T6640.8A (October 30, 1987) further directs assessment of impacts on farmlands as part of the NEPA process for all transportation projects.

The majority of the footprints for Build Alternatives A, B, C, D, and F are located almost entirely within Urbanized Areas as defined by the U.S. Census Bureau. The only Build Alternatives that include areas outside designated Urban Areas are Alternatives C and D. These two alternatives have a small portion of NH 28 in Londonderry, located outside the Urban Area, but are also not in proximity to any Prime or Unique Farmlands or Farmlands of Statewide or Local Importance. All other portions of the Build Alternatives would be within mapped Urban Areas. Those farmland areas that are within these Urbanized Areas are not protected under the FPPA. Therefore, no farmland impacts would be anticipated as a result of implementing any of the Build Alternatives. A copy of the completed Farmland Conversion Impact Rating Form AD 1006 is provided in Appendix A, *Agency Correspondence*. NRCS responded on February 27, 2006, and determined that no further action will be required under the FPPA regardless of the Build Alternative selected.

Additional coordination with NRCS was undertaken in July 2018. The farmland conversion impact rating for corridor type projects was updated for each Build Alternative, and the relative value of each alternative corridor is 34 or less. Also, because the preferred alternative does not include any land that is prime, statewide, or locally important farmland, it is not subject to the FPPA.

4.1.2 Study Area

The study area defined for the initial screening of alternatives encompassed about 26 square miles within western portions of Derry and eastern Londonderry in western Rockingham County, NH (Figure 4.1-1). A large study area was necessary at that stage of the Project to consider a wide range of potential alternatives for meeting the Project purpose and need. The 26-square-mile study area was also used for the 2007 DEIS and concurred with by federal and state regulatory/resource agencies at an agency Scoping Meeting on July 30, 1998. For this FEIS, the study area for each resource was redefined to focus data collection and reporting on existing conditions to the area where there is the potential for direct impacts from the Build Alternatives (A, B, C, D, and F). The rationale for each of the updated resource study areas is described in the appropriate resource sections. Finally, a larger, five-town study area is used to identify potential indirect effects and cumulative impacts related to the Project (see Chapter 5).[8]

4.2 Traffic and Transportation

4.2.1 Affected Environment

Existing Access to Interstate 93

I-93 is a north-south highway, which connects Interstate 91 near St. Johnsbury, Vermont, to Interstate 95 in Canton, Massachusetts, and it is a major link in the Interstate system and an important part of the National Highway System. The highway passes through the Towns, nearly

[8] The limits of the economic study area were agreed upon in consultation with state and federal agency staff at a meeting held on August 25, 2005. Given that there are no major changes in the basic alignment of the alternatives under consideration since the 2007 DEIS, the previously agreed on study area remains reasonable for this FEIS.

bisecting the study area. Primary access to the Towns is via NH 102 (Exit 4) and NH 28 (Exit 5), both located in Londonderry and approximately 3.6 miles apart.

The Exit 4 interchange provides full directional access between I-93 and NH 102. To the east and west of the interchange, NH 102 provides access to the central business districts of Derry and Londonderry, respectively. To the west in Londonderry, NH 102 intersects NH 128, a two-lane, north-south highway, approximately two miles west of I-93, near the western boundary of the study area. To the east, in Derry, NH 102 intersects NH 28, a two- to four-lane, north-south highway approximately 1.1 miles east of I-93 and NH 28 Bypass, a two-lane, north-south highway, at the Derry Traffic Circle 2.1 miles east of I-93.

The Exit 5 interchange provides full directional access between I-93 and NH 28, and is located approximately 3.6 miles north of Exit 4. To the west in Londonderry, NH 28 intersects NH 128 1.3 miles west of I-93. To the east and south, NH 28 passes through the intersection with Folsom Road and Tsienneto Road (known locally as Ross' Corner), three miles south of Exit 5, and crosses NH 102 in downtown Derry.

Figure 4.2-1 shows the I-93 Exit 4 and Exit 5 interchanges.

Existing Roadway Network

I-93, as noted above, is a north-south oriented, full access control roadway. It has a posted speed limit of 65 miles per hour (mph) through the study area and four travel lanes, two in each direction. The average daily traffic (ADT) in 2015 was approximately 35,000 vehicles in each direction or 71,000 total vehicles per day, and NHDOT functionally classifies it as a principal arterial, Interstate (NHDOT, 2016a; 2017a). Two interchanges exist in the study area serving NH 102 (Exit 4) and NH 28 (Exit 5).

NHDOT is in the process of upgrading I-93 from four to eight lanes between Salem, New Hampshire, at the Massachusetts border and Manchester, New Hampshire, ending at Exit 6 at the I-293 interchange, more than 3 miles north of Exit 5. Exit 5 reconstruction was completed in 2014. Exit 4 reconstruction is currently ongoing with anticipated completion in fall 2020 (NHDOT, 2017b). Widening the I-93 mainline to six lanes is currently ongoing between Exits 4 and 5 with anticipated completion in fall 2019. Final construction of the fourth lane in each direction (eight lanes total) will be achieved with a separate project in the NHDOT Ten-Year Plan with anticipated completion in fall 2020 (NHDOT, 2017b). The No Build and all Build Alternatives under study for the Exit 4A Project assume completion of the I-93 widening project.

NH 102, also known as Nashua Road in Londonderry and Broadway in Derry, is a northeast-southwest oriented roadway with partial access control west of I-93 and no access control east of I-93 connecting Nashua to Chester, New Hampshire. It has a posted speed limit of 30 mph through the study area and has four travel lanes, two in each direction from the I-93 interchange and west. To the east, it has two travel lanes, one in each direction. The ADT in 2014 was approximately 18,000 total vehicles per day, and NHDOT functionally classifies it as an urban principal arterial—other (NHDOT, 2016c; 2017a). The roadway travels through a more urban environment to the east of I-93, extending through downtown Derry.

NH 28 is a north-south oriented roadway connecting Massachusetts to Manchester, New Hampshire with partial access control in the vicinity of the Exit 5 interchange. It has a posted speed limit of 30 mph through the study area. There are four travel lanes in the vicinity of the I-93 Exit 5 interchange (two lanes in each direction). To the south, it has two travel lanes, one in

each direction, with the exception of a section from Ashleigh Drive to Ross' Corner within which there are four lanes. The ADT in 2014 was approximately 16,000 total vehicles per day, and NHDOT functionally classifies it as an urban minor arterial (NHDOT, 2016b; 2017a).

NH 28 Bypass is a north-south route that enters Derry to the north from Auburn and terminates at its junction with NH 28. This roadway is classified as a minor arterial. The Average Annual Weekday Traffic (AAWDT) in 2016 was approximately 12,250 total vehicles per day, and NHDOT functionally classifies it as a minor arterial (NHDOT, 2017a).

Tsienneto Road is an east-west road that travels through Derry to the north of NH 102 between NH 28 and NH 102 crossing NH 28 Bypass. It has a posted speed limit of 30 mph. The section west of NH 28 Bypass is a three-lane roadway, and the section east of NH 28 Bypass is a two-lane roadway. The AAWDT in 2016 was approximately 15,585 total vehicles per day, and NHDOT functionally classifies it as a minor arterial (NHDOT, 2017a).

Folsom Road is an east-west two-lane road that travels through Derry to the north of NH 102 between NH 28 and Madden Road. It has a posted speed limit of 30 mph. The AAWDT in 2016 was approximately 12,070 total vehicles per day, and NHDOT functionally classifies it as a collector (NHDOT, 2017a).

Ross' Corner is a major intersection of five roadways in northwestern Derry. The roadways are NH 28 (known as Crystal Avenue to the south and Manchester Road to the north), Tsienneto Road from the east, Folsom Road from the west, and Pinkerton Street from the southeast. Minor intersection and signal modifications to Ross' Corner were completed in 1999.

Pinkerton Street is an east-west two-lane road that travels through Derry between Tsienneto and NH 28 Bypass. It has a posted speed limit of 30 mph. The AAWDT in 2016 was approximately 10,722 total vehicles per day, and NHDOT functionally classifies it as a minor arterial (NHDOT, 2017a).

Londonderry Road is a north-south two-lane local road in Londonderry that travels between NH 102 and Ash Street. It has a posted speed limit of 35 mph.

Franklin Street is a north-south local road in western Derry that serves residences and some businesses. It connects NH 102 in downtown Derry to Folsom Road. An extension of Franklin Street (known as Franklin Street Extension) extends to the north of Folsom Road and connects to B Street. It carries a low amount of traffic (<2,000 vehicles per day).

Linlew Drive is an east-west local two-lane road in Derry that connects NH 28 to NH 28 Bypass. It has a posted speed limit of 30 mph.

