5.0 INDIRECT EFFECTS AND CUMULATIVE IMPACTS

This chapter provides an overview of the regulatory framework and definitions of indirect and cumulative impacts, the methodologies used to develop future land use forecasts with and without the Project, and an assessment of indirect and cumulative impacts to environmental resources.

5.1 Regulatory Framework

CEQ regulates implementation of NEPA and defines three types of effects: direct, indirect, and cumulative.

"**Direct impacts** are caused by the action and occur at the same time and place (40 Code of Federal Regulations [CFR] 1508.8)." Examples of direct impacts include displacements resulting from the acquisition of ROW or the fill placed in wetlands in order to construct a roadway improvement. The uncertainty associated with assessing direct impacts is very low relative to indirect and cumulative impacts.

"**Indirect effects** are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems, including ecosystems (40 CFR 1508.8)."

The National Cooperative Highway Research Program Report 403: *Estimating the Indirect Effects of Proposed Transportation Projects* identifies three types of indirect effects:

- Encroachment-Alteration Effects—alteration of the behavior and functioning of the affected environment caused by project encroachment (physical, chemical, or biological) on the environment.
- Induced Growth Effects—changes in the intensity of the use to which land is put that are caused by the action/project. These changes would not occur if the action/project does not occur. For transportation projects, induced growth is attributed to changes in accessibility caused by the project.
- Induced Growth-related Effects—alteration of the behavior and functioning of the affected environment attributable to induced growth.

"**Cumulative impact** is the impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7)." According to FHWA's *Interim Guidance: Questions and Answers Regarding the Consideration of Indirect and Cumulative Impacts in the NEPA Process*, cumulative impacts include the total of all impacts to a particular resource that have occurred, are occurring, and will likely occur as a result of any action or influence, including the direct and reasonably foreseeable indirect impacts of a proposed project (FHWA, 2003).

5.2 Land Use Forecasting

5.2.1 Overview

A land use forecasting process was undertaken as an essential element of the assessment of indirect and cumulative impacts for this Project. The end product of the land use forecast was local-level population and employment inputs used in the travel demand modeling for the 2040 No Build and Build conditions. SNHPC's regional travel demand model was used to assess how the Project and alternatives may affect travel patterns in the 2040 design year. The travel demand model requires information on local-level population and employment patterns to forecast the number of trip origin and end points in the future. In addition to estimating the number of trips, type of trips, and destination of trips, the travel demand model includes a representation of the roadway network (including highway capacity and speed). The travel demand model assigns trips to specific routes, which forms the basis for the total traffic volumes forecasted for each roadway. Separate model runs are required to represent the 2040 roadway network without the Project (2040 No Build) and with the Project completed (2040 Build). The travel demand model output is used in the Supplemental Draft EIS (SDEIS) traffic analyses, which in turn provide key inputs to analyses of traffic noise and air quality.

The land use forecasting methodology explicitly accounts for potential changes in the quantity and/or location of future development potentially caused by the Project and incorporates those growth changes within the SNHPC travel demand model. As a result of including potential induced growth impacts in the travel demand model for the 2040 Build condition, the approach used for this SDEIS ensures consistency between the traffic analysis and the other land use-related portions of the SDEIS, including indirect and cumulative impacts. The overall land use forecasting process used is consistent with the recommendations of FHWA's *Interim Guidance on the Application of Travel and Land Use Forecasting in NEPA* (FHWA, 2010). Specifically, the forecasting effort included reviewing the suitability of existing forecasts; collaborating with land use/socioeconomic forecast experts, local planners, and the development community; and documenting the basis for assumptions.

5.2.2 Methodology

The methodology used to develop the 2040 No Build and Build conditions land use forecasts included obtaining existing population and employment forecasts and interviewing local land use planners, socioeconomic data experts, and representatives of the development community. Appendix B, *Land Use Scenarios Technical Report*, provides the detailed methods used to develop the 2040 No Build and Build conditions.

Study Area

The study area for the Build and No Build conditions is the "economic study area" described in the 2007 Draft EIS (DEIS), as shown in Figure 5.2-1. This study area encompasses 143 square miles within the two Towns of Derry and Londonderry, as well as Auburn, Chester, and Sandown. The five-town study area was determined by considering the likely geographic extent of potential direct, indirect, and cumulative effects related to land use and development—Derry and Londonderry would be directly affected, and Auburn, Chester, and Sandown may experience indirect effects from improved access and travel time to I-93. 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 SDEIS.

Analysis Timeframe

The temporal scope of analysis for the land use scenarios is based on past development trends and a future-planning horizon for which information on reasonably foreseeable future development is available. The Towns of Derry and Londonderry experienced rapid growth beginning in the 1960s and 1980s, respectively, based on available and affordable housing and favorable schools. Londonderry adopted a growth management ordinance (a subset of its zoning ordinance) in 1988 and readopted it in 1998. The ordinance was allowed to expire in 2015. Derry adopted a growth management ordinance (also a subset of its zoning ordinance) in 1999, which is still active. As a result, the past time horizon for consideration of development trends is 1990, the point at which the rapid growth began to be controlled (see Appendix B, Section 3.1, *Past Population and Employment Trends*). The future time horizon is 2040, which is the design year for the Project as well as a time horizon that encompasses the long-range comprehensive plans and long-range transportation plans for the study area. The 2040 future analysis year is also the analysis year that will be used for the transportation and air quality/noise impact analyses for the Project. The baseline or existing conditions model year for the transportation analyses for the Project is 2015; consequently, 2015 land use and socioeconomic data are also reviewed in this analysis.

Data Reviewed

Existing population and employment forecasts, comprehensive plans, and available development data were reviewed, including the following:

- U.S. Census Bureau 1990, 2000, and 2010 Decennial Census data (U.S. Census Bureau, 1990, 2000, and 2010)
- New Hampshire Employment Security (NHES) Economic and Labor Market Information Bureau employment data from 2004 and 2014 (NHES, 2015)
- New Hampshire Office of Energy and Planning (OEP)[21] County and Municipal Populations Projections 2010–2040 (OEP, 2016a, 2016b)
- SNHPC's Moving Southern New Hampshire Forward: 2015-2035 Regional Comprehensive Plan (SNHPC, 2014) and letter to the Director of Derry Planning Department regarding population and dwelling unit projections (SNHPC, 2012a)
- SNHPC Population and Household Projections 2010-2050 (SNHPC, 2012b), and updated 2015-2040 Household Projections based on OEP Population Projections (SNHPC, 2016a)
- SNHPC Employment Projections for 2010-2050 based on New Hampshire Employment Security and NHDOT data (SNHPC, 2012c), SNHPC Updated Employment Estimates for 2015 (SNHPC, 2016b), and SNHPC Updated Employment Projections for 2020-2040 (SNHPC, 2016c)

[21] As of 2017, OEP is now the Office of Strategic Initiatives (OSI).

- Rockingham Planning Commission (RPC) 2015 Regional Master Plan (RPC, 2015)
- Woodmont Commons PUD Application Materials (Pillsbury Realty Development, LLC, 2013)
- Master Plans of Derry and Londonderry (Town of Derry, 2010; Town of Londonderry, 2013)
- Master Plans of Chester, Auburn, and Sandown (Chester Planning Board, 2015; SNHPC, 2007; Sandown Master Plan Steering Committee et al., 2013)
- SNHPC Regional Comprehensive Plan (SNHPC, 2010)
- Regional Economic Development Center of Southern New Hampshire 2016 Comprehensive Economic Development Strategy (Regional Economic Development Center of Southern New Hampshire, 2016)
- Environmental constraints on development and local land use controls

Land Use Interviews

The purpose of these structured interviews and outreach was to inform and support the analysis of reasonably foreseeable future growth, identify predicted future growth areas under No Build and Build conditions, and estimate the indirect land use effects of the Project and alternatives.

Interviews were conducted on July 25–26, 2016, with planners from the Towns of Derry and Londonderry, SNHPC, and OEP. In addition, because the Woodmont Commons Project is planned adjacent to Exit 4A, a representative of Pillsbury Realty Development was interviewed. Finally, to gather information from municipalities identified in the economic/secondary impacts study area in the 2007 DEIS, telephone interviews were conducted with local planners from the Towns of Auburn, Chester, and Sandown. Materials, including maps and interview summaries, used to gather information via in-person and telephone interviews are included in Appendix B.

In conjunction with the information gathered through the interviews, data in Section 5.2.3 were reviewed to develop the forecasts associated with the 2040 No Build and Build conditions.

Uncertainty/Limitations

As with any attempt to forecast future growth or development, there are limitations to the accuracy and certainty of the results of the land use forecasts. This uncertainty is impossible to quantify given that land use change occurs as result of numerous individual private land use decisions and other factors such as global and local economic conditions, housing trends and costs, availability of public water and sewer service, fuel prices, and long-term technological changes. The 2040 No Build and Build conditions were developed through consideration of the latest available population and employment projections from state and regional agencies as well as input from planners and others knowledgeable of local conditions and trends. The forecasting process was consistent with the best practices recommended in FHWA's interim guidance on travel and land use forecasting. As a result, the land use forecasts provide a reasonable basis for comparing alternatives in the SDEIS and assessing potential indirect and cumulative impacts as required by CEQ's NEPA regulations. The land use forecasts also provide a logical construct and ensure consistent SDEIS evaluation of transportation and land use impacts.

The No Build and Build land use forecasts developed as a result of this analysis should be considered as possible outcomes, and the addition and/or shift in type of development anticipated with the Project should be considered as trends rather than absolute predictions that a certain number of residential units or gsf of commercial or industrial development would occur in a specific location. Ultimately, development within the study area under the No Build and Build conditions will be based on what the Towns will permit and what the market can support.

5.2.3 Population, Household, and Employment Projections

This section includes a summary of the 2040 projections for population, household, and employment that were used as the basis for the No Build condition. Appendix B contains detailed information on past population, household, and employment trends as well as the development of the 2040 projections by SNHPC and OSI (formerly OEP).

Population and Household Projections

SNHPC develops whole-town and zonal (TAZ) population, household, and employment projections for the towns within its region to coordinate regional and local planning. Because SNHPC is also the official Metropolitan Planning Organization of the region, its future projections are also used in the travel demand modeling for the regional long-range transportation plan. For this analysis, SNHPC used the more recent (2016) OSI (formerly OEP) population projections for Derry, Londonderry, and Auburn. As discussed in Appendix B, the population projections for the Town of Chester were adjusted based on additional input from land use interviews. Finally, because Sandown is in the RPC area and not the SNHPC area, information on Sandown households was derived from the RPC 2015 Master Plan (RPC, 2015). Table 5.2-1 and Table 5.2-2 provide population projections by municipality and revised Chester population projections, respectively. Table 5.2-3 shows the household projections through 2040.

Employment Projections

SNHPC also makes TAZ-level projections for employment based on quarterly employment averages from NHES that it compares to building permit data to estimate the number of jobs per square foot of non-residential development. The method used by SNHPC to generate updated TAZ-level projections is detailed in memoranda provided in Appendix B.

Table 5.2-4 includes updated 2015 projections based on state data adjusted to reflect the fact that SNHPC's 2010 employment information calculated directly from the employer database is slightly higher than the state data. Table 5.2-4 then uses the 5-year percent increases from SNHPC's 2012 employment projections to recalculate projections for 2020–2040 using the updated 2015 projections. Appendix B includes a memorandum outlining the methodology used to project employment. The notable decline in Chester employment in 2015 is due to the closing of Chester College in 2012, and the rebound in employment in 2020 is projected based on the opening of Busche Academy at the old Chester College (Jaschik, 2012; Williams, 2015). Busche Academy was approved and officially recognized as a non-public (private) school in October 2017. This dip in Chester employment values creates an elevated average annual growth rate for the town for 2015–2040 (2.21 percent); for comparison, the average annual growth rate from 2010–2040 was 0.62 percent.

Table 5.2-1. OEP 2016 Population Projection by Municipality for 2015–2040

Municipality	2015[a]	2020	2025	2030	2035	2040	Average Annual Growth Rate 2015–2040
Derry	32,948	32,459	32,018	32,733	33,144	33,222	0.03%
Londonderry	24,891	25,434	26,057	26,639	26,973	27,036	0.33%
Auburn	5,315	5,560	5,828	5,959	6,033	6,048	0.52%
Chester	4,887	5,199	5,536	5,660	5,731	5,744	0.65%
Sandown	6,255	6,604	6,984	7,140	7,229	7,246	0.59%
Study Area Total	74,296	75,256	76,423	78,131	79,110	79,296	0.26%
Rockingham County	300,569	307,013	314,418	321,441	325,474	326,238	0.33%

Source: OEP (2016a)
[a] 2015 data are an estimate.

Table 5.2-2. Revised Chester Population Projection for 2015–2040

Municipality	2015[a]	2020	2025	2030	2035	2040	Average Annual Growth Rate 2015–2040
Chester	4,887	5,457	6,027	6,101	6,177	6,253	0.99%

Source: Town of Chester (see Appendix B)
[a] 2015 data are the estimates provided by OSI (formerly OEP).

Table 5.2-3. SNHPC and RPC Household Projections

Municipality	2010[a]	2015[b]	2020	2025	2030	2035	2040	Average Annual Growth Rate 2015–2040
Derry	12,537	12,656	12,436	12,236	12,496	12,645	12,673	0.01%
Londonderry	8,438	8,628	8,812	9,022	9,219	9,332	9,353	0.32%
Auburn	1,765	1,923	2,012	2,108	2,156	2,182	2,188	0.52%
Chester	1,534	1,621	1,811	2,001	2,026	2,051	2,077	0.99%
Sandown[c]	2,072	2,193	2,321	2,457	2,601	2,753	2,914	1.14%
Study Area Total	26,346	27,021	27,392	27,825	28,497	28,963	29,205	0.31%

Source: SNHPC (2016a; 2017), RPC (2015)

[a] 2010 households were provided by SNHPC and based on U.S. Census Bureau information.

