3

Affected Environment

3.1 Introduction

This chapter provides a description of the existing or baseline conditions in the study area. Current traffic and transportation conditions as well as natural, socio-economic, and cultural resources are described. It is this affected environment that potential improvements and their associated impacts of the various project alternatives will be evaluated against (see Chapter 4).

3.2 Transportation

This section summarizes the traffic data collection effort, traffic volume trends, existing operational conditions, and vehicle crash research, and identifies existing infrastructure deficiencies. The section also includes a discussion on High Occupancy Vehicle (HOV) facilities and Transportation Demand Management (TDM).

The data collection effort includes origin-destination surveys, travel time and delay surveys, vehicle occupancy counts, and vehicle classification counts.

The Traffic Volumes Section (3.2.2) and the Existing Traffic Operations Section (3.2.3) summarize the existing traffic volume trends, the development of appropriate design hour volumes, and the results of the existing traffic operations evaluation.

The infrastructure conditions and needs assessment includes a discussion of the existing highway facility layout and identifies geometric deficiencies along the corridor. This assessment also includes a description of pavement conditions and a summary of bridge conditions within the study area.

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3.2.1 Traffic Data Collection

Because of the regional nature of the service I-93 provides, data collection efforts were concentrated both within and outside the study corridor. In addition, due to the size and scope of the study of I-93 between Manchester and Salem, New

Hampshire, an extensive data collection program was required. From this information existing travel patterns, characteristics, and the facility level of service was determined. The data collection program consisted of the following components:

- Origin – Destination Survey
- Travel Time and Delay Survey
- Vehicle Occupancy Counts
- Compilation of Traffic Volume and Vehicle Classification Counts

Details of each component are discussed briefly below. Traffic volumes and vehicle classification counts were available through the New Hampshire Department of Transportation (NHDOT).

3.2.1.1 Origin-Destination Study

In 1992, during the months of June and July, an extensive origin-destination survey was conducted of motorists traveling along I-93 and at roadway locations that parallel or feed I-93. Survey locations were set-up, where motorists were momentarily stopped and given a postcard survey questionnaire. Motorists were asked to answer the questions and return the cards by mail at no cost to the respondent.

Note that because a number of years have passed since the original survey was conducted, a more limited, but more recent, survey was conducted in October and November of 2001 for the purpose of validating the previous survey results. The recent survey, which is summarized below, did substantiate the findings of the original survey.

The recent 2001 survey consisted of the distribution of survey cards between 6:00 AM and 10:00 AM to motorists entering I-93 southbound at Exits 1 through 5. In addition, survey cards were distributed to southbound motorists at the Hooksett Toll Plaza. A total of 16,108 survey questionnaires were distributed with an overall response rate of 32 percent (5,170 cards). The highest response rate was attained from motorists entering the highway at Exit 1, while the lowest response rate was recorded at Exit 5.

Of the total respondents, which includes those receiving cards at the Hooksett Tolls, approximately 50 percent were ending their trip in Massachusetts. However when considering only the respondents entering the highway at Exits 1 through 5, approximately 80 percent were destined to Massachusetts. The highest number of respondents began their morning trip in Salem (462), followed by Derry (405), Londonderry (352), Windham (217), and Manchester (139).

Questions pertaining to other trip characteristics such as, trip purpose, vehicle occupancy, potential mass transit ridership, and travel frequency were posed. The responses are briefly described below.

Trip Purpose

During peak travel hours, I-93 is primarily used as a commuting facility between home and work. At the time they received the survey card, a total of 92 percent of the respondents began their respective trips from home and a total of 84 percent were traveling to work. Less than 1 percent of the total respondents stated that they were traveling to a mass transit terminus: carpool lot, bus stop, or train station.

Vehicle Occupancy

Eighty-two percent of respondents indicated that they made their respective trips alone, while 11 percent of the trips included one passenger, and 7 percent of the vehicles carried more than one passenger. To validate the results on this question, vehicle occupancy counts were conducted along I-93 southbound south of Exit 1 on Tuesday, April 23, 2002 and on Tuesday, May 7, 2002 from 6:00 AM to 10:00 AM. The occupancy counts revealed a substantially higher percentage of single occupancy vehicles (92 percent) with only 8 percent of vehicles with more than one occupant. One reason for the discrepancy is that the survey card return rate may be higher in vehicles with multiple occupants because a passenger is more likely to fill out the survey card during the commute while the motorists who is traveling alone is more likely to put the card aside while driving. Therefore, the actual percentage of single occupancy vehicles is likely closer to the 92 percent that was observed than the 82 percent that was obtained through the survey.

Carpool/Vanpool Use

Drivers were asked whether or not the trip they were taking at the time that they received the card was part of a carpool or vanpool; 97 percent responded in the negative. Of those whose trip was part of a carpool or vanpool, 75 percent were part of a daily carpool/vanpool, while 25 percent used this form of travel only occasionally.

Preferred Mass Transit

Drivers were given a list of potential mass transit options and asked which they would likely use, if they were made available to them: 61 percent responded that they would not use mass transit; 29 percent would ride a train; 15 percent would likely use a bus; and 10 percent would arrange travel on highway lanes developed for high occupancy vehicles (HOV).

Frequency of Travel

A total of 73 percent of the drivers responded that the trip they were taking at the time they received the questionnaire occurred five or more times per week. In

contrast, only 9 percent of the respondents replied that the trip occurred less than one time per week, and 8 percent replied that the trip was taken one to two times per week.

3.2.1.2 Travel Time and Delay Study

A travel time and delay study was conducted along I-93 from the I-293 split in Manchester to the Massachusetts state line in April 2000. The travel time runs were conducted in the southbound direction during the weekday morning peak period and in the northbound direction during the weekday evening peak period. Checkpoints consisting of the interchanges were established along the corridor to note travel times. The prevailing travel speeds between checkpoints were recorded.

The results of the travel time and delay study confirm that under existing conditions, motorists experience substantial delay along the I-93 corridor during the weekday morning and evening peak commuter periods.

During the morning peak period in the southbound direction, the prevailing speeds were recorded as follows:

Segment	2000 AM Peak Southbound Prevailing Speed
I-293 to Exit 5	60-70 mph
Exit 5 to Exit 4	55-65 mph
Exit 4 to Exit 3	50-65 mph
Exit 3 to Exit 2	40-50 mph
Exit 2 to Exit 1	30-40 mph
Exit 1 to State line	55-65 mph

During the morning peak period in the southbound direction, motorists generally travel under free flow conditions from I-293 to Exit 5 with prevailing speeds ranging from 60 mph to 70 mph. Travel speeds slow (50 mph – 65 mph) with more noticeable congestion between Exit 5 and Exit 3. Between Exit 3 and Exit 2 more substantial congestion is experienced with speeds reduced to 40 mph to 50 mph. The most substantial congestion in the southbound direction is experienced between Exit 2 and Exit 1 with speeds reduced to 30 mph to 40 mph. The wider cross section south of Exit 1 allows speeds to increase to 55 mph to 65mph.

During the evening peak period in the northbound direction, the recent travel time runs revealed the following average travel speeds:

Segment	2000 PM Peak Northbound Prevailing Speed
State line to Exit 1	15-35 mph
Exit 1 to Exit 2	20-40 mph
Exit 2 to Exit 3	35-60 mph
Exit 3 to Exit 4	55-65 mph
Exit 4 to Exit 5	60-70 mph
Exit 5 to I-293	60-70 mph

During the evening peak period in the northbound direction, motorists experience substantial delay south of Exit 1 with travel speeds recorded at 15 mph to 35 mph. Traffic flow along this segment is routinely "bumper to bumper". Substantial congestion continues to be experienced between Exit 1 and Exit 2 with only modest increases in travel speeds ranging from 20 mph to 40 mph. Somewhat higher speeds (35 mph to 60 mph) are obtained between Exit 2 and Exit 3. The level of congestion begins to diminish north of Exit 3 where speeds of 55 mph to 65 mph were recorded between Exit 3 and Exit 4. North of Exit 4, motorists can generally travel at free flow conditions with speeds ranging from 60 mph to 70 mph.

3.2.1.3 Vehicle Classification

The classification of vehicles by type (i.e. passenger car, single unit truck, tractor-trailer, bus) is an important part of the data collection program, specifically for use in air quality and noise studies along the study corridor. Vehicle classification counts have been performed periodically in various locations along I-93 within the study area as required to address specific project needs. Counts performed in the late 1980's/early 1990's indicated that truck traffic made up approximately 7.5 percent of the total traffic volume. Classification counts performed in 1997 between Exits 3 and 4 indicated that truck volumes were running about 10 percent of total traffic. Counts in 1999 between Exits 1 and 2 showed the truck percentage to be 9.5 percent. In summary, the data indicates that while percentage of truck traffic is increasing to some degree, I-93 remains largely a commuting facility with passenger vehicles making up a vast majority of the vehicles along the corridor.

■

3.2.2 Traffic Volumes

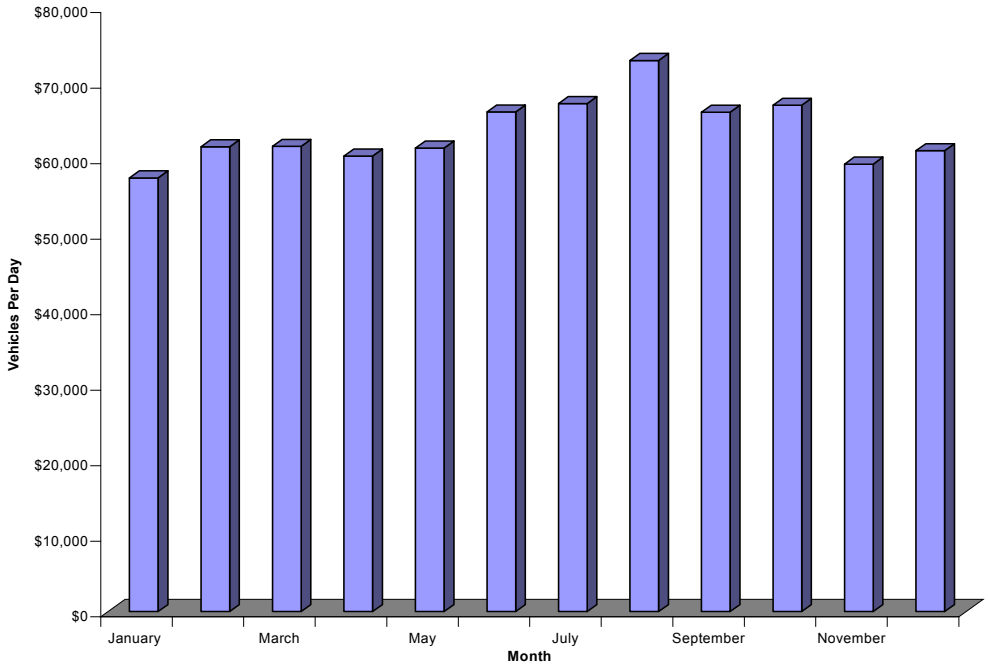
The purpose of this section is to establish and evaluate the existing traffic conditions along the study corridor. This section includes a discussion on traffic volume trends, the development of an appropriate design hour volume condition, and the results of the existing conditions traffic operations evaluation.

Traffic Volume Trends

The NHDOT maintains two (2) automatic traffic volume recorder stations (24 hour operation) along I-93 northbound and southbound within the study area – Station 399001/399002 in Salem, just south of Rockingham Park Boulevard, and Station 489003/489004 in Windham, north of Exit 3. To supplement these counts, the NHDOT conducted 1997 weekday morning and evening peak period traffic counts at each interchange (Exit 1 through Exit 5) area. These peak hour volumes were seasonally adjusted to reflect an annualized average weekday condition based on review of monthly traffic volume variations at the Salem and Windham control counting stations. Peak hour traffic volumes are approximately nine percent of daily volumes, and reflect the commuter orientation of the corridor where approximately 60 percent of the traffic flow is southbound in the morning peak hour, and northbound in the evening peak hour.

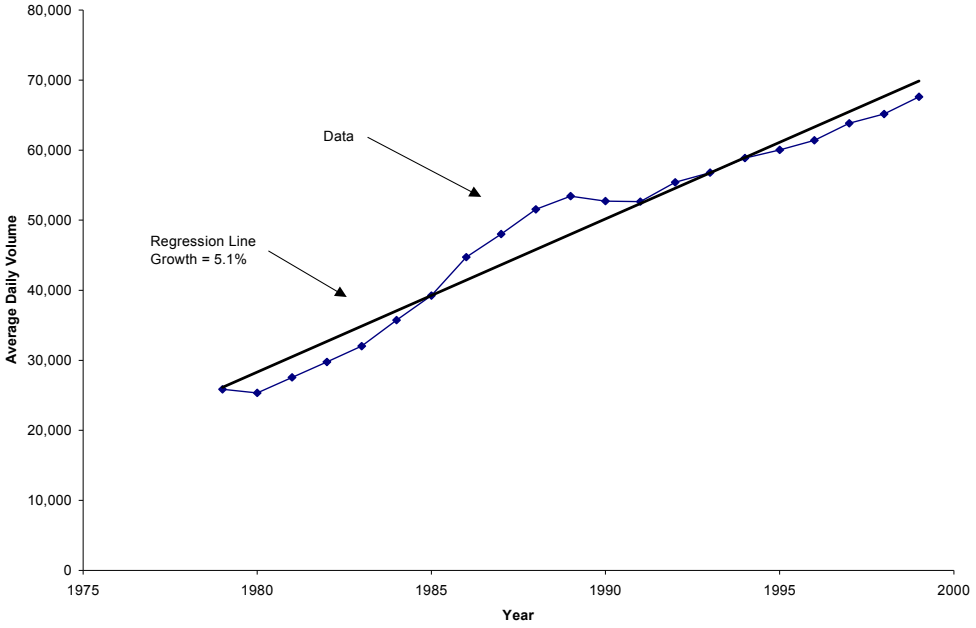
Examination of the monthly variation in average daily traffic (ADT) along I-93 shows August with an ADT of 73,000 vehicles per day (vpd) as the peak month. Despite the influence of ski activity during the winter months, the volume of traffic on a daily basis is somewhat higher during the summer recreational months of June, July, August and September. October volumes (67,000 vpd) reflect foliage season. The monthly variations are shown graphically in **Exhibit 3.2-1**.

Exhibit 3.2-1
Monthly Variations, I-93 at Fordway Extension Bridge in Derry Average Daily (1997)



In addition to reviewing seasonal trends, historical traffic growth trends were also examined. The NHDOT permanent traffic recorder count station located along the northbound and southbound barrels between Exits 3 and 4 have provided historical traffic volume data for the past 20 years. The growth in ADT (total northbound and southbound) is depicted in **Exhibit 3.2-2**. The ADT over the 20-year period revealed an average annual growth rate of 5.1 percent. The most substantial growth occurred during the 1980's with the rate of increase slowing during the 1990's. In fact the rate of growth has been steadily declining since the mid-1980's with rates decreasing from 9.9 percent (1980 to 1985), to 5.4 percent (1985 to 1990), to 2.6 percent (1990 to 1995), and to 1.9 percent (1995 to 2000).

Exhibit 3.2-2
Windham (Exits 3-4) Derry Town Line —Average Annual Traffic Growth



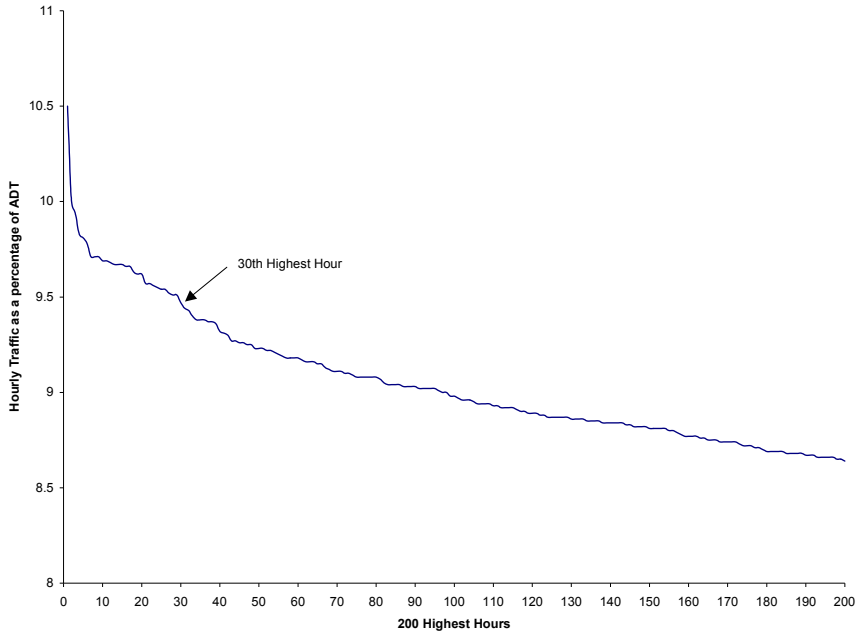
The general unit of measure used to quantify roadway usage is the average daily traffic (ADT), which is defined as the total volume of traffic during a given period of time divided by the number of days in that time period. A more specific unit of measure is known as the average annual daily traffic volume (AADT), which is determined by dividing the total yearly volume by the number of days in the year. Although an actual AADT can only be established at a continuous count station, AADTs can be estimated along segments of roadways by applying adjustment factors developed from data collected at continuous count stations to specific daily or hourly counts.

While the AADTs are an important measure, it is the hourly volume condition that is primarily used to evaluate and design roadway facilities. However, because hourly traffic volumes can vary substantially over the course of a day and throughout the

year, it is necessary to select an appropriate design hourly volume condition. A design based on the (maximum) peak hour traffic of the year is not the appropriate design hour volume condition. Designs based on such extreme conditions would be a poor investment of public funds given the size of the facility that would be required. Similarly, the average hourly traffic volume condition would result in an inadequate design as it would be exceeded half of the time. In accordance with industry practice, the hourly traffic volume used for the purpose of design should not be exceeded very often or by very much, while on the other hand, it should not be so high that the volume of traffic would rarely be high enough to make full use of the facility.

As recommended in *A Policy on Geometric Design of Highways and Streets*[18], the hourly traffic volume that should generally be used for the design of a highway facility is the 30th highest hour volume of the year. Given the economic considerations involved in the planning and design of roadway facilities, this design criteria is selected since the 30th highest hourly volume generally reflects a "point of diminishing return" in that a substantial increase in design requirements would accommodate only very few periods of higher traffic volumes. This condition is reflected in the curve, as shown in **Exhibit 3.2-3**, which tends to steepen quickly to the left of the 30th highest hour

Exhibit 3.2-3
Peak Hour to ADT Relationship—I-93 at Fordway Bridge in Derry (1997)



18 American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, Washington, D.C., 2001.

indicating much higher volumes for the inclusion of only a few more of the higher hourly volumes, while the curve flattens to the right indicating many hours in which the volume is not much lower than the 30th highest hour.

Based on the data provided at the NHDOT permanent count station, the 30th highest hour volume is approximately 9.4 percent of the ADT. The Directional Design Hour Volume (DDHV) split shows approximately 60 percent of the total hourly traffic traveling in the peak direction.

As shown in Table 3.2-1, the 1997 ADT along the corridor ranges from a low of approximately 61,800 vehicles per day (vpd) between Exits 3 and 4 to a high of approximately 104,400 vpd south of Exit 1. The DHV ranges from approximately 5,800 vehicles per hour (vph) to 9,800 vph. Similarly, the DDHV ranges from approximately 3,500 vph to approximately 5,900 vph.

Table 3.2-1
1997 Base Year Traffic Volumes[4]

Segment	ADT[1]	DHV[2]	DDHV[3]
MA State Line to Exit 1	**104,400**	9,800	5,900
Between Exits 1 and 2	**81,100**	7,600	4,600
Between Exits 2 and 3	**74,900**	7,000	4,200
Between Exits 3 and 4	**61,800**	5,800	3,500
Between Exits 4 and 5	**64,900**	6,100	3,700
North of Exit 5	**69,300**	6,500	3,900

1 ADT – Average Daily Traffic
2 DHV – Design Hour Volume (9.4% of ADT)
3 DDHV – Directional Design Hour Volume (60% of DHV)
4 All Volumes are based on I-93 Subarea Traffic Model (see Traffic Forecasting Section)

The 1997 weekday morning and evening peak hour traffic volumes at each of the study corridor intersections are presented in **Figures 3-16 and-3-17**.

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3.2.3 Existing Traffic Operations

The volume of traffic along the I-93 corridor indicates the importance of the corridor to the regional transportation system, but does not necessarily give an indication of the quality of traffic flow. To assess the quality of traffic flow along the corridor and other study area roadways, capacity analyses were conducted to determine how well the I-93 corridor serves the traffic demands placed upon it. The traffic performance

measures and the evaluation criteria used in the operational analyses are based on the methodology presented in the 2000 Highway Capacity Manual[19].

A primary result of capacity analysis is the assignment of level of service which is a qualitative measure describing operational conditions within a traffic stream and their perception by a motorist or passenger. Level of service generally describes these conditions in terms of such factors as speed and travel time, density or freedom to maneuver, traffic interruptions, comfort and convenience, and safety and, in so doing, provides an index to quality of traffic flow. Six levels of service (LOS) are defined[20] ranging in letter designation from LOS A to LOS F, with LOS A representing the best operating condition and LOS F representing the worst. LOS C describes a stable flow condition and is considered desirable for peak or design hour traffic flow. LOS D is generally considered acceptable where the cost and impacts of making improvements to provide LOS C are deemed unjustifiable. Level of Service E is capacity.

The results of the freeway segment analyses, as summarized in Table 3.2-2, show poor operating conditions (LOS E) along I-93 from Exit 1 to Exit 3. Field observations reveal that the traffic congestion associated with the capacity conditions in the northbound direction during the PM peak hour often reverberates south of Exit 1 and into Massachusetts.

When considering the operating conditions of a highway, it is important to consider the magnitude of congestion in terms of the time frame over which a poor level of service occurs. The level of service ratings in Table 3.2-2 are based on a one-hour period. The peak period for I-93 actually extends well beyond a single hour. This phenomenon, which is known as "peak hour spreading," occurs when segments of a corridor are so congested that the poor level of service extends into the hour before and the hour following the peak hour. In doing so, the actual operating conditions of the highway are somewhat worse (and the number of motorists affected greater) than what is indicated by evaluating a single one hour period.

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19 2000 Highway Capacity Manual, Special Report 209, Transportation Research Board, Washington, D.C.
20 ibid.

Table 3.2-2
1997 Existing Conditions - Freeway Segment Analysis Summary

Segment	DHV[1]	DDHV[2]	# Lanes	LOS[3]
MA state line to Exit 1	9,800	5,900	3	E
Exit 1 to Exit 2	7,600	4,600	2	E
Exit 2 to Exit 3	7,000	4,200	2	E
Exit 3 to Exit 4	5,800	3,500	2	D
Exit 4 to Exit 5	6.100	3,700	2	D
North of Exit 5	6,500	3,900	2	D

1 DHV=Design Hour Volume.
2 DDHV=Directional Design Hour Volume..
3 LOS=Level of Service..

The poor level of service for 1997 peak hour traffic flow and the congestion associated with the main line capacity between Exits 1 and 3 also extend to interchange traffic operations, as summarized in Table 3.2-3. LOS F conditions exist during the morning peak hour at the Exit 1 southbound off- and on-ramps, at the Exit 2 southbound off- and on-ramps (weaving movement), and at the Exit 3 southbound on-ramp. Capacity (LOS E) conditions exist at the Exit 3 southbound off-ramp. During the evening peak hour, interchange capacity is exceeded (LOS F) at the Exit 1 northbound on-ramp, at the Exit 2 northbound on- and off-ramps, and at the Exit 3 northbound off-ramp.

Table 3.2-3
Interchange Ramp Junction Analysis Summary — 1997 Existing Conditions

Interchange Movement	Level Of Service	
	AM Peak Hour	PM Peak Hour
Exit 1		
NB off ramp	A	B
NB on ramp	B	F
SB off ramp	F	D
SB on ramp	F	D
Exit 2		
NB off ramp	B	F
NB on ramp	B	F
SB off ramp (weave)	F	D
Exit 3		
NB off ramp	B	F
NB on ramp	B	D
SB off ramp	E	C
SB on ramp	F	C
Exit 4		
NB off ramp	B	D
NB on ramp	B	C
SB off ramp	D	C
SB on ramp (from E)	C	B
SB on ramp (from W)	D	B
Exit 5		
NB off ramp	B	C
NB on ramp	C	C
SB off ramp	C	C
SB on ramp	C	C

LOS Level of Service

■

3.2.4 Crash Statistics

Crash statistics compiled by the New Hampshire Department of Transportation are based on information provided by the New Hampshire Department of Safety (NHDOS). These data are only as accurate as what is reported to the NHDOT. Statistics for the six-year period of January 1995 through December 2000 were reviewed. The crash data for the study area, which extends from the Massachusetts state line to I-293, revealed a total of 1,690 crashes during the six-year period. A summary of the crash data is presented in Table 3.2-4.

Table 3.2-4
Crash Summary (January 1995 – December 2000)

Location	Property Damage Only	Personal Injury	Fatal Crash	Total
From MA state line to Exit 1	87	57	1	145
At Exit 1	17	6	0	23
From Exit 1 to Exit 2	45	53	3	151
At Exit 2	17	6	0	23
From Exit 2 to Exit 3	141	69	1	211
At Exit 3	23	4	0	27
From Exit 3 to Exit 4	347	131	4	482
At Exist 4	24	9	0	33
From Exit 4 to Exit 5	159	71	3	233
At Exit 5	25	8	1	34
From Exit 5 to I-293	174	105	4	283
At I-293	7	5	0	12
Unknown	31	2	0	33
Total	1147	526	17	1690

Year		Month	
1995	253	January	198
1996	236	February	129
1997	203	March	176
1998	292	April	115
1999	243	May	153
2000	463[1]	June	138
Total	1690	July	125
		August	136
Surface Condition		September	123
Dry	1204	October	142
Wet	196	November	116
Snow/Ice	270	December	139
Debris	4	Total	1690
Unknown/Other	16		
Total	1690		

1 Beginning in the year 2000, a more detailed accident recordkeeping system was initiated.

Although caution should be applied when attempting to relate crash trends to potential causation, the following trends have been identified.

The segment of I-93 between Exits 3 and 4 recorded the highest number of crashes with 482 crashes (29 percent). Two hundred and thirty-eight crashes (17 percent) were recorded between Exit 5 and I-293. The segments between Exits 4 and 5, and between Exits 2 and 3 recorded 233 crashes (14 percent) and 211 crashes (12 percent), respectively. The segments between Exit 1 and Exit 2, and between the MA state line and Exit 1 recorded the fewest crashes with 151 (9 percent) and 145 (9 percent), respectively. The number of crashes that occurred at each of the interchanges range from a low of 12 at I-293 to a high of 34 at Exit 5.

The roadway surface condition was recorded as dry for 1,204 crashes (71 percent), snow or ice for 270 crashes (16 percent), and wet for 196 crashes (12 percent). Four crashes were related to debris in the roadway. The road condition for the remaining 16 crashes are unknown.

Of the total 1,690 crashes, 1,147 (68 percent) were limited to property damage only, while 526 crashes (31 percent) resulted in personal injury. Seventeen crashes (1 percent) resulted in a fatality. Of note, 13 of the 17 fatal crashes involved only a single vehicle.

The number of crashes that occurred between 1995 and 1997 revealed a steady decline with the number of crashes each year recorded at 253, 236 and 203 respectively. However, the trend was broken in 1998 when 292 crashes were recorded. The number of crashes again declined in 1999 with 243 crashes reported. A substantial increase in the number of crashes was reported in 2000 with 463 crashes, presumably reflecting ongoing efforts by the NHDOT and the New Hampshire Department of Safety (NHDOS) to improve record keeping and accuracy relative to crash data.

The month of March recorded the highest number of crashes with 176. The next four highest months were January, March, May, and October with 198, 176, 153, and 142, respectively.

■

3.2.5 Geometric Deficiencies

This section summarizes the geometric concerns and deficiencies that currently exist along the I-93 segment under study. These were identified by comparing the existing horizontal and vertical geometry with parameters listed in *A Policy on Geometric Design of Highways and Streets,*[21] *(AASHTO)* and *The Policy for Interstate Highways (AASHTO)* for the same type of highway facility and based on current NHDOT standards. AASHTO provides desirable and minimum/maximum design parameters for each design element, which allow for some flexibility in design. The desirable value provides a somewhat higher level of safety, efficiency and comfort, relative to the minimum/maximum design parameters. Both must be balanced with acceptable impacts and costs. Desirable values are preferred particularly for Interstate-type facilities, where the public expectations are generally higher.

I-93 is a major link in the Interstate System and functions as a principal arterial interstate highway, also referred to as a freeway. Access to this facility within the study area, is only available from the five interchanges spaced along the corridor.

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21 American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, Washington, D.C., 2001.

The connecting roadways at each interchange function as minor arterials, which serve as links between the municipalities in the region. Four types of facilities were identified for establishing design criteria for comparison and evaluation. These facilities and some of the corresponding design criteria are shown in Table 3.2-5.

Table 3.2-5
Road Design Criteria

	Roadway Classifications			
	Local Road	**Arterials**	**Ramps**	**Freeways**
Design Speed	30-40 mph	40-50 mph	50 mph (at nose) 30-40 mph (on ramp)	70 mph
Maximum Grade	8%	5% desirable	4% desirable	4% desirable
Minimum Grade	0.5%	0.5%	0.5%	0.5%
Superelevation	4% maximum	8% maximum 4% max. @ intersections	6% maximum	8% maximum
Horizontal and Vertical Curves	AASHTO minimum or better	AASHTO minimum or better	AASHTO minimum or better	AASHTO minimum or better
Lane Width	11 ft. minimum 12 ft. desirable	12 ft.	16 ft.	12 ft.
Shoulders	4 ft. minimum	4 ft. minimum	Varies	10 ft. to 12 ft.
Access Control	None	Control desirable	Full Control required	Full Control required
Intersection/ Interchange Spacing	600 ft. desirable	0.25 mile desirable		1.0 mile urban 2.0 mile rural
		Structures Criteria		
		Minimum Vertical Clearance: 16 ft. – 6 in. over major roadways 14 ft. – 6 in. over minor roadways 22 ft. – 6 in. over railroads Minimum grade 1% (desirable)		

The following is a summary of the roadway elements along the I-93 corridor where the existing roadway geometry does not meet current recommended design criteria based on current AASHTO and NHDOT standards. Where possible, improvements would be made to upgrade the existing facility and provide for current desirable design standards. In areas where geometric improvements would create unacceptable environmental or socio-economic impacts or involve unreasonable costs, those roadway elements would likely be improved to the minimum standards allowable.

I-93 Mainline

South of Exit 1 - the Rest Area/Welcome Center has a less than desirable length for the deceleration lane and on and off-ramp geometry that will only accommodate a 30 mph design speed.

Between Exits 1 and 2 - there are no geometric deficiencies along the I-93 mainline.

Between Exits 2 and 3 - the southbound barrel has a down-grade of 4.5% between Brookdale Road and Pelham Road.

Between Exits 3 and 4 - both the southbound and northbound barrels have grades as steep as 5 percent.

Between Exits 4 and 5 - there are no geometric deficiencies along the I-93 mainline.

Between Exit 5 and the I-93/I-293 split in Manchester – flat grades of less than the minimum 0.5 percent exist along the I-93 mainline, both northbound and southbound, near Bodwell Road. In addition, the tapers for creating the split between I-93 and I-293 are short and abrupt, but are being addressed as part of the project to rehabilitate the bridges carrying I-93 over Bodwell Road and Cohas Brook.

Interchanges

Exit 1 consists of a three-legged, trumpet type interchange.

- Southbound On-Ramp
  - Two on-ramp lanes converge with two I-93 travel lanes and taper to three through lanes at a minimum rate of 50:1 (70:1 desirable for multi-lane merge condition).

- Southbound Off-Ramp
  - 300 feet parallel deceleration length (less than minimum length of 550 feet)
  - Southbound Off-Ramp radii at 180 feet (<30 mph design; minimum radii is 230 feet)

- Northbound On-Ramp
  - 30:1 Acceleration Taper (50:1 minimum)

- Northbound Off-Ramp
  - Short weave (2000 feet) between Rest Area On-Ramp and Exit 1 Off-Ramp

Exit 2 is a partial cloverleaf/partial diamond interchange.

- The southbound direction poses a problem for traffic trying to exit the highway while traffic is trying to enter the highway over such a short weave distance. This short weaving section (675 feet) is less than the minimum length required by NHDOT design standards (1000 feet) for good operation with projected traffic volumes.

- Close spacing between the southbound ramps/NH 97 intersection and the Keewaydin Drive/NH 97 intersection creates poor traffic operations between signals.

- Northbound On-Ramp
  - 25:1 acceleration taper (50:1 minimum)

- Steep up-grade from Northbound On-Ramp (4%) transitioning into grade of I-93 Northbound (3%) creates difficulty for trucks to merge into I-93 Northbound traffic.

Exit 3 is a half-cloverleaf interchange. The Southbound Off and Northbound On ramps are loop ramps.

- Southbound Off-Ramp
  - Southbound Off-Ramp grade of 5% (the down-grade coupled with the relatively sharp horizontal curvature further complicates the geometry of this ramp).

- Southbound On-Ramp merge with the I-93 mainline is a problem due to the short acceleration length of 1100 feet, which is less than the desirable length of 1400 feet (or the AASHTO minimum length of 1350 feet).

- Northbound On-Ramp
  - 45:1 acceleration taper with a 4-foot shoulder (minimum taper is 50:1 with a 10-foot shoulder).
  - Steep grade from Northbound On-Ramp (4%) transitioning into grade of I-93 Northbound (3%) creates difficulty for trucks to accelerate and merge into I-93 Northbound traffic.

- NH 111
  - Steep grade of 4.9% along NH 111 between Northbound and Southbound barrels (greater than 4% grade for arterial highway where traffic may be stopped on approach to an intersection is undesirable).

Exit 4 is a full diamond interchange with a free flow loop ramp that connects NH 102 Westbound to I-93 Southbound.

- Northbound On-Ramp
  - Acceleration lane has a 4 foot shoulder (standard is 10 feet at nose of on-ramp).

- Southbound Off-Ramp
  - Steep grade of 6% exceeds desirable maximum of 4%.
  - Sag vertical curve at nose has a 35 mph design speed (50 mph desirable).

- NH 102
  - Steep grade of 6% (greater than 4% grade for arterial highway where traffic may be stopped on approach to an intersection is undesirable).
  - Northbound off-ramp traffic queue on occasion extends the length of the off-ramp and on into the Northbound mainline.

Exit 5 is a full diamond interchange.

- All ramps are relatively short, resulting in traffic queues extending onto the I-93 mainline.

- Southbound On-Ramp
  - 35:1 acceleration taper with a 4-foot shoulder (minimum is 50:1 taper with a 10-foot shoulder).

- Southbound Off-Ramp
  - 250 foot long parallel deceleration length (less than 340 feet minimum).

- Northbound Off-Ramp
  - 250 foot long parallel deceleration length (less than 340 feet minimum).

- Northbound On-Ramp
  - 45:1 acceleration taper with a 4 foot shoulder (minimum is 50:1 taper with a 10-foot shoulder).
  - Vertical Curve at the nose has a 35 mph design speed (50 mph desirable).

- Short vehicle storage lengths along NH 28 between the ramp intersections.

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3.2.6 Infrastructure Deficiencies

The existing highway was originally built in the 1960's and since that time, much of the facility has not undergone any major upgrades within the study area. Since 1990 there have been two capacity improvements along this segment of I-93. These involved widening in the northbound direction south of Exit 1 to accommodate traffic for the Mall at Rockingham Park and the reconstruction of the Exit 4 Interchange. The Rest Area just south of Exit 1 was also reconstructed in 1993, and the weigh stations just north of Exit 3 were reconstructed and expanded in 2000.

In addition to the existing geometric deficiencies identified above, a number of infrastructure deficiencies have also been identified.

Roadway

Some of the existing roadway infrastructure deficiencies, (specifically, outdated cable guard rail, deteriorating drainage systems and pipes, and deteriorating pavement)

are a direct result of the age of the facility. The NHDOT has recently replaced the outdated cable guard rail system as part of a safety upgrade along this segment of I-93. The existing pavement surface requires rehabilitation and it is expected that subsurface analysis will indicate that roadway base materials will require rehabilitation over some sections of the corridor.

Bridges

There are 43 bridges on I-93 or over I-93, within the study limits. Within the past ten years, five of these bridges have been replaced, five have been rehabilitated and widened (for traffic control purposes during construction), and another four are currently under construction for rehabilitation and widening. The most recent bridge construction projects have been completed with the future widening in mind, to hopefully minimize the additional construction needed as part of the widening resulting from this study.

Eighteen of the 43 bridges are considered to be in "red list" condition (indicating the need for replacement or substantial rehabilitation). Thirteen have been identified as structurally deficient. In addition, 10 bridges do not meet NHDOT minimum vertical clearance criteria.

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3.2.7 High Occupancy Vehicle Facilities

Currently, there are no high occupancy vehicle (HOV) lanes in New Hampshire on any facilities and none within the 18-mile segment of I-93 under study. There are two park-and-ride lots that serve carpools/vanpools and commuter bus operations. These are described in the Transportation Demand Management section. Massachusetts also has no HOV lanes on I-93 until just before the City of Boston. The Merrimack Valley Planning Council recently completed a corridor traffic study for I-93 through Methuen and Andover, Massachusetts that included a recommendation that an HOV facility north of I-495 would not be an appropriate investment.

With respect to the southbound HOV lane located on I-93 as it approaches Boston, a study done in 1994 by the Massachusetts Highway Department to consider extending the HOV lane north from the Charles River Crossing to the I-93/I-95/ MA 128 Interchange concluded that the project would attract too many additional HOVs. The HOV lane is currently operating near capacity and encouraging more HOVs would be counter productive. The study underscored the sensitive balance required to make HOV lanes effective and practicable.

■

3.2.8 Transportation Demand Management

Transportation Demand Management (TDM) encompasses a variety of strategies that are designed to change personal travel behavior to reduce the demand for

automobile use and the need for highway capacity expansion. This is accomplished through measures that reduce the number or length of trips or that move trips out of times of peak roadway congestion. TDM measures include conventional transportation services such as bus service, rail service, and providing park and ride lots, as well as lesser known strategies, such as work hour management, parking restrictions, and congestion pricing.

TDM programs are frequently targeted at work trips because commuters account for the majority of peak-hour travel (generally the periods of greatest roadway congestion) and because work trip patterns are generally consistent day-to-day. TDM programs that currently exist in the I-93 corridor are promoted at least in part through the NHDOT, the Rockingham Planning Commission and the Manchester Airport's Transportation Management Association (TMA). In addition, several TMAs operating in Massachusetts provide TDM programs that serve residents of New Hampshire while reducing traffic along I-93 in both New Hampshire and Massachusetts.

3.2.8.1 Park-and-Ride Lots

To support those who travel by carpool, vanpool or bus, the NHDOT officially recognizes a number of park-and-ride lots (not all are owned and maintained by the NHDOT) (see Table 3.2-6). A number of these serve drivers who use the I-93 corridor between Manchester and the New Hampshire/Massachusetts state line.

Existing Park-and-Ride Lots

The park-and-ride lots that serve users of I-93 are listed in Table 3.2-6. All are along I-93, either in the study area or to the north, or along I-89. Only the lots in Concord and Londonderry located along I-93 are served by bus. (There is a bus station and stop in downtown Manchester as well) They are the two largest lots with 744 spaces. They are also the most heavily utilized.

Table 3.2-6
New Hampshire Park-and-Ride Lots[22]

Town	Location on	Number of Spaces	Occupancy Counts (8/98)	Occupancy Counts (10/99)	Services
I-89 Corridor					
New London	Exit 12, NH 103A	45	19	13	L, S, T
Warner	Exit 9, NH 103	20	10	11	L, T
Concord	Exit 2, NH 13 (Clinton Street)	100	31	48	P, L
I-93 Corridor					
New Hampton	Exit 23 East, NH 104	15	7	10	
Tilton	Exit 20, US 3 East	63	5	27	L,T
Boscawen	Exit 17, US 4	27	22	24	L
Concord*	Exit 14, Stickney Avenue	273	268	196	P, L, S, T*
Bow	Jct. of I-89 and I-93, NH 3A	60	38	60	P, L
Hooksett	Exit 11, Hackett Hill Road	45	23	8	L
Londonderry*	Exit 4, NH 102	471	389	406	P, L, S, T*
Windham	Exit 3, NH 111	150	46	67	L,S
Total		1,269	858	870	

P= Phone; L = Lighting; S = Shelter; T = Bus Transit;
T* These lots are served by Concord Trailways, which provides commuter transit service in the corridor.

Proposed Park-and-Ride Lots

The park-and-ride lot in Windham was upgraded in 1998 to further encourage travelers to use the facility. The lot is located approximately 0.8 miles west of I-93 on Wall Street just off NH 111 with access via the unsignalized intersection of NH 111 and Wall Street. It was previously served by bus transit to Boston; however, this service was curtailed due to the lack of customers and the delay buses experienced accessing the lot.

The NH 111, Windham-Salem Final Environmental Impact Study (FEIS) recommended that consideration should be given to developing a new park-and-ride facility in North Salem off NH 111 that would provide parking for carpoolers and possibly bus transit service from the North Salem/Windham area to points south. The property was purchased as part of the NH 111 Windham-Salem project, but was not proposed to be constructed until sometime in the future when use of the facility seems more assured.

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22 Occupancy counts for Londonderry and Windham were provided by the Rockingham Planning Commission. All other counts are from NHDOT, and most were completed in August of 1998. NHDOT usually does regular counts in October and finds that those completed in August tend to be lower, due to summer vacations. The count for the Bow lot in July 1999 was a random count.

The Salem-Plaistow-Windham MPO submitted a CMAQ proposal in 1998 for a lot that would accommodate ride-sharing and intercity bus service, and would be located off Rockingham Park Boulevard near Exit 1 in Salem. Plans include 460 parking spaces and a bus station with rest rooms, phones, lighting, bike racks, trash receptacles, landscaping, and signage on I-93. Acquisition of the site was accomplished by NHDOT, and preliminary designs were developed. Permitting issues involving prime wetlands put the project on hold at least until the layout for I-93 is resolved.

Outside of New Hampshire, a new park-and-ride lot was opened in Methuen, Massachusetts in spring 2001. Located off I-93 on Pelham Street (Exit 47), the lot contains approximately 188 parking spaces for commuters who carpool/vanpool or use commuter bus service to Boston. Amenities include a shelter, bike racks, wooden benches, trash receptacle, lighting, landscaping and signage on I-93. The bus provider relates that use of the lot and bus ridership is much less than expected.

As a temporary measure, discussions have been underway between Cisco Corporation, the Town of Salem, the Rockingham Planning Commission (RPC), the NHDOT and Trombley Bus Company of providing bus service out of an unused portion of the Cisco parking lot off Exit 2. Initial optimism that bus service would be forthcoming, has receded in light of the bus provider's low ridership from the recently opened Methuen lot previously discussed.

3.2.8.2 Ride-Matching

The NHDOT operates a Statewide Ride-Share Program through its Bureau of Rail and Transit. The program is approximately six years old and is working towards building a substantial database. There are currently over 550 people registered for ridematching. This number continues to grow thanks in large part to the Rideshare Program's new website, www.nhrideshare.com, which allows registration forms to be filled out and submitted on line.

The NHDOT's Ride-Share Coordinator also promotes ride-sharing through individual employers by sponsoring transportation events, providing marketing materials, and encouraging employers to adopt TDM strategies such as guaranteed ride home programs, parking management, flex-time, and telecommuting. In this process, the State mainly targets rural areas, and depends on the Regional Planning Commissions to work with employers in the urbanized areas.

The RPC also promotes ride-matching through the State's Ride-Share Program. Four years ago the RPC conducted an extensive outreach to approximately 25 targeted employers, trying to educate them about TDM opportunities and encourage them to implement programs. As part of its TDM efforts, the RPC produced a "Transit Guide" for the Salem, Plaistow, and Windham area to promote the use of transit. This guide provides information on all intercity (interstate) bus service, Massachusetts commuter

rail service, carpool and vanpool matching services, and health and human service transportation options in the region.

Massachusetts-based CARAVAN for commuters also provides ride-matching services for New Hampshire residents who work in Massachusetts and Massachusetts' residents who work in New Hampshire. CARAVAN currently has 14 vanpools that travel in the I-93 corridor from Manchester, Londonderry, Windham, Salem, and Plaistow to Boston.

3.2.8.3 Transportation Management Association (TMA) Initiatives

The Manchester Airport TMA was formed in 1994 with CMAQ funds to mitigate traffic impacts associated with airport activity. It is now totally supported by its members, which include the municipalities of Manchester and Londonderry, the Manchester Airport, the Manchester Transit Agency, the Manchester Chamber of Commerce, Blue Cross/Blue Shield, United Parcel, Felton Brush, Inc., Freudenberg-NOK, Acu-Pak, Mack's Apples, and Stonyfield Farm.

The TMA offers a full range of TDM programs and has formed 20 carpools at Blue Cross/Blue Shield, following its relocation from Concord. Member programs include:

- GIS-based ride-matching for carpools and vanpools
- Information about private bus routes and local bus service providers
- Guaranteed ride home program for employees
- Preferential parking for carpools and vanpools
- Employer consultations regarding transportation and commuting issues
- Employee Transportation Coordinator training
- Quarterly commuter newsletter
- Marketing materials
- Transportation awareness events
- Consultations regarding telecommuting and flexible work arrangements

Massachusetts has a number of TMAs that provide a full range of services to many New Hampshire residents, who work along the I-93 corridor and in Boston. The Massachusetts TMAs that have the greatest likelihood of influencing travel on the I-93 corridor in the study area are:

- The River Road TMA in Andover
- The Junction TMO (Transportation Management Organization) serving the Ballardvale Street and Lowell Junction area in Andover and Wilmington
- The Artery Business Committee TMA in Boston
- Commuter Works/MASCO in Boston (Longwood Medical and Academic Area)
- The Interinstitutional TMA in Boston (Boston Medical Center)

- The Logan TMA at Logan Airport
- The Seaport TMA in South Boston
- The Charles River TMA in Cambridge
- The 128 Business Council TMA

The River Road TMA in Andover estimates that approximately 25 percent of the employees from its member companies live in New Hampshire. As a result, all of its ride-sharing services, which are available to all employees, serve New Hampshire residents. These include ride-matching and guaranteed ride home programs. Further, as described in Proposed Bus Transit Service section below, the Merrimack Valley Regional Transit Authority (MVRTA) has applied for CMAQ funding through the Massachusetts Highway Department to initiate express bus service from southern New Hampshire to the River Road employment area. In April 2002, the NHDOT in a cooperative effort between the Massachusetts Executive Office of Transportation and Construction, the Merrimack Valley Regional Transit Authority, The Junction Transportation Management Organization (TMO), implemented express bus service for New Hampshire employees working at Wyeth BioPharma in Andover, Massachusetts. The pilot project, which provides for a Guaranteed Ride Home will allow approximately 350 New Hampshire employees an alternative commuting option while helping to reduce traffic on I-93, the local roadways and improving air quality. Many members of Boston TMAs provide support for vanpools and transit ridership, which benefit New Hampshire residents traveling to Boston.

3.2.8.4 Bus Transit Services

No publicly owned bus transit service exists in the I-93 corridor. However, Concord Trailways, a private bus carrier, provides commuter service between southern New Hampshire and Boston and the Merrimack Valley Regional Transit Authority provides a dedicated express commuter service from the I-93 Park and Ride lots at Exit 3 in Windham and from Exit 4 Park and Ride lot in Londonderry to Wyeth BioPharma, a 1600 employee biopharmaceutical company in Andover, Massachusetts. Approximately 350 New Hampshire residents commute to the facility daily. The express commuter service will provide for four morning departures from New Hampshire to Wyeth and four evening rush hour departures to accommodate different shifts. The new bus will accommodate 49 passengers and two wheelchairs with the one-way fare for Wyeth employees being $3.00.

Concord Trailways operates two routes in the I-93 corridor that offer commuter-oriented service between southern New Hampshire and Boston, as well as Logan Airport-oriented service that extends into northern New Hampshire. Service provided is as follows:

Concord-Manchester-Boston-Logan Airport

Southbound, daily, weekday service includes 18 trips that depart from Concord or Manchester between 5:00 AM and 6:00 PM. There are seven trips that pass through the study area during the morning peak commuting period. Scheduled travel time from Manchester to South Station in Boston for these peak period trips varies between one hour and ten minutes, and one hour and thirty minutes. The longest trips include a stop in Londonderry (at Exit 4).

Northbound, daily, weekday service includes 16 trips that depart Logan or Boston for Manchester between 7:15 AM and 9:25 PM. There are seven trips that pass through the study area during the evening peak commuting period. Scheduled peak period travel times from South Station to Manchester vary between one hour, and one hour and fifteen minutes.

Fares between Concord and South Station are $12.50 one-way, $24.00 round trip and $63.00 for a commuter weekly pass. Fares between Manchester and South Station are $10.00 one-way, $19.00 round trip and $56.00 for a commuter weekly pass.