Ashleigh Drive is a road that leads to a cul-de-sac in Derry from an intersection with NH 28. Because this road could become part of the proposed alternatives, it is included in this study.

Multimodal Transportation Facilities

Transit Services and Park and Rides

In the study area, there are three bus routes and two park-and-ride lots serviced by the buses. Bus operations include Boston Express, Concord Coach Lines, and Cooperative Alliance for Regional Transportation.

Boston Express operates express bus service between Concord, New Hampshire, and Boston, Massachusetts. Two bus stops in the study area are North Londonderry, located in the Exit 5 park and ride lot, off NH 28 and Londonderry at Exit 4, located in the park and ride lot, off NH 102. Buses either service one stop, then express to Boston during the AM peak period, but stop at both Londonderry stops on the return trip. A total of nine inbound buses operate during the AM peak period (6:00 a.m.–9:00 a.m.) from either stop, and 12 buses operate in the return direction during the PM peak period (4:00 p.m.–7:00 p.m.) (Boston Express, 2016).

Concord Coach Lines operates express bus service between northern New Hampshire and Boston, Massachusetts. One bus stop in the study area is North Londonderry at Exit 5, located in the park and ride lot, off NH 28. A total of six southbound buses operate over the course of the day, and five northbound buses operate during the course of the day (Concord Coach Lines, 2017).

Cooperative Alliance for Regional Transportation is a specialty shuttle service that serves the study area by providing on-call rides and scheduled local shuttle routes to shopping and medical services. The routes can include deviations to accommodate patron requests (CART, n.d.). The shuttle service also serves the two park and rides located near I-93 at Exit 4 in Londonderry and Exit 5 in North Londonderry. Both are served by buses.

Londonderry Exit 4 Park and Ride is operated by Boston Express, and Boston Express is the only bus that services the facility. It contains 452 parking spaces and provides a bus shelter and bicycle rack (NHGov, 2017a).

North Londonderry Park and Ride is operated by Boston Express and is served by Boston Express and Concord Coach Lines. It contains 728 parking spaces and provides a bus shelter and bicycle rack (NHGov, 2017b).

New Hampshire does not have a high occupancy vehicle lane in the state.

Rail Service

The former Manchester & Lawrence (M&L) Railroad line, which passes between Manchester, New Hampshire, and Lawrence, Massachusetts through Salem, Windham, Derry, and Londonderry, has been discontinued and abandoned. Limited freight service previously available along the line between Salem and Lawrence was discontinued circa 1999. Within its town limits, Derry owns the M&L ROW, affording opportunities for use as a recreational trail. NHDOT also holds an easement that prevents any development within 30 feet of the former railroad ROW.

In Londonderry, NHDOT owns most of the M&L ROW. A section near the Londonderry/Derry town line is privately owned. Also, for its expansion, the Manchester-Boston Regional Airport purchased a section of the M&L ROW from the Boston & Maine Railroad line.

Bicycle and Pedestrian Facilities

With the abandonment of local rail lines and recent increased interest in outdoor recreational activities, state, regional, and local agencies have been actively pursuing the development of recreational trails in the region to encourage alternative modes of transportation and to provide corridors for recreation. This is evident within the study area, and several of these efforts are described in the following sections.

Planning Efforts

NHDOT developed the NH Statewide Bicycle and Pedestrian Plan in 1995 (updated in 2000) (NHDOT, 2000) as an element of the state's long-range statewide transportation plan. This plan outlined specific bicycle/pedestrian-related goals and objectives for the state and established planning and design criteria for bicycle facilities. NHDOT has also prepared regional bicycle maps showing bike routes within the state.

The NH State Trails Plan (Rizzo Associates, 2005) identified abandoned railroad corridors and other facilities that could be used for bicycle and pedestrian paths. The Plan also provides guidelines for developing trails. This Plan and the Salem to Concord Bikeway Feasibility Study (Rizzo Associates, 2003) identify the former M&L rail bed as a likely trail through the region.

The Town of Derry also produced a plan for bikeways and paths. With funds available through the Federal Intermodal Surface Transportation Efficiency Act and Transportation Equity Act for the 21st Century, the planned facilities would link various sections of town and promote safe passage of persons using these facilities.

Londonderry's Master Plan indicates that trail systems are needed for recreation and educational purposes. The Town has identified this issue as a "priority recreation resource." Londonderry is connected to the statewide network of bicycle trails created in the above-mentioned SNHPC master plan.

Local Recreational Trails/Paths

Bicycle and multi-use trails within the study area are discussed in Section 4.19 and include the following:

- Old Trolley Line Trail
- Londonderry Rail Trail
- Rail Trail Path
- Derry Rail Trail
- Derry Bicycle Path
- Rider Fields Trail

Airports

The Manchester-Boston Regional Airport, located outside and northwest of the study area, influences the transportation infrastructure of the study area, as its social and economic implications are felt on a regional scale. The Airport provides passenger and freight services and is vital to the NH economy. It attracts passengers from Maine, Vermont, and Massachusetts, in addition to NH. No other airports are located in the immediate vicinity of the study area.

Traffic Data

The study area for the Project was established and agreed upon during development of the 2007 DEIS and encompasses the expected extent of the roadway network that would likely be influenced by the introduction of a new I-93 interchange and associated connector roadways. An

updated inventory of the key area roadways and intersections was conducted to ensure that the traffic modeling and subsequent analyses reflect existing conditions.

The various contracts for the I-93 widening project affecting the study area also needed to be considered. The Exit 5 improvements are already in place, and the Exit 4 interchange is being reconstructed now as part of Contract 14633-D. The widening of the mainline I-93 to four lanes between Exits 4 and 5 will also be completed as part of this existing contract.

Traffic Counts

As discussed in Appendix C, *Traffic Technical Report*, the traffic counting program was developed for the Project, based on the key roadway segments and intersections in the study area, to assist in the development of 2015 base AAWDT volumes for use in the traffic model calibration. Most of these locations were counted in 2005 as part of the preparation of the original 2007 DEIS document. This effort was coordinated with the annual traffic counting programs conducted by both the NHDOT and SNHPC within the study area, and the new data collected in May and June of 2016 while school was still in session. Some of these locations had already been counted in 2014 or 2015 (NHDOT, 2016a, 2016b, 2016c).

The Automatic Traffic Recorder (ATR) counts were taken for a 3- to 5-day period. An ATR is a count obtained from placing black tubes across the road that record each time two vehicle axles cross the tube. A listing of the locations is included below and shown in Figure 2 of Appendix C.

- Interstate Locations (15 ATRs):
  - A. I-93 Exit 4—NB and SB on- and off-ramps (five ramps)
  - B. I-93 Exit 5—NB and SB on- and off-ramps (four ramps)
  - C. I-93 NB and SB south of Exit 4 (two mainlines)
  - D. I-93 NB and SB between Exits 4 and 5 (two mainlines)
  - E. I-93 NB and SB north of Exit 5 (two mainlines)
- State Highways/Local Streets (21 ATRs):

1. Crystal Avenue (NH 28), south of Tsienneto Road
2. Folsom Road, west of NH 28
3. Pinkerton Street, east of Tsienneto Road
4. Tsienneto Road, west of NH 102
5. Tsienneto Road, east of Pinkerton Street
6. Chester Road (NH 102), east of NH 28 Bypass (Sylvestri Circle)
7. North Main Street (NH 28 Bypass), north of Pinkerton Street (Academy Drive)
8. North Main Street (NH 28 Bypass), north of Tsienneto Road
9. South Main Street (NH 28 Bypass), south of Thornton Street
10. NH 102, east of Griffin Street
11. NH 102, west of Abbot Street

12. Fordway, over Beaver Brook
13. Franklin Street, north of Folsom Road
14. Ash Street at Londonderry Town line
15. Crystal Avenue (NH 28), south of Rollins
16. NH 102, east of Hampton Drive
17. NH 102, at Derry Town line
18. NH 28, at Derry/Londonderry Town line
19. NH 28, north of Liberty Drive
20. Gilcreast Road, north of NH 102
21. Ash Street, east of Londonderry Road

In addition, intersection turning movement counts were obtained during AM and PM peak periods covering 19 intersections within the study area. These include the original 17 intersections from the 2007 DEIS plus two new ones to cover the east end of the study area.

Development of 2015 AAWDT Base Volumes

The primary tool used to forecast the future 2040 volumes was the SNHPC travel demand model. Prior to using the model all traffic count data must be consistent from the same base year. Because the counts were obtained from multiple years, they were adjusted to create a 2015 base year balanced network using the following three processes.