[b] 2015 data are an estimate.

[c] Data are from the RPC 2015 Regional Master Plan, with 2040 projections based on the "strong, dispersed growth" scenario. Household data were not available for 2015-2035; therefore, this table includes straight-line growth between 2010 and 2040.

Table 5.2-4. SNHPC and RPC Employment Projections (Number of Jobs)

Municipality	2010	2015	2020	2025	2030	2035	2040	Average Annual Growth Rate 2015–2040
Derry	7,825	8,384	8,373	8,785	9,254	9,760	10,322	0.84%
Londonderry	13,624	13,517	14,008	14,961	16,000	16,751	17,550	1.05%
Auburn	1,651	1,846	1,960	2,135	2,331	2,534	2,760	1.62%
Chester[a]	528	368	418	459	506	565	635	2.21%
Sandown[b]	399	419	440	463	486	510	536	0.99%
Study Area Total	24,027	24,534	25,199	26,803	28,576	30,121	31,802	1.04%

Source: SNHPC (2012c, 2016b, 2016c), RPC (2015)

Notes: 2010 values were developed in 2012. 2015 projections were updated in 2016. 2020 through 2040 projections were then adjusted to reflect the 2012 5-year projection increases based on the updated 2015 projections.

[a] The notable decline in Chester employment in 2015 is due to the closing of Chester College in 2012, while the rebound in employment in 2020 is projected based on the opening of Busche Academy at the old Chester College (Jaschik, 2012; Williams, 2015). Busche Academy was approved and officially recognized as a non-public (private) school in October 2017. For reference, average annual growth rate in Chester between 2010 and 2040 is 0.65% compared to the elevated 2.24% shown in the table.

[b] Data from the RPC 2015 Regional Master Plan, with 2040 projections based on the "strong, dispersed growth" scenario. Employment data were not available for 2015-2035; therefore, this table includes straight-line growth between 2010 and 2040.

5.2.4 Land Use Interviews

Interviews with local land use planners assisted with the development of the No Build and Build land use forecasts by identifying development trends in their respective towns and providing spatial and temporal information on planned and proposed developments. The following summaries of development trends are based on these interviews. More detailed summaries of these interviews are provided in Appendix B. The draft interview summaries were provided to all participants for review and comment, and the final interview summaries were approved by the participants.

Derry

Since 1990, the rapid growth that Derry experienced from the 1960s through the 1980s has slowed. Derry's growth management ordinance was instituted in the mid-1990s along with changes in zoning to control density of residential development. In addition, the segmented ownership in the central business district and lack of large parcels of available land for development make substantial future growth impracticable. Currently, Derry is experiencing a trend of population decline related to an aging population and an outward migration of young adults as they seek employment and educational opportunities elsewhere.

The area immediately to the east of I-93, along Folsom Road north of North High Street, has been rezoned to encourage higher quality industrial and commercial development near the Project. Additionally, residential areas south of Folsom Road and North High Street might be re-zoned to Industrial/Commercial zoning. The Derry planning staff indicated that the Project could have an effect on the timing and intensity of development/redevelopment in this small, industrial-zoned area. Effects on commercial/industrial development in other areas of the town are not anticipated. The commercial zoning district along the southern end of Rockingham Road (Route 28) was revised in 2013, and some commercial development has occurred in that area. In addition, water and sewer services are being expanded along Rockingham Road to continue to encourage commercial development along that corridor.

Although no large parcels are suitable for large-scale developments, a 13-unit market-rate apartment building is planned near the central business district. An area along South Main Street/Rockingham Road is zoned for commercial development, and the town is extending water and sewer service to allow the area to develop at a higher density.

The limits of water and sewer service, the lack of large parcels, and the topography in the eastern portion of Derry serve to limit development. Lot size requirements and conserved land are also factors constraining any major single-family home developments in Derry. Because of the large number of development constraints, Derry planning staff suggested that the Project would be unlikely to induce additional residential development in Derry. However, the Project would encourage areas recently rezoned as industrial and commercial to develop by providing direct access to I-93.

Londonderry

Since 2000, the rapid growth experienced in the 1980s and 1990s has slowed, and the current development trends are based on access to undeveloped or underdeveloped land and the presence or absence of municipal services (water/sewer), which affects the density of development. For example, the industrial development on Pettengill Road is driven by undeveloped land with

access to Raymond Wieczorek Drive (Manchester Airport Access Road). The Project would not affect this industrial development in northwest Londonderry. Although a few parcels are available in west Londonderry, the Project would not likely affect their future development because the Project would provide access only to the east of I-93.

On the east side of I-93, the Project would affect the timing and type of growth in Londonderry—the interchange and connector road would provide access and opportunity for commercial, institutional, and higher density residential development.

Woodmont Commons is a planned mixed-use urban village in the Town of Londonderry. The developer, Pillsbury Realty Development, LLC, owns approximately 630 acres bordering the east and west sides of I-93. Based on the PUD Master Plan (Pillsbury Realty Development, LLC, 2013), Woodmont Commons is divided into several phases, and development will occur over a 20-year period. The Town of Londonderry issued a conditional approval for the Phase I design plans in November 2016.

The Woodmont Commons development density with and without the Project is presented in the PUD Master Plan (Pillsbury Realty Development, LLC, 2013), and town planning staff indicated that the "without Exit 4A" scenario presented in the approved 2013 PUD Master Plan was based on design review meetings that included town staff, Project engineers/planners, and the town's review consultant. Thus, the "with" and "without" Exit 4A scenarios (i.e., with Project and without Project scenarios) presented in the PUD Master Plan should not be construed as projections of growth, but rather should provide an upper cap on the maximum amount of development that could occur. This explains why less commercial development is allowed on the west side of I-93 without the Project than with it, even though the Project would provide no westerly access.

Without the Project, the Woodmont Commons development on the east side of I-93 would likely be a residential development model (up to 330 units as allowed by the PUD). The Londonderry planning staff agreed that the 400,000 gsf of office development potentially allowed according to the PUD east of I-93 without the Project would likely not occur given the amount of traffic mitigation that would be required. Instead, a more realistic development scenario without the Project would be the aforementioned residential development with a small number of commercial businesses serving the needs of the 330 residential units (such as a convenience store or pharmacy).

With the Project, the current programming for the east side, which is also preferred by the Town of Londonderry, is for commercial land use accessed via Exit 4A. The developer expects a mixed-use build-out on the east side of I-93 to the level indicated by the caps in 2013 PUD Master Plan by 2040. In other words, the PUD caps represent a reasonable "Build" scenario for the Project. No development would be expected to start until after the completion of the Project (currently expected by 2022). No potential development east of I-93 has been pre-sold or pre-leased (see Woodmont Commons Land Use Interview Summary, Appendix B).

With regard to development associated with Build Alternatives A, B, C, D, and F (from the 2007 DEIS), planners stated that growth in Londonderry under Alternatives C and D would be more in line with a No Build Alternative (or without the Project) because these alternatives would not provide access to the parcels that Woodmont Commons plans to develop for commercial and/or institutional use. Given the easterly only access of the Project, development of the interchange would likely have little effect on the job growth or attraction of industries west of I-93.

Auburn, Chester, and Sandown

Auburn

Auburn is largely a bedroom community of about 16,000 acres with limited businesses. About a quarter of its area (4,200 acres) is the watershed for Massabesic Lake, which is the water supply for the City of Manchester. This limits the area available for development.

The primary drivers of growth are location and, more recently, the change in high school from Manchester to Pinkerton Academy. Auburn is located near Exits 1 and 2 of NH 101, which provides convenient access to I-93. Auburn's development has been different from most of the surrounding communities because it did not experience a decrease in development associated with the 2007–2008 recession. Auburn has issued approximately 35 new home building permits per year, and that did not change after 2007–2008. The Town Administrator stated that these new home permits are typically for custom homes on larger lots, and this trend of type and rate of residential development is expected to continue.

The Town Administrator indicated that the Project is not likely to affect development and population growth in Auburn. Travel time may improve if some of the traffic on I-93 is pulled off the interstate by the Project, but this effect would likely be minor. Auburn residents would not be likely to use Exit 4A to travel from I-93 to Auburn because NH 101 already provides convenient access to the northern portion of the town, and the southern portion is closer to the existing Exit 5 than to Exit 4A.

Chester

Chester is a rural community east of Derry. Access to I-93 is primarily through the Town of Derry. Chester is currently experiencing significant growth pressure in the form of a recent resurgence (spring 2016) of single-family residential development. Development activity has recently restarted on many of the subdivisions that have been dormant or partially complete since the 2007–2008 recession. Chester currently has approved or pending permits to develop about 300 lots, which are anticipated to be developed in the next 5 to 7 years (2022–2024) (Appendix B). In addition, the town has two 30-lot and three 5-lot subdivisions that will be approved in the near future. One of the 30-lot subdivisions is a Phase I–there will likely be an additional 90 lots in that 550-acre subdivision. The Chester Master Plan 2015 also recognizes this trend for residential growth in Chester. The plan notes that SNHPC projects that approximately 96 dwelling units would be constructed every 5 years through 2050 based on the town's historic growth rate and past building permit trends (Chester Planning Board, 2015). This long-term projection equates to an average of about 19 new home permits per year.

The primary drivers for additional residential development in Chester are good schools and the desire for rural living. Because the resurgence of residential/subdivision development is recent, it will likely be a year or two before Chester experiences a significant increase in elementary school enrollment. It is too early to determine whether a commensurate increase in school-age population or a shift in demographics of the population would occur; however, an increase is expected because most of the new homebuyers in Chester have one or more children.

Given Chester's access to I-93 through Derry, the planning coordinator indicated it was likely that the Project would induce additional residential development in Chester because of improved access to I-93.

Although the Project would enable additional growth in Chester, the town has a growth management provision in its zoning ordinance that would go into effect if pressure on school, fire, and police services outstrips the town's ability to keep pace with development. An open space subdivision provision is in place to encourage subdivisions to be creatively designed in a way that reduces sprawl and protects natural resources and rural character.

Sandown

Sandown is a rural community east of Derry, and highway access to the town is either by I-93 (via NH 102 through Derry) or by I-495 (via 121A through Plaistow). The primary driver for growth in Sandown is affordable housing—the bulk of housing in Sandown would be considered starter homes with regard to price and size. In addition, the Planning Board member interviewed indicated that transportation access to I-495 and an increase in telecommuting have contributed to population growth due to an increase in people seeking affordable housing. Sandown experienced a major influx of people during the 1990s until the recession in 2007–2008; however, Sandown is experiencing a resurgence of development similar to Chester. A 50-unit apartment building was recently approved, and two developments initially planned for residents ages 55 and older are now being developed for individuals of any age.

Although Sandown has had growth management ordinances in the past, these ordinances are no longer in place because of lawsuits by developers. Sandown is now focused on buying and conserving land to reduce the available developable land in the town. Sandown purchased 200 acres for conserved open space that had been approved for 154 dwellings for residents ages 55 and older, resulting in a reduction of housing potential in Sandown. The Planning Board is considering applying for another Community Technical Assistance Project grant to acquire and conserve more land. Most of the larger tracts have been developed, and Sandown has only a few 100-acre tracts left that could be developed as larger subdivisions.

Sandown has numerous wetlands and rivers, and in addition to purchasing land for conservation purposes, the town has a vernal pool protection provision in its zoning ordinance that includes a 25-foot buffer around vernal pools and a building setback requirement of 50 feet. In addition, the Planning Board has passed variable road width and stormwater regulations to reduce impervious surface and promote low impact development. The conservation measures are designed to improve the quality of natural resources and allow the town to reduce the amount of development and associated increase in school enrollment.

The Planning Board member stated during the interview that the widening of I-93 is having a substantial effect on growth in Sandown by reducing travel times on I-93, which makes Sandown more attractive for young homebuyers. The Planning Board member believes the Project has the potential to induce additional residential development in Sandown by providing better access and reduced travel time to I-93.

5.2.5 Summary of Indirect Land Use Impacts

The 2040 Build condition was developed by adding population, households, and employment growth from development anticipated to be induced by the Project to 2040 No Build condition values. Induced development presented for the 2040 Build condition is based on Alternative A. Alternatives A and B would induce the greatest amount of development relative to the other

Build Alternatives. A comparison of Alternatives B, C, D, and F to the 2040 Build condition (Alternative A) follows the presentation of the anticipated growth for Alternative A.

Alternative A

This section first discusses the incremental impact of Alternative A (e.g., indirect land use effects) and then provides a summary of the total 2040 Build condition land use forecast.

Indirect Land Use Effects

The additional reasonably foreseeable future development under Alternative A was identified through the land use planner interviews. Table 5.2-5 provides a summary of the incremental growth anticipated to be induced by Alternative A, which includes changes in the density and type of development anticipated for Woodmont Commons, as well as commercial and industrial growth in Derry induced by improved access to I-93. Detailed explanations of the induced development anticipated for Woodmont Commons, commercial and industrial growth in Derry, and induced residential development in Chester and Sandown and the population, household, and employment projections as a result of this induced development are provided in Appendix B. The Pettengill Road industrial area and the Market Basket redevelopment area are not anticipated to be affected by the Project. Also, through the land use interviews, it was determined that the Project would not induce development in Auburn (see Appendix B).