Londonderry-Boston

Southbound, daily, weekday service includes 8 buses that depart Londonderry between 5:40 AM and 8:50 AM. Scheduled travel times vary between 50 minutes, and one hour and ten minutes.

Northbound, daily, weekday service includes 10 buses that depart Boston between 1:00 PM to 8:15 PM. Scheduled travel times vary between fifty-five minutes and one hour.

Fares between Londonderry and South Station are $9.00 one-way, $17.50 round trip and $53.00 for a commuter weekly pass.

Additional Bus Service Along I-93

Three additional Concord Trailways routes provide less frequent service from more northern towns in New Hampshire. This service is oriented toward travel to Logan Airport and includes:

- Laconia-Tilton Jct.-Concord-Manchester-Boston-Logan Airport
  - Southbound, daily, weekday service operates between 7:00 AM and 4:00 PM and provides two morning and one evening bus.
  - Northbound, daily, weekday service operates between 9:15 AM and 7:25 PM and provides one morning and four evening buses.
- Berlin-Conway-Meredith-Boston-Logan Airport – provides one trip each way daily on weekdays with one additional trip on Fridays.

- Littleton-Lincoln-Plymouth-Boston-Logan Airport – provides one trip each way daily on weekdays with additional service when Plymouth State College is in session.

Existing Ridership

Table 3.2-7 presents annual ridership for various segments of Concord Trailways bus routes that serve the southern New Hampshire to Boston market. These routes use the I-93 corridor through the project study area. Annual ridership on Concord Trailways Manchester/Londonderry south routes during 1999 was 265,000 passengers. An additional 115,000 passengers utilized Concord Trailways services originating from Concord south. Services north of Concord carried 45,000 passengers. In total, southern New Hampshire bus services accounted for an estimated 425,000 passengers. None of these services provided interim stops within Massachusetts.

Table 3.2-7
1999 Concord Trailways I-93 Corridor Ridership

Origin	Yearly Ridership
North of Concord	45,000
Concord South	115,000
Manchester/Londonderry South	265,000
Total	425,000

On February 28, 2000 Concord Trailways surveyed their riders to determine the communities from which it draws its ridership. Surveys were conducted at the Londonderry and Manchester bus stops.

Two hundred forty two (242) surveys were tabulated from passengers using the service from Londonderry. Eighty-five (35 percent) of the survey respondents indicated that they lived in Londonderry. An additional seventy-seven respondents (32 percent) were from Derry and the remaining 33 percent came from a number of other surrounding communities.

One hundred twenty six (126) surveys were collected from passengers boarding in Manchester. Nearly two-thirds of the respondents (84) were from Manchester with the remaining respondents coming from several other surrounding communities.

Proposed Bus Transit Service

Intercity bus transit between Windham/Salem and Boston was funded in the Fiscal Year 1994 Transportation Improvement Program for the region. Concord Trailways was selected to provide this service, which would offer six round trips daily.

However, implementation of this service is on hold pending the construction of a park-and-ride lot in Salem.

Currently, all existing commuter oriented bus service between New Hampshire and Massachusetts is targeted at the Boston commuter and does not serve destinations north of downtown Boston in Massachusetts. To meet the existing demand for this type of service, the Merrimack Valley Regional Transit Authority (MVRTA) in Massachusetts has applied for CMAQ funding through the Massachusetts Highway Department to initiate express bus service from southern New Hampshire to the Lowell Junction employment area in Andover. This service would be similar to service recently implemented to transport workers living in New Hampshire to the Wyeth Bio-Pharma Company in Andover, Massachusetts. The Lowell Junction bus service could potentially make stops at the Hooksett, Londonderry and Windham park-and-ride lots on I-93 in New Hampshire to provide commuter service to Lowell Junction area employers. MVRTA is coordinating its planning and funding efforts with the NHDOT and the three Regional Planning Commissions in Southern New Hampshire.

3.2.8.5 Rail Transit Services

Passenger Rail

Two north-south rail corridors exist within the region served by I-93. Corridors include the former Boston and Maine (B&M) New Hampshire Main Line (West Rail Corridor) west of I-93, and the former B&M Manchester and Lawrence Branch (East Rail Corridor) east of I-93 (shown on **Figure 2.3-37)**.

The West Rail Corridor generally parallels US 3 between Manchester, NH and Lowell, MA and the East Rail Corridor generally parallels I-93 between Manchester, NH and Salem, NH. Both rail corridors connect with existing MBTA commuter rail lines in Lowell and Lawrence, respectively.

West Rail Corridor

The West Rail Corridor extends 30 miles from Manchester through Bedford, Merrimack, and Nashua to Lowell, Massachusetts. In the past, passenger rail service was operated by the Boston & Maine (B&M) Railroad from Concord, Manchester, and Nashua to Boston. The B&M terminated passenger rail service in June 1967. In January 1980, the Massachusetts Bay Transit Authority (MBTA) and New Hampshire Transit Authority (NHTA) inaugurated a demonstration project that offered commuter rail service between Boston and Nashua, Manchester, and Concord. This 13-month program was funded by a federal grant through the United States Department of Transportation. The service reached a peak of 240-250 daily round trips on a schedule that offered a travel time in excess of two hours from Concord to Boston. This demonstration project fulfilled its purpose by identifying the latent demand for rail

service in southern New Hampshire. It was discontinued when the funding for the demonstration project was expended.

At present, daily freight traffic is provided along the line by Springfield Terminal Railway (Guilford Transportation Industries or GTI). Service from Lowell to Nashua Yard consists of main line and local freight trains, as well as "unit coal" trains that head north to Bow, NH. Train service north of Nashua consists of trains serving local industries or the unit coal trains serving Bow. Mainline through freight trains also operate between Nashua and Boston in the late evening or very early morning hours. In March 1999, GTI was operating the unit coal train to Bow three days a week. Local freight service was operated daily from the Nashua Yard south to service customers located along the line to Lowell. Similarly, local freight service was offered daily from Nashua to the north.

East Rail Corridor

The East Rail Corridor extends from Manchester through Londonderry, Derry, Windham, and Salem to Lawrence, Massachusetts. The 28-mile corridor is the former B&M Manchester and Lawrence Branch. In the past, when offered, passenger service along the M&L was always limited because of the light population density along the line and the use by the B&M of the New Hampshire Main Line as the preferred through route from Manchester to Boston. Regularly scheduled passenger rail service along the route was discontinued by the B&M in July, 1953. Special passenger trains continued to operate from Boston to Rockingham Park on race days until September 1961.

Today, the M&L Branch sees some limited activity serving freight rail customers between Lawrence and Salem. On the south end, a single track exists from Lawrence to Rockingham Park in Salem. Guilford Rail System operates the infrequent local freight service to the few remaining rail customers. North of Rockingham Park, the track has been removed for a thirteen-mile section from Windham to Londonderry and the corridor is owned by the NHDOT, but is used as a recreational trail under the control of New Hampshire Department of Resources and Economic Development (NHDRED). From Londonderry to Manchester, the track has been removed and the railroad right-of-way in areas has been sold.

Current Rail Initiatives

Passenger (commuter) rail service is not currently operated into southern New Hampshire. Residents of this area have the option of driving to Massachusetts and parking at existing MBTA stations. In December 2001 the Northern New England Passenger Rail Authority began Amtrak passenger rail service between Portland, ME and Boston, MA. This service includes stops in Exeter, Dover, and Durham, NH.

Over the past two decades, a number of studies have been conducted examining the feasibility of passenger (commuter) rail service between the southern New Hampshire region and Boston, Massachusetts. These studies include:

- "New Hampshire Rail Passenger Demonstration Program," New Hampshire Transportation Authority, 1981
- "Salem Commuter Rail Study," Rockingham Planning Commission, 1984
- "The Southern New Hampshire and Northern Middlesex Commuter Rail Preliminary Feasibility Study," Guilford Transportation Industries, January 1986 (Revised November 1986)
- "Passenger Rail Feasibility Study for the Nashua Area," Nashua Regional Planning Commission, 1988
- "The Passenger Rail Feasibility Study Phase II: Development of Implementation Strategies," Nashua Regional Planning Commission, 1990
- "Commuter Rail Feasibility Study for Manchester NH," prepared for the Southern New Hampshire Planning Commission by Vanasse Hangen Brustlin, Inc., August 1994
- "Technical Memorandum – NHRRA Rail Proposal (I-93 Corridor Commuter Rail)," Salem-Plaistow-Windham MPO Technical Advisory Committee, May 1997 (Revised June 1997)
- "Major Investment Study – Nashua Passenger Rail Service," Nashua Regional Planning Commission, June 1999

The most recent of these studies completed by the NRPC in June 1999 documents an incremental approach to the restoration of service along a 30.6-mile section of the former B&M New Hampshire Main Line (NHML) rail corridor between Lowell and Manchester (West Rail Corridor). The approach examined by the NRPC considers a two-phase program to restore passenger service. Phase 1 would include an extension of service from the existing MBTA terminus in Lowell to a new park and ride station located near the F.E. Everett Turnpike at Exit 2 (Sagamore Bridge) in Nashua. The Phase 1 effort would extend service approximately 11 miles. For Phase 2, the NRPC is considering a further extension of the service from Nashua to Manchester, a distance of 19 miles. Within this 19-mile segment, three potential station sites are being considered: Star Drive in Merrimack, the proposed Manchester Airport Access Road in Bedford, and Granite Street in Manchester. Each of these station sites could be considered as an interim terminus of service, if additional incremental phases of work are necessary. The Major Investment Study (MIS) estimates daily boardings of approximately 900 passengers at the Nashua station. If there were a Nashua and Merrimack station, the estimated daily boardings are projected to be 750 in Nashua and 250 in Merrimack. The restoration of passenger service between Nashua and Lowell is moving forward independent of the I-93 widening project. Work efforts are underway for developing preliminary engineering and operating plans, evaluating the environmental impacts, and finalizing the project parameters, which

will be presented in the context of an Environmental Assessment. Service is expected to be in operation in the Summer of 2004.

Another study to be undertaken by New Hampshire and Massachusetts jointly is anticipated to begin in early 2003. The intent of this I-93 transit study is to evaluate alternative transportation modes and corridors in Massachusetts and New Hampshire as a first step towards implementing a full range of transit services for the region currently served by I-93 from Manchester, NH to Boston, MA. Alternatives include rail and bus services in and along the I-93 highway corridor, the abandoned Manchester-Lawrence rail branch, and alternatives connecting Boston and Manchester via existing MBTA service at Lawrence, the Anderson transit facility, or bus-rail combinations. The study will be conducted in four phases and includes the design horizon for the year 2025.

The study is expected to help guide future public and private investment decisions involving alternative corridors and various modes of public transportation.

- Phase 1 is proposed to begin in early 2003 and will focus on the identification of institutional issues, service projections, data collection/information gathering and presentation to the public.

- Phase 2 will expand on data collected as part of Phase 1, incorporate public input received and provide an alternatives analysis, culminating in the recommendations for preferred alternatives.

- Phase 3 will include development of a draft report to be presented to the public for comment.

- Phase 4 will result in a final report following consideration of the input received in Phase 3.

In general, Phase 1 is expected to be complete by July 2003, Phase 2 by March 2004, Phase 3 by September 2004, and Phase 4 by June 2005. Sequencing and scheduling may be adjusted as the scope of the study and study process are refined.

Other possible locations to reintroduce rail passenger service into New Hampshire include service between Plaistow, NH and Lawrence MA; and between Portsmouth, NH and Newburyport, MA. Once in Massachusetts, passengers would be able to continue on to Boston. Coordination between New Hampshire and Massachusetts officials is on-going. Major hurdles to overcome include finding the necessary funding to make infrastructure improvements in both states.

3.3 Air Quality

This section presents the results of the air quality study, which evaluates impacts from project-related motor vehicle traffic associated with the I-93 roadway improvements. The 1990 Clean Air Act Amendments (CAAA) and the New Hampshire State Implementation Plan (SIP) require that a proposed project not cause any new violation of the National Ambient Air Quality Standards (NAAQS), or increase the frequency or severity of any existing violations, or delay attainment of any NAAQS.

3.3.1 Introduction

The air quality study contains a microscale (local) analysis. The microscale analysis evaluated carbon monoxide (CO) concentrations at sensitive receptor locations and changes in CO emissions in the study area from motor vehicles, which are the primary source of CO emissions from the proposed project. The air quality study discusses the proposed project's regional emissions and its compliance with the Transportation Conformity criteria. For traffic-related impacts, the pollutants of interest are carbon monoxide and ozone. The primary concerns are:

- Whether the proposed roadway alternatives will create or exacerbate violations of CO standards, and
- Whether the proposed action will increase or decrease the regional emissions of ozone precursors [primarily volatile organic compounds (VOCs) and nitrogen oxides (NOx)].

The CAAA resulted in states being divided into attainment and non-attainment areas, with classifications based upon the severity of their air quality problems. The proposed project is located in the towns of Salem, Windham, Derry, Londonderry, and the City of Manchester. The City of Manchester was redesignated by the USEPA in November 29, 2000 as being in attainment for CO (see 65 CFR 71060). The USEPA also approved its maintenance plan to insure it remains in attainment. The remaining towns are attainment areas for CO. The towns of Salem, Windham, Derry, and Londonderry are part of the Eastern Massachusetts and Southern New Hampshire ozone non-attainment area, which is classified as "Serious." The City of Manchester is located in the Manchester ozone non-attainment, which is classified as "Marginal."

3.3.2 Mobile Source Analysis

The air quality study was prepared consistent with U.S. Environmental Protection Agency (USEPA) modeling procedures. The microscale analysis calculated maximum CO concentrations at receptor locations for each intersection for existing

(1997), the estimated year of completion (2010), and design (2020) years for the No-Build and Build Alternatives. The traffic (volumes and speeds) and emission data were developed for each alternative. The local air quality impacts of the proposed project were calculated based on these data. The 1997 existing condition reflects current traffic conditions in the study area. The 2010 and 2020 No-Build Alternatives reflect the existing traffic volumes increased to account for anticipated background traffic volume growth. The 2010 and 2020 Build Alternative volumes reflect the future No-Build Alternative traffic volumes plus the changes in traffic distribution caused by this I-93 project.

3.3.2.1 Emissions: Mesoscale Analysis

A total burden analysis, including this project, was completed for inclusion in the "Fiscal Year 2001 Conformity Determination." The Conformity document was reviewed by the USEPA and the USDOT and approved by the USDOT in January 2001. Therefore, a regional analysis outside of that completed for the next conformity determination is not necessary.

3.3.2.2 Microscale Analysis

Dispersion Model

The microscale analysis was conducted utilizing the CAL3QHC[23] Version 2 model for free flow and intersection roadway links. CAL3QHC is recommended by the USEPA and is required by USEPA Region I for the air quality analysis of major congested intersections. The effect and extent of vehicle queuing on CO levels at each intersection is determined by CAL3QHC at the intersection of analysis by evaluating the following input; the MOBILE5b[24] idle emission rates, exhaust emission factors, total signal cycle time, effective red time, volumes, roadway geometry, and capacity of intersection. The data are used to develop queuing links at approaches of each analysis site.

Analysis Sites

The USEPA has set the NAAQS for CO to protect the public health. The NAAQS for CO is 35 parts per million (ppm) for a 1-hour period and 9 ppm for an 8-hour period, each not to be exceeded more than once per year. The predominant source of pollution anticipated from the proposed project is emissions from project-related motor vehicle traffic. CO is directly emitted by motor vehicles and its concentration can be estimated by computer modeling.

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23 User's Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections, US Environmental Protection Agency, Office of Air Quality Planning and Standards, Technical Support Division; Research Triangle Park, NC; EPA-454/R-92-006; November 1992.

24 The September 14, 1996 release of MOBILE5b (Mobile Source Emission Factor Model), USEPA, Office of Mobile Sources, Ann Arbor, MI.

The objective of the microscale analysis was to evaluate the CO concentrations at congested intersections in the study area during the peak CO season (winter). The intersections in the study area were ranked based on traffic volumes and level of service under the various Build Alternatives. The following intersections (depicted in **Figures 3.3-1, Sheets 1 through 3**) were selected for analysis because they represent the most congested intersections that are most likely to be affected by project-related traffic in the study area:

- I-93 Exit 2 southbound off-ramp, Pelham Road (NH 97), and Keewaydin Drive
- I-93 Exit 2 northbound off-ramp and Pelham Road (NH 97)
- I-93 Exit 3 northbound off-ramp at NH 111
- Fordway and NH 102

A fifth location, representing the highway right-of-way, was also included in the analysis. A receptor was located along the right-of-way south of Exit 1, where the highest traffic volumes on the I-93 mainline occur.

The microscale analysis calculates maximum 1-hour and 8-hour CO concentrations in the project area. The USEPA's CAL3QHC computer model was used to predict CO concentrations at receptor locations. The CAL3QHC pollution dispersion model calculates the air quality impacts from vehicles in both free-flow and idle operation by creating a three-dimensional model that represents the roadway and receptor geometry. Traffic, emission, and meteorological data were entered into the model to predict maximum 1-hour CO concentrations at the receptor locations. The receptor locations were placed in areas where the public has access. Typically, the receptor locations were placed at the edge of the roadway, but not closer than 10 feet (3 meters) from the nearest travel lane, so that they were not within the roadway mixing cell. The microscale analysis evaluated 66 receptor locations near the intersections. Of the 66 receptor locations, 16 sensitive receptors were selected in the study area to represent the receptor locations. These sensitive receptors are shown on **Figure 3.3-1, Sheet 3**. The results of the microscale analysis are presented in Tables 4.3-1 and 4.3-2. These values represent the highest concentrations for each quadrant of each intersection. Receptor locations located farther away from the intersections will have lower concentrations because of the CO dispersion characteristics. Receptors that are along major roadways (I-93) are also expected to have lower CO concentrations, because the emission factors for vehicles traveling along these roadways are much lower than the emission rates for vehicles queuing at intersections.

The 1-hour CO concentrations were calculated directly from the USEPA computer model, using peak hour traffic and emission data. The 8-hour CO concentrations were derived by applying a persistence factor of 0.7 to the 1-hour CO concentrations. USEPA recommends the use of a 0.7 persistence factor when monitoring data for a local area are not available.

Emission Factors

The vehicle emission factors used in the microscale analysis were obtained using the USEPA MOBILE5b computer model. MOBILE5b calculates CO emission factors for motor vehicles in grams per vehicle-mile. The emission factors calculated in this study were adjusted to reflect New Hampshire-specific conditions such as temperatures representative of the winter CO season (30^0 F). The detailed MOBILE5b input and output data are available upon request.

Worst Case Meteorological Conditions

The worst case meteorological conditions, including wind speed, stability class, ambient temperature, and persistence factor were selected and utilized for the microscale analysis peak one-hour period as follows:

- Wind Speed: 3.3 feet/second
- Wind Direction: Worst Case wind angle search
- Wind Angles: 10 degrees increments from 0 to 360 degrees
- Stability Class: D
- Temperature: 30 degrees Fahrenheit
- Mixing Height: 3,280 feet

CO Background Values

The CO concentrations presented in the results include background CO concentrations. The background concentrations are the constant and diffuse levels of CO that is typically present due to numerous sources throughout the area. A background CO concentration of 2.0 ppm was used for both the 1-hour and 8-hour analysis.

■

3.3.3 Model Predictions

The microscale analysis demonstrated that the 1997 1-hour CO concentrations ranged from a minimum of 3.9 parts per million (ppm) at the highway right-of-way to a maximum of 10.7 ppm at I-93 Exit 2 northbound ramp intersection at Pelham Road. The corresponding maximum 8-hour CO concentrations ranged from a minimum of 3.3 ppm to a maximum of 8.1 ppm. The microscale results for all the receptor locations are presented in Tables 4.3-1 and 4.3-2. All the 1-hour and 8-hour concentrations are below the CO NAAQS of 35 and 9 ppm, respectively.

3.4 Water Resources

Surface water resources within the study area consist of lakes, ponds, streams, and the watersheds that drain into them. Existing water quality conditions and their

designated uses are protected by the surface water quality regulations administered by the New Hampshire Department of Environmental Services, Water Supply and Pollution Control Division (Env WS 1700). Surface water resources are classified as either Class A or B depending on the designated uses and water quality conditions in the water body. Nearly all major surface water resources within the study area are classified B with the exception of Canobie Lake, which is used as a public water supply. Class A is the highest classification and designates water quality that is uniformly excellent and is generally acceptable for water supply uses. Without adequate treatment, discharges of polluting substances into Class A waters are prohibited. Class B designates water quality that is of high aesthetic value and acceptable for swimming and other recreation and as fish habitat. Discharges of polluting substances into Class B waters without adequate treatment are prohibited.

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3.4.1 Surface Water Resources

3.4.1.1 Watersheds

The following five watershed systems are within the study area and shown on **Figure 3.4-1**:

- Spickett River Watershed,
- Golden Brook Watershed,
- Beaver Brook Watershed,
- Little Cohas Brook Watershed, and
- Cohas Brook Watershed

South of Exit 3, much of the existing I-93 roadway is in the Spickett River watershed and crosses a number of tributary streams. Between Exits 3 and 4, a major portion of the existing I-93 roadway is located near the major drainage divide between the Golden Brook watershed and the Spickett River watershed and then enters the Beaver Brook watershed just south of Exit 4. A section of the roadway just south of Exit 5 and a small portion just north of Exit 5 is within the upper reaches of the Little Cohas Brook watershed. However, neither the Little Cohas Brook nor any of its tributaries are actually crossed by or located directly adjacent to the existing I-93 roadway. The remaining roadway, north of Exit 5, is located within the Cohas Brook watershed.

3.4.1.2 Lakes and Ponds

This section identifies lakes and ponds that may be impacted by the highway improvements identified by this project (**Figure 3.4-1**). Canobie Lake and Cobbetts Pond are the largest and perhaps the most important lakes in the study area. Both are extensively used for recreation purposes and Canobie Lake serves as the primary water supply source for the Town of Salem. Both of these lakes, or major portions

thereof, are located in the Town of Windham just south of Exit 3 Interchange and are adjacent to and downgradient to large portions of the I-93 roadway.

Canobie Lake

Canobie Lake is located east of I-93 between Exits 2 and 3 on the Windham/Salem town line. This lake is classified as a Class A waterbody and it currently serves as the primary water source for the Town of Salem. The water intake and pumping station are located on the northeast shore. In July 1995, a new filtration treatment plant was completed for added protection against pathogens and other microorganisms. Canobie Lake has a watershed area of approximately 1400 acres, an estimated surface area of about 373 acres and a maximum depth of 44 feet (NAI 1998). It appears to be fed mostly from groundwater with limited surface water inputs from two intermittent streams draining from the west along I-93 and two intermittent streams draining from the north. Much of its shoreline is extensively developed with homes including an amusement park that exists on the south east shore. Approximately 6,500 feet of the existing I-93 roadway in between the Brookdale Road overpass and the Exit 3 Interchange are located within the watershed. The two tributary streams originate along this stretch of roadway and drain into Canobie Lake. These streams are referred to as the south tributary and the north tributary to Canobie Lake (**Figure 3.4-1**). The outlet of Canobie Lake is Policy Brook, which is located on the east shore.

Canobie Lake has been periodically sampled by the UNH Freshwater Biology Group and was last sampled in the summer of 1994. The data indicates that phosphorus concentrations in the surface water layers were generally low, at approximately 9.0 to 10 microgram/liter (ug/l) or part per billion, but were much higher in the bottom layers indicating that the bottom sediments could be releasing phosphorus during anoxic (i.e., low-oxygen) conditions. One sampling event had phosphorus readings as high as 40-45 ug/l in the bottom layers. Low dissolved oxygen levels were also detected at a depth. Measurements of both water clarity and chlorophyll A (a measure of algal plant abundance) were low to moderate, relative to the average levels found in New Hampshire lakes but indicate slightly worsening conditions relative to previous measurements. Free-floating and attached "mats" of nuisance green algae (*Mougeotia* sp.) were noted as prevalent on most sampling dates. Canobie Lake is considered to be mesotrophic but trending towards eutrophic conditions (J. Schloss, Pers. Comm. UNH Biology Group, March 2002).

Cobbetts Pond

Cobbetts Pond is located just west of Canobie Lake and on the west side of I-93, just south of the Exit 3 Interchange. It has a surface area of approximately 345 acres and a watershed of about 2,050 acres. Its deepest point is estimated to be 60 feet. Cobbetts Pond is a highly regarded recreational resource in the area. Much of its shoreline is developed with year-round and seasonal homes that are serviced by onsite septic systems. Similar to Canobie Lake, its surface water inputs are limited to one or two intermittent streams. One stream, locally referred to as Dinsmore Brook, originates just northeast of the Exit 3 Interchange on the Searles Castle property. Runoff from

much of the Exit 3-Interchange area, including the on and off-ramps and portions of the I-93 mainline drain into this stream and eventually to the Pond. In addition, about 0.75 mile of NH 111, west of the interchange, is also within the Pond's watershed.

Cobbetts Pond has been sampled on annual basis since 1988 as part of the volunteer lakes monitoring group of the New Hampshire Department of Environmental Services (NHDES) Biology Bureau. Data collected in August of 2000 indicates that Cobbetts Pond has an average phosphorus concentration in the surface water layers of about 9.0 ug/l, based on data from two sampling stations. This concentration is lower than the average phosphorus level of 12 ug/l found in New Hampshire lakes but, again, phosphorus concentrations in the bottom layers were higher and ranged between 15 to 20 ug/l, which are more typical of mesotrophic conditions. The increase in phosphorus concentrations in the bottom layers is most likely due to internal releases from bottom sediments during anoxic conditions. Sampling data collected in 1990 indicated that there was little to no dissolved oxygen at depths below 10 meters (33 feet) (NAI, 1990). Historical data going back to 1988 indicates that phosphorus levels in the surface waters have increased in Cobbetts Pond by about 2.0 ug/l over the 12 year period (NHDES 2000). Both Cobbetts Pond and Canobie Lake have shown moderate amounts of algal productivity and are susceptible to worsening conditions with increased phosphorus inputs.

Crystal Lake

Crystal Lake is located approximately 1,000 feet west of I-93 just south of the junction with I-293 in Manchester and is used for recreational purposes by the City of Manchester. The lake is approximately 19 acres in size and includes a municipal beach at its southeastern end. The NHDES has categorized this lake as being eutrophic, meaning it has relatively high levels of algal and nuisance weed growth presumably due to the nutrient inputs from the watershed (Estabrook, 1990). Much of the area immediately surrounding the lake is extensively developed with numerous residential homes. According to NHDES, approximately 1,800 feet of the I-93 southbound lanes are in the watershed. However, there is no apparent stream that flows from the I-93 area directly to the lake. The outlet of Crystal Lake drains to Cohas Brook.

There are several small ponds that are located adjacent to I-93 that are less than 10 acres in size. These include a small, unnamed pond near North Lowell Road in Windham, Wheeler Pond near Exit 4, and an unnamed pond just north of Exit 5. Since they are less than 10 acres in size, they are not classified as Great Ponds and are not listed as public water bodies according to the NHDES. These small ponds may be remnants of historic excavation activity in sand and gravel areas.

3.4.1.3 Streams and Tributaries

Twenty-one (21) streams, rivers and tributaries were identified within the project area. The project area consists of a 4,000-foot wide corridor centered over the existing I-93 roadway from just south of the Massachusetts border north to the I-293/I-93 Interchange. The project area contains several moderate to large streams and many small tributary streams. The two largest streams include the Spickett River and Beaver Brook, which have estimated watershed areas of well over 10.0 square miles. These streams represent the major river systems in the project area and are fed by many of the smaller tributary streams in the area. There are two moderately-sized streams including Policy Brook and Porcupine Brook that are located in the southern end of the project area and have estimated watershed areas of 2,500 to 3,200 acres or about 3.0 to 5.0 square miles. Cohas Brook, at the northern end of the project area, is also considered to be a moderate-size stream with an estimated watershed area of about 5,000 acres or 8.0 square miles. The other streams in the project area are generally much smaller and are primarily tributary or headwater streams with estimated watershed areas of less than 640 acres or 1.0 square mile in size.

As discussed earlier, the existing I-93 roadway from Salem to Manchester traverses through five (5) major watershed areas (Section 3.4.1.1). The following provides a more detailed description of the perennial streams within the project area that are crossed or located directly adjacent to the existing roadway, starting in the south and progressing northward.

Spickett River

The Spickett River is located at the southernmost end of the study area, near the Massachusetts/New Hampshire border and is the largest stream in the study area. It has an estimated watershed area of 64.2 square miles at the point where it flows beneath Hampshire Road near the state border and includes most of the land area within the Town of Salem, much of the easterly portions of the Town of Windham, and extending as far north as the eastern portions of Derry. It receives minimal direct runoff from I-93, but about 5.5 miles of the existing I-93 roadway, from the state border to just south of Exit 3, are in its watershed. Various portions of I-93 drain into its tributaries including Policy Brook, Harris Brook and Porcupine Brook and are discussed below. The Spickett River empties into the Merrimack River after it spills over a dam in Methuen, Massachusetts about 2.0 miles south of the state border.

The Spickett River has been prone to flooding during previous large storm events, particularly along Haigh Avenue in Salem. The U.S. Geological Survey has recently installed a permanent flow gage at the Hampshire Road bridge to provide real-time flow data that will allow for improved monitoring of peak flow conditions. The downstream dam in Methuen, Massachusetts creates backwater conditions and raised water levels upstream, as far north as just beyond its confluence with Policy Brook in Salem, New Hampshire. The downstream stream course appears to have

been realigned where it passes through the I-93/US-213 interchange in Methuen, Massachusetts.

Tributary to Harris Brook

Just north of the state border, a small tributary to Harris Brook parallels along the west side of the existing I-93 roadway for about 3500 feet before emptying into Harris Brook which is located south of the state border. This tributary has an estimated watershed area of about 330 acres based on a review the USGS topographic map. It appears that runoff from nearly a mile of the existing I-93 southbound lanes, from a point just south of Exit 1 drains into this brook. Much of its watershed contains residential areas along Cross Street, Hampshire Road, Salem Street and Brady Road on the west side of I-93.

Policy Brook

Policy Brook flows parallel along the east side of I-93 within 500 feet of the northbound lanes for about 1.0 mile from just north of the northbound Salem Rest Area, until it empties into the Spickett River about 800 feet north of the state border. Policy Brook originates as the outlet of Canobie Lake and has an estimated drainage area of about 3,500 acres in size. A short section of the I-93 roadway just north of Exit 2, near the CISCO manufacturing plant also drains into Policy Brook. It flows south through much of the commercially developed areas along North Policy Road, Pelham Road, South Policy Road, and Rockingham Park Boulevard. The amount of impervious area associated with the Rockingham Mall and the adjacent Rockingham Park race track property alone is estimated to consist of well over 100 acres. Just north of Rockingham Park, the stream flows through a series of culverts and then daylights on the south side, where it is joined by Porcupine Brook.

Tributary to Porcupine Brook

The tributary to Porcupine Brook is a small stream that originates just west of the Exit 1 Interchange and flows through the southern half of the interchange area and then easterly crossing beneath Rockingham Park Boulevard before joining up with Porcupine Brook. It appears that this tributary may be fed by the groundwater discharge from the large stratified-drift aquifer in this area. Its watershed is estimated to be about 350 acres and is likely to receive a fair amount of roadway runoff from the Exit 1 Interchange and Rockingham Park Boulevard.

Porcupine Brook

Porcupine Brook originates in the southeast portion of Windham within a large wetland complex just south of Cobbetts Pond. A portion of the existing I-93 roadway near the Windham/Salem town line drains to this large wetland area. The main channel of the brook develops in Salem and flows south, entering the project area from the west about 0.75 mile north of Exit 1 crossing beneath the southbound lanes. The brook then flows within the existing I-93 median area for about 1,800 feet before crossing beneath the northbound lanes near the Lowell Road underpass. Porcupine

Brook then flows along the east-side of the northbound lanes and the base of the northbound on-ramp embankment and then along Rockingham Park Boulevard before turning south under Rockingham Park Boulevard and joining with Policy Brook. The original stream channel has likely been modified and relocated as part of the original I-93 construction, the construction of Rockingham Park Boulevard and the Rockingham Mall. Porcupine Brook appears to be fed by groundwater discharge associated with a large stratified-drift aquifer that exists in this area (See Groundwater Resources in Section 3.4.2). Its watershed area is estimated to be about 2,500 acres in size and includes an unnamed tributary that originates in the infield area within the west side of the Exit 2 interchange. This tributary crosses beneath the I-93 southbound and northbound lanes and joins up with Porcupine Brook about 0.4 miles south of Exit 2.

South Tributary to Canobie Lake

The south tributary to Canobie Lake represents one of two small intermittent streams that originate just west of the existing I-93 roadway and flow into the west side of Canobie Lake. This tributary flows into the southwest corner of the lake within about 500 feet of I-93. As discussed earlier, Canobie Lake is the primary drinking water supply source for the Town of Salem. The pumping station used to draw water for the public water supply is located on the opposite, or northeast, side of the lake. The watershed area associated with this tributary is estimated to about 165 acres and includes about 2,000 feet of the existing I-93 roadway. Given the relatively small size of the watershed, this stream is considered to support only seasonal, intermittent flow.

North Tributary to Canobie Lake

About 3,000 feet further north and just south of Exit 3, near the NH 111A underpass, another small intermittent stream originates within the median area near NH 111A and the I-93 northbound lanes and drains into a northwest cove of Canobie Lake. About 2,500 feet of the existing I-93 roadway is estimated to be within the watershed of this north tributary of Canobie Lake. This stream is similar in size as the south tributary with an estimated watershed of about 160 acres and is considered to support only seasonal, intermittent flow.

The Northeast Tributary to Cobbetts Pond – Dinsmore Brook

The northeast tributary to Cobbetts Pond, locally referred to as Dinsmore Brook, represents the principal surface water input to Cobbetts Pond. Cobbetts Pond is considered to be primarily fed by groundwater discharge and to a lesser extent by surface water inputs. This tributary has two branches with the main branch originating northeast of Exit 3 on the Searles Castle property, flows through the Exit 3-Interchange area and into the northeast corner of Cobbetts Pond. Another smaller branch originates to the north of Exit 3 within the median area of I-93. The entire watershed size is estimated to be about 200 acres and includes about 1.0 mile of the I-93 roadway and another 0.8 mile of NH 111 and most of the southbound ramp area associated with Exit 3.

South Tributary to Golden Brook

About 1.0 mile north of Exit 3, another small tributary appears to originate within 200 feet of the southbound lanes at a location opposite Jenny's Hill. Its watershed includes about 2,000 feet of I-93 roadway just west of Jenny's Hill. It flows in a southwesterly direction and is joined by the north tributary to Golden Brook before crossing through the central village portion of Windham along NH 111 and eventually joins with Golden Brook below the outlet of Cobbetts Pond. Its watershed, upstream of I-93, is estimated to be about 210 acres in size.

North Tributary to Golden Brook

A little further north, another tributary to Golden Brook originates near the existing I-93 roadway. The stream channel associated with this tributary appears to begin within a large wetland area located just east of the northbound lanes. Its watershed is slightly larger than the south tributary, discussed above, and is estimated to include about 290 acres, upstream of I-93. About 4,000 feet of the existing I-93 roadway is estimated to be within its watershed. As mentioned earlier, this north tributary meets up with the south tributary and eventually flows into Golden Brook, below the outlet of Cobbetts Pond.

South Tributary to Flatrock Brook

About 2.3 miles north of Exit 3, near where North Lowell Road crosses beneath I-93, a small headwater tributary to Flatrock Brook appears to originate just west of the I-93 southbound lanes. This stream begins in a wetland area around a small pond, about 1.0 acre in size, on the west side of I-93. It then flows in an easterly direction beneath I-93 and beneath Morrison Road and then into Mitchell Pond, which is about 1.0 mile east of I-93. The main stem of Flatrock Brook appears to begin below Mitchell Pond. The upstream watershed area associated with this tributary is estimated to be only about 125 acres in size and includes about 2,500 feet of existing I-93 roadway. Its watershed contains a fair amount of residential development along Morrison Road, North Lowell Road and County Road.

North Tributary to Flatrock Brook

This headwater stream to Flatrock Brook originates just east and north of the Windham Depot area. There appear to be two branches with one branch originating approximately 100 feet east of the I-93 roadway and another that begins north of the Windham Depot area. The two branches join and then flow in an easterly direction crosses beneath North Lowell Road and along the base of the abandoned Boston and Maine railroad bed and then joins Flatrock Brook just below Mitchell Pond. The watershed area of this tributary is estimated to be about 350 acres upstream of its crossing with the abandoned rail bed.

South Tributary to Beaver Brook

This unnamed tributary to Beaver Brook originates just west of I-93, in the northern portions of the Town of Windham and crosses beneath I-93 about a 0.5 mile north of the Windham/Derry town boundary. This stream flows in a northeasterly direction and empties into the Beaver Brook on the east side of I-93 near the downtown village of West Derry and near Exit 4. This stream traverses through a large portion of the stratified-drift aquifer that is associated with Beaver Brook and, therefore, is likely to be supported in large part by groundwater discharge from the surrounding sand and gravel deposits. It has an estimated watershed area of about 1150 acres, upstream of I-93, and appears to flow through a large wetland complex located just east of I-93.

North Tributary to Beaver Brook

Another smaller unnamed tributary to Beaver Brook forms just south of the actual Beaver Brook/I-93 crossing. This stream flows in a westerly direction, opposite of the southern tributary, and flows parallel to and eventually into Beaver Brook about 2.0 miles west of I-93. Its watershed area, upstream of I-93, is estimated to be only about 145 acres.

Beaver Brook

Beaver Brook represents the second largest stream in the project area behind Spickett River. Beaver Brook flows in a southeasterly direction with much of its watershed located within the Town of Derry and includes a large upstream impoundment called Beaver Lake, a highly regarded recreation source in the area. The river is crossed by I-93 essentially right at the Derry/Londonderry town boundary. The Derry Wastewater Treatment Facility discharges to the brook just east or upstream of I-93. A large stratified sand and gravel deposit is located within the Beaver Brook corridor. Its upstream watershed is estimated to be span over 25 square miles or more than 15,000 acres. About 4.0 miles downstream at a US Geological Survey gaging station located near the intersection of Routes 111 and 128 in West Windham, the Beaver Brook watershed is estimated to increase to about 41 square miles in size.

Tributary to Wheeler Pond

North of Exit 4, another tributary stream originates to the west side of I-93 and flows parallel to and within 100 feet of the southbound lanes for about 0.75 mile and then crosses beneath I-93, near the Pillsbury Road overpass and eventually empties into Wheeler Pond located next to the northbound on-ramp at Exit 4. Wheeler Pond is less than 10 acres and is not listed on the state's official list of public water bodies in accordance with RSA 271:20.II. The outlet to Wheeler Pond crosses beneath NH Route 102 within the study area and eventually makes its way to Beaver Brook through a series of culverts located in West Derry. The upgradient watershed area for this tributary, above Wheeler Pond, is estimated to be about 550 acres.

Tributary to Hoods Pond - near Stonehenge Road

This small tributary stream originates in a large wetland just west of I-93, in between Exits 4 and 5 and near the Stonehenge Road overpass. It flows easterly beneath I-93 and then southerly for about 2.0 miles, where it flows into Hoods Pond. Hoods Pond is a small pond of about 2 to 3 acres in size located in the heavily developed area just north of the West Derry downtown area. The upstream watershed, above I-93, is estimated to be about 320 acres in size.

Tributary to Little Cohas Brook

The tributary to Little Cohas Brook originates about 2,000 feet to the west of I-93 in North Londonderry and just south of Exit 5. The stream flows northerly crossing beneath NH 28 about 1,000 feet west of the Exit 5 Interchange, but is not crossed by the I-93 roadway. Its watershed area above the crossing with NH 28 is estimated to be about 520 acres and includes about 4,000 feet of the existing I-93 roadway south of Exit 5 and most of the Exit 5 Interchange area.

Cohas Brook

Cohas Brook is the third largest stream in the study area and originates from several headwater streams located in northeast Londonderry and the western portions of Auburn. Much of its watershed area is comprised of sand and gravel deposits, which contribute groundwater discharge and help to sustain base flow in the headwater streams. Most of the I-93 roadway, north of Exit 5, is within the Cohas Brook watershed. A small section of the southbound lanes drains to Crystal lake first and then eventually into Cohas Brook. The brook flows west and then north crossing beneath the northbound lanes of I-93 about 0.5.mile north of the Londonderry/Manchester city line. It then flows north within the median of I-93 for nearly 1.0 mile and receives flow from a small stream, named Long Pond Brook, before crossing a back underneath the northbound lanes and continuing north before joining the outlet stream of Massabesic Lake. It then flows west crossing through the interchange area of I-93 and I-293 and further west around the Manchester Airport and eventually into the Merrimack River. Its watershed area, upstream of the point where it crosses the I-93/I-293 interchange, is estimated to be about 5,000 acres.

Long Pond Brook

Long Pond Brook is a small tributary stream to Cohas Brook that originates as the outlet out of Long Pond located about 3,500 feet east of I-93 and near Lake Massabesic. The Pond itself is about 2,500 feet long by about 400 feet wide. The entire watershed of the Brook is estimated to be about 370 acres, of which, nearly 95% is upgradient of the I-93 roadway. Only about the last 100 feet of the Brook enters the project area as it flows beneath the northbound lanes and joins Cohas Brook within the median area.

Tributary to Cohas Brook

The tributary to Cohas Brook is another small stream located at the very northern end of the project area. The stream originates about 1.0 mile north of the project area along the I-93 northbound lanes and flows south within 100 feet of the northbound lanes and empties into the Cohas Brook just as Cohas Brook turns westward and flows through the I-93/I-293 Interchange area. The watershed to this stream is estimated to be only about 120 acres.

3.4.1.4 Aquatic Life

Lakes, ponds, and streams within the study area are inhabited with fish, amphibians, reptiles, invertebrates, and aquatic plants. Numerous State of New Hampshire laws protect these aquatic resources by protecting the water quality of lakes and streams. The New Hampshire Department of Environmental Services (DES) is responsible under (RSA 21-0:1) for control of water pollution, protection of water supplies, regulation of waste disposal that may affect water quality, and regulation of dams.

Game fish are managed by the State of New Hampshire Fish and Game Department (NHF&GD) and their harvest is regulated by State legislation. The State of New Hampshire has also adopted fishing regulations which include the quantity and allowable size of fish that can be kept, the time and season during which fishing for these species can occur and licensing procedures.

Waterbodies in the study area support several coldwater species (salmonids) and several warmwater species including yellow perch, (*Perca flavescens)*, white perch, (*Morone americana)*, smallmouth bass, (*Micropterus dolomieu*), largemouth bass, (*Micropterus salmoides)*, and pickerel (*Esox niger*). The NHF&GD has been augmenting native and introduced species of fish populations for several decades and compiles yearly fish stocking records and water quality related information for lakes, streams and ponds within the State. Stocked waterbodies within the study area include the Spickett River, Canobie Lake, Beaver Brook, and Little Cohas Brook. With the exception of Beaver Brook, currently stocked with rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*) and brook trout (*Salvelinus fontinalis*), the Spickett River, Canobie Lake and Little Cohas Brook are stocked only with brook trout (D. Walsh 2002; NHF&GD pers. Comm.). Brook trout are the predominant sportfish in Hillsboro and Rockingham Counties, and can be found in lakes and streams throughout the entire study area.

The Spickett River, Policy Brook, Porcupine Brook, Beaver Brook, Little Cohas Brook and Cohas Brook are the major waterways in the study area, and support fish species including brook trout, brown trout and rainbow trout. These waterways are generally low-gradient, meandering point-bar, riffle-pool alluvial channels with broad, well-defined floodplains. In addition to these six major waterways, 15 additional perennial and 58 intermittent watercourses are located within the study area. The

majority of these waterways are characterized as low-gradient, slightly entrenched waterways with moderately embedded substrates. Embeddedness refers to the degree that larger particles, including cobble and gravel, are covered or surrounded by fine sediment. In the vicinity of the study area, most waterways exhibited varying levels of embeddedness. Roadway sand and untreated stormwater entering these waterways has impacted the viability of aquatic ecosystem functions and processes by degrading habitat for invertebrates, fish and amphibians.

Principal lakes in the study area include Canobie Lake, Cobbetts Pond and Crystal Lake. Trophic surveys conducted by the NHDES Water Supply and Pollution Control Division-Biology Bureau in 1987 and 1988 indicated that Canobie Lake had a mesotrophic status. Trophic studies of Cobbetts Pond conducted by NHDES Water Supply and Pollution Control Division-Biology Bureau in 1986 and 1987 indicated that this pond was also mesotrophic and exhibited indications of becoming eutrophic. Mesotrophic waterbodies typically have a moderate amount of nutrients (nitrogen and phosphorous) with eutrophic lakes having more nutrients and oligotrophic lakes having lower concentrations of nutrients. Mesotrophic lakes are therefore productive, but not so productive that algal blooms dominate their ecology. Due to their higher productivity, water temperatures and other physical and chemical parameters these waterbodies support warmwater fish species.

Electro-shocking and net survey efforts conducted concurrently with trophic studies indicated that the following species were present in Canobie Lake: smallmouth bass, largemouth bass, eastern chain pickerel, rainbow trout, yellow perch, white perch, brown bullhead (*Ameiurus nebulosus*), golden shiner (*Notemigonus crysoleucas*), common sunfish (*Lepomis* sp.), black crappie (*Pomoxis nigromaculatus*), pumpkinseed sunfish (*Lepomis gibbosus*) and American eel (*Anguilla rostrata*). Cobbetts Pond contained eastern chain pickerel, yellow perch, brown bullhead, pumpkinseed sunfish and alewives (*Alosa pseudoharengus*). Numerous smaller ponds and streams scattered throughout the study area provide suitable habitat for one or more of these fish species.

Specifics of the stream crossings, both bridges and culverts, are summarized in Table 3.4-1. Refer to **Figure 3.4-1** for locations of stream crossings.

