm- traffic lights are problematic creating stand still traffic (June through October).

Traffic light sensors could be used at additional locations.

Need for traffic light synchronization.

Guardrail vs. cable, guardrail preferable, many steep drop-offs along NH Route 25

Most intersections on NH Route 25 have line of sight issues; specific areas of concern include Fox Hollow Road, Redding Lane, Glidden Road (T^2 to study this intersection – results available from Moultonborough Police Chief).

Priority intersections identified by Moultonborough Police Chief: 1) Sheridan Road, 2) Moultonborough Neck Road, 3) Glidden and Redding Roads.

Aubuchon Hardware exit is confusing/dangerous for cars headed north on Moultonborough Neck.

Bean Road intersection when making a left is an issue.

Sheridan Road and Redding Lane, left turns are challenging.

Marvin Road area is problematic. Businesses generate vehicle and pedestrian traffic, area lacks pedestrian facilities, blind spot exists, limited site distance, vehicle speeds create safety concerns. Pedestrian ways needed.

Marvin Road – open ditches should be converted to paved over, underground drainage to increase shoulder width. Existing shoulder material is poor quality, too soft.

Moultonborough Church – officer directing traffic was hit by a car.

Crosswalk needed between Country Store and Church/Artie's Subs and Pizza.

Potential for traffic light, sensor is needed at church.

NH DOT has indicated widening will cause church land loss and make pedestrian crossings more difficult.

West-bound left turn into church, road widening has caused problems with passing on right.

At Country Store, trying to get on Holland is very difficult. Country Store sign is an obstacle for line of sight, rise in the road limits line of sight too.

Center Harbor -- improved section of road yields greater speeds.

Center Harbor -- variation in posted speed limits and lack of enforcement creates safety issues.

Center Harbor – Canoe restaurant and downtown key areas of concern. Canoe workers' walk to work unsafe.

Evenings at the bandstand and other community events, no crosswalk is available.

Center Street and Lake Street left turns.

Lake Street -- trailered boat traffic, business traffic, and pedestrian traffic.

Center Harbor Village vehicles don't stop for pedestrians and pedestrians do not use crosswalks.

Shoulder width into village limited, creates pedestrian safety issues.

Left turn lane for Bean Road is too short.

Five business centers exist from Center Harbor to Moultonborough, what is the feasibility of frontage roads? Defined access points in these areas would be beneficial.

Inconsistent speed limits corridor wide; this is confusing for motorists.

Corridor is identified as a bicycle route, but is a hazard to bikers.

NH Route 25 is a major trucking route and the only east/west route from and to Maine.

Road is too narrow for volume of traffic.

Land use in the corridor has changed from seasonal to year-round occupancy, increasing local demand.

Consistent shoulders are needed corridor-wide, width to accommodate safe walking and biking.

Seasonal traffic an issue from June to October.

Potential locations for turning movement counts:

Fox Hollow
NH Route 109 S
NH Route 109 N
Moultonborough Neck Road
Redding Lane
Lake Shore Drive

APPENDIX B: ITE Committee 4M-25 Speed Zone Guidelines Recommended Practices

Final Draft Version

It should be noted that this report is a draft version and is not yet an official ITE recommendation. Permission to publish this was granted by the committee.

Introduction

The purpose of speed zoning as stated in the Uniform Vehicle Code is to establish a speed limit which is reasonable and safe for a given section of roadway. There are at least two difficulties when interpreting this statement. The first is a question of reasonable to whom?, and the second is the implication that there is truly a cause and effect relationship between speed limits and safety.

It is clear from the controversy surrounding the use of speed zones that there are differences of opinion as to what is a reasonable speed among drivers, residents, legislators and enforcement officers. Thus, compliance with the vehicle code in determining the appropriate speed limit to post in a speed zone requires a definition of the term reasonable speed.

The use of speed zones to increase safety depends on the assumption that a direct relationship exists between a change in the speed limit and a change in driver behavior that results in increased safety. Changing speed limits alone seldom changes speed characteristics of the traffic stream, indicating that this assumption is likely invalid. In fact, the net result of current practice that results in decreasing the speed limit is that a higher percentage of the drivers are now in violation of the speed limit, while their speeds have not changed. It is improbable that this results in increased safety. It may only serve as an ineffective substitute for other traffic engineering measures that could result in increased safety.

However, speed zoning as a traffic engineering tool should not be ignored. It is widely used, and many states, counties, and cities have developed policies and guidelines for the implementation of speed zones. Speed zoning, when properly applied and enforced, contribute to highway safety.

Inconsistencies in Speed Zoning

In a survey conducted by this committee, the most frequently cited reasons for establishing speed zones is to increase safety and to inform the motorist of the reasonable speed for this segment of the road. However, there are serious inconsistencies in the practice of speed zoning which make it difficult to justify speed zoning as either a safety measure or a means of communicating the reasonable speed to the motorist. These inconsistencies are described as follows:

1. Location of Speed Zones. Even though traffic engineers and the public both perceive speed zoning to be a safety tool, such zones are frequently established primarily in response to citizen demands rather than where an accident or potential accident problem exists. It is not surprising, then, that studies of accident reductions resulting from speed zoning are inconclusive. If speed zones are to be an effective safety device, the profession needs consistent guidelines, based on an engineering analysis, to determine where and when to establish these zones.

2. Speed Limits. Most traffic engineers support the use of the 85^{th} percentile speed as a basis for determining the appropriate speed limit. However, the majority of posted speed limits in speed zones nationwide are much lower than the 85^{th} percentile speed, and in many cases, lower than the average speed. The limits are often set to reflect either legislatively created limits or simply to accommodate the demands of the public. The profession also needs to be consistent in applying guidelines for posting speed limits in speed zones. Uniformity in the application of traffic control devices is one of the goals of the traffic engineering profession.

3. Enforcement Tolerance. This final inconsistency refers to the practice of enforcing the speed limit in speed zones. Where speed limits are artificially low, the enforcement tolerance must be high. Since enforcement action against a large proportion of a traffic stream is not possible, the enforcement tolerance must be increased when the speed limit is set below the 85^{th} percentile speed. While a large tolerance may be necessary for zones where the speed limit is artificially low, it is not appropriate to use this same tolerance where the speed limit is set at or near the 85^{th} percentile speed. Since all speed zones have identical signing, the motorist cannot distinguish between the two types of speed zones.

Rationale for Consistent Speed Zone Guidelines

Several studies have demonstrated that drivers who travel either slower or faster than the 85^{th} percentile speed of the traffic stream have a higher accident involvement rate than those drivers whose speed is close to the 85th percentile speed. Posting the speed limit at the 85^{th} percentile speed informs the motorist of the speed which is expected to minimize their risk of an accident. Thus, the overriding basis (from a safety perspective) for speed zoning should be that the creation of the zone, and the speed limit posted, reflects the maximum speed considered to be safe and reasonable (i.e., the 85^{th} percentile speed).

A second rationale for consistency in speed zoning practice is the desire for equitable treatment of motorists. When speed limits are set artificially low, and enforcement action cannot be directed at all the violators, the enforcement officer has too much discretion in selecting the motorists to be penalized. The cost of being selected can include both a fine and an increase in the cost of insurance. This type of enforcement ultimately leads to poor public relations for both the traffic engineering agency and the enforcement agency.

A third rationale is the need for consistency between the speed limit and other traffic control devices. Signal timing and sight distance requirements, for example, must be based on the prevailing speed of traffic. If these values are based on a speed limit that does not reflect the prevailing speed of traffic, safety may be compromised.

If speed zones are to fulfill their intended function as a traffic control device used to enhance highway safety and operations, these inconsistencies must be eliminated. As currently practiced, speed zoning violates one of the basic traffic engineering premises stated in the national *Manual on Uniform Traffic Control Devices*: "uniformity means treating similar situations in the same way. The use of a standard device does not, in itself, constitute uniformity. A standard device used where it is not appropriate is as objectionable as a nonstandard device..."

The most desirable method of eliminating these inconsistencies would be to require all speed zones to be based on an engineering study and to enforce all speed limits with equal rigor. Unfortunately, traffic engineers, enforcement agencies, and the courts seem to be moving in the opposite direction, with more speed zones being established based on other criteria, more speed limits being set incorrectly, and greater tolerance in the enforcement of these speed limits.

Guidelines

The following guidelines will provide a consistent basis for the application of engineering principles to speed zoning.

1. Speed zones shall only be established on the basis of an engineering study. Each speed zone should be periodically restudied to determine that the established speed limit is appropriate. The suggested maximum interval is five years. In addition, an engineering study should be conducted whenever there is a change in the roadway that would affect the prevailing speed. Such changes would include elimination of parking, added lanes, signal coordination, changes in roadside development, etc.

2. The engineering study includes an analysis of the current speed distribution of free-flowing vehicles. The speed limit within a speed zone shall be set at the nearest 5 MPH increment to the 85th percentile speed or the upper limit of the 10 MPH pace. No speed zone shall be established in a location where the 85th percentile speed is within +/- 3 MPH of the statutory speed limit. The existing speed limit within a speed zone shall not be changed if the 85th percentile speed is within +/- 3 MPH of the posted speed limit.

3. The engineering study may include other factors such as:

a. Geometric features, including: Vertical and horizontal alignment and sight distance;
b. Roadside development;
c. Road and shoulder surface characteristics;
d. Pedestrian and bicycle activity;
e. Speed limits on adjoining highway segments;
f. Accident experience or potential.

However, in no case should the speed limit be set below the 67th percentile speed of free flowing vehicles.

4. Speed zones should not be used to warn motorists of hazardous conditions. If a hazardous condition exists within the road segment under study, this condition should be corrected or an appropriate warning sign in conjunction with an advisory speed plate should be posted.

5. Enforcement of speed limits within speed zones should be uniform. Efforts should be made to coordinate the implementation of speed zones and the enforcement policies with the governing enforcement agency.