- The counts were adjusted based on the count season to allow for seasonal traffic fluctuations and represent a more typical October or April time period.
- The counts were adjusted to correct for the number of axles that triggered the counter to record a vehicle. Large trucks with more than two axles were counted as two or even three separate vehicles because the counter is programmed to record a vehicle every two axles that cross a sensor or tube.
- The counts were increased or decreased following a growth factor calculated separately for I-93 mainline and all other roadways (including the I-93 ramps). The I-93 mainline applied a 1.1 percent growth per year based on comparing multiple years of data for a counter on I-93, and all other roadways applied a 2.5 percent growth per year rate based on comparing multiple years of data for a counter on NH 28. Counts were increased or decreased by the appropriate rate depending on whether the counts were before 2015 or after 2015 (no adjustment was applied to 2015 counts).

In addition to creating the 2015 daily traffic volumes, the turning movement volumes obtained at the 19 intersections were used to develop the percentage of the daily volume equal to AM and PM peak hour volumes. The same percentage is applied to the future 2040 volumes produced by travel demand model to create 2040 peak hour volumes for each alternative. All traffic analysis required peak hour volumes to ascertain the intersection and freeway operations and queuing. Table 4.2-1 contains traffic count summary for I-93. Table 4.2-2 contains the traffic count summary for roadways serving Londonderry and Derry.

Table 4.2-1. Traffic Count Summary—Interstate 93

Location		Raw Count	Adjusted 2015 Count
		Vehicles per year (AAWDT)	
A	Exit 4 NB Off-ramp	10,249	9,993
	Exit 4 NB On-ramp	10,303	10,045
	Exit 4 SB Off-ramp	9,862	9,615
	Exit 4 SB On-ramp—EB to SB	5,310	5,177
	Exit 4 SB On-ramp—WB to SB	4,767	4,648
	Exit 4 NB Off-ramp	10,249	9,993
	Exit 4 NB On-ramp	10,303	10,045
	Exit 4 SB Off-ramp	9,862	9,615
B	Exit 5 NB Off-ramp	5,745	5,601
	Exit 5 NB On-ramp	9,580	9,341
	Exit 5 SB Off-ramp	9,520	9,282
	Exit 5 SB On-ramp	5,645	5,504
C	I-93, South of Exit 4—NB		35,578
	I-93, South of Exit 4—SB	71,000	35,574
D	I-93, between Exits 4 and 5—NB		35,578
	I-93, between Exits 4 and 5—SB	71,000	35,574
E	I-93, North of Exit 5—NB		40,250
	I-93, North of Exit 5—SB	76,000	40,889

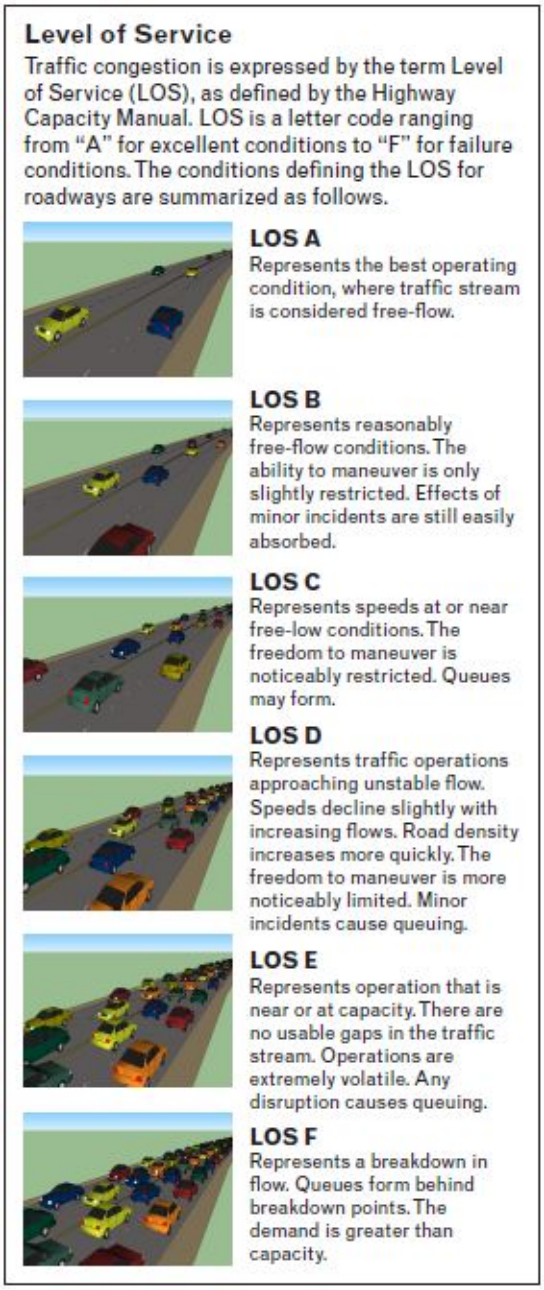
Table 4.2-2. Traffic Count Summary—Roadways serving Londonderry and Derry

	Location	Raw Count	Adjusted 2015 Count
		Vehicles per year (AAWDT)	
1	Crystal Avenue (NH 28), south of Tsienneto Road	15,585	15,195
2	Folsom Road, west of NH 28	12,070	11,768
3	Pinkerton Street, east of Tsienneto Road	10,722	10,454
4	Tsienneto Road, west of NH 102	5,532	5,394
5	Tsienneto Road, east of Pinkerton Street	15,012	14,637
6	Chester Road (NH 102), east of NH 28 Bypass (Sylvestri Circle)	7,456	7,270
7	North Main Street (NH 28 Bypass), north of Pinkerton Street (Academy Drive)	8,615	8,400
8	North Main Street (NH 28 Bypass), north of Tsienneto Road	12,250	11,944
9	South Main Street (NH 28 Bypass), south of Thornton Street	14,341	13,982
10	NH 102, east of Griffin Street	16,000	16,400
11	NH 102, west of Abbot Street	14,000	14,350
12	Fordway, over Beaver Brook	5,200	5,330
13	Franklin Street, north of Folsom Road	1,800	1,845
14	Ash Street at Londonderry Town line	6,600	6,765
15	Crystal Avenue (NH 28), S of Rollins	13,000	13,000
16	NH 102, east of Hampton Drive	32,000	32,000
17	NH 102, at Derry Town line	22,656	22,090
18	NH 28, at Derry/Londonderry Town line	17,324	16,891
19	NH 28, north of Liberty Drive	13,000	13,000
20	Gilcreast Road, north of NH 102	10,070	9,818
21	Ash Street, east of Londonderry Road	6,900	6,900

Operational and Queuing Analysis Tools

The study analyzed the study area intersections using Synchro™ Traffic Signal Coordination Software. Two analyses were performed for traffic, including an intersection capacity analysis and an intersection queueing analysis. The intersection capacity analysis used the Synchro™ software tool and various input values as described in the following sections to determine the LOS or driver perception of an intersection's operation. The intersection queuing analysis used the Synchro™ tool to determine different levels of queuing or the length that vehicles may back up at an intersection.

LOS is the primary measure of traffic operations for both signalized and unsignalized intersections. LOS is a standard performance measure developed by the transportation profession to quantify driver perception for such elements as travel time, number of stops, total amount of stopped delay, and impediments caused by other vehicles. LOS provides a scale that is intended to match motorists' perception of how a transportation facility operates and to provide a scale to compare different facilities.



Signalized Intersection Level of Service

The LOS for signalized intersections is based on the HCM 2000 method and requires inputs to determine an accurate LOS (TRB, 2000). HCM 2010 or HCM 6 methods were not followed because the signal timings and phasing were not HCM 2010/ HCM 6 compliant, for example, signal timings included pedestrian-only phases.

Primary inputs include the following: vehicular volumes, pedestrian volumes, traffic signal timings, roadway geometry, speed limits, truck percentages, and peak hour factor (the measure of vehicle 15-minute flow rate). The average vehicle control delay, measured in seconds per vehicle, is calculated using these parameters and represents the average extra delay in seconds per vehicle caused by the presence of a traffic control device or traffic signal, including the time required to decelerate, stop, and accelerate. The LOS can be characterized for the entire intersection, each intersection approach, and each lane group. Signalized intersections that exceed a delay of 55 seconds have LOS E and those with a delay of 80 seconds or more have LOS F. Table 4.2-3 shows the average control delay and corresponding LOS for signalized intersections.

Table 4.2-3. Signalized Intersection Control Delay and LOS Thresholds—HCM 2000 Method

LOS	Average Control Delay (seconds/vehicle)	Description
A	Less than or equal to 10	Stable conditions
B	>10–20	
C	>20–35	
D	>35–55	
E	>55–80	Unstable conditions
F	More than 80	Above capacity and unstable conditions

Source: TRB (2000)

To determine the LOS of an intersection, the critical input values were entered into the analysis software (Synchro™), and the average vehicle delay (seconds per vehicle) was calculated. Based on the average vehicle delay, the LOS was determined for all movements (left, through, and right), approaches, and the intersection as a whole.