Table 3.4-1
Stream Crossings – Bridges and Culverts

Segment	Watercourse Name/Type	Watershed	Fish Habitat	Northbound ID#	Southbound ID#	Con nectivity[1]	Perennial/ Intermittent	Average Width (feet)		Average Depth (inches)		Dominant Substrate	Average Flow[2] (CFS)	Culvert Diameter (Inches)	Crossing Type[3]	Comments
								East of I-93	West of I-93	East of I-93	West of I-93					
A	**Tributary to Harris Brook**	Spickett River	yes	-	77S	No	perennial	-	10	-	12	sand, gravel	< 0.5	24	RCP	North portion is drainage swale, southern portion may support warmwater species
B	Drainage swale[4]	Spickett River	no	77A	-	No	intermittent	n/a	-	n/a	-		n/a	18	CMP	Conveys stormwater only
	Policy Brook	Spickett River	yes	77B	-	No	perennial	12	-	12	-	cobble, gravel	10	120	CMP	May supports warmwater species
	Drainage swale	Spickett River	no	77C	-	No	intermittent	n/a	-	n/a	-	n/a	n/a	24	RCP	Conveys stormwater only
	Drainage swale	Spickett River	no	-	76S	No	intermittent	-	n/a	-	n/a	sand	n/a			No defined channel, stormwater only
	Tributary to Porcupine Brook	Spickett River	yes	75N	75S	Yes	perennial	12	10	18	9	sand, gravel	3	36	RCP	Channel slightly downcut, may support warmwater species, some exposed gravels
	Intermittent watercourse	Spickett River	no		74S	No	intermittent	-	84	-	8	sand	0-standing water	18	RCP	Excavated channel conveying stormwater only
	Drainage swale	Spickett River	no	74A	-	no	intermittent	n/a	-	n/a	-	n/a	n/a	18	RCP	Conveys stormwater only
C	Drainage swale	Spickett River	no	73N	73S	yes	intermittent	1.3	2	1	n/a	vegetated	0-standing water	24	RCP	Excavated channel conveying stormwater only
	Drainage swale	Spickett River	no	-	72S	no	intermittent	-	2	-	6	sand	< 0.1	18	CMP	Severely degraded excavated channel
	Drainage swale	Spickett River	no	-	71S	no	intermittent	-	1.6	-	5	silt, sand	< 0.1	24	RCP	Conveys stormwater only
	Porcupine Brook	Spickett River	yes	70N	70S	yes	perennial	1.0	15	20	18	cobble, gravel	9	120	bridge	Cobble/subangular gravel substrate provides spawning habitat
	Drainage swale	Spickett River	no	-	69S	no	intermittent	-	n/a	-	n/a	n/a	n/a	24	RCP	Conveys stormwater only
	Tributary to Porcupine Brook	Spickett River	no	68N	68S	yes	perennial	10	4	7	6	sand	2	60	RCP	Short section of degraded channel; two unidentified fish observed
	Drainage swale	Spickett River	no	-	67S	no	intermittent	-	3	-	5	sand	< 0.1	24 and 36	RCP	Significantly embedded channel
	Tributary to Porcupine Brook	Spickett River	yes	-	66S	no	perennial	-	3	-	8	sand, gravel	1.0	48	RCP	Unidentified fish observed in portion of channel south of Main street
	Drainage swale	Spickett River	no	66A	-	no	intermittent	3	-	1	-	sand, gravel	< 0.1	18	RCP	Outflow from small impoundment
	Drainage swale	Spickett River	no	66B	-	no	intermittent	n/a	-	n/a	-	n/a	n/a	12	RCP	Seep and drainage swale contribute hydrology
	Drainage swale	Spickett River	no	66C	-	no	intermittent	n/a	-	n/a	-	n/a	n/a	unknown (buried)	RCP	Conveys stormwater only
	Drainage swale	Spickett River	no	66D	-	no	intermittent	7	-	10	-	boulder, cobble	1.0	60	RCP	Perennial outflow from PFO and unnamed pond
	Drainage swale	Spickett River	no	66E	-	no	intermittent	6	-	3	-	sand, gravel	< 0.2	24	RCP	Portion of tributary to Porcupine Brook
	Drainage swale	Spickett River	no	-	65S	no	intermittent	-	1.5	-	4	sand, subangular gravel	0.3	24	RCP	Conveys stormwater only, reduced iron in channel
	Drainage swale	Spickett River	no	-	64S	no	intermittent	-	n/a	-	n/a	n/a	n/a	12	RCP	No flow or defined channel, conveys stormwater only
	Drainage swale	Spickett River	no	-	63S	no	intermittent	-	n/a	-	n/a	n/a	n/a	12	CMP	No flow or defined channel, conveys stormwater only
	Intermittent watercourse	Spickett River	no	-	62S	no	intermittent	-	> 5	-	8	cobble, gravel	2.0	24	RCP	Part of 61, conveys stormwater only
	Drainage swale	Spickett River	no	61N	61S	yes	intermittent	-	4	-	7	cobble, gravel	0.75	24	RCP	Tributary to Policy Brook, step-pool system
	Drainage swale	Spickett River	no	61A	-	no	intermittent	3	-	5	-	cobble, gravel	< 0.2	12 and 24	RCP	Stormwater from median strip, eastern edge of NB lane
	Intermittent watercourse	Spickett River	no	60N	60S	yes	intermittent	3	-	3	-	sand, gravel	< 0.1	24	RCP	Tributary to Canobie Lake, also drains median strip
D	Intermittent watercourse	Spickett River	no	59N	59S	yes	intermittent	1.5	-	5	-	cobble, small boulder	< 0.2	24	RCP	Conveys stormwater from upgradient swales
	South Tributary to Canobie Lake	Spickett River	yes	58N	58S	yes	perennial	4	3	5	7	cobble, sand	1.5	48	RCP	May provide fish habitat, production export; Canobie Lake stocked with eastern brook trout (*Salvelinus fontinalis*)
	Intermittent watercourse	Spickett River	no	57A	-	no	intermittent	4	-	3	-	cobble, gravel	0.3	14	RCP	Conveys stormwater from drainage swales
	Intermittent watercourse	Spickett River	no	-	57S	no	intermittent	-	n/a	-	n/a	n/a	0-standing water	18	RCP	No channel, depressional wetland
	North Tributary to Canobie Lake	Spickett River	no	56N	56S	yes	perennial	-	18	-	5	sand, gravel	< 0.1	12	CMP	Conveys stormwater and overland flow; Canobie Lake stocked with eastern brook trout (*Salvelinus fontinalis*)
	Intermittent watercourse	Golden Brook	no	-	55S	no	intermittent	-	3	-	8	silt, sand	0.5	12?	RCP	Buried with sediment to culvert bell
	Drainage swale	Golden Brook	no	55A	-	no	intermittent	n/a	-	n/a	-	n/a	n/a	12	RCP	Conveys stormwater only, no defined channel
	Intermittent watercourse	Golden Brook	no	55B	-	No	intermittent	n/a	-	n/a	-	n/a	n/a	30	RCP	Channel undefined, diffuse flow in wetland

1 Connectivity denotes a continuous east-west culvert connection under the northbound and southbound lanes.
2 Channel flow was estimated in cubic feet per second (CFS) by determining the cross section (average width x average depth) of the watercourse and estimating the city in feet per second (FPS).
3 Crossing type abbreviations: reinforced concrete pipe (RCP), corrugated metal pipe (CMP) and bridge (also referred to as a box culvert). SCH 40 denotes schedule 40 extruded polyvinyl chloride piping.
4 Drainage swale denotes an area with no defined channel; typically a maintained, grass-lined swale. Some swales, or portions of, have been stabilized with riprap, cobble, gravel, concrete, or small boulders.

Table 3.4-1 (continued)

Segment	Watercourse Name/Type	Watershed	Fish Habitat	Northbound ID#	Southbound ID#	Connectivity[1]	Perennial/ Intermittent	Average Width (feet)		Average Depth (inches)		Dominant Substrate	Average Flow[2] (CFS)	Culvert Diameter (Inches)	Crossing Type[3]	Comments
								East of I-93	West of I-93	East of I-93	West of I-93					
D Cont'd	**Tributary to Cobbetts Pond**	Golden Brook	yes	55C	-	no	perennial	4	-	8	-	sand, gravel	1.5	48	RCP	Heavily embedded channel; portions may support small warmwater fishery
	Intermittent watercourse	Golden Brook	no	-	54S	no	intermittent	-	24	-	5	sand, gravel	< 0.1	18	RCP	Conveys stormwater only, excavated channel
	Drainage swale	Golden Brook	no	-	53S	no	intermittent	-	n/a	-	n/a	n/a	n/a	18	CMP	Conveys stormwater only, no defined channel
	Intermittent watercourse	Golden Brook	no	-	52S	no	intermittent	-	4	-	10	cobble, small boulder	1.5	24	RCP	High-gradient step-pool watercourse
	Intermittent watercourse	Golden Brook	no	52N	-	no	intermittent	1.8	-	2	-	sand, gravel	2.0	36	RCP	Step-pool watercourse, possible fish habitat
	Drainage swale	Golden Brook	no	-	52A	no	intermittent	-	n/a	-	n/a	n/a	n/a	18	RCP	Vegetated swale with no defined channel conveying stormwater
	Drainage swale	Golden Brook	no	-	52B	no	intermittent	-	n/a	-	n/a	n/a	n/a	24	RCP	Conveys stormwater via swales, no defined channel
	Drainage swale	Golden Brook	no	-	52C	no	intermittent	-	n/a	-	n/a	n/a	n/a	12 and 18	RCP and PVC	Riprap depressional area conveying stormwater and overland flow
	Drainage swale	Golden Brook	no	-	52D	no	intermittent	-	n/a	-	n/a	n/a	n/a	18	RCP	Riprap swale conveys overland flow from upgradient areas
	INTERMITTENT watercourse	Golden Brook	no	-	52E	no	intermittent	-	3.3	-	7	sand, gravel	2.0	n/a	n/a	No culvert crossings along proposed alignment
	Intermittent watercourse	Golden Brook	no	-	52F	no	intermittent	-	n/a	-	1	silt, sand	< 0.1	24	RCP	No defined channel, diffuse flow through PEM
	Intermittent watercourse	Golden Brook	no	-	52G	no	intermittent	-	n/a	-	n/a	n/a	n/a	18	RCP	Conveys stormwater from grass swales
	Intermittent watercourse	Golden Brook	no	-	52H	no	intermittent	-	n/a	-	n/a	unknown	n/a	18	RCP	Conveys stormwater and flow from small isolated wetlands north of Route 111
	Intermittent watercourse	Golden Brook	no	-	52I	no	intermittent	-	3	15	-	unknown	0-standing water	Unknown (submerged)	unknown	Submerged culvert conveying flow from small isolated POW
	Tributary to Cobbetts Pond	Golden Brook	no	51N	51S	yes	perennial	1.3	-	4	-	n/a	0.3	24 and 6	RCP and PVC	Step-pool watercourse with undercut banks
	Intermittent watercourse	Golden Brook	no	-	50S	no	intermittent	-	24	-	5	sand, gravel	0.3	24	RCP	High gradient step-pool watercourse
	Intermittent watercourse	Golden Brook	no	-	49S	no	intermittent	-	n/a	-	n/a	n/a	n/a	24	RCP	No defined channel, conveys stormwater only
	South Tributary to Golden Brook	Golden Brook	yes	-	48S	no	perennial	-	3	-	12	sand, gravel	1.0	60	RCP	Part of south tributary to Golden Brook
	Intermittent watercourse	Golden Brook	no	47A	-	no	intermittent	n/a	-	n/a	-	sand	0-standing water	18	RCP	No defined channel, drains PFO and swales
	South Tributary to Golden Brook	Golden Brook	no	47N	47S	yes	perennial	1.5	-	5	-	n/a	< 0.2	48	RCP	Receives flow from PFO, drainage swales and weigh station impervious surface areas
	Intermittent watercourse	Golden Brook	no	-	46S	no	intermittent	-	n/a	-	n/a	n/a	n/a	24	RCP	Conveys stormwater from drainage swales
	Intermittent watercourse	Golden Brook	no	-	45S	no	intermittent	-	n/a	-	n/a	n/a	n/a	12	RCP	Conveys stormwater to downgradient catch basin
	Intermittent watercourse	Golden Brook	no	45A	-	no	intermittent	1.2	-	2	-	n/a	< 0.1	24 and 36	RCP	Conveying flow from swales and PFO
	Intermittent watercourse	Golden Brook	no	45B	-	no	intermittent	36	-	5	-	n/a	< 0.1	24 and 36	RCP	Draining upgradient PFO and conveying stormwater
	Intermittent watercourse	Golden Brook	no	45C	-	no	intermittent	n/a	-	n/a	-	n/a	n/a	24	RCP	Drains upgradient seep and drainage swales
	North Tributary to Golden Brook	Golden Brook	no	-	44S	no	perennial	-	1.7	-	14	riprap	< 0.2	18	RCP	Drains PFO, and convey stormwater from upgradient swales
	Intermittent watercourse	Golden Brook	no	-	43S	no	intermittent	-	2	-	4	sand, gravel	< 0.2	18	CMP	Convey stormwater to downgradient PFO
	Intermittent watercourse	Golden Brook	no	43A	-	no	intermittent	n/a	-	n/a	-		n/a	24, 6	RCP, CMP	Conveys stormwater from drainage swales
	South Tributary to Flatrock Brook	Golden Brook	yes	42N	42S	yes	perennial	6	-	5	-	cobble, gravel	1.0	36	RCP	Culverted under highway to 42, outflow to dead wood swamp; fish habitat observed
	North Tributary to Flatrock Brook	Spickett River	no	41N	41S	yes	perennial	4	2	4	7	sand, gravel	0.4	24	RCP	Outflow from large PFO, may support warm water fish species
E	Intermittent watercourse	Spickett River	no	40N	40S	yes	intermittent	0.8	n/a	1	n/a	n/a	< 0.1	24	RCP	Conveys stormwater from median swales and drains upgradient PFO, no defined channel southbound
	Intermittent watercourse	Spickett River	no	39N	39S	yes	intermittent	3	1.2	4	3	sand, gravel	< 0.3	24	RCP	Step-pool channel draining upgradient PFO and conveying drainage swale stormwater
	Intermittent watercourse	Spickett River	no	38N	38S	yes	intermittent	2	2	3	3	cobble, gravel	0.2	24	RCP	Receives flow from upgradient seep wetland, and drainage swales
	South Tributary to Beaver Brook	Beaver Brook	yes	37N	37S	yes	perennial	10	11	13	>24	sand, gravel	2.0	60	RCP	Conveying drainage from POW east to PEM; fish habitat in some reaches
	Drainage swale	Beaver Brook	no	37A	-	no	intermittent	n/a	-	n/a	-	n/a	n/a	18	CMP	Conveys stormwater from upgradient catch basins; no defined channel
	Intermittent watercourse	Beaver Brook	no	37B	-	no	intermittent	n/a	-	n/a	-	n/a	n/a	24	RCP	Conveys stormwater from drainage swales to PEM
	Drainage swale	Beaver Brook	no	-	36S	no	intermittent	-	n/a	-	n/a	n/a	n/a	24	RCP	Conveys stormwater from swales; no defined channel
	Intermittent watercourse	Beaver Brook	no	-	35S	no	intermittent	-	1.5	-	2	cobble, gravel	< 0.2	18	CMP	Narrow downcut channel with step-pool morphology
	Intermittent watercourse	Beaver Brook	no	34A	-	no	intermittent	-	-	-	-	n/a	n/a	12	CMP	Conveys stormwater for drainage swales into downgradient PFO
	North Tributary to Beaver Brook	Beaver Brook	yes	34N	34S	yes	perennial	4	5	6	6	riprap	0.5	48	RCP	Outflow from PEM; marginal fish habitat; may support warmwater fishery
	Beaver Brook	Beaver Brook	yes	33N	33S	yes	perennial	25	25	24	24	sand, gravel	12	288 x 96	bridge	Fish habitat, otter activity observed, steep undercut banks
	Intermittent watercourse	Beaver Brook	yes	32N	32S	yes	intermittent	> 4	3	5	3	sand, silt	0.4	36	RCP	drains PEM in median and PFO west of SB lane; broad diffuse flow in median
	Drainage swale	Beaver Brook	no	32A	-	no	intermittent	n/a	-	n/a	-	n/a	n/a	12	CMP	Conveying stormwater from drainage swales

1 Connectivity denotes a continuous east-west culvert connection under the northbound and southbound lanes.
2 Channel flow was estimated in cubic feet per second (CFS) by determining the cross section (average width x average depth) of the watercourse and estimating the velocity in feet per second (FPS).
3 Crossing type abbreviations: reinforced concrete pipe (RCP), corrugated metal pipe (CMP) and bridge (also referred to as a box culvert). SCH 40 denotes schedule 40 extruded polyvinyl chloride piping.
4 Drainage swale denotes an area with no defined channel; typically a maintained, grass-lined swale. Some swales, or portions of, have been stabilized with riprap, cobble, gravel, concrete, or small boulders.

Table 3.4-1 (continued)

Segment	Watercourse Name/Type	Watershed	Fish Habitat	Northbound ID#	Southbound ID#	Connectivity[1]	Perennial/ Intermittent	Average Width (feet)		Average Depth (inches)		Dominant Substrate	Average Flow[2] (CFS)	Culvert Diameter (Inches)	Crossing Type[3]	Comments
								East of I-93	West of I-93	East of I-93	West of I-93					
E Cont'd	**Tributary to Beaver Brook (outflow from Wheeler Pond)**	Beaver Brook	no	32B	-	no	perennial	5	-	7	-	cobble	2.5	48	RCP	Outflow from Wheeler Pond
	Drainage swale	Beaver Brook	no	32C	-	no	intermittent	n/a	-	n/a	-	n/a	n/a	24	RCP	Conveying stormwater only; discharges to upland area
	Intermittent watercourse	Beaver Brook	no	-	31S	no	intermittent	-	2	-	7	sand	< 0.2	24	RCP	30' of channel between two culverts
	Intermittent watercourse	Beaver Brook	no	30N	30S	yes	intermittent	3	1.5	2	3	cobble, gravel	0.4	48	RCP	Drains upgradient PFO, outfall from excavated pond, conveys stormwater via off ramp swale
	Drainage swale	Beaver Brook	no	30A	-	no	intermittent	n/a	-	n/a	-	n/a	n/a	14	RCP	Conveys stormwater from median drainage swale
	Drainage swale	Beaver Brook	no	30B	-	no	intermittent	n/a	-	n/a	-	n/a	n/a	14	RCP	Conveys stormwater from median drainage swale
	Drainage swale	Beaver Brook	no	30C	-	no	intermittent	n/a	-	n/a	-	n/a	n/a	14	RCP	Conveys stormwater from median drainage swale
	Drainage swale	Beaver Brook	no	29N	29S	yes	intermittent	n/a	n/a	n/a	n/a	n/a	n/a	24	RCP	Conveys stormwater from upgradient drainage swales; no defined channel
	Intermittent watercourse	Beaver Brook	no	28N	28S	yes	intermittent	5	3	8	4	silt, sand	< 0.25	12	RCP	Conveying stormwater from median drainage swales to downgradient strip of PSS/PFO
	Tributary to Wheeler Pond	Beaver Brook	yes	27N	27S	yes	perennial	6	4	7	8	cobble, gravel, sand	1.0	60	RCP	May support small fishery in south channel west of SB lane; receives stormwater via swales
	Tributary to Wheeler Pond	Beaver Brook	yes	26N	26S	yes	perennial	10	10	8	8	sand, organic , small cobble	0.5	24	RCP	Receives stormwater via median drainage swale; contributes to perennial watercourse along SB lane
	Intermittent watercourse	Beaver Brook	yes	25AN	25AS	yes	intermittent	4	4	4	4	cobble, gravel	0.5	18	RCP	Outflow from POW/PEM appears to cease flowing; reduced iron on substrate in median
	Intermittent watercourse	Beaver Brook	no	25N	25S	yes	intermittent	5	10	2	20	coarse sand	<0.1	36	RCP	Small scour pool at headwall; drains east PFO and drainage swale to west PFO
	Drainage swale	Beaver Brook	no	24N	24S	yes	intermittent	n/a	n/a	n/a	n/a	n/a	n/a	24, 6	RCP, CMP	No defined channel; convey stormwater via upgradient swales; drains to PFO
	Intermittent watercourse	Beaver Brook	no	-	23S	no	intermittent	-	9	-	15	sand, gravel	0-standing water	18	RCP	Turbid pool with reduced iron; receives stormwater via drainage swales
	Tributary to Wheeler Pond	Beaver Brook	no	22N	22S	yes	perennial	6	10	5	18	sand, gravel	0-standing water	18	RCP	Receives stormwater via drainage swales; drains large PFO
	Tributary to Wheeler Pond	Beaver Brook	no	21N	21S	yes	perennial	12	n/a	14	n/a	n/a	0-standing water	24	RCP	No channel or flow west side; drains to PFO; gw seepage?
	Drainage swale	Beaver Brook	no	-	20S	no	intermittent	-	n/a	-	n/a	n/a	n/a	24	RCP	No defined channel, conveys stormwater only
	Intermittent watercourse	Beaver Brook	no	20A	-	no	intermittent	n/a	-	n/a	-	n/a	n/a	24	RCP	Conveys stormwater only; no defined channel
	Intermittent watercourse	Beaver Brook	no	20B	-	no	intermittent	n/a	-	n/a	-	n/a	n/a	24	RCP	Conveys stormwater only; no defined channel
	Tributary to Hoods Pond	Beaver Brook	yes	19N	19S	yes	perennial	5	4	6	8	cobble, subangular gravel	1	60	RCP	Conveys stormwater from swales and overland flow; Hoods Pond stocked with eastern brook trout (*Salvelinus fontinalis*)
F	Intermittent watercourse	Beaver Brook	no	19AN	19AS	yes	intermittent	4	4	3	3	cobble, gravel	< 0.2	24	RCP	Draining upgradient PFO seep wetland; culverted through median; no exposed channel in median
	Intermittent watercourse	Beaver Brook	no	-	19B	no	intermittent	3	-	6	-	sand, gravel	< 0.2	18	CMP	Excavated channel contributing flow to PFO; receives flow via drainage swales and upgradient catch basins
	South Tributary to Cohas Brook	Beaver Brook	yes	18N	18S	yes	perennial	5	2	5	5	cobble, subangular gravel	0.25	24, 18	RCP	Outflow from small PFO; receives stormwater via drainage swales
	Intermittent watercourse	Little Cohas Brook	no	17N	17S	yes	intermittent	n/a	n/a	n/a	n/a	n/a	n/a	24	RCP	Conveying stormwater via upgradient swales and seep area at base of cut face
	Drainage swale	Little Cohas Brook	no	-	16S	no	intermittent	-	n/a	-	n/a	n/a	n/a	24	RCP	No defined channel, conveys stormwater only
	Tributary to Little Cohas Brook	Little Cohas Brook	yes	-	15S	no	perennial	-	3	-	6	cobble, gravel, sand	< 0.25	24	RCP	Drains upgradient PFO and receives overland flow from fill slope; slow disuse flow through emergent vegetation
	Drainage swale	Little Cohas Brook	no	15A	-	no	intermittent	6	-	4	-	cobble, gravel	< 0.1	18	RCP	Riprap swale filled with algae, reduced iron and manganese; receives stormwater and overland flow
	Drainage swale	Little Cohas Brook	no	-	14S	no	intermittent	-	n/a	-	n/a	n/a	0-standing water	24	RCP	Drainage swale with small areas of ponded water
	Drainage swale	Little Cohas Brook	no	-	13S	no	intermittent	-	n/a	-	n/a	n/a	n/a	24, 12	RCP, CMP	Conveys stormwater to upland grassy area
	Intermittent watercourse	Little Cohas Brook	no	-	12S	no	intermittent	-	4	-	2	sand, gravel	0-standing water	24	RCP	Conveys stormwater and drains upgradient PFO

1 Connectivity denotes a continuous east-west culvert connection under the northbound and southbound lanes.
2 Channel flow was estimated in cubic feet per second (CFS) by determining the cross section (average width x average depth) of the watercourse and estimating the velocity in feet per second (FPS).
3 Crossing type abbreviations: reinforced concrete pipe (RCP), corrugated metal pipe (CMP) and bridge (also referred to as a box culvert). SCH 40 denotes schedule 40 extruded polyvinyl chloride piping.
4 Drainage swale denotes an area with no defined channel; typically a maintained, grass-lined swale. Some swales, or portions of, have been stabilized with riprap, cobble, gravel, concrete, or small boulders.

Table 3.4-1 (continued)

Segment	Watercourse Name/Type	Watershed	Fish Habitat	Northbound ID#	Southbound ID#	Connectivity[1]	Perennial/ Intermittent	Average Width (feet)		Average Depth (inches)		Dominant Substrate	Average Flow[2] (CFS)	Culvert Diameter (Inches)	Crossing Type[3]	Comments
								East of I-93	West of I-93	East of I-93	West of I-93					
F Cont'd	**Tributary to Little Cohas Brook**	Little Cohas Brook	yes	11N	11S	yes	perennial	2	7	15	10	sand, silt, subangular gravel	1.5	36	RCP	Receives stormwater via swales and catch basins; west portion may support warm water fish species; Little Cohas Brook (in Londonderry) stocked with eastern brook trout (*Salvelinus fontinalis*)
	Drainage swale	Little Cohas Brook	no	-	10S	no	intermittent	-	n/a	-	n/a	sand	n/a	14	RCP	Conveys stormwater only, no defined channel, discharges to PEM
	Drainage swale	Little Cohas Brook		10A	-	no	intermittent	n/a	-	n/a	-	n/a	0-standing water	12	SCH 40 PVC	90 degree PVC elbow discharging to pool; no defined channel
	Intermittent watercourse	Cohas Brook	yes	9N	9S	yes	intermittent	10	2	12	6	sand, gravel	0.25	24	RCP	Conveys stormwater and drains seep; channel morphology not favorable for fish
	Drainage swale	Cohas Brook	no	-	8S	no	intermittent	-	n/a	-	n/a	cobble, boulder	n/a	24	RCP	Conveys stormwater only; no defined channel
	Drainage swale	Cohas Brook	no	8A	-	no	intermittent	n/a	-	n/a	-	n/a	n/a	24	RCP	No defined channel; conveys stormwater only to adjacent PFO
	Drainage swale	Cohas Brook	no	8B	-	no	intermittent	n/a	-	n/a	-	n/a	n/a	24, 6	RCP, CMP	No defined channel; conveys stormwater only to adjacent PFO
	Intermittent watercourse	Cohas Brook	yes	-	7S	no	intermittent	-	18	-	4	boulder, cobble, small gravel	< 0.25	36	RCP	Receives flow from slope PFO, step-pool morphology
	Intermittent watercourse	Cohas Brook	no	6N	6S	yes	intermittent	2	n/a	4	n/a	cobble, boulder, subangular gravel	0.5	36	RCP	No defined channel west of SB lane; conveys stormwater from drainage swales in median
	Intermittent watercourse	Cohas Brook	no	6B	-	no	intermittent	1.2	-	0.5	-	sand	< 0.1	24, 18	RCP, RCP	Conveys stormwater from upgradient drainage swales, drains to PFO; also receives flow from seep area
	Cohas Brook	Cohas Brook	yes	5A	-	yes	perennial	2.5	-	12	-	sand	25	372 x 144	bridge	Channel substrate predominantly dynamic, coarse sand, heavily embedded, no cover in channel for fish; Little Cohas Brook (in Londonderry) stocked with eastern brook trout (*Salvelinus fontinalis*)
	Intermittent watercourse	Cohas Brook	no	-	5S	no	intermittent	1.2	-	< 1.0	-	cobble, boulder	0- standing water	24	RCP	Receives flow from upgradient seep, slightly downcut channel, also conveys stormwater from upgradient drainage swales
	Intermittent watercourse	Cohas Brook	no	-	4S	no	intermittent	2.3	-	2	-	rounded and subangular gravel	< 0.5	40	RCP	Outflow from upgradient PFO; receives stormwater from riprap swale; well-entrenched channel
	Drainage swale	Cohas Brook	no	4A	-	no	intermittent	n/a	-	n/a	-	n/a	n/a	18	RCP	Conveys stormwater, no defined channel, area under construction
	Intermittent watercourse	Cohas Brook	no	4B	-	no	intermittent	n/a	-	8	-	sand	0- standing water	24	RCP	Outflow from PEM to Cohas Brook; debris partially blocking culvert; receiving large quantities of sand from upgradient construction areas
	Long Pond Brook	Cohas Brook	yes	4C	-	no	perennial	24	-	6	-	sand	0.4	60	RCP	Heavily aggraded channel; receiving large quantities of sand from upgradient construction areas
	Drainage swale	Cohas Brook	no	4D	-	no	intermittent	n/a	-	n/a	-	boulder, riprap	n/a	12 (2), 6	RCP (2), CMP	Riprap swale conveying stormwater from catch basins into Cohas Brook; newly constructed
	Cohas Brook	Cohas Brook	yes	4E	-	no	perennial	1.6	-	18	-	sand, coarse gravel	25	n/a	bridge	New piers from bridge, area completely altered, riprap slopes along channel, channel substrate heavily embedded, no cover or channel complexity
	Cohas Brook	Cohas Brook	no	3N	3S	yes	perennial	2.5	3.3	15	15	silt, sand, gravel	25	384 (32 feet)	bridge	Heavily embedded substrate, receives stormwater via catch basins, banks reinforced with boulders, no channel complexity
	Intermittent watercourse	Cohas Brook	yes	-	2S	no	intermittent	-	5	-	8	coarse sand, gravel	1.5	24	RCP	Connects large PEM to Cohas Brook
	Intermittent watercourse	Cohas Brook	no	2A	-	no	intermittent	n/a	-	n/a	-		n/a no water	18	RCP	Drains median area into large PEM
	Drainage swale	Cohas Brook	no	-	1S	no	intermittent	-	3	8	-	silt, sand, riprap	0- standing water	30	RCP	Conveys stormwater from catch basing to Cohas Brook, outfall area significantly downcut
	North Tributary to Cohas Brook	Cohas Brook	yes	1A	-	yes	perennial	4	-	10	-	sand	0.5	n/a	n/a	Channel parallel to NB lane, tributary to Cohas Brook; fish observed under submerged vegetation

1 Connectivity denotes a continuous east-west culvert connection under the northbound and southbound lanes.
2 Channel flow was estimated in cubic feet per second (CFS) by determining the cross section (average width x average depth) of the watercourse and estimating the velocity in feet per second (FPS).
3 Crossing type abbreviations: reinforced concrete pipe (RCP), corrugated metal pipe (CMP) and bridge (also referred to as a box culvert). SCH 40 denotes schedule 40 extruded polyvinyl chloride piping.
4 Drainage swale denotes an area with no defined channel; typically a maintained, grass-lined swale. Some swales, or portions of, have been stabilized with riprap, cobble, gravel, concrete, or small boulders.

3.4.1.5 Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) established a requirement to describe and identify "essential fish habitat" (EFH) in each federal fishery management plan. EFH is defined as "those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity". "Waters" include aquatic areas and their associated physical, chemical and biological properties.

Fishery Management Councils determine which areas will be designated as EFH. The New England Council has determined that the Merrimack River and tributaries to the Merrimack River are EFH. The MSA requires all federal agencies to consult with the National Marine Fisheries Service (NMFS) on all proposed federal actions that may adversely affect EFH.

Designated EFH in the study area includes Cohas Brook, Little Cohas Brook and the Spickett River (L. Chiarella, NMFS, pers. comm., July 31, 2002). The Spickett River is designated since it is a second order tributary to the designated Merrimack River in Lawrence, Massachusetts. NMFS concerns for this project relative to EFH include both direct impacts to the stream itself or its banks and any indirect impacts on water quality due to stormwater runoff and associated erosion and sedimentation during construction activities.

3.4.1.6 Wild, Scenic, or NH Designated Rivers

There are no rivers, brooks, or streams in the study area either under study or currently listed with the National Wild and Scenic Rivers Program. None of the rivers, brooks or streams in the study area are under study either for protection, or are currently designated, as natural, rural, or community rivers under the New Hampshire Rivers Management and Protection Program under RSA Chapter 483.

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3.4.2 Groundwater Resources

3.4.2.1 Stratified-Drift Aquifers

According to previous US Geological Survey (USGS) hydrogeologic investigations, there are two primary stratified drift aquifers located in the study area (Flanagan and Stekl, 1992). The two primary deposits are located at either end of the study area and are associated with the major river systems in the project area (**Figure 3.4-2**). Stratified-drift aquifers are typically composed of well-sorted sand and gravel material deposited by the melt waters of the late Pleistocene age glaciers when they

retreated northward approximately 13,000 to 20,000 years ago. Depending on the overall size and depth of the deposits, the inherent porosity (i.e., void space) and permeability, these stratified-drift deposits can be highly-productive aquifers for water supply purposes. Approximately 79 percent of the groundwater drawn from high capacity wells in the lower Merrimack and Coastal River basins is pumped from wells screened in stratified-drift aquifers (Stekl and Flanagan, 1992). The same US Geological Survey study estimated that approximately 24 % of the southeastern New Hampshire region consisting of about 327 square miles, and includes the area south of Manchester and east of the Merrimack River from Londonderry to New Castle, is composed of stratified-drift deposits. The most productive stratified-drift aquifers are generally those that are composed of coarse-grained material lending to higher permeability values and have a saturated thickness or depth of more than 40 feet. These types of deposits typically have higher transmissivity values, which is a relative measure of the aquifer's capacity to transmit water and is based on permeability and the saturated thickness of the aquifer. Transmissivity values of more 2,000 square feet per day are generally needed to support large capacity wells.

The stratified-drift aquifer at the southern end of the study area extends from just south of the Massachusetts border northward to a point of just south of Exit 2 (**see Figure 3.4-2**). This aquifer generally follows the river valley associated with the Spickett River and extends throughout much of the watersheds of Harris Brook, Porcupine Brook and Policy Brook. Most of the southern stratified-drift aquifer area is considered to have relatively low transmissivity values of less than 1000 square feet per day because it is composed of fine-grained material and has shallow depths of less than 20 feet. There are several isolated areas within the aquifer that are considered to have medium transmissivity values of 1000 to 2000 square feet per day. One of these areas is a relatively small area that is located between the northbound Salem Rest Area and the Cross Street overpass and is traversed by the existing I-93 roadway. Another area is located west of I-93 and northwest of Exit 1, between Lowell Road and the Northeastern Glider Port. This area is composed of coarse grained material and has depths of 40 feet. The Town of Salem has two municipal wells located in this general area, referred to as the Turner and Donigan Wells. The Turner well is located about 3,000 feet due west of Exit 1 and south of Lowell Road. The Donigan Well is located more to the north and about 3,000 west of Exit 2. Both of these wells are bedrock wells, according to NHDES data, and have not been used for more than a decade due to the detection of volatile organic compounds in the Turner Well and taste, odor and color problems in the Donigan Well. Thus, Salem's municipal water system is principally supplied by Canobie Lake.

Another larger section of the aquifer with medium transmissivity values is located to the east of the project area near the intersection of Rockingham Park Boulevard and NH 28. Much of the land area overlying this portion of the stratified-drift aquifer area is already developed with commercial properties and residential uses. This aquifer is not considered to be highly favorable for future wells given the known contamination problems and the extent of the existing development and related potential contamination sources within this aquifer area. Most of the residences and

commercial properties throughout the project area are serviced by the Salem municipal water system.

The stratified-drift deposit located at the northern end of the project corridor covers a broad area associated with both the Beaver Brook and Cohas Brook watersheds. Again, the stratified deposits are generally located within the low-lying areas and along the river valleys and exclude the higher terrain areas that are generally composed of till deposits. Within the Beaver Brook watershed, narrow areas of stratified drift deposits generally follow the same course as the tributary to Wheeler Pond, the tributary to Hoods Pond and the main stem of Beaver Brook. Most of these deposits are considered to have coarse-grained material but have low transmissivity values of less than 1000 ft^2/day because of shallow depths of less than 20 feet deep (Flanagan and Stekl, 1992). However, a section the stratified-drift aquifer located within the Beaver Brook river valley and near where I-93 crosses over Beaver Brook has transmissivity values of 1000 to 2000 ft^2/day and up to 2000 to 4000 ft^2/day for a small section just upgradient or east of the highway crossing (Flanagan and Stekl, 1992). The Town of Derry has an inactive municipal well located within this upgradient portion of the aquifer but has not used the well since the early 1980s. The municipal water system that supplies the western portion of the Town of Derry is connected to the Manchester Water Works system.

About 0.7 mile of the existing I-93 roadway is within the portion of the stratified-drift aquifer associated with the Beaver Brook crossing. The Exit 4-Interchange area is located outside of the stratified-drift area and nearly 2.0 miles of the existing roadway in between Exit 4 and the Stonehenge Road underpass to the north is within the stratified-drift area associated with the tributary to Wheeler Pond.

Further north in the study area, about a 0.4 mile section of existing I-93, just north of Exit 5, is within the Cohas Brook portion of this stratified-drift aquifer. Another section of the existing I-93 roadway, consisting of roughly 2.0 miles, starting just south of the Londonderry/Manchester town line and continuing northward to the I-93/I-293 Interchange is within this same stratified-drift aquifer. All of this section of existing roadway is within the low transmissivity portions of the aquifer. There are no municipal or community wells within the Cohas Brook portion of the aquifer. A small area about 1500 feet east and upgradient of the I-93 roadway, near the Londonderry/Manchester town line, is considered to have transmissivity values of up to 4000 ft^2/day.

Bedrock aquifers generally pertain to the groundwater contained in the void space in fractures of crystalline bedrock. The yield potential for bedrock aquifers depends on the size and density of the fractures and is typically lower than that of overburden wells that are located in stratified-drift aquifers. Bedrock aquifers are often relied upon for private and small public water supply wells. Within the study area, the greatest density of bedrock wells appears to be in the town of Windham, near the Exit 3 Interchange. More details on public wells located in the project area are provided in the next section.

3.4.2.2 Public Wells

The NHDES Water Supply Engineering Bureau, under the Drinking Water Source Protection Program, monitors the status and maintains data on all public water supply wells throughout the State. Pursuant to State law (RSA 485), a public water supply well is defined as a piped water system, serving 15 or more services or 25 or more people for at least 60 days per year. Public supply wells are categorized into the following groups:

- **Community Well** – A well servicing 15 or more connections, or 25 or more of the same people for 365 days per year. (Serving residential homes or buildings such as apartments, condominiums, mobile home parks, etc.)

- **Non-Community Well** – Any non-residential well servicing 15 or more connections, or 25 or more people either in a Non-transient or Transient Facility as defined below:

  - **Non-transient** – 15 or more services or 25 or more of the same people at least 180 days of the year. (Includes schools, daycare facilities, office buildings and commercial facilities with permanent employees).

  - **Transient** – 15 or more services, or 25 or more different people, at least 60 days per year (Includes restaurants, motels, ski areas and campgrounds).

Table 3.4.1 and **Figure 3.4-2** present information for sixteen (16) public water supply wells that are located within 2000 feet of the existing I-93 roadway according to the data provided by the NHDES Water Supply Engineering Bureau (April 2002). There are four residential, community well systems serving either single family homes or multi-family complexes including the Pennichuck Water Company wells next to Canobie Lake, the Sisters of Mercy well serving the Searles Castle property in Windham, the wells for the McCauley Commons Condominiums off Searles Road in Windham, and the wells serving the Boumil Grove Condominiums in Londonderry. The Well Head Protection Area (WHPA) radius around these wells ranges from 1,500 to 4,000 feet. There are three non-residential, community wells servicing the Early Years Kindergarten/Day Care facility in Windham, the Semiconductor Circuits, Inc. facility along Route 111 in Windham and Taylor's Day Care in the Windham Depot area. The WHPA radius around these wells ranges from 1200 to 1300 feet. There are five non-community, transient wells that service the Castleton Banquet Facility, the Plaza 93 and the Yankee Trader facilities along NH 111 in Windham and Taylor's Ballroom and the Go-Go Convenience Store in the Windham Depot area. NHDES as a general policy has not established WHPAs around non-community, transient wells generally because they have much lower production rates. There are four wells that are listed as inactive including the well serving NHDOT's Rest Area in Salem, the Berges Realty well in Windham, the Applewood Learning Center and the Springwood Hills wells off Seasons Lane in Londonderry.

The largest community well system pertains to three bedrock wells located off West Shore Road, next to Canobie Lake that are owned and operated by the Pennichuck Water Works, Inc. These wells supply drinking water to about 200 nearby homes and businesses along the West Shore Road area in Windham. These wells are located about 400 feet east of the existing I-93 roadway and the northbound on and off ramps at Exit 3. Another bedrock well serving the Boumil Grove condos in Londonderry is the only other community well that is located relatively close (i.e., < 500 feet) to the existing I-93 roadway. The other two residential, community wells are located about 1500 feet away and upgradient of the I-93 roadway. There are several businesses served by non-community, transient wells that are within 500 feet of the existing I-93 roadway including the Castleton Banquet Facility, the Plaza 93 and the Yankee Trader in Windham. All of the other wells are about 1,000 feet or more from the existing I-93 roadway.

NHDES has developed *Recommendations for Groundwater Protection Measures When Siting or Improving Roadway in WHPAs* (NHDES 1995). NHDES recommends a graduated, increasing scale of various protection measures depending on the well capacity, distance from the new or reconstructed roadway and whether the roadway is within the well's WHPA. The recommendations apply to existing community or non-community, non-transient public supply wells. These measures and their applicability to the present project are discussed in greater detail in Section 4.4.2.

Table 3.4-2
Public Water Supply Wells Located Within the Project Area

Well No.[1]	Town	Facility Name	Status	WHPA Radius[2]	System Type[3]
1	Salem	Salem Rest Area (NHDOT)	Inactive	NA[4]	N
2	Windham	Pennichuck Water Co. (4 wells) West Shore Road	Active	4000 ft	C
3	Windham	Berges Realty Range Road, Rte 111A	Inactive	NA	P
4	Windham	Semiconductor Circuits, Inc. (2 wells) Route 111	Active	1200 ft	P
5	Windham	Sisters of Mercy –Searles Property 21 Searles Road	Active	2000 ft	C
6	Windham	Yankee Trader 115 Indian Rock Rd. Rte 111	Active	NA	N
7	Windham	Plaza 93-Dunkin Donuts Route 111	Active	NA	N
8	Windham	Castleton Banquet Facilities 92 Indian Rock Rd	Active	NA	N
9	Windham	Early Years Kindergarten 71 Indian Rock Rd.	Active	1300 ft	P
10	Windham	McCauley Common Condos 37 Searles Road	Active	2000 ft	C
11	Windham	Taylors Country Day Care 125 North Lowell Road	Active	1300 ft	P
12	Windham	Taylors Ballroom 122 North Lowell Road	Active	NA	N
13	Windham	Go-Go Mart 132 North Lowell Road	Active	NA	N
14	Londonderry	Boumil Grove Condos 1 Charleston Avenue	Active	1500 ft	C
15	Londonderry	Applewood Learning Center 1 Palmer Drive, Rte 102 (East)	Inactive	NA	P
16	Londonderry	PEU/Springwood Hills Seasons Lane	Inactive	NA	C

Notes:

1 Well No. refers to the well numbers presented in **Figure 3.4-2**.

2 WHPA radius as measured from NHDES public well location maps (April 3, 2002).

3 System type refers to:

C= Community well serving residential customers or buildings (i.e., homes, condominiums, mobile homes, etc.)

P= Non-community, non-transient supply well serving 25 or more of the same people at least 180 days of the year (i.e., businesses, day-care, schools, etc.).

N= Non-community, transient supply wells serving 25 or more different people at least 60 days of the year (i.e., restaurants, motels, campgrounds, etc.).

4 NA = Not applicable for non-community, transient wells or not available for other inactive well systems.

3.5 Floodplains

Floodplains within the study area are shown on Flood Insurance Rate Maps for each of the study area communities. The limits of the 100-year floodplains are depicted on **Figure 3.5-1** for the study area. Also shown are the watercourse reaches with designated Regulatory Floodways.

Salem, Windham, Derry, Londonderry and Manchester have adopted local regulations governing development within the areas designated as special flood hazard areas on FEMA's Flood Insurance Rate Maps (FIRM). The regulations generally require a local permit for work within the 100-year floodplain, and provide for development to meet standards consistent with federal requirements for construction within floodplains. In general, the project proponent must demonstrate that a proposed action will not cause more than a one-foot increase in the existing 100-year flood level.

In addition, all five municipalities in the study area have local ordinances prohibiting encroachments within the "Regulatory Floodway" that would result in any increase in flood levels within the community during the base (100-year) flood discharge. The "Regulatory Floodway" is generally defined as the channel of a river or other watercourse and the adjacent land areas that must be reserved to discharge the base flood without cumulatively increasing the water surface elevation more than one foot at any point. Along watercourses that do not have a designated Regulatory Floodway, no encroachment is permitted within specified zones on each community's FIRM, unless the applicant demonstrates that the cumulative effect of the proposed development, when combined with all existing and anticipated development, will not increase the water surface elevation of the base flood more than one foot at any point in the community.

Potential floodplain crossings or encroachments, that may be of concern, occur at the Spickett River, Policy Brook, and Porcupine Brook in Salem; Canobie Lake, Cobbetts Pond, and a tributary of Golden Brook in Windham; Beaver Brook near the Derry/Londonderry town line; two tributaries to Beaver Brook, one in Derry and one in Londonderry; and Cohas Brook and Long Pond Brook in Manchester.

Of the floodplains in the study area, the following may involve encroachment or crossing of regulatory floodways:

- Spickett River in Salem
- Beaver Brook in Derry and Londonderry
- Tributary D – Beaver Brook in Londonderry
- Cohas Brook in Manchester

A brief description of major floodplains that may be affected follows:

Spickett River at Southern Boundary of Salem

The 100-year floodplain in this vicinity varies in width up to approximately 1,600 feet, with a 300-foot floodway. The drainage area at this point is 61.6 square miles, with a base flood peak discharge of 1,900 cubic feet per second (cfs), and a mean floodway velocity of 1.1 feet per second (fps). The base flood elevation data are available from profiles furnished in the Flood Insurance Study for the Town of Salem.

Policy Brook and Porcupine Brook in Salem

Floodplain descriptive data are not available for the reaches of these brooks located within the existing I-93 corridor. Also, floodplain elevation data are not indicated on the FIRM panels for these reaches.

Canobie Lake and Cobbetts Pond, Windham

No descriptive data are furnished for the Canobie Lake or Cobbetts Pond floodplains, and elevation data are not listed for these areas in the Flood Insurance Study for Windham or on the FIRM panel.

Tributary A - Golden Brook

Existing I-93 crosses the upper reach of this tributary. The floodplain varies in width, from approximately 200 to 450 feet at the existing embankment crossings. Elevation data are not given on the FIRM for this reach.

Beaver Brook at Derry/Londonderry Town Line

The 100-year floodplain at this location varies in width, from roughly 500 to 900 feet on the FIRM panels for Derry and Londonderry. The regulatory floodway is approximately 300 feet in width.

The drainage area of Beaver Brook at this point is 26.3 square miles, and the base flood peak discharge is 1860 cfs, with a floodway mean velocity of 1.5 fps. Base flood elevations for this reach are identified in the Flood Insurance Studies for Derry and Londonderry.

Wheeler Pond in Londonderry

The 100-year floodplain to Wheeler Pond consists of two tributary (south-flowing) watersheds in the vicinity of Londonderry Road and Dickey Street. The floodplain boundaries all lie within 1,000 feet and are parallel to I-93 study corridor.

Pillsbury Road Tributary (Tributary D) of Beaver Brook in Londonderry

The 100-year floodplain of this reach lies to the east of I-93 and criss-crosses Londonderry Road. The floodplain and floodway are variable in width in this vicinity **(refer to Figure 3.5-1)**. At the closest point to I–93, the base floodplain is generally 100 to 250 feet wide, with a regulatory floodway of 10 to 20 feet wide. Floodway mean velocity ranges from 2.3 to 7.9 fps, with the upper value occurring at the uppermost limit of the Tributary D drainage area. At the town limits, this tributary has a drainage area of 1.5 square miles and a base flood peak discharge of 245 cfs.

Cohas Brook (Great Cohas Brook) in Manchester

The Cohas Brook has an extensive floodplain area intertwined with the interchange of I-93 with I-293/NH 101. The floodplain configuration is complex **(Figure 3.5-1)**. The regulatory floodway at the crossing by the I-93 embankments is 125 to 150 feet wide, with an estimated mean velocity for the 100-year flood of 2.6 to 2.9 fps. The nearest downstream location for which flood discharge data is furnished in the Flood Insurance Study is South Willow Street, where the contributing watershed is about 66 square miles, and the base flood discharge is 3600 cfs. Floodplain elevation data are provided for the Great Cohas Brook in the Flood Insurance Study for Manchester.

3.6 Land Resources

This section describes the existing conditions within the study area for land resources including geology and soils, farmlands, wetlands, and wildlife. The descriptions provide both an inventory of the resources and a baseline for comparison of future conditions with the project as described in Chapter 4 – Environmental Consequences.

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3.6.1 Geology and Soils

The study area lies geographically in what has been called the Seaboard Lowland section of the New England physiographic province, one of the subdivisions of the Appalachian Highlands (Fenneman, 1938). The area is generally composed of low rolling hills that rise 100 to 300 feet above the river valleys. There is no pronounced topographic trend, although in the central portion of the study area there is a somewhat northwesterly trend. The lowest point in the study area is along the Massachusetts border in Salem -- approximately 110 feet above sea level. The highest point, Warner Hill, is in central Derry at 605 feet above sea level. Jenny's Hill in Windham reaches 500 feet, while the area near the Bridge Street overpass on I-93 in Windham is 510 feet above sea level.

The project lies entirely within the drainage basin of the Merrimack River, which flows southerly on the western edge of several of the towns in the study area.

Several major tributaries drain the study area: Cohas and Little Cohas Brooks in the northern third, Beaver Brook in the middle third, and Golden Brook and the Spickett River system in the southern third. Lakes and ponds of various sizes are present in the study area and range in elevation from approximately 150 to 290 feet above sea level. The largest, Massabesic Lake in Manchester, is 251 feet elevation. It flows into Cohas Brook. Beaver Lake in Derry is 287 feet above sea level and drains into Beaver Brook. Cobbetts Pond at 177 feet elevation in Windham drains into Golden Brook. Numerous ponds and lakes are located in the Spickett River watershed including Canobie Lake (elevation 219 feet), Seavey Pond (246 feet), Shadow Lake (159 feet), Millville Lake (136 feet) and Arlington Mill Reservoir (160 feet).

Much of the present landscape character in the study area is the result of continental glaciation that occurred between 10,000 and one million years ago during the Pleistocene Epoch. As the glacier moved from the northwest to southeast, it scoured and smoothed the underlying bedrock, picking up soil, rock, and other debris. These materials were later deposited as glacial drift when the ice sheet melted.

The bedrock of the study area is metamorphic rock consisting of schists and granulites that are probably of the Silurian and Devonian age, and plutonic gneisses of the Late Devonian age. Most of the bedrock, from the Massachusetts border almost to the Londonderry-Manchester border, belongs to the Silurian Merrimack Group. The northernmost portion of the study area is underlain by Late Devonian Massabesic gneiss that consists chiefly of pink biotite-microline gneiss.

Plutonic rocks form several bodies in the study area. The Ayer grandiorite forms one five-mile long body that intersects I-93 at the Windham-Salem boundary near Canobie Lake. A foliated binary granite body 11 miles long intersects I-93 in Londonderry. The rocks in the study area dip very steeply and are part of a synclinal structure trending northeast. The synclinal axis of this structure transects the study area.

In some places glacial till was "dumped" in oval-shaped hills called drumlins, one of which is located just north of Exit 2 on the south side of I-93. Ice-contact deposits were formed within and alongside glaciers that moved through the valleys in the study area. Glacial outwash and stratified drift deposits are found in the Beaver Brook and Cohas Brook stream valleys of the study area.

Several pro-glacial lakes formed in the larger stream basins of the study area including Glacial Lake Methuen (near Exit 2), Glacial Lake Golden Brook (near Cobbetts Pond), and Glacial Lake Derry (in the Bear Brook Valley beginning just south of Exit 4 and extending north along the I-93 corridor). As the meltwater streams entered these lakes, the fine-grained sediments settled out forming sequences of sand, silt, and clay deposits -- referred to as glacio-lacustrine deposits up to 30 feet in thickness. These deposits overlay the till and outwash deposits.

The study area also contains swamp deposits of the Halorene age that contain muck, peat, silt and sand. These are scattered throughout the study area, overlying the glacial till. These deposits, usually five to ten feet thick, formed from accumulating organic materials in depressional areas.