Legal Issues

In addition to the application of the Speed Zoning Guidelines, some changes in laws or ordinances would be required to eliminate inconsistencies in speed zoning. This would include the codification of the requirement for engineering study justification of speed zones as well as a requirement for a periodic restudy. It should also include some distinction in terms of enforcement. For example, on roadways where these guidelines are not followed, enforcement should only be based on violation of the Basic Speed Law.

Definitions

As used in this document, the following terms are defined as:

1. Speed zone - A section of street or highway where a speed limit is different than the statutory speed limit that has been established.
2. Speed limit - The maximum (or minimum) speed permitted on a section of street or highway. This limit may be statutory or it may be established within a speed zone on the basis of an engineering study.
3. Basic Speed Law - no person shall operate a motor vehicle at a speed greater than is reasonable and proper for the prevailing conditions.
4. 85^{th} (67^{th}) percentile speed - The speed at or below which 85 percent (67 percent) of the sample of free-flowing vehicles are traveling. This speed should be determined by conducting a spot speed study following the procedure contained in the Manual of Transportation Engineering Studies.
5. Pace - The 10 MPH band of travel speeds containing the largest number of observed vehicles.
6. Advisory speed - The speed at which a specific feature along the street or highway may be safely traversed.
7. Tolerance - The numerical difference between the speed limit and the minimum speed at which enforcement action is taken.

Bibliography

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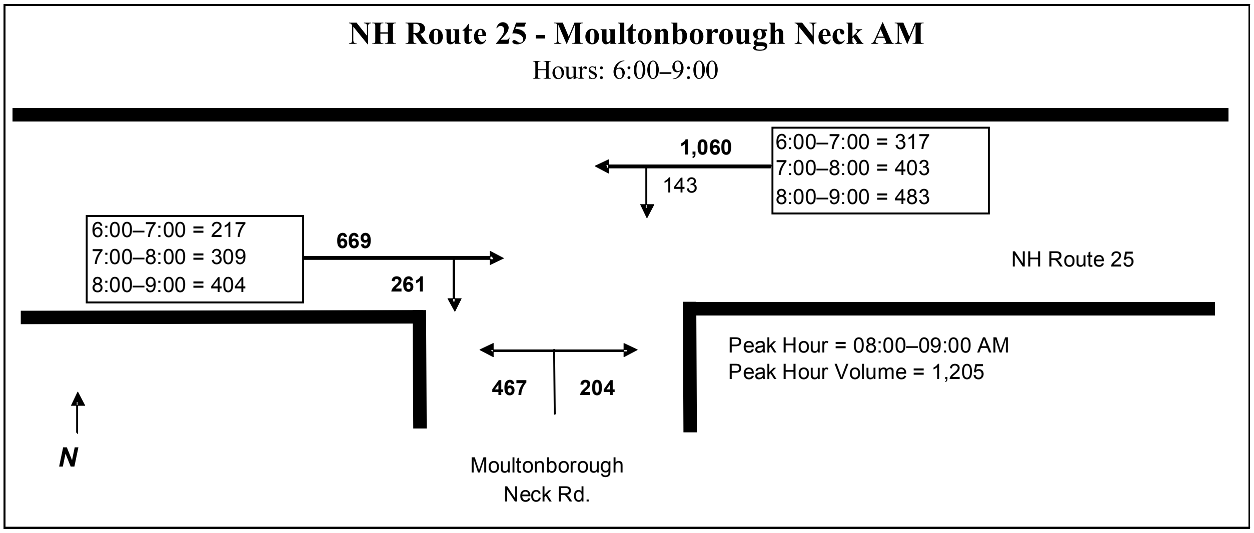
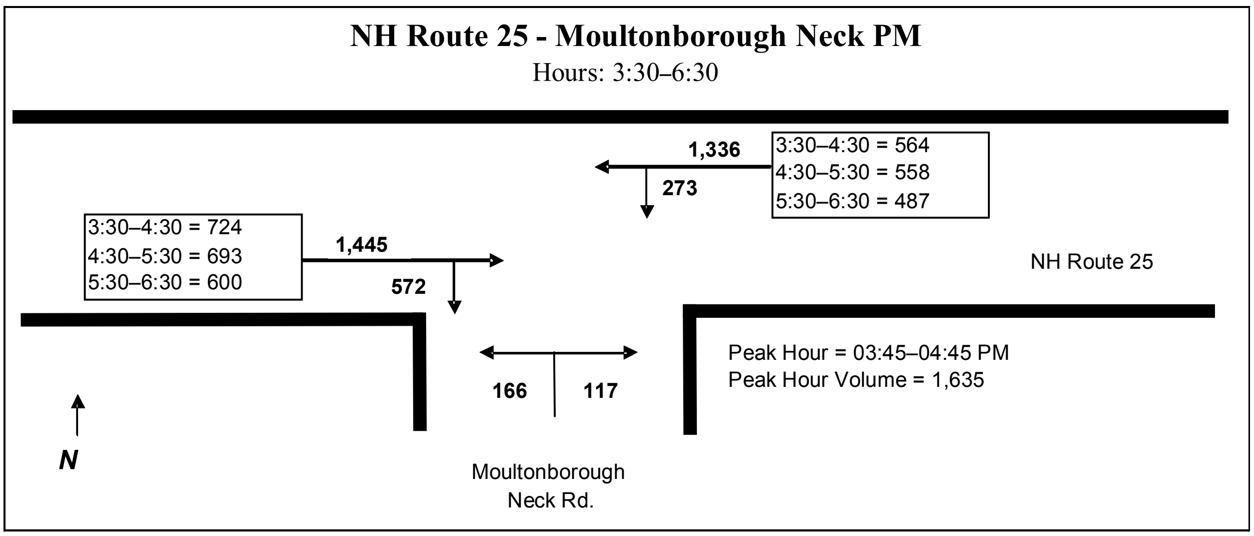
3. *Synthesis of Speed Zoning Practices.* US Department of Transportation, Federal Highway Administration, July 1985.
4. *Manual of Transportation Engineering Studies,* 1st Edition, Institute of Transportation Engineers, 1994.

APPENDIX C: Turning Movement Counts





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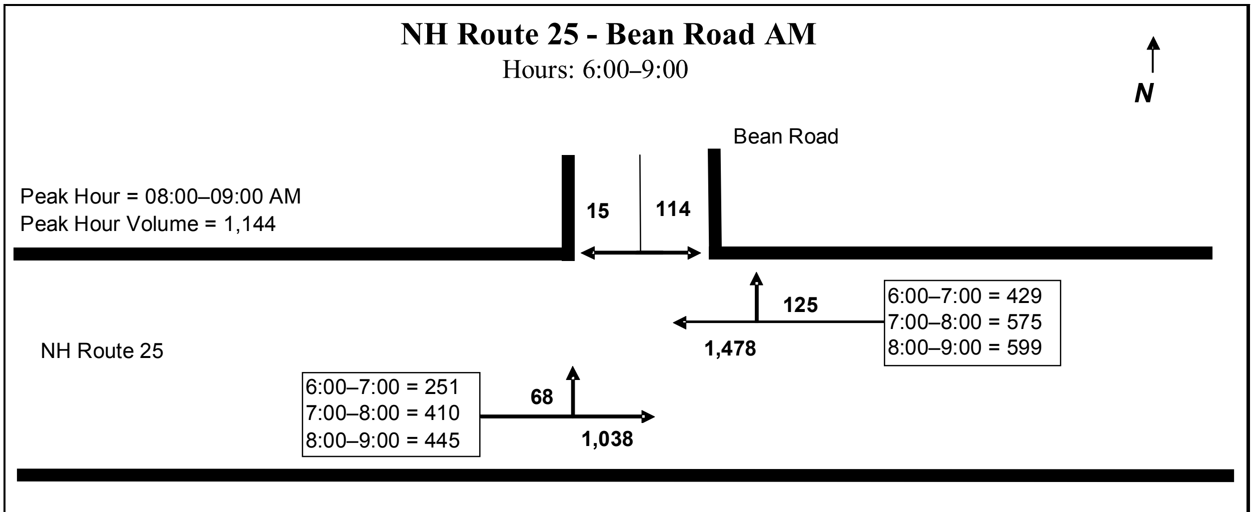