Table 5.2-5. Summary of Indirect Land Use Effects of Alternative A

Development Name	Type/Land Use	Residential Units	Hotel Rooms	Commercial Area (gsf)	Institutional (gsf)	Industrial Area (jobs)
Derry	Commercial/ Industrial	NA	NA	0	NA	168[b]
Woodmont Commons– West of I-93	Mixed Use– Commercial/ Residential	6	0	322,000	40,000	NA
Woodmont Commons– East of I-93[a]	Mixed Use– Commercial/ Residential	3	200	693,400[a]	420,000	NA
Chester	Residential	371	NA	NA	NA	NA
Sandown	Residential	9	NA	NA	NA	NA
Total		**389**	**200**	**1,015,400**	**460,000**	**168**

Source: Pillsbury Realty Development, LLC (2013), Interviews with the Towns and a Woodmont Commons representative (see Appendix B).

[a] Based on the interview with the representative of Pillsbury Realty Development on August 7, 2016, it was agreed that developing the upper cap of 400,000 gsf of commercial uses on the East side of I-93 for Phase 1 was unlikely without Exit 4A due to the traffic mitigation that would be required (see Appendix B and footnotes to Table 8). This Build condition value total assumes the difference between the likely No Build Phase 1 commercial development (400,000 gsf–6,600 gsf) plus the remainder of the East side development that would be anticipated as a result of the access provided by Exit 4A (300,000 gsf).

[b] Because it is not possible to predict which type of jobs would result from Derry's industrial rezoning and redevelopment due to the flexible nature of the Industrial District IV zoning that allows retail, commercial, and industrial development, all jobs were assumed to be in the industrial category.

2040 Build Condition Land Use Forecast Summary

Based on the information presented above and in Appendix B, the 2040 Build condition population for the study area is estimated to be 83,654, as outlined in Table 5.2-6, an increase of 1,163 people over the No Build condition. Table 5.2-7 and Table 5.2-8 show the total households and employment (jobs), respectively, for the study area under the 2040 Build condition. The total number of 2040 Build households for the study area is estimated to be 34,190, an increase of 389 households over the No Build condition (Table 5.2-7), and the 2040 Build employment for the study area is estimated to be 39,975 jobs, an increase of 4,681 jobs over the No Build condition (Table 5.2-8). The large increase in employment under the Build condition is primarily attributable to the additional build out of Woodmont Commons that Londonderry will permit with the completion of Exit 4A.

Table 5.2-6. Total 2040 Build Condition Population for Study Area

Municipality	2040 No Build Population	2040 Build Incremental Development Project Population	Total 2040 Build Population	Percent Difference between No Build and Build
Derry	33,222	0	33,222	0.00%
Londonderry	30,885	25	30,910	0.08%
Auburn	6,048	0	6,048	0.00%
Chester	6,253	1,117	7,370	16.40%
Sandown	7,246	21	7,267	0.29%
Study Area Total	83,654	1,163	84,818	1.38%

Table 5.2-7. Total 2040 Build Condition Households for Study Area

Municipality	2040 No Build Households	2040 Build Incremental Development Project Households	Total 2040 Build Households	Percent Difference between No Build and Build
Derry	12,673	0	12,673	0.00%
Londonderry	10,695	9	10,704	0.08%
Auburn	2,187	0	2,187	0.00%
Chester	2,077	371	2,448	16.40%
Sandown	2,914	9	2,923	0.29%
Study Area Total	30,546	389	30,935	1.26%

Table 5.2-8. Total 2040 Build Condition Employment for Study Area

Municipality	2040 No Build Employment	2040 Build Incremental Development Employment	Total 2040 Build Employment	Percent Difference between No Build and Build
Derry	10,479	346	10,825	3.25%
Londonderry	20,875	4,335	25,210	18.81%
Auburn	2,764	0	2,764	0.00%
Chester	641	0	641	0.00%
Sandown	536	0	536	0.00%
Study Area Total	35,294	4,681	39,975	12.44%

Alternative B

Compared to Alternative A, Alternative B would be expected to result in similar commercial and industrial growth in Derry. Although the exact location of the connector road would be different from that proposed for Alternative A, Alternative B would provide access to the area zoned as Industrial IV and the area being considered for rezoning. The development associated with Woodmont Commons and Chester would be similar under Alternatives A and B. As previously mentioned, the Project is not expected to affect the industrial developments in the northwest portion of Londonderry or residential development in Auburn. Finally, the anticipated increased rate of residential development in Chester and Sandown would be similar under Alternatives A and B.

Alternative C

The commercial and industrial development anticipated in Derry under Alternative A would not be realized under Alternative C because the rezoned parcels along Folsom Road north of North High Street would not have direct access to the interchange. The alignment of Alternative C would constrain additional commercial/industrial development due to lack of available land adjacent to the ROW. As the alignment approaches I-93, a transmission line and conservation areas limit the available land for development. Where the alignment follows NH 28, the adjacent land is largely built out with commercial and industrial uses. Although it is possible that some of the commercial and industrial parcels could be redeveloped, it is unlikely to result in a substantive net gain of commercial or industrial space because of the size of the individual parcels.

Londonderry planning staff and the Woodmont Commons representative indicated that Alternative C would limit access to the area available for development near I-93 to an extent that, if this alternative were selected, the Woodmont Commons area on the east side of I-93 would be developed as detailed under the No Build condition (e.g., primarily residential, 330 households). As previously mentioned, the Project is not expected to affect the industrial developments in the northwest portion of Londonderry or residential development in Auburn. Finally, the anticipated increased rate of residential development in Chester and Sandown would be similar under Alternatives A and B given that the Alternative C interchange/roadway

improvements would still provide a bypass of downtown Derry (although with a less direct route than Alternative A).

Alternative D

Development under Alternative D would be the same as that anticipated under Alternative C because the interchange would be located in the same location as Alternative C. Roadway improvements would follow Tsienneto Road to connect with NH 102 (similar to Alternative A).

Alternative F

Alternative F would involve an upgrade of NH 102 between Londonderry Road and the NH 28 Bypass. Development under Alternative F in the area of Woodmont Commons and the industrial area of Derry would be the same as that anticipated under the No Build condition. Indirect land use impacts on Chester and Sandown are not anticipated. Although the improvements on NH 102 would reduce congestion through downtown Derry, Alternative F does not include improvements that would enable commuters to bypass downtown Derry, thereby encouraging growth in Chester or Sandown.

5.3 Development under the 2040 No Build and Build Conditions

The 2040 No Build condition is the reasonably foreseeable future development anticipated without construction of the Project. The 2040 Build condition is the reasonably foreseeable future development anticipated if the Project is built and includes both the growth that is attributable to the improved transportation access created by the Project, as well as growth that is independent of the Project. The difference between the No Build and Build conditions is the indirect land use–or incremental–impact of the Project. As noted in Section 5.2.5, Alternatives A and B are anticipated to induce similar amounts development relative to each other and greater amounts development relative to Alternatives C, D, and F. Therefore, the induced development presented for the 2040 Build condition is based on Alternatives A and B to identify maximum potential indirect effects from the Project.

Both the 2040 No Build and 2040 Build conditions were developed after analyzing a variety of data sources and based on interviews with planners in local jurisdictions to ensure a collaborative process for land use and travel forecasting assumptions. Forecasting assumptions were also developed for the alternatives, as discussed in Section 5.2.5. The overall process was guided by FHWA's *Interim Guidance on the Application of Travel and Land Use Forecasting in NEPA* (FHWA, 2010).

The *Land Use Scenarios Technical Report* (Appendix B) defined the No Build and Build conditions and provided socioeconomic inputs (i.e., population, households, and jobs) associated with each development. The socioeconomic inputs were used in the traffic modeling and analysis. For this analysis, additional information on the area of potential land disturbance associated with reasonably foreseeable future development is required to assess the indirect and cumulative impacts of this future development on environmental resources. Detailed information on each of these developments is provided in Appendix B.

The following sections present the development footprints for the known developments identified in the *Land Use Scenarios Technical Repor*t and a summary of the incremental development anticipated to be induced by the Project.

5.3.1 Development Footprints for Known Developments

This section includes a summary of assumptions made regarding the development footprints for each major development as well as the identification of a range of footprints under the No Build and Build conditions, as applicable. The "footprint" refers to assumed area of land disturbance associated with each development. Within each development discussion, assumptions used to generate the range of footprints are identified. The purpose of defining the footprints of each development is to aid in the quantification of potential indirect and cumulative impacts to environmental resources. Development footprints have been created for the following developments:

1. Market Basket Redevelopment
2. Woodmont Commons West—Phase I
3. Woodmont Commons West—Remainder
4. Woodmont Commons East
5. Derry Industrial Development
6. Chester Residential

Figure 5.3-1 shows the approximate locations of each of these developments. These footprints are used in the indirect effects and cumulative impacts analyses.

The Pettengill Road industrial development (Map ID 7 on Figure 5.3-1) would not be affected by the Project; therefore, developing detailed development footprint assumptions was not warranted. Access to those parcels is provided by Pettengill Road and Raymond Wieczorek Drive (Manchester Airport Access Road). As outlined in the *Land Use Scenarios Technical Report* (Appendix B), employment projections by TAZ for the Pettengill Road industrial area under the No Build condition were obtained from SNHPC. The Build Alternatives would not alter future employment in this area.

Market Basket Redevelopment

The new Market Basket was constructed on the other side of the plaza from the original grocery store. The 26.7-acre redevelopment approved by the Town of Londonderry in 2015 involved the demolition of about 74,000 gsf of commercial space and the addition of about 42,000 gsf of commercial development (Town of Londonderry, 2015). Construction is complete, and the 42,000 gsf is occupied (Figure 5.3-2).

In addition, there are four commercial pads available for development within the redevelopment area along John R. Michels Way, the roadway running through the Woodmont Commons development area connecting Garden Lane and Pillsbury Road. Although the four pad sites have not been approved for development, it is possible that they could provide an additional 20,000 to 30,000 gsf of commercial development. As such, 30,000 gsf of potential additional commercial development has been included in the 2040 No Build condition.

The development footprint considered for the cumulative impacts analysis includes the four pad sites that could accommodate 30,000 gsf within the larger Market Basket Redevelopment area. These sites as well as parking are assumed to be accommodated by the larger Market Basket

Redevelopment area (Figure 5.3-2). The development footprint would not change under the Build condition.

Woodmont Commons West—Phase I

Construction for Woodmont Commons West, Phase I began in June 2017 and includes mixed use residential and commercial space, with about 60 percent retail space and 40 percent office space; five restaurants, including one restaurant/brewery; a hotel; a concert venue; and individual elderly living. Phase I is anticipated to be completed by 2020 regardless of whether or not Exit 4A is constructed. The development footprint considered for the cumulative impacts analysis is based on the approved site plan and includes about 52.3 acres (Table 5.3-1). Parking in included within the site plan. The development footprint would not change under the Build condition.

Woodmont Commons West—Remainder

The remainder of Woodmont Commons West is anticipated to be completed by 2040. The maximum growth caps outlined in the Woodmont Commons PUD Master Plan were used in the development of the No Build and Build conditions to provide a conservative estimate of indirect impacts (i.e., using the upper bound allowable growth results in predicting greater environmental impacts). The PUD includes a proposed pond within the remainder of the Woodmont Commons West development, which appears to be based on expansion and enhancement of the existing Duck Pond. The Duck Pond is mapped as a 30.14-acre prime wetland. The PUD states that the proposed residential and commercial development is not dependent on the proposed pond expansion; page 19 of the PUD shows a possible alternative plan to leave the area in its natural state "if the proposed pond in WC-3 is not approved by State or Federal authorities having jurisdiction." As a result, the proposed pond is not included in the development footprint.

For analysis of indirect effects and cumulative impacts to resources, the minimum and maximum development footprints are considered to be the area of disturbance. The development densities proposed in the PUD do not lend themselves to having large areas of undisturbed land. The actual development that occurs within the Woodmont Commons PUD by 2040 may be less than this maximum depending on economic conditions and regulatory approvals.

No Build Condition

Table 5.3-1 and Figure 5.3-3 show the range of potential development footprints under the No Build condition.

Table 5.3-1. Woodmont Commons West—Remainder Development Footprints under the No Build Condition

Development		2040 No Build Condition	
		Minimum Footprint (acres)	Maximum Footprint (acres)
Residential (units)	570	52.3	Based on the concept in the PUD Master Plan
Hotel (rooms)	215	0.5	
Commercial Area (gsf)	519,926	3.0	
Institutional (gsf)	0	0.0	
Parking (spaces)	2,784	19.2	
Total		**75.0**	**103.2**

Source: Pillsbury Realty Development, LLC (2013)

The maximum footprint is based on the concept shown in the PUD Master Plan (page 21) and includes parking. The minimum footprint of development was based on the following assumptions:

- The PUD Master Plan development standards include a minimum lot size for single-family residential use of 3,200 square feet. Assuming the minimum lot size, the anticipated 570 residential units would require approximately 42 acres of disturbance. The minimum footprint for residential areas has been increased by 25 percent to include other aspects associated with the residential development, such as utilities, stormwater treatment, and internal circulation. The PUD is designed to encourage higher density development compared to the typical development within the Town of Londonderry.
- The 215 hotel rooms are anticipated to require about 0.5 acre. A Sleep Inn hotel near Manchester Airport was used as a reference property–this hotel had 100 rooms and occupied 40,976 square feet, including common areas and work spaces (Town of Londonderry, 2017b). The footprint is based on a 4-story building (the maximum height for buildings outlined in the Master Plan).
- The 519,926 gsf of commercial development outlined in the PUD Master Plan is assumed to be built in 4-story buildings, which is the maximum height for commercial buildings as outlined in the Master Plan.
- Parking space standards are outlined in the Woodmont Commons PUD Master Plan (page 150). About 2,784 spaces are anticipated to accommodate the hotel and other commercial development. Although parking space dimensions are assumed to be an average of 8-feet wide and 18-feet long, 300-square-feet per parking space was used to account for circulation.