Soils series as described in the soil survey maps produced by the Natural Resource Conservation Service (NRCS) for Rockingham County (unpublished) and Hillsborough County (Eastern Part) were each grouped into the categories based on predominant parent material or land-use. Seven major soil categories were identified in the I-93 study area (**Figure 3.6-1**). These major parent material or land use categories are:

- Glacial Till
- Glacio-Fluvial Deposits
- Marine/Lacustrine
- Alluvial Deposits
- Peat
- Gravel pits
- Urban or Made Land

Soils derived from glacial till are the most common type identified within the I-93 corridor area. Glacial till, which comprises approximately 62.3 percent of the study area, is spread uniformly across the region and generally provides the base from which the other soil parent materials were derived following glaciation.

Glacial-fluvial soils cover 17.2 percent of the study area. Glacial-fluvial deposits are the sandy or silt loam textured soils that developed from eroded material carried, then deposited by glacial streams and floods. Soils derived from glacial-fluvial deposits occur in three major bands across the region. Each of these bands occur in proximity to the major river systems located in the area (Cohas Brook, Beaver Brook and Porcupine/Policy Brook). The well drained Canton and excessively drained Windsor series are common around Cohas Brook. The somewhat poorly to poorly drained Pipestone series dominates the glacial-fluvial soils around Porcupine and Policy Brooks in the Salem area. While the moderately well drained Deerfield and excessively drained Hinckley soils can be found around Beaver Brook in the Londonderry/Derry area.

Urban or made land makes up 6.2 percent of the study area. Urban or made land includes any areas identified in the soil series maps that consist mainly of sandy or gravely fill material that has been placed on terraces, floodplains, and uplands. The amount of fill that may have been placed varies from 20 inches to 20 feet. Similarly, urban or made land also includes any areas where 85 percent or more of the land area is covered with buildings, asphalt or concrete. Typically, these areas include business districts, industrial parks and shopping centers.

Gravel pit areas, which include open excavations from which gravel or sand have been removed, make up 2.0 percent of the study area. Excavations of granite, areas commonly identified as quarries, are also included under this category. Most pit areas range in size from 2 to 40 acres.

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3.6.2 Farmlands

3.6.2.1 Important Farmland Soils

The four categories of important farmland soils, addressed in the Farmland Protection Policy Act (FPPA) of 1984, include prime farmland, unique farmland, farmland of statewide importance, and farmland of local importance. In addition, active farmland or agriculture areas are discussed. Each farmland category is described below:

1. **Prime Farmland** is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops. It has the soil quality, growing season, and moisture supply needed to economically produce a sustained high yield of crops when the land is treated and managed using acceptable farming methods. Prime farmland produces the highest yields with minimal inputs of energy and economic resources and causes the least damage to the environment. Prime farmland usually has an adequate and dependable supply of moisture from precipitation or irrigation. It also has a favorable temperature and growing season and acceptable acidity or alkalinity. It has few or no rocks and is permeable to water and air. Prime farmland is not excessively erodible or saturated with water for long periods and either does not flood frequently or is protected from flooding. The slope ranges mainly from 0 to 8 percent. Prime farmland may now be in crops, pasture, or woodland, but not urban and built-up land or water areas. It must either be used for producing food or fiber or be available for these uses.

2. **Unique Farmland** is land other than prime farmland that is used for the production of specific high value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality and/or high yields of a specific crop when treated and managed according to acceptable farming methods. Examples of such crops in New Hampshire are apple orchards, lowbush blueberries, vegetable truck gardens, and maple sugar groves.

3. **Farmland of Statewide Importance** is land, in addition to prime and unique farmlands, that is of statewide importance for the production of food, feed, fiber, forage, and oilseed crops. Generally, these farmlands include those areas that are nearly prime farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods.

4. **Farmland of Local Importance** includes certain additional farmlands for the production of food, feed, fiber, forage, and oilseed crops.

Figure 3.6-2 depicts the categories of farmland as identified from NRCS soil survey maps and from windshield surveys within the I-93 study area.

In general, the designation of prime farmland and farmland of statewide and local importance is based on soils characteristics. The NRCS for Rockingham County and the NRCS for Hillsborough County provided a list of soil map units identified as prime farmland and farmland of statewide and local importance.[25] This information, including the soil name and associated map symbol, is shown in Table 3.6-1 and **Table 3.6-2**. Unique farmland soils have not been classified by the NRCS in either Rockingham or Hillsborough Counties.

Table 3.6-1
Important Farmland Soils, Rockingham County

Prime Farmland	
Map Symbol	**Soil Name[1]**
532 A	Belgrade sil
32A	Boxford sil
62 A,B	Charlton fsl
38 A,B	Eldridge fsl
37A, B	Melrose fsl
44 A,B	Montauk fsl
66 A,B	Paxton fsl
460 B	Pennichuck channery vfsl
4	Pootatuck fsl
446 A,B	Scituate-Newfields complex fsl
68 A, B	Sutton fsl
30A	Unadilla vfsl
29 A,B	Woodbridge fsl

[1] sil= silt loam; fsl = fine sandy loam; vfsl = very fine sandy loam; gfsl = gravelly fine sandy loam; lfs= loamy fine sand; ls = loamy sand

25 The Derry, Londonderry, Salem, and Windham portions of I-93 Study Area are located within Rockingham County, while the City of Manchester lies within the eastern part of Hillsborough County.

Table 3.6-1 (Continued)

Farmland of Statewide Importance	
Map Symbol	**Soil Name[1]**
46 A,B,C	Acton fsl
532 B	Belgrade sil
32 B	Boxford sil
42 B,C	Canton gfsl
62 C	Charlton fsl
510 A,B,C	Hoosic gfsl
37 C	Melrose fsl
10 A,B,C	Merrimack fsl
44 C	Montauk fsl
66 C	Paxton fsl
460 C	Pennichuck channery vfsl
531 B	Scio vfsl
446 C	Scituate fsl
14 A,B	Sudbury fsl
31 B,C	Suffield sil
68 C	Sutton fsl
30 B	Unadilla vfsl
29 C	Woodbridge fsl
Farmland of Local Importance	
43 B	Canton gfsl, very stony
63 B	Charlton fsl, very stony
313 A	Deerfield fsl
305	Lim-Pootatuck complex
45 B	Montauk fsl, very stony
67 B	Paxton fsl, very stony
533	Raynham sil
646 A	Ridgebury vfsl
656 A	Ridgebury vfsl
5	Rippowam-Pootatuck complex
33A	Scitico sil
538 A	Squamscott fsl
546 A	Walpole vfsl
26 A,B	Windsor ls

[1] sil= silt loam; fsl = fine sandy loam; vfsl = very fine sandy loam; gfsl = gravelly fine sandy loam; lfs= loamy fine sand; ls = loamy sand

Table 3.6.2
Important Farmland Soils, Hillsborough County (Eastern Part)

Map Symbol	Soil Name[1]
Prime Farmland	
AgA	Agawam fsl
AgB	Agawam fsl
BaA	Belgrade sil
BdA, B	Bernardston Variant vfsl
MoB	Montauk fsl
NnA, B	Ninigret vfsl
Oc	Occum fsl
Om	Occum fsl, high bottom
PbB	Paxton fsl
PhB	Pennichuck fsl
PtA, B	Pittstown Variant loam
Pu	Pootatuck fsl
WoA, B	Woodbridge loam
Farmland of Statewide Importance	
BaB	Belgrade sil
BdC	Bernardston Variant vfsl
CaB, C	Canton fsl
CpB	Chatfield-Hollis-Canton fsl
MoC	Montauk fsl
PbC	Paxton fsl
PhC	Pennichuck fsl
SsA, B, C	Scituate fsl
Farmland of Local Importance	
BeC	Bernardston Variant stony vfsl
CmB, C	Canton stony fsl
DeA, B	Deerfield lsf
MtB, C	Montauk stony fsl
PfB, C	Paxton stony fsl
StA, B	Scituate stony fsl
Su	Suncook lfs
WdA, B	Windsor ls
WvB	Woodbridge stony loam

[1]sil = silt loam; fsl = fine sandy loam; vfsl = very fine sandy loam; gfsl = gravelly fine sandy loam; lfs = loamy fine sand; ls = loamy sand

3.6.2.2 Active Farmland

Active farmlands are lands that are currently in active agricultural use. These lands were identified from aerial photos and windshield surveys, and include only those lands in, or adjacent to, the I-93 corridor. Actively farmed land includes a cornfield in the southeast quadrant of Exit 1; truck gardens in Salem along South Policy Road west of I-93; hay fields and pastures in Windham on the north and south side of NH111A west of I-93, and along the south side of Lowell Road and east side of Morrison Road east of I-93; an extensive orchard (Woodmont) in Londonderry along the south side of Pillsbury Road just north of Exit 4; and hayfields also in Londonderry along the east side of Noyes Road west of I-93; and hayfields in Manchester along the west side of Mammoth Road west of I-93. No active farmland was identified in Derry within the study corridor.

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3.6.3 Wetland Resources

Studies over the past few decades have found that wetlands provide habitat for numerous aquatic plant and animal species, and function in the protection and enhancement of surface and groundwater resources. Wetlands help to filter and purify water by trapping soil particles along with the pollutants they carry before these pollutants enter watercourses. Wetlands have an ability to absorb nutrients such as nitrogen and phosphorus, and later release these nutrients when they are less likely to degrade water quality. Wetlands act to regulate the release of stormwater by acting as temporary storage basins, which can lower flood crests and reduce the destructive potential of severe storms. Wetlands stabilize the shores along rivers and lakes, and further buffer the destructive forces of storms by absorbing the impact of waves. These actions alone can protect vast areas of shoreline property. Some wetlands also augment groundwater supplies by passing surface water and direct precipitation through the wetland soil into the underlying aquifers. The realization that wetlands provide certain functions and values from which the general public may benefit has led to the passage of Federal, State and local wetland laws and ordinances.

Federal protection is accorded wetlands under Section 404 of the Clean Water Act and Section 10 of the Federal Rivers and Harbors Act. The U.S. Army Corps of Engineers (Corps) is charged with the duty of overseeing and regulating activities in wetlands at the Federal level. The U.S. Environmental Protection Agency (EPA) also reviews projects that may impact wetlands and has veto authority over discharges they find unacceptable.

The State of New Hampshire regulates activities in wetlands under RSA 482-A, which grants regulatory authority to the NH Department of Environmental Services Wetlands Bureau (NHWB).

Communities in New Hampshire possess, at minimum, recommendation authority to the NHWB as to whether a permit to dredge or fill wetlands should be issued. The bulk of this recommendation responsibility is placed on the local conservation commissions. Individuals concerned about the protection of wetlands for certain projects generally express their concerns through the local commissions.

Communities also have the ability to enact their own ordinances to regulate activities in wetlands. Four of the five communities affected by the I-93 improvement have wetland protection ordinances in place. The City of Manchester does not have a wetland conservation district. Most communities designate these areas subject to local jurisdiction as Wetland or Conservation Districts. The land area subject to a local wetland or conservation ordinance varies from community to community.

Within the study area, both Salem and Derry have afforded additional protection to wetlands under RSA 482-A:15, by which a community may designate certain wetlands "prime wetlands", which requires additional review and scrutiny of projects affecting these areas. Evaluative methodologies are employed by municipalities to determine functions and values of selected wetlands to designate as prime. The municipality holds a public hearing to vote on the designation. If approved by the community, the DES is provided with documentation substantiating the nomination. Upon approval of the submission, DES will apply the applicable rules to any project within or adjacent to a prime wetland. To this end, all projects that are in or adjacent to prime wetlands are classified as major projects. Prime wetland projects require field inspections and public hearings to be held by DES.

3.6.3.1 Wetland Occurrence

Identification of Wetlands

At present in New Hampshire, the Federal and State regulatory agencies identify and delineate wetlands based on a three-parameter approach, which considers plants, soils and hydrology in the interpretation of the wetland/upland boundary. These agencies identify wetlands according the 1987 Corps of Engineers Wetland Delineation Manual (1987 Manual), that was developed and prepared by the U. S. Army Corps of Engineers (ACOE).

Wetland cover types in the study area have been identified according to the U.S. Fish and Wildlife Service (USFWS) classification system (Cowardin et al., 1979). The USFWS classification system uses a hierarchy broken into systems, subsystems, classes, and subclasses to categorize wetlands and deepwater habitats. Systems (marine, estuarine, riverine, lacustrine and palustrine) refer to the type of hydrologic setting in which the wetlands are found (or in relation to) i.e. oceans, estuaries, rivers, lakes and other vegetated non-tidal wetlands. Along the I-93 project corridor only palustine or riverine systems exist. The following types of cover type

classifications were mapped (described later), and include areas of palustrine forested (PFO), palustrine emergent (PEM), palustrine scrub/shrub (PSS), palustrine open water (POW) systems, riverine open water unknown bottom (ROW), riverine unconsolidated bottom (R3UB), and riverine intermittent stream (R4SB).

Palustrine systems include all non-tidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens and other wetlands in tidal areas with low salinity. Areas mapped as PFO cover type are forested wetlands containing vegetation that is 20 feet tall or taller in the overstory, and contain an understory of younger trees or shrubs, and an herbaceous layer. The PEM cover type refers to areas dominated by erect, rooted , herbaceous hydrophytes, excluding mosses and lichens. The vegetation is present for most of the growing season in most years. Wetlands mapped as PSS include areas dominated by woody vegetation less than 20 feet tall. The species include true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions. Scrub-shrub wetlands may represent a successional stage leading to forested wetland, or they may be relatively stable communities. POW refers to wetlands that contain small ponds or areas of ponded water that are too deep to support emergent plants. They may be surrounded by other palustrine cover types or may be small depressional areas with steep banks surrounded by upland. In most cases, wetlands identified and assessed within the I-93 corridor are associated with streams (named and unnamed), and ponds and lakes. These surface water resources are described in detail in Section 3.4.1.

Riverine systems include wetlands and deepwater habitats contained within a channel, with two exceptions: wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and habitats with water containing ocean-derived salts in excess of 0.5 parts per thousand (not found within the I-93 corridor). Upland islands or palustrine wetlands may occur in the channel, but they are not included in the riverine system. Areas mapped as ROW are those having non-tidal deeper water, where the stream bottom (typically sands, mud and organic matter) is submerged most of the time. Areas designated as R3UB are swifter moving systems located further upstream in the watershed with stream bottoms consisting of some or all of the following materials: cobble-gravel, sand, mud and organics. The R4SB designation refers to streams that flow intermittently and have a variety of stream bottom materials i.e. bedrock, rubble, cobble-gravel, sand, mud, organic, and vegetated. Riverine systems along the I-93 corridor for the most part are bordered by palustrine wetland systems.

In 1989, a delineation and general assessment of wetlands in and around I-93 from Salem to Manchester was performed for the NHDOT. A detailed delineation of wetlands for the area within the median of I-93 was conducted, and a more cursory examination and delineation of wetlands was completed for the areas outside of, but adjacent to, the northbound and southbound barrels of I-93. Wetland delineation criteria were based on the 1989 Federal Manual, which is similar to the 1987 Manual but uses more conservative parameters resulting in more conservative (more wetland

area) boundaries. Wetland systems were identified and delineated on 1" = 50' scale topographic maps provided by the NHDOT. Corps transect data sheets justifying placement of the wetland/upland boundary within the I-93 median area were also completed.

Additionally, National Wetland Inventory (NWI) maps, prepared by the U.S. Fish and Wildlife Service, were reviewed to determine the extent of wetlands within the project corridor. NWI maps show wetlands across a region based on wetland hydrology and a preponderance of certain vegetative communities. These maps are available in digital format from Complex Systems at the University of New Hampshire for interpretation in ARC INFO software under a Geographic Information System (GIS). NWI maps from this computer mapping system were combined with the wetlands delineated and identified in 1989 to produce the wetland boundaries shown on **Figure 3.6-3** (General Wetlands).

During July 1998, the wetlands within the I-93 corridor were field reviewed. Using the 1987 Manual, previous wetland delineations were revised and updated on wetland base maps. Also during July 1998, preliminary wetland delineation was extended to the first major intersection beyond the immediate interchange areas for Exit 1 to Exit 5. The wetlands shown on **Figure 3.6-4** include the July 1998 revisions and extensions of preliminary wetland mapping for the project area. The state-designated prime wetlands and wetlands of local importance are sub-categories of wetlands established by the five municipalities that comprise the study area and are shown on the figure. The location of vernal pools is also included on **Figure 3.6-4**. (For a detailed discussion of vernal pools, see Sections 3.6.4.3 and 4.6.4).

Prime Wetlands

The towns of Salem and Derry have designated some wetlands as prime wetlands. When so designated by individual towns, these wetlands take on a level of regulatory importance higher than wetlands not so designated. In effect, prime wetlands cannot be impacted unless the project is public in nature; mitigation will provide replacement of all functions and values, and the impacts are truly unavoidable. As such, prime wetlands are given special consideration in the analysis of alternatives for proposed development activities.

According to the NHWB, 24 areas of wetlands are designated as prime in Salem, and 29 areas are considered prime wetland in Derry. Of these 53 prime wetlands, six areas occur within one-half mile east or west of I-93. Within the highway corridor, two areas of prime wetlands are located each in Salem, and Derry. In Salem, a portion of prime wetland #16 is located west of Exit 1. Portions of prime wetland #17 are located east of Exit 1, south of Rockingham Park Boulevard, and to the east and west of the highway, north of Exit 1. In Derry, prime wetland #6F is crossed by I-93, south of Fordway. Prime wetland #7F is located to the east of the highway, north of prime wetland #6F. Prime wetlands were reviewed and updated by professional wetland scientists during July 1998. Following a town vote, portions of

the two wetlands in Salem, listed as prime, were de-listed in 2001. The updated distribution of prime wetlands is shown on **Figure 3.6-4**.

3.6.3.2 Description of Wetland Systems and Functions and Values

Twenty-seven wetland systems were identified and assessed within the I-93 project corridor in April and May 2002. Comprising roughly 475 acres in total, the wetland systems are grouped according to hydrologic connectivity, location within watersheds or subwatersheds, or are split along existing manmade features such as roadways. Locations of wetland systems within the project corridor are shown on **Figure 3.6-3**. Areal extent (acreage) of wetlands is calculated from the area contained within designated wetland system boundaries shown on the figure.

The majority of wetlands throughout the project study area comprise a network of interconnected systems contained within five major watersheds and several subwatersheds. In general, wetlands located within the southern one-third of the project corridor are more disturbed, altered, and fragmented than those in the northern two-thirds. Proximity to existing roads and commercial and residential development have degraded portions of most wetlands from the Massachusetts border extending to the weigh stations in Windham. Other wetlands, north of the weigh stations to the northerly project terminus, have been adversely affected to a lesser degree by adjacent land development.

Using the Highway Methodology Workbook Supplement (ACOE, 1999), function and value assessments were performed in April and May 2002 at 56 locations in the vicinity of potential impacts within the project corridor. The locations where assessments were performed are shown on **Figure 3.6-5** (Wetlands Systems Functions and Values). One wetland system function and value box was prepared for each wetland system, representing a composite of individual assessments performed within each of the 27 systems. Total wetland acreage and a summary of their functions and values are provided in Table 3.6-3.

Some of the larger wetland systems within the corridor contain several habitat types, allowing a wide range of assessed functions and values. Other wetlands have limited functions and values due to their location near the highway, other roadways or developed land. In these areas, wetland edges in many locations are degraded and/or altered. Illegal dumping of debris and trash, and sediments (from drainage culverts and runoff) have degraded wetland areas that extend for 50 feet or more from the roadway edge in some locations. In addition, off-road vehicle use is occurring within and along wetland edges in many areas along the highway.

Table 3.6-3 Summary of Wetland Resources Within the I-93 Study Corridor

Wetland Number	Wetland Name	Watershed	Total Wetland Area (acres)	Cover Type(s)	Ground water Recharge/ Discharge	Floodflow Alteration	Fish and Shellfish Habitat	Sediment/ Toxicant Retention	Nutrient Removal	Production Export	Sediment/ Shoreline Stabilization	Wildlife Habitat	Recreation	Educational/ Scientific Value	Uniqueness/ Heritage	Visual Quality/ Aesthetics
1	Policy Brook/Spickett River	Spickett River	3.7	PFO, PEM, POW	X	0	0	0	X	0	X	0	X		0	X
2	Spickett River Tributary	Spickett River	22.3	PFO, PEM		0	X	0	X		X	0				
3	Porcupine Brook Tributary	Spickett River	40.2	PFO, PEM, POW, PSS	X	0		0	X	X	X	0				X
4	Porcupine Brook	Spickett River	21.5	PFO, PEM, PSS	X	0	0	0	X	X	X	0				X
5	Exit 2	Spickett River	13.1	PFO, PEM, PSS	X	0	X	0	0	X	X	0				X
6	Policy Brook	Spickett River	13.1	PFO, PEM	X	0	0	0	0	X	X	0				X
7	Porcupine Brook Tributary	Spickett River	1.0	PFO, PEM	X	0		0	X		X	0				X
8	Canobie Lake South Tributary	Spickett River	2.3	PFO, PSS	X	0		0	X		X	0				X
9	North Tributary to Policy Brook	Spickett River	2.0	PFO	0	X		0	X		X	0				X
10	Canobie Lake West Tributary	Spickett River	8.3	PFO, PEM, PSS	X	0	X	0	0	0	X	0			X	X
11	Route 111A	Spickett River	28.6	PFO, PEM, POW	X	0	X	0	0	0	X	0			X	X
12	Exit 3	Golden Brook	19.8	PFO, PEM, PSS,POW	X	0	0	0	0	0	X	0			X	X
13	Route 111	Golden Brook	17.1	PFO	X	0	X	0	0	0	X	0	X	0	0	X
14	Weigh Stations South	Golden Brook	5.4	PFO, PEM	X	0	X	0	0	X	X	X				X
15	Weigh Stations North	Golden Brook	11.6	PFO, PEM	X	0		0	0	X	X	0				X
16	Bridge Street Pond	Spickett River	7.1	PFO, PSS	X	0		0	0	X	X	0	X			
17	Windham North	Spickett River	14.9	PFO, PSS		0		0	X	X	X	X	X			
18	Derry South	Spickett River	11.8	PFO, PSS, PEM	X	0		0	0	X	0	0				X
19	Derry Central/North	Beaver Brook	16.9	PFO, PEM, POW	0	0	0	0	0	X	X	0				X
20	Beaver Brook	Beaver Brook	23.5	PFO, PEM, PSS	X	0	0	0	0	X	X	0				X
21	Wheeler Pond and Tributary	Beaver Brook	15.4	PFO, PEM, PSS	X	0	0	0	0	X	X	0	X	X	X	0
22	Pillsbury Road to PSNH Easement	Beaver Brook	28.5	PFO, PEM, PSS, POW	X	0	X	0	0	X	X	0	X		X	X
23	Stonehenge Road	Beaver Brook	13.5	PFO, PEM, POW	X	0		0	0	X		0				
24	Londonderry Central	Little Cohas Brook	10.9	PFO, PEM, PSS	X	0		0	0	X	X	0			0	X
25	Exit 5	Little Cohas Brook	46.7	PFO, PEM, PSS	X	0	0	0	0	0	X	0	X	X	X	0
26	Cohas Brook	Cohas Brook	31.7	PFO, PEM, PSS	0	0	0	0	0	X	X	0				X
27	I-93/I-293 Interchange	Cohas Brook	45.0	PFO, PEM, PSS	X	0	0	0	0	0	X	0			0	0

Data based on VHB Field Evaluation conducted April – May 2002

X = Function/Value Present

0 = Principal Function.

Note: No known populations of wetland-dependent threatened or endangered species are present in the study area.

Wetland System 1 – Policy Brook/Spickett River

Wetland System 1 is a riverine system (R3UB) associated with Policy Brook and the Spickett River located east of the highway and north of the New Hampshire and Massachusetts border in Salem. Totaling 3.7 acres, areas of PFO and PSS lie adjacent to the stream and river. Surrounding areas include residential, farmland and industrial properties and forested uplands. Portions of the wetland nearest the highway are littered with trash and debris.

Policy Brook was apparently altered and straightened during the original highway construction as it flows parallel from a point north of the Exit 1 Rest Area to its confluence with the Spickett River just north of the border. A rest area detention basin (PEM) contributes drainage to the brook. Layers of sediments (sand and silt) are found in forested areas adjacent to the deeply cut channel, suggesting recent and frequent flooding events. Dominant vegetation in areas of PFO adjacent to the stream and along the banks include red maple (*Acer rubrum*), swamp white oak (*Quercus bicolor*), and eastern white pine (*Pinus strobus*). Small areas of PSS are vegetated mostly with highbush blueberry (*Vaccinium corymbosum*), silky dogwood (*Cornus ammomum*), and glossy buckthorn (*Rhamnus frangula*).

Wetland System 1 supports eleven of the thirteen standard functions and values in wetland systems. The wetland's principal functions are floodflow alteration, fish and shellfish habitat, sediment/toxicant retention, production export, wildlife habitat and uniqueness. Bordering the Spickett River, the wetland is mostly located within the 100-year floodplain, retaining higher volumes of water during flood events than under normal conditions. The wetland also supports a high density of vegetation that takes up water, as well as providing stabilization and retention of sediments and toxicants. The stream and wetland are easily observed by the public from several viewing locations along I-93, and an extensive community of river birch (*Betula nigra*) is located southeast of the river/stream confluence approximately 150 feet east of the highway.

Wetland System 2 – Harris Brook Tributary

Wetland System 2 is located in Salem, to the west of the highway near the state boundary and extending to Brady Road. Totaling 22.3 acres, and primarily a large area of PFO, smaller strips of PSS and PEM occur along the edge of an intermittent stream (R4SB) that is tributary to Harris Brook. Wetland System 2 was apparently segmented from Wetland System 1 by the construction of I-93. The tributary stream flows into Harris Brook (which flows into the Spickett River) south of the state border. Forested areas and residential development are located in surrounding locations to the west of Wetland System 2. Litter and debris are found along the edge of the highway into the wetland edge and intermittent stream. Vegetation in the PFO includes red maple, highbush blueberry, glossy buckthorn, eastern white pine, cinnamon fern (*Osmunda cinnamomea*), sensitive fern (*Onoclea sensibilis*), and tussock sedge (*Carex stricta*).

Wetland System 2 supports six of the standard functions and values found in wetland systems. Principal functions include floodflow alteration, sediment/toxicant retention, and wildlife habitat. Dense residential development located near the northern two-thirds of this system has impacted the system by reducing the areal extent of the wetlands, increasing nutrient loading, and fragmenting wildlife habitat.

Wetland System 3 – Porcupine Brook Tributary

Wetland System 3 is a riverine wetland system (R3UB), and includes areas of PFO, PEM, and PSS (totaling 40.2 acres) adjacent to, and within, the Exit 1 Interchange, south of Route 38 in Salem. Porcupine Brook and its perennial tributary flow through the wetland system. Porcupine Brook enters the system east of the northbound on-ramp. The tributary is culverted through the interchange from the west, and ultimately joins with Policy Brook east of the project corridor. Vegetation in areas of PFO is dominated by red maple, highbush blueberry, and eastern white pine. Areas of PEM are vegetated with cattail (*Typha latifolia*), purple loosestrife (*Lythrum salicaria*), sensitive fern, reed-canary grass (*Phalaris arundinacea*), and soft rush (*Juncus effusus*). Vegetation in the small areas of PSS adjacent to the southbound on-ramp includes glossy buckthorn, highbush blueberry, gray birch (*Betula populifolia*), and meadowsweet (*Spiraea latifolia*).

Wetland System 3 supports eight of the standard wetland functions and values. Principal functions include floodflow alteration, sediment/toxicant retention, and wildlife habitat. Apparent historical drainage ditches are located within the PFO south of the tributary stream. Further west of the interchange, areas of PFO and PEM are expansive and largely undisturbed. The Town of Salem designated these areas as prime wetlands. South of Rockingham Park Boulevard and east of the project area, the PEM and PSS bordering Porcupine Brook is designated as prime wetland, although the vegetation is largely comprised of purple loosestrife, an invasive species. Some areas within the interchange are also degraded with trash and roadway sediments due to direct discharge of stormwater. Invasive plant species also limit the potential of these areas to provide as many functions as wetlands located further from the roadway to the west.

Wetland System 4 – Porcupine Brook

Wetland System 4 is located in Salem, north of Route 38 and includes a riverine and palustrine wetland system associated with Porcupine Brook (R3UB). Comprising 21.5 acres, areas of PFO and PSS to the east and west of I-93, and within the median, are included in wetland system. Vegetation within Wetland System 4 consists primarily of red maple, glossy buckthorn, highbush blueberry, silky dogwood, and tussock sedge.

Wetland System 4 supports nine of the standard functions and values found in wetland systems. Principal functions include floodflow alteration, fish and shellfish

habitat, sediment/toxicant removal and wildlife habitat. The western portion of the wetland bordering Porcupine Brook occupies a large 100-year floodplain and retains higher volumes of water during flood events than under normal conditions. Sedimentation of the watercourse within the median probably limits use of this stretch of the brook by fish and shellfish. An abundance of vegetation promotes potential sources of sediment and toxicant retention as well as nutrient removal. Porcupine Brook is a Class B stream and has sufficient food sources to attract wildlife. Evidence of use of the wetland system by beaver and ducks was observed. Two sections of Wetland System 4 (one each to the east and west of the highway) have been designated as prime wetlands by the Town of Salem. These areas are predominantly forested wetlands dominated by red maple.

Wetland System 5 – Exit 2

Wetland System 5 (13.1 acres in total), is located in Salem, west of and within the southbound on and off ramps at the Exit 2 Interchange. Areas to the north and south of NH 97 (Pelham Road) are included in this system, which drains to Porcupine Brook located to the south. Wetland System 5 includes larger areas of PFO, and PEM, and narrow sections of PSS that exhibit degradation due to roadway runoff and sedimentation, and littering with trash and debris. Red maple, eastern white pine, gray birch, highbush blueberry, cinnamon fern, and mosses (*Sphagnum* spp.) dominate vegetation in the areas of PFO. Areas of PSS and PEM (located within the southbound on and off ramps) are dominated by glossy buckthorn, speckled alder (*Alnus rugosa*), winterberry holly (*Ilex verticillata*), common elderberry (*Sambuca canadensis*), meadowsweet, sensitive fern, tussock sedge, cattail, and purple loosestrife.

Wetland System 5 supports nine of the standard functions and values found in wetland systems. Principal functions include floodflow alteration, sediment/toxicant retention, nutrient removal, and wildlife habitat. Highly developed surrounding land, (primarily industrial and commercial) limits some wetland functions of this system. Excessive sedimentation and dumping of trash and debris were noted.

Wetland System 6 – Policy Brook

Wetland System 6 is located in Salem, east of I-93 and includes areas to the north and south of Pelham Road that drain to the east and south towards Policy Brook. The stream flows southward through an area of PFO and is culverted beneath Pelham Road. Areas of PSS and PEM are also present within Wetland System 6, south of Pelham Road. Total wetland area contained in this system is 13.1 acres. Vegetation includes red maple, swamp white oak, highbush blueberry, arrow-wood (*Viburnum dentatum*), witherod (*Viburnum cassinoides*), cinnamon fern, and Sphagnum mosses. Items of trash and debris are located in wetlands south of Pelham Road.

Wetland System 6, in areas north of Pelham Road, supports nine of the standard functions and values found in wetland systems. Principal functions in these areas

include floodflow alteration, fish and shellfish habitat, sediment/toxicant retention, nutrient removal, and wildlife habitat. This wetland system has the ability to absorb and detain excess water during flood events and diffuses water flow. The wetland has a high density of vegetation that takes up water as well as providing stabilization and retention of sediments and toxicants. The wetland also supports wildlife habitat and its high density of vegetation supplies a good food source for wildlife. In areas south of Pelham Road, commercial, light industrial and residential development is located near these wetland systems which are largely degraded due to sedimentation, and refuse and debris dumping. Principal functions in these areas are limited to sediment/toxicant removal, floodflow alteration, and nutrient removal.

Wetland System 7 – Porcupine Brook Tributary

Wetland System 7 is located in Salem, north of Exit 2 and south of Brookdale Road. The wetland system, consisting of small areas of PFO, PSS and PEM comprising 1.0 acre, is associated with an intermittent tributary stream (R4SB) that flows from north to south beneath the highway and west to Porcupine Brook. Surrounding development contributes stormwater and runoff directly to the wetland system, which exhibits signs of degradation evidenced by surface and filamentous algae in areas of ponded water contained within wooded areas. Areas of PFO located immediately to the east and west of the highway are vegetated with red maple, gray birch, yellow birch (*Betula allegheniensis*), poison ivy (*Toxicodendron radicans*), elderberry, highbush blueberry, common winterberry, and cinnamon fern. An area of PEM, located within the highway median is vegetated largely with common reed (*Phragmites australis*), with lesser amounts of purple loosestrife, cattail and species of sedges (*Carex* spp.).

Wetland System 7 supports seven of the standard functions and values found in wetland systems. Principal functions are floodflow alteration, sediment/ toxicant retention and wildlife habitat. Limited by its small size, the area of PEM located within the median, provides some nutrient removal in addition to sediment/toxicant retention.

Wetland System 8 – Canobie Lake South Tributary

Wetland System 8 is located in Salem, north of Brookdale Road, near the Windham municipal boundary. Totaling 2.3 acres, areas of PFO, PSS, and PEM, slowly drain to Canobie Lake located to the north. Dominant vegetation within areas of PFO consist of red maple, eastern white pine, swamp white oak, highbush blueberry, cinnamon fern, and poison ivy. Areas of PEM and PSS are vegetated with red maple, highbush blueberry, sweet pepperbush (*Clethra alnifolia*), arrow-wood, swamp fetterbush (*Leucothoe racemosa*), swamp azalea (*Rhododendron viscosum*), maleberry (*Lyonia ligustrina*), glossy buckthorn, cattail, and tussock sedge.

Wetland System 8 supports seven of the standard functions and values found in wetland systems. Principal functions include floodflow alteration, sediment/toxicant retention, and wildlife habitat. A relatively diverse shrub plant

community could provide habitat and food sources for wildlife. However, surrounding residential development and the adjacent highway, fragment the potential habitat. Trash, debris and reduced water quality (large amounts of filamentous and surface algae), were noted in some areas.

Wetland System 9 – North Tributary to Policy Brook

Wetland System 9, comprising 2.0 acres, is located in Windham, southwest of Canobie Lake. Drainage from wetlands (PFO) in this area is directed away from Canobie Lake by a shallow intermittent stream (R4SB) that is culverted beneath the northbound lane then back under the roadway further south eventually draining into Policy Brook. Vegetation in Wetland System 9 consists mainly of red maple, swamp white oak, black birch (*Betula lenta*), eastern white pine, highbush blueberry, and cinnamon fern.

Wetland System 9 supports seven of the standard functions and values. Principal functions include groundwater recharge/discharge, sediment/toxicant retention, and wildlife habitat. Roadway sediments, trash/debris, and iron staining within the drainage channel was noted within wetland areas nearest the highway, indicated degraded conditions within the wetland.

Wetland System 10 – Canobie Lake West Tributary

Wetland System 10 is located in Windham, west of Canobie Lake. Totaling 8.3 acres in size, areas of PFO, located to the east and west of the highway, and PEM, located within the median, characterize the wetland cover types in this system. A perennial tributary (R3UB) flows through the wetland system from west to east to Canobie Lake. Surrounding land use is primarily residential. Dominant vegetation within areas of PFO includes red maple, yellow birch, common winterberry, highbush blueberry, and cinnamon fern. The area of PEM within the median is vegetated with cattail, purple loosestrife, common reed, reed-canary grass, species of horsetail (*Equisetum* spp.), and blue flag (*Iris versicolor*).

Wetland System 10 supports ten of the standard functions and values found in wetlands. Principal functions include floodflow alteration, sediment/toxicant retention, nutrient removal, production export, and wildlife habitat. An area of well-established *Phragmites* (an invasive species) at the southern end of the marsh, within the median, is limiting some functions of this wetland system.

Wetland System 11 – Route 111A

Wetland System 11 is a large wetland system (28.6 acres) located in Windham, south of NH 111A. Much of the wetland area (PFO, PSS, POW, and PEM) is located within the I-93 median. Drainage from the system flows northward through the median then eastward, finally outletting on the north side of Canobie Lake. Vegetation in areas of PFO and PSS includes red maple, swamp white oak, species of ash (*Fraxinus* spp.), speckled alder, common winterberry, highbush blueberry, silky dogwood,

elderberry, poison ivy, and cinnamon fern. Areas of PEM are primarily vegetated with cattail, sensitive fern, and purple loosestrife. Lesser amounts of silky dogwood, speckled alder, and common winterberry are found at the marsh edges. Vernal Pool 6 is located in an area of forested and scrub/shrub wetland within the I-93 median, south of the median crossover.

The diversity of wetland types within Wetland System 11 supports ten of the standard functions and values. Principal functions include floodflow alteration, sediment/toxicant retention, nutrient removal, production export, and wildlife habitat. The large marsh located within the median and to the east of it, provide an expansive area for floodwaters to be retained. A constricted outlet located beneath the northbound lane limits outflow from the system allowing long settling times for sediments and toxicants and nutrient uptake by dense vegetation within the marsh.

Wetland System 12 – Exit 3

Wetland System 12, located within Windham, adjacent to and within the Exit 3 Interchange. Areas of PFO, POW, PSS, and PEM totaling 19.8 acres comprise Wetland System 12. Two unnamed perennial streams (R3UB) flow through the area from north to south, beneath NH 111 to Cobbetts Pond. Vegetation includes red maple, eastern white pine, speckled alder, common winterberry, gray birch, cattail, purple loosestrife, buttonbush (*Cephalanthus occidentalis*), sensitive fern and tussock sedge.

In part, due to a diversity of cover types, Wetland System 12 supports ten of the standard functions and values found in wetland systems. Principal functions are floodflow alteration, fish and shellfish habitat, sediment/toxicant retention, nutrient removal, production export and wildlife habitat. The Wetland System flows into Cobbetts Pond through a constricted outlet that slows water movement and allows for sediment and toxicants to settle out of suspension and be absorbed by emergent vegetation. Perennial tributaries provide suitable habit for establishment of fish species. The wetland system also supports groundwater recharge/discharge, sedimentation retention, production export, wildlife habitat, and uniqueness functions. Private wells located downstream indicate the system contributes to groundwater recharge. Food production of the system contributes to the wildlife populations in the area, songbirds and other species were observed during field surveys.

Wetland System 13 – Route 111

Wetland System 13 is located along NH 111, west of I-93 in Windham. PFO, POW, PSS, and PEM wetland cover types (totaling 17.1 acres) are all found within this system. Several intermittent streams (R4SB) are located in this wetland system, which drains to Cobbetts Pond, located to the south. Vegetation in areas of PFO and POW includes red maple, swamp white oak, sweet pepperbush, highbush blueberry, arrow-wood, swamp rose, spicebush (*Lindera benzoin*), cinnamon fern, and *Sphagnum* mosses. Pronounced hummock/hollow topography is found within the bouldery

surfaces of the forested wetland areas. Areas of PEM and PSS are vegetated with cattail, purple loosestrife, meadowsweet, speckled alder, and tussock sedge.

A diversity of wetland types in Wetland System 13 supports twelve of the standard functions and values found in wetland systems. Principal functions are floodflow alteration, sediment/toxicant retention, nutrient removal, production export, wildlife habitat, educational/scientific value, and uniqueness. A tributary of Golden Brook flows through the area and its sinuosity contributes to flow diffusion, sediment retention and nutrient removal. Interspersion of upland and wetlands throughout the area contributes to wildlife habitat diversity and provides ample food sources. An important local landmark, Indian Rock, is situated north of Route 111 in an upland area between areas of forested wetland.

Wetland System 14 – Weigh Stations - South

Wetland System 14, totaling 5.4 acres, is located in Windham, south of the drainage divide that bisects the weigh stations located between Exits 3 and 4. Drainage from the areas of PFO, portions of which are located within the highway median, outlet to tributaries (R4SB) of Golden Brook located west of the highway. A small area of POW (Vernal Pool 13) is located within the highway median within a larger area of PFO. Probably the most degraded vernal pool habitat identified within the corridor, its location in the highway median is probably a factor limiting its use by breeding amphibians. Vernal Pool 22 (PFO) is also located within the system, to the west of the southbound lane, opposite the acceleration lane from the weigh station. Vegetation in areas of PFO includes red maple, yellow birch, arrow-wood, eastern hemlock (*Tsuga canadensis*), eastern white pine, highbush blueberry, cinnamon fern, and *Sphagnum* mosses.

Wetland System 14 supports nine of the standard functions found in wetland systems. Principal functions are floodflow alteration, sediment/toxicant retention, and nutrient removal. Dense vegetation and long detention times contribute to the wetland system's ability to remove sediment, toxicants, and nutrients. The wetland system also supports wildlife habitat. Evidence of degradation to wetlands within the median include areas of direct sedimentation and siltation due to untreated stormwater runoff, and debris and trash along the highway shoulders and wetland edges.

Wetland System 15 – Weigh Stations - North

Wetland System 15 is located in Windham, directly north of Wetland System 14, and includes areas 11.6 acres in size, of PFO and PEM located within the median and to the east and west of the highway. Vegetated with many of the same species as Wetland System 14, areas of PFO in this system drain westward to a tributary (R4SB) to Golden Brook. Areas of PEM are vegetated with cattail, tussock sedge, reed-canary grass, and emergent woody shrubs. Located at the northern end of the weigh station, the area of PEM conveys drainage to a vegetated drainage basin located east of the paved parking area associated with the weigh stations. Observed use of the

area of PEM, as amphibian-breeding habitat (Vernal Pool 15A), was documented during fieldwork.

Wetland System 15 supports eight of the standard functions found in wetland systems. Principal functions include floodflow alteration, sediment/toxicant retention, nutrient removal, and wildlife habitat. Bordering Golden Brook, a large portion of this wetland system is located within 100-year floodplain and retains higher volumes of water during flood events than under normal conditions. The forested wetland to the east of the corridor supports a high density of vegetation that is able to attenuate nutrients. A high diversity in plant community structure indicates the potential use of the wetland by wildlife.

Wetland System 16 – Bridge Street Pond

Wetland System 16, located in Windham, south of North Lowell Road, includes areas of POW (Bridge Street Pond) and PFO west of the highway, and PEM/POW east of the highway. Total wetland area within the system amounts to 7.1 acres. Dominant vegetation includes red maple, cattail, purple loosestrife, arrow-wood, and reed-canary grass. Surrounding land use is predominantly residential.

Wetland System 16 supports eight of the standard functions and values. Principal functions include floodflow alteration, sediment/toxicant retention, nutrient removal, and wildlife habitat. Use of the wetlands and upland areas adjacent to wetlands by off-road vehicles was evidenced by the presence of deeply cut and meandering dirt trails in several locations.

Wetland System 17 – Windham North

Wetland System 17 is located in Windham north of North Lowell Road and south of the Derry municipal border. Totaling 14.9 acres, areas of PFO (including isolated depressions) dominate the wetland cover type found in this system. Wetland System 17 drains to the east toward Flat Rock Brook. Small areas of PEM, located closer to the highway, appear to be receiving less drainage in recent years as evidenced by dense areas of red maple shrubs and saplings located in communities dominated by emergent herbaceous plants. Other vegetation includes eastern white pine, black birch, arrow-wood, maleberry, highbush blueberry, common winterberry and tussock sedge. Surrounding land use consists primarily of residential development.

Wetland System 17 supports seven of the standard functions and values found in wetland systems. Principal functions are floodflow alteration and sediment/toxicant retention. Vernal Pool 18 is located in a small area of depressional PFO located within this wetland system east of the highway.

Wetland System 18 – Derry South

Wetland System 18 is located in Derry, north of the Windham municipal boundary. Totaling 11.8 acres, wetland cover types include PFO and POW located to the east of

the highway and PFO and PEM located west of the highway. This wetland system drains to the east toward Flat Rock Brook. Vernal Pool 18 is located in a small area of depressional PFO. Vegetation in areas of PFO is dominated by red maple and highbush blueberry. Areas of PEM include cattail and tussock sedge, and some sections are impacted by extensive use of off-road vehicles. The wetland is adjacent to a mix of residential, civic/institutional, and recreational/open space/agricultural. Land to the east is labeled as Prime Farmland.

Wetland System 18 supports eight of the standard thirteen functions found in wetland systems. The wetland's principal functions are floodflow alteration, sediment/toxicant retention, nutrient removal, sediment/shoreline stabilization, and wildlife habitat. The slow movement of water through this wetland allows nutrients to be retained and processed for use by emergent vegetation. The wetland also supports a high density of vegetation that takes up water as well as providing stabilization and retention of sediments and toxicants. Varied wetland classes yield food sources for wildlife.

Wetland System 19 – Derry Central North

Wetland System 19, comprising 16.9 acres, is located in Derry, north of Wetland System 18 and south of Kendall Pond Road. Consisting mostly of large areas of PEM to the east of the highway, smaller areas of PFO are located at the edges of PEM near the highway and POW is located to the west of I-93. A railroad corridor bisects the area of PEM located to the east of the highway. Dominant vegetation in the wetland system includes red maple, highbush blueberry, cattail, purple loosestrife, elderberry, wool grass (*Scirpus cyperinus*), and tussock sedge. The wetland system, which drains westward via a tributary to Beaver Brook, is adjacent to a mix of residential, open space and agricultural properties.

Wetland System 19 supports nine of the standard thirteen functions and values characteristic of wetland systems. Principal functions are groundwater recharge/discharge, floodflow alteration, fish and shellfish habitat, sediment/toxicant retention, nutrient removal, and wildlife habitat. One of the areas of PFO is apparently fed by groundwater that flows along a shallow channel extending from a culvert that drains an area of bedrock outcropping located within the median. No contributing area of surface drainage was observed. The Town of Derry designates the large area of PEM located to the east of the highway as well as the tributary that flows from it west of the highway, as prime wetlands.

Wetland System 20 – Beaver Brook

Wetland System 20 is a riverine and palustrine system located east and west of the highway, straddling the Derry/Londonderry municipal line and extending to the north, just south of Exit 4. Totaling 23.5 acres, the wetland system includes areas of POW, PFO, PSS and PEM that drain to Beaver Brook (R3UB), which flows northeast to southwest through the southern parts of the system. Vegetation within areas of PFO, PSS, and PEM includes red maple, glossy buckthorn, meadowsweet, arrow-

wood, speckled alder, American elm (*Ulmus americana*), purple loosestrife, tussock sedge, and skunk cabbage (*Symplocarpus foetidus*). In addition to the previously listed species, vegetation along the deeply cut banks of Beaver Brook includes silky dogwood, elderberry and eastern white pine. Surrounding land use includes residential, recreational, open space, treatment ponds, agricultural fields as well as designated farmland of local importance.

Wetland System 20 supports nine of the functions and values attributable to wetlands. Principal functions include floodflow alteration, fish and shellfish habitat, sediment/toxicant retention, nutrient removal, and wildlife habitat. The wetland system is adjacent to four constructed sewer treatment ponds directly north of Beaver Brook's 100-year floodplain. The wetlands bordering Beaver Brook are relatively flat with a moderate density of vegetation that is able to provide flood storage for the surrounding uplands. The slow movement of water through Wetland System 20 allows nutrients to be retained and processed for use by emergent vegetation. The wetland also supports a high density of vegetation that takes up water as well as providing stabilization and retention of sediments and toxicants. There are numerous wetland classes that yield food sources for wildlife.

Wetland System 21 – Wheeler Pond and Tributary

Wetland System 21 is located in Londonderry, north of Exit 4 and south of the Pillsbury Road overpass. Wetland System 21, comprising 15.4 acres, contains PFO, POW, PSS, and PEM cover types. Wheeler Pond makes up the largest portion of Wetland System 21. The eastern edges of the pond have been altered by development (paved surfaces and rip-rap) that extends to the pond's edge. Areas of PEM and PSS fringe the open water area of the pond on the remaining sides. Vegetation in these areas includes red maple, speckled alder, black willow (*Salix nigra*), meadowsweet, cattail, purple loosestrife, sensitive fern, and tussock sedge. Duckweed (*Lemna minor*) was observed in deeper water areas of PEM on the southern side of the pond. An unnamed perennial tributary (R3UB) to Wheeler Pond flows along the eastern edge of the northbound lane and provides food sources and habitat for fish and wildlife. An area of PFO adjacent to the stream was altered by apparent cutting of vegetation and dumping of refuse east of the highway. Surrounding land use consists of limited residential, and is mainly commercial and industrial. A small amount of agricultural land is also located to the west of the system.

Wetland System 21 supports twelve of the standard thirteen functions and values found in wetland systems. Principal functions are floodflow alteration, fish and shellfish habitat, sediment/ toxicant retention, nutrient removal, wildlife habitat and visual quality/aesthetics. The relatively flat conditions of the wetland allow for flood storage. The wetland also supports a high density of vegetation that takes up water as well as providing stabilization and retention of sediments and toxicants. The slow movement of water through the wetland system and bordering Wheeler

Pond allows nutrients to be retained and processed for use by emergent vegetation. An active beaver dam is located at the northern edge of the pond.