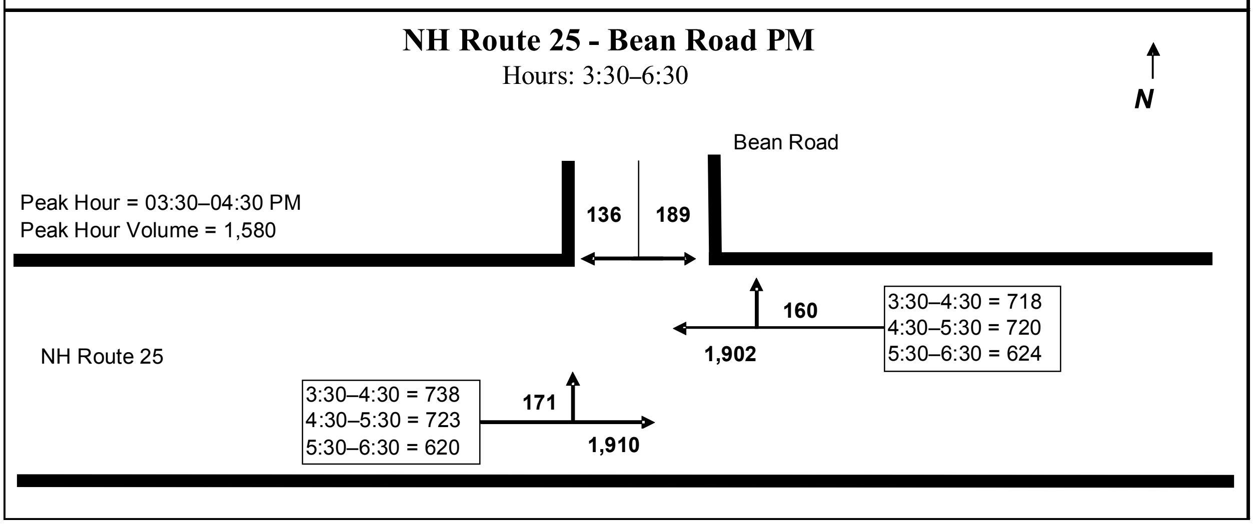

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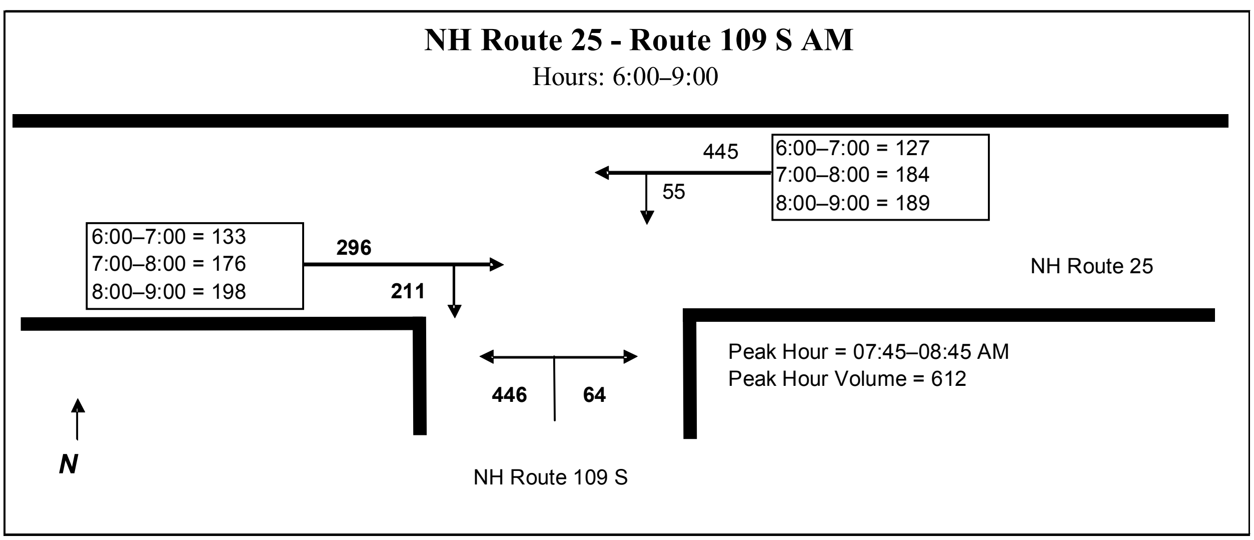

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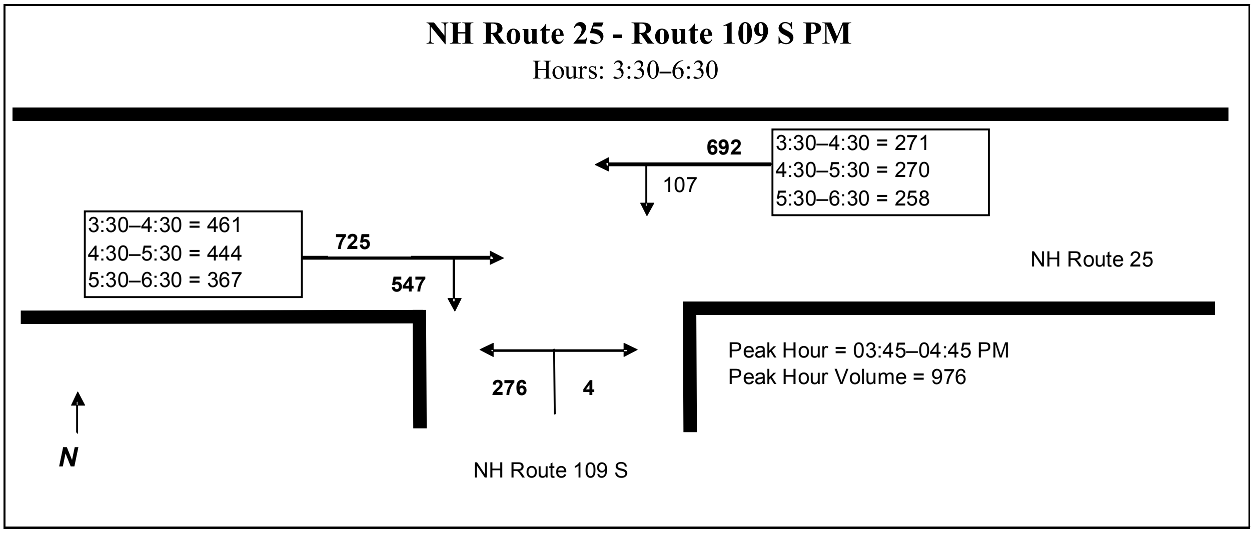

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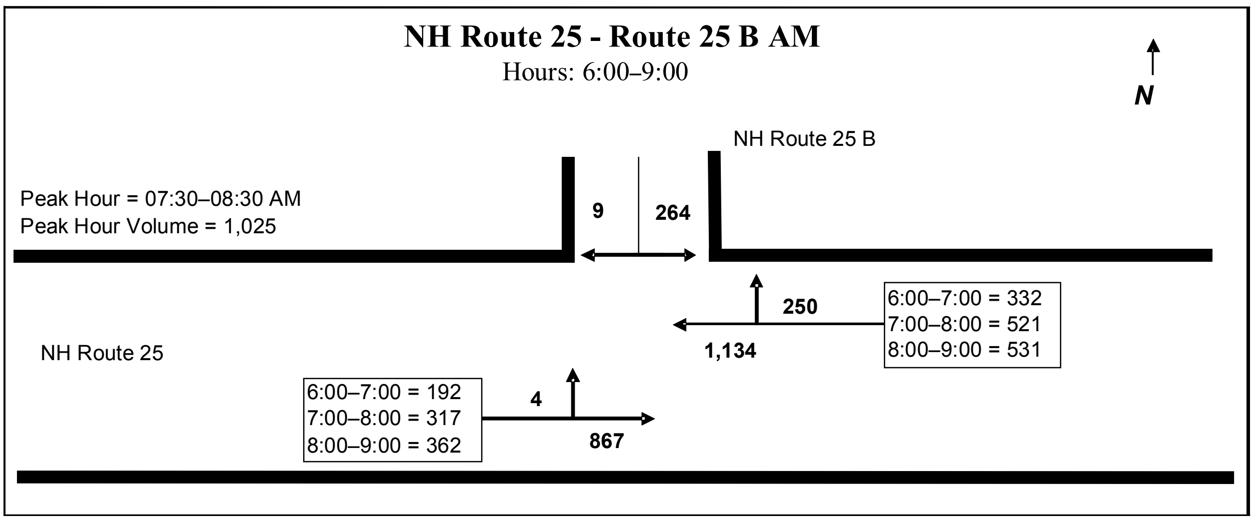

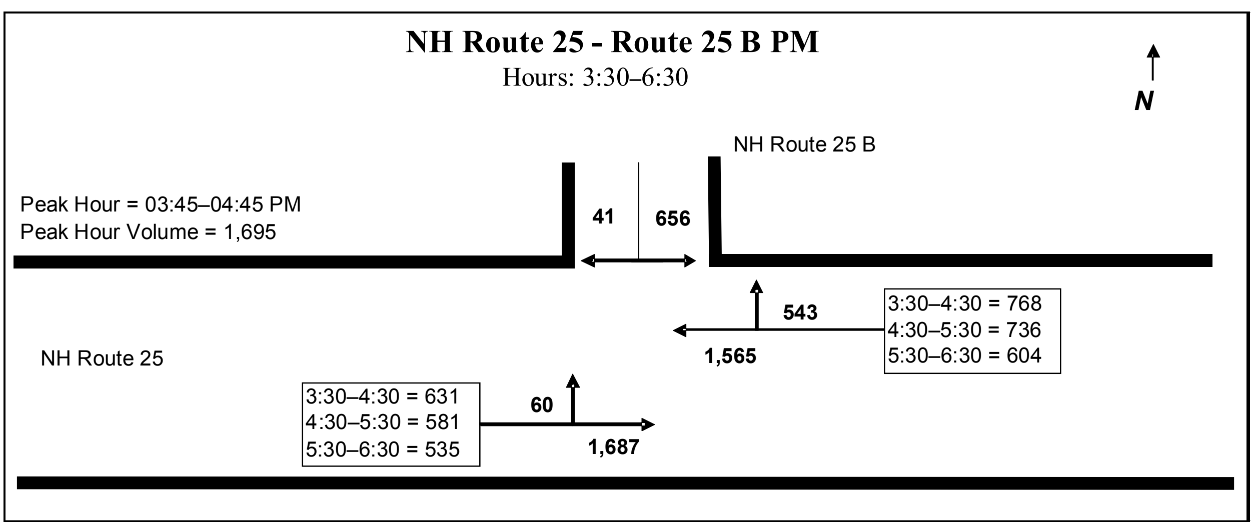

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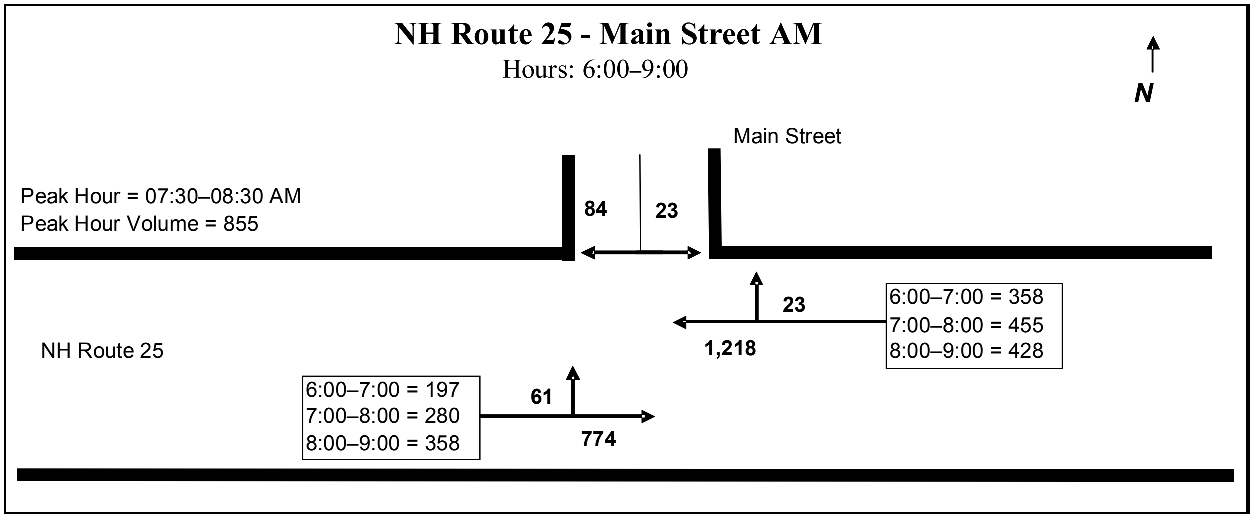