Unsignalized Intersection Levels of Service

The LOS for unsignalized intersections (i.e., STOP-controlled intersections) is based on the Highway Capacity Manual 2000 method and requires the same inputs as a signalized intersection (TRB, 2000). The average vehicle control delay, in seconds per vehicle, is calculated following the Highway Capacity Manual 2000 procedures and represents the average delay caused by the presence of a stop sign and the time required to decelerate, stop, and accelerate. The LOS for a two-way, STOP-controlled (TWSC) intersection (i.e., unsignalized intersection) is determined for each minor-street movement or shared movement as well as the major-street left turns. LOS F is assigned if the movement's control delay exceeds 50 seconds. Table 4.2-4 shows the average control delay and corresponding LOS for unsignalized intersections. The worst LOS at one-way, STOP-controlled, and TWSC intersections represents the delay for the minor approach only.

Table 4.2-4. Unsignalized Intersection Control Delay and LOS Thresholds—HCM 2000 Method

LOS	Average Control Delay (seconds/vehicle)	Description
A	Less than or equal to 10	Stable conditions
B	>10-15	
C	>15-25	
D	>25-35	
E	>35-50	Unstable conditions
F	More than 50	Above capacity and unstable conditions

Source: TRB (2010)

Freeway Operations Analysis

The LOS for freeway facilities is based on the HCM 2010 method and requires inputs to determine an accurate LOS. Primary inputs include:

- vehicular volumes
- roadway geometry
- speed limits
- truck percentages
- peak hour factor

Freeway facilities are evaluated based on the density of vehicles. The higher the density the slower the vehicles travel and the worse the operations. Based on the vehicle density, the HCM provides LOS equivalents to represent the driver's perception of the facility operation. Table 4.2-5 shows the density and corresponding LOS for signalized intersections.

Table 4.2-5. HCM Freeway Facility Level of Service

LOS	Freeway Merge and Diverge Facilities Density (passenger cars/ mile/ lane)	Description
A	0-10	Passing operation
B	>10-20	
C	>20-28	
D	>28-35	
E	>35	Unstable conditions
F	Demand Exceeds Capacity	Above capacity and unstable conditions

Source: TRB (2010)

The study analyzed the I-93 freeway facilities using Highway Capacity Software (HCS) 2010. Analyses were performed for ramp merge and diverge facilities. The HCS relied on various input values to determine the LOS or driver perception of a freeway segment's operation.

Existing Conditions Traffic Analysis Results

Based on the freeway operations analysis, all facilities operate at LOS D or better in 2015 during the AM and PM peak periods. Table 4.2-6 contains the freeway operation summary and Appendix C contains the detailed assessment.

Based on the signalized intersection operations analysis, one signalized intersection operated overall at LOS F during the PM peak hour at Ross' Corner (Intersection #11). All other intersections operated overall during the AM and PM peak hour at LOS D or better.

Based on the unsignalized intersection operations analysis, seven unsignalized intersections had at least one Stop-sign controlled approach operating at LOS F. These included the following locations:

- NH 102/Londonderry Road (Intersection #5) during both peak periods
- North High Street/Ash Street Extension (Intersection #8) during the PM peak hour
- Tsienneto Road/Pinkerton Street (Intersection #12) during both peak periods
- NH 28/Scobie Pond Road (Intersection #15) during both peak periods
- NH 102/NH 28 Bypass/East Derry Road (Intersection #16) during both peak periods
- NH 28 Bypass/Pinkerton/Nesmith (Intersection #17) during both peak periods
- NH 102/Tsienneto Road (Intersection #19) during the PM peak hour

Figure 4.2-2 shows the existing conditions LOS results. Table 4.2-7 contains the intersection operations summary. More detailed operations and queueing analysis as well as an assessment of downtown Derry congestions is contained in Appendix C.

Table 4.2-6. Existing Condition Freeway Analysis

Location		Facility Type	Time Period	LOS
A	I-93 Northbound to NH 102	Diverge	AM	B
			PM	D
	NH 102 to I-93 Northbound	Merge	AM	B
			PM	C
	I-93 Southbound to NH 102	Diverge	AM	C
			PM	C
	NH 102 Westbound to I-93 Southbound	Merge	AM	B
			PM	B
	NH 102 Eastbound to I-93 Southbound	Merge	AM	C
			PM	B
B	I-93 Northbound to NH 28	Diverge	AM	C
			PM	C
	NH 28 to I-93 Northbound	Merge	AM	D
			PM	D
	I-93 Southbound to NH 28	Diverge	AM	D
			PM	D
	NH 28 to I-93 Southbound	Merge	AM	C
			PM	C
C	I-93 South of Exit 4—Northbound	Mainline	AM	B
			PM	D
	I-93 South of Exit 4—Southbound		AM	C
			PM	D

Location		Facility Type	Time Period	LOS
D	I-93 between Exits 4 and 5—Northbound	Mainline	AM	C
			PM	C
	I-93 between Exits 4 and 5—Southbound		AM	B
			PM	B
E	I-93 North of Exit 5—Northbound	Mainline	AM	C
			PM	D
	I-93 North of Exit 5—Southbound		AM	D
			PM	C

Table 4.2-7. Existing Condition Intersection Analysis

Location		AM Peak Hour		PM Peak Hour	
		Average Delay	LOS	Average Delay	LOS
1	Exit 4 SB Off-Ramp/NH 102	7.0	A	15.2	B
2	Exit 4 NB Off-Ramp/NH 102	28.4	C	25.3	C
3	Exit 5 SB Off-Ramp/NH 28	20.3	C	19.6	B
4	Exit 5 NB Off-Ramp/NH 28	14.1	B	15.1	B
5	NH 102/Londonderry Road[a]	43.0	F	79.8	F
6	NH 102/Fordway	25.7	C	33.0	C
7	NH Routes 102/28	39.9	D	39.9	D
8	North High Street/Ash Street Extension[a]	15.4	C	123.5	F
9	North High Street/Madden Road[a]	18.7	C	27.2	D
10	North High/Folsom/Franklin Streets[a]	14.2	B	23.7	C
11	Ross' Corner (Folsom/NH 28)	37.1	D	47.4	D
12	Tsienneto Road/Pinkerton Street[a]	154.3	F	282.3	F
13	NH 28/Linlew Drive	13.3	B	18.9	B
14	NH 28/Ashleigh Drive	16.9	B	24.0	C
15	NH 28/Scobie Pond Road[a]	143.2	F	[b]	F
16	NH 102/NH 28 Bypass/East Derry Road[a]	96.6	F	240.0	F
17	NH 28 Bypass/Pinkerton/Nesmith[a]	296.3	F	76.5	F
18	NH 28 Bypass/Tsienneto Road	36.5	D	35.4	D
19	NH 102/Tsienneto Road[a]	19.3	C	60.9	F

[a] Unsignalized intersections do not have an overall LOS; worst-case approach LOS reported.
[b] HCM 2000 calculation exceeds 300 seconds.

Crash Data

Crash data from the NH Department of Safety covering the last five full calendar years were obtained within the limits of the study area, bounded by I-93 to the west, NH 102 to the south, NH Routes 28 and 28 Bypass north of Tsienneto Road to the north, and the Tsienneto Road/NH 102 intersection to the east. The records were assigned to specific roadway segments or individual intersections if sufficient locational information was available. In some cases these identifiers overlapped, so the sum of the segment and intersection crashes is more than the total.

A total of 716 crashes were identified within the Project area within the five-year time span, with only one fatality (a single-car incident in 2014 on NH 102 in Londonderry). Approximately 24 percent of the crashes were injury or fatality, with just under 87 percent of these occurring on the major roadways. NH Routes 102 and 28 combined for 2/3 of the total reported crashes (48 per year) and Interstate 93 accounting for 19 percent (25 per year). On an individual basis, the traffic circle at NH 28 Bypass and NH 102 had the most reported crashes, averaging almost 5 per year. Detailed NHDOT crash data from 2010 to 2014 for roadways and major intersections in the study area is provided in Appendix C.

4.2.2 Environmental Consequences

This section compares the No Build Alternative to the five proposed Build Alternatives to assess their impacts on traffic and downtown Derry pedestrian safety. The primary tool used to evaluate the potential effects of the No Build and Build Alternatives was SNHPC's travel demand model. Appendix C, *Traffic Technical Report*, provides detailed assumptions regarding the traffic projections.