Wetland System 22 – Pillsbury Road to PSNH Easement

Wetland System 22 is located in Londonderry, between Pillsbury Road and the drainage divide to the north located along the PSNH power line easement. Areas of PFO, POW and PEM, totaling 28.5 acres, are located within the highway median and to the east and west of it. These wetland areas drain southward to the perennial tributary to Wheeler Pond described previously in the Wetland System 21 description. Surrounding land use consists primarily of residential properties. Vegetation within the PFO west of the highway includes red maple, ash, silky dogwood, highbush blueberry, common winterberry, elderberry, American elm, skunk cabbage, and bittersweet (*Celastrus* sp.). Areas of POW and PEM are found east of the highway. Vernal Pools 20 and 21 are located within 100 feet of the roadway edge in these areas. Due to their proximity to the roadway, trash and debris are located within the edge of these seasonally flooded wetlands. Further northward, a dirt trail is located within the wetland in a previously altered area. Vegetation in the areas of PEM includes tussock sedge, buttonbush, common winterberry, red maple, highbush blueberry, speckled alder, arrow-wood, gray birch, and royal fern (*Osmunda regalis*).

Wetland System 22 supports eleven of the standard functions and values found in wetland systems. Principal functions include floodflow alteration, sediment/toxicant retention, nutrient removal and wildlife habitat. Wetland System 22 functions effectively at slowing surface and stormwater flow and diffuses the water prior to entering into the 100-year floodplain downstream of Pillsbury Road.

Wetland System 23 – Stonehenge Road

Wetland System 23, totaling 13.5 acres, is located in Londonderry, north of the PSNH power line easement (drainage divide) to a point just north of Stonehenge Road at the Beaver Brook/Little Cohas Brook watershed divide. Drainage from a large area of PEM is culverted beneath the highway south of Stonehenge Road, and continues eastward to areas of PFO, PSS and POW east of the highway, eventually to Hood Pond which outlets to Beaver Brook in Derry. Dominant vegetation in the wetland system includes red maple, highbush blueberry, common winterberry, cattail and tussock sedge.

Wetland System 23 supports six of the standard functions found in wetland systems. Principal functions are floodflow alteration, sediment/toxicant retention, nutrient removal, and wildlife habitat. Areas of impounded water are able to trap sediments and toxicants. Wetland System 23 has various vegetation classes that provide food and breeding habitat for wildlife.

Wetland System 24 – Londonderry Central

Wetland System 24 is located in Londonderry, north of Wetland System 23 extending to a point just south of the Exit 5 off-ramp. Depressional areas of PFO and PEM are located east of the highway, with narrow strips of PSS found within the highway median. Wetland System 24, comprising 10.9 acres, drains slowly toward Beaver Brook via wetland areas located east of Rockingham Road. Areas of PFO in this system exhibit a hummock/hollow topography and contain diverse plant communities, with nearly thirty species identified. Dominant plants include yellow birch, black birch, red maple, highbush blueberry, arrow-wood, nannyberry (*Viburnum lentago*), common winterberry, rhodora (*Rhododendron canadensis*), cinnamon fern, royal fern, lady fern (*Athyrium filix-femina*), tussock sedge and *Sphagnum* mosses. Adjacent land use is primarily residential, with some commercial development located at the northern end of the system.

Wetland System 24 supports nine of the standard functions and values characteristic of wetland systems. Principal functions include floodflow alteration, sediment/toxicant retention, nutrient removal, wildlife habitat, and uniqueness/heritage. Highway drainage to the area is trapped in the depressional areas where toxicants and sediments settle out. Dense layers of vegetation utilize nutrients contained within the stormwater.

Wetland System 25 – Exit 5

Wetland System 25 is a large area (totaling 46.7 acres), located adjacent to and within the Exit 5 Interchange, and extending to the drainage divide, located about 3,000 feet to the north. Wetland areas along Route 28 are also included in Wetland System 25. A railroad corridor bisects the southern end of the pond and PEM, north of NH 28 and a power line easement extends across the highway north of these areas. Drainage from the system flows toward Little Cohas Brook to the west of the highway. Areas of POW, PFO, and PEM are located immediately north of the north and south bound exit ramps. Dominant vegetation in areas of PFO includes red maple, yellow birch, elm, eastern white pine, gray birch, highbush blueberry, arrow-wood, common winterberry, and cinnamon fern. Areas of PSS and PEM (located primarily where stormwater is being conveyed to or from) are vegetated with speckled alder, silky dogwood, gray dogwood (*Cornus racemosa*), glossy buckthorn, gray birch, cattail, purple loosestrife, sensitive fern and tussock sedge. Debris, trash, and sediments were noted in these areas. Land adjacent to Wetland System 25 is mostly developed as residential, commercial and industrial properties.

Wetland System 25 supports twelve of the standard functions and values determined to be attributes of wetland systems. Principal functions include floodflow alteration, fish and shellfish habitat, sediment/toxicant retention, nutrient removal, production export, wildlife habitat, and visual quality/aesthetics. The wetland lies in a visible, flat area that has large flood storage potential. The wetland also supports a high density of vegetation that takes up water as well as providing stabilization and retention of sediments and toxicants.

Wetland System 26 – Cohas Brook

Wetland System 26 is a riverine (R3UB) and palustrine forested wetland system located in Londonderry and Manchester, north of the Cohas Brook/Little Cohas Brook watershed divide. The 31.7-acre system, which is primarily located between the north and southbound lanes, extends northward to Bodwell Road where Cohas Brook exits the system. Areas of POW, PFO, PSS, and PEM are associated with the brook, which receives flow from intermittent tributaries (R4SB) located on both sides of the highway and Long Pond Brook located east of the highway. PEM wetlands located east of the highway, and opposite Bodwell Road, showed signs of degradation. Trash, debris and degraded water quality (surface algae mats) were observed. Vegetation found within Wetland System 26 includes red maple, swamp white oak, yellow birch, black birch, common winterberry, eastern hemlock, eastern white pine, arrow-wood, royal fern, cinnamon fern, meadowsweet, tussock sedge, purple loosestrife, species of bulrush (*Scirpus* spp.), blue flag, cattail, reed-canary grass and duckweed.

Wetland System 26 supports nine of the standard functions and values characteristic of wetland systems. Principal functions are groundwater recharge, floodflow alteration, fish and shellfish habitat, sediment/toxicant retention, nutrient removal, and wildlife habitat. Bordering Cohas Brook, wetlands in this system occupy large areas of the 100-year floodplain and retain much higher volumes of water during flood events than under normal conditions. Wetlands bordering the stream support a high density of vegetation that uptake water as well as providing stabilization and retention of sediments and toxicants. The abundance and diversity of vegetation also provides food and shelter for wildlife. Cohas Brook supports fish and provides habitat for various amphibians, reptiles and birds.

Wetland System 27 – I-93/I-293 Interchange

Wetland System 27, is located in Manchester, in the areas surrounding the intersection of I-93 with I-293, and within the highway median. The 45-acre system is comprised of areas of POW, PFO, PSS, and PEM. Cohas Brook flows westward through the southern reaches of the system. Vegetation in areas of PFO and PSS near the stream is similar to that in Wetland System 26. The large area of PEM within the interchange is vegetated mostly with cattail, with lesser amounts of purple loosestrife, and reed-canary grass. Fringes of PSS are vegetated with meadowsweet, gray birch, speckled alder, silky dogwood, highbush blueberry, and alternate-leaved dogwood (*Cornus alternifolia*). Surrounding land use is primarily residential, commercial, recreational and agricultural property.

Wetland System 27 supports ten of the standard functions and values found in wetland systems. The wetland's principal functions are floodflow alteration, fish and shellfish habitat, sediment/toxicant retention, nutrient removal, production export, wildlife habitat, uniqueness/heritage, and visual quality/aesthetics. Bordering Cohas Brook, this wetland occupies a large amount of 100-year floodplain and provides a large area of flood storage potential. The wetland also supports a high

density of vegetation that takes up water as well as providing stabilization and retention of sediments and toxicants. The stream and wetland are easily observed by the public from several viewing locations along I-93.

3.6.3.3 Vernal Pools

Vernal pools are ephemeral wetlands that fill annually with water due to precipitation, runoff, and rising groundwater. The pools occur yearly in the same spot, typically in small woodland depressions, kettle holes, oxbows on river floodplains, and gravel pits. In most years these unique wetland areas become completely dry, losing water through evaporation and transpiration. These wet-dry cycles preclude permanent populations of predatory fish, making these seasonal areas ideal breeding habitat for some amphibians and invertebrates. Viable vernal pools also require adjacent forested upland because the amphibian species disperse to these areas for non-breeding portions of their life cycles. Vernal pools also provide suitable habitat for reptiles and other wildlife.

Certain species (wood frog, spotted salamander, blue-spotted salamander, Jefferson salamander, marbled salamander, and fairy shrimp) depend completely upon vernal pools for parts of their life cycles and are known as indicator or obligate vernal pool species. Other amphibians, reptiles, and invertebrates utilize vernal pools and other types of wetlands for parts of their lifecycles and are known as non-indicator or facultative species.

In 1996, 2001 and 2002, the I-93 corridor from Salem to Manchester was investigated to determine the location and extent of vernal pools. Using New Hampshire Fish and Game Department (NHF&GD) guidelines, visual inspections of the pool's water column, substrate, vegetation and surrounding upland habitat were performed. Photographs were taken of each area inspected. Species identification and counts of aquatic invertebrates and amphibian egg masses, juveniles and adults were made. Physical characteristics such as pool dimension, maximum and average water depth, and water temperature were also noted. The presence (or absence) of vernal pool indicator species (fairy shrimp, wood frog, spotted salamander, blue-spotted salamander, Jefferson salamander, and marbled salamander) determined whether an area was classified as a vernal pool or not. Areas determined to be vernal pools are shown on **Figure 3.6-4**.

In April 1996, an investigation of 19 potential vernal pools concluded that seven of the 19 pools met the criteria used for vernal pool designation. In May 2001, follow-up inspections were conducted on 23 potential vernal pools within the corridor (including those studied in the 1996 study). Of the seven areas previously classified as vernal pools in 1996, six were confirmed to be vernal pools in 2001. Eleven additional areas were designated as vernal pools and six areas were documented as being potential vernal pools in the May 2001 study.

In April 2002, the 23 areas identified as vernal pools or potential vernal pools in the 2001 study were re-examined. Of the 17 areas previously identified as vernal pools, six were determined to have the necessary indicator species. Of the six potential vernal pools identified in 2001, only one was identified as a vernal pool, having the necessary indicator species. Areas were eliminated as vernal pools in 2002 because they lacked indicator species (some of these areas also lacked non-indicator species). In addition, most eliminated pools were nearly or entirely lacking pooled water and/or had water that was degraded or apparently of insufficient quality to support indicator vernal pool species. Several of these areas in 2002 were choked with pine needles, leaves, branches, and debris and the water appeared to be high in tannins. Other areas were littered with trash/debris, had large amounts of filamentous or surface algae, distinct anaerobic or sulfurous odors, and/or typically supported large populations of mosquito larvae.

In general, areas classified as vernal pools within the I-93 corridor are depressional areas located within wooded habitats and isolated from direct roadway drainage. Although most of the pools studied are located within 100 feet of the roadway, buffering vegetated strips (forested and grassed) appear to provide enough protection to the pools to allow breeding activity to continue. Sufficient upland habitat in the remaining adjacent areas is likely a key factor in maintaining the use of these areas by vernal pool species. A comparison of data obtained in 1996, with confirmatory data collected in 2002, indicates agreement with the number of pools identified within the study corridor.

Following are descriptions of the seven areas, identified as vernal pools, located within the I-93 highway corridor. All data were collected during April 2002. Water temperatures were taken at 6 to 8 inches below the surface.

2002 Vernal Pool Descriptions

Vernal Pool 6

Vernal Pool 6 (VP6) is located south of Exit 3, within the highway median in Wetland System 11. Located about 150 feet west of the northbound lane and 50 feet south of the median crossover road, the pool slowly drains to the north via a partially obstructed metal culvert beneath the crossover road. No direct highway drainage was observed discharging into the vernal pool area. A thick emergent shrub layer and overhanging tree branches provide ample attachment sites within the adequate depths of water in the vernal pool. Numerous wood frog and spotted salamander egg masses were observed in the central portions of the pool. Surrounding upland habitat consists of a mixed deciduous forest along the northern, western and southern edges (preferred by most frog and salamander species), and open grassy highway median along the eastern edge. The northern and eastern edges of the vernal pool show some signs of degraded water quality evidenced by filamentous/surface algae, and anaerobic odors. Items of trash were also observed in the wetland in these areas.

Width: 100 feet **Length:** 200 feet **Water Temperature:** 61ºF
Maximum Water Depth: 2 feet **Average Water Depth:** 1 foot
Pool Substrate: decaying organic matter (leaves, twigs, branches) underlain by thick muck layer over silts and sands
Pool Vegetation: buttonbush, winterberry, red maple, black birch, highbush blueberry, sweet pepperbush, Canada mayflower, tussock sedge, sphagnum moss
Surrounding Upland: mixed deciduous forest vegetated with red oak and eastern white pine
Observed Aquatic Invertebrates: fairy shrimp, fingernail clam, amphibious snail, predacious diving beetle, mosquito larvae
Observed Adult/Juvenile Amphibians: adult wood frog (2)
Observed Indicator Species: fairy shrimp, wood frog egg masses (numerous), spotted salamander egg masses (6), adult wood frog (2)

Vernal Pool 13

Vernal Pool 13 (VP13) is located in Wetland System 14, south of the weigh stations within the median of I-93. Located at the bottom of a steep embankment, within a depressional area about 100 feet from the edge of the northbound lane, overhanging and emergent woody stems provide shade and potential attachment sites for amphibians. The vernal pool drains slowly to the west to an adjacent forested and scrub/shrub wetland. Limited actual use of the area by breeding amphibians was noted during field inspections, as the area appears to be quite degraded due to its proximity to the highway. Surrounding upland habitat consists of deciduous forest with greater amounts of softwood located to the south and west. The amount of upland habitat adjacent to the pool, is restricted by its position in the landscape i.e. within the highway median. VP13 exhibits signs of water quality degradation as evidenced by the presence of surface and filamentous algae.

Width: 30 feet **Length:** 50 feet **Water Temperature:** 48ºF
Maximum Water Depth: 4 feet **Average Water Depth:** 2.5 feet
Pool Substrate: decaying organic matter (leaves, pine needles), thick organic muck
Pool Vegetation: eastern hemlock (overhanging), highbush blueberry, winterberry, cinnamon fern
Surrounding Upland Vegetation: deciduous forest vegetated with red oak, eastern hemlock, white pine, gray birch, red maple, American hazelnut, partridgeberry, wintergreen
Observed Aquatic Invertebrates: fairy shrimp, caddisfly larvae, water strider
Observed Adult/Juvenile Amphibians: None
Observed Indicator Species: wood frog egg masses (2), fairy shrimp (few individuals)

Vernal Pool 15A

Vernal Pool 15A (VP15A) is located north of the northbound weigh station in Wetland System 15. Located about 50 feet from the edge of pavement northeast of the weigh station, the vernal pool slowly discharges into a detention basin to the

south. Drainage from paved surface does not appear to enter the pool directly. A mix of emergent herbaceous and woody vegetation, and varying amounts of cover over the pool, provides a mix of breeding habitat for amphibians and invertebrates. Water quality within the vernal pool is apparently good as evidenced by a varied number of invertebrates, and as many as 7,500 wood frog eggs contained within numerous masses affixed to herbaceous plants at the surface of the water. Surrounding uplands consist of areas of deciduous and coniferous forest to the north and east. Although bordered by paved areas of the northbound weigh station to the west and detention basin to the south, sufficient habitat exists for adult stages of amphibian life cycles.

Width: 50-75 feet **Length:** 100 feet **Water Temperature**: 46ºF
Maximum Water Depth: 2 feet **Average Water Depth:** 1.5 feet
Pool Substrate: emergent herbaceous deep muck
Pool Vegetation: red maple, highbush blueberry, maleberry, sweet pepperbush, sedges, sensitive fern, cinnamon fern, cattail, reed canary grass
Surrounding Upland: deciduous and coniferous forest vegetated with white oak, eastern white pine, eastern hemlock, American elm, sheep laurel, tree clubmoss
Observed Aquatic Invertebrates: water strider, caddisfly larvae, fingernail clam, isopod, amphipod, amphibious snail, aquatic oligochaete worm
Observed Adult/Juvenile Amphibians: adult wood frog, spring peeper (chorusing)
Observed Indicator Species: wood frog egg masses (numerous), adult wood frog

Vernal Pool 18

Vernal Pool 18 (VP18) is a small area located about 0.5 miles south of the Windham/Derry town line within Wetland System 17. Located approximately 70 feet east of the northbound lane, the isolated depression contains many oak leaves and pine needles. Upland areas adjacent to the vernal pool consist of deciduous and coniferous forest to the north, east and south. To the west, the edge of the highway right-of-way is more sparsely vegetated. A cart path extends through this area and may be used by off-road vehicles. Limited size of the pool, small volume of water, lack of attachment sites, and apparent high water acidity may be limiting factors for breeding amphibians in this pool.

Width: 15 feet **Length:** 30 feet **Water Temperature:** 56ºF
Maximum Water Depth: 2 feet **Average Water Depth:** 1.5 feet
Pool Substrate: oak leaves and pine needles underlain by organic layer over sands
Pool Vegetation: red maple, highbush blueberry
Surrounding Upland: deciduous forest vegetated with eastern white pine, red and white oak, red maple, hazelnut, species of club-moss
Observed Aquatic Invertebrates: fairy shrimp(many), predacious diving beetle, water strider, mosquito larvae
Observed Adult/Juvenile Amphibians: 1 adult wood frog
Observed Indicator Species: fairy shrimp, adult wood frog

Vernal Pool 20

Vernal Pool 20 (VP20) is located in Wetland System 22, approximately 75 feet east of the northbound lane. The pool is 500 feet north of Vernal Pool 21, to which it slowly discharges along the toe of slope of the roadway shoulder. Emergent herbaceous and woody vegetation on the northern and western sides of the pool, provides many attachment sites for egg masses (observed location). Standing dead trees contain bird nesting cavities, and fallen trees throughout the pool are suitable for basking turtles. The surrounding mixed deciduous forested upland, extending for thousands of feet to the north, east and south, is excellent habitat for adult salamanders and reptiles. A large (30-inch) ribbon snake was observed at the edge of pool. Vernal Pool 20 is perhaps of the highest overall quality of those studied within the corridor, as evidenced by the diversity and number of amphibian, invertebrate, and reptile species. However, water quality at the western edge of the pool is showing some signs of degradation (filamentous algae and litter) due to its proximity to the highway.

Width: 70 feet **Length:** 140 feet **Water Temperature:** 54ºF
Maximum Water Depth: 3 feet **Average Water Depth:** 2 feet
Pool Substrate: thin layer of muck over firm pebbly sand substrate
Pool Vegetation: red maple, buttonbush, cinnamon fern, highbush blueberry, meadowsweet, speckled alder, sensitive fern, skunk cabbage
Surrounding Upland: oak, hickory, and maple deciduous forest
Observed Aquatic Invertebrates: fairy shrimp (many), predacious diving beetle, water boatman, whirligig beetle, water strider, mosquito larvae, caddisfly larvae, fingernail clam, midge larvae
Observed Adult/Juvenile Amphibians: green frog
Observed Indicator Species: wood frog egg masses (10), spotted salamander egg masses (8), fairy shrimp

Vernal Pool 21

Vernal Pool 21 (VP21) is located in Wetland System 22 approximately 1500 feet north of the Ash Street/Pillsbury Road overpass north of Exit 4 and 500 feet south of Vernal Pool 20. Located about 75 feet from the edge of pavement, VP21 is mostly open water and emergent marsh. Many dead trees with bird nesting cavities, and windfalls suitable for basking turtles are located throughout the pool. Emergent shrubs located within the northern and western central areas of the pool provide attachment sites for the egg masses that were observed. Surrounding upland habitat is similar to that adjacent to Vernal Pool 20, and extends for thousands of feet to the north, east and south. Filamentous, surface algae and trash, were noted near the western edge of the pool, indicating water quality degradation, probably due to its proximity to the highway.

Width: 100 feet **Length:** 200 feet **Water Temperature:** 58ºF
Maximum Water Depth: 2 feet **Average Water Depth:** 1.5 feet
Pool Substrate: muck layer over silt and fine sands

Pool Vegetation: blue joint grass, reed canary grass, cattail, speckled alder, red maple, highbush blueberry, meadow-sweet, water lily, sensitive fern, cinnamon fern
Surrounding Upland: forested wetland and upland vegetated with red maple, oak, white pine, hazelnut, tree club-moss.
Observed Aquatic Invertebrates: water strider, mosquito lavae, caddisfly larvae, water mite, fingernail clam, midge larvae, predacious diving beetle, whirligig beetle
Observed Adult/Juvenile Amphibians: hatching spotted salamanders
Observed Indicator Species: wood frog egg masses (3), spotted salamander egg masses (8) and hatching juveniles

Vernal Pool 22

Vernal Pool 22 (VP22) is located in Wetland System 14, approximately 100 feet south of the southbound weigh station. Located about 50 feet from the edge of pavement near the acceleration lane from the weigh station, the pool is located in a depressional area and segmented from the highway shoulder by a dirt haul road. The pool may be located in an old borrow pit as suggested by historic (highway construction) and active (logging and off-road vehicles) land use in the area. Surrounding upland habitat to the south, west and north consists of moderate to steeply sloped deciduous forest. Water quality is apparently good in VP22, as evidenced by abundant numbers of amphibian indicator species.

Width: 30-40 feet **Length:** 80-100 feet **Water Temperature:** 56ºF
Maximum Water Depth: 4 feet **Average Water Depth:** 2.5 feet
Pool Substrate: branches and leaves underlain by a thick organic muck layer over silt and fine sands
Pool Vegetation: red maple, witch hazel, fetterbush, American elm, sensitive fern
Surrounding Upland Vegetation: oak, white pine, hazelnut, witch hazel
Observed Aquatic Invertebrates: fairy shrimp, caddisfly larvae, water strider, predacious diving beetle
Observed Adult/Juvenile Amphibians: None
Observed Indicator Species: spotted salamander egg masses (8), fairy shrimp

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3.6.4 Wildlife Resources

New Hampshire has 318 species of terrestrial wildlife (vertebrates other than fish) species that occur as either migrants or residents. This variety of wildlife species is valuable to the state both economically relative to tourism and recreational activities, and as integral components of ecological food webs, energy flow, and biodiversity.

The U.S. Fish and Wildlife Service (USFWS) is responsible for managing and protecting migratory wildlife species. Except for threatened and endangered species and their associated "critical habitats", Federal protection of wildlife on private property is confined to migratory species and is not extended to their habitat.

The NHF&GD is responsible for managing and protecting resident wildlife species. NHF&GD has promulgated rules (NH Administrative Rules Fis Chapter 1000) for the protection and management of these species. These rules pertain almost entirely to the exploitation of the species and not to the habitats. The rules set seasons, bag limits, and legal means for the taking of game, fish, and furbearing species.

Some wildlife habitat is protected as state forests, state parks, or state-owned or state-managed wildlife management areas where additional restrictions on land use apply. In 1987 the NHF&GD made public a resolution encouraging the protection of deer wintering areas (deer yards) through education, cooperative agreements, leases, easements, and acquisitions. However, no blanket legal protection was given to deer yards on privately owned lands.

Wildlife and wildlife habitats that are considered to be important issues in land development include deer yards, high quality wetlands, waterfowl nesting habitat, vernal pools, and heron rookeries. Also, other natural ecological communities or habitats are valued for their rarity, uniqueness of their biotic assemblages (in a regional context), or high natural biodiversity or abundance of wildlife.

3.6.4.1 Existing Resources

The USFWS, NHF&GD, New Hampshire Natural Heritage Inventory (NHNHI), Audubon Society, Southern New Hampshire Regional Planning Commission, Rockingham Planning Commission, and the Conservation Commissions of Manchester, Londonderry, Derry, Windham, and Salem, were contacted about available information on the past, present, or probable existence of important wildlife species or wildlife habitats in the study area. NHF&GD, NHNHI, Audubon, Southern New Hampshire Planning Commission, and the Conservation Commissions of Manchester and Salem responded.

NHF&GD responded that it knew of no important wildlife habitats such as deer yards or heron rookeries (however one was recorded during this study) within the median strip or immediately adjacent to the I-93 corridor. There are a few active beaver ponds adjacent to the highway right-of-way that provide valuable wildlife habitat for a number of species in this heavily developed area of the state. The freshwater marsh at the junction of I-293 and I-93 provides habitat for waterfowl, including birds, aquatic mammals, and amphibians.

NHNHI's response documented the occurrence of a number of state-listed rare, threatened, or endangered species in the vicinity of the study area (see Section 3.7), but mentioned no other important wildlife populations or habitats.

In addition to providing information on officially state-listed threatened and endangered species, Audubon Society provided a list of 13 wildlife species, which

may occur in the study area and which they believe are of concern based on current population levels (**Table 3.6-4**). However, none of these species are officially listed as threatened or endangered.

Table 3.6-4
Wildlife Species that the Audubon Society of New Hampshire Considers of Management Concern, and Likely to Occur in the Study Area

Common Name	Scientific Name	Habitat
Jefferson Salamander	*Ambustana jeffersonianum*	Moist woodlands, swamps, wet meadows
Spotted Turtle	*Clemmys guttata*	Bogs, wet meadows, wooded streams, dry sandy uplands with exposed soil and sparse vegetation for nesting
Blanding's Turtle	*Emydoidea blandingii*	Shallow soft-bottomed ponds, swamps, marshes, dry sandy uplands to sparse vegetation for nesting
Eastern Hog-nosed Snake	*Heterodon platyrhinos*	Open woodlands with sandy soil
Least Bittern	*Ixobrychus exilis*	Deep emergent marshes
Red-shouldered Hawk	*Buteo lineatus*	Swampy woods, mature hardwoods
Sora	*Porzana carolina*	Deep, emergent marshes
Eastern Screech Owl	*Otus asio*	Open woodlands, shade trees
Whip-poor-will	*Caprimulgus vociferous*	Dry, open woods
Golden-winged Warbler	*Vermivora chrysoptera*	Brushy fields, thickets
Vesper Sparrow	*Pooecetes gramineus*	Dry open uplands
Grasshopper Sparrow	*Ammodramus savannarum*	Dry grasslands
New England Cottontail	*Sylvilagus transitionalis*	Dense, shrubby woodlands

A review of published materials including USGS topographic maps and National Wetlands Inventory Maps, NHDOT's previous work on wetlands within the I-93 right-of-way, and windshield surveys in 1992, 1993 and 1998 of the study area, indicate that a wide variety of wildlife habitats exist within the study area, including upland hardwood forests, upland softwood forests, mixed upland forests, forested (primarily red maple) wetlands, scrub-shrub wetlands, emergent marshes, wet meadows, lakes, ponds, streams, rivers, agricultural fields and pastures, "old fields" (i.e., shrublands), and recently disturbed areas.

Practically all of the wildlife habitats along the study corridor have been affected in some fashion by their proximity to the highway. Residential and commercial development is prevalent along this section of I-93, particularly in Salem and Manchester. The wildlife value of much of the existing habitat is reduced due to fragmentation (by the encroaching development and the highway itself), frequent human disturbance such as vehicular traffic, human activity (including occasional foot and ATV activity, noise, and pollution from highway and development runoff, and various other non-point sources.

The most valuable existing habitats in the study area are the riparian areas along the rivers and streams, lakes and ponds with accompanying buffer zones, and the larger wetlands (particularly the emergent wetlands). Also, any large contiguous blocks of forest, particularly those on public property or within wetlands where there is some measure of protection against development, are important study area habitats. The Manchester Conservation Commission, as well as Federal and State natural resource agencies, consider the riparian wetland complex along Cohas Brook to be a particularly high value wetland.

3.6.4.2 Spring Field Survey - 2001

During May 9-10, 2001, the entire project corridor, from the Massachusetts/New Hampshire state line north to the I-293/I-93 split in Manchester was investigated. This spring survey was performed for the purpose of documenting wildlife corridors and wildlife habitat of concern as well as locating threatened or endangered plant and animal species. Wildlife observation stations were designated in relation to wetland systems in order to obtain an overall understanding of the existing natural resources.

A comprehensive list of wildlife species observed on May 9 and 10, 2001, is shown in Table 3.6-5. Species are listed as to the station they were located at, as well as by the way they were located (i.e., auditory or visual).

Table 3.6-5
Wildlife Species Observed During Spring 2001 Surveys

Common Name	Scientific Name	Evidence	Station Recorded
Birds			
American robin	*Turdus migratorius*	Visual/Auditory	1, 2B, 2D, 4B, 4C, 10A, 11 east, 11 west, 12, 13A
Red-winged blackbird	*Agelaius phoeniceus*	Visual/Auditory	1, 2B, 2D, 3, 4C, 6A, 6B, 8, 9A, 10A, 11 east, 11 west, 12, 13A
Phoebe	*Sayornis phoebe*	Visual/Auditory	1
American goldfinch	*Carduelis tristis*	Visual/Auditory	1, 4B, 4C, 7A, 10A, 11 east, 13A
Killdeer	*Charadrius vociferus*	Visual/Auditory	1
Pine warbler	*Dendroica pinus*	Visual/Auditory	1, 4A, 9B, 11 east
White-crowned pigeon	*Columba leucocephala*	Visual	1
Tufted Titmouse	*Parus bicolor*	Visual/Auditory	1, 2, 2D, 4A, 4B
Black-capped chickadee	*Parus atricapillus*	Visual/Auditory	1, 2B, 3, 4A, 4B, 4C, 7B, 8, 13A

Table 3.6-5 (continued)

Common Name	Scientific Name	Evidence	Station Recorded
Common grackle	*Quiscalus quiscula*	Visual/Auditory	2B, 2D, 3, 4C, 8, 9B, 10A, 11 east, 11 west, 12, 13A, 13B
Chipping sparrow	*Spizella passerina*	Visual/Auditory	4A
Blue Jay	*Cyanocitta cristata*	Visual/Auditory	2D, 4A, 7A, 7B, 9A
Northern flicker	*Colaptes auratus*	Visual/Auditory	4C, 10A, 13A
Song sparrow	*Melospiza melodia*	Visual/Auditory	1, 2B, 2D, 4C, 6B, 7A, 8, 10A, 11 east, 12, 13A
Gray catbird	*Dumetella carolinensis*	Visual/Auditory	2B, 2D, 12, 13A
Yellow-throated warbler	*Dendroica dominica*	Visual/Auditory	2B, 12, 13A
House finch	*Carpodacus mexicanus*	Visual/Auditory	2B, 12
Baltimore oriole	*Icterus galbula*	Visual/Auditory	2B, 4B, 8, 10A, 12
Mallard	*Anas platyrhynchos*	Visual	2B, 12, 13A, 13B
American crow	*Corvus brachyrhynchos*	Visual/Auditory	2B, 2D, 12
Canada goose	*Branta canadensis*	Visual/Auditory	2D, 6B, 7A, 10A
Cardinal	*Cardinalis cardinalis*	Visual/Auditory	2D
Northern oriole	*Icterus sp.*	Visual/Auditory	3, 4C, 13B
Chickadee	*Parus sp.*	Visual/Auditory	most stations
Spotted sandpiper	*Actitis macularia*	Visual	4C, 13
Great blue heron	*Ardea herodias*	Visual	6A, 11 east
Tree sparrow	*Spizzela arborea*	Visual	6A, 8, 10A, 13B
Common yellowthroat	*Geothlypstrichas*	Visual/Auditory	7A, 13B
Black and white warbler	*Mniotilta varia*	Visual/Auditory	7B
Mourning dove	*Zenaida macroura*	Visual/Auditory	8, 10, 13A, 13B
Downy woodpecker	*Picoides pubescens*	Visual/Auditory	8
White-breasted nuthatch	*Sitta carolinensis*	Visual/Auditory	8
Tree swallow	*Tachycineta bicolor*	Visual/Auditory	13A
Rough-winged swallow	*Stelgidopteryx serripennis*	Visual/Auditory	13A
Northern mockingbird	*Mimus polyglottos*	Visual/Auditory	8, 9A, 10A
Warbling vireo	*Vireo gilvus*	Visual/Auditory	8
Amphibians			
Spring peeper	*Pseudacris crucifer*	Visual/Auditory	8, 9A
Green frog	*Rana clamitas melanota*	Visual/Auditory	2B, 3, 4B, 4C, 6C, 7B, 8, 11 east, 12
Pickerel frog	*Rana palustris*	Visual	6C

Table 3.6-5 (continued)

Common Name	Scientific Name	Evidence	Station Recorded
Mammals			
Raccoon	*Procyon lotor*	Tracks in mud	2B, 12, 13A
Beaver	*Castor Canadensis*	Old dams, girdled saplings, chewed tree stumps	2B, 2D, 3, 4C, 6A, 6B, 7A, 8, 9B, 10A, 11 east, 12, 13A
Otter	*Lutra canadensis*	Tracks in mud	13A
Red Fox	*Vulpes fulva*	Tracks in mud	2D
Muskrat	*Ondatra zibethicus*	Nipped sedges and cattails	6C
Eastern Cottontail	*Sylvilagus floridanus*	Visual	4B

3.6.4.3 Habitats and Wildlife Use

The various habitats or vegetation cover types found in the study area are described below. Habitat characteristics and location of each type determine the mix of wildlife species that will be present. Species representative of each type are given. A list of species which could potentially utilize these habitats was compiled from the NEWILD Computer Program (Thomasma *et al*. 1998) and is included in Appendix D.

Upland Types

Natural upland habitats in the study corridor include three forested communities (hardwood dominated, softwood dominated, and mixed), shrublands, grasslands including pastures and hayfields, and orchards. Although residential yards and other suburban/urban areas provide some habitat to wildlife, their value is typically low compared to natural, undisturbed areas.

Hardwood Forest

The mature hardwood forests in the study area are typically dominated by red oak and northern hardwoods (American beech, yellow birch, and sugar maple) often with a large component of softwoods (white pine and hemlock). There are usually four layers of vegetation, but only the overstory is dense. Common shrub species include witch hazel, beaked hazelnut, northern wild raisin and seedlings of red maple, American beech, white pine, hemlock, and red oak. The herbaceous layer is typically sparse consisting of Canada mayflower and several species of ferns. A litter layer comprised of leaves and dead twigs covers the ground.

Young hardwood stands, as typically found in recently cutover areas, are dominated by pioneer species like gray birch, quaking aspen and pin cherry, as well as sprouts of red oak. With the reduced canopy layer (i.e., shade) in these young stands, the herbaceous and shrub layer is usually dense.

In general, the greater the number of vegetation layers and the density of each (called structural diversity), the greater is the diversity of bird species (MacArthur and MacArthur 1961). The mature hardwood stands have a moderate level of structural diversity while the young stands slightly higher. The mature stands are characterized by bird species preferring a closed canopy (e.g., sharp-shinned hawk, barred owl, red-eyed vireo, black and white warbler, scarlet tanager), moderate size tree boles (e.g., downy woodpecker, brown creeper, white-breasted nuthatch) or a forest floor with a thick litter layer including logs and scattered patches of herbaceous cover (redback salamander, wood thrush, ovenbird). Mammals include gray fox, gray squirrel, southern flying squirrel, eastern chipmunk, and white-footed mouse. In comparison, the young stands are characterized by species more commonly associated with early successional stages like shrublands (e.g., ruffed grouse, American redstart, chestnut-sided warbler, willow flycatcher, eastern cottontail, white-footed mouse, short-tailed shrew). White-tailed deer browse in both mature and young hardwood stands. Wild turkeys also forage in both age classes.

Softwood Forest

Areas of softwood forest are dominated by either white pine or hemlock. Structural diversity is typically low to moderate. The dense shading results in an undeveloped shrub and herbaceous layer. The litter layer is characterized by needles and dead branches, leading to a highly acidic environment that also inhibits herbaceous growth.

Although softwood stands typically serve as deer wintering areas (because of the protection they afford from winds and low temperatures), their proximity in the study area to human development and the highway itself preclude them from serving this function. Other species typically associated with softwood forests include red squirrel, porcupine, black-capped chickadee, veery, and blackburnian warbler.

Mixed Forest

The largest forested stands in the study area are typically mixed forest and composed of species found in both hardwood and softwood types. Structural diversity varies from moderately low to moderately high. Structurally these mixed stands are similar to hardwood stands and contain many of the same wildlife species (veery, rose-breasted grosbeak, red-backed salamander, eastern chipmunk, and gray squirrel).

Shrubland

Shrubland in the study area includes primarily “old fields" reverting to young forest. Old fields are classified as shrubland when they contain a shrub layer of at least 30 percent coverage with the remainder dominated by dense grasses and forbs.

Bird species typically associated with shrublands include chestnut sided warbler, common yellowthroat, rufous-sided towhee, prairie warbler, American goldfinch, field sparrow, and song sparrow. Common mammal species include white-footed mouse, short-tailed shrew, red fox, and eastern cottontail.

Grassland/Agricultural Field

This habitat type includes both pastures and mowed fields, as well as the mowed right-of-way edge of the highway. Structural diversity is characteristically low with the mowing diminishing both the cover and food value of the habitat. Nonetheless the edge created between this and other more mature forested areas is very valuable. Species typical of this habitat and its edge include red-tailed hawk, eastern meadowlark, American robin, American goldfinch, song sparrow, yellow warbler, woodchuck, meadow vole, eastern cottontail, and red fox. In hot summer nights, white-tailed deer will also be seen grazing in open fields where they can escape forest insects.

Orchard

Orchards are a habitat type closely related to grasslands because of their evenly spaced trees and the mowed herbaceous layer. The historic Woodmont orchard along the west side of I-93 north of Exit 4 is particularly impressive. Species representative of this type are typically a mix of those found in grasslands and young forests (e.g., American kestrel, rose-breasted grosbeak, Baltimore oriole, eastern kingbird, woodchuck, meadow vole, short-tailed shrew, and red fox).

Wetland Types

Wetlands are a particularly important habitat for wildlife (see Section 3.6.3.2). All amphibians require water or wet areas for breeding so their occurrence is dependent on wetlands. Vernal pools provide essential breeding habitat for mole salamanders (Genus *Ambystoma*) as well as wood frogs (see Section 3.6.3.3). Many reptile species also depend on wetlands.

Described below are the major wetland types found in the study area along with representative species of each.

Forested Wetlands (Forested Swamps)

Forested wetlands in the study area are typically dominated by red maples with varying amounts of hemlock, white pine, spruce and balsam fir intermixed. The typical interspersion of water and trees creates high structural diversity that enhances this habitat's value for wildlife. Common species include a variety of amphibians (spring peeper, gray treefrog, wood frog, bullfrog, green frog, mole salamanders) and reptiles (eastern ribbon snake, ringneck snake, painted turtle, snapping turtle).

The avian community found in red maple swamps is typically composed of facultative species, those which are found in upland forests as well, e.g., black-capped chicadee, gray catbird, ovenbird, wood thrush, American robin and blue jay; (Golet *et al*. 1993). Other bird species appear to be attracted to this habitat because of the presence of water, e.g., wood duck, American black duck, and mallard. Bird species perhaps most characteristic of forested wetlands of the northeast include northern waterthrush, Canada warbler, and veery (Golet *et al*. 1993). Among raptors, red-shouldered hawks are probably most characteristic of forested wetlands where they both nest and hunt. Characteristic mammalian species include beaver, raccoon, mink, woodland jumping mouse, and white-footed mouse.

Scrub-Shrub Swamp

Scrub-shrub swamps in the study area are dominated by species like highbush blueberry, willow, alder, dogwood, and northern arrowwood. Structural diversity is low because of the lack of multiple vegetation layers. Nonetheless there is typically dense shrub growth, along with dense herbaceous growth in spots. Seasonally this habitat (like forested wetlands) is frequently flooded by an adjacent stream or runoff from surrounding uplands.

Amphibians and reptiles commonly found in shrub swamps include spring peepers and wood frogs, while the presence of open water enhances the attraction for snapping turtles and painted turtles. Bird species commonly found in this habitat include American woodcock, song sparrow, alder flycatcher, and tree swallow. Mammalian species include white-footed mouse, meadow jumping mouse, and raccoon.

Emergent Marsh

There are generally two types of emergent marshes in the study area: shallow marshes with water depths up to 1.5 feet characterized by persistent vegetation such as cattails, pickerel weed, and two common invasive species, purple loosestrife and phragmites; and deep marshes with water depths up to 6.0 feet characterized by emergent vegetation such as cattails, pickerel weed, and floating-leaved plants like pond lily, yellow water lily, and water shield. Frequently “wet meadows” or “sedge meadows” are included in the shallow marsh category. These meadows will have up to 6 inches of water in winter or early spring, but with an exposed, saturated soil surface in summer (Thomasma *et al*. 1998).

Typical species found in marshes include mallard, sora rail, American bittern, great blue heron, red-winged blackbird, muskrat, foraging white-tailed deer, and common snapping turtle. During the dry summer months, meadow vole, meadow jumping mouse and American kestrel will be observed in shallow marshes and sedge meadows.

Open Water (Ponds & Lakes)

There are three large lakes or ponds in the study area: Canobie Lake, Cobbetts Pond, and Crystal Lake. Characteristics and the water quality classification of each are described under Surface Water Resources, Section 3.4.1. Two additional large ponds are Wheeler Pond at Exit 4 and an unnamed pond (identified as Exit 5 pond) and marsh along the eastside of I-93 just north of Exit 5.

Wildlife use of these open-waterbodies is largely a reflection of the surrounding or bordering habitats. The margins of the lakes and ponds contain areas of either deep or shallow marsh, while in other areas, lake-front homes or woodlands line their edge.

Wildlife representative of ponds and lakes include bull frog, pickerel frog, painted turtle, common loon, hooded merganser, common merganser, mallard, Canada goose, beaver, otter, and mink.

3.6.4.4 Important Wildlife Habitats

Some of the habitats in the study area are particularly important to wildlife. These include seven confirmed vernal pools; several known locations of threatened or endangered species; three large riparian corridors, and a heron rookery. Vernal pools are described in detail under Wetland Resources in Section 3.6.3.3. Threatened and endangered species are addressed separately in Section 3.7 because of their special protection status.

Riparian Corridors

All the perennial streams crossed by the 19.8-mile segment of I-93 have riparian corridors associated with them. Most of these are already severed to some extent by the highway. Wildlife passage through culverts or under bridges is dependent on the width of the opening, length of culvert, and of course the size of the particular species, i.e., white-tailed deer and moose may be forced to cross over the highway rather than under it. Particularly important stream crossings, because of their size and expanse, include Cohas Brook, Beaver Brook, and Porcupine Brook. An extensive riparian corridor lies along the Spickett River, although this river is not crossed by I-93 in New Hampshire.

Heron Rookeries

In their 1992 letter, Audubon reported that three active great blue heron (*Ardea herodias*) rookeries occur within south central New Hampshire, but indicated they are outside the project's influence. During the July 1998 field review, field biologists noted an active rookery with three active great blue heron nests located west of the highway in Wetland System 14, approximately 1,500 feet south of the southbound weigh station in Windham.

3.6.4.5 Wildlife Refuges

There are no publicly or privately-owned wildlife refuges within the study area.

3.7 Threatened and Endangered Species

Federal Regulatory Protection

The Endangered Species Act of 1973 ("ESA") (P.L. 93-205), as amended in 1973 and 1978, recognizes the need, and provides the means to protect rare plants, invertebrates and vertebrate species of fish and wildlife, and provides for the protection and/or acquisition of critical habitats and the management of endangered species. Per the 1978 Amendments to the ESA, separate (geographically or genetically isolated) but rare populations of fish and wildlife (but not plants or invertebrates) may be protected as well as entire species. Listed species are categorized as either endangered species (which are in danger of extinction throughout all or a substantial portion of its ranges) or threatened species (which are likely to become endangered throughout all or a substantial portion of its range).

Section 7 of the ESA dictates that all federal agencies must consult the U.S. Fish and Wildlife Service (USFWS) to ensure that actions taken under federal funding, federal assistance, or federal permits (e.g. Section 404 Army Corps Permits) do not jeopardize the existence of threatened or endangered species. Jurisdiction is given to the USFWS to recommend changes to the project to avoid such jeopardy (including impacts to the habitat as well as to the plants or animals themselves).

State Regulatory Protection

In New Hampshire, the Endangered Species Conservation Act (RSA 212-A) delegates authority and responsibility for the listing and protection of threatened and endangered species of wildlife to the NHF&GD. This statute outlines NHF&GD authority and direct other state agencies to take reasonable steps to insure their actions do not jeopardize the continued existence of threatened or endangered species or result in the destruction or modification of their critical habitat. NHF&GD has in turn promulgated the rules for the protection of these species in Fish and Game Rules, Conservation of Endangered Species. Species eligible for listing under these rules include invertebrates and vertebrate species of fish and wildlife (plants are not included). Protected animal species are placed in one of two categories, threatened or endangered, depending on their rarity.

NHF&GD manages threatened and endangered species cooperatively with the New Hampshire Natural Heritage Inventory (NHNHI). The NHNHI has compiled information on the distribution and abundance of these species from the literature, from files of area scientists, and from various field surveys, into computerized data

banks. These data banks provide information on the present, past, or probable existence of such species for improved land use planning and environmental impact assessment.

The New Hampshire Native Plant Protection Act RSA 217-A, enacted by the State Legislature in 1987, established the authority for the state to develop a list of rare plant species. The NHNHI was empowered with this authority and developed the list in NH Administrative Rules Chapter Res 1100. Plants deemed as rare in the State and in need of protection were listed as either endangered, threatened, or special concern plant species in descending order of rarity.

Unlike federally listed species, plant or wildlife species need only be rare within the State of New Hampshire to be state-listed, not rare over the entire range of the species. Therefore, many state-listed species are rare because New Hampshire is at the edge of their range, or because there is a limited amount of habitat for the species within the state. Legal protection is also much less stringent in state statutes. Besides the prohibitions on the taking or killing of state-listed wildlife species, protection of state listed plants or animals is largely restricted to recommendations by the aforementioned state agencies for the approval or disapproval of projects which might impact the environment. All projects initiated or funded by the state, or applying for such state permits as Wetlands Dredge and Fill Permits, or Site Specific Permits, are forwarded to NHF&GD and NHNHI, which have the opportunity to recommend approval or denial.

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3.7.1 Plants

3.7.1.1 Federal Threatened and Endangered Plant Species

No federally listed threatened or endangered plant species are known to occur in or near the project area.

3.7.1.2 State Rare, Threatened and Endangered Plant Species

There are four populations of state-threatened or endangered plant species with documented occurrence in the vicinity of the I-93 corridor as of June 2002. (See Table 3.7-1.) Based on mapped information provided by the NHNHI and supplemented by field work conducted during the project development, only one population is known to occur in close proximity to the proposed project: a population of wild lupine (*Lupinus perennis*) found on the west side of the project corridor just south of Exit 2 in Salem.

Table 3.7-1
State-Listed Threatened and Endangered Plant and Animal Species in the Project Vicinity

Scientific Name	Common Name	Ranks		Status	Location	Last Observed
Animal Species						
Heterodon platyrhinos	Eastern hog-nose snake	S2	G5	ST	Manchester Bricket Rd/I-93	1977
Plant Species						
Arethusa bulbosa	Arethusa	S1	G4	SE	Windham Depot	1909 (Historical)
Lupinus perennis	Wild lupine	S1	G5	ST	Between Exits 1 and 2 on west side of I-93	1985
Rhododendron viscosum	Swamp azalea	S2	G5	ST	Southeast of Exit 1	1957 (Historical)
Rhododendron viscosum	Swamp azalea	S2	G5	ST	Northeast of Exit 2, South of NH 38	1958 (Historical)

Ranks: **S1** = Critically imperiled in state because of extreme rarity.
S2 = Imperiled in state because of rarity (6-20 occurrences).
G4 = Apparently secure globally but may be rare in parts of range.
G5 = Demonstrably secure globally but may be rare in parts of range.
Note: These data are from a database check for reported occurrences conducted by the NHNHI in 2002.
"Historical" records are those occurrences for which a population was once observed, but has not been recovered for a long duration. They are not normally a concern from the viewpoint of the NH Natural Heritage Inventory.
Status: **SE** = State Endangered.
ST = State Threatened.

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3.7.2 Wildlife

3.7.2.1 Federal Threatened and Endangered Wildlife Species

According to the USFWS, bald eagles *(Haliaeetus leucocephalus)* have established a nest along the Merrimack River in the Manchester/Bedford area. Additionally, each winter, several bald eagles can be found along the Merrimack River from Franklin south to the Massachusetts line, where they hunt in ice-free areas of the River. Based on their review of the project, however, the USFWS expressed the opinion that the I-93 project would have no direct effects on eagles (M. Bartlett, USFWS, letter dated June 12, 2002; Appendix E).

The New England cottontail *(Sylvilagus transitionalis)* is a species for which the USFWS is considering federal listing. The habitat for this species is early successional or shrub-dominated habitats, which include old fields, brushy areas, open woodlands, and recent clear cuts. Although the species has not been directly observed during field work associated with this project, these habitat types are present in the project corridor. Due to the limited understanding of the distribution of this species in the project area, the USFWS recommends that its presence/absence be determined for the study area (M. Bartlett, USFWS, letter dated June 12, 2002; Appendix E). This work will be done prior to the completion of the Final EIS. If the species is found in the study area, further coordination with USFWS will be undertaken.