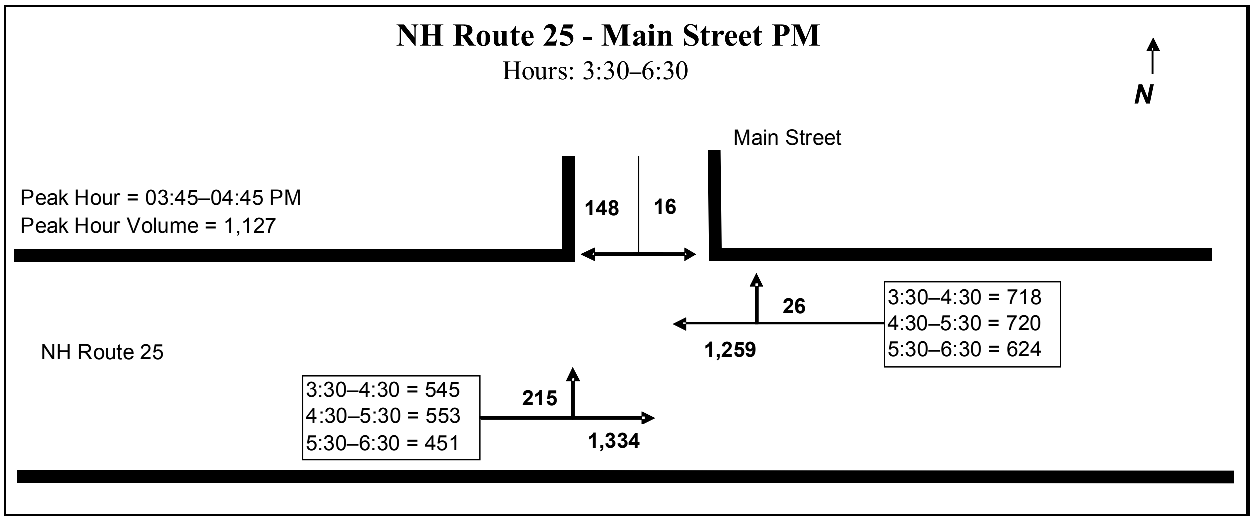

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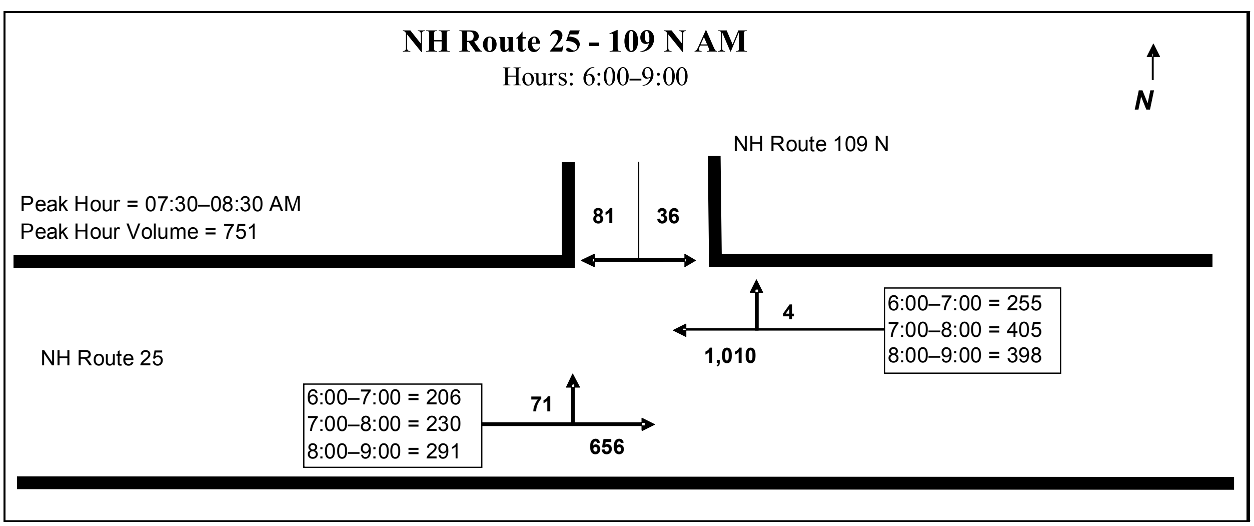

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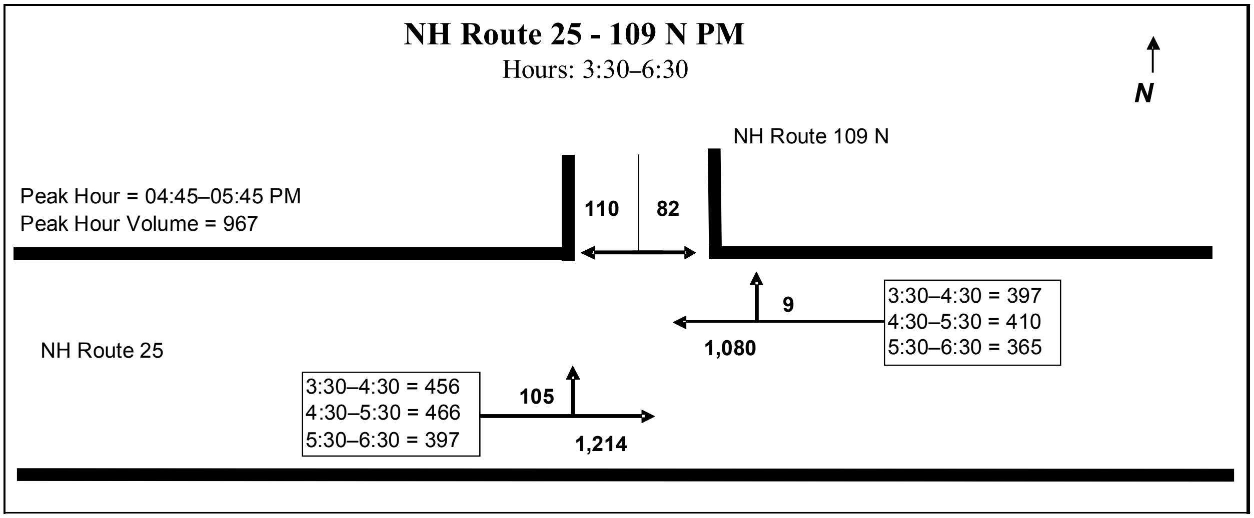

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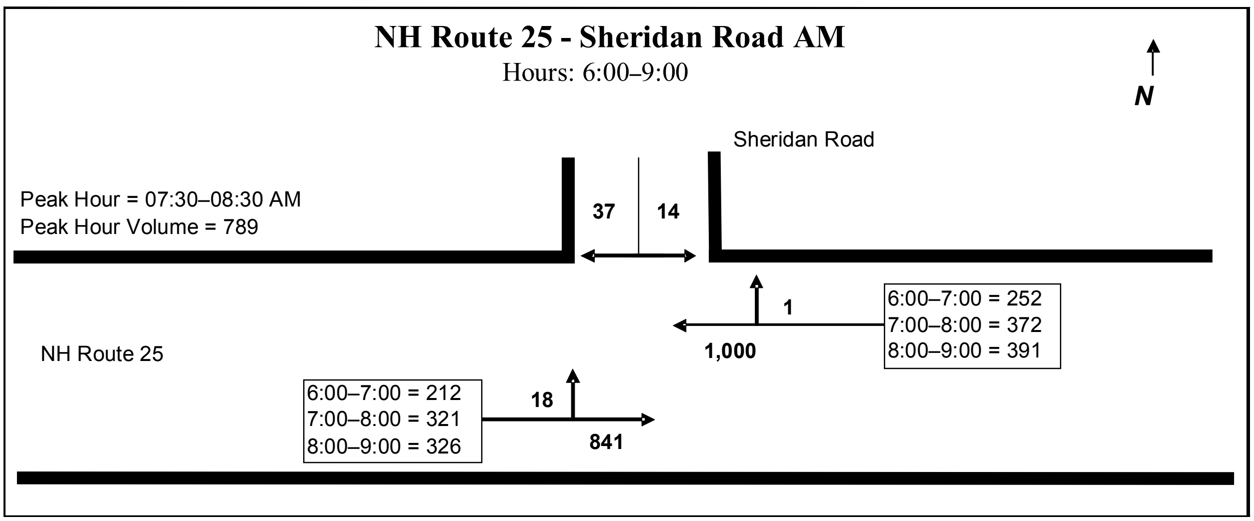