Build Condition

Table 5.3-2 and Figure 5.3-4 show the range of development footprints under the Build condition. The maximum footprint is based on the concept shown in the PUD Master Plan (page 21) and includes parking. The minimum footprint of development was based on the minimum lot standards for residential and all commercial and institutional development contained in 4-story buildings.

Table 5.3-2. Woodmont Commons West—Remainder Development Footprints under the Build Condition

Development		2040 Build Condition	
		Minimum Footprint (acres)	Maximum Footprint (acres)
Residential (units)	576	52.9	Based on the concept in the PUD Master Plan
Hotel (rooms)	215	0.5	
Commercial Area (gsf)	841,926	4.8	
Institutional (gsf)	40,000	0.2	
Parking (spaces)	3,949	27.2	
Total		**85.7**	**228.1**

Source: Pillsbury Realty Development, LLC (2013)

Woodmont Commons East

No Build Condition

Under the No Build condition, Woodmont Commons East is anticipated to include 330 residential units and about 6,600 gsf of ancillary commercial space. Under the Build condition, the development is anticipated to be consistent with the maximum permissible development outlined in the September 2013 PUD Master Plan (see subarea WC-12), which includes 330 residences, a 200-room hotel, 420,000 gsf of institutional uses (such as a hospital or assisted living facilities), and 700,000 gsf of commercial/office uses.[22]

Table 5.3-3 and Figure 5.3-5 show the range of development footprints under the No Build condition. Under the No Build condition, Franklin Street and Ash Street were assumed as access points for circulation and fire department access (based on the PUD Master Plan).

Table 5.3-3. Woodmont Commons East Development Footprints under the No Build Condition

Development		2040 No Build Condition	
		Minimum Footprint (acres)	Maximum Footprint (acres)
Residential (units)	330	30.3	60.6
Hotel (rooms)	0	0.0	0.0
Commercial Area (gsf)	6,600	0.2	0.2
Institutional (gsf)	0	0.0	0.0
Parking (spaces)	682	4.7	4.7
Subtotal		35.2	65.5
Connecting Roads		6.6	4.0
Total		**41.8**	**69.5**

Source: Pillsbury Realty Development, LLC (2013)

The No Build condition development footprints (Figure 5.3-5) are based on the following assumptions:

- The developer has an incentive to minimize direct vernal pool/wetland impacts to lower mitigation costs. Therefore, unconstrained uplands would be developed first.
- The PUD Master Plan assumes a minimum lot size for single-family residential use of 3,200 square feet. Under the low range footprint, the anticipated 330 residential units would require a minimum of 24 acres of disturbance. The minimum footprint was increased by 25 percent to include other aspects associated with residential development, such as utilities, stormwater treatment, and internal circulation.
- The maximum footprint assumes that the developer uses much larger lot sizes than the minimum outlined in the PUD Master Plan more typical of suburban

[22] The Master Plan specifically allows for flexibility on the specific mix of uses between Nursing Homes and Assisted Living, Accommodations and Commercial Uses on a per square foot basis.

residential development. Given the wetland and vernal pool constraints on the parcel, it is possible that the lot size used for residential development could be up to two times the minimum lot size listed in the PUD Master Plan (i.e., 6,400 square feet). Using this assumption, the maximum footprint for 330 residential units would require about 48 acres of disturbance. As with the minimum footprint, the maximum footprint has been increased by 25 percent to accommodate the aforementioned additional aspects of residential development.

- The 6,600 gsf of supporting commercial development would be constructed as a one-story building.
- Parking space standards outlined in the Woodmont Commons PUD Master Plan (page 150). About 682 spaces are anticipated under the No Build condition. Although parking space dimensions are assumed to be an average of 8-feet wide and 18-feet long, 300 square feet per parking space was used to account for circulation.
- Connecting roads were based on the PUD Master Plan. The maximum footprint connecting roads occupy less area than the connecting roads for the minimum footprint because the development for the maximum footprint encompasses some of the road area.

Build Condition

Table 5.3-4 and Figure 5.3-6 show the range of development footprints under the Build condition.

Table 5.3-4. Woodmont Commons East Development Footprints under the Build Condition

Development		2040 No Build Condition	
		Minimum Footprint (acres)	Maximum Footprint (acres)
Residential (units)	333	30.6	Based on the concept in the PUD Master Plan
Hotel (rooms)	200	0.5	
Commercial Area (gsf)	693,400	4.0	
Institutional (gsf)	420,000	2.4	
Parking (spaces)	3,831	26.4	
Subtotal		63.8	105.5
Connecting Roads		4.1	2.8
Total		**67.9**	**108.3**

Source: Pillsbury Realty Development, LLC (2013)

The Build condition maximum footprint is based on the concept shown on page 35 of the PUD Master Plan. The minimum footprint is derived from the PUD Master Plan concept with the following assumptions (Figure 5.3-6).

- The PUD Master Plan assumes a minimum lot size of 3,200 square feet. Under the minimum footprint, the anticipated 333 residential units would require about

31 acres of disturbance. The minimum footprint for residential areas has been increased by 25 percent to include other aspects associated with the residential development, such as utilities, stormwater treatment, and internal circulation.

- The 200 hotel rooms are anticipated to require about 2 acres. A Sleep Inn hotel near Manchester Airport was used as a reference property–this hotel had 100 rooms and occupied 40,976 square feet, including common areas and work spaces (Town of Londonderry, 2017b). The footprint is based on a 4-story building, which is the maximum height for buildings outlined in the Master Plan.
- The 693,400 gsf of commercial development and 420,000 gsf of institutional development outlined in the PUD Master Plan is assumed to be built in 4-story buildings, which is the maximum height for commercial and institutional buildings as outlined in the Master Plan.
- Parking space standards outlined in the Woodmont Commons PUD Master Plan (page 150). About 3,831 spaces are anticipated to accommodate the hotel and other commercial development. Although parking space dimensions are assumed to be an average of 8-feet wide and 18-feet long, 300 square feet per parking space was used to account for circulation.
- As noted in Section 5.2.5, under Alternatives C, D, and F, Woodmont Commons East would develop as anticipated under the No Build condition.

Derry Industrial Development

The Derry industrial development is a combination of the potential for redevelopment of existing lower density industrial development and rezoning of parcels currently zoned as medium high density residential to industrial. Under the No Build condition, the Town of Derry is unlikely to take measures to rezone the parcels to industrial use. In addition, the No Build condition does not offer improved access as an incentive for redevelopment. As a result, a development footprint has not been created for the No Build condition.

As outlined in the *Land Use Scenarios Technical Report*, the anticipated Derry industrial redevelopment and rezoning is anticipated to result in jobs 346 jobs. The redevelopment and rezoning would include 346 parking spaces.

The Industrial zoning Districts IV and VI permit a range of commercial and industrial uses, including general retail, industrial office, and industrial/manufacturing. The employees per gsf for each of these uses ranges from 300 gsf/employee for industrial office to 800 gsf/employee for industrial/manufacturing (RKG, 2016). The maximum footprint under the Build condition assumes that 800 gsf/employee would be required, while the minimum footprint assumes 300 gsf/employee would be required. In addition, parking was estimated to require 300 square feet per employee to account for an average parking space size of 8 feet by 18 feet and circulation within the lot. Table 5.3-5 and Figure 5.3-7 show the range of development footprints under the Build condition.

Table 5.3-5. Derry Industrial Development Footprints under the Build Condition

Development		2040 Build Condition	
		Minimum Footprint (acres)	Maximum Footprint (acres)
Industrial Office	300 gsf/employee	2.4	
Industrial/Manufacturing	800 gsf/employee		6.3
Parking (spaces)	346	2.4	2.4
Total		**4.8**	**8.7**

Chester Residential

Under the No Build condition for the Project, about 2,029 households are anticipated in Chester by 2040. Under the Build condition, about 2,400 households are anticipated by 2040, an increase of 371 households. To calculate the land conversion for the indirect effects and cumulative impacts analysis, the following additional metrics were used: available land, housing supply, minimum lot size as outlined in the zoning ordinance.

A build out study was prepared for Chester as part of the NHDOT Community Technical Assistance Project considering future growth impacts to the region as related to I-93 widening project. The purpose of a build out study is to assess a town's future growth and development given the amount and capacity of available developable land and then estimates what the ultimate growth and development of the town could be considering various zoning standards. It is not intended to be a prediction of actual development that would occur by a particular date; rather, it is a hypothetical development capacity analysis. Using GIS-based Community Viz software and the town's existing zoning standards and the Generalized Future Land Use Map, the study estimated that the Town of Chester could experience a build out of 5,762 homes resulting in a future population of around 14,751 (Town of Chester, 2015). Based on the 2015 Chester Master Plan, about 5,471acres of developable land are available in Chester. The calculation of developable land is based on the amount of land zoned as General Residential/Agricultural less the natural constraints identified through a GIS analysis. Natural constraints include: hydric soils; steep slopes; Federal Emergency Management Agency-mapped floodplains; farm soils, and conservation lands. Based on the 2015 Chester Zoning Ordinance, the minimum lot size for single-family residences is 2 acres.

Table 5.3-6 shows the anticipated development footprints under the No Build and Build conditions. No range in footprint is provided under the No Build condition. Under the Build condition, the maximum footprint is based on the high growth scenario as outlined in the *Land Use Scenarios Technical Report*, and the minimum footprint is based on the moderate growth scenario as outlined in the *Land Use Scenarios Technical Report* (Appendix B).[23]

[23] The population and households calculated for the high growth scenario are anticipated to be the incremental effect of the Project, and these numbers are used in the population and household projections for the 2040 Build condition.

Table 5.3-6. Chester Residential Development Footprints

Scenario	Range	Households	Land Required (acres)
2040 No Build Condition	NA	2,029	4,058.0
2040 Build Condition Incremental Effect of Exit 4A	Low	178	356.0
	High	371	741.9
2040 Build Condition–Total	Low	2,207	4,414.0
	High	2,400	4,799.9

The maximum footprint of the 2040 Build condition footprints could be accommodated by the available, developable land in Chester (Town of Chester, 2015). Although the development footprints assumed using the minimum lot sizes, it is not possible to determine the limits of disturbance within each lot. As a result, spatial representations of the potential development footprints have not been created due to the variability of location of and disturbance required by these developments. For impact assessment purposes, the entire 2-acre lot is assumed to be disturbed. With larger lot development, some land would presumably not be disturbed; therefore, 2 acres of disturbance per household remains a reasonable assumption for larger lot sizes.

5.4 Indirect Effects and Cumulative Impacts

5.4.1 Methodology

Study Area Boundaries and Analysis Year

The study area for assessing cumulative impacts consists of the Towns of Derry, Londonderry, Chester, Auburn, and Sandown (Figure 5.2-1). This study area is appropriate for cumulative impact assessment because it encompasses the extent of direct and indirect impacts of the Project, as well as the surrounding areas and associated environmental resources.

Resources for Analysis

The detailed analysis of indirect and cumulative impacts is focused on those resources that could be substantially affected by the Project in combination with other past, present, and reasonably foreseeable future actions, and resources currently in poor or declining health or at risk even if Project effects are relatively small. The following resources were identified for inclusion in the indirect and cumulative impact analysis based on consideration of the status of each resource, the potential direct and indirect effects of the Project and areas of concern identified through previous Project public involvement and agency coordination:

- Streams, Wetlands, and Vernal Pools
- Water Quality
- Wildlife Habitat
- Cultural Resources

Because this Project incorporates indirect land use effects directly in the SNHPC transportation model, the traffic analysis presented in Section 4.2 constitutes a complete assessment of

cumulative impacts on traffic (including indirect land use effects and background growth that would occur regardless of the Project). The air quality and noise assessments used the traffic study outputs as inputs. Therefore, the air quality and noise assessments presented in Sections 4.4 and 4.5, respectively, constitute complete cumulative impact assessments.

Detailed Analysis Methodology

Indirect effects and cumulative impacts to resources were identified based on the aforementioned development footprints under the Build and No Build conditions. Direct impacts summarized in the resource sections include a range based on Build Alternatives. More detailed information on direct effects associated with each Build Alternative is provided in Chapter 4, *Affected Environment and Environmental Consequences*. In addition, cumulative impacts related to background growth under the No Build Alternative were considered qualitatively, taking into account the applicable regulatory framework for each environmental resource.

Resource Condition and Trends

For each resource selected for analysis, information on health, status, and trends was gathered from published reports and data available from USGS, USFWS, EPA, NHDES, NHFGD, and USDA, among others. This inventory meets the NEPA requirement to consider the impacts of past and present actions on resources as part of the cumulative impact analysis.

Impacts of Other Reasonably Foreseeable Future Actions

Cumulative impact analysis includes consideration of the impacts of the other reasonably foreseeable transportation projects and land development attributable to population and employment growth. Other projects and developments need to be included in the analysis if they are "reasonably foreseeable." Section 3.6.1 outlines the other transportation projects included as part of the 2040 No Build condition transportation network, and Section 5.3.1 lists the key major land development projects included in the No Build condition. The cumulative impact analysis considers other reasonably foreseeable public and private developments by using population and employment forecasts for the No Build and Build conditions. In addition, the reasonably foreseeable development within the immediate vicinity of Alternative A was quantified through the development footprints analysis (summarized in the "No Build Impact" columns in Table 5.4-1).