3.7.2.2 State Threatened and Endangered Wildlife Species

There is only one state-threatened or endangered wildlife species (eastern hognose snake) with a recorded occurrence in the vicinity of the project area (Table 3.7-1).

In addition to the previous NHNHI list of documented occurrences of state-listed species in the study area, the Audubon Society of New Hampshire (Audubon) expressed concern about the following 12 wildlife species that they characterized as having a "high potential of occurrence" in the study area:

- The Pied-billed Grebe (*Podolymbus podiceps*), is a small diving bird, that typically breeds/nests in emergent/open water wetlands of at least 50 acres, and uses lakes, ponds, and rivers. Substantial amounts of emergent wetlands and surface waters exist within and near the study area and may provide habitat for this species. However, NHNHI has not documented this species in the study area.

- The state-listed endangered Upland Sandpiper (*Bartramia longicauda*) has had a nesting population as recently as 1984 at the Manchester Airport. This shorebird nests in wide open habitat such as airports, pastures, and hayfields. However, NHNHI has not documented this species in the study area.

- The Merrimack River within Manchester and Londonderry constitutes a major portion of New Hampshire's primary bald eagle (*Haliaeetus leucocephalus*) wintering area; however, Audubon expressed the opinion that the project would have no impact on bald eagles or their habitat and the USFWS and the NHF&GD have not identified their presence in the project area.

- The Sedge Wren (*Cistithorus platensis*), a small state-listed endangered species, uses emergent marshes and sedge meadows during breeding and migrating seasons. However, NHNHI has not documented this species in the study area.

- Henslow's Sparrow (*Ammodramus henslowii*) is a small, state-listed endangered species that breeds in wet meadows and moist, weedy fields. However, NHNHI has not documented this species in the study area.

- According to Audubon, the Brook Floater (*Alasmidonta varicosa*), a state-listed endangered species of mollusk is known to occur in the Merrimack River in Manchester. However, Audubon assumed the project would have no impact on the species unless it precipitated a siltation event far downstream in the Merrimack River.

- The Common Loon (*Gavia immer*), a state-listed threatened species, is known to nest at Massabesic Lake in Manchester. However, Audubon felt it unlikely that the project would impact this species.

- According to Audubon, the Northern Harrier (*Circus cyaneus*), a large, state-listed threatened species of hawk has been reported from Derry, Londonderry, and Manchester in the past decade. However, the Society felt it unlikely that the project could impact this species which forages over large open fields, pastures, and marshes.

- The Osprey (*Pandion haliaetus*), a large piscivorous raptor (state-listed threatened) is known to forage in the Merrimack River, in ponds of all sizes, and in wetlands with open water in the area during migration. However, Audubon felt it unlikely that the project would impact the species.

- Audubon indicated that downtown Manchester supports one of the state's largest populations of Common Night Hawks (*Chordeiles minor*), a state-listed threatened species which commonly nests on flat graveled roof tops. Again Audubon felt the project would have no impact on this species.

- The Purple Martin (*Progne subis*), a state-listed threatened bird species, typically nests in man-made birdhouses adjacent to extensive open fields and water. Audubon related that sightings were made in Manchester in 1982, but that the project is unlikely to affect this species.

- The Cooper's Hawk (*Accipiter cooperii*) is a small bird-eating hawk that is state-listed as threatened. Sightings have been made of this bird in Manchester (in the last 10 years) and Windham (in the 1970's). The Cooper's Hawk nests in deciduous and mixed forests. These habitats are found within the study area. However, NHNHI has not documented this species in the study area.

3.8 Noise Environment

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3.8.1 Introduction

The New Hampshire Department of Transportation[26] (NHDOT) and Federal Highway Administration[27] (FHWA) noise impact assessment procedures for Type I projects were used to identify receptor locations, to predict existing and future highway noise levels, to determine project noise impacts, and to evaluate noise mitigation measures in the I-93 (Salem to Manchester) improvement project area. A Type I project is a highway project that results in the construction of a new highway or the physical alteration of an existing highway that substantially changes either the horizontal or vertical alignment or increases the number of through travel lanes.

Noise is defined as unwanted or excessive sound. Sound becomes unwanted when it interferes with normal activities such as sleep, work, or recreation. The individual human response to noise is subject to considerable variability since there are many emotional and physical factors that contribute to the differences in reaction to noise.

Sound (noise) is described in terms of loudness, frequency, and duration. Loudness is the sound pressure level measured on a logarithmic scale in units of decibels (dB). For community noise impact assessment, sound level frequency characteristics are based upon human hearing, using an A-weighted (dBA) frequency filter. The A-weighted filter is used because it approximates the way humans hear sound. Table 3.8-1 presents a list of common indoor and outdoor sound levels. The duration characteristics of sound account for the time-varying nature of sound sources.

The most common way to account for the time-varying nature of sound (duration) is through the equivalent sound level measurement, referred to as L_{eq}. The L_{eq} averages the background sound levels with short-term transient sound levels and provides a uniform method for comparing sound levels that vary over time. The time period used for highway noise analysis is typically one hour. The peak hour L_{eq} represents the noisiest hour of the day/night and usually occurs during the peak periods of automobile and truck traffic. The FHWA guidelines and criteria require the use of the one-hour L_{eq} for assessing highway noise impacts on different land uses.

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26 *Policy and Procedural Guidelines for the Assessment and Abatement of Highway Traffic Noise for Type I Highway Projects*, New Hampshire Department of Transportation, July 1996.

27 *Procedures for Abatement of Highway Traffic Noise and Construction Noise*, Federal Highway Administration's Title 23 Code of Federal Regulations, Part 772.

Table 3.8-1
Indoor and Outdoor Sound Levels

Outdoor Sound Levels	Sound Pressure (μPa)		Sound Level (dBA)	Indoor Sound Levels
	3,324,555	-	110	Rock Band at 5 m
Jet Over-Flight at 300 m		-	105	
	2,000,000	-	100	Inside New York Subway Train
Gas Lawn Mower at 1 m		-	95	
	632,456	-	90	Food Blender at 1 m
Diesel Truck at 15 m		-	85	
Noisy Urban Area—Daytime	200,000	-	80	Garbage Disposal at 1 m
		-	75	Shouting at 1 m
Gas Lawn Mower at 30 m	63,246	-	70	Vacuum Cleaner at 3 m
Suburban Commercial Area		-	65	Normal Speech at 1 m
	20,000	-	60	
Quiet Urban Area—Daytime		-	55	Quiet Conversation at 1 m
	6,325	-	50	Dishwasher Next Room
Quiet Urban Area—Nighttime		-	45	
	2,000	-	40	Empty Theater or Library
Quiet Suburb—Nighttime		-	35	
	632	-	30	Quiet Bedroom at Night
Quiet Rural Area—Nighttime		-	25	Empty Concert Hall
Rustling Leaves	200	-	20	
		-	15	Broadcast and Recording Studios
	63	-	10	
		-	5	
Reference Pressure Level	20	-	0	Threshold of Hearing

Source: Highway Noise Fundamentals, Federal Highway Administration, September 1980.
μPA MicroPascals describe pressure. The pressure level is what sound level monitors measure.
DBA A-weighted decibels describe pressure logarithmically with respect to 20 μPa (the reference pressure level).

The following general relationships exist between hourly traffic noise levels and human perception:

- A 1 or 2 dBA increase/decrease is not perceptible to the average person.
- A 3 dBA increase/decrease is a doubling/halving of acoustic energy, but is just barely perceptible to the human ear.
- A 10 dBA increase/decrease is a tenfold increase/decrease in acoustic energy, but is perceived as a doubling/halving in loudness to the average person.

The FHWA has established noise abatement criteria[28] to help protect the public health and welfare from excessive vehicle traffic noise. Traffic noise can adversely affect human activities such as communication. Recognizing that different areas are sensitive to noise in different ways, the FHWA has established Noise Abatement Criteria (NAC) according to land use. The NAC are described in Table 3.8-2. The NHDOT and FHWA consider a receptor location to be impacted by noise when existing or future sound levels approach (within 1 dBA), are at, or exceed the NAC, or when future sound levels exceed existing sound levels by 15 dBA or more. It is generally considered that a 0-5 dBA increase/ decrease represents a slight change in noise levels, a 6-14 dBA increase/decrease represents a moderate change in noise levels, and a 15 dBA or greater increase/decrease represents a substantial change in noise level. The feasibility of noise mitigation is evaluated when noise impacts are identified at receptor locations.

Table 3.8-2
Noise Abatement Criteria (NAC)
One-Hour, A-Weighted Sound Levels in Decibels (dBA)

Activity Category	$L_{eq}(h)$[1]	Description of Activity Category
A	57 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purposes.
B	67 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (Exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	--	Undeveloped lands
E	52 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Source: 23 CFR Part 772 - *Procedures for Abatement of Highway Traffic Noise and Construction Noise.*
1 $L_{eq}(h)$ is a energy-averaged, one-hour, A-weighted sound level in decibels (dBA).

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3.8.2 Methodology

The noise analysis evaluated the highest noise levels in the study area. The highest noise levels were found to occur during the evening peak hour traffic commuting period for receptor locations adjacent to the northbound lanes of I-93 and during the morning peak hour traffic commuting period for receptor locations adjacent to the southbound lanes of I-93. The determination was based upon a review of hourly traffic data and noise monitoring data, which was conducted during peak and

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28 *Procedures for Abatement of Highway Traffic Noise and Construction Noise*, Federal Highway Administration's Title 23 Code of Federal Regulations, Part 772.

off-peak traffic periods along I-93. A noise monitoring program measured existing peak hour sound levels at nineteen receptor locations within the study area to help establish existing sound levels and to calibrate the noise model to the specific roadway locations. The sound levels were calculated using the FHWA's approved Traffic Noise Model (TNM)29. The modeling input data included peak hour traffic volumes, truck mix, vehicle speeds, and roadway and receptor geometry. The existing and future sound level predictions were based on the appropriate receptor peak hour traffic commuting period. The noise analysis calculated the sound levels at receptor locations and compared the results to the NHDOT and FHWA noise impact criteria. Where noise impacts were identified, mitigation measures were evaluated to determine if they were reasonable and feasible.

The study area was evaluated to identify receptor sites that have outdoor activities that might be sensitive to highway noise. In evaluating the I-93 corridor, the study area was subdivided into approximately 30 locations containing receptor sites that are sensitive to highway noise. Within the subdivisions, approximately 1,000 receptor sites were identified along the existing I-93 corridor from Salem to Manchester. Table 3.8-3 presents the receptor locations. The receptor locations, which predominately included outdoor ground level areas between the roadways and the buildings, are shown in Figures 3.8-1 to 3.8-23. Most of the receptor locations (residences) fall into the FHWA's "Activity Category B", which has a noise abatement criterion of 67 dBA. Other land uses, such as commercial buildings, (i.e., those that do not involve temporary overnight residence), are in FHWA "Activity Category C" which has a noise abatement criterion of 72 dBA.

29 *FHWA* Traffic *Noise Model - Version 1.1*, US Department of Transportation, FHWA -PD-96-009, September 2000.

Table 3.8-3
Receptor Locations

Receptor Location Number	Receptor Location	Number of Receptor Sites Represented
Location 1	Hanson Avenue. – Salem	120
Location 2	Valeska Lane. – Salem	50
Location 3	Cross Street. – Salem	35
Location 4	McLarnon Road – Salem	110
Location 5	Woodland Terrace – Salem	25
Location 6	Lowell Road – Salem	70
Location 7	Brookdale Road – Salem	25
Location 8	May Lane Drive – Salem	40
Location 9	South Shore Road – Windham	14
Location 10	Squire Armour Road – Windham	16
Location 11	Wildwood Road – Windham	25
Location 12	NH 111A – Windham	13
Location 13	West Shore Road – Windham	5
Location 13 Center	Between I-93 travel lanes – Windham	2
Location 14 East	Gov. Dinsmore Road – Windham	23
Location 14	Country Road – Windham	27
Location 15	Morrison Road – Windham	16
Location 16	Spinnaker Drive – Derry	45
Location 17	Tracy Drive – Derry	20
Location 18	Fordway Extension – Derry	20
Location 19	Mathew Drive – Derry	80
Location 20	Charleston Avenue – Londonderry	40
Location 21	Reo Lane – Londonderry	5
Location 22	Ash Street – Londonderry	10
Location 23	Trolley Car Lane – Londonderry	35
Location 24	Seasons Lane – Londonderry	22
Location 25	Rockingham Road – Londonderry	27
Location 26	Perkins Road – Londonderry	5
Location 27	Newton's Meadow Way – Manchester	51
Location 28	Bodwell Road – Manchester	40
Location 29	Cohas Avenue – Manchester	35
	Totals	1051

Source: VHB, Inc.

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3.8.3 Existing Conditions

Sound Level Measurements

A sound level program was conducted to obtain a sampling of the existing sound levels in the I-93 corridor and to provide a database for calibrating the noise model. The noise monitoring was conducted at nineteen receptor locations, typically residences, from March

to December of 2001. These noise measurements were collected in conformance with the FHWA noise monitoring guidelines[30]. Traffic data were obtained at the same time as the sound level data. This traffic data included traffic volumes, vehicle mix (automobiles, medium trucks, and heavy trucks), and operating speeds. Noise sources in the study area included vehicles on I-93 and vehicles on local roadways. **Figures 3.8-1 to 3.8-23** presents the location of the noise monitoring sites. Table 3.8-4 presents the results of the noise monitoring program and the predicted results from the TNM. Little to no difference between the monitored results and the predicted results confirms that the Traffic Noise Model has been calibrated properly.

Table 3.8-4
Noise Monitoring Data

Receptor Location Number	Monitoring Site[1]	Monitored[3]	Predicted[3]	Difference[3]
Location 1	Hanson Avenue – Salem	71[2]	72[2]	+1
Location 2	Valeska Lane – Salem	66[2]	64	-2
Location 4	MacGregor Street – Salem	64	63	+1
Location 8	Jewell Drive – Salem	64	64	0
Location 9	South Shore Road – Windham	74[2]	72[2]	-2
Location 11	Wildwood Road – Windham	71[2]	68[2]	-3
Location 12	Locust Road – Windham	66[2]	66[2]	0
Location 12	Armstrong Road – Windham	55	57	+2
Location 14	Jackman Ridge Road - Windham	57	59	+2
Location 16	Spinnaker Drive – Derry	59	60	+1
Location 17	Tracy Drive – Derry	63	63	0
Location 19	Friar Tuck Lane – Derry	60	59	-1
Location 20	Charleston Avenue – Londonderry	68[2]	66[2]	-2
Location 23	Trolley Car Lane - Londonderry	61	62	+1
Location 24	Seasons Lane – Londonderry	65	64	-1
Location 25	Rockingham Road - Londonderry	60	57	-3
Location 27	Newton's Meadow Way - Manchester	71[2]	70[2]	-1
Location 27	Bodwell Road – Manchester	64	62	-2
Location 28	Pahray Lane – Manchester	58	58	0

Source: VHB, Inc.
1 The monitoring sites are depicted in **Figures 3.8-1 to 3.8-23**.
2 The sound level approaches is at or exceeds the FHWA noise abatement criterion.
3 A-Weighted Sound Level in Decibels (dBA)

30 *Measurement of Highway-Related Noise*, US Department of Transportation, Federal Highway Administration, FHWA-PD-96-046, May 1996.

Existing Sound Levels

The existing sound levels for the study area were calculated using the TNM that was calibrated based upon the noise monitoring data. The results presented in Table 3.8-5 represent the highest sound levels in the study area that have been calculated using the existing peak hour traffic data. The study area includes a diversity of building types, such as, residential, commercial, and public buildings. The results of the noise analysis demonstrate that a majority of receptor locations currently experience sound levels that approach, are at, or exceed the NAC.

Table 3.8-5
Existing Sound Levels (dBA)

Receptor Location[1] Number	Receptor Type	Receptor Location	Existing Sound Levels
Location 1	Residential	Hanson Avenue – Salem	61 to 71
Location 2	Residential	Valeska Lane – Salem	56 to 70
Location 3	Residential	Cross Street – Salem	62 to 68
Location 4	Residential	McLarnon Road – Salem	59 to 66
	Commercial	Cross Street – Salem	64 to 68
Location 5	Residential	Woodland Terrace – Salem	58 to 67
	Commercial	S. Policy St / Raymond Ave – Salem	56 to 67
Location 6	Residential	Lowell Road - Salem	60 to 68
	Commercial	Keewaydin Drive – Salem	57 to 66
Location 7	Residential	Brookdale Road – Salem	60 to 70
Location 8	Residential	May Lane Drive – Salem	59 to 67
	Commercial	Manor / Industrial Parkway – Salem	54 to 68
Location 9	Residential	South Shore Road – Windham	66 to 70
Location 10	Residential	Squire Armour Road – Windham	48 to 65
Location 11A	Residential	Wildwood Road – Windham	58 to 68
Location 11B	Residential	Wildwood Road – Windham	58 to 68
Location 12A	Residential	Route 111A – Windham	58 to 66
Location 12B	Residential	Route 111A – Windham	58 to 66
Location 13A	Residential	West Shore Road – Windham	57 to 61
Location 13B	Residential	West Shore Road – Windham	57 to 61
Location 13 Center A	Residential	Between I-93 travel lanes – Windham	55 to 60
Location 13 Center B	Residential	Between I-93 travel lanes – Windham	55 to 60
Location 14 East	Residential	Gov. Dinsmore Road – Windham	54 to 61
Location 14	Residential	Country Road – Windham	58 to 68
Location 15	Residential	Morrison Road – Windham	58 to 66
Location 16	Residential	Spinnaker Drive – Derry	51 to 66
Location 17	Residential	Tracy Drive – Derry	52 to 66
Location 18	Residential	Fordway Extension – Derry	57 to 69
Location 19	Residential	Mathew Drive – Derry	55 to 66
	Commercial	Kendall Pond Road – Derry	60 to 66

Table 3.8-5 (continued)

Receptor Location[1] Number	Receptor Type	Receptor Location	Existing Sound Levels
Location 20	Residential	Charleston Avenue - Londonderry	52 to 66
Location 21	Residential	Reo Lane – Londonderry	58 to 66
	Commercial	Londonderry Road - Londonderry	58 to 66
Location 22	Residential	Ash Street - Londonderry	62 to 66
Location 23	Residential	Trolley Car Lane - Londonderry	59 to 66
Location 24	Residential	Seasons Lane - Londonderry	56 to 70
Location 25	Residential	Rockingham Road - Londonderry	49 to 66
Location 26	Residential	Perkins Road - Londonderry	49 to 62
Location 27	Residential	Newton's Meadow Way - Manchester	54 to 67
Location 28	Residential	Bodwell Road - Manchester	50 to 68
Location 29	Residential	Cohas Avenue - Manchester	50 to 67

Source: VHB, Inc.

[1] See Sound Level Contours presented in **Figures 3.8-1 to 3.8-23.**

3.9 Visual Resources

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3.9.1 Resource Features

The existing I-93 corridor can be treated as a single visual landscape unit due to the relative uniformity of the topography and adjacent land use. The existing highway is bordered for much of its length within the study area by forest growth, with white pine predominant in upland areas and red maple the most common species in wetlands. This dense forested buffer means that few places afford an extended view from the highway. Similarly, there are a few locations where the highway can be observed from a substantial distance.

In several areas (primarily near the interchanges), development is close to the existing roadway, with a limited, if any, buffer of natural vegetation between the land use activity and the highway. These more urbanized visual units feature commercial and retail developments, which serve motorists and local residents, and are of low visual quality.

Potential areas that may be of scenic concern include land between the highway and Canobie Lake in Salem, Cobbetts Pond and Searles Castle in Windham and Crystal Lake in Manchester.

Scenic resources listed in local community master plans and situated close to the highway corridor include the following:

- A section of Brady Avenue in Salem, west of I-93, unofficially considered a scenic route,
- Some "open vista" areas identified in Derry's Master Plan, and
- Woodmont Orchards in Londonderry.

It should be noted that the Brady Avenue designation is not formal and that some of the farmland that was the reason for its scenic character was developed in recent years. Derry's open vista areas have no official designation or protection. Portions of Woodmont Orchards have been sold for development. Table 3-18 contains a listing of all known visual resources in the project corridor.

No scenic easements are known to be associated with the existing highway in the study area.

Table 3.9-1
Visual Resources in the Interstate-93 Project Vicinity

Salem	Brady Avenue scenic road Residential buffers
Windham	Canobie Lake Buffer Cobbetts Pond Buffer Residential buffers Searles Castle
Derry	Open vista to east Open vista to west Residential buffers
Londonderry	Woodmont Orchards Residential buffers
Manchester	Crystal Lake buffer Residential buffers

3.10 Cultural Resources

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3.10.1 Introduction

Preliminary identification of architectural historical, historical, and archaeological resources, collectively known as historic properties under 36 CFR 800, was completed in 1990 through 2002 for the Salem to Manchester I-93 Study Area in the Towns of Salem, Windham, Derry, and Londonderry, and the City of Manchester. The purpose of the investigation is to identify areas of sensitivity that may represent constraints to transportation improvements within the I-93 corridor. The archaeological work was initially conducted in 1990 through 1992 and updated in 2001, and the architectural historical survey was completed in 2001 and 2002. The study includes reconnaissance and intensive level architectural history surveys of individual resources and districts, a Phase IA archaeological reconnaissance-level survey of the entire project area, and supplemental Phase IA and intensive, Phase IB testing of historical and Native American archaeological resources in many of the archaeologically sensitive areas. This report summarizes the results of the archaeological and architectural historical surveys and provides recommendations for further work.

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3.10..2 Regulatory Overview

3.10.2.1 Federal Requirements

Historical properties and archaeological resources that are listed in or are eligible for listing in the National Register of Historic Places are afforded protection by Section 106 of the National Historic Preservation Act (NHPA) and Section 4(f) of the Department of Transportation Act of 1966.

Section 4(f) of the Department of Transportation Act

Section 4(f) of the Department of Transportation Act of 1966 (49USC 3030) states that "…special effort should be made to preserve the natural beauty of the countryside and public park and recreation lands, wildlife and waterfowl refuges and historic sites." Regulations governing 4(f) implementation specify that there can be no taking of public park or recreation lands or impairment of wildlife and waterfowl refuges or historic sites without a thorough investigation into all prudent and feasible alternatives. Such alternatives may range from project modifications to "no-build." If it is determined that no prudent and feasible alternative exists and that public park or recreational lands, wildlife and waterfowl refuges, or historic sites must be acquired or impaired, the FHWA must demonstrate that implementation or other alternatives would result in extraordinary costs, and/or social, economic, or

environmental impacts. In addition, the proposed project or program must include all possible planning to minimize harm to these historical properties and other resources.

National Historic Preservation Act

Congress enacted the National Historic Preservation Act (NHPA), as amended, in 1966 to ensure that the effects of federal, federally funded, or federally permitted projects on historic buildings, neighborhoods, landscapes, and archaeological sites are considered. Through the NHPA, amended in 1976, 1980, and 1992, Congress sought to involve the federal government as an active participant in the Nation's preservation efforts.

Section 106 of the NHPA requires federal agencies to take into account the effects of their activities and programs on any historic district, site, building, structure, or object that is included, or eligible for inclusion, in the National Register of Historic Places. The resources and the effects on those resources are evaluated by the State Historic Preservation Office (SHPO) and the federal agencies having jurisdiction, in this case the Federal Highway Administration (FHWA), the lead agency. In New Hampshire, the SHPO is in the New Hampshire Division of Historical Resources (NHDHR). Prior to the approval of the undertaking, the agency must afford the Advisory Council on Historic Preservation (ACHP), established under Title II of the NHPA, a reasonable opportunity to comment on the undertaking.

The procedures followed in the Section 106 review are referred to as the "Section 106 process" and are set forth in regulations issued by the ACHP. The ACHP's regulations, *Protection of Historic Properties* (36 CFR 800) govern the Section 106 process. The ACHP does not have the authority to halt or terminate projects that will affect historic properties; rather, its regulations emphasize consultation among the responsible federal agencies, the State Historic Preservation Officer (SHPO), and other interested, consulting parties, to identify, evaluate eligibility, determine the potential effect of the project on historic properties, and if possible, to agree upon ways to protect the affected properties.

Public Responsibilities Under Section 106

In addition to the participation of federal and state agencies in the Section 106 review process, the January 2000 regulations at 36 CFR 800 require that the federal agencies consult with the public about the projects and its affects on historic properties. The segment of the public specifically involved in the consultation process under these regulations generally includes immediately affect property owners; local and statewide historical, archaeological, preservation, heritage, and planning organizations; and the Native American community. It is the responsibility of the lead federal agency to provide adequate opportunity for these groups to receive information on the project and share their views. Typically, those individuals and organizations request consulting party status in writing from FHWA, and receive notification of their consulting party status. Consulting parties are notified of public

meetings involving the project and meetings set to specifically discuss historical issues related to the project. Such parties are frequently provided minutes of these meetings. The comments involving historical properties are taken into account during the design stage.

In addition, the information on historical properties developed by state and federal agencies for this project is available to the community, citizens, and local officials, to enact ordinances protecting historic properties. The material can also be incorporated into the community master plan to identify historical resources and preserve them for future enrichment of the community.

3.10.2.2 State Requirements

The New Hampshire Division of Historical Resources (NHDHR) that includes the SHPO office is charged under RSA 227-C:9, Directive for Cooperation in the Protection of Historic Resources, to coordinate the identification and evaluation of cultural resources in the State of New Hampshire.

The New Hampshire Division of Historical Resources, in cooperation with the NH Department of Transportation (NHDOT) and FHWA, has established a method of identification and evaluation to meet the requirements of historic preservation review, a responsibility established under RSA 227-C:9. The purposes of this process are to (1) locate and identify historical, architectural, archaeological, and historical archaeological resources within the project's impact area; (2) apply the criteria for evaluation of significance to a resource to determine possible eligibility to the National Register of Historic Places (National Register), if not already listed or nominated; (3) assess the probable effects of a project on resources listed on or eligible for, the National Register; and (4) develop appropriate mitigation methods to lessen the project' impact on historic properties.

The NHDHR prepared "Procedures for Identifying Cultural Resources That May Be Affected by State or Federal Transportation Projects in New Hampshire" in November 1992. These procedures were partially updated in 2001. This document offers specific guidance for cultural resource survey efforts undertaken as a component of transportation improvement projects.

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3.10.3 Evaluation of Property Significance: The National Register Criteria, Elements of Integrity, and Historic Contexts

Historical, architectural, archaeological, and historical archaeological properties that are usually fifty or more years in age gain significance for the National Register under four National Register criteria, seven elements of integrity, and the associated

historical contexts significant to New Hampshire's historical development. The National Register criteria recognize historic property significance within four areas:

- Criterion A: contribution to the understanding of local, state, and/or national historical trends and events;
- Criterion B: association with historically important individuals;
- Criterion C: representation of architectural styles and building forms and types as well as the work of a master; and
- Criterion D: Native American Pre-Contact or historic data that the property may provide through site investigation.

The seven elements of property integrity, which are not of equal importance in the evaluation of significance for every property, recognize property design, material, workmanship, location, setting, association, and feeling.

The significance of historic properties can be established only when evaluated within its historical context. The National Register guidelines explain that "Historic contexts are those patterns, themes, or trends in history by which a specific occurrence, property, or site is understood and its meaning (and ultimately its significance) within prehistory or history is made clear" (National Park Service n.d.: 7). A historical context has three components: the historical theme, the period during which the theme occurred, and the area to which it applies. The areas under consideration for this study include the five towns within the project area, the towns of Salem, Windham, Derry, and Londonderry, and the City of Manchester as well as the lower Merrimack River Valley along which the towns are located. The period for a given context is generally defined by the period during which it is represented in the area by its associated properties. Each context is represented by a group of property types. For example, such property types as the gristmill and the commercial flourmill represent the theme of flour milling. Significance evaluation of each property often compares the integrity of the subject property with properties within its property type and associated with its historical context. For example, a brick-making site may be evaluated as ineligible for the National Register because other sites associated with the brick-making context within the region and belonging to that property type and period are more intact.

The NHDHR recognizes the following themes that characterize pre-contact and historic Native American archaeological properties within the project area: Native American Indian Lithic Technology, Native American Indian Ceramic Technology, Native American Riverine Adaptation/Exploration, Native American Indian Upland Adaptation, Post-Columbian Native American Contact with Europeans, and Pre-Columbian Native American Cultures for the Native American archaeological sites.

Significant themes for architectural, historical, and historical archaeological properties within the project area include Orchards and Cider Production, 1650-present; Local Scale Dairying Farming, 1800-present; Dairy Farming for Urban Markets, 1880-1940; Market Gardening and Truck Farming in New Hampshire, 1900-present; Mixed Agriculture and the Family Farm, 1630-present; Shoemaking and Outwork/home Manufacture, 1830-1920; Brick Making for Local and Regional Markets, 1650-1920; Granite Quarrying and Stone Cutting, 1790-Present; The Railroads in NH, 1842-1960; Street Railroads in NH, 1880-1950; Pre-Automobile Land Travel, 1630-1920; Automobile Highways and Culture, 1900-present; Water Supply and Distribution in New Hampshire, 1850-present; European and Middle Eastern Immigration to New Hampshire; Commerce, Industry, and Trade in Village and Town Centers, 1630-Present; Suburban/Bedroom Community Growth in New Hampshire, 1850-present; and Summer Home Tourism, 1880-present

Thus, to evaluate National Register eligibility for historic properties, it must possess significance under one or more of the four criteria, represent a significant historical context, and possess integrity in comparison to other properties of its type.

Brief contexts associated with the archaeological, historical archaeological, architectural/historical properties are noted under the discipline headings below.

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3.10.4 Archaeological Resources

Definitions

Archaeological resources include cultural and culturally associated remains below the surface of the ground as well as ruins above it. The later resources may include standing buildings, structures, and objects when these resources are examined primarily for the data they may contain.

Native American archaeological resources are those locations and resources once occupied by Native American or Indian peoples. They both pre- and post-date the initial period of European settlement of the Americas.

For the purposes of this project, historical archaeological resources are those sites and associated resources that usually date to and after the period of initial European contact with Native Americans. They not only include below ground resources and foundations or ruins but also the culturally associated landscapes and standing buildings. The data associated with these sites includes not only the archaeological records but also the written, oral, and pictorial documents. While these resources are examined primarily for the data they may contain, associated standing resources may also gain significance for their architecture.

Method

The locations of known archaeological sites were considered as constraints to the project design in this study. These locations were identified through several Phases of study. The first included a Phase IA, reconnaissance level survey with background research and visual inspection to define areas of archaeological site sensitivity. Such areas are those that are likely to contain archaeological resources, but evidence of archaeological deposits has not necessarily been documented. **Figure 3.10-1** shows the archaeological constraints to the project. (See Section 3.10.3.3 for a more detailed discussion of phases in archaeological investigations.)

Bunker, Potter, and Green (1990) performed the reconnaissance survey of the project corridor in 1989-1990. A documentary review of the state-wide archaeological site files of the Division of Historical Resources and the NH Archaeological Society, published and unpublished site reports, local and regional histories, historic maps, the National Register of Historic Places, and early USGS maps; interviews with local historians, and study of local archaeological collections; review of the environmental characteristics of the survey area using recent topographical maps and soil surveys; and a combined walk-over and windshield visual inspection of the project area established expectations for the type and location of archaeological resources for both Native American and historical archaeological sites (Bunker, Potter, and Green 1990: 3-4).

From this reconnaissance study, archaeological sensitivity areas were selected and mapped for more intensive documentary and field investigations. Native American sites were expected along major and minor water courses including Cohas, Policy, Beaver, Porcupine, and Harris brooks, along the margins of lakes or ponds including Canobie Lake and Cobbetts Pond, along the margins of wetlands, and in a several types of upland settings. Preferred, Native American site locations were expected to coincide with level, well-drained, terraces near surface water features in upland locations. Locations with stony or poorly drained soil associations and steep slopes and irregular terrain were not likely to be archaeologically sensitive for Native American sites. Locations of Native American archaeological sensitivity selected within the I-93 median included the banks of the Porcupine, Golden, and Beaver brooks and a large interior wetland of the Canobie Lake drainage. In addition to those selected on the basis of their natural setting, sensitive areas also included locations with previously recorded sites. For the upland areas on minor streams and wetlands, small, special activity or seasonal Native American sites of any period were anticipated. In addition, sites along the Cohas drainage were expected to exhibit evidence of multiple habitations and to include a diversity of tools and materials in their artifact assemblages. Sites might range in size between 5 square meters and 100 square meters. Although they may occur in any period, those with a Late Archaic temporal affiliation dating between ca. 6000 and 3000 before the present (B.P.) appeared most likely.

Expectations for the type and setting of historical archaeological resources were also developed during this 1990 reconnaissance survey. Documents analyzed for this portion of the study included local and regional histories, historic maps, and the NHDHR site files and inventory of historic properties. On the basis of this research, the following site types were anticipated: abandoned travel routes such as rail beds and road corridors, remains of dwellings and farmsteads, isolated dumps, mill remains, and the remains of other local industries and craft locations (Potter and Bunker 1991: 5-8).

Potter and Bunker completed the intensive, Phase IB archaeological study of twenty archaeologically sensitive locations within the median of the project corridor in 1991 (Potter and Bunker 1991). The intensive survey of these sensitivity areas included additional pedestrian inspection and continued map research to understand the local topography and soils as well as the level of disturbance from previous highway construction. This review eliminated one location and reduced testing in others. A sampling strategy was devised for each sampling area. Multiple transects were generally placed along the margins of natural features, following natural brook courses, wetland boundaries, and terrace edges. Tests were placed at 8-meter intervals along each transect. Measuring 50 X 50 cm, all shovel tests were excavated by hand to culturally sterile subsoil. Soils were screened through one-quarter inch wire screening. Notations about soil color, soil texture, artifact content, disturbances, anomalies, and natural features were made on standard forms. Scaled field sketches depicted the location of the testing and natural and cultural features. Artifacts were processed and deposited at the NHDHR. The locations of historical archaeological sites were examined through pedestrian survey. Intensive, Phase IB subsurface testing occurred only at the Dickey Road Brickyard site (27 Hb 18) along Cohas Brook. Instead, data were gathered from documentary sources and surface inspection to determine the age, size, function, and character of the resources. Site inventory forms were completed and Smithsonian site numbers were assigned for each identified Native American and historical archaeological site.

In 1992, the Public Archaeology Laboratory (PAL) conducted supplemental testing at 42 Native American archaeologically sensitive areas that were identified by Bunker, Potter, and Green in 1990 areas along the shoulders of the I-93 corridor (see Tables 3.10-2 and 3.10-3). A field scatter of historic cultural materials was gathered in eight of these areas, and three aboveground, historic features were identified. PAL conducted a walk-over of each of the sensitivity areas along the shoulders to determine the testing method, utilizing one of three survey methods. Ten sensitivity areas were eliminated from further investigation at this stage because of disturbance.

The survey methods for the remaining 32 sensitivity areas included: 1. a survey at 10-meter intervals across one or more transects in small testing areas; 2. the excavation of an array of 13 shovel tests in a staggered grid pattern in 30-meter by 30-meter blocks, or 3. the judgmental placement of units. All units measured 50 cm by 50 cm and were excavated to sterile soil. Screening occurred through a one-quarter inch wire mesh. Investigated areas were mapped and recorded. However, historical

archaeological sites did not receive subsurface investigation. The final report for this study was completed in 2001 (PAL 2001: 6-16).

Because the historical archaeological sites and aboveground remains were treated somewhat differently during the archaeological surveys, a summary of project approach specific to these sites is noted. The potential for the project area to contain historical archaeological sites was examined in several phases of the study. The reconnaissance, Phase IA study in 1990 by Bunker, Potter, and Green identified locations sensitive for these sites both in the median and along the shoulders of the project area. Their study included pedestrian surface inspection for depressions, aboveground artifact deposits, and building remains as well as the examination of historic maps and secondary sources that might suggest past site locations. Although the reconnaissance study identified other historical archaeological sites in the median (Table 3.10-1), Potter and Bunker conducted Phase IB or intensive testing only at the Dickey Road Brickyard Site (Tables 3.10-2 and 3.10-3). The supplemental testing conducted by the PAL in 1992 examined only the historical archaeological sites located within the archaeologically sensitive areas identified by Bunker, Potter, and Green's 1990 reconnaissance survey. The 1991 reconnaissance study generated a list of 57 historical structures, ruins, and depressions along the shoulders and in the median that require Phase IB study (Table 3.10-4). The quarry site, Taylor Grist Mill site, building foundations and cellar holes, collapsed structures, stonewall enclosures, and dumps may potentially be historical archaeological sites.

The locations of the park and ride lot facilities were not determined until late in the early phases of the study and were consequently not reviewed as part of the initial reconnaissance level survey by Bunker, Potter, and Green (1990) or as part of the supplemental Phase IA survey by Public Archaeology Laboratory in 1992/2001. In 2001, PAL performed a Phase IA archaeological study of the Exits 2, 3, and 4 and options 1 and 2 of the Exit 5 Park and Ride. Park and rides received only surface inspection and a document review including the statewide site survey files maintained by NHDHR and no subsurface testing (PAL 2001: 141).

Following a public hearing and the identification of a Selected Alternative, the extent of project impacts will be further identified, necessitating additional archaeological testing of resources in the area for the selected alternative to evaluate site significance and complete mitigation. Subsequently, the method to be followed is as described in the archaeological resources conclusions (section 3.10.3.3).

3.10.4.1 Native American Archaeological Resources

Contexts

The Study Area is situated within the upper Merrimack River drainage. Investigations along the drainage have identified Native American sites ranging in

age from the Early Archaic (10,000-7500 B.P.) to the Late Woodland (1000-450 B.P.) period. Completed investigations in the project area located Middle (7500-5000 B.P.), Late (5000-3000 B.P.), and Transitional Archaic (3600-2500 B.P.) sites located along the terraces of Cohas Brook, along small, unnamed streams, and adjacent to Canobie Lake and Cobbetts Pond; and a small wetland. The Woodland period (3000-450 B.P.) was also weakly represented along Cohas Brook. Investigations to date have not recognized occupations in the Paleo-Indian (12,500-10,000 B.P.), Early Archaic (10,000-7500 B.P.), and the contact period between Native Americans and Europeans dating after 450 B.P. To date, most of the identified remains are located along Cohas Brook where a dense pre-contact, Native American occupation is identified. The function or use of many of these remains has yet to be determined. Identified functions include a possible fishing station, short-term campsite, and tool reduction workshop.

As evidenced by the five sites located during the investigations for this project as well as three of the six sites identified by the PAL investigations, the Cohas Brook area appears to be a favored setting during the pre-contact period. Cohas Brook is a prominent waterway that joins the Merrimack River and Lake Massabesic. Its setting would have been favorable for pre-contact use and settlement with its high banks, well-drained sandy soils, and level terrace surfaces. The diversity of associated microenvironments would have assured multiple resources through all seasons. The locale offered the lacustrine environment of Lake Massabesic, the riverine environment of the Merrimack River, stable wetlands, a perennial stream, and a protected interior setting along Cohas Brook. Quartz sizable enough for tool manufacture may have been locally available in veins or outcrops near Lake Massabesic. Historically speaking, this area was well known for its anadromous fish, and this resource may have been available during the pre-contact period.

The occupations along the Cohas Brook drainage span a long time period. Its Middle and Late Archaic components are well represented. The Dickey Plain Site is prominent among these sites and has yielded a large artifact collection for these two time periods as well as a limited collection for the Woodland period. A diversity of tool types, including a cache of large blades, are found in this collection and a number of volcanic stone materials can be visually distinguished. The site is situated on the west bank of the Cohas Brook near the confluence of other water resources that includes wetlands. This setting ensures access to multiple resources and may have served as a congregating place (Potter and Bunker 1991: 65-67).

The sites investigated in the I-93 median during the Phase IB testing by Potter and Bunker (1991) share a number of traits that firmly place them within the expected range of variation for the area adjacent to Cohas Brook in the northern end of the project area. They are all located on sandy, well-drained soils and have intact stratigraphy affected only by plowing. The distance from water extends up to 500 feet, but sites are set on the sandy soils closest to surface water. The sites overlook either Cohas Brook itself or wetlands that drain the brook system. Similar tool materials were discovered at all the sites. A distinctive reddish-brown volcanic stone

was discovered at the Dickey Plain site extension (27 Hb 216) that resembles the material used to manufacture the cache of blades found in the Marshall Collection. Several of the sites may be dated to the Middle to Late Archaic in the region. This tool material diversity is interpreted as an increasing dynamism that intensified through the Late Archaic as local populations grew and long distance contacts expanded.

Each of the five sites discovered in the 1990-91 have the ability to provide pertinent data for addressing research topics in the Cohas Brook and Merrimack Valley. The sites offer well-preserved archaeological contexts that will facilitate data collection and interpretation. Information may be collected on Late Archaic trade, exchange, or communication within and beyond the area. Information may also be gathered on the specific nature of settlement along Cohas Brook. The relationship of site size and density as indicators of settlement duration, seasonality, population size, and distance of occupation areas from the main stream or large wetlands may be explored. The role of the individual sites as satellites or extensions of larger sites may be addressed. Artifact variation and tool material selection may be studied as keys to understanding the dynamics of the Late Archaic period.

Thus, if impact cannot be avoided, continued archaeological investigation of the Native American sites along Cohas Brook is recommended. The ability of Native American sites along Cohas Brook to produce data on the noted topics as well as determine their continued integrity since the 1990-1991 work would require investigation in a Phase II determination of eligibility study.

Based on the limited testing by the PAL 1992/2001 study, two sites along the shoulders that are also in the Cohas Brook area at the north end of the project area appear to be associated with the Middle Archaic (Table 3.10-2). Testing at Site 27 Hb 219 recovered a high density of cultural material from thirteen test units. These materials included quartz, felsite, rhyolite, and hornfels flakes and a single felsite Neville biface. However, testing has not yet identified associated cultural features. This site may be affiliated with the Dickey Plain Site (27-Hb-199). Testing of site 27-Hb-220 located cultural material including felsite, quartz, rhyolite, hornfels, and jasper flakes and one quartz, Middle Archaic Neville biface.

Four additional areas along the shoulder tested by PAL contained Native American cultural materials (27 Rk 331, 27 Rk 333, 27 Rk 336, and 27 Hb 218). They appear to represent small loci of activity and contain varying quantities of lithic debitage. The fourth, a small site (27 Hb 218) includes two quartz flakes and one quartz biface in one test unit. The cultural affiliation of these four sites was not be identified. Because these four sites recommended by PAL for further study along the shoulders (Table 3.10-2) of the project area received less intensive investigations during the supplemental Phase IA testing, an understanding of their vertical and horizontal extent, period of occupation and cultural affiliation, function, and significance is less well developed (Public Archaeology Laboratory 2001). Further, more intensive testing of these sites is recommended.

Identified Properties

A brief summary of the sites identified in the median by Potter and Bunker (1991) for further testing follows (see Table 3.10-1).

Dickey Plain Site Extension (II) (27 Hb 216) is located in Manchester on a small terrace within the highway median strip between Interstates 93 and 293. The site yielded a high density of artifacts including hornfels, quartz, quartzite, chert, and volcanic stone flakes, biface fragments, edge tool fragments, cores, utilized cobbles, and bifaces diagnostic of the Late Archaic (Small Stemmed) and Transitional Archaic (Atlantic) periods were recovered. Some evidence of a large tool workshop was present.

Dickey Plain Site Extension (III) (270 Hb 20) occurs on a flat terrace on the north bank of Cohas Brook in Manchester. A total of 65 quartz, volcanic, hornfels, and quartzite flakes; one biface base; one core; one edge tool fragment; and one biface fragment were found. A Carbon-14 (C-14) date within Late Archaic Period was recovered from the site. Because of the types of artifacts found and the location of the site in close proximity to Cohas Brook, the Dickey Plain III Site may have functioned as a fishing station.

Hayward Site (27 Hb 15) is located in Manchester in the vicinity of a small wetland. A quartz Squibnocket biface datable to the Late Archaic Period, a quartz biface base, one volcanic biface midsection, one volcanic flake, and one hornfels flake were recovered. On the basis of these finds, the Hayward Site was probably a short-term campsite.

Owens Site (27 Hb 16) located on a terrace of a wetland pond developed from a minor tributary of Cohas Brook in Manchester. The site included two quartz cores, three volcanic flakes, two quartz flakes, and one quartzite flake. No diagnostic tools or features were found and therefore no specific site age was identified.

Lovering Site (27 Hb 17) is located on a terrace of Cohas Brook near a minor tributary confluence in Manchester. The site contained three small, discrete loci of flaking debris. A total of 26 quartz and volcanic flakes and fire-altered rock and a possible hearth feature were located. Although no diagnostic artifacts were found, the lithic materials recovered at the site correspond to other Late Archaic sites within the Merrimack River drainage. Other cultural periods may be represented.

The study undertaken by the Public Archaeology Laboratory identified the following additional Native American sites along the shoulders of I-93 (see Table 3.10-2).

Site 27 Rk 331 is located in Windham. A small locus of activity, the site measures approximately 100 ft x 200 ft in size, and is situated on a gently sloping terrace. A total of two quartz and three felsite flakes were recovered from the site. However, no diagnostic tools or features were found to adequately date the site.

Site 27 Rk 333 is situated on a low-lying terrace adjacent to a re-routed stream in Windham. A total of 88 pieces of quartz chipping debris was recovered within this site. Flake types found include 86 unmodified flakes, one utilized flake, and one shatter. The high concentration of lithic debris from such a small area in two adjacent 50 x 50 cm test pits suggests a possible tool reduction workshop. Without diagnostic cultural materials or materials from which radiocarbon dates could be derived, the site is not datable.

Site 27 Rk 336 is located in Windham on a sloping terrace north of a small stream. The site appears to represent a small locus of activity. However, temporally diagnostic artifacts or features were found. A total of five quartz and two felsite flakes were recovered.

Site 27 Hb 218 is located west of Cohas Brook in Manchester. Lithic materials recovered from the site include one quartz biface tool fragment and two quartz flakes. The site is considered a small "find spot" since additional testing around the area failed to recover additional cultural material.

Site 27 Hb 219 is situated adjacent to a small stream in the vicinity of Cohas Brook in Manchester. About fifty fragments of chipping debris were recovered from thirteen units at the site. Lithic materials include quartz, hornfels, felsite, and rhyolite flakes. In addition to the chipping debris, one felsite Neville biface was found. On the basis of the diagnostic Neville point, this site can be dated to the Middle Archaic Period (7500-5000 B.P.). No features were present.

Site 27 Hb 220 is located east of a stream near Cohas Brook in Manchester. Eight test units yielded quartz, felsite, hornfels, jasper, and rhyolite flakes. The presence of a quartz Neville biface associates this site with the Middle Archaic Period.

The Phase IA study by Bunker, Potter, and Green had identified areas of Native American archaeological sensitivity along the corridor. Table 3.10-3 lists by sensitivity area number those areas that require further, Phase IB testing. Although the supplemental testing conducted to date produced neither Native American or historical archaeological resources, the testing interval was not sufficiently close to identify the spatially small sites typical of the area.

The project includes the design of park and ride lots at Exits 2, 3, and 5 with Options 1 and 2. The location of the park and ride lots was not determined until late in the preliminary design process. PAL conducted a Phase IA in 2001 to determine the level of archaeological sensitivity at these locations. The literature search failed to locate identified Native American sites within the proposed park and ride lots. Because of the level of disturbance and steep slopes within the proposed areas, PAL concluded that all of the proposed locations for the park and ride lot options except Option 2 for Exit 5 possess low archaeological sensitivity. Because of its location adjacent to wetlands and an intermediate stream, a moderate archaeological

sensitivity was assigned to Option 2 at Exit 5. The report recommended further, Phase IB intensive survey of a portion of the park and ride lot and the access road if this option is developed (PAL 2001: 141-55). Depending on the final design of the park and ride lots, some additional follow-up investigations may be necessary at other locations.

3.10.4.2 Historic Archaeological Resources

Contexts and Site Significance in Historical Archaeology

The significance of historical archaeological sites is determined by weighing a number of considerations. These considerations include the data that excavation of the site can provide to an understanding of the cultural development of the immediate property as well as the context or contexts with which it is associated; the integrity of the site; the spatial, functional, and decorative integrity and perhaps the number of the historically associated buildings, structures, and other landscape features remaining at the site; comparison with other, similar sites associated with the context/contexts and contain a similar the type of data; and, often, the extent of data that resources such as oral tradition, written materials, maps, and other pictorial sources may provide.

In any given project area, historical archaeological resources and architectural historical resources often gain significance under similar historical contexts. However, along the Salem-Manchester project area, many of the contexts associated with the early communities of the area are represented only in the historical archaeological context. Those contexts established by the NHDHR for which the historical archaeological sites may gain significance include: Brick Making for Local and Regional Markets, 1650-1920; Wood Products Mills and Shops in New Hampshire; Early Exploration and Settlement in the interior of New Hampshire, 1623-1770; Granite Quarrying and Stone Cutting, 1790-present; and Grain Farming and Grist Milling, 1650-Present. These contexts are briefly noted with their associated historical archaeological sites below. The Architectural History Section (see Section 3.10.4) provides a brief description of the Mixed Agriculture and the Family Farm, 1630-present that is also a significant context for many of the sites that appear to be associated with a farmstead. The specific thematic associations of many of the historical archaeological sites still require determination.