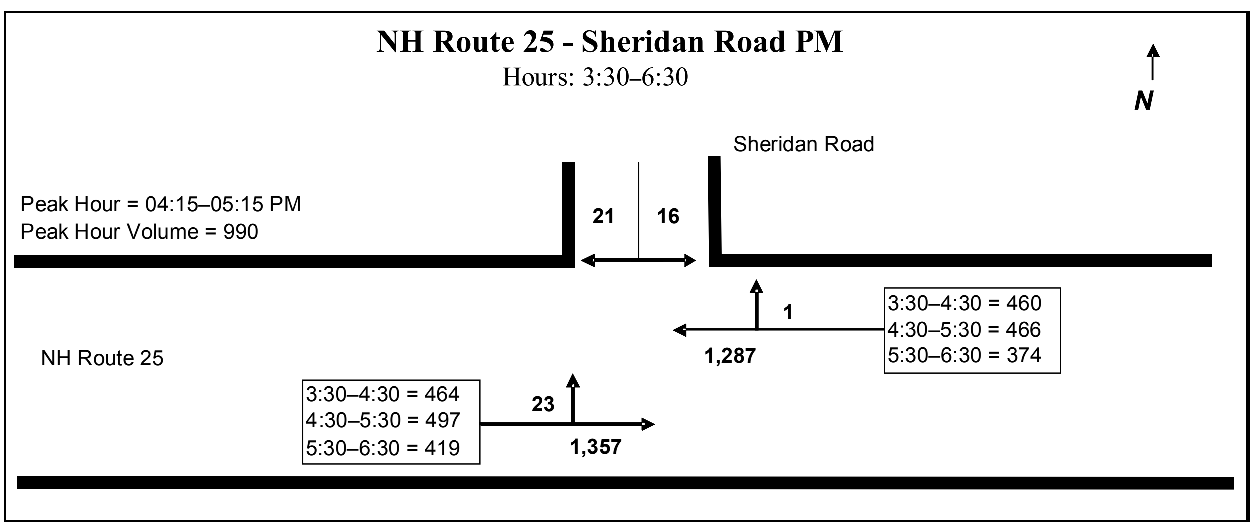

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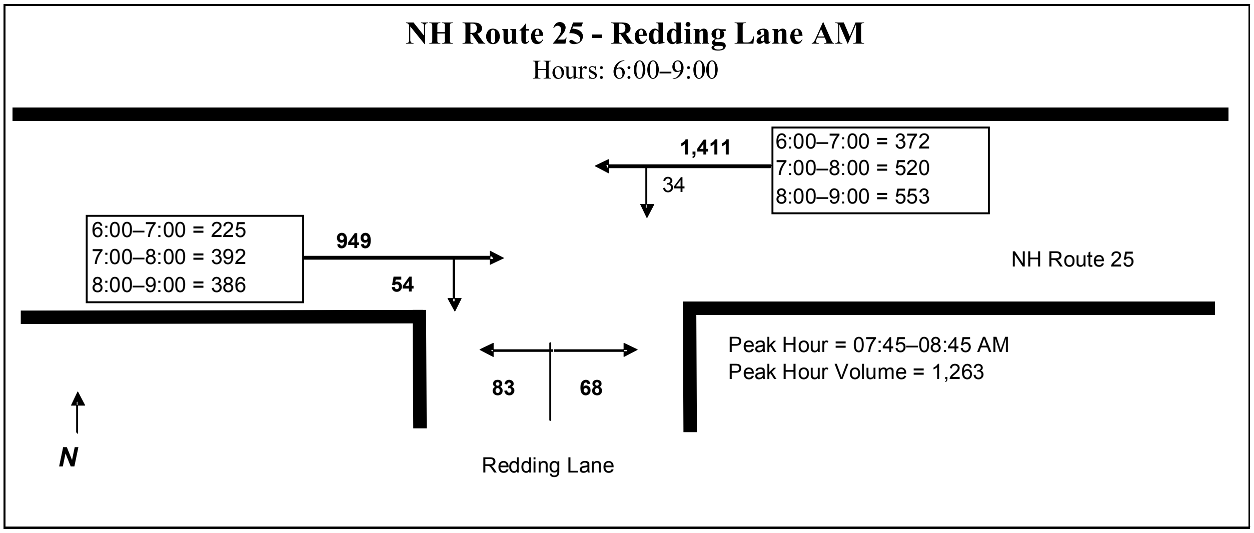

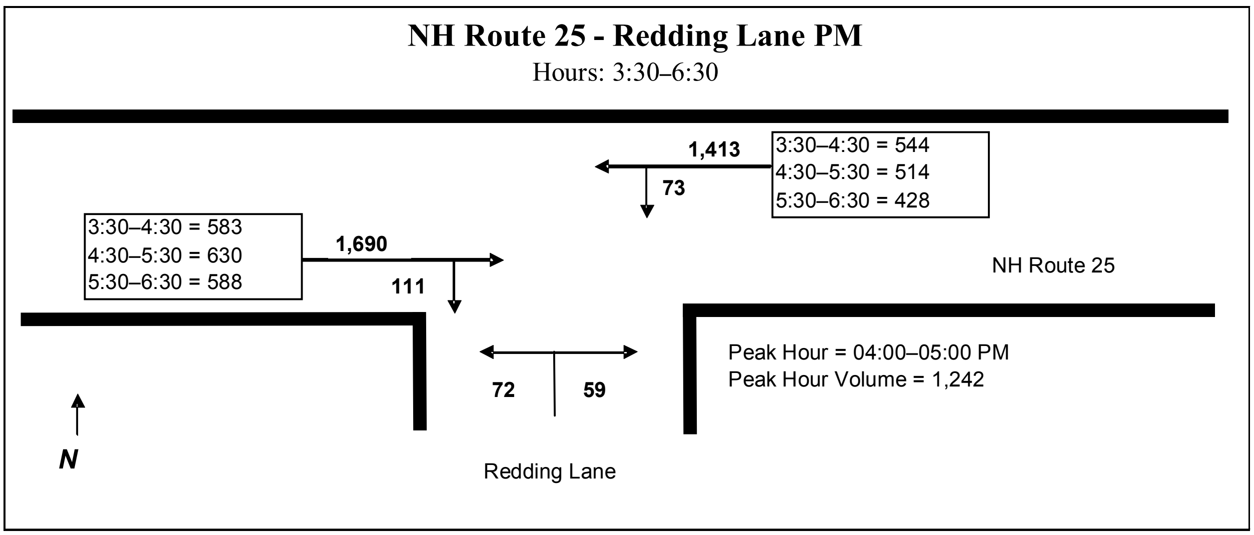

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APPENDIX D: Moultonborough Build-out Analysis Assumptions

Environmental Constraints

Areas that are environmentally constrained according to existing land use regulations were calculated using GIS software as follows:

Constraint	Description
Conservation Lands	Unbuildable
Slopes	Unbuildable at 25 percent or greater
Soils	Minimum lot size based on soil type and slopes
Water body	50-foot setback
Wetlands	Unbuildable; no setback requirement

Zoning Constraints

Lot size restrictions outlined in the town zoning ordinance were applied to each parcel. The application of zoning restrictions was based on town input, the dominant zone, existing land use, and access to NH Route 25. Parcels with development potential that span more than one zone were divided. Split lots were created for all non-built-out parcels that were located in more than one zone. If the lot was developed, the location of the development was identified and applied to that portion of the lot. If splitting a lot would create an undeveloped substandard lot, the lot was not split. Substandard lots were considered unbuildable because they did not meet the minimum lot size.

Zone	Permitted Residential Units	Minimum Lot Size	Commercial Maximum Lot Coverage
Commercial - Zone A	Single Family and Multi-family	Soils based	50 percent
Commercial - Zone B	Single Family and Multi-family	Soils based	50 percent
Commercial - Zone C	Single Family and Multi-family	Soils based	50 percent
Residential	Single Family and Duplex	Soils based	NA

Institutional Constraints

Parcels that are owned by town, state, or federal governments or a utility company were considered built-out, unless otherwise specified by the town.

Land Currently in Use

To determine land currently in use, the Moultonborough assessor database and non-residential parcels were analyzed using aerial photography. The assessor database identified "living area" while an aerial photo-interpretation calculated size of other impervious surfaces, for example parking lots, and commercial and industrial buildings. If an area of land that is currently in use was larger than the minimum lot size, this area was considered unbuildable.

Existing units were defined through a windshield survey. Multi-unit structures' existing units could vary from the actual number of units, in the case of an apartment complex, in-law apartments, duplex, or other rental properties.

Moultonborough Neck Process and Assumptions

- Applied same environmental constraints
- Used soils-based lot sizing
- Used Land Use Code in assessor database to determine existing use
- Applied trip generation values from manual to Land Use Code for each parcel
- Future trip generation values assumed all buildable land would be built as single family residential

APPENDIX E: Clarification of Terms

Crash Avoidance System

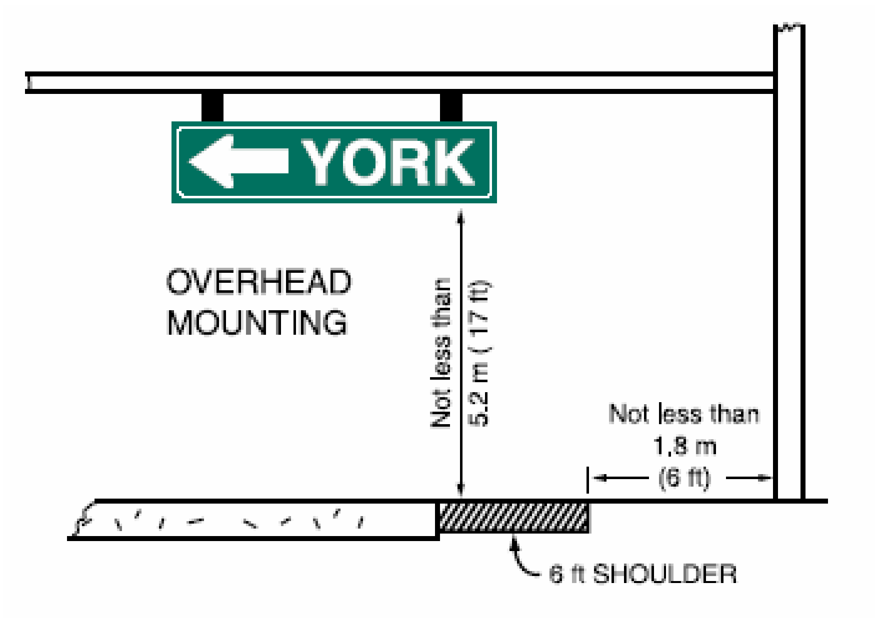
The term 'crash avoidance system' pertains to a system being tested in the state of Pennsylvania as follows (Source: Pennsylvania Department of Transportation (Penn DOT)):