Table 5.4-1. Anticipated Development Footprints under the No Build and Build Conditions

Development	Minimum Footprint				Maximum Footprint			
	No Build Impact (acres)	Incremental Build Condition Impact		Build Condition Total Impact (Cumulative Impact [acres])	No Build Impact (acres)	Incremental Build Condition Impact		Build Condition Total Impact (Cumulative Impact [acres])
		Direct Effect (acres)	Indirect Effect (acres)			Direct Effect (acres)	Indirect Effect (acres)	
Exit 4A (footprint)	0	21.51-89.91	-	21.51-89.91	0	21.51-89.91	-	21.51-89.91
Woodmont Commons Phase I and Market Basket	79.1	-	-	79.1	79.1	-	-	79.1
Woodmont Commons West (Remainder)	75.0	-	10.7	85.7	103.2	-	124.9	228.1
Woodmont Commons East[1]	41.8	-	26.1	69.9	69.5	-	38.8	108.3
Derry Industrial Development	-	-	4.8	4.8	-	-	8.7	8.7
Total	**195.9**	**21.51-89.91**	**41.6**	**259.01-327.41**	**251.8**	**21.51-89.91**	**172.4**	**445.71-514.11**

Note: 1. For Woodmont Commons East, the Build condition is used for the analysis of Alternatives A and B. As discussed in Section 5.2.5, under Alternatives C, D, and F, Woodmont Commons East is anticipated to develop as outlined under the No Build condition.

Direct Impacts

Because direct impacts are considered as part of the Project contribution to cumulative impacts, a summary of these impacts is provided for each resource (based on the information presented in Chapter 4).

Indirect Effects

Section 5.2, *Land Use Forecasting*, provides a detailed review of the methods used to assess indirect land use effects of the Project. As detailed in Section 5.2.5 and Table 5.2-5, changes in land use associated with Alternative A include an increase in commercial and industrial development in Derry; additional residential, commercial, and institutional development associated with Woodmont Commons west and east of I-93 in Londonderry; and increased residential development in Chester and Sandown. Nearly all of these land use changes involve the conversion of undeveloped land to developed uses. The additional commercial and industrial development in Derry would involve redevelopment of currently developed land. Table 5.4-1 provides a summary of the minimum and maximum development footprints associated with known developments in the study area. The footprints associated with the conversion in land use were used to calculate impacts to other resources within the study area. In all cases, development permits from the towns would be required, which would ensure that land use changes are compatible with existing and planned land use and zoning.

Potential for Cumulative Impacts

The cumulative impact assessment for each resource draws conclusions about the aggregate or total impact on each resource as a result of all the actions included in the No Build condition, plus the direct and indirect impacts of the Project. These conclusions regarding cumulative impacts take into account the status of each resource (the result of past and present actions), and countervailing trends, such as restoration programs and environmental regulations, that could lead to overall improvements in the status of a resource, even though it is being impacted by development.

5.4.2 Streams, Wetlands, and Vernal Pools

Resource Condition and Trends

Methodological issues exist with comparing historical wetland acreage between various studies to form a comprehensive timeline of past resource conditions. One study (Economic Research Service/USDA, 1998) that attempted to adjust for these differences estimated that there were about 599,400 acres of wetlands in New Hampshire in 1780, and 132,800 acres or 22 percent of these were converted to other uses between 1780 and 1954. During this time period, most wetland conversion was for agriculture and encouraged by federal policy. From 1954 to 1982, the acreage of wetlands in New Hampshire is estimated to have increased by about 23,100 acres to 489,700 acres. This increase was likely the result of the abandonment of less productive agricultural land. Between 1982 and 1992, the area of wetlands in New Hampshire is estimated to have decreased by about 13,600 acres or 2.7 percent. These wetland impacts were primarily associated with urban development. Wetland losses in more recent years have been greatly

slowed in comparison to past impacts by regulatory protections, including Section 404 of the CWA and the New Hampshire Wetland Rules.

The NWI estimates that there are 12,098 acres of wetlands (including waterbodies/streams) in the study area, covering 12.8 percent of the total area. No similar study area-wide data are available on the presence of vernal pools. However, vernal pools have been delineated in the Woodmont Commons East area (see Figures 4.12-8 and 4.12-9).

Impacts from Other Actions

Development activity unrelated to the Project at Woodmont Commons Phase I and Market Basket, and Woodmont Commons West (Remainder) would not result in impacts to streams, wetlands, or vernal pools. Development activity unrelated to the Project at Woodmont Commons East could impact 0.16 to 0.17 acre of non-prime, non-vernal-pool wetlands, 0.007 to 0.009 acre of vernal pools, and 302 linear feet of streams (Tables 5.4-2–5.4.10). No prime wetlands would be affected by this development activity.

Of the parcels containing the known developments considered in this analysis, vernal pools are only mapped on property identified as the Woodmont Commons East development. In addition to the potential vernal pool impacts, potential impacts to terrestrial habitat adjacent to vernal pools were evaluated. Development unrelated to the Project could impact 0.62 to 1.05 acres of terrestrial habitat within 100 feet of vernal pools and 38.56 to 65.52 acres of terrestrial habitat within 750 feet of vernal pools (Tables 5.4-11–5.4-13).

Direct Impacts

As detailed in Section 4.12, the Project would impact between 152 and 2,281 linear feet of streams; Alternative A would impact 2,281 linear feet of streams. The Project would directly impact between zero and 8.85 acres of non-prime, non-vernal-pool wetlands; Alternative A would fill 3.13 acres. The Project would directly fill between zero and 0.07 acre of prime wetlands; Alternative A would fill 0.07 acre. The Project would directly impact between 0 and eight vernal pools, totaling 0 to 1.15 acres; Alternative A would impact eight vernal pools, totaling 1.15 acres. Direct impacts to upland habitat within 100 feet and 750 feet that would be affected around each vernal pool were quantified for each Alternative and are provided in Section 4.12. Alternative A would impact upland within 100 feet of five vernal pools and upland within 750 feet of 25 vernal pools (many of which are overlapping).

Indirect Effects

Induced Development

Depending on the Build Alternatives and range of footprints for future development projects, additional development induced by the Project at Woodmont Commons East and West (Remainder) would impact 2 to 73 linear feet of streams, 0.01 to 0.65 acre of non-prime, non-vernal-pool wetlands, and zero to 0.435 acre of vernal pools. No prime wetlands would be affected by development induced by the Project.

Within a 100-foot buffer of the vernal pools, development induced by the Project within Woodmont Commons East could impact between zero and 6.75 acres of adjacent terrestrial habitat. Within a 750-foot buffer of the vernal pools, development induced by the Project within

Woodmont Commons East could impact between 22.10 and 32.38 acres of adjacent terrestrial habitat.

The Derry industrial development anticipated to be induced would not impact streams, wetlands, or vernal pools. Additional indirect effects could occur as result of increased residential development in Chester, but insufficient detailed information is available to quantify the impact in Chester. Most mapped wetlands would be avoided in Project planning and permitting. Any effect would be small in comparison to the land development expected in the study area under the No Build condition. In addition, any additional impacts would be subject to compensatory mitigation to offset impacts.

Habitat Alteration and Encroachment

In addition to development that could be induced by the Project, other indirect effects include habitat alteration and encroachment related to the direct impacts resulting from the Project. Impacts to wetlands, including vernal pools, may result from changes in hydrology from stormwater directed to wetlands from the Project, fragmentation of habitat used by wetland-dwelling wildlife, edge effects from removal of vegetation next to wetlands, and noise and light disturbance once the road is operational. Impacts to the 100-foot VPE and 750-foot CTH for each vernal pool are quantified in Section 4. Fragmentation of habitat is included as an impact in the vernal pool habitat analysis.

Potential for Cumulative Impacts

No direct impacts to surface waters (i.e., ponds, lakes) would occur under any of the alternatives or as a result of the known developments. Woodmont Commons West (Remainder) involves the creation of a pond within the minimum and maximum development footprints under the Build and No Build conditions. The following tables show the range of indirect effects and cumulative impacts on streams, wetlands, and vernal pools based on the Build Alternatives:

- Tables 5.4-2 through 5.4.4—streams
- Tables 5.4-5 through 5.4-7—non-vernal pool wetlands
- Tables 5.4-8 through 5.4-10—vernal pools
- Tables 5.4-11 through 5.4-13—terrestrial habitat adjacent to vernal pools

Under the No Build condition, considering maximum footprints, reasonably foreseeable development could impact about 302 linear feet of streams; 0.16 to 0.17 acre of non-prime, non-vernal-pool wetlands; and 0.007 to 0.009 acre of vernal pools. Additionally, within a 100-foot buffer of the vernal pools, development under the No Build condition could impact 1.05 acres of adjacent terrestrial habitat. Within a 750-foot buffer of the vernal pools, development induced by the Project within Woodmont Commons East could impact 65.52 acres of adjacent terrestrial habitat.

Depending on Build Alternative, considering maximum footprints, the incremental impact of induced development from the Project could impact 20 to 73 linear feet of streams; 0.00 to 10.23 acres of non-prime, non-vernal-pool wetlands; and zero to 1.15 acres of vernal pools.

Cumulative impacts from reasonably foreseeable development under the Build condition, considering maximum footprints, could impact between 475 and 2,656 linear feet of streams;

1.23 and 10.23 acres of non-prime, non-vernal-pool wetlands; zero to 0.07 acre of prime wetlands); and 0.009 to 1.595 acres of vernal pools.

Additionally, cumulative impacts from reasonably foreseeable development under the Build condition, considering maximum footprints, could impact between 1.05 and 12.26 acres of terrestrial habitat within a 100-foot buffer of the vernal pools and between 68.44 and 118.0 acres of terrestrial habitat within a 750-foot buffer of the vernal pools. Under Alternative A, considering the maximum footprints, the cumulative impact on streams, wetlands, and vernal pools includes:

- 2,656 linear feet of streams;
- 4.56 acres of non-prime, non-vernal-pool wetlands;
- 0.07 acre of prime wetlands;
- 1.595 acres of vernal pools;
- 12.17 acres of terrestrial habitat within 100 feet of vernal pools; and
- 116.28 acres of terrestrial habitat within 750 feet of vernal pools.

In addition, development projects can result in impacts on adjacent water bodies and the areas surrounding water bodies from alteration of stream geomorphology, loss of structural complexity, changes to stream hydraulics, reduction of stream flow, shading by engineered structures, vegetation clearing, changes in water temperature and DO, and increased pollutant loading. These impacts can result in loss or degradation of aquatic habitat.

A Section 404 permit would be required for developments impacting streams, wetlands, and vernal pools. As noted in Appendix L, *Consideration of Woodmont Commons East Aquatic Resource Impacts and Mitigation for NEPA and Section 404 Permitting*, USACE's Section 404 permitting regulations require that "All compensatory mitigation will be for significant resource losses which are specifically identifiable, reasonably likely to occur, and of importance to the human or aquatic environment. Also, all mitigation will be directly related to the impacts of the proposal, appropriate to the scope and degree of those impacts, and reasonably enforceable" (33 CFR 320). Developers would have to obtain separate Section 404 permits for each individual development and demonstrate that their development proposal avoids and minimizes impacts to the extent practicable in accordance with Section 404 (b)(1) guidelines. Mitigation measures commensurate with the level of impacts to wetland resources would be developed by the private developer to compensate for unavoidable impacts to water resources. Mitigation would be in accordance with NH RSA 482-A:28 and NHDES Wetland Rules and with federal Section 404 guidelines in 40CFR (b)(1).

Table 5.4-2. Indirect Effects and Cumulative Impacts to Streams Based on Alternative A

Development		No Build Condition Impact (linear feet)	Incremental Build Condition Impact		Build Condition Cumulative Impact (linear feet)
			Direct Effect (linear feet)	Indirect Effect (linear feet)	
Exit 4A (Alternative A Footprint)		-	2,281	-	2,281
Woodmont Commons Phase I and Market Basket		-	-	-	0
Woodmont Commons West (Remainder)	Minimum Footprint	-	-	-	0
	Maximum Footprint	-	-	20	20
Woodmont Commons East	Minimum Footprint	302	-	2	304
	Maximum Footprint	302	-	53	355
Derry Industrial	Minimum Footprint	-	-	-	0
	Maximum Footprint	-	-	-	0
Total	**Minimum Footprint**	**302**	**2,281**	**2**	**2,585**
	Maximum Footprint	**302**	**2,281**	**73**	**2,656**

Table 5.4-3. Indirect Effects and Cumulative Impacts to Streams Based on Alternative B

Development		No Build Condition Impact (linear feet)	Incremental Build Condition Impact		Build Condition Cumulative Impact (linear feet)
			Direct Effect (linear feet)	Indirect Effect (linear feet)	
Exit 4A (Alternative B Footprint)		-	1,341	-	1,341
Woodmont Commons Phase I and Market Basket		-	-	-	0
Woodmont Commons West (Remainder)	Minimum Footprint	-	-	-	0
	Maximum Footprint	-	-	20	20
Woodmont Commons East	Minimum Footprint	302	-	2	304
	Maximum Footprint	302	-	2	304
Derry Industrial	Minimum Footprint	-	-	-	0
	Maximum Footprint	-	-	-	0
Total	**Minimum Footprint**	**302**	**1,341**	**2**	**1,645**
	Maximum Footprint	**302**	**1341**	**22**	**1,665**

Table 5.4-4. Indirect Effects and Cumulative Impacts to Streams Based on Alternatives C, D, and F

Development		No Build Condition Impact (linear feet)	Incremental Build Condition Impact		Build Condition Cumulative Impact (linear feet)
			Direct Effect (linear feet)	Indirect Effect (linear feet)	
Exit 4A (Alternative C Footprint)		-	562	-	553
Exit 4A (Alternative D Footprint)		-	557	-	575
Exit 4A (Alternative F Footprint)		-	153	-	152
Woodmont Commons Phase I and Market Basket		-	-	-	0
Woodmont Commons West (Remainder)	Minimum Footprint	-	-	-	0
	Maximum Footprint	-	-	20	20
Woodmont Commons East	Minimum Footprint	302	-	-	302
	Maximum Footprint	302	-	-	302
Derry Industrial	Minimum Footprint	-	-	-	0
	Maximum Footprint	-	-	-	0
Alternative C Total	**Minimum Footprint**	**302**	**562**	**0**	**864**
	Maximum Footprint	**302**	**562**	**20**	**884**
Alternative D Total	**Minimum Footprint**	**302**	**557**	**0**	**859**
	Maximum Footprint	**302**	**557**	**20**	**879**
Alternative F Total	**Minimum Footprint**	**302**	**153**	**0**	**455**
	Maximum Footprint	**302**	**153**	**20**	**475**