No Build Alternative

The No Build Alternative represents the future conditions in the Project design year of 2040 if all planned roadway improvements are implemented, Woodmont Commons is partially built out, and other background growth would follow the demographic projections as described in Chapter 5, *Indirect Effects and Cumulative Impacts*. I-93 Exit 4A would not occur, and downtown Derry would continue to experience traffic issues.

Table 3.6-1 in Section 3.6.1 provides a list of the projects included in the No Build Alternative. Based on Appendix C, Table 7, there would be a reduction in trips on north-south roadways such as NH 28 Bypass, NH 28, and Fordway under the No Build Alternative. The widening of I-93 to four lanes each way would provide more north-south capacity. Comparing existing traffic volumes to those anticipated under the No Build Alternative shows the following volume changes:

- Mainline volumes on I-93 would increase between 64 and 68 percent, which would result in a 2.5 percent annual growth rate.
- Ramp volumes at Exit 4 would increase between 95 and 125 percent.
- Ramp volumes at Exit 5 would grow between 45 and 50 percent.
- Volume would increase along NH 102 west of Exit 4.

Woodmont Commons would contribute to these volume increases at Exit 4, and background growth projected reflected in the demographic projections in Chapter 5 would contribute to the

growth in traffic along I-93 and surrounding roadway network. The volume changes reflect a shift from north-south roadways paralleling I-93 to I-93 and not east-west roadways serving downtown Derry and Londonderry. Under the No Build Alternative, freeway conditions would not improve at Exit 4 as the I-93 northbound on-ramp from NH 102 would continue to queue into NH 102, 13 study area intersection operations would operate under failing condition (LOS E or F), and 6 study area intersections would operate at acceptable conditions. Therefore, this alternative would have adverse impacts on the freeway operations and adverse impacts (13 failing versus 6 passing) on the study area intersections.

Figure 4.2-3 shows the No Build Alternative LOS results. The No Build intersection and freeway operations summaries are contained in the comparison tables under each alternative. Appendix C contains detailed assessments of No Build Alternative conditions.

Build Alternatives

Alternative A

Under the preferred alternative, there would be a reduction in trips on east-west roadways including NH 102 and NH 28 (Appendix C, Table 7). The creation of a new parallel route to NH 102 would create a shift in traffic patterns away from NH 102 through downtown Derry. Comparing the No Build Alternative to the preferred alternative shows the following volume changes:

- Mainline volumes on I-93 between Exits 4 and 4A would decrease an average of 3 percent and between Exits 4A and 5 would increase an average of 10 percent.
- Volumes along NH 102 east of Exit 4 would decrease by 28 percent.
- Volumes along NH 28 east of Exit 5 would decrease by 21 percent.
- Volumes would increase along NH 102 west of Exit 4.

Based on the analysis under the preferred alternative compared to the No Build Alternative, all freeway facilities would operate at LOS D or better. Ten intersections would improve from LOS E or F to LOS B through D or improve from LOS F to LOS E. Four intersections would degrade from LOS B through D to LOS E or LOS F. All new intersections and freeway facilities created under the preferred alternative would operate at LOS D or better. Figure 4.2-4 shows the preferred alternative LOS results. Table 4.2-8 provides a comparison between the No Build and the preferred alternative freeway analysis. Table 4.2-9 provides a comparison between the No Build and the preferred alternative intersection analysis. Appendix C contains the detailed freeway and intersection analysis.

Table 4.2-8. Comparison between No Build and the Preferred Alternative Freeway Analysis

Location		Facility Type	Time Period	No Build LOS	Preferred Alternative LOS
A	I-93 Northbound to NH 102	Diverge	AM	A	A
			PM	B	B
	NH 102 to I-93 Northbound	Merge	AM	C	B
			PM	C	C
	I-93 Southbound to NH 102	Diverge	AM	C	C
			PM	F	A
	NH 102 Westbound to I-93 Southbound	Merge	AM	B	B
			PM	B	A
	NH 102 Eastbound to I-93 Southbound	Merge	AM	C	C
			PM	B	B
B	I-93 Northbound to NH 28	Diverge	AM	C	C
			PM	C	D
	NH 28 to I-93 Northbound	Merge	AM	C	C
			PM	C	C
	I-93 Southbound to NH 28	Diverge	AM	D	C
			PM	D	C
	NH 28 to I-93 Southbound	Merge	AM	C	C
			PM	C	B
C	I-93 South of Exit 4—Northbound	Mainline	AM	B	B
			PM	C	C
	I-93 South of Exit 4—Southbound		AM	C	C
			PM	B	B
D	I-93 between Exits 4 and 5—Northbound	Mainline	AM	B	C[a]
			PM	C	C[a]
	I-93 between Exits 4 and 5—Southbound		AM	C	D[a]
			PM	C	D[a]
E	I-93 North of Exit 5—Northbound	Mainline	AM	C	C
			PM	C	C
	I-93 North of Exit 5—Southbound		AM	C	C
			PM	C	C

Note: Green shading represents improving from operating at a failing LOS to operating at an acceptable LOS.

[a] Represents the worst-case LOS between Exits 4 and 4A or Exits 4A and 5.

Table 4.2-9. Comparison between No Build and the Preferred Alternative Intersections Analysis

	Location	No Build		Preferred Alternative	
		AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
1	Exit 4 SB Off-Ramp/NH 102	D	F	C	**D**
2	Exit 4 NB Off-Ramp/NH 102	E	F	E	F
3	Exit 5 SB Off-Ramp/NH 28	E	C	**D**	C
4	Exit 5 NB Off-Ramp/NH 28	D	D	**E**	D
5	NH 102/Londonderry Road	B	E	B	**B**
6	NH 102/Fordway	C	D	C	D
7	NH Routes 102/28	D	D	**E**	D
8	North High Street/Ash Street Extension[a]	F	F	**C**	F
9	N High/ Madden (NB) Connector Road/ N High St (Alt A)[b]	D	F	C	**D**
10	North High/Folsom/Franklin Streets[b]	B	D	B	C
11	Ross' Corner (Folsom/NH 28)	F	E	**C**	**C**
12	Tsienneto Road/Pinkerton Street[b]	C	F	B	**B**
13	NH 28/Linlew Drive	B	B	B	C
14	NH 28/Ashleigh Drive	B	C	B	C
15	NH 28/Scobie Pond Road[a]	F	D	**B**	C
16	NH 102/NH 28 Bypass/East Derry Road[c]	D	F	**F**	**E**
17	NH 28 Bypass/Pinkerton/Nesmith[a]	A	A	**F**	**F**
18	NH 28 Bypass/Tsienneto Road	E	F	**C**	**C**
19	NH 102/Tsienneto Road[b]	C	F	A	**B**
20	Exit 4A SB off ramp/Connector Road	N/A	N/A	D	C
21	Exit 4A NB off ramp/Connector Road	N/A	N/A	C	B
27	NH 102/English Range Road[a]	N/A	N/A	C	D

Note: Green shading represents improving from operating at a failing LOS to operating at an acceptable LOS; red shading indicates moving from an acceptable LOS to a failing LOS.

[a] Unsignalized intersection do not have an overall LOS; worst-case approach LOS reported.

[b] Unsignalized intersection under No Build and signalized intersection under the preferred alternative.

[c] Roundabout analysis based on HCM 6 procedure.

The creation of a new parallel route to NH 102 in conjunction with the full build out of Woodmont Commons would substantially contribute to changes in the travel pattern and increases in overall study area volume. Based on the analysis of trip patterns from the SNHPC travel demand model, the preferred alternative would provide a more parallel route to NH 102 and bypass downtown Derry by creating a new connection between I-93 and eastern Derry. Under the preferred alternative, freeway conditions would improve at Exit 4, 11 study area intersection operations would improve, and 4 study area intersections would worsen. Therefore, this alternative would result in beneficial impacts on the freeway operations and beneficial impacts (11 improved versus 4 worsened) to the study area intersections. At least one of the intersections performing worse than the No Build Alternative would be addressed by the Woodmont Commons traffic mitigation requirements imposed by Londonderry.

Based on the Woodmont Commons Memorandum of Understanding, to "unlock" parcels within the PUD Master Plan for the developer to continue construction, the developer must submit a traffic study to the Londonderry Planning Board to ascertain the level of roadway mitigation necessary to handle the new vehicle trips generated (Pillsbury Realty Development, LLC, 2018). The assessment in this study does not include the future mitigation because the future mitigation is not known until completion of the next set of Woodmont Commons traffic studies.