> "Penn DOT Engineering District 10 is testing a new innovative crash avoidance system on Route 38 in Concord and Washington Townships, Butler County. The system is designed to improve safety at two intersections on Route 38 at Route 1010 (Hooker Road) in Concord Township and Route 138 (North Washington Road) in Washington Township through the use of Intelligent Transportation Systems (ITS) technology. The project is the first of its kind in Pennsylvania and only the second application of this technology in the United States. The state-of-the-art crash avoidance system uses fiber optic signs that provide an advanced warning of oncoming traffic to all vehicles approaching these intersections. The electronic signs are intended to alert drivers on Route 38 that there are other vehicles approaching the intersection from crossing routes and that they should be cautious and slow down. The system will also serve as an extra tool in assisting drivers on Hooker Road and North Washington Road in determining when it is safe to proceed onto or across Route 38. The project took longer than originally expected to complete because the software needed to control the system required special programming. Penn DOT decided to implement this new technology after concerns about safety at the two intersections were voiced by students at Moniteau High School. Penn DOT engineers decided the only alternative to removing several buildings - virtually eliminating two small communities - to improve sight distance was to try the crash avoidance system…"

For the NH Route 25 corridor, a variation to the Penn DOT system might be lighted signage above the 'TRAFFIC AHEAD' sign. This signage would illuminate when a vehicle is stopped or slowing to turn in red letters 'STOPPED' and 'TRAFFIC AHEAD' in white. The approach used in Pennsylvania could be adapted by NH DOT; perhaps simplified to indicate only that traffic crossing/stopped ahead when flashing.

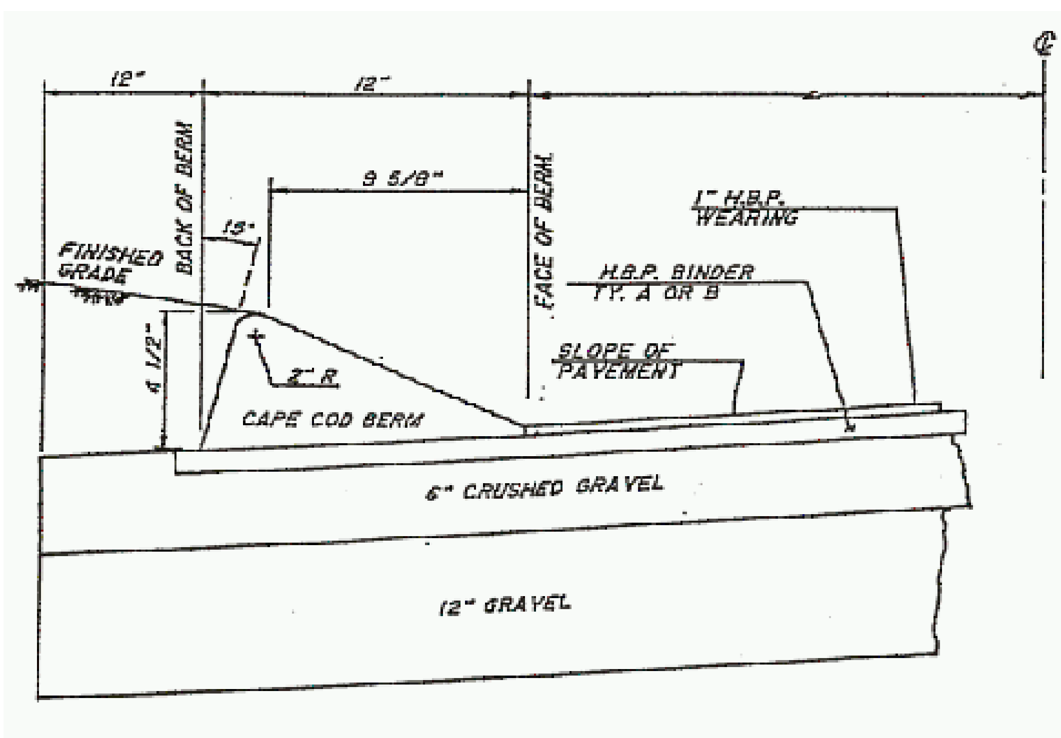
Overhead Signs

The Manual on Uniform Traffic Control Devices (MUTCD, US DOT, 2003, as amended) allows overhead signs to have a green background with white lettering, similar to the signs illustrated on the photos contained in this document. However, it is important to note that the signs shown in the illustrations in this report are *for location illustrative purposes only*.



Cape Cod Berm

A sample detail of a 'cape cod berm' related to roadway edge of pavement is also provided below.



Source: US DOT FHWA Manual on Uniform Traffic Control Devices (MUTCD), 2003.

APPENDIX F: Fox Hollow Road – Safety Improvements Cost Estimate

Fox Hollow Road - Estimate of Quantities

Item No.	Description	Unit	Estimated Total	Unit Price	Total
	PAVEMENT				
203.3	UNCLASSIFIED EXCAVATION - 30"	CY	750	$10.00	$7,500.00
304.1	SAND (F) - 8"	CY	200	$22.00	$4,400.00
304.2	GRAVEL (F) - 8"	CY	200	$23.00	$4,600.00
304.3	CRUSHED GRAVEL (F) - 8"	CY	200	$26.00	$5,200.00
403.11	HOT BITUMINOUS PAVEMENT, MACHINE METHOD	TON	300	$60.00	$18,000.00
628.2	SAWCUT	LF	1100	$2.00	$2,200.00
632.0104	RETROREFLECTIVE PAINT PAVE. MARKING, 4" LINE	LF	2800	$0.50	$1,400.00
632.02	RETROREFLECTIVE PAINT PAVEMENT MARKING, SYMBOL OR \	SF	60	$1.35	$81.00
	MISC.				
	OVERHEAD SIGN WITH POST	EA	1	$50,000.00	$50,000.00
670.	ADVANCED WARNING SIGN	EA	2	$2,000.00	$4,000.00
	EARTH WORK				
203.1	COMMON EXCAVATION	CY	1400	$5.00	$7,000.00
	RETAINING WALL				
670.	PRECAST CONCRETE SEGMENTAL RETAINING WALL	SF	2500	$30.00	$75,000.00
	DRAINAGE				
	HEADWALLS	EA	2	$3,000.00	$6,000.00
585.3	STONE FILL, CLASS C	CY	130	$47.00	$6,092.59
593.411	GEOTEXTILE: PERM. EROSION CONTR. CLASS 1, NONWOVEN	SY	350	$3.00	$1,050.00
603.00212	12" R.C. PIPE, 2000D	LF	25	$40.00	$1,000.00
	GUARD RAIL				
606.140	BEAM GUARDRAIL (STANDARD SECTION- WOOD POSTS)	LF	300	$20.00	$6,000.00

Fox Hollow Road - Estimate of Quantities

Item No.	Description	Unit	Estimated Total	Unit Price	Total
606.147	BEAM GUARDRAIL (TERMINAL UNIT TYPE G-2)	U	2	$550.00	$1,100.00
	SubTotal				$200,623.59
	OTHER:				
	MOBILIZATION (10%)				$20,062.36
	EROSION CONTROL (5%)				$10,031.18
	TRAFFIC CONTROL (5%)				$10,031.18
	CONTINGENCIES (30%)				$60,187.08
	SubTotal				$100,311.80
	TOTAL				$300,935.39
	TOTAL ESTIMATE			SAY	$300,000.00

Notes:

1. This estimate is based on a Concept Plan which shows only approximate existing conditions that are not from instrument field survey. Proposed conditions are based on limited engineering and are conceptual in nature. The Concept Plan is not for construction; it was prepared for conveying feasible improvement options in a general way. The total estimate is therefore approximate and suitable only for general planning purposes. The quantities and corresponding costs could vary significantly upon completion of a field survey base plan and preliminary designs.

2. The Fox Hollow Road estimate provided above generally includes the approximate cost for pavement widening, markings and overhead / advanced warning signage. The amount of pavement widening as well as the length/height of retaining wall required to implement this concept has been approximated. This is based on minimal technical information and is therefore subject to significant change during design. A potential cost savings could be realized through slope work in lieu of retaining walls provided that potential slope stabilization, rock excavation and Right of Way issues are not substantial (can not be determined at this time). Unit prices are based on FY 2007 weighted average bid prices published by NHDOT. Additional items such as mobilization, erosion control, and traffic control are approximated through typical %.

3. The price for advanced warning signage indicated above assumes standard NHDOT signs. The cost for vehicle-actuated advanced warning system has not been included. The cost to install such a system would be on the order of an additional $50,000.