Table 5.4-5. Indirect Effects and Cumulative Impacts to Non-prime, Non-vernal-pool Wetlands Based on Alternative A

Development		No Build Condition Impact (acres)	Incremental Build Condition Impact		Build Condition Cumulative Impact (acres)
			Direct Effect (acres)	Indirect Effect (acres)	
Exit 4A (Alternative A Footprint)		-	3.13	-	3.13
Woodmont Commons Phase I and Market Basket		-	-	-	0.00
Woodmont Commons West (Remainder)	Minimum Footprint	-	-	-	0.00
	Maximum Footprint	-	-	0.65	0.65
Woodmont Commons East	Minimum Footprint	0.16	-	0.01	0.17
	Maximum Footprint	0.17	-	0.20	0.37
Derry Industrial	Minimum Footprint	-	-	-	0.00
	Maximum Footprint	-	-	0.41	0.41
Total	**Minimum Footprint**	**0.16**	**3.13**	**0.01**	**3.30**
	Maximum Footprint	**0.17**	**3.13**	**1.26**	**4.56**

Table 5.4-6. Indirect Effects and Cumulative Impacts to Non-prime, Non-vernal-pool Wetlands Based on Alternative B

Development		No Build Condition Impact (acres)	Incremental Build Condition Impact		Build Condition Cumulative Impact (acres)
			Direct Effect (acres)	Indirect Effect (acres)	
Exit 4A (Alternative B Footprint)		-	8.85	-	8.85
Woodmont Commons Phase I and Market Basket		-	-	-	0.00
Woodmont Commons West (Remainder)	Minimum Footprint	-	-	-	0.00
	Maximum Footprint	-	-	0.65	0.65
Woodmont Commons East	Minimum Footprint	0.16	-	-	0.16
	Maximum Footprint	0.17	-	0.15	0.32
Derry Industrial	Minimum Footprint	-	-	-	0.00
	Maximum Footprint	-	-	0.41	0.41
Total	**Minimum Footprint**	**0.16**	**8.85**	**0.00**	**9.01**
	Maximum Footprint	**0.17**	**8.85**	**1.21**	**10.23**

Table 5.4-7. Indirect Effects and Cumulative Impacts to Non-prime, Non-vernal-pool Wetlands Based on Alternatives C, D, and F

Development		No Build Condition Impact (acres)	Incremental Build Condition Impact		Build Condition Cumulative Impact (acres)
			Direct Effect (acres)	Indirect Effect (acres)	
Exit 4A (Alternative C Footprint)		-	8.40	-	8.40
Exit 4A (Alternative D Footprint)		-	3.60	-	3.60
Exit 4A (Alternative F Footprint)		-	0.00	-	0.00
Woodmont Commons Phase I and Market Basket		-	-	-	0.00
Woodmont Commons West (Remainder)	Minimum Footprint	-	-	-	0.00
	Maximum Footprint	-	-	0.65	0.65
Woodmont Commons East	Minimum Footprint	0.16	-	-	0.16
	Maximum Footprint	0.17	-	-	0.17
Derry Industrial	Minimum Footprint	-	-	-	0.00
	Maximum Footprint	-	-	0.41	0.41
Alternative C Total	**Minimum Footprint**	**0.16**	**8.40**	**0.00**	**8.56**
	Maximum Footprint	**0.17**	**8.40**	**1.06**	**9.63**
Alternative D Total	**Minimum Footprint**	**0.16**	**3.60**	**0.00**	**3.76**
	Maximum Footprint	**0.17**	**3.60**	**1.06**	**4.83**
Alternative F Total	**Minimum Footprint**	**0.16**	**0.00**	**0.00**	**0.16**
	Maximum Footprint	**0.17**	**0.00**	**1.06**	**1.23**

Table 5.4-8. Indirect Effects and Cumulative Impacts to Vernal Pools Based on Alternative A

Development		No Build Condition Impact (acres)	Incremental Build Condition Impact		Build Condition Cumulative Impact (acres)
			Direct Effect (acres)	Indirect Effect (acres)	
Exit 4A (Alternative A Footprint)		-	1.151	-	1.151
Woodmont Commons Phase I and Market Basket		-	-	-	0.000
Woodmont Commons West (Remainder)	Minimum Footprint	-	-	-	0.000
	Maximum Footprint	-	-	-	0.000
Woodmont Commons East	Minimum Footprint	0.007	-	0.000	0.007
	Maximum Footprint	0.009	-	0.435	0.444
Derry Industrial	Minimum Footprint	-	-	-	0.000
	Maximum Footprint	-	-	-	0.000
Total	**Minimum Footprint**	**0.007**	**1.151**	**0.000**	**1.158**
	Maximum Footprint	**0.009**	**1.151**	**0.435**	**1.595**

Table 5.4-9. Indirect Effects and Cumulative Impacts to Vernal Pools Based on Alternative B

Development		No Build Condition Impact (acres)	Incremental Build Condition Impact		Build Condition Cumulative Impact (acres)
			Direct Effect (acres)	Indirect Effect (acres)	
Exit 4A (Alternative B Footprint)		-	1.091	-	1.091
Woodmont Commons Phase I and Market Basket		-	-	-	0.000
Woodmont Commons West (Remainder)	Minimum Footprint	-	-	-	0.000
	Maximum Footprint	-	-	-	0.000
Woodmont Commons East	Minimum Footprint	0.007	-	0.000	0.007
	Maximum Footprint	0.009	-	0.315	0.324
Derry Industrial	Minimum Footprint	-	-	-	0.000
	Maximum Footprint	-	-	-	0.000
Total	**Minimum Footprint**	**0.007**	**1.091**	**0.000**	**1.098**
	Maximum Footprint	**0.009**	**1.091**	**0.315**	**1.415**

Table 5.4-10. Indirect Effects and Cumulative Impacts to Vernal Pools Based on Alternatives C, D, and F

Development		No Build Condition Impact (acres)	Incremental Build Condition Impact		Build Condition Cumulative Impact (acres)
			Direct Effect (acres)	Indirect Effect (acres)	
Exit 4A (Alternative C Footprint)		-	0.274	-	0.274
Exit 4A (Alternative D Footprint)		-	0.286	-	0.286
Exit 4A (Alternative F Footprint)		-	0.000	-	0.000
Woodmont Commons Phase I and Market Basket		-	-	-	0.000
Woodmont Commons West (Remainder)	Minimum Footprint	-	-	-	0.000
	Maximum Footprint	-	-	-	0.000
Woodmont Commons East	Minimum Footprint	0.007	-	-	0.007
	Maximum Footprint	0.009	-	-	0.009
Derry Industrial	Minimum Footprint	-	-	-	0.000
	Maximum Footprint	-	-	-	0.000
Alternative C Total	**Minimum Footprint**	**0.007**	**0.274**	**0.000**	**0.281**
	Maximum Footprint	**0.009**	**0.274**	**0.000**	**0.283**
Alternative D Total	**Minimum Footprint**	**0.007**	**0.286**	**0.000**	**0.293**
	Maximum Footprint	**0.009**	**0.286**	**0.000**	**0.295**
Alternative F Total	**Minimum Footprint**	**0.007**	**0.000**	**0.000**	**0.007**
	Maximum Footprint	**0.009**	**0.000**	**0.000**	**0.009**

Table 5.4-11. Indirect Effects and Cumulative Impacts to Terrestrial Habitat Adjacent to Vernal Pools Associated with Alternative A

Development		Vernal Pool Buffer	No Build Condition Impact (acres)	Incremental Build Condition Impact		Build Condition Cumulative Impact (acres)
				Direct Effect (acres)	Indirect Effect (acres)	
Exit 4A (Alternative A footprint)		100-foot	-	4.37	-	4.37
		750-foot	-	18.38	-	18.38
Woodmont Commons Phase I and Market Basket		100-foot	-	-	-	0.00
		750-foot	-	-	-	0.00
Woodmont Commons West (Remainder)	Minimum Footprint	100-foot	-	-	-	0.00
		750-foot	-	-	-	0.00
	Maximum Footprint	100-foot	-	-	-	0.00
		750-foot	-	-	-	0.00
Woodmont Commons East	Minimum Footprint	100-foot	0.62	-	0.55	1.17
		750-foot	38.56	-	21.75	60.31
	Maximum Footprint	100-foot	1.05	-	6.75	7.80
		750-foot	65.52	-	29.48	95.00
Derry Industrial	Minimum Footprint	100-foot	-	-	-	0.00
		750-foot	-	-	0.35	0.35
	Maximum Footprint	100-foot	-	-	-	0.00
		750-foot	-	-	2.90	2.90
Total	**Minimum Footprint**	**100-foot**	**0.62**	**4.37**	**0.55**	**5.54**
		750-foot	**38.56**	**18.38**	**22.10**	**79.04**
	Maximum Footprint	**100-foot**	**1.05**	**4.37**	**6.75**	**12.17**
		750-foot	**65.52**	**18.38**	**32.38**	**116.28**

Table 5.4-12. Indirect Effects and Cumulative Impacts to Terrestrial Habitat Adjacent to Vernal Pools Associated with Alternative B

Development		Vernal Pool Buffer	No Build Condition Impact (acres)	Incremental Build Condition Impact		Build Condition Cumulative Impact (acres)
				Direct Effect (acres)	Indirect Effect (acres)	
Exit 4A (Alternative B footprint)		100-foot	-	5.15		5.15
		750-foot	-	19.10		19.10
Woodmont Commons Phase I and Market Basket		100-foot	-	-	-	0.00
		750-foot	-	-	-	0.00
Woodmont Commons West (Remainder)	Minimum Footprint	100-foot	-	-	-	0.00
		750-foot	-	-	-	0.00
	Maximum Footprint	100-foot	-	-	-	0.00
		750-foot	-	-	-	0.00
Woodmont Commons East	Minimum Footprint	100-foot	0.62	-	0.55	1.17
		750-foot	38.56	-	23.58	62.14
	Maximum Footprint	100-foot	1.05	-	6.06	7.11
		750-foot	65.52	-	30.53	96.05
Derry Industrial	Minimum Footprint	100-foot	-	-	-	0.00
		750-foot	-	-	0.35	0.35
	Maximum Footprint	100-foot	-	-	-	0.00
		750-foot	-	-	2.85	2.85
Total	**Minimum Footprint**	**100-foot**	**0.62**	**5.15**	**0.55**	**6.32**
		750-foot	**38.56**	**19.10**	**23.93**	**81.59**
	Maximum Footprint	**100-foot**	**1.05**	**5.15**	**6.06**	**12.26**
		750-foot	**65.52**	**19.10**	**33.38**	**118.00**

Table 5.4-13. Indirect Effects and Cumulative Impacts to Terrestrial Habitat Adjacent to Vernal Pools Associated with Alternatives C, D, and F

Development		Vernal Pool Buffer	No Build Condition Impact (acres)	Incremental Build Condition Impact		Build Condition Cumulative Impact (acres)
				Direct Effect (acres)	Indirect Effect (acres)	
Exit 4A (Alternative C footprint)		100-foot	-	2.83	-	2.83
		750-foot	-	23.24	-	23.24
Exit 4A (Alternative D footprint)		100-foot	-	2.96	-	2.96
		750-foot	-	23.84	-	23.84
Exit 4A (Alternative F footprint)		100-foot	-	0.00	-	0.00
		750-foot	-	0.00	-	0.00
Woodmont Commons Phase I and Market Basket		100-foot	-	-	-	0.00
		750-foot	-	-	-	0.00
Woodmont Commons West (Remainder)	Minimum Footprint	100-foot	-	-	-	0.00
		750-foot	-	-	-	0.00
	Maximum Footprint	100-foot	-	-	-	0.00
		750-foot	-	-	-	0.00
Woodmont Commons East	Minimum Footprint	100-foot	0.62	-	-	0.62
		750-foot	38.56	-	-	38.56
	Maximum Footprint	100-foot	1.05	-	-	1.05
		750-foot	65.52	-	-	65.52
Derry Industrial	Minimum Footprint	100-foot	-	-	-	0.00
		750-foot	-	-	0.35	0.35
	Maximum Footprint	100-foot	-	-	-	0.00
		750-foot	-	-	2.92	2.92
Alternative C Total	**Minimum Footprint**	**100-foot**	**0.62**	**2.83**	**0.00**	**3.45**
		750-foot	**38.56**	**23.24**	**0.35**	**62.15**
	Maximum Footprint	**100-foot**	**1.05**	**2.83**	**0.00**	**3.88**
		750-foot	**65.52**	**23.24**	**2.92**	**91.68**
Alternative D Total	**Minimum Footprint**	**100-foot**	**0.62**	**2.96**	**0.00**	**3.58**
		750-foot	**38.56**	**23.84**	**0.35**	**62.75**
	Maximum Footprint	**100-foot**	**1.05**	**2.96**	**0.00**	**4.01**
		750-foot	**65.52**	**23.84**	**2.92**	**92.28**
Alternative F Total	**Minimum Footprint**	**100-foot**	**0.62**	**0.00**	**0.00**	**0.62**
		750-foot	**38.56**	**0.00**	**0.35**	**38.91**
	Maximum Footprint	**100-foot**	**1.05**	**0.00**	**0.00**	**1.05**
		750-foot	**65.52**	**0.00**	**2.92**	**68.44**

5.4.3 Water Quality

Resource Condition and Trends

The study area is located within the Lower Merrimack River basin. The Merrimack River forms in New Hampshire from the confluence of the Pemigewasset and the Winnipesaukee Rivers and flows through Massachusetts, where it empties into the Atlantic Ocean in Newburyport.