Identified Properties and Associated Contexts

A brief discussion of the potentially significant historical archaeological sites located by the three archaeological studies follows. A complete list may be found in Tables 3.10-1 through 3.10-4 and their locations are noted in **Figure 3.10-1**.

Table 3.10-1
Potentially significant archaeological sites identified within the Median of the I-93 during Phase 1B Testing by Bunker, Potter, and Green (1990)

Site No.	Name	Town	Description	Recommendations
27 Hb 17	Lovering	Manchester	Possible Late Archaic site with 3 discrete activity areas. Possible hearth feature.	Phase II Evaluation if avoidance is not possible.
27 Hb 216	Dickey Plain Site Extension	Manchester	Large site (3500 m2) located on terrace containing late Archaic.	Phase II Evaluation if avoidance is not possible.
27 Hb 20	Dickey Plain Site Extension	Manchester	Marginal part of site, close proximity to 27 Hb 216.	Phase II Evaluation if avoidance is not possible.
27 Hb 16	Owens Site	Manchester	Small site, no diagnostic materials. Includes historical archaeological site denoted as the Finn House.	Phase II Evaluation if avoidance is not possible.
27 Hb 15	Hayward Site	Manchester	Small discrete locus of cultural material including stone tools. Site dates to Late Archaic based on presence of Squibnocket projectile point.	Phase II Evaluation if avoidance is not possible.
27 Hb 18	Dickey Road Brickyard Site	Manchester	Small, family operated brickyard dating to the mid-1800s. Portions of brickyard may have been destroyed during highway construction.	Phase II Evaluation if avoidance is not possible.
27 Hb 19	Corning Mill Site	Manchester	Mill site on Cohas Brook including breached and fragmentary milldam.	Phase II Evaluation if avoidance is not possible.
27 Rk 8	County Rd. Dugout Site I	Windham	Cellar hole with partially collapsed wall and collapsed chimney base.	Phase II Evaluation if avoidance is not possible.
27 Rk 9	County Rd. Dugout Site II	Windham	Similar to 27 Rk 8. Part of multiple resource County Road complex.	Phase II Evaluation if avoidance is not possible.
27 Rk 7	John Dinsmore Site	Windham	Foundation remains of a house, rectangular depression of outbuilding, and well. Other features include stone cellar stairway, possible cistern, granite doorsteps, and large stone chimney. Part of the multiple resource County Road complex.	Phase II Evaluation if avoidance is not possible.
27 Rk 316	Barlow Site	Windham	Found through an interview with the landowner, the site contained small quartz points and a steatite pip.	Complete Phases I and II if avoidance is not possible.

Table 3.10-2
Archaeological sensitivity areas along the I-93 shoulders receiving supplemental Phase 1A testing by Public Archaeology Laboratory in 1992 and partially updated in 1998 and 2001 and requiring further investigations at the Phase 1B level.

Site No.	Name/Type	Town	Description	Recommendations
27 Rk 327	Historic Dump	Salem	Twentieth century deposits containing plastic, glass, slag evident.	Archival Research and close interval testing if avoidance is not possible.
27 Rk 328	Historic Dump	Salem	Small fragments of ceramic with red bodied coarse and earthenware, a machine-cut nail, and calcined bone.	Archival Research and close interval testing if avoidance is not possible.
27 Rk 329	Historic Dump	Salem	Twentieth century deposit including aluminum and molded glass.	Archival Research and close interval testing if avoidance is not possible.
27 Rk 330	Historic Dump	Salem	Iron and glass.	Archival Research and close interval testing if avoidance is not possible.
27 Rk 331	Native American	Windham	Small locus of activity with five fragments of lithic debitage recovered from four test units. No evidence of features.	Additional testing if avoidance is not possible.
27 Rk 332	Historic Stone-lined Well	Windham	Isolated stone-lined well with no historic cultural material recovered during subsurface testing. A limited review of historic maps did not provide identification of the property.	Archival Research and close interval testing if avoidance is not possible.
27 Rk 333	Native American	Windham	Small locus of activity with a total of 88 fragments of lithic debitage recovered from two test units. A 22 x 52 m area was tested with 22 test units using a combination of block and array testing.	Additional Phase II testing if avoidance is not possible.
27 Rk 334	Historic Stone Bldg. Foundation	Windham	North wall and portions of east and west walls visible. No historic material recovered during subsurface testing. Initial review of historic maps did not provide identification of the property.	Archival Research and close interval testing if avoidance is not possible.
27 Rk 335	Historic Stone Dam	Windham	Stone dam associated with small pond. No historic material was recovered during subsurface testing. Initial review of historic maps did not provide an identification of the property.	Archival Research and close interval testing if avoidance is not possible.
27 Rk 336	Native American	Windham	Small locus of activity with a total of seven fragments of lithic debitage recovered from four test units. No evidence of features.	Additional testing if avoidance is not possible.
27 Rk 337	Historic Dump Site	Windham	Site contained glass, iron, brick, whiteware, creamware, earthenware, red-bodied ware, pearlware, and porcelain. No evidence of structural building remains with initial testing.	Archival Research and close interval testing if avoidance is not possible.

Table 3.10-2 (continued)

Site No.	Name/Type	Town	Description	Recommendations
27 Rk 343	Indian Rock	Windham	A large stone commemorative marker with plaque reputedly used to ground corn.	Found not to be archaeologically sensitive by V. Bunker (May 2002). Site is eligible as a historic site (see section 3.10.4.3).
27 Hb 218	Native American	Manchester	Small locus of activity with two quartz flakes and one quartz biface recovered from a single test unit.	Additional testing if avoidance is not possible.
27 Hb 221	Historic Dump Site	Manchester	Site contained molded and unmolded glass, whiteware, yellowware, stoneware and iron. No evidence of structural building remains with initial testing.	Archival Research and close interval testing if avoidance is not possible.
27 Hb 219	Native American	Manchester	High density of cultural material recovered from 13 units. Materials include quartz, felsite, rhyollite, hornfels flakes, and felsite Neville biface. No evidence of features. Middle Archaic Period based on Neville Point. Possibly part of the Dickey Plain Site (27-Hb-199).	Additional testing if avoidance is not possible.
27 Hb 222	Historic Dump Site	Manchester	One fragment of iron. Initial review of historic maps failed to identify the property owner.	Archival Research and close interval testing if avoidance is not possible.
27 Hb 220	Native American	Manchester	Cultural material recovered within eight test units including felsite, quartz, rhyollite, hornfels, and jasper flakes. One Middle Archaic, quartz Neville biface recovered. Middle Archaic Period based on Neville Point.	Additional testing if avoidance is not possible.
27 Hb 26	Historic Dump Site	Manchester	Site contained porcelain, glass, iron, buff-bodied coarse ware, whiteware, and brick.	Archival Research and close interval testing if avoidance is not possible.

Table 3.10-3
Archaeological sensitivity areas along the shoulders of the I-93 Project Corridor that were initially identified by Bunker, Potter, and Green (1990) in the Phase 1A and received supplemental, Phase 1A testing by Public Archaeology Laboratory in 1992 and partially updated in 1998/2001

Location No.	Town	Description	Recommendations
NA 1-7-3	Salem	A 15x30 meter area was tested as a block with 7 test units. No archaeological remains located to date.	*Further Phase 1B testing to bring the interval to 8 meters required.
NA 2-10-7	Salem	A 45x45 meter area was tested with 4 test units that were judgmentally placed. No archaeological remains located to date.	*Further Phase 1B testing to bring the interval to 8 meters required.
NA 2-10-8	Salem	A 15x30 meter area was tested with 6 test units along transects. No archaeological remains located to date.	*Further Phase 1B testing to bring the interval to 8 meters required.
NA 2-15-13	Salem	A 22x30 meter area was tested as a block with 11 test units. No archaeological remains located to date.	*Further Phase 1B testing to bring the interval to 8 meters required.
NA 3-18-14	Salem	A 22x37 meter area was tested as a block with 23 test units. No archaeological remains located to date.	*Further Phase 1B testing to bring the interval to 8 meters required.
NA 3-24-20	Salem	An area containing a single historic artifact was tested with 10 units along a transect.	*Further Phase 1B testing to bring the interval to 8 meters required. If further historic artifacts emerge, property-specific historical research will be required.
NA 3-25-21	Windham	A 30x60 meter area was tested with 42 test units using a combination of block, transect, and array testing. Four Native American artifacts were located.	**Further Phase II testing required.
H 3-30-24	Windham	A 37x45 meter area was examined without subsurface archaeological testing. The area contained a disturbed, rubble stone foundation. No artifact deposits were identified to date.	*Phase 1B testing using 8 meter intervals and judgmental testing required to determine if Native American and/or historic subsurface deposits exist. Mapping, photography, and description of foundation and property-specific historical research required.
NA 4-45-30B	Windham	A 37x37 meter area was tested with 5 test units in a block. No Native American artifacts were identified to date.	*Further Phase 1B testing to bring the interval to 8 meters required.
H 4-47-33	Windham	A 15x15 meter area was examined by placed 4 test units along transects. A historic stone dam was present. No artifact deposits were located to date.	*Phase 1B testing using 8 meter intervals and judgmental testing required to determine if Native American and/or historic subsurface deposits exist. Mapping, photography, and description of stone dam and property-specific historical research required.
NA 4-54-40	Derry	An area was tested with 11 units using the block method. No archaeological deposits were located to date.	*The area of sensitivity defined in Phase 1A should be tested at the Phase 1B level at 8-meter intervals.

Table 3.10-3 (continued)

Location No.	Town	Description	Recommendations
NA 4-57-41	Derry	A 22x30 meter area was tested with 13 test units using the block method. No archaeological deposits were located to date.	*Further Phase 1B testing to bring the interval to 8 meters required.
NA 4-59-45	Londonderry	A 37x90 meter area was tested with 8 test units along transects. No archaeological deposits were located to date.	*Further Phase 1B testing to bring the interval to 8 meters required.
NA 4-62-46	Londonderry	An area was tested with 13 test units using the block method. No archaeological deposits were located to date.	*The area of sensitivity defined in Phase 1A should be tested at the Phase 1B level at 8-meter intervals.
NA 5-67-47	Londonderry	A 15x22 meter area was tested with 4 test units along transects. No archaeological deposits were located.	*Further Phase 1B testing to bring the interval to 8 meters required.
NA 5-71-49	Londonderry	A 15x15 meter area was tested with 14 test units along transects. No archaeological deposits were located to date.	*Further Phase 1B testing to bring the interval to 8 meters required.
NA 5-71-50	Londonderry	A 15x22 meter area was tested with 4 test units along transects. No archaeological deposits were located to date.	*Further Phase 1B testing to bring the interval to 8 meters required.
NA 6-79-56	Londonderry	A 15x105 meter area was tested with 10 test units along transects. No archaeological deposits were located to date.	*Further Phase 1B testing to bring the interval to 8 meters required.
NA 6-79-57	Londonderry	A 15x37 meter area was tested with 6 test units along transects. No archaeological deposits were located to date.	*Further Phase 1B testing to bring the interval to 8 meters required.
NA 6-92-82	Manchester	A 45x45 meter area was tested with 4 judgmental test units. No archaeological deposits were located to date.	*Further Phase 1B testing to bring the interval to 8 meters required.
H 6-92-83	Manchester	A 22x30 meter area was tested with 20 test units using a combination of block and transect methods. One historic artifact was located to date.	*Further Phase 1B testing to bring the interval to 8 meters required. If additional historic artifacts are located, property specific research is required.
NA 6-94-89	Manchester	A 45x105 meter area was tested with 19 test units using a combination of the block and transect method. No archaeological deposits were identified to date.	*Further Phase 1B testing to bring the interval to 8 meters required.
NA 6-96-91	Manchester	The 15x75 meter sensitive area was not tested.	*Phase IB testing is required.

* For the completion of the Phase IB, the entire area does not need to be re-examined at 8m intervals, but tests should be added at 8 meter intervals to shorten the interval in sensitive areas and extend the testing areas where microtopography warrants.

** For the Phase II testing, test at 4m intervals, taking into account PAL's testing in arrays at 5m. Other testing approaches may be used, for example trenches, where warranted.

Table 3.10-4
Historic architectural remains identified by Bunker, Potter and Green (1990) in the shoulders and median of the I-93 Corridor and renumbered by Public Archaeology Laboratory in the 1998/2001 report.

Location No.	Type	Location/Town	Description	Recommendations for Phase 1B/II Study if Impacted
H 2-13/15-5	Transp.	N. of Main St./ Salem	Trolley bed remains	Identify trolley line, period of service, and use; map; photograph; and describe.
H 2-13-6	Transp.	E of I-93/Salem	Stone Bridge Abutments	Identify bridge's relationship to the roadway, period of service, and use; map; photograph; and describe.
H 2-14-7	Ind	E of I-93/Salem	Quarry Site	Identify owner, period of use, and use of quarry; map, photograph, and describe.
H 2-17-11	Ind	E of I-93/Salem	Taylor Grist Mill Site	Conduct Phase 1B testing including historical research, mapping and photography of surface remains description, and shovel testing at 8 m intervals.
H 3-28/29-13	Transp.	Median/Windham	Old Road Bed (I-93 crossover)	Identify roadway, period of use, and extent of route; place on map; photograph; and describe.
H3-31-17	Agri	Rte 11A, W of I-93/ Windham	Barn Foundation that may be located on the Dinsmoor property (site 27-Rk-7)	Phase II evaluation including close interval testing of all foundation remains and additional historical research as need to interpret site remains (see Table 1)
H3-32-21	Transp.	E and W of I-93/ Windham	Old Rte. 111A Road Bed	Identify roadway, period of use, and extent of route; place on map; photograph; and describe.
H 3-33-25	Res/Agri	E of I-93/Windham	Collapsed structure and barn foundation	Conduct Phase 1B testing including historical research mapping and photography of surface remains description, and shovel testing at 8 m intervals.
H 4-35/36-26	Landscaping	E of I-93/Windham	Searles Estate stone wall at Searles School	Map, photograph, and describe the affected wall and associate it with the larger National Register eligible area.
H 4-38-27	Res/Agri	County & Indian Rock Rd./ Windham	2 foundations associated with Robert/John Howard Dinsmoor dating to ca. 1780/1877	Conduct Phase 1B testing including historical research, mapping and photography of surface remains, description, and shovel testing at 8 m intervals.
H 4-38/40/ 47-28	Transp.	Weave E and W of I-93/ Old County Road/ Windham	Old County Road Bed	Identify roadway, period of use, and extent of route; place on map; photograph; and describe. Testing by trenching across the road to determine construction may be necessary (see 4-38-29).
H 4-38-29	Transp.	Old County Road, W of I-93/ Windham	Stone Bridge Abutments	Identify roadway, period of use, and extent of route; place on map; photograph; and describe (see 4-38/40/47-28).
H 4-42-30	Res/Agri	E of I-93/Windham	Carriage House Foundation associated with a Dinsmoor property. Now on Brentwood Estate.	Conduct Phase 1B testing including historical research, mapping and photography of surface remains, description, and shovel testing at 8 m intervals.

Table 3.10-4 (Continued)

Location No.	Type	Location/Town	Description	Recommendations for Phase 1B/II Study if Impacted
H 4-43-31	Ind	E of I-93/ Windham	Stone dump	Map, photograph, and describe remains. Attempt to identify source of stones through historical research and examination of surrounding ground surface. Some shovel testing may be necessary.
H 4-48/50-33	Transp.	E and W of I-93/ Windham	Old Roadway	Identify roadway, period of use, and extent of route; map; photograph; and describe
H 4-52/54-35	Transp.	W of I-93/Windham & Salem	Abandoned Rail Bed along the B & M line. Extant by the mid-1800s.	Identify the original line and subsequent transfers with periods of use and extent of route; map; photograph; and describe.
H 4-55/56-36	Transp.	W of I-93/Derry	Old Roadway	Identify roadway, period of use, and extent of route; place on map; photograph; and describe.
H5-67-39	Transp.	W of I-93/ Londonderry	Trolley Track Bed, Currently Paved	Identify historic owner of trolley line, period of service and use; map; photograph; and describe.
H 5-67/69-40	Transp.	W and E of I-93/ Londonderry	Old Pillsbury Road Bed	Identify roadway, period of use, and extent of route; place on map; photograph; and describe
H 5-67-41	Res/Agri	W of I-93/ Londonderry	Cellar hole w/assoc. barn foundation	Conduct Phase 1B testing including historical research, mapping and photography of surface remains, description, and shovel testing at 8 m intervals.
H 5-67-42	Res/Agri	W of I-93/ Londonderry	Cellar hole	Conduct Phase 1B testing including historical research, mapping and photography of surface remains, description, and shovel testing at 8 m intervals.
H 5-69-44	Res/Agri	E of I-93/ Londonderry	Collapsed Structure	Conduct Phase 1B testing including historical research, mapping, elevations if needed, and photography of surface remains, description, and shovel testing at 8 m intervals.
H 5-70/74-45	Transp.	E of I-93 Londonderry	Old Road Bed	Identify roadway, period of use, and extent of route; place on map; photograph; and describe
H 5-77/79-47	Transp.	E and W of I-93/ Londonderry	Railroad Bed	Identify the original line and subsequent transfers with periods of use and extent of route; map; photograph; and describe.
H 6-79-48	Agri	Power line ROW/ Londonderry	Stonewall Enclosure	Conduct Phase 1B testing including historical research, mapping, and photography of surface remains, description, and shovel testing at 8 m intervals to assist in determination of function and location of associated remains.
H 6-82-49	Transp.	E of I-93/ Londonderry	Old Road Bed	Identify roadway, period of use, and extent of route; place on map; photograph; and describe.
H 6-93/94-51	Transp.	I-93 median/ Manchester	Remains of Bricketee Road Bed	Identify roadway, period of use, and extent of route; place on map; photograph; and describe.

Key: Transp = Transportation; Ind = Industrial; Res = Residential; Agri = Agricultural

Following the Revolution, towns in the region began to develop craft-based industry such as small, water-powered industries that supplemented the agricultural economy. These industries included gristmills, sawmills, carding, tanneries, brickyards, and other light industries. Important mill locations included Beaver Brook in Derry Village, Kendall Pond in Londonderry, Spickett River in Salem Village or North Salem, Policy Brook downstream from Canobie Lake north of Salem Depot, and along the millpond along Cohas Brook below the outlet of Lake Massabesic (Preservation Company [Project Area Form] 2002: 24).

Potter and Bunker conducted Phase IA and Phase IB level study of a small, family-operated brickyard identified as the Dickey Road Brickyard site (27 Hb 18) near Cohas Brook. As population and the market expanded, brick making became a common local industry along the Merrimack Valley and locally in the Cohas Brook vicinity in the mid-nineteenth century. The area offered the necessary resources for the industry including a workable clay source, firewood to fuel the kilns, and a cheap labor force as well as a large market. The industry tended to be spatially mobile as clay beds became exhausted. Evidences that remained at this site include indications of kiln firing, brick discard, and a possible clay pit. Usually, few structural remains except perhaps for the brick floor are associated with such a complex. Deed research suggests that it operated between 1845 and 1855 and was probably run by either the Dickey or McQueston family. All phases of brick manufacture probably occurred at the site (Potter and Bunker 1991: 45-47).

Also located along Little Cohas Brook, the Corning Mill site (27 Hb 19) received a visual and pedestrian survey but no subsurface testing. The remains of a milldam associated with the sawmill, a massive stone alignment about 50 meters in length, mark the surface of the site. Highway embankment fill may cover a portion of the site. Small sawmills were found along the watercourses of the area as early as the 1730s and continuing until the late nineteenth century. Deed research indicates that George Corning owned the Corning Mill by 1787 and that it was rebuilt in 1804. Use of the yard ceased between 1814 and 1836 (Potter and Bunker 1991: 53-55).

Much of the project area developed an agricultural economy from the time of settlement between the mid-1700s in the early twentieth century. Archaeological sites clearly identified to date relate to the Mixed Agriculture and the Family Farm, 1630-present context. Farms were in the area as early as the mid-eighteenth century. The early economy was based on semi-subsistence agriculture. The soil was generally productive for crops of grasses for livestock feed including corn and oats. Marshes became important natural sources of feed hay. Livestock included horses and cows. Surplus livestock and crops were marketed in the developing settlements. Scotch-Irish Derry farmers also produced flax. Turnpikes were built across the region in the opening years of the nineteenth century and the Merrimack River became navigable by 1807. These corridors permitted the movement of goods and the growth of industry provided markets for agricultural surplus. Area farms prospered from this trade. The arrival of the railroads at mid-century facilitated the transportation of agricultural goods to the developing industrial cities. Mixed farming was practices through the

mid-nineteenth century. Milk and cream were used for home consumption, and butter became the primary cash dairy product. A small number of farm families also made cheese. Swine, cattle, and sheep were also kept for meat and wool production. Primary plant crops included corn, potatoes, oats, hay, rye, barley, and beans. Fresh products from apple and peach orchards, small truck farms, diary and poultry farms with supporting feed crops of hay and corn gained importance in the late nineteenth and early twentieth century. However, by the second half of the nineteenth century, area farms had begun to contract in number and size. Except for small pockets such as the Armenian farming communities, many of the orchards and poultry farms disappeared from the area between the 1920s and 1940s (Preservation Company [Project Area Form] 2002: 23-52).

The two early County Road Dugout sites (27 Hb 8-9), the John Dinsmoor Site (27 Rk 7), and the Robert Dinsmoor site (H 4-38-27) are part of the Old County Road Complex of sites in the Town of Windham that include three cellar holes and a historic dump as well as five other areas containing above-ground remains. This study area was originally within a large, 2,800-acre parcel owned and settled by Robert Dinsmoor beginning in ca. 1741. The date of the original land grant to Dinsmoor is not known. Some of this area remained in the family as late as 1892. Dinsmoor participated in the early government of the area, serving as one of three commissioners organizing the newly established Town of Windham. William Dinsmoor, his son, inherited the location of these sites in a 1400-acre tract in 1751.

Abandoned in the 1960s, the entire length of County Road was in use by the mid-eighteenth century. The road defined in part by its walls and ditches is itself considered a potential historical resource (Table 3.10-4). Along with several part-time crafts including carpentry, blacksmithing and coopering practiced within a farmstead setting, farming remained the primary occupation of the residents along County Road. The area remained a small farm neighborhood during the nineteenth century. These rural neighborhoods had geographic boundaries, were characterized by inhabitants that shared similar cultural backgrounds, and were maintained by a spirit of cooperation in areas ranging from road maintenance, exchange of tools and machinery, assistance during illness, and additional special services and agricultural tasks. Members of one family settled four of the farms by 1811. Edward Searles purchased much of the area between 1901 and 1917. By the early 1960s, only two houses remained along County Road.

The two County Road Dugout sites (27 Rk 8-9) are located along the former County Road. Their foundations may represent the habitations of the earliest settlers who may have constructed them between 1700 and 1750. On the basis of their research, Potter and Bunker (1991: 59) note that such dugouts were constructed by excavating into the hillsides and securing the interior with stone or boards. The structures were often located near future, permanent residence. An excavated cavity with exposed bedrock rear walls and partially collapsed, dry-laid stonewalls define the two cellar holes at 27 Rk 8-9. The collapsed stone chimney pile is located in the center of the rear walls. Both sites likely represent early strategies needed to survive the first few years of settlement.

John Dinsmoor, the grandson of Robert Dinsmoor, initially settled and built on the John Dinsmoor Site (27 Rk 7) in 1811. He erected a dwelling, barn, and blacksmith shop. Although abandoned by 1920, the house and barn continued to stand until at least 1949. The cellar hole is lined with stone capped with sill stones, and a massive, interior stone chimney pile is located in the rectangular depression. A row of stones along a rectangular depression representing the location of an outbuilding and a well compose the remainder of the site. This property represents a farmstead likely participating in mixed agriculture of the early nineteenth century (Potter and Bunker 1991: 55-64).

Subsequent historical research in the area by Preservation Company for property WND0203, the Sidney and Dorothy Walters House, noted the foundations for the 1885 John H. Dinsmoor house and several outbuildings. In addition, it noted the remains of several other farms including the G. Parker Farm and the Parker Pond Dam, which are located in the vicinity of 27 Rk 7 (Preservation Company [Individual Forms: Windham] 2002: 5).

The supplemental, Phase IA archaeological test excavations completed by the PAL in 1992 located eight artifact deposits (27 Rk 327, 27 Rk 328, 27 Rk 329, 27 Rk 330, 27 Rk 337, 27 Hb 221, 27 Hb 222, and 27 Rk 338) and three aboveground structural remains in the Town of Windham (27 Rk 332, 27 Rk 334, 27 Rk 335) (see Table 3.10-2).

Unassociated with visible aboveground structural remains, the artifact deposits date from the nineteenth and early to mid-twentieth centuries. The isolated aboveground structural remains in the Town of Windham include a stone-lined well, a stone foundation, and a stone and earthen dam associated with a small pond. Further Phase IB research to pinpoint their historical associations would include the identification of the parcel and passed property owners with which these deposits are associated as well as the identification of associated remains and function of the property during the time of occupation. Identification of property function would permit the site's association with a broader historical context, an important step to determination of National Register significance. Based on the results of the archival research relating to the eleven resources, the Phase IB archaeological testing of the area adjacent to the artifact deposits as well as associated archaeological remains may be needed. The aboveground remains should also receive a complete architectural description.

Table 3.10-4 lists additional structural remains identified by the Phase IA study of the project corridor conducted by Bunker, Potter, and Green in 1990. Many of these remains are associated with historic transportation corridors. Several sites are associated with past industries and include a quarry and site of a number of small-scale industries. In 1825, a British immigrant name Burpee established a house and stocking mill at 8-10 Fairmont Road. The mill was later converted to a friction match factory and then a machine shop that burned in the early nineteenth century. Becoming known as Titcomb's mill, a two-story carriage factory and shingle mill was erected at the site some time later. This mill burned in 1842. Across the street from this

site stood the Policy Brook gristmill of Phineas Rollins that was erected in 1834. Although the mill burned in 1875, a second gristmill was erected on the site that operated until the 1920s. Both mills ground primarily corn. The raceway and pond remains visible at these locations (Preservation Company [Fairmont Road Historic Area] 2002: 10).

Additional sites within Table 3.10-4 include trolley beds, rail beds, stone bridge abutments, and abandoned roadbeds. Several barns and functionally unidentified foundations and locations of building collapse probably associated with former farmsteads and residences as well as stonewalls and stone enclosures are also listed. Additional study for the impacted properties in Table 3.10-4 would include historical research to identify ownership, extent and associated properties, and more specifically to define their functions. Depending on the results of the historical review, the foundation remains, remains of collapsed buildings, and industrial remains may require further, Phase IB archaeological testing and architectural descriptions.

3.10.4.3 Archaeological Resources Conclusions

Determinations of eligibility for the National Register of Historic Places were not made for either the Native American or historical archaeological resources within the project area. Such determinations will be made after the identification of the Selected Alternative during the Final Design phase. The identified resources listed in Tables 3.10-1 through 3.10-4 that will be potentially impacted by the Selected Alternative would receive further study under the standard method established by NHDHR for archaeological investigations.

The standard method for the resources receiving a Phase IA examination, those listed in Table 3.10-4 and the park and ride lot associated with Option 2 of Exit 5, would receive Phase IB, intensive, subsurface testing. This study involves the excavation of .50 X .50 meter units at 8m intervals across the archaeologically sensitive areas as well as the further development of the historical and pre-contact contexts associated with the resource. Those locations receiving a supplemental Phase IA study, those sites listed in Tables 3.10-2 and 3.10-3, would require additional testing to close the interval from 8 to 10 meters as well as further development of the associated historical and pre-contact contexts. Any aboveground historical archaeological remains would also require an architectural description, photographic documentation, and mapping. Those sites from Tables 3.10-2 through 3.10-4 that contain identifiable archaeological remains as well as those already tested at a Phase IB level in Table 3.10-1 would require a Phase II evaluation to determine if the resources are eligible for the National Register of Historic Places. Phase II testing would entail the exposure of horizontally larger areas of the identified site through 1 X 1 meter or larger units. Included in this study would be the comparison of the subject sites with others in the region associated with similar contexts to determine whether the former possess an equal or greater site integrity and ability to provide information on the shared context or contexts.

If those resources found eligible for the National Register of Historic Places and impacted by the Selected Alternative cannot be avoided, then redesign to avoid any adverse effect would first be considered. If redesign is not possible or practicable, a determination of the need for preservation in-place versus data recovery would be made. Based on experience with archaeological resources in New Hampshire, it is considered unlikely that preservation in-place would be necessary and that satisfactory mitigation can be achieved through Phase III data recovery. If data recovery is deemed necessary, it would be completed in accordance with the Secretary of Interior's Standards. Data recovery excavations address specific research questions that data gained from the significant sites as well as from the broader contexts with which they are associated can address.

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3.10.5 Historic Architectural Resources

3.10.5.1 Methods and Procedures

Survey

All work was done in accordance with the methodology created to identify historical and architectural resources, adopted by the New Hampshire Department of Transportation, the New Hampshire Division of Historical Resources, and the Federal Highway Administration in October 1991. The methodology used to identify archaeological resources is addressed separately in Section 3.10.3.

The I-93 Improvement Project Area includes the eighteen-mile portion of I-93 in southern New Hampshire between the Massachusetts border at Salem, extending north through the towns of Salem, Windham, Derry, Londonderry to the southern part of the City of Manchester, terminating at the intersection of I-93, I-293 and NH101. There are five interchanges between these points, numbered Exits 1-5, south to north.

Historic resources were examined at three levels, shown on three different maps. The largest area was examined in the Project Area Form, which covered an approximately one-mile-wide area centered on I-93. A smaller area of an approximately 1000-foot swath centered on I-93 was examined in more detail in the Windshield Survey. The smallest examination area was the project impact area, where individual historic resources were considered in depth.

Initial work was done to form a large-scale overview for understanding contexts in which to identify individual historic resources. Then a Windshield Survey was conducted using the Project study area maps, which covered an area on each side of the eighteen-mile long I-93 corridor. Every property over fifty years old was

identified and photographed as part of this effort. This information was brought by Preservation Company to several in-depth meetings of the Determination of Eligibility (DOE) Committee consisting of New Hampshire Department of Transportation (NHDOT), New Hampshire Division of Historic Resources (NHDHR), Federal Highway Administration (FHWA) and project engineers to determine exact project impacts on the resources that had been identified in the Windshield Survey. When these were determined, in-depth survey was conducted for those properties using either a reconnaissance- or intensive-level inventory form. The level of survey was determined in coordination with the DOE Committee based on a judgment of integrity of the potential resources. Historic Districts were recorded on NHDHR Area Forms.

The Project Area Form was prepared to provide context for the review of individual properties. It covers a larger area than the Windshield Survey, encompassing village centers and historic areas near the I-93 corridor and along the major cross roads; it is approximately one mile wide, centered on I-93. Photographs were taken of notable and representative properties and historic areas or villages located in the vicinity of I-93. Photograph locations are shown on the base map, created from USGS topographic maps.

The Project Area Form relies heavily on the considerable previous work done in area towns (most of it by Preservation Company, author of the current I-93 Project Area Form), so much of the information was excerpted from previous reports. These sources include the Salem Townwide Area Form, Windham Townwide Area Form and Project Area Form prepared 1991-1992 by Monroe, Hill and Federer for the Route 111: Windham-Salem Project, and the Area Form prepared for the Salem Depot project by Lisa Mausolf in 1998. In 1986, a townwide survey of Derry was conducted by Lynne Emerson Monroe, for the Derry Historic District Commission and Historical Society, that served as the basis for the Historic Resources chapter of the Derry Master Plan, which included Patricia Neil's "Developmental History of Derry, New Hampshire." In 2001, Preservation Company completed a Derry Townwide Area Form and individual survey forms for properties along Route 102 in West Derry for the Exit 4: Derry-Londonderry Project. In 1993, Preservation Company completed in Londonderry, the "Airport Access" or Bedford-Manchester-Londonderry, F-042-1(1), 11512 Project. Lynne Emerson Monroe and Kari Ann Federer of Preservation Company completed a Scoping Report, a Londonderry Townwide Area Form (1995), a North Londonderry Historic District Area Form, and survey forms for individual properties impacted by the project. A city-wide windshield survey of Manchester was conducted in 1991 by Lisa Mausolf, for the City Planning Department. This survey divided the city into some forty-three areas, which were addressed on NHDHR Area Forms. Areas E24, E25 and E26 are in the current study area.

Survey numbers and boundaries of individual properties and historic districts that had previously been determined eligible for the National Register in the above

projects were shown on the Project Area map. Existing National Register listings were also indicated.

Historic properties located within the project impact areas were individually surveyed and shown on project base maps. The project impact area is defined by a band approximately 500 feet on either side of the existing northbound and southbound lanes, with a minimum width of 1,000 feet. At interchanges the area extends to each side of the existing I-93 rights-of-way approximately 2,000 feet along the connecting roadways. New "park and ride" facilities are planned at Exits 2, 3, and 5, and properties in those areas were also surveyed.

A total of thirty-eight properties and potential five historic districts (containing twenty-two individual properties also surveyed individually) were surveyed as part of this undertaking. Three districts and nine individual properties were determined eligible for the National Register of Historic Places. In addition, six individual properties and a historic district in the project area had previously been determined eligible for the National Register. All are listed below:

Table 3.10-5
List of Properties and Districts

Survey Number	Tax Map/ Parcel	Address	Type of Form	Notes/Description	Eligible Acreage	Eligibility
SALEM						
SAL0201	135/9359	38 Cross Street	Front	early 20th century gable front		not eligible
SAL0202	135/9362	32 Cross Street	Full	early 20th century gable front		not eligible
SAL0203	135/8922	25 Cross Street	Front	barn converted to apartments		not eligible
Area SAL-D1	maps 141 and 134	Salem Street	District	Armenian Settlement Historic District	105.08 acres	eligible (A)
SAL0204	127/8919	19 Cross Street	Full	Kinzler House	5.79 acres	eligible (A)
SAL0205	126/4160	4 MacGregor	Full	one small house in "Mac" subdivision, cabbage farm		not eligible
Area SAL-D2	map 97	Fairmont Road	Area	Fairmont Road Potential Historic District		not eligible
SAL0206	97/4424	20 Fairmont Road	Full	ca. 1920 Reynolds House, gambrel		not eligible
SAL0207	97/7865	33 Fairmont Road (Boyer Lane)	Full	20th century Craftsman, stone foundation		not eligible
SAL0208	97/4415	19 Fairmont Road	Full	early 20th century house		not eligible
SAL0209	97/4416	21 Fairmont Road	Full	early 20th century cape		not eligible
SAL0210	97/4423	22 Fairmont Road	Full	early 20th century gable front		not eligible
SAL0212	97/4426	8-10 Fairmont Road	Front	ca. 1920 Fairmont House, large, 2-family		not eligible
SAL0213	97/4414	2 Point A Road	Front	ca. 1907 Square House, Thomas House		not eligible
SAL0214	97/4413	4 Point A Road	Front	ca. 1920, small with front bay		not eligible

Table 3.10-5 (continued)

Survey Number	Tax Map/ Parcel	Address	Type of Form	Notes/Description	Eligible Acreage	Eligibility
SAL0215	97/4412	6 Point A Road	Front	ca. 1917 McMaster House, hip roof, stone work		not eligible
SAL0216	97/4410	26 South Policy Street	Front	ca. 1924 Bungalow, hip roof, chicken house		not eligible
SAL0217	97/4409	28 South Policy Street	Front	ca. 1942 stone foundation, flat-roofed garage		not eligible
SAL0218	97/4408	30 South Policy Street	Front	ca. 1922, vernacular with porch		not eligible
SAL0219	97/3948	29-31 South Policy Street	Front	Policy Brook Farm, Hagopian Farm		not eligible
SAL0211A and SAL0211B	97/7851	27, 25 Pelham Road	2 Fronts	2 mid-20th c. capes on one parcel		not eligible
SAL0220	87/7441	70 Brookdale Road	Full	late 19th century cape with barn		not eligible
SAL0221	87/7507	63-65 Brookdale Road	Front	early 20th century cape		not eligible
SAL0222	87/7504	61 Brookdale Road	Front	early 20th century Bungalow		not eligible
WINDHAM						
Area WND-D1	12-A	off Searles Road	District	Searles Castle Historic District	95 acres	eligible (A, B and C)
WND0200B	22-B-31	115A South Shore Road	Front	early 20th century cottage on Canobie Lake		not eligible
WND0200A	22-B-31	115 South Shore Road	Full	20th century split level on Canobie Lake		not eligible
WND0202	17-G-20	82 Range Road	Full	Colonial Revival cape		not eligible
WND0084	17-G-40	85 Range Road	continuation sheet	previously surveyed property: Sally Park House		not eligible
WND0085	17-G-26	86 Range Road	continuation sheet	previously surveyed property: George F. Armstrong House (Common Man Restaurant on lot)	1 acre, part of parcel that abuts Range Road and includes the house	eligible (C)
WND0086	17-G-30	88 Range Road	continuation sheet	previously surveyed property: Robert Armstrong House	0.82 acres	eligible (C)
WND0203	11-C-5	3 Wyman Road	Front	Ranch with rubble stone foundation and chimney		not eligible
WND0206	11-C-125	30' off Indian Rock Road on old Route 111	Full	Indian Rock, 6 feet tall	rock footprint + 10' radius	eligible (A through Criterion Exception F)
WND0033	17-J-80	Indian Rock Road	continuation sheet	previously surveyed George Dinsmore Craftsman style (stone) house	1.1 acre	eligible (C)
WND0205	2-A/600	117 North Lowell	Full	19th century connected farmstead		not eligible

Table 3.10-5 (continued)

Survey Number	Tax Map/ Parcel	Address	Type of Form	Notes/Description	Eligible Acreage	Eligibility
DERRY - no individual or district present in project area						
LONDONDERRY						
LON0115	10/147	7 Reo Lane	Front	former telephone switching building		not eligible
Area LON-D1	map 10	Pillsbury Road	District	Woodmont Orchard Historic District	196 acres	eligible (A)
LON0102	10/58	6 Buyck Lane	Front	camp		not eligible
LON0116	10/00	Ash Street	Full	Ash Street Bridge, ca. 1961, AKA Robert Prowse Bridge (designer)	bridge footprint and approaches	eligible (C through Criterion Exception G)
LON0114	13/21	79 Stonehenge Road (corner of Perkins)	Full	Reed Paige Clark Homestead, Stonehenge house, ca. 1844	114.4 acres	eligible (A, C)
LON0110	13/23	16 Perkins Road	Full	ca. 1780 cape, no outbuildings		not eligible
LON0111	12/96, 13/22, 24-4	22 Perkins Road	Full	ca. 1944 cape w/stone chimney and foundation, barns and coop		not eligible
LON0113	16/1	48 Perkins Road	Full	ca. 1790 cape w/mid-20th century porch		not eligible
LON0155	16/3	62 Perkins Road	continuation sheet	previously surveyed Greek Revival sidehall		not eligible
LON0080	15/54	79 Perkins Road	continuation sheet	on corner of Route 28, previously surveyed Atwood/Plummer House		not eligible
Area LON-D2	map 16	Route 28/ Rockingham Road	District	Meadow Estates Potential Historic District		not eligible
LON0103	16/43	99 Rockingham Road	Full	shed-roofed ranch, ca. 1952, Shepard House	9 acres	Individually eligible (C)
LON0104	16/94	111 Rockingham Road	Full	ranch, ca. 1942-47		not eligible
LON0105	16/88	117 Rockingham Road	Full	ranch, ca. 1955, Gearty House		eligible (C through Criterion Exception G)
LON0106	16/84	121 Rockingham Road	Full	ranch, ca. 1955		not eligible
LON0107	16/82	118 Rockingham Road	Full	ranch, ca. 1955, Raiche House		not eligible
LON0108	16/86	114 Rockingham Road	Full	ranch, ca. 1952		not eligible
LON0117	16/93	113 Rockingham Road	Full	ranch, ca. 1952, Moody House	1.4 acres	individually eligible (C)
LON0109	16/90	112 Rockingham Road	Full	ranch, ca. 1957		not eligible

Table 3.10-5 (continued)

Survey Number	Tax Map/ Parcel	Address	Type of Form	Notes/Description	Eligible Acreage	Eligibility
MANCHESTER						
MAN0010	812/0002	2081 Bodwell Road	Full	stone house, Clark House	35.17 acres	eligible (C)
MAN0011	832/19	759 Corning Road	Front	mid-20th century cape		not eligible
MAN0012	832/18	769 Corning Road	Front	mid-20th century cape		not eligible
MAN0013	832/17	781 Corning Road	Front	moved, mid-20th century cape		not eligible
MAN0014	832/16	787 Corning Road	Front	gable-front converted camp		not eligible
MAN0020	832/15	805 Corning Road	Front	converted camp		not eligible
MAN0015	832/14	849 Corning Road	Front	converted camp		not eligible
MAN0016	0826/0005	718 Bodwell Road	Front	converted camp		not eligible
MAN0017	0826/0007	730 Bodwell Road	Front	converted camp		not eligible
Area MAN-D1	826/0009	Cohas Avenue	District	Manchester Low Service Pumping Station	54.5 acres + 1 rod on north side of Cohas Brook	eligible (A, C)
MAN0019	0612/0001	539 Brickett Avenue	Front	altered cape with barn		not eligible

Determination of Eligibility

The intensive level survey information was deemed sufficient to determine significance and eligibility for the National Register of Historic Places. The Determination of Eligibility (DOE) Committee, comprised of representatives from NHDOT, NHDHR, and FHWA, met on February 13 and 27, 2002. All final determinations of National Register eligibility were made by consensus. The resulting Determination of Eligibility forms for each eligible property that is potentially impacted within the project area are on file with each agency and included in Appendix G.

The criteria (36 CFR Part 60) by which National Register eligibility is determined are:

Criterion A: Resources that are associated with events or trends that have made a significant contribution to the broad patterns of our history.

Criterion B: Resources that are associated with the lives of persons significant in our past.

Criterion C: Resources that embody the distinctive characteristics of a type, period or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguished entity whose components may lack individual distinction.

Criterion D: Resources that have yielded, or may be likely to yield, information important in prehistory or history.

To be eligible for inclusion, resources must also retain integrity, defined as the quality of location, setting, design, materials, workmanship, feeling and association sufficient to clearly convey a property's history and significance.

Criteria Consideration F for commemorative properties states that a property can be eligible if design, age, tradition or symbolic value has invested it with its own significance. Criteria Consideration G states that properties less than fifty years old may be eligible if of exceptional significance.

There are no properties in the study area currently listed on the National Register of Historic Places. During this study, eleven individual properties and four historic districts were determined eligible for listing on the National Register of Historic Places.

3.10.5.2 Historic Context of Study Area

The following narrative is taken from the Project Area Form completed in 2002. Additional text on the significance of the architectural development of the area is available from NHDOT and NHDHR.

Definition of Study Area

Interstate 93, I-93 (also known as the Alan B. Shepard Highway between the Massachusetts line and Hooksett, New Hampshire) is the primary route north from Boston, through Lowell to the cities of Manchester, Concord and points north. The I-93 Project is defined by the Interstate corridor, beginning at the state line just north of Methuen, Massachusetts, passing through the southeastern New Hampshire towns of Salem, Windham, Derry and Londonderry, terminating at the I-293 interchange southeast of downtown Manchester.

Interchanges along I-93 intersect with the region's primary west-east highways. These include Routes 97 (Exit 2) and 38 in Salem. In Windham, Exit 3 is located at Route 111. The Derry exit (Exit 4) is located just over the Londonderry town line, west of West Derry. This interchange with NH Route 102, which passes southwest-northeast through West Derry and Derry Village. This State route was established between Hudson and Derry in 1915, and from Derry to Raymond in 1919. Exit 5 is located in the northern part of Londonderry where the Interstate crosses Route 28. Immediately to the east on Route 28 is Wilson's Crossing and northwest of Exit 5 off of Route 28 is the village of North Londonderry. The north end of the Project Area is I-293, which connects NH Route 101, the primary east-west road through the state, with U.S. Route 3 and the F.E. Everett Turnpike, which run south-north along the west side of the Merrimack River.

The historical development of the region was directly linked to its central location between major industrial cities, Manchester, Nashua, Lowell, Lawrence and Haverhill. Transportation routes from various periods of the area's development, parallel each other, running southeast-northwest. All were superceded in importance by the Interstate when it was completed in the study area in 1963.

As new transportation corridors were established, village centers developed along them, often resulting in a complete shift in emphasis within each town.

The earliest north-south route was the Merrimack River to the west of the study area. The early highway along the west bank of the river later became U.S. Route 3. Parallel to it is the F.E. Everett Turnpike built in the 1950s.

The first major through-road was the Londonderry Turnpike, built in 1806, it extended from Lowell to Concord. The Turnpike, a straight road running southeast-northwest, survives as NH Route 28 through Salem and Windham, and as Bypass 28 from Derry north. It continues north through Auburn, east of the Study Area. Derry Village developed as the "Lower Village" around the Turnpike and mills on Beaver Brook. It reflected a shift in the town center from the older village of East Derry or the "Upper Village." The old turnpike fell into disuse later in the nineteenth century, but was rebuilt as a state road in the 1930s.

Another important early south-north route was Mammoth Road, built in 1831 from Lowell to Manchester, passing through Londonderry, just west of the study area. The new road became the focus of Londonderry's small town center. Mammoth Road now forms NH Route 128 through Londonderry, passes through North Londonderry village, and continues as Route 28A northerly into the eastern part of Manchester.

During the second half of the nineteenth century, the railroad played a major role in the region's development patterns. The Manchester and Lawrence Railroad, which opened in 1849, is now abandoned. It is located east of I-93 through much of the study area, crossing to the west in Londonderry and continuing into Manchester. The railroad paralleled the west side of the old Turnpike through Salem, and gave rise to a new village center, Salem Depot, west of the early town center. Near the Derry town line, Windham Depot developed as a small center around the junction of the Manchester and Lawrence and a second line, the Worcester, Nashua and Portsmouth Railroad, running southwest-northeast. The Manchester and Lawrence ran diagonally through the southwest corner of Derry, and the focus of activity in the town shifted west again to what became West Derry, or Derry Depot. In Londonderry, villages developed on the rail line at Wilson's Crossing and North Londonderry, where the rails intersected Mammoth Road. The line continued north into Manchester, west of the study area. Manchester was the junction of the Concord and Montreal Railroad, which ran parallel to the Merrimack River. The Concord and Portsmouth Railroad runs west-east from Manchester north of the study area.

NH Route 28, which was replaced as a south-north through road by the Interstate, was improved in the early twentieth century as a State highway connecting Lawrence and Manchester. It is located along the old Turnpike through Salem Depot and Windham, east of the study area. In Derry, Route 28 turns west and north through the center of West Derry. The highway continues north as Rockingham Road curving through Londonderry, past Wilson's Crossing, under the Interstate and northwest to North Londonderry. It follows a bypass segment built in the 1950s, past North Londonderry. Route 28 follows the historic route of Mammoth Road a short distance north and then veers northwest onto South Willow Street. The path of Mammoth Road, north into Manchester, is Route 28A. Bypass Route 28 follows the path of the old Londonderry Turnpike, east of I-93 through Derry Village and north.

Historical Background

1719-1740: Settlement and Growth, Agriculture and Small-Scale Industry

Prior to permanent European settlement in the area, the lands along the east side of the Merrimack River were known as Nutfield for the abundance of chestnut trees found by the earliest travelers to Amoskeag Falls (Hazlett 1915; Willey 1896). As early as 1622 grants were made along both sides of the Merrimack, first by the Penacook Indians and the royal government in England and later by the provinces of Massachusetts and New Hampshire. Most were never occupied, but confusion over titles and boundaries lasted for many years (Blood 1948; Browne 1902; Clarke 1875; Monroe and Federer 1993).

During the early Colonial period, the territory included in the study area was claimed by both Massachusetts and New Hampshire. The battle over the southern boundary of the latter state was not resolved until 1740. During the seventeenth century, New Hampshire was annexed periodically to Massachusetts, making the southern boundary unimportant. However, in the early 1700s, as New Hampshire began to assume its own identity under the leadership of Governor John Wentworth, the quarrel over the boundary precipitated the final separation of New Hampshire from Massachusetts and initiated the settlement of "second tier" towns in the southern third of the state. In an attempt to strengthen New Hampshire's claim to land in the Merrimack valley, Wentworth used his ability to charter towns. However, Massachusetts' governor Belcher did the same. The race to solidify land claims through town charters began in 1722 with New Hampshire's incorporation of Londonderry, originally called Nutfield. Massachusetts retaliated in 1725 by granting the town of Rumford (now Concord) to the north.

The original town of **Londonderry** encompassed what are now Derry and Londonderry, as well as Windham and parts of Manchester and Salem. **Windham**, taking its name from a town in Ireland, was set off from the southern part of Londonderry in 1741. During the same period, the southern portion of Salem, at the southern edge of the study area, was at first a part of Haverhill, Massachusetts, and in 1735, it was included in the new town of Methuen, Massachusetts. After the state boundary dispute was finally resolved, **Salem** was incorporated in 1750. In 1752 the

southeastern portion of Windham was added to Salem. The northern part of Londonderry was set off in 1751 as Derryfield, later known as **Manchester**. **Derry** remained part of Londonderry until 1827.