APPENDIX G: Glidden Road – Safety Improvements Cost Estimate

Glidden Road - Estimate of Quantities

Page 1 of 1

Item No.	Description	Unit	Estimated Total	Unit Price	Total
	PAVEMENT				
632.0104	RETROREFLECTIVE PAINT PAVE. MARKING, 4" LINE	LF	3000	$0.50	$1,500.00
632.02	RETROREFLECTIVE PAINT PAVEMENT MARKING, SYMBOL OR W	SF	60	$1.35	$81.00
	ADVANCED WARNING SIGN	EA	2	$2,000.00	$4,000.00
	OVERHEAD SIGN WITH POST	U	1	$50,000.00	$50,000.00
	EARTH WORK				
203.2	ROCK EXCAVATION	CY	100	$30.00	$3,000.00
	SubTotal				$58,581.00
	OTHER:				
	MOBILIZATION (10%)				$5,858.10
	EROSION CONTROL (5%)				$2,929.05
	TRAFFIC CONTROL (5%)				$2,929.05
	CONTINGENCIES (30%)				$17,574.30
	SubTotal				$29,290.50
	TOTAL				$87,871.50
	TOTAL ESTIMATE			SAY	$90,000.00

Notes:

1. This estimate is based on a Concept Plan which shows only approximate existing conditions that are not from instrument field survey. Proposed conditions are based on limited engineering and are conceptual in nature. The Concept Plan is not for construction; it was prepared for conveying feasible improvement options in a general way. The total estimate is therefore approximate and suitable only for general planning purposes. The quantities and corresponding costs could vary significantly upon completion of a field survey base plan and preliminary designs.

2. The Glidden Road estimate provided above generally includes the approximate cost for pavement markings and overhead / advanced warning signage. It has been assumed that no pavement widening is required to implement this concept. This is based on minimal technical information and is therefore subject to significant change during design. Unit prices are based on FY 2007 weighted average bid prices published by NHDOT. Additional items such as mobilization, erosion control, drainge and traffic control are approximated through typical %.

3. The price for advanced warning signage indicated above assumes standard NHDOT signs.

APPENDIX H: Lake Street – Safety Improvements Cost Estimate

Lake Street - Estimate of Quantities

Item No.	Description	Unit	Estimated Total	Unit Price	Total
	PAVEMENT				
203.3	UNCLASSIFIED EXCAVATION - 30"	CY	170	$10.00	$1,700.00
304.1	SAND (F) - 8"	CY	50	$22.00	$1,100.00
304.2	GRAVEL (F) - 8"	CY	50	$23.00	$1,150.00
304.3	CRUSHED GRAVEL (F) - 8"	CY	50	$26.00	$1,300.00
403.11	HOT BITUMINOUS PAVEMENT, MACHINE METHOD	TON	70	$60.00	$4,200.00
628.20	SAWCUT	LF	380	$2.00	$760.00
632.0104	RETROREFLECTIVE PAINT PAVE. MARKING, 4" LINE	LF	550	$0.50	$275.00
632.0112	RETROREFLECTIVE PAINT PAVE. MARKING, 12" LINE	LF	70	$1.00	$70.00
632.0124	RETROREFLECTIVE PAINT PAVE. MARKING, 24" LINE	LF	350	$1.50	$525.00
	DUROTHERM INLAID PATTERNS	SF	1350	$12.00	$16,200.00
	SIDEWALK				
203.3	UNCLASSIFIED EXCAVATION - 10"	CY	305	$10.00	$3,049.38
209.1	GRANULAR BACKFILL - 6"	CY	230	$30.00	$6,900.00
608.24	4" CONCRETE SIDEWALK (F)	SY	1100	$50.00	$55,000.00
609.01	STRAIGHT GRANITE CURB	LF	2030	$20.00	$40,600.00
	GRASS STRIP				
203.3	UNCLASSIFIED EXCAVATION - 4"	CY	110	$10.00	$1,100.00
641.	LOAM - 4"	CY	125	$30.00	$3,752.41
644.15000	PARK SEED TYPE 15	LB	25	$40.00	$1,000.00
	RETAINING WALL				
670.	PRECAST CONCRETE SEGMENTAL RETAINING WALL	SF	2000	$30.00	$60,000.00
203.3	UNCLASSIFIED EXCAVATION	CY	200	$10.00	$2,000.00

Lake Street - Estimate of Quantities

Item No.	Description	Unit	Estimated Total	Unit Price	Total
	MISC.				
	COUNTDOWN PEDESTRIAN SIGNALS	EA	2	$20,000.00	$40,000.00
	SubTotal				$240,681.79
	OTHER:				
	MOBILIZATION (10%)				$24,068.18
	EROSION CONTROL (5%)				$12,034.09
	TRAFFIC CONTROL (5%)				$12,034.09
	DRAINAGE AND UTILITIES (30%)				$72,204.54
	CONTINGENCIES (30%)				$72,204.54
	SubTotal				$192,545.43
	TOTAL				$433,227.22
	TOTAL ESTIMATE			SAY	$435,000.00

Notes:

1. This estimate is based on a Concept Plan which shows only approximate existing conditions that are not from instrument field survey. Proposed conditions are based on limited engineering and are conceptual in nature. The Concept Plan is not for construction; it was prepared for conveying feasible improvement options in a general way. The total estimate is therefore approximate and suitable only for general planning purposes. The quantities and corresponding costs could vary significantly upon completion of a field survey base plan and preliminary designs.

2. The Lake Street estimate provided above generally includes the approximate cost for sidewalks, pavement widening and markings, and grass landscaping areas. Quantities for retaining walls are based on minimal technical information and are therefore are subject to substantial change during design. The potential cost impacts due to Right of Way issues can not be determined at this time. Unit prices are based on FY 2007 weighted average bid prices published by NHDOT. Additional items such as mobilization, erosion control, drainge and traffic control are

APPENDIX I: Sheridan Road – Safety Improvements Cost Estimate

Page 1 of 2

Sheridan Road - Estimate of Quantities

Item No.	Description	Unit	Estimated Total	Unit Price	Total
	PAVEMENT				
203.3	UNCLASSIFIED EXCAVATION - 30"	CY	250	$10.00	$2,500.00
304.1	SAND (F) - 8"	CY	65	$22.00	$1,430.00
304.2	GRAVEL (F) - 8"	CY	65	$23.00	$1,495.00
304.3	CRUSHED GRAVEL (F) - 8"	CY	65	$26.00	$1,690.00
403.11	HOT BITUMINOUS PAVEMENT, MACHINE METHOD	TON	100	$60.00	$6,000.00
628.2	SAWCUT	LF	1020	$2.00	$2,040.00
632.0104	RETROREFLECTIVE PAINT PAVE. MARKING, 4" LINE	LF	3220	$0.50	$1,610.00
670.	ADVANCED WARNING SIGN	EA	2	$2,000.00	$4,000.00
	OVERHEAD SIGN WITH POST	U	1	$50,000.00	$50,000.00
	EARTH WORK				
203.1	COMMON EXCAVATION	CY	950	$5.00	$4,750.00
203.6	EMBANKMENT-IN-PLACE (F)	CY	1000	$7.00	$7,000.00
	DRAINAGE				
	HEADWALLS	EA	2	$3,000.00	$6,000.00
585.3	STONE FILL, CLASS C	CY	130	$47.00	$6,092.59
593.411	GEOTEXTILE: PERM. EROSION CONTR. CLASS 1, NONWOVEN	SY	350	$3.00	$1,050.00
603.00212	12" R.C. PIPE, 2000D	LF	25	$40.00	$1,000.00
	GUARD RAIL				
606.140	BEAM GUARDRAIL (STANDARD SECTION- WOOD POSTS)	LF	200	$20.00	$4,000.00
606.147	BEAM GUARDRAIL (TERMINAL UNIT TYPE G-2)	U	2	$550.00	$1,100.00
	SubTotal				$101,757.59
	OTHER:				
	MOBILIZATION (10%)				$10,175.76
	EROSION CONTROL (5%)				$5,087.88
	TRAFFIC CONTROL (5%)				$5,087.88
	CONTINGENCIES (30%)				$30,527.28

Sheridan Road - Estimate of Quantities

Item No.	Description	Unit	Estimated Total	Unit Price	Total
	SubTotal				$50,878.80
	TOTAL				$152,636.39
	TOTAL ESTIMATE			SAY	$150,000.00

Notes:

1. This estimate is based on a Concept Plan which shows only approximate existing conditions that are not from instrument field survey. Proposed conditions are based on limited engineering and are conceptual in nature. The Concept Plan is not for construction; it was prepared for conveying feasible improvement options in a general way. The total estimate is therefore approximate and suitable only for general planning purposes. The quantities and corresponding costs could vary significantly upon completion of a field survey base plan and preliminary designs.

2. The Sheridan Road estimate provided above generally includes the approximate cost for pavement widening, markings and overhead / advanced warning signage. The amount of pavement widening as well as the length/height of embankment required to implement this concept has been approximated. This is based on minimal technical information and is therefore subject to significant change during design. The potential cost impacts for Right of Way issues can not be determined at this time. Unit prices are based on FY 2007 weighted average bid prices published by NHDOT. Additional items such as mobilization, erosion control, and traffic control are approximated through typical %.

3. The price for advanced warning signage indicated above assumes standard NHDOT signs. The cost for vehicle-actuated advanced warning system has not been included. The cost to install such a system would be on the order of an additional $50,000.

APPENDIX J: Redding Lane - Safety Improvements Cost Estimate

Redding Lane - Estimate of Quantities

Item No.	Description	Unit	Estimated Total	Unit Price	Total
	PAVEMENT				
203.3	UNCLASSIFIED EXCAVATION - 30"	CY	300	$10.00	$3,000.00
304.1	SAND (F) - 8"	CY	80	$22.00	$1,760.00
304.2	GRAVEL (F) - 8"	CY	80	$23.00	$1,840.00
304.3	CRUSHED GRAVEL (F) - 8"	CY	80	$26.00	$2,080.00
403.11	HOT BITUMINOUS PAVEMENT, MACHINE METHOD	TON	120	$60.00	$7,200.00
628.2	SAWCUT	LF	650	$2.00	$1,300.00
632.0104	RETROREFLECTIVE PAINT PAVE. MARKING, 4" LINE	LF	3700	$0.50	$1,850.00
632.02	RETROREFLECTIVE PAINT PAVEMENT MARKING, SYMBOL OR W	SF	60	$1.35	$81.00
	MISC.				
670.	ADVANCED WARNING SIGN	EA	2	$2,000.00	$4,000.00
	OVERHEAD SIGN WITH POST	U	1	$50,000.00	$50,000.00
	EARTH WORK				
203.1	COMMON EXCAVATION	CY	850	$5.00	$4,250.00
	SubTotal				**$77,361.00**
	OTHER:				
	MOBILIZATION (10%)				$7,736.10
	EROSION CONTROL (5%)				$3,868.05
	DRAINAGE (15%)				$11,604.15
	TRAFFIC CONTROL (5%)				$3,868.05
	CONTINGENCIES (30%)				$23,208.30
	SubTotal				**$50,284.65**
	TOTAL				**$127,645.65**
	TOTAL ESTIMATE			SAY	**$130,000.00**

Notes:

1. This estimate is based on a Concept Plan which shows only approximate existing conditions that are not from instrument field survey. Proposed conditions are based on limited engineering and are conceptual in nature. The Concept Plan is not for construction; it was prepared for conveying feasible improvement options in a general way. The total estimate is therefore approximate and suitable only for general planning purposes. The quantities and corresponding costs could vary significantly upon completion of a field survey base plan and preliminary designs.