During the early to mid-20th century, rivers in New England were polluted by untreated municipal and industrial sewage released directly into surface waters. Pulp, paper, and other mills were major water pollution sources. Water quality in the study area has improved dramatically in the past 50 years as a result of economic changes, the CWA, and other programs that have required the treatment of wastewater, eliminated phosphate in detergents, and reduced use of phosphorous fertilizer by farmers. For example, mean annual total phosphorous concentrations in Merrimack River have decreased 38 percent from 0.13 mg/L (1967–1984 average) to 0.08 mg/L (1985–2000 average) (USGS, 2003). Nitrate concentrations in the Merrimack River, while substantially higher than in the early 1900s, have also decreased in the last 20 years.

Chloride is a pollutant of concern in New England. In the Merrimack River the mean-annual chloride concentration increased 760 percent from 2.9 mg/L (1900−17 average) to 24.9 mg/L (1976–1995 average) (USGS, 2003). This increase is attributed to deicing salt applications to roadways, parking lots and other impervious surfaces. However, chloride concentrations in the Merrimack River are still well below the chronic standard of 230 mg/L.

As discussed in Section 4.11, the Project lies within the Upper Beaver Brook watershed. Beaver Brook, south of the Project, flows west under I-93 and then south into Massachusetts where it joins the Merrimack River in Lowell. Upper Beaver Brook has been subject to water quality investigations since 2003 in response to proposed development in the watershed, including widening and improvements to I-93 (NHDES, 2008a).

NHDES oversees regulatory programs and other initiatives designed to protect and restore the quality of the surface and groundwater resources in New Hampshire. These programs include stormwater discharge permits, shoreland protection standards, AoT permits, drinking water source protection, surface water quality assessment, and TMDL programs, among others. A detailed review of the regulatory framework for water resources is provided in Section 4.11.1.

Impacts from Other Actions

Under the No Build Alternative, impacts to water quality from nutrient loading, sediment, and chloride are possible due to other projects and residential and commercial growth, and the corresponding increases in impervious surface cover and stormwater runoff. As noted in Table 5.4-1, the anticipated footprints for known developments under the No Build Alternative range from 196 to 252 acres. A portion of this development would be impervious surfaces. Impacts would be moderated to a large extent by federal and state regulations designed to protect and improve existing water quality.

Direct Impacts

An analysis of impacts to water quality, including pollutant loading in the Beaver Brook watershed directly attributable to the Project is provided in Section 4.11. The increase in

impervious surface with the Project is anticipated to be in the range of 3.0–27.4 additional acres, with Alternative A requiring 21.4 additional acres of impervious surface. The additional phosphorous, nitrogen, chloride, and TSS loads that would be incurred by each Alternative are also provided in Section 4.11.

Indirect Effects

Chloride

This analysis assumes a range of footprints of Woodmont Commons with separate accountings for Woodmont Commons East and Woodmont Commons West (including Market Basket expansion) to clearly account for the two related but separate actions. A separate estimate for additional Derry Industrial development is also provided. New private road lane-miles and parking acreage were determined based on the documentation provided in the *Land Use Scenarios Technical Report* (Appendix B). Determinations for parking were made by assuming a 300 square-foot requirement for each expected parking space, including travel aisles associated with the parking spaces. For new private roadways, each divided roadway length was assumed to equal a single lane length, and each non-divided roadway length was assumed to equal two lane lengths. Thus, the total mileage of divided streets was multiplied by one, and non-divided street mileage was multiplied by two to yield total lane-miles. Existing roadways within Woodmont Commons were assumed to receive no additional salt loading, even if those roadways were to be upgraded, except when additional lane-miles were proposed.

Residential development is not included in this calculation because the nature of residential development, including lot size and road layout, is not foreseeable. Chester is anticipated to have the largest proportion of increase in residential development, where approximately 11 percent of the town (1,784 acres) falls into the Upper Beaver Brook watershed.

Total Suspended Solids and Nutrients

As with the chloride analysis, the analysis of TSS and nutrients assumes a range of footprints for Woodmont Commons with separate accountings for Woodmont Commons East and Woodmont Commons West (including Market Basket expansion). A separate estimate for additional Derry Industrial development is also provided. The anticipated development footprints presented in Table 5.4-1 were used to determine pollutant loads resulting under the No Build and Build conditions. The total footprint acreages were entered into the NHDES SIMPLE method spreadsheet model (NHDES, 2015b) to determine an estimated pollutant load. For the SIMPLE model, we assumed annual rainfall of 40 inches, a runoff fraction of 0.9, land use category of "Residential (general)" as this land use category is more conservative (i.e., greater pollutant load impact) than other potentially viable land use categories, and 50 percent impervious area. These criteria result in estimated loading rates of 406.8 lbs/acre/year TSS; 1.6 lbs/acre/year total phosphorous; and 8.9 lbs/acre/year TN.

Results

The new parking and private roadways associated with known future developments are summarized in Table 5.4-14.

Table 5.4-14. Indirect Impacts New Parking and Roadways Summary

Develop-ment Activity	No Build Condition			Build Condition			Incremental Development Attributable to Exit 4A		
	Parking (acres)	Min Footprint Lane Miles	Max Footprint Lane Miles	Parking (acres)	Min Footprint Lane Miles	Max Footprint Lane Miles	Parking (acres)	Min Footprint Lane Miles	Max Footprint Lane Miles
Woodmont Commons East	4.70	4.43	6.18	26.38	6.14	7.53	21.69	1.71	1.35
Woodmont Commons West	19.17	6.14	8.32	27.20	7.11	19.93	8.02	0.97	11.60
Additional Derry Industrial	0	0	0	2.38	0	0	2.38	0	0

The Woodmont Commons West and East developments will contribute to future chloride loading in the Beaver Brook watershed. Chloride loading for parking was determined using the application rate used in the *Data Report for the Total Maximum Daily Loads for Chloride for Waterbodies in the Vicinity of the I-93 Corridor from Massachusetts to Manchester, NH: Policy-Porcupine Brook Beaver Brook Dinsmore Brook North Tributary to Canobie Lake* (NHDES, 2007) of 6.4 tons/acre/year. This rate is in turn based on an analysis of salt use by maintainers of private roads and parking lots that was specifically prepared for the Beaver Brook TMDL titled "Salt Loading Due to Private Winter Maintenance Practices" (Sassan and Kahl, 2007). Sassan and Kahl established a range of 5.7–6.4 tons/acre/year, with 6.4 tons/acre/year being the average rate for educational institutions which had the best records of salt purchases and areas serviced. Sassan and Kahl acknowledge that there is a high degree of variability in salt application rate reporting from private applicators.

Chloride loading for new streets was determined from new lane-miles. Each divided roadway length was assumed to equal a single lane length, and each non-divided roadway length was assumed to equal two lane lengths. Thus, the total mileage of divided streets was multiplied by one, and non-divided street mileage was multiplied by two to yield total lane-miles. Existing roadways within Woodmont Commons were assumed to receive no additional salt loading, even if those roadways were to be upgraded, except when additional lane-miles were proposed. When additional lanes miles were added to existing roadways, the new lane-miles were added to the new lane-miles calculation. New chloride loading was determined using the average FY08–FY16 municipal rates, per methods described in Section 3.3.

Table 5.4-15. Salt Loading Attributable to Indirect Impacts (Tons/Year)

Develop-ment Activity	No Build Condition			Build Condition			Incremental Development Attributable to Exit 4A		
	Parking	Min Footprint	Max Footprint	Parking	Min Footprint	Max Footprint	Parking	Min Footprint	Max Footprint
Woodmont Commons East	30.1	47.0	65.5	168.9	65.1	79.8	138.8	18.2	14.3
Woodmont Commons West	122.7	65.1	88.2	174.1	75.4	211.2	51.3	10.3	123.0
Additional Derry Industrial	0.0	0.0	0.0	15.3	0.0	0.0	15.3	0.0	0.0
Total	**152.8**	**112.1**	**153.7**	**358.2**	**140.6**	**291.0**	**205.4**	**28.5**	**137.3**
Potential Additional Salt Load Range	***264.8–306.5 tons/year***			***498.7–649.2 tons/year***			***233.9–342.7 tons/year***		

Under these scenarios, the salt loading from incremental development attributable to the construction of Exit 4A could range from 233.9 tons/year to 342.7 tons/year. All future development (including additional development induced by construction of Exit 4A) will require implementation of reasonable and practical BMPs to reduce chloride loading, consistent with the Chloride Reduction Plans required in the MS4 permit and/or AoT permitting (as was required for Woodmont Commons Phase I, included in the *Chloride Technical Report*). The 2017 MS4 permit has additional requirements for private sector salt applicators including requiring all existing and future private parking lot and private roadway owners to only utilize salt applicators who are trained and certified according to Env-Wq-2203 Certification of Commercial Applicators, report annual salt usage to the University of New Hampshire Technology Transfer Center or to the MS4 permittee, and include the private sector in a MS4 permittee's Chloride Reduction Plan. These measures will ensure reduction of salt loads in the private sector including indirect impacts as well as watershed-wide impacts.

New development attributable to indirect Project impacts would result in new impervious surface within Upper Beaver Brook watershed. The addition of new impervious surfaces which contribute stormwater runoff to surface waters has the potential to add new TSS and nutrient loads to the watershed. The anticipated development footprints under the no build and build conditions were entered into the NHDES SIMPLE method spreadsheet model (NHDES, 2015b) to determine the potential pollutant load that could result from the foreseeable new actions. The results of the SIMPLE method analysis are presented in Table 5.4-16 for a range of development scenarios including no build, build, and incremental development and for each development activity presented as the range of potential pollutant load based on the anticipated minimum and maximum development footprints.

Table 5.4-16. Pollutant Loading Attributable to Indirect Impacts Based on Anticipated Minimum and Maximum Development Footprints (lbs/Year)

Develop-ment Activity	No Build Condition			Build Condition			Incremental Development Attributable to Exit 4A		
	TP (lbs/ year)	TN (lbs/ year)	TSS (lbs/ year)	TP (lbs/ year)	TN (lbs/ year)	TSS (lbs/ year)	TP (lbs/ year)	TN (lbs/ year)	TSS (lbs/ year)
Woodmont Commons East	191–236	1,700–2,102	691,664–855,022	208–436	1,853–3,880	753,647–1,578,547	17–200	152–1,779	61,983–723,525
Woodmont Commons West	67–111	595–990	242,140–402,602	109–173	967–1,542	393,333–627,364	42–62	372–553	151,193–224,762
Additional Derry Industrial	0–0	0–0	0–0	8–14	68–124	27,806–50,398	8–14	68–124	27,806–50,398
Total	**258–347**	**2,295–3,092**	**933,805–1,257,624**	**324–623**	**2,888–5,546**	**1,174,786–2,256,308**	**67–276**	**592–2,455**	**240,982–998,684**

Notes: TP = total phosphorous, TN = total nitrogen, TSS = total suspended solids

Potential for Cumulative Impacts

Cumulative effects to water quality could occur from the ongoing developments in Woodmont Commons East and West that are planned with or without the Project, the construction of Exit 4A, and the development that is anticipated to occur attributable to the Project (summarized under development scenarios with Exit 4A in Table 5.4-16), and additional development that may occur within the Beaver Brook watershed not yet anticipated. All new development would be subject to state and federal permitting requirements to manage pollutants within the watershed.

5.4.4 Plant Communities and Wildlife

Resource Condition and Trends

During the 1700s and 1800s, a majority of the forested land in New Hampshire was cleared for agriculture. In addition to habitat loss, many fish and wildlife species were extirpated by overhunting and fishing. The condition of forests and many other types of wildlife habitat have greatly improved since the early 1900s, as a result of declines in the area devoted agriculture and the formation of wildlife and conservation agencies, regulatory protections and restoration programs for threatened and endangered species. Current issues facing wildlife habitat quantity and quality include increased low-density development in suburban and rural areas that results in habitat fragmentation. In 1983, the reforestation that followed farming and logging of the 19th and 20th centuries reached its peak, with 87 percent of the state's lands forested. However, by 1997, the state's forest cover dropped three percent, to 84 percent as the result of the conversion of forest land for development (NHFGD, 2005).

As discussed in Section 4.16, NHFGD has developed statewide and regional ranking and identified the highest condition habitat relative to all polygons of a given habitat type in the state. The NH Wildlife Action Plan (WAP) provides an assessment of habitat value, ranking all lands within NH as follows: (1) highest ranked in the state by ecological condition (#1), (2) highest ranked in the biological region by ecological condition (#2), (3) supporting landscapes (#3), and (4) not ranked (all the rest). Rankings are generally based on landscape biological diversity, landscape integrity, minimum human influence, and the presence of documented rare wildlife or significant ecological features. The evaluation of indirect effects and cumulative impacts is based on the potential impact to these ranked habitats.

As discussed in Section 4.17.1, no federally endangered species are known to be present in the Project area, and no federally endangered species occurrence records were associated with the development footprints under the No Build and Build conditions. Therefore, indirect effects and cumulative impacts to federally protected species are not anticipated.

Several state-listed threatened and endangered plant species have been documented within or adjacent to the study area (see Section 4.17.1). None have been specifically documented within the potential area of impact for the Project. Additionally, none of these plants have been documented within the development footprints under the No Build and Build conditions. Based on available habitat and recent records in the Project area, the northern black racer (state threatened) has been recorded in the vicinity of Alternative A; however, no occurrences of the black racer were recorded within the anticipated development footprints. Because northern black racers use a wide variety of forested and open habitat types, including uplands and wetlands, the potential for indirect effects and cumulative impacts is discussed in the following subsections.