Alternative B

Under Alternative B, there would be a reduction in trips on north-south roadways such as NH 28 and NH 28 Bypass (Appendix C, Table 7). The creation of a new route to northeast Derry would create a shift in traffic patterns from NH 28 Bypass to I-93 for destinations south of Derry. Comparing the No Build Alternative to Alternative B shows the following volume changes:

- Mainline volumes on I-93 between Exits 4 and 4A would decrease an average of 1 percent and between Exits 4A and 5 would increase an average of 10 percent.
- Volumes along NH 102 east of Exit 4 would decrease by 28 percent.
- Volumes along NH 28 east of Exit 5 would decrease by 35 percent.
- Volumes would increase along NH 102 west of Exit 4.

Based on the analysis under Alternative B compared to the No Build Alternative, all freeway facilities would operate at LOS D or better. Nine intersections would improve from LOS E or F to LOS B through D. Three intersections would degrade from LOS B through D to LOS F. All new intersections and freeway facilities created under Alternative B would operate at LOS D or better, except Connector Road/Tsienneto Road (Intersection #24) and NH 102/English Range Road (Intersection #27), which would operate at LOS E. Figure 4.2-5 shows the Alternative B LOS results. Table 4.2-10 provides a comparison between the No Build and Alternative B freeway analysis. Table 4.2-11 provides a comparison between the No Build and Alternative B intersection analysis. Appendix C contains the detailed freeway and intersection analysis.

Table 4.2-10. Comparison between No Build and Alternative B Freeway Analysis

Location		Facility Type	Time Period	No Build LOS	Alternative B LOS
A	I-93 Northbound to NH 102	Diverge	AM	A	A
			PM	B	B
	NH 102 to I-93 Northbound	Merge	AM	C	C
			PM	C	C
	I-93 Southbound to NH 102	Diverge	AM	C	C
			PM	F	C
	NH 102 Westbound to I-93 Southbound	Merge	AM	B	B
			PM	B	A
	NH 102 Eastbound to I-93 Southbound	Merge	AM	C	C
			PM	B	B
B	I-93 Northbound to NH 28	Diverge	AM	C	C
			PM	C	D
	NH 28 to I-93 Northbound	Merge	AM	C	C
			PM	C	C
	I-93 Southbound to NH 28	Diverge	AM	D	C
			PM	D	C
	NH 28 to I-93 Southbound	Merge	AM	C	B
			PM	C	B
C	I-93 South of Exit 4—Northbound	Mainline	AM	B	B
			PM	C	C
	I-93 South of Exit 4—Southbound		AM	C	C
			PM	B	B
D	I-93 between Exits 4 and 5—Northbound	Mainline	AM	B	C[a]
			PM	C	C[a]
	I-93 between Exits 4 and 5—Southbound		AM	C	D[a]
			PM	C	D[a]
E	I-93 North of Exit 5—Northbound	Mainline	AM	C	C
			PM	C	C
	I-93 North of Exit 5—Southbound		AM	C	C
			PM	C	C

Note: Green shading represents improving from operating at a failing LOS to operating at an acceptable LOS.

[a] Represents the worst-case LOS between Exits 4 and 4A or Exits 4A and 5.

Table 4.2-11. Comparison between No Build and Alternative B Intersections Analysis

	Location	No Build		Alternative B	
		AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
1	Exit 4 SB Off-Ramp/NH 102	D	F	C	D
2	Exit 4 NB Off-Ramp/NH 102	E	F	D	F
3	Exit 5 SB Off-Ramp/NH 28	E	C	C	B
4	Exit 5 NB Off-Ramp/NH 28	D	D	D	C
5	NH 102/Londonderry Road	B	E	A	B
6	NH 102/Fordway	C	D	C	C
7	NH Routes 102/28	D	D	D	D
8	North High Street/Ash Street Extension[a]	F	F	B	F
10	North High/Folsom/Franklin Streets[a]	B	D	B	F
11	Ross' Corner (Folsom/NH 28)	F	E	C	D
12	Tsienneto Road/Pinkerton Street[a]	C	F	F	F
13	NH 28/Linlew Drive	B	B	A	B
15	NH 28/Scobie Pond Road[a]	F	D	B	C
16	NH 102/NH 28 Bypass/East Derry Road[b]	D	F	C	C
17	NH 28 Bypass/Pinkerton/Nesmith[a]	A	A	F	F
18	NH 28 Bypass/Tsienneto Road	E	F	C	C
19	NH 102/Tsienneto Road[c]	C	F	A	B
20	Exit 4A SB off ramp/Connector Road	N/A	N/A	D	D
21	Exit 4A NB off ramp/Connector Road	N/A	N/A	C	B
22	Connector Road/NH 28	N/A	N/A	C	C
23	Connector Road/NH Bypass 28	N/A	N/A	C	B
24	Connector Road/Tsienneto Road[a]	N/A	N/A	E	A
27	NH 102/English Range Road[a]	N/A	N/A	C	E

Note: Green shading represents improving from operating at a failing LOS to operating at an acceptable LOS; red shading indicates moving from an acceptable LOS to a failing LOS.

[a] Unsignalized intersections do not have an overall LOS; worst-case approach LOS reported.

[b] Roundabout analysis based on HCM 6 procedure.

[c] Unsignalized intersection under No Build and signalized intersection under Alternative B.

The creation of a new parallel route to NH 102 in conjunction with the full build out of Woodmont Commons would contribute substantially to these volume changes. Alternative B would create a new direct connection to areas northeast of downtown Derry. Based on the travel patterns reported from the model, this new connection would attract more north-south regional trips by shifting vehicles from the NH 28 Bypass to I-93 because the travel time to access I-93 would drop with the Alternative B alignment. The trips destined to locations south of Derry and Londonderry would use I-93 rather than the NH 28 Bypass starting from the new I-93 Exit 4A interchange. The model also indicates that Alternative B would have more downtown Derry pass-through trips than the preferred alternative. A majority of the affected intersections would be a result in a shift of trip patterns to access the Alternative B alignment. Under Alternative B, freeway conditions would improve at Exit 4, the I-93 NB on-ramp from NH 102 would continue to queue into NH 102, eleven study area intersection operations would improve, and three study area intersections would worsen. Therefore, this alternative would result in beneficial impacts to the freeway operations and beneficial impacts (11 improved versus 3 worsened) to the study area intersections.

Alternative C

Under Alternative C, there would be a reduction in trips on several roadways such as NH 28 and NH 102 (Appendix C, Table 7). The creation of a new route to NH 28 would create a shift in traffic patterns from NH 28 to Exit 4A along I-93 to access destinations along NH 28 in Derry. Comparing the No Build Alternative to Alternative C shows the following volume changes:

- Mainline volumes on I-93 between Exits 4 and 4A would decrease an average of 7 percent and between Exits 4A and 5 would increase an average of 13 percent.
- Volumes along NH 102 east of Exit 4 would decrease by 24 percent.
- Volumes along NH 28 east of Exit 5 would decrease by 45 percent.

Based on the analysis under Alternative C compared to the No Build Alternative, all freeway facilities would operate at LOS D or better. Seven intersections would improve from LOS E or F to LOS B through D. Four intersections would degrade from LOS B through D to LOS E or LOS F. All new intersections and freeway facilities created under Alternative C would operate at LOS D or better, except NH 102/English Range Road (Intersection #27), which would operate at LOS E. Figure 4.2-6 shows the Alternative C LOS results. Table 4.2-12 provides a comparison between the No Build and Alternative C freeway analysis. Table 4.2-13 provides a comparison between the No Build and Alternative C intersection analysis. Appendix C contains the detailed freeway and intersection analysis.

Table 4.2-12. Comparison between No Build and Alternative C Freeway Analysis

Location		Facility Type	Time Period	No Build LOS	Alternative C LOS
A	I-93 Northbound to NH 102	Diverge	AM	A	A
			PM	B	B
	NH 102 to I-93 Northbound	Merge	AM	C	B
			PM	C	B
	I-93 Southbound to NH 102	Diverge	AM	C	C
			PM	F	C
	NH 102 Westbound to I-93 Southbound	Merge	AM	B	B
			PM	B	B
	NH 102 Eastbound to I-93 Southbound	Merge	AM	C	C
			PM	B	B
B	I-93 Northbound to NH 28	Diverge	AM	C	C
			PM	C	C
	NH 28 to I-93 Northbound	Merge	AM	C	C
			PM	C	C
	I-93 Southbound to NH 28	Diverge	AM	D	C
			PM	D	C
	NH 28 to I-93 Southbound	Merge	AM	C	C
			PM	C	C
C	I-93 South of Exit 4—Northbound	Mainline	AM	B	B
			PM	C	C
	I-93 South of Exit 4—Southbound		AM	C	C
			PM	B	B
D	I-93 between Exits 4 and 5—Northbound	Mainline	AM	B	C[a]
			PM	C	C[a]
	I-93 between Exits 4 and 5—Southbound		AM	C	C[a]
			PM	C	C[a]
E	I-93 North of Exit 5—Northbound	Mainline	AM	C	C
			PM	C	C
	I-93 North of Exit 5—Southbound		AM	C	C
			PM	C	C

Note: Green shading represents improving from operating at a failing LOS to operating at an acceptable LOS.