2. The Redding Lane estimate provided above generally includes the approximate cost for pavement widening, markings and overhead / advanced warning signage. The amount of pavement widening required to implement this concept has been approximated. This is based on minimal technical information and is therefore subject to significant change during design. Unit prices are based on FY 2007 weighted average bid prices published by NHDOT. Additional items such as mobilization, erosion control, drainage and traffic control are approximated through typical %.

3. The price for advanced warning signage indicated above assumes standard NHDOT signs.

APPENDIX K: Site Plan Checklist for Access Management

Site Plan Review Checklist: Route 11 Corridor

Item	YES	NO
Vehicle Access		
Access Points ▪ Corresponds to minimum driveway spacing requirements determined by speed limit		
▪ One driveway maximum; two for special circumstances		
▪ Shows access points on both sides of road (where applicable).		
▪ Consolidates driveways when adjacent to existing development and anticipates future shared driveway (near lot line).		
Double-frontage lots (lots that front two roadways/corner lots) ▪ Access is to be provided at the lower functionally classified roadway		
Shared Driveways ▪ May be required for existing driveways during site redevelopment		
▪ Required where feasible in new development		
Inter-parcel Connections ▪ Cross-easement required and recorded for vehicle and pedestrian circulation with the Corridor Overlay District		
Driveway Spacing ▪ Meets driveway spacing requirements of Corridor Overlay District		
Sight Distance ▪ Meets sight distance requirements		
Corner Clearance ▪ Meets corner clearance requirements of Corridor Overlay District		
Dimensional Requirements ▪ Meets minimum frontage requirements for new parcels		
▪ Meets intersection off-set requirements of the Corridor Overlay District		
▪ Meets intersection throat length/distance requirements of the Corridor Overlay District		
▪ Adequate driveway width provided		
▪ Maximum driveway width not exceeded		
▪ Adequate number of Entry & Exit Lanes (Left/Right/Through)		
▪ Adequate entering and exiting curb radii provided at driveways		
▪ Driveway Grade Change: Maximum 5%; 3% recommended		
▪ Proposed driveways align opposite existing driveways across Route 11, where feasible		
Parking Lot Layout ▪ Adequate on-site circulation provided in conjunction with driveway throat length to prevent entering vehicles backing up into arterial/collectors		
▪ Provides for inter-connected parking lots to existing adjacent development		
▪ Shared parking is implemented		
▪ Meets Design Guidelines established for zoning districts abutting Route 11		
Other Site Design Elements ▪ Meets signage guidelines		
▪ Landscaping provides buffering of parking areas from Route 11		
▪ Plan provides adequate Pedestrian Circulation/Connectivity		
▪ Incorporates Frontage/Backage or Service Roads as specified in Site Master Plans		
▪ Site Plan shows parcel lines for adjoining properties		
Planning Data ▪ Trip Generation Data		
▪ Parking and internal circulation plans		
▪ Plan shows speed Limits for all roadway frontage		

APPENDIX L: Sample Memorandum of Understanding

MEMORANDUM OF UNDERSTANDING

FOR

COORDINATING HIGHWAY ACCESS MANAGEMENT

BETWEEN

NEW HAMPSHIRE, DEPARTMENT OF TRANSPORTATION

AND

CITY/TOWN OF ________________________

This Memorandum of Understanding is made between the State of New Hampshire, Department of Transportation (hereinafter referred to as "DEPARTMENT") and the Town (or City) of _________________ (hereinafter referred to as "TOWN" (or "CITY") and entered into on ______________.

The Parties to this Understanding witness that:

WHEREAS, the DEPARTMENT has the statutory responsibility and permitting authority, under RSA 236, to issue driveway access permits on state highways; and

WHEREAS, the TOWN, has the statutory authority, pursuant to RSA 237:13, V, for highways under their jurisdiction to issue driveway and access permits, where the Planning Board regulates the subdivision of land under RSA 674:34; additionally under RSA 674, the Town may regulate the use and site development of property adjoining the highway; and

WHEREAS, the DEPARTMENT and the TOWN mutually recognize the continuing necessity to plan and coordinate future land use and access to highways, in order to preserve highway capacity and public safety; and

WHEREAS the DEPARTMENT and the TOWN mutually recognize and agree that preserving the safety and maximizing the capacity of state highways is in the public interest,

THEREFORE, BE IT RESOLVED, that the following provisions of this Memorandum of Understanding are agreeable to all parties.

Article I: Statement of Purpose

The DEPARTMENT and CITY/TOWN enter into this Understanding to improve access management of state highways within its boundaries. For the purposes of this Understanding, access management shall include coordination in the planning, design, control, and determination of access points to facilities, and in the issuance of driveway access permits.

Article II: Scope of Understanding

The provisions of this Understanding shall apply to all state highways or segments of state highways located within the CITY/TOWN as identified in CITY/TOWN access management plan and agreed upon by the CITY/TOWN and the DEPARTMENT (list of highways follows):

____

____

____

Article III: Joint Responsibilities

1. It shall be the joint responsibilities of the DEPARTMENT and the CITY/TOWN to develop and adopt agreed upon procedures for the coordination between site plan approvals and driveway access permits.

2. The CITY/TOWN and the DEPARTMENT may establish Access Management Technical Guidance Committee for the purpose of coordinating the concurrent review of site plans and driveway access permit applications to ensure their conformance with state and local access management plans and/or standards.

Article IV: Responsibilities of the CITY/TOWN

1. Access management standards developed, adopted, and/or enforced by a CITY/TOWN shall not conflict with best practices for access management where a state highway is involved. These standards may take the form of zoning ordinances, site plan review, subdivision regulations and requirements, roadway construction standards, or a combination of these, and shall be applied to all future development and redevelopment of land accessing state highways. Such standards shall be developed in constitution with the DEPARTMENT and Regional Planning Commissions. Copies of all such standards and subsequent amendments thereto, shall be provided to the DEPARTMENT to be kept on file at the Central and District Offices.

2. Where appropriate and necessary as determined by the Town, the Town may develop, in cooperation or consultation with the DEPARTMENT, adopt, and amend site or parcel-specific access management plans for specific highway corridors or segments. Such plans shall define the number, as well as general location and design, of future access locations to be permitted on specific parcels or sites. The plans and any subsequent amendments thereto, shall be forwarded to the DEPARTMENT to be kept on file at the Central and District Offices. The number, location, and design of access points shall be consistent with the Department's "Policy for the Permitting of Driveways and Other Accesses to the State Highway System."

3. In the event that waivers or variances to the adopted access management standards or plans are proposed, the Town shall inform the DEPARTMENT of such waivers or variances prior to local approval of the plans. Notice will be made prior to the issuance of the local approval and with sufficient time to allow for comment from and consultation with the DEPARTMENT.

4. The CITY/TOWN shall notify the DEPARTMENT District Engineer upon receipt of any development proposal or change of use that will require a state driveway access permit and solicit input regarding access design.

5. The CITY/TOWN shall require that driveway access(es), including type, design, number, and location, be permitted only in accordance with its adopted access management standards and any applicable site-specific plans.

6. The CITY/TOWN shall coordinate and cooperate with the DEPARTMENT throughout the development/driveway permitting process (including approval of access development), as described in the procedures set forth in Article III Section 1.

Article V: Responsibilities of the DEPARTMENT

1. The DEPARTMENT'S Design Bureaus and District Engineer will provide information, technical assistance, and advice to the CITY/TOWN in the development of local access management standards and site or parcel level access management plans.

2. The DEPARTMENT District Engineer shall notify the CITY/TOWN designee upon receipt of any application for driveway access permits and scheduled scoping meetings by transmitting a copy of such application or meeting notice, along with a request for comments. On DEPARTMENT sponsored projects, the DEPARTMENT'S Project Manager will bear the responsibility to notify the CITY/TOWN of the DEPARTMENT'S intentions.

3. The DEPARTMENT District Engineer shall coordinate and cooperate with the CITY/TOWN throughout the development/driveway permitting process (including issuance of driveway permits), as described in the procedures set forth in Article III Section 1.

Article VI: Effective Date and Amendments to Memorandum of Understanding

1. This Understanding shall become effective upon execution by the DEPARTMENT and the CITY/TOWN and shall remain in force until terminated under provisions of Article VII, or until superseded by a new Understanding.

2. This Understanding may be amended as facts or circumstances warrant or as may be required by state or federal laws, administrative regulations, or other orders or guidelines having the full force and effect of the law.

Article VII: Termination of Understanding

The DEPARTMENT or CITY/TOWN may terminate this Understanding by giving ninety (90)-day written notice of such termination to the other party.

IN WITNESS WHEREOF, the parties have hereto caused this Understanding to be executed by their proper officers and representatives.

FOR THE CITY/TOWN OF ______________________________:

by____ **Date**____________________
Planning Board Chairman

by____ **Date**____________________
Board of Selectmen Chairman /Mayor

FOR STATE OF NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION:

By____ **Date**____________________
District Engineer

By____ **Date**____________________
Commissioner