Impacts from Other Actions

Development activity unrelated to the Project at Woodmont Commons Phase I and Market Basket and Woodmont Commons West (Remainder) could impact habitats that are highest ranked in the state. About 52.2 acres of WAP Tier 1 habitat is mapped within the Woodmont Commons Phase I and Market Basked footprint. The minimum and maximum footprints for Woodmont Commons West (Remainder) under the No Build scenario include 18.26 and 36.47 acres of WAP Tier 1 habitat, respectively (Table 5.4-14).

Development activity unrelated to the Project at Woodmont Commons East and Woodmont Commons West (Remainder) could impact 25.01 to 32.72 acres of supporting landscapes (WAP Tier 3) (Table 5.4-15-17). Development activity unrelated to the Project would not impact habitat that is highest ranked in its biological region (WAP Tier 2).

It is possible that northern black racers could use habitat within the development footprints. NH's Endangered Species Conservation Act (1979) makes it unlawful to export, take, possess, sell or offer for sale, deliver, carry, transport, or ship endangered and threatened wildlife species. The NHDES AoT permitting process allows for the NHFG Nongame and Endangered Wildlife Program to provide recommendations to for the protection of special-status species. Through this process, proposed developments could be required to evaluate potential impacts to the northern black racer, including direct mortality due to construction. Effects from development activity related to habitat loss, fragmentation, and road mortality could occur.

Direct Impacts

The Project would directly impact between zero and 22.49 acres of supporting landscapes and between zero and 0.17 acre of habitat that is highest ranked in the biological region. The Project would have no impact on habitats that are highest ranked in the state.

As discussed in section 4.17, recent records exist for northern black racer within the footprints of Alternatives A and B. Because racers use a wide variety of habitats, the entire undeveloped parcel intersected by Alternatives A and B potentially provides suitable habitat, and the sections of Alternatives A and B that would cross it would result in habitat loss, habitat fragmentation, and increased potential for road mortality. Additionally, recent records exist for the northern black racer in the vicinity of Alternatives C and D, near the initial portions of these footprints. No recent records exist for the northern black racer near Alternative F.

Indirect Effects

Additional development induced by the Project at Woodmont Commons West (Remainder) could impact 9.21 to 45.19 acres of habitats that are highest ranked in the state depending on the range of footprints of future development projects. In addition, under Build Alternatives A and B, development induced by the Project at Woodmont Commons East and West (Remainder) could impact 26.07 to 83.11 acres of supporting landscapes depending on the range of footprints of future development projects. Under Build Alternatives C, D, and F, induced development within Woodmont Commons West could impact between 2.13 and 54.36 acres of supporting landscapes. Under these Build Alternatives, there would be no induced development in Woodmont Commons East. Additional development induced by the Project would not impact habitat that is ranked highest in its biological region. Additional indirect effects could occur as result of increased residential development in Chester, but insufficient detailed information is available to quantify the impact in Chester.

As with the potential effects of known developments, it is possible that northern black racers could use habitat within the development footprints induced by the Project. As noted above, through the NHDES AoT permitting process, proposed developments could be required to evaluate potential impacts to the northern black racer, including direct mortality due to construction. Effects from development activity related to habitat loss, fragmentation, and road mortality could occur.

Potential for Cumulative Impacts

As discussed in Section 4.16, direct impacts on plant communities from the Project would result from the removal of vegetation and the conversion of undeveloped land to developed land within the footprint of the roadway. Adjacent areas would also be subject to indirect effects of vegetation clearing. Indirect effects can include increased sunlight penetrating forested areas, altered hydrology in wetlands, and a potential increase in sediment and toxicants from the new roadway. The most prevalent undeveloped cover types in the Project area are northern hardwood forests and conifer forests, and these are the most affected plant community types.

Table 5.4-17 shows the anticipated direct, indirect, and cumulative effects on the WAP-highest ranked wildlife habitat in the state. Table 5.4-18 shows the anticipated direct, indirect, and cumulative effects on the WAP-ranked supporting landscapes under the various Build Alternatives. None of the development footprints under the No Build or Build conditions would

impact habitat ranked as highest in the biological region. Woodmont Commons West (Remainder) is the only known development that would impact wildlife habitat ranked highest in the state, and these impacts would be expected under both the No Build and Build conditions.

Cumulative impacts from reasonably foreseeable development under the Build condition, considering maximum footprints, could impact 133.86 acres of habitats that are highest ranked in the state and between 150.23 and 201.47 acres of supporting landscapes, depending on the specific footprints of future development projects.

It is possible that cumulative impacts to the northern black racer population could occur from the Project and reasonably foreseeable future development. As noted above, through the NHDES AoT permitting process, proposed developments could be required to evaluate potential impacts to the northern black racer, including direct mortality due to construction. Effects from development activity related to habitat loss, fragmentation, and road mortality could occur.

Impacts to wildlife habitat, including habitat for the northern black racer, would be moderated by the countervailing effect of planning efforts that focus growth in existing settled areas, substantive protections under environmental protection laws, and the trend of increased land conservation. Despite additional incremental impacts, the overall health of wildlife habitat in the study area would not be substantially impacted. Forested lands would continue to make up a substantive proportion of land cover in the study area, and many species would continue to recover as a result of improved management and protection.

Table 5.4-17. Indirect Effects and Cumulative Impacts to WAP Highest Ranked Wildlife Habitat in the State (Tier 1)

Development		No Build Condition Impact (acres)	Incremental Build Condition Impact		Build Condition Cumulative Impact (acres)
			Direct Effect (acres)	Indirect Effect (acres)	
Exit 4A (Any Build Alternative)		-		-	0.00
Woodmont Commons Phase I and Market Basket		52.20	-	-	52.20
Woodmont Commons West (Remainder)	Minimum Footprint	18.26	-	9.21	27.47
	Maximum Footprint	36.47	-	45.19	81.66
Woodmont Commons East	Minimum Footprint				0.00
	Maximum Footprint				0.00
Derry Industrial	Minimum Footprint	-	-	-	0.00
	Maximum Footprint	-	-	-	0.00
Total	**Minimum Footprint**	**70.46**	**0.00**	**9.21**	**79.67**
	Maximum Footprint	**88.67**	**0.00**	**45.19**	**133.86**

Table 5.4-18. Indirect Effects and Cumulative Impacts to WAP Supporting Landscapes (Tier 3) under Alternative A

Development		No Build Condition Impact (acres)	Incremental Build Condition Impact		Build Condition Cumulative Impact (acres)
			Direct Effect (acres)	Indirect Effect (acres)	
Exit 4A (Alternative A footprint)		-	15.37	-	15.37
Woodmont Commons Phase I and Market Basket		-	-	-	0.00
Woodmont Commons West (Remainder)	Minimum Footprint[a]	25.01	-	2.13	27.14
	Maximum Footprint	32.72	-	54.36	87.08
Woodmont Commons East	Minimum Footprint	36.10	-	21.99	58.09
	Maximum Footprint	63.15	-	27.48	90.63
Derry Industrial	Minimum Footprint	-	-	-	0.00
	Maximum Footprint	-	-	-	0.00
Total	**Minimum Footprint**	**61.11**	**15.37**	**24.12**	**100.60**
	Maximum Footprint	**95.87**	**15.37**	**81.84**	**193.08**

[a] As shown in Figures 5.3-3 and 5.3-4, there is a shift in the minimum Build condition footprint for Woodmont Commons West (Remainder). The total change in area is 10.7 acres; however, the shift results in an increase in impacts on highest ranked habitat in the state and a decrease in impacts on supporting landscapes.

Table 5.4-19. Indirect Effects and Cumulative Impacts to WAP Supporting Landscapes (Tier 3) under Alternative B

Development		No Build Condition Impact (acres)	Incremental Build Condition Impact		Build Condition Cumulative Impact (acres)
			Direct Effect (acres)	Indirect Effect (acres)	
Exit 4A (Alternative B footprint)		-	22.49	-	22.49
Woodmont Commons Phase I and Market Basket		-	-	-	0.00
Woodmont Commons West (Remainder)	Minimum Footprint[a]	25.01	-	2.13	27.14
	Maximum Footprint	32.72	-	54.36	87.08
Woodmont Commons East	Minimum Footprint	36.10	-	23.94	60.04
	Maximum Footprint	63.15	-	28.75	91.90
Derry Industrial	Minimum Footprint	-	-	-	0.00
	Maximum Footprint	-	-	-	0.00
Total	**Minimum Footprint**	**61.11**	**22.49**	**26.07**	**109.67**
	Maximum Footprint	**95.87**	**22.49**	**83.11**	**201.47**

[a] As shown in Figures 5.3-3 and 5.3-4, there is a shift in the minimum Build condition footprint for Woodmont Commons West (Remainder). The total change in area is 10.7 acres; however, the shift results in an increase in impacts on highest ranked habitat in the state and a decrease in impacts on supporting landscapes.

Table 5.4-20. Indirect Effects and Cumulative Impacts to WAP Supporting Landscapes (Tier 3) under Alternatives C, D, and F

Development		No Build Condition Impact (acres)	Incremental Build Condition Impact		Build Condition Cumulative Impact (acres)
			Direct Effect (acres)	Indirect Effect (acres)	
Exit 4A (Alternative C Footprint)		-	8.69	-	8.69
Exit 4A (Alternative D Footprint)		-	1.85	-	1.85
Exit 4A (Alternative F Footprint)		-	0.00	-	0.00
Woodmont Commons Phase I and Market Basket		-	-	-	0.00
Woodmont Commons West (Remainder)	Minimum Footprint	25.01	-	2.13	27.14
	Maximum Footprint	32.72	-	54.36	87.08
Woodmont Commons East	Minimum Footprint	36.10	-	-	36.10
	Maximum Footprint	63.15	-	-	63.15
Derry Industrial	Minimum Footprint	-	-	-	0.00
	Maximum Footprint	-	-	-	0.00
Alternative C Total	**Minimum Footprint**	**61.11**	**8.69**	**2.13**	**-71.93**
	Maximum Footprint	**95.87**	**8.69**	**54.36**	**158.92**
Alternative D Total	**Minimum Footprint**	**61.11**	**1.85**	**2.13**	**65.09**
	Maximum Footprint	**95.87**	**1.85**	**54.36**	**152.08**
Alternative F Total	**Minimum Footprint**	**61.11**	**0.00**	**2.13**	**63.24**
	Maximum Footprint	**95.87**	**0.00**	**54.36**	**150.23**

5.4.5 Cultural Resources

Resource Condition and Trends

Cultural resources include archaeological resources and historic architectural resources. Section 4.18.3 includes detailed information on the cultural context for the area. Past development, unrelated to the Project, has affected historic resources in southern New Hampshire. Historic resources have been destroyed directly because of deteriorating conditions, development pressures, or both. Numerous regulatory protections and programs at various levels of government have been designed to encourage the preservation of historic resources.

Impacts from Other Actions

Historic properties and districts can be protected from alteration through local designations and design review. Known developments in the study area are not anticipated to result in adverse effects to known historic resources. Archaeological resources are difficult to identify without substantial investigation and are more difficult to protect through local development regulations.

Continued population growth in the study area may place some development pressure on unprotected historic properties and districts and may result in the loss of archaeological resources such as Native American sites.

Direct Impacts

Archaeological resources would not be impacted by the Project. Section 4.18.5 outlined the direct impacts for the Build Alternatives. As discussed in Section 4.18, Alternative A would result in an adverse effect to the M&L Railroad Historic District. It would not result in adverse effects to any other historic resources. The effects on historic resources from Alternative B would be expected to be the same as Alternative A. Alternatives C, D, and F would be anticipated to result in adverse effects to historic resources.

Indirect Effects

Historic properties and districts can be protected from alteration through local designations and design review. There are no known NHRP-eligible resources adjacent to Woodmont Commons West, Woodmont Commons East, and Derry Industrial developments. As a result, development anticipated to be induced by the Project is not expected to result in adverse effects to known historic resources in the study area.

Specific indirect effects on archaeological resources resulting from land use change cannot be reasonably estimated because of the uncertainty associated with the size, type, and location of resources within the development footprints. When private development requires a federal action, such as a permit to impact waters of the U.S., under Section 404 of the CWA, the potential impacts on archaeological resources would be studied to comply with Section 106 of the NHPA–compliance with Section 106 and other federal laws is a requirement of the Section 404 permit. However, if a permit is not needed, potential effects on archaeological resources would not be evaluated. Therefore, private development, such as the Chester residential development, could result in impacts on unknown archaeological resources.

Potential for Cumulative Impacts

Historic properties and districts can be protected from alteration through local designations and design review. Regardless of the Project, known developments in the study area are not anticipated to result in adverse effects to known historic resources. Alternatives A and B would result in an adverse effect to the M&L Railroad Historic District. Alternatives C and D would be anticipated to result in adverse effects to the Reed Paige Clark Homestead. Alternative F would be anticipated to result in adverse effects to historic resources within the Broadway Historic District (Area B) located along NH 102.

Archaeological resources would not be impacted by the Project. As noted above, it is not possible to reasonably estimate indirect effects on archaeological resources resulting from land use change because of the uncertainty associated with the size, type, and location of resources within the development footprints. Original and subsequent archaeological surveys have indicated that archaeological sites and sensitivity areas are absent from the Build Alternative alignments; thus, none of the Build Alternatives are expected to result in impacts on archaeological resources.

As noted in the previous section, given the private nature of the known developments considered in this indirect effects and cumulative impacts analysis, unless a Section 404 permit is required, Section 106 of the NHPA would not apply. It is possible that potential impacts to cultural resources could be mitigated through the Section 404 permitting process. Additionally, there are local programs within the Towns designed to maintain these resources (e.g., preservation easements, preservation tax incentives, local historic districts, and local building codes and review standards for historic structures).