[a] Represents the worst-case LOS between Exits 4 and 4A or Exits 4A and 5.

Table 4.2-13. Comparison between No Build and Alternative C Intersections Analysis

	Location	No Build		Alternative C	
		AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
1	Exit 4 SB Off-Ramp/NH 102	D	F	D	E
2	Exit 4 NB Off-Ramp/NH 102	E	F	E	F
3	Exit 5 SB Off-Ramp/NH 28	E	C	C	B
4	Exit 5 NB Off-Ramp/NH 28	D	D	D	C
5	NH 102/Londonderry Road	B	E	A	B
6	NH 102/Fordway	C	D	C	C
7	NH 102/28	D	D	C	D
8	North High Street/Ash Street Extension[a]	F	F	D	F
10	North High/Folsom/Franklin Streets[a]	B	D	B	F
11	Ross' Corner (Folsom/NH 28)	F	E	C	D
12	Tsienneto Road/Pinkerton Street[a]	C	F	F	F
13	NH 28/Linlew Drive	B	B	A	B
15	NH 28/Scobie Pond Road[a]	F	D	F	F
16	NH 102/NH 28 Bypass/East Derry Road[b]	D	F	C	C
17	NH 28 Bypass/Pinkerton/Nesmith[a]	A	A	F	E
18	NH 28 Bypass/ Tsienneto Road	E	F	C	C
19	NH 102/Tsienneto Road[c]	C	F	B	B
20	Exit 4A SB off ramp/Connector Road	N/A	N/A	C	B
21	Exit 4A NB off ramp/Connector Road	N/A	N/A	A	A
22	Connector/NH 28	N/A	N/A	C	C
23	Connector Road/NH Bypass 28	N/A	N/A	C	C
24	Connector Road/Tsienneto Road[a]	N/A	N/A	A	A
25	Connector Road/NH 28	N/A	N/A	B	B
27	NH 102/English Range Road[a]	N/A	N/A	C	E

Note: Green shading represents improving from operating at a failing LOS to operating at an acceptable LOS; red shading indicates moving from an acceptable LOS to a failing LOS.

[a] Unsignalized intersections do not have an overall LOS; worst-case approach LOS reported.

[b] Roundabout analysis based on HCM 6 procedure.

[c] Unsignalized intersection under No Build and signalized intersection under Alternative C.

Alternative C provides variations to Alternatives A and B in terms of the connection route between I-93 and eastern Derry. This alternative would include a new proposed interchange in a more northern location; therefore, it would not create the best parallel route to downtown Derry. This alternative would create more of a bypass to NH 28 between I-93 Exit 5 and where NH 28 intersects the alignment, and it would attract more vehicle trips from NH 28 than NH 102 and far fewer trips to Exit 4A than Alternatives A and B. A majority of the affected intersections would be affected by a shift of trip patterns to access the Alternative C alignment. Under Alternative C, freeway conditions would improve at Exit 4, nine study area intersection operations would improve, and four study area intersections would worsen. Therefore, this alternative would result in beneficial impacts on the freeway operations and beneficial impacts (nine improved versus four worsened) on the study area intersections.

Alternative D

Under Alternative D, there would be a reduction in trips on several roadways such as NH 28 and NH 102 (Appendix C, Table 7). Similar to Alternative C, a new route to NH 28 would shift traffic patterns from NH 28 Exit 4A along I-93 to access destinations along NH 28 in Derry. Comparing the No Build Alternative to Alternative D shows the following volume changes:

- Mainline volumes on I-93 between Exits 4 and 4A would decrease an average of 9 percent and between Exits 4A and 5 would increase an average of 13 percent.
- Volumes along NH 102 east of Exit 4 would decrease by 16 percent.
- Volumes along NH 28 east of Exit 5 would decrease by 47 percent.

Based on the analysis under Alternative D compared to the No Build Alternative, all freeway facilities would operate at LOS D or better. Nine intersections would improve from LOS E or F to LOS B through D or improve from LOS F to LOS E. Two intersections would degrade from LOS B through D to LOS F. All new intersections and freeway facilities created under Alternative D would operate at LOS D or better. Figure 4.2-7 shows the Alternative D LOS results. Table 4.2-14 provides a comparison between the No Build and Alternative D freeway analysis. Table 4.2-15 provides a comparison between the No Build and Alternative D intersection analysis. Appendix C contains the detailed freeway and intersection analysis.

Table 4.2-14. Comparison between No Build and Alternative D Freeway Analysis

Location		Facility Type	Time Period	No Build LOS	Alternative D LOS
A	I-93 Northbound to NH 102	Diverge	AM	A	A
			PM	B	B
	NH 102 to I-93 Northbound	Merge	AM	C	B
			PM	C	B
	I-93 Southbound to NH 102	Diverge	AM	C	C
			PM	F	C
	NH 102 Westbound to I-93 Southbound	Merge	AM	B	B
			PM	B	B
	NH 102 Eastbound to I-93 Southbound	Merge	AM	C	C
			PM	B	B
B	I-93 Northbound to NH 28	Diverge	AM	C	C
			PM	C	D
	NH 28 to I-93 Northbound	Merge	AM	C	C
			PM	C	C
	I-93 Southbound to NH 28	Diverge	AM	D	C
			PM	D	C
	NH 28 to I-93 Southbound	Merge	AM	C	C
			PM	C	C
C	I-93 South of Exit 4—Northbound	Mainline	AM	B	B
			PM	C	C
	I-93 South of Exit 4—Southbound		AM	C	C
			PM	B	B
D	I-93 between Exits 4 and 5—Northbound	Mainline	AM	B	C[a]
			PM	C	C[a]
	I-93 between Exits 4 and 5—Southbound		AM	C	C[a]
			PM	C	C[a]
E	I-93 North of Exit 5—Northbound	Mainline	AM	C	C
			PM	C	C
	I-93 North of Exit 5—Southbound		AM	C	C
			PM	C	C

Note: Green shading represents improving from operating at a failing LOS to operating at an acceptable LOS.

[a] Represents the worst-case LOS between Exits 4 and 4A or Exits 4A and 5.

Table 4.2-15. Comparison between No Build and Alternative D Intersections Analysis

	Location	No Build		Alternative D	
		AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
1	Exit 4 SB Off-Ramp/NH 102	D	F	D	**E**
2	Exit 4 NB Off-Ramp/NH 102	E	F	E	F
3	Exit 5 SB Off-Ramp/NH 28	E	C	**C**	B
4	Exit 5 NB Off-Ramp/NH 28	D	D	D	C
5	NH 102/Londonderry Road	B	E	A	**B**
6	NH 102/Fordway	C	D	C	C
7	NH 102/28	D	D	D	D
8	North High Street/Ash Street Extension[a]	F	F	**D**	F
10	North High/Folsom/Franklin Streets[a]	B	D	B	F
11	Ross' Corner (Folsom/NH 28)	F	E	**C**	**D**
12	Tsienneto Road/Pinkerton Street[b]	C	F	C	**C**
13	NH 28/Linlew Drive	B	B	B	C
14	NH 28/Ashleigh Drive	B	C	C	C
15	NH 28/Scobie Pond Road[a]	F	D	F	**F**
16	NH 102/NH 28 Bypass/East Derry Road[c]	D	F	D	**D**
17	NH 28 Bypass/Pinkerton/Nesmith[a]	A	A	**F**	**F**
18	NH 28 Bypass/Tsienneto Road	E	F	**C**	**C**
19	NH 102/Tsienneto Road[b]	C	F	A	**C**
20	Exit 4A SB off ramp/Connector Road	N/A	N/A	B	B
21	Exit 4A NB off ramp/Connector Road	N/A	N/A	A	A
25	Connector Road/NH 28	N/A	N/A	B	B
27	NH 102/English Range Road[a]	N/A	N/A	C	D

Note: Green shading represents improving from operating at a failing LOS to operating at an acceptable LOS; red shading indicates moving from an acceptable LOS to a failing LOS.

[a] Unsignalized intersections do not have an overall LOS; worst-case approach LOS reported.

[b] Unsignalized intersection under No Build and signalized intersection under Alternative D.

[c] Roundabout analysis based on HCM 6 procedure.

Alternative D provides a variation to Alternatives A, B, and C in terms of the connection route between I-93 and eastern Derry. This alternative would include a new proposed interchange in a more northern location; therefore, it would not create the best parallel route to downtown Derry. This alternative would create more of a bypass to NH 28 between I-93 Exit 5 and where NH 28 intersects the two alignments, and it would attract more vehicle trips from NH 28 than NH 102 and far fewer trips to Exit 4A than Alternatives A and B. Under Alternative D, freeway conditions would improve at Exit 4, 10 study area intersection operations would improve, and 2 study area intersections would worsen. Therefore, this alternative would result in beneficial impacts on the freeway operations and beneficial impacts (10 improved versus 2 worsened) on the study area intersections.

Alternative F

Under Alternative F, there would be a minor change in trips on NH 28 and NH 102 (Appendix C, Table 7). Improvements to NH 102 would create a minor shift in traffic patterns throughout the study area. Comparing the No Build Alternative to Alternative F shows the following volume changes:

- Mainline volumes on I-93 between Exits 4 and 4A and between Exits 4A and 5 would not change.
- Volumes along NH 102 east of Exit 4 would increase by 10 percent.
- Volumes along NH 28 east of Exit 5 would decrease by 3 percent.

Based on the analysis under Alternative F compared to the No Build Alternative, the SB I-93 off-ramp to NH 102 would remain LOS F. Six intersections would improve from LOS E or F to LOS C through D or improve from LOS F to LOS E. Four intersections would degrade from LOS B through D to LOS E or LOS F. One intersection would improve during the AM peak hour and degrade during the PM peak hour. Figure 4.2-8 shows the Alternative F LOS results. Table 4.2-16 provides a comparison between the No Build and Alternative F freeway analysis. Table 4.2-17 provides a comparison between the No Build and Alternative F intersection analysis. Appendix C contains the detailed freeway and intersection analysis.

Table 4.2-16. Comparison between No Build and Alternative F Freeway Analysis

Location		Facility Type	Time Period	No Build LOS	Alternative F LOS
A	I-93 Northbound to NH 102	Diverge	AM	A	A
			PM	B	B
	NH 102 to I-93 Northbound	Merge	AM	C	C
			PM	C	C
	I-93 Southbound to NH 102	Diverge	AM	C	C
			PM	F	F
	NH 102 Westbound to I-93 Southbound	Merge	AM	B	B
			PM	B	B

Location		Facility Type	Time Period	No Build LOS	Alternative F LOS
	NH 102 Eastbound to I-93 Southbound	Merge	AM	C	C
			PM	B	B
B	I-93 Northbound to NH 28	Diverge	AM	C	C
			PM	C	C
	NH 28 to I-93 Northbound	Merge	AM	C	C
			PM	C	C
	I-93 Southbound to NH 28	Diverge	AM	D	C
			PM	D	C
	NH 28 to I-93 Southbound	Merge	AM	C	B
			PM	C	C
C	I-93 South of Exit 4—Northbound	Mainline	AM	B	B
			PM	C	C
	I-93 South of Exit 4—Southbound		AM	C	C
			PM	B	B
D	I-93 between Exits 4 and 5—Northbound	Mainline	AM	B	C
			PM	C	C
	I-93 between Exits 4 and 5—Southbound		AM	C	C
			PM	C	D
F	I-93 North of Exit 5—Northbound	Mainline	AM	C	C
			PM	C	C
	I-93 North of Exit 5—Southbound		AM	C	C
			PM	C	C

Table 4.2-17. Comparison between No Build and Alternative F Intersections Analysis

Location		No Build		Alternative F	
		AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
1	Exit 4 SB Off-Ramp/NH 102	D	F	D	**E**
2	Exit 4 NB Off-Ramp/NH 102	E	F	E	F
3	Exit 5 SB Off-Ramp/NH 28	E	C	E	C
4	Exit 5 NB Off-Ramp/NH 28	D	D	D	D
5	NH 102/Londonderry Road	B	E	B	**C**

Location		No Build		Alternative F	
		AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
6	NH 102/Fordway	C	D	C	C
7	NH Routes 102/28	D	D	C	C
8	North High Street/Ash Street Extension[a]	F	F	D	F
9	North High Street/Madden Road[a]	D	F	D	E
10	North High/Folsom/Franklin Streets[a]	B	D	B	F
11	Ross' Corner (Folsom/NH 28)	F	E	C	D
12	Tsienneto Road/Pinkerton Street[a]	C	F	F	F
13	NH 28/Linlew Drive	B	B	B	B
14	NH 28/Ashleigh Drive	B	C	B	C
15	NH 28/Scobie Pond Road[a]	F	D	D	F
16	NH 102/NH 28 Bypass/East Derry Road[b]	D	F	E	F
17	NH 28 Bypass/Pinkerton/Nesmith[a]	A	A	D	E
18	NH 28 Bypass/Tsienneto Road	E	F	C	C
19	NH 102/Tsienneto Road[a]	C	F	C	F
27	NH 102/English Range Road[a]	N/A	N/A	C	D

Note: Green shading represents improving from operating at a failing LOS to operating at an acceptable LOS; red shading indicates moving from an acceptable LOS to a failing LOS.

[a] Unsignalized intersections do not have an overall LOS; therefore, worst-case approach LOS is reported.

[b] Roundabout analysis based on HCM 6 procedure.

Alternative F would minimally change vehicle trip patterns. Under Alternative F, freeway impacts would continue to occur at Exit 4 as the I-93 NB on-ramp from NH 102 would continue to queue into NH 102, seven study area intersection operations would improve, and two study area intersections would worsen. Therefore, this alternative would not result in significant impacts on the freeway and would result in beneficial impacts (seven improved versus three worsened) to the study area intersections.

4.2.3 Mitigation

The Project is needed to address projected 2040 traffic volumes and would result in beneficial effects along NH 102 and at nearby intersections. Anticipated future traffic demand is addressed through the design of the Project, and through the Town of Londonderry's site plan review process for each development phase of the Woodmont Commons PUD. As a result, no additional traffic mitigation is proposed.

4.3 Land Use, Zoning, and Public Policy

This section addresses land use, zoning, and public policy. Parks, recreational resources, and conservation lands are discussed in Section 4.19.

Transportation projects may affect land use both directly and indirectly. Direct land use impacts may include changes in land use from ROW acquisition and residential and/or business displacements to accommodate new or expanded transportation facilities. Changes in land use because of a transportation project, or the transportation project itself, may be inconsistent with future land use plans and goals put forth in municipal and regional plans and regulations. Finally, transportation projects may influence the location and form of future development by making some areas relatively more accessible and therefore more attractive for development. This type of induced growth effect, along with related potential impacts on land use patterns and environmental resources, is evaluated in Chapter 5.

4.3.1 Affected Environment

In NH, land use is regulated at the local level by municipalities through zoning and subdivision regulations. Zoning ordinances regulate land uses by area and the type and form of built improvements allowed within each land use. Subdivision ordinances seek to control the density of development on new parcels of land. Land use can also be influenced by other public policy goals expressed as part of land use, transportation, and infrastructure planning processes.

Current land use and zoning conditions were identified using GIS datasets of land use by tax parcel and zoning district boundaries provided by the Towns. In addition, the data were supplemented with reference to the Towns' zoning ordinances (Town of Derry, 2016a; Town of Londonderry, 2016). The study area for the analysis of direct effects to land use was defined as the land area within 500 feet of the proposed alternative alignments, which corresponds to the study area for direct effects to noise levels (Figure 4.3-1). Field visits and windshield surveys were used to verify land use conditions.

Land use policies and plans for the Project area were identified through a review of the following comprehensive and master plans:

- Master Plan of Derry (Town of Derry, 2010)
- Comprehensive Master Plan of Londonderry (Town of Londonderry, 2013)
- Southern New Hampshire Planning Commission's Moving Southern New Hampshire Forward: 2015-2035 Regional Comprehensive Plan (SNHPC, 2014)

This section summarizes land use and zoning along the Build Alternative corridors (A, B, C, D, and F), as well as municipal land use plans in Derry and Londonderry. Regional land use patterns and land use policies are discussed in Chapter 5, *Indirect Effects and Cumulative Impacts*.

Land Use

Land uses along Alternatives A, B, C, and D include commercial, industrial, single-family and multi-family residential, institutional, civic, and open space. Alternative F runs along NH 102 through downtown Derry, and the land uses are primarily commercial and residential with other uses including institutional, civic, recreational (golf course), and industrial. Land uses along the alignments are described in more detail in the following sections and shown in Figure 4.3-1.

Alternative A

Between I-93 and the Londonderry-Derry town boundary, land use is open space/undeveloped; however, the land is slated for future development as part of the Woodmont Commons PUD.