European settlement in Nutfield (**Londonderry**) actually began in 1719. The settlers were Scotch-Irish Presbyterians who emigrated from Londonderry, Ireland, in 1718. They were descendants of Presbyterians who fled religious persecution in Scotland in 1612. Following a century of conflicts with the native Catholic Irish, a group determined to seek religious freedom in the New World. Five boatloads left Ireland in the Spring of 1718 and arrived in Boston three months later (Londonderry Historical Society 1979:I). Various congregations who had come with their ministers dispersed.

Those led by Rev. James MacGregor sought available land for settlement and eventually selected Nutfield. Sixteen families arrived there on April 17, 1719, along with Rev. MacGregor (Derry Historic Research Committee 1977:4). Temporary cabins were erected and a common field cleared and planted on West Running Brook. By the fall of 1719, close to fifty-four families had arrived (Hurd 1882:565). The group petitioned Massachusetts and then New Hampshire for incorporation as a township, and in 1722, the twelve square mile territory became the Town of **Londonderry**, named for the Irish city from which most of the settlers had come. The first meetinghouse was constructed between 1720 and 1722 in what became Londonderry's first village center, now East Derry. Rev. James MacGregor preached there until his death in 1729 (Historical Booklet Committee 1969:16; Hurd 1892:177).

Land was laid out in a series of divisions. Home lots were sixty acres each; the second division lots were forty acres, selected as an amendment to make up for what each home lot was lacking (Hurd 1882:567; Monroe and Federer 1994). The first division in December 1719 was the Double Range, in which long, parallel home lots were laid out on either side of West Running Brook in what is now **Derry** (Beckley and Watts 1975:28; Hurd 1882:567; Monroe and Federer 1995). The second and third divisions, made in the early 1720s, were the "English Range" in the northwest corner of the present town of Derry and "Aiken's Range" to the south of it. The "Three-quarter Mile Range", in which ownership remained controversial for many years, occupied the north central part of Derry (Beckley & Watts 1975:31, 32, 35, 47). Ayer's (or Eayer's) Range was on the eastern edge of what is now Londonderry, but the settlers built their houses on the eastern ends of the lots in Derry. The area that developed as the present town of **Londonderry**'s village center was laid out ca. 1728 as the High Range (Londonderry Historical Society 1962b:42). The rest of Londonderry was laid out in large irregular tracts of less valuable land, given in the second division amendment and highway lands in the 1730s (Hurd 1882:569; Monroe and Federer 1995).

The initial colonists were joined by steady infusions of new immigrants arriving from Northern Ireland. At the same time, English settlers from Massachusetts moved northward into the Merrimack Valley in increasing numbers. Settlement in the

region was spurred by the needs of the colony for more land and by the desire to protect unclear claims to land along the Merrimack River (Monroe and Federer 1993).

In an early attempt to claim land on the River, John Goffe Jr. and his two brothers-in-law, all relatives of Londonderry colonists, settled near the mouth of Cohas Brook in 1722. They were the first settlers in what would become **Manchester**, and established saw and grist mills in the vicinity later known as Goffe's Falls. In 1729, to maintain claim to land at Amoskeag Falls, three men from Londonderry settled near what would become downtown Manchester. (Eventually English colonists, rather than the Londonderry Scotch-Irish, received title to the land at Amoskeag when Derryfield was chartered in 1751) (Monroe and Federer 1993).

Windham was laid out as part of Londonderry in the 1720s. The first settlement occurred southeast of Cobbetts Pond on Copp's Hill. Land in the Range between Canobie Lake and Cobbetts Pond was laid out in 1728. It was divided into 21 long, narrow strips averaging fifty acres. Residents of Londonderry were given land as an amendment to earlier divisions. Range Road was laid out in 1739, and many large and productive farms were established in the mid-eighteenth century. A number of them remained in the same families for generations (Morrison 1883:45, 160).

The region's early economy was based on subsistence farming. The soil was generally productive for crops of grasses for livestock feed, Indian corn and oats. Livestock included horses and cows, and the meadows (marshes) were of great value as a source of feed hay. The Scotch-Irish were the first in North America to cultivate the white potato, an important staple crop (Hurd 1882:567).

The Scotch-Irish were also the first to engage intensively in household manufacturing of linen. They brought flax seed, spinning wheels and looms with them from Ireland, and as soon as the land was ready, they cultivated flax, which was considered among their most valuable produce. Londonderry was soon well known for its high grade of linen throughout the colonies (Derry Historic Research Committee 1977:4; Monroe and Federer 1995).

Londonderry's limited water power was utilized by the grist and sawmills, which were necessary corollaries to agriculture. The first were built in 1719 on Beaver Brook at what became **Derry Village**. In 1721, six men received the right to build a dam and sawmill on Aiken Brook, creating Horne Pond, now within **West Derry**. The first mill in present day **Londonderry** was built in 1731 on Beaver Brook at what is now Kendall Pond. Another early mill was operated by David McAfee at the later site of Manter's Mills in the northeast corner of Londonderry (Historical Booklet Committee 1969:11-12; Hurd 1885:571; Parker 1851:86-87).

The earliest roads and settlement patterns followed routes oriented toward the falls at Amoskeag. Many of the principal roads were laid out in the 1720s. The route from the mills at **Derry Village** to Amoskeag Falls was laid out in 1724, along Old Derry Road and Bodwell Road. Kendall Pond Road dates from 1723. East Pillsbury

Road was the original road between the **Londonderry** center and **Derry** Village. The section of road between what are now Derry Village and West Derry was laid out in 1737, as was a road connecting Derry Village and what would become North Londonderry. The main east-west road through Londonderry (now Stonehenge and Litchfield Roads) was built in 1744 (Monroe and Federer 1994; Hurd 1885:570; Derry Historic Research Committee 1977:4). A path along the east bank of the Merrimack (now Route 3A/Brown Avenue) was in existence as early as 1734 (Hurd 1885:577).

Londonderry grew rapidly and by the 1730s the town (including at that time the present towns of Londonderry, Derry, Windham and part of Manchester) accounted for one-tenth of New Hampshire's population (Parker 1851:316).

Settlement of **Salem** began in the 1730s as people from Haverhill and Methuen moved northward seeking grazing lands. The center of settlement was at what became Salem Village (Gilbert 1907:47, 84). A road from Salem Village to what would become Salem Depot was first laid out in 1737 (Main Street, Route 97). The Messer's Crossing area in the southeast corner of Salem was also the site of early settlement. What is now Hampshire Road and Pond Street, across the south edge of Salem, was laid out in 1735 (Mausolf 1998).

1740-1806: East and West Parishes of Londonderry, Windham and Salem Incorporated, Population Growth

By 1740, Londonderry's population was large enough that the western part of town was set off as a separate parish. The East Parish, covering most of **Derry**, retained its meetinghouse at East Derry. The West Parish encompassed all of present **Londonderry** and a small part of Derry. It was incorporated through the petition of some forty families living in the western part of town where a meetinghouse had been built a few years earlier. The division was made partly because of the distance to the church in the eastern part of town, and partly because of dissatisfaction with the East Parish minister, Reverend William Davidson. Reverend David MacGregor, son of the town's first minister, served as the first pastor of the West Parish. Because some East Parish families also preferred Rev. MacGregor, the General Court allowed forty residents of each parish to be members of the other. For years, some families traveled miles to church, passing each other on their way. This practice ceased in 1778, just after MacGregor's death (Parker 1851:93; Beckley and Watts 1975:170). The original meetinghouse in the West Parish was located on Hardy Road. Londonderry's oldest burying ground, the "Cemetery on the Hill" is located nearby.

Windham was set off from Londonderry and incorporated as a town in 1741. **Salem** contained about seventy-five scattered homesteads when it was incorporated in 1750 (Gilbert 1907). A part of Windham was annexed to Salem two years later. The boundaries between Londonderry and Windham continued in flux for the next fifty years, as parts of Londonderry were exchanged, until a final determination was made in 1805.

Manchester was chartered as Derryfield in 1751. It developed slowly as the land was considered poor for agriculture. Fishing and the potential water-power of the Merrimack and its tributaries were the impetus for settlement. Villages developed at Goffe's Falls, Amoskeag and Piscataquog. The partial paths of Mammoth and Bodwell Roads were in place by this time, and the original Manchester center developed on what became Mammoth Road, in the southeast corner of the current urban core, northwest of the study area. A meetinghouse was built there in 1758 (Mausolf 1991).

In 1769, both East and West Parishes of **Londonderry** began construction of new meeting houses. The eastern one is still extant in East Derry. The western church, which was not completed until the 1780s, was placed more centrally, near "Hardy's Corner" at the intersection of Pillsbury and Gilcreast Roads. It was located on the western edge of the Project Area, west of Woodmont Orchards. The Valley View Cemetery was established nearby. (In 1845 the building was moved west and remodeled to become the Londonderry Town Hall) (Historical Booklet Committee 1969; Monroe and Federer 1995).

During the end of the 18th century, following the American Revolution, towns in the region began to develop small water-powered industries, supplementing the agricultural economy. These included gristmills, sawmills, tanneries, brickyards, and other light industry. Beaver Brook at **Derry** Village and Kendall Pond in **Londonderry** were important mill sites. In **Salem** sawmills, gristmills, carding mills and shingle mills were located along the Spickett River in Salem Village and what would become North Salem. For a time, mills operated on Policy Brook, downstream from Canobie Lake, north of what became Salem Depot. The first cotton mills were established at the Amoskeag Falls in **Manchester** in the 1790s. Various industries operated on the "Mill Pond" on Cohas Brook below the outlet of Lake Massabesic.

In the late eighteenth century, **Londonderry** received an influx of a number of families from Ipswich, Massachusetts who were of English Puritan descent. Londonderry (still including Derry) became the second largest town in New Hampshire, with 2,389 residents in 1767, and 2,590 in 1775. At that time, **Salem** had a population of 1,084, while **Windham's** was 529. **Manchester,** which remained primarily a rural, agricultural community at this time, grew slowly from 285 people in 1775 to 362 in 1790 (Bureau of the Census 1909). **Londonderry**'s population continued to rise slowly, but steadily to 2622 in 1790, 2650 in 1800, and 2766 in 1810 (Parker 1851:316).

1806-1847: Londonderry Turnpike, Stage Coach Era, Town of Derry Incorporated

The early 1800s were an era of prosperity, aided by improved transportation networks. The Merrimack River became navigable in 1807 with the construction of a canal around the Amoskeag Falls at **Manchester**. Increasing amounts of produce

and lumber were transported by canal boats to the growing manufacturing centers of Lowell and Lawrence, and to Boston via the Middlesex Canal.

The region was even more strongly impacted by the 1806 opening of the Londonderry Turnpike, which now forms the western edge of the study area. It became the most direct land route (sixty-three miles) between Boston and Concord, which officially became New Hampshire's capital in 1808. The road was designed to be as straight as possible, between Concord to the state line, where it connected to the Essex Turnpike of Massachusetts. The Turnpike passed diagonally through the towns of **Windham** and **Salem**. This east-west division of the towns, changed their development and foreshadowed future transportation in a north-south direction along this corridor. New industries developed to support travel on the turnpike, including stage lines, taverns and blacksmith shops. A toll gate was located in Salem north of Canobie Lake near what is now the intersection of Routes 28 and 111 (the toll house was demolished ca. 1880) (Morrison 1975:164). A tavern was located nearby to the south (Gilbert 1907). In **Derry**, a new village developed on the Turnpike and by the 1820s had replaced East Derry as the town center (Monroe 1986). Derry Village became a center of trade, through which large quantities of lumber, pork, butter and eggs, and all the surplus of the farm were transported, and the location of carding, fulling, saw and shingle mills. **Manchester** had not yet begun to develop as a major industrial site and the Turnpike bypassed it on the east.

The Amoskeag mills soon changed the history of the region. In 1810, the Amoskeag Cotton and Wool Factory was incorporated. In 1828 it was purchased by a group of Boston investors who had recently established mill towns at Lowell and Lawrence. They soon laid out mills, canals and housing that became the core of downtown **Manchester**. The name of the town was officially changed from Derryfield to Manchester in 1810. As of 1830, Manchester had a population of 877. By the 1840s, Amoskeag and other textile mills employed more than 5,000 people.

In 1827, due to its size and population, the large town of **Londonderry** was divided in half. The eastern part, although it was the older section of town, received a new name when it was incorporated as **Derry** on July 2, 1827. The western half retained the name Londonderry (Hurd 1892:168). As of 1830, Londonderry had a population of 1,467, while Derry had 2,178. At the same time, **Windham**'s population peaked at nearly a thousand, while **Salem** had 1,302 residents (Bureau of the Census 1909:19). Over the next twenty years, Derry's population decreased (1,850 in 1850), while Londonderry's increased (1,731 in 1850). While East Derry remained the location of Derry's Town meetinghouse, Derry Village developed on the Turnpike. Its expansion included the construction of businesses, and the Congregational and Methodist churches.

In 1831, the history of the region was impacted by the construction of another new road, called Mammoth Road. The new route between Concord and Boston ran due north-south through **Londonderry**, superceding the Turnpike through Derry as the route for stagecoaches and transport of farm produce to Lowell and Boston. Traffic

was diverted from the Turnpike and its proprietors turned the road over to the towns in 1838. Small population centers developed on the new road, including what would develop as the **Londonderry** town center. A tavern and livery stable and store were located in this area. In 1837, Mammoth Road became the location of the new Presbyterian Church. In 1845, the old meetinghouse was moved nearby and remodeled as the Town Hall. A Methodist Church was built in 1856 (Beckley and Watts 1975:170, 177; Hurd 1882:580). North Londonderry was the location of White's Tavern and store. A stage coach rest stop and mail transfer point was located on Mammoth Road (Route 128) at the corner of Nashua Road (Route 102), at Shephard's or Plummer's Tavern (now the Homestead Restaurant) (Beckley & Watts 1975:25). Mammoth Road runs due south-north through the geographical center of **Manchester**, passing east of the present urban core. It passed through what was then Manchester Center (north of the intersection of Mammoth and Island Pond Roads), but which soon declined in importance as the downtown area began to develop. The southeast corner of Manchester remained a rural area. In 1840, residents of the vicinity established the Stowell Cemetery on Bodwell Road. The District 9 schoolhouse was located at the corner of Bodwell and Corning Roads (Mausolf 1991).

Improved roads and the proximity of growing industrial cities allowed area farmers to prosper. Better transportation also facilitated the beginnings of the shoe industry through the outwork distribution system. Small shoe shops were located throughout the towns in the study area. The first larger shoe shop in the Area was built in 1830, by the Manter family who already had a prosperous sawmill in the northeast corner of **Londonderry**. Shoes were shipped to Boston by river and canal boat. Barrels were made in nearby cooper shop and were shipped by sea to Cape Cod for fish packing (Londonderry Historical Society 1972:134).

1847-1870: Railroad Era, New Villages Develop, Agricultural Prosperity, Amoskeag Mills, Shoe Industry

The end of the stagecoach era in the region began with the construction of the Concord and Nashua Railroad in 1838, replacing Mammoth Road in importance as a north-south route (Hurd 1885:577; Parker 1851:314). The study area was directly impacted by the construction in 1847-49 of the Manchester and Lawrence Railroad (soon taken over by the Boston and Maine, becoming the Manchester and Lawrence Branch), connecting the two rapidly growing manufacturing centers. The railroad meant the end of the turnpike as the primary travel route. Railroad stations became centers of new development and in several cases replaced older town centers.

In **Salem**, the railroad ran parallel and close to the west side of the Londonderry Turnpike (now Route 28). Just below the town line in Methuen was Messer's Depot, near the major road intersection known as Messer's Crossing. The location of Salem's depot, east of the older town center, gave rise to a new village Salem Depot. The area expanded dramatically after 1860 and became the town's commercial and industrial center. The extant railroad station was built in 1867 on the north side of Main Street, and the freight depot (also extant) stood farther north between the railroad and the turnpike (Route 28). Various industries and businesses were soon

built nearby. Public buildings included the Methodist Church on Pleasant Street. The "Old Stone Schoolhouse" on the west edge of the village, corner of North Policy and Main, served the community from 1825 to 1873 (Mausolf 1998).

In **Windham**, the turnpike and railroad forked at the head of Canobie Lake. While the turnpike continued toward Concord, passing through Derry Village, the railroad headed northeast toward Manchester. Windham's depots were located near the Turnpike junction and near the northern edge of town. The railroad passed through the western part of **Derry**, about a mile and a half west of the old Turnpike, along a route chosen for its more level topography (Historical Booklet Committee 1969:26). The railroad formed the core of a new village, Derry Depot or West Derry, which soon replaced the older villages as the town center (Monroe 1986). The **Londonderry** railroad station was located in the northern part of that town where the line crossed Mammoth Road, just south of White's Tavern. A village grew up around it known as Londonderry Depot or North Londonderry. A second depot was located to the east, at what became known as Wilson's Crossing, and a post office opened there in 1862 (Monroe and Federer 1994). From North Londonderry, the railroad headed north into **Manchester** through undeveloped land that later became the edge of the Manchester Airport.

The railroad initially benefited area farmers, as much of what was produced was exported to the nearby industrial cities to feed the booming populations (Monroe and Federer 1995). Mixed farming was practiced through the mid-nineteenth century. Milk and cream were used for home consumption, but butter was the primary cash dairy product. A small number of farm families also made cheese. Swine, cattle, and sheep were also kept for meat and wool. Primary plant crops included corn, potatoes, oats, hay, rye, barley, and beans. By this period, flax was no longer grown in Derry. Fewer than 25% of area farms had orchards at this time (Bureau of the Census 1850). Harvey P. Hood, whose dairy would play a major role in the history of **Derry**, took advantage of railroad access to Boston, when he established a dairy farm there in 1848 to supply his Charlestown, Massachusetts milk route. Over the course of several years, Hood amassed a 320-acre farm in the center of Derry between West Derry and Derry Village (Neil 1986).

The textile factories in **Manchester** expanded rapidly in the mid-nineteenth century changing the face of the region. As of 1850, Manchester had a population of 13,932. In 1860, the population was 20,107. At that time, a third of Manchester's residents were foreign born, mostly Irish. Due to building restrictions in the city center, people seeking less expensive building lots selected sites on the outskirts of the city. One of the small villages that developed was known as "Hallsville," located at the southeast corner of the urban center, northeast of the I-93/I-293 Interchange.

The shoe industry was introduced during this period, through outwork production for factories in nearby Massachusetts cities (Derry Historic Research Committee 1977:19). Small shoe shops were located on farms throughout area towns. The first larger shoe factory in **Derry** was built near the Depot in the 1850s. At Wilson's

Crossing in **Londonderry**, shoes were hand-stitched at Richardson's shoe factory from the 1850s. To the north off Old Derry Road, the Manter shoe factory employed twenty men and twenty women in 1860, manufacturing 22,000 pair of shoes a year (Bureau of the Census 1860). The first shoe factory in **Salem** Depot was established in 1856 by Prescott Hall who played a major role in the development of the village (Mausolf 1998).

As new transportation and industries developed, **Derry**'s population fluctuated from 2,034 in 1840 to 1,850 in 1850 and 1,995 in 1860. With migration west and to industrial cities, rural **Windham**'s population decreased to only 753 in 1870. **Londonderry'**s peaked in 1850 at 1,731 and declined to 1,405 by 1870. **Salem**, with a stronger industrial base, was able to maintain its population, increasing steadily to 1,603 in 1870 (Bureau of the Census 1909).

1870-1900: Shoe Industry, Derry Depot, Salem Depot, Amoskeag Mills Expand, Population Boom, Specialized Farming

The shoe industry was responsible for the rapid growth of West **Derry** during the last decades of the nineteenth century. The advent of steam power allowed industries flexibility of location, and the railroad corridor was the most convenient for transportation. In 1870, Col. William S. Pillsbury, who had been manufacturing shoes in Londonderry, purchased the older factory at Derry Depot and established what would become the W.S. and R.W. Pillsbury company (Derry Historic Research Committee 1977:25). Wood products, barrels and boxes, were a secondary industry. Derry Depot (West Derry) grew rapidly as a busy downtown, the focus of business activity in the town. Broadway was lined by large commercial blocks by the end of the nineteenth century. The shoe industry was also a major factor in **Salem** Depot's development. Hall's shoe shop was enlarged and the F.P. Woodbury Shoe Company was established in 1880.

In **Londonderry**, steam power was installed at Richardson's shoe factory at Wilson's Crossing. About 1870, the factory employed twenty-five men and seven women. Its success was short-lived however, and the factory was not rebuilt after it burned in 1880. Manter's factory remained in business, and about 1865, Manter employee and in-law J.M. Platt built a new shoe factory nearby. The building burned ten years later and the business was relocated to a nearby blacksmith shop. Workers could be housed in a nearby twenty-room boardinghouse. Manter's grist mill closed down in 1868, while the sawmill continued on a reduced scale until ca. 1890 (Londonderry Historical Society 1972). North Londonderry, on the eastern edge of the study area, also became a small industrial site, with businesses near the railroad depot. A shoe factory was established there by G.F. MacGregor in 1868, and was converted to steam power when it was taken over by Corning in 1875. In 1878, Annis Grain and Lumber company was formed and it soon operated a gristmill, lumber business and general store near the railroad depot. Nearby was the Fessenden Stave and Heading Manufacturing where some forty men were employed (Monroe and Federer 1995). North Londonderry grew into Londonderry's largest village, with several stores, mills, railroad station, and a neighborhood of residential side streets. During the

same period, Londonderry's public buildings and churches in the town center were also updated.

In 1872, a second rail line, the Nashua to Rochester Railroad was built, passing southwest-northeast through **Windham** and continuing through the corner of Derry. Near Windham's northern town line, its junction with the Manchester and Lawrence Railroad became a small village known as Windham Depot, with store, grist and sawmill located near the railroad station.

In **Manchester**, the Amoskeag Mills expanded and absorbed other factories. In the 1870s Amoskeag employed more than 4,000 and another 5,000 worked at smaller, associated textile mills. Shoe factories also operated in the city, including Kimball Brothers Shoe and Hoyt Shoe in East Manchester established in the 1880s and 90s. In the 1890s, the city's population topped 50,000.

Londonderry, like other agricultural towns in the region, suffered population losses after the Civil War, declining steadily to a low of 1,220 in 1890. Then, as local industries expanded, it rebounded to 1,408 by 1900. **Derry** experienced little growth in the mid-1800s, but increased rapidly from 1,809 people in 1870 to 2,140 in 1880, then boomed to reach 3,583 by 1900. **Salem** grew to 1,809 in 1880 and 2,041 in 1900. **Windham's** population continued to shrink, reaching 632 in 1890 (Bureau of the Census 1940).

In the late nineteenth century, fresh products in demand in urban markets became increasingly the focus of area farms. Fresh milk, collected in cans and shipped from the depot, became a more important cash product. Poultry began to replace other livestock in importance during this period. Crops of hay and corn remained important for animal feed, but grains were imported from the West by rail. Horses replaced oxen as draft animals. Market gardening to raise fresh vegetables for the nearby cities increased in importance. Orchards of apple trees, and to a lesser extent peaches, became a major component of all farms in this area where the soil was well suited for them (Bureau of the Census 1880). The H.P. Hood Company was a major outlet for dairy farms in the region, shipping around 20,000 quarts of milk to Boston each day from facilities at **Derry** Depot, as well as producing butter and cheese (Derry Historic Research Committee 1977:181).

However, during this period, many area farms were abandoned as residents went to work in the growing factories. Remaining farmers supplemented their incomes by taking in summer boarders. In **Londonderry**, boardinghouses included the Laurels in North Londonderry, and Echo Farm (burned 1916) at Wilson's Crossing.

The area's lakes and ponds became attractive to tourists and tourism became a major part of the region's economy. Crystal Lake had been a popular local swimming hole since the mid-nineteenth century (Mausolf 1991). At the outlet of Massabesic Lake in **Manchester** was the Mill Dam Hotel (Hurd 1892). The northern shore of the Lake developed as an upscale retreat with the Massabesic Hotel, accessed by the Concord

and Portsmouth Railroad (Mausolf 1991). Canobie Lake in **Windham** and **Salem** became a destination and recreation point for city people. Visitors came to stay at boardinghouses for summer vacations and summer residences were built near the lake shores. In the 1890s, three of Windham's twelve boardinghouses were located on Range Road on the ridge between Canobie Lake and Cobbetts Pond. They included Lakeview Farm, "Bella Vista" and the Johnson family's Highland View Farm. The historic farms stretched between the two bodies of water and property owners began erecting summer cottages on the lakes at either end. The first cottage on Cobbetts Pond was built in 1886. It was followed by many more in the 1890s. The owners of "Bella Vista" established a cabin colony known as "Camp Bell" at the northern end of their land, on the south shore of Cobbetts Pond. On the northwest side of Canobie Lake, cottages were built beginning in the 1880s on "Johnson's Point" by the Johnsons of Highland View Farm. The cottages were rented for many years, then sold into private hands in the 1950s (Monroe and Federer 1992).

It was the railroad that allowed large numbers of people to travel to summer homes and for day-trips at lakefront attractions. A railroad station was built in 1885 at the north end of Canobie Lake in **Windham** near the intersection of the old Londonderry Turnpike (Route 28) and Range Road (Route 111). This became known as Canobie Lake Depot, and a village by the same name grew up nearby, including a store and post office, blacksmith's shop and several residences. Residents of Lawrence, Methuen, Haverhill, and even Boston came to Canobie Lake Village by train and were transported by horse and wagon to local boarding houses and cabins. Dance halls and recreation areas were established on the lake shores. The largest of these was Policy Pond Grove or Granite State Grove, which was established on the north shore of Canobie Lake in the 1850s and greatly expanded in the 1880s. The Grove included boat rentals, bowling alleys, a dance hall, cook house, shooting gallery, and skating rink (Town History Committee 1975:94, 64).

The late nineteenth century was also marked by the rapid development of technology. A large fire in **Manchester** in 1870 was the impetus for establishing the Manchester Water Department. The City built reservoirs and a pumping station in the eastern corner of the city beginning in 1872. Lake Massabesic was the water source. A dam and a canal were located at the southwest corner of the lake; they fed a pumping station located on the west side of Cohas Avenue. A force main ran over 7,000 feet from the pumping station to the reservoir at the junction of Island Pond Road, Cohas Avenue and Mammoth Road, and gravity fed water from this reservoir to the city.

In **Derry**, a telegraph line was installed between the three villages in 1877. In 1882, a telephone line connected Derry Village and Derry Depot (Hurd 1892:176). The Derry Electric Light Company was formed in 1891 and a power plant established in West Derry on Horne's Pond. Downtown sections were electrified first and the process was not completed in rural areas until about 1930. The first power in Londonderry was generated by Merrill of North Londonderry in 1907, and that whole town was electrified by 1932 (Schmidtchen 1977:5).

A new mode of transportation, which would have a significant impact on the tourist industry, was introduced in the 1890s. The Chester and Derry Railroad was chartered in 1891, but construction was not completed until 1896. East of the study area, it began at the railroad station in **Derry** Depot, ran east through Derry Village, on to Beaver Lake, and through to Chester. Trolleys were timed to connect with B&M trains, and the cars carried considerable freight and mail from the depot (Historical Booklet Committee 1969:27-28).

1900-1920s: Streetcar Era, Summer Tourism, Industrial Peak, Commercial Development and Civic Activity, Road Improvements

The streetcar era peaked in the early 1900s. An electric railroad connecting Manchester and Derry was proposed as early as 1901 and opened in 1907. The Manchester and Derry Railway ran from south of Goffe's Falls in southern **Manchester**, over land to North **Londonderry**, then paralleled Mammoth Road south for about a mile, before turning east through woods and fields and to the railroad depot in **Derry**. For much of its history, hourly service was provided on the route, seven days a week (Cummings 1960:20, 28). The streetcar allowed Derry and Londonderry residents to commute to work in Manchester, brought tourists out of the city to Beaver Lake in Derry, where the Chester and Derry Electric Railroad opened Beaver Lake Pavilion in 1901 (Schmidtchen 1977:13). The City of **Manchester** built a bathhouse and a swimming beach on Crystal Lake. The first bathhouse was erected in 1919. The existing structure was built by the Civilian Conservation Corps (C.C.C.) in 1939-41 (Mausolf 1991).

The **Salem** Division of the Massachusetts Northeastern Street Railway was built between 1900 and 1903, with fifty-six miles of track connecting Salem with Haverhill and Nashua. The trolley lines came from Lawrence and Methuen in the south, parallel to the west side of South Policy Street, and from Nashua and Lowell in the west, overland between Pelham Road and Route 38. They converged in the southwestern part of Salem Depot near the intersection of South Policy Street and Raymond Avenue. From there, a branch continued to a terminus on the southeast edge of Canobie Lake. The main line ran east on Main Street (Route 97) toward Haverhill. The 1902 car barn is extant on Main Street. The convergence, known as "Point A Station," was the largest trolley crossing in southern New Hampshire. In the vicinity were a waiting station, Heaps' Store and a small hotel known as the Fairmont House, which operated during the early 1900s.

In 1902, the Northeastern Street Railway opened Canobie Lake Park, on the southeast shore of the Lake in **Salem**, creating an attraction and destination point (Turner and Noyes 1975:92, 213). (It was one of a number of amusement parks operated by street railway companies, including Paragon Park in Nantasket, Horn Pond in Woburn, Pine Island Park in Manchester, and Willand Pond in Somersworth.) The new park replaced Granite State Grove in importance after the latter was destroyed by fire in 1909. Another recreational destination was Rockingham Park built in **Salem** in 1905 by a group of New York promoters, who hoped to make Salem part of the grand

circuit of racetracks. They purchased the land, laid out the track, erected grandstands and paddocks. However, when the State outlawed gambling in 1906, the group suffered severe financial losses (Mausolf 1998).

Besides the large recreation spots, a great deal of building took place in the first half of the twentieth century, when seasonal cottages were constructed along the shores of Cobbetts Pond and Canobie Lake in **Windham** and **Salem**. By 1912 there were some seventy cabins on Cobbetts Pond (Town History Committee 1975:68). In 1903, the Armstrong family, owners of the Sally Park House (WND0084), the George F. Armstrong (WND0085) and Robert Armstrong (WND0086) Houses, and large tracts of surrounding land (much of it now covered by I-93), began to subdivide their land on the northwest shore of Canobie Lake. A road was built from Range Road at the Thom/Dinsmoor House to the Lake and some thirty lots were laid out along West Shore Road. Buyers were from Lawrence and Methuen. By 1906, six cottages had been built and five more were in progress. Another thirty lots were offered for sale in that same year. Later, the owner of the George F. Armstrong House (WND0085) opened a beach with bathhouses, picnic grove and refreshment stand on his land at the northeast end of Cobbetts Pond. In the 1920s, John Evans from Lawrence created Bella Vista beach and dance hall, which became popular with day-trippers, on Cobbetts Pond on land associated with the Moses Haseltine House (Monroe and Federer 1992). Development of South Shore Road in Salem began in the early 1900s.

During the early 1900s, the character of the town of Windham, and Salem as well, was strongly influenced by the residency of eccentric millionaire Edward F. Searles. Born in 1841, Searles rose from work as a bobbin boy in the mills of Methuen, Massachusetts, to became a prominent interior designer in New York. His marriage to the widow of San Francisco magnate Mark Hopkins, gave him a quarter share of the Southern Pacific Railroad upon her death in 1891. With this inheritance Searles indulged his passion for medieval architecture. His estate at Stillwater Manor on World's End Pond in **Salem** (southeast of study area) was begun in the 1890s. In 1905 he built Searles Castle in **Windham** which became his primary residence. These and other important buildings in Windham and Salem were in collaboration with eminent Boston architect Henry Vaughan. The Castle is located in the study area, on the northeast side of the Exit 3 interchange (determined eligible under the Windham/ Salem 10075 Project). To the east on Route 111 is the Searles School and Chapel (listed on National Register). Searles amassed a vast amount of property (several thousand acres) between his estates. At one time he owned the entire territory north of Canobie Lake, and reportedly could drive the twenty miles between Methuen and Windham without leaving his property. He contributed large amounts of money to local towns. Numerous examples of stone work are found throughout the town of Windham, as indication of the influence of the materials and mode of construction used by Searles and Vaughan (Monroe and Federer 1991b).

Improvement of area roads for automobile travel began in the early 1900s. The earliest north-south highway to be developed through the region was the central trunk line established by the State in 1907 along what is now Route 3 on the west side

of the Merrimack River. State improvements to other highways soon followed. In 1904 the old Londonderry Turnpike, from Messer's Corner to **Salem** Depot, was "macadamized" with funds donated by Edward F. Searles. Local factory owners Woodbury and Tenney funded work north to the **Windham** line (Mausolf 1998). A major reconstruction of the Londonderry Turnpike took place in 1914. These segments of the old Londonderry Turnpike became part of State Route 28, which was created in 1913-15 (numbered in the early 1920s) as a south-north highway from the Massachusetts line north to Manchester (Turner and Noyes 1974:102). Route 28 turned off the old Turnpike in Derry and the segment to the north remained essentially abandoned. NH Route 102 was established between Hudson and Derry in 1915, and from Derry to Raymond in 1919. Sections were straightened in the 1930s. The Town of Londonderry began improvements to Mammoth Road in 1917 (Monroe and Laprey 2001; Schmidtchen 1977:13-14).

The area prospered through the first quarter of the twentieth century, due to the nearby manufacturing centers of Nashua, Manchester and Lowell, which provided employment, a steady need for produce, and a supply of manufactured goods. As of the 1910s, the Amoskeag mills in **Manchester** were at the peak of operation and success, employing as many as 17,000 workers (Monroe and Federer 1993 1992). The City's population topped 70,000 in 1910 and peaked in 1920 at 78,384 (Bureau of the Census 1940).

This was the height of **Derry**'s shoe industry. Several large factories were built and occupied by a series of companies, whose financial successes appear to have been short-lived. Derry Depot contained the Pillsbury shoe factory, Perkins & Hardy Shoe, Derry Shoe Company, V.H. Moody Shoe, Emerson Shoe and Woodbury Shoe. Wood products also remained important. **Derry**'s population continued to increase from 3,583 in 1900, to 5,123 in 1910. West Derry grew as a commercial center, with the construction of new commercial blocks, as well as a new Town building. Manufacturing continued at **Salem** Depot (Turner and Noyes 1974:147). During the same period, small-scale local industries declined and Seavey's sawmill in **Windham** Depot was demolished (Town History Committee 1975:17). The larger Annis Grain and Lumber Company in North **Londonderry** remained prosperous and rebuilt its complex after a series of fires in the early 1900s. Londonderry's population grew again, to 1,533 residents in 1910 (Monroe and Federer 1995).

Agriculture remained the focus of the economy in the outlying areas of all study area communities. In **Derry**, the Hood Company continued operations after Harvey P. Hood's death in 1900, and dairy farming for fresh milk production remained important to area farms. During the same period, apples became the principal crop throughout the region, particularly in **Londonderry**. Originally part of the "Baldwin belt," named for the apple variety that became popular in northeast Massachusetts and southern New Hampshire in the late nineteenth century (Folger and Thomson 1921: 33-34), the impetus for orchard expansion in Londonderry was the introduction in 1900 of a new variety of apple, the McIntosh, which was developed in Canada and became popular for its excellent flavor and color. The apple industry in

Londonderry was introduced when Rosecrans Pillsbury, owner of the Pillsbury shoe factory in Derry, publisher of the Manchester Union and operator of a large dairy farm, planted the McIntosh orchards now known as Woodmont Orchards, located on the west side of I-93, north of Exit 4. Londonderry's other major orchard, Moose Hill Orchards was established about the same time by Wallace Mack (Schmidtchen 1977:10; Monroe and Federer 1995). The industry flourished with the introduction of refrigerated storage in 1915 at Woodmont Orchards. Beginning in the 1910s, dairy farms were converted to orchard production. Apples were marketed mainly in New England, though exports to Europe were common in the 1920s and 1930s (Schmidtchen 1977:11). Cider mills were located at West Derry and North Londonderry.

On Range Road in **Windham**, a large orchard was established by the Dinsmoor family (on the north side of Range Road, southwest of I-93). It contained 4.5 acres of apple trees, two acres each of peaches and pears, as well as grapes. Fruit was shipped by rail from Windham to Lawrence. On the south side of Range Road, on land extending to and beyond present I-93, the Thom/Dinsmoor House property was operated as a huge pig farm from the 1890s to the 1920s. Hogs were butchered nearby in Salem and the meat shipped by rail to Boston from Canobie Lake Station. The Johnson family operated a large dairy farm at Highland View Farm on Range Road, and had a milk route in Salem. What is now Nassar's Orchard on the east edge of the study area in Windham was also established during this period.

Poultry farming also increased, often combined with orchard production and market gardening. One poultry farm and market garden in the study area was that of Ferdina and Albina Cote whose family created a small neighborhood known as Coteville near the Derry-Londonderry line. The Cotes moved from Nashua and purchased a house on twenty-four acres in 1904 (Schmidtchen 1977:232; Monroe and Federer 1995). In the study area in **Salem,** a large poultry farm was located at 92 Cross Street. The immigration of Armenian farmers into the section of south Salem along Salem and Cross Streets heralded the explosion of the market gardening or "truck farming" era in that town. These typically large and industrious families cleared significant amounts of land on both sides of these streets and successfully grew large quantities of vegetables for sale locally and in the nearby factory cities of Haverhill, Lawrence and Lowell (Turner and Noyes 1974).

1920s-1950: Automobile Era, Decline of Industry and Farming, Summer Home Tourism

By the 1920s, the automobile had replaced the railroad and the trolley as a means of transportation. The Manchester and Derry Railway, which was never a financial success, closed in 1926, and the Derry and Chester line ceased operation in 1928 (Neil 1986). The last streetcar on the Salem Division ran in 1929. Railroad travel also came to an end. The Manchester and Lawrence remained in operation on a reduced scale. By the 1920s the Wilson's Crossing station was no longer in use and the building was moved to North Londonderry to replace its depot which had burned. The Worcester, Nashua, and Portland Division of the Boston and Maine, passing through Windham

Depot shut down in 1934 (Derry Historic Research Committee 1977:69). Passenger service was offered on the Manchester and Lawrence once a week on Sundays until 1953. Limited freight traffic continued into the late twentieth century.

Highway construction became increasingly important to the region. In **Salem**, Route 28 was widened somewhat in 1931-32 and became four lanes in 1950. In 1937-38, a portion of the old Londonderry Turnpike in **Derry** (which had fallen into disrepair and disuse, was repaired and reopened by the Works Progress Administration). The increased mobility allowed area residents to commute farther to work expanding opportunities for employment.

Automobile-related businesses increased, with service garages, filling stations, auto showrooms, and roadside dining establishment appearing with more frequency. Following World War I, Rockingham Park was used periodically for automobile and motorcycle racing. When gambling was legalized again in 1933, Rockingham Park returned to horse racing and became one of the State's largest sources of revenue. Motels, trailer parks and restaurants were built in the vicinity to serve workers and visitors to the track (Mausolf 1998). Canobie Lake Park was sold at auction and reopened under private ownership in 1932. A new parking lot for 5,000 cars opened off North Policy Street (Seed and Khalife 1996:53).

The automobile also allowed large numbers of families to establish small lakefront vacation homes. The shores of Beaver Lake and Island Pond in Derry, Canobie Lake and Cobbetts Pond in Windham and Salem, and Crystal Lake in Manchester became densely settled with small cottages during this period. Farm boardinghouses had become less popular and all in the area closed during the 1920s. Cottage owners came primarily from southern New Hampshire and northeastern Massachusetts. At the same time, the region's industrial prosperity came to an end. The closing of the Amoskeag mills in **Manchester** in 1936 had a considerable impact on the area. After peaking in 1920, Manchester's population declined and hovered around 77,000 during the next two decades. In West **Derry,** the shoe industry continued on a reduced scale, with various companies operating for short periods. Derry's population fluctuated in the low 5,000s through this period. The village of West Derry continued to grow as a commercial center and numerous new public buildings were constructed, including a library, Masonic Temple, Veterans' Memorial building, and Post Office. **Salem** Depot also grew with the construction of public buildings including St. Joseph's Church in 1929. As a whole, Salem continued to grow slowly from 2,318 in 1920 to 3,267 in 1940. In North **Londonderry**, the Fessenden lumber yard and stave mill employed some thirty people as of the 1930s, but all other local industries had closed by this time (Schmidtchen 1977:9). Londonderry's population fluctuated between 1,300 and 1,400. **Windham**'s population reached a low in 1930 of 538 and then returned to its late nineteenth century size, topping 600 by 1940 (Bureau of the Census 1940).

The number of farms in the area continued to decline. On Range Road in **Windham**, the fruit farm of the Lake View House was largely abandoned after the 1920s. The

pig farm at the Thom/Dinsmoor House closed. By the 1940s, dairy farming had ceased on all but the Johnson's Highland View Farm. Several farmers operated vegetable farms and had roadside stands during this period (Monroe and Federer 1992). In **Salem,** the small Armenian market farms continued to prosper, though profits began to be impacted by the competition brought on by the refrigerated transport of produce from such other agricultural regions as the Midwest and California. The H.P. Hood Company sold its farm in **Derry** in 1938 after the demand for certified milk dropped. During the same period, poultry farming increased. A large egg grading and auction facility opened in West Derry in 1934, drawing business from all over New England. Mixed farming and truck farming continued on a reduced scale through the mid-twentieth century. From **Salem** farms, fresh milk was delivered to the nearby cities of Methuen and Lawrence, Massachusetts (Turner and Noyes 1974:158). Orchards in **Londonderry** continued to expand modestly through World War II, though the European export business of the 1920s and 1930s disappeared during the war years, dramatically reducing international profits (Schmidtchen 1977: 10-11).

Another form of transportation, the airplane, had nearly as great an impact on the history of the region as the automobile. In 1927, Smith Field was established by the City of Manchester (Monroe 1991). In 1940, as World War II escalated, it was taken over by the military, an airbase rapidly constructed and renamed Grenier Field (Monroe 1991).

1950-Present: Highways, Commuting, Residential Development

During the second half of the twentieth century, the development of the area continued to be directly tied to regional transportation routes.

Communities in the study area grew at unprecedented rates, due to the construction of several major highways and the growth of the technology industry in nearby Nashua and the Mass. Route 128 and I-495 beltway areas in Massachusetts. West of the study area, the F.E. Everett Turnpike (parallel to older Route 3, along the west side of the Merrimack), opened between Manchester and Nashua in 1955. Construction of Interstate 93 began in 1961, and the opening of the highway in 1963 was the single-most influential event in the twentieth century development of the region. The high speed road replaced older routes between the cities of Lowell, Manchester, Concord and points north, and brought southern New Hampshire within an easy drive of Boston. New Hampshire's favorable tax rate and the region's proximity to Massachusetts brought extensive new settlement, which resulted in a boom of new building to accommodate the increase in population. Area towns became "bedroom communities."

Londonderry's population more than doubled between 1960 and 1970, from 2,457 to 5,346. **Derry** grew from 6,987 to 11,712, and reached 18,875 by 1980 (Bureau of the Census 1990). **Salem's** population in 1974 approached 19,000 (Turner and Noyes 1974:4). Between 1980 and 1990, **Derry's** population grew more than fifty percent

from 18,875 to 29,603. **Londonderry's** population increased from 13,598 to 19,781, and **Windham's** from 5,664 to 9,000. **Manchester** grew from 90,936 people in 1980 to 99,567 in 1990 (Bureau of the Census 1990).

Automobile transportation made the railroad obsolete. As of 1950, passenger service through **Derry** and **Londonderry** was offered once a week on Sundays. The last passenger train passed through Salem, Windham, Derry and Londonderry in 1953. Freight transport continued on a limited scale, revived briefly by the energy crisis of the 1970s. As of the 1990s, the Manchester and Lawrence line was active for freight traffic between Salem and Lawrence, while northern sections were inactive (Monroe and Federer 1993). Trains ran from Boston to Rockingham Park in Salem until 1962 (Turner and Noyes 1974:86). The **Manchester** Airport has played an increasing role in the economy of the region. Grenier Field was returned to public use in 1957, and the Manchester Airport Authority was created in 1959 (Monroe 1991). The airport was expanded considerably in the late twentieth century.

In the late twentieth century, manufacturing declined and the workforce became dominated by service sector, technical and other non-manufacturing jobs. The shoe industry in West **Derry** only partially recovered after World War II, due to competition with southern mills that had access to cheaper labor and power. The end of the industry came in the 1980s with the closing of the last two factories. To some extent, the shoe industry was replaced with high-tech manufacturing companies, located primarily along Route 28 (Neil 1986). Older industries in **Salem** were also closed. As of the 1970s, there were only two local factories, the Granite State Potato Chip Company and the Salem Coca Cola Bottling Company, both located on Route 28 (Turner and Noyes 1974:158, 150). Industrial development in the region focused on the **Manchester** Airport and industrial parks around it, particularly to the south in **Londonderry** where large tracts of undeveloped land were available. By the late twentieth century, only a small percentage of area residents worked in the same town in which they lived. In Derry, as of 1986, 73 percent of workers commuted to other towns and of these, 34 percent worked in Massachusetts (Monroe 1986).

Local farming essentially came to an end, though many properties retain agricultural land and buildings. In the late twentieth century, apples are the only surviving local crop in **Londonderry**. They are marketed throughout New England, and exported to Canada and South America, while apple picking is a popular tourist attraction in the fall (Schmidtchen 1977:11; Monroe and Federer 1995). There are currently five commercial orchards in Londonderry, with Woodmont Orchards being the largest at almost 200 acres under cultivation. Nassar's Orchard operates on the west edge of the study area in **Windham**. In **Salem**, poultry farming peaked in 1950, and by the 1960s all poultry farmers were out of business. Dairy farming also declined until there were only two dairy farms operating in town in 1974 (Turner and Noyes 1974:158). The Armenian market farm era came to an end in the mid-1950s, when the competition brought about by new developments in the transportation and storage of produce effectively made these small local farming operations an anachronism.

Only one small market farm continues to operate in the area, the Peters farm stand at the southeast intersection of Kelley Road and Cross Street. Other Salem farms include South Policy Farm run by the Hagopian family, the Donabedian Farm on Lawrence Road and another on Kelley Road. In Windham, the Johnson family of Range Road operated a dairy farm until 1980 (Monroe and Federer 1992). The Johnson Farm, which continues as a market farm with roadside shop, is now one of the only operating farms in the project area.

Population growth resulted in a major building boom in the study area towns as throughout Southern New Hampshire. In rural areas, land that had once been pasture and field, and had reforested during the first half of the Twentieth century, became the location of tracts of houses. In Salem, the building boom created extensive residential subdivision and newer homes were erected among the older buildings in historic areas. An early subdivision was Noyes Terrace in South Salem (southeast of study area) built in 1948. Other mid-twentieth century subdivisions are "The Macs" built off Kelly Road in the early 1960s and the large area between Millville Road and Route 28 north of Salem Depot. Most of the lakefront cottages in the study area were converted to year-round use. In **Windham** a great deal of recent development has occurred on the west side of Canobie Lake and the shores of Cobbetts Pond. At the north end of the study area, substantial single-family and multi-family residential development has occurred along Bodwell Road, with the west side of the road being largely apartment complexes, while the east side has seen substantial individual new houses and several small subdivisions. Virtually all of this construction dates from the 1970s and thereafter, though some ranch house construction from the 1950s appears along the north end of Bodwell Road and Cohas Avenue, at the northernmost end of the study area, closest to downtown Manchester.

New commercial and business development focused around interchanges along I-93. In **Salem,** Exit 1 leads to the vast Mall at Rockingham Park. Large scale commercial development has also taken place along Route 28 in Salem and on a less dense scale to the north in Windham. Commercial and office development in Londonderry is concentrated along Route 102 near Exit 4 on I-93, just west of the older village of West Derry. East of the study area, Route 28 (Crystal Avenue and Rockingham Road north of West Derry is heavily developed, the one of nearly every chain of restaurant and store. To the north, Route 28 on either side of Exit 5 on I-93 is also the location of commercial activity.

3.10.5.3 Individual Properties and Historic Districts Eligible for the National Register of Historic Places

A total of thirty-eight properties and five potential historic districts (containing twenty-two individual properties also surveyed individually) were surveyed as part of this undertaking.

The material developed for this study is available at NHDHR, NHDOT and FHWA, along with documentation and discussion of eligibility.

The following is a description of those properties that have been determined eligible for the National Register of Historic Places.

Salem

The Armenian Settlement Historic District (SAL-D1) is located in southwestern Salem, west of I-93 near Exit 1. The area encompasses approximately 105 acres along Salem Street between the intersection of Salem Street, Cross Street and Brady Avenue and the Massachusetts border. The Armenian Settlement Historic District is eligible for the National Register under Criterion A for its associations with the significant regional trend of Armenian immigrant settlement in America and its evolution over 100 years.

Armenians began immigrating to the United States after 1890, when the political persecution by the ruling Turkish government became untenable. This treatment worsened over time, with mass executions of Armenians occurring intermittently over the next two decades, culminating in the Armenian Genocide of 1915.

This rural neighborhood of south Salem is directly associated with the earliest influx of Armenian immigrants who purchased land and established farmsteads here in the first years of the twentieth century for the purpose of market gardening. They later established other businesses here, particularly in heavy construction.

The Kinzler House (SAL0204) is eligible for the National Register of Historic Places under Criterion A for its historical associations with road agent Bill Kinzler and New Hampshire's Good Roads Movement as it unfolded in the Town of Salem throughout the 20th century. Kinzler, who was born in this house and lived here all his life, was responsible for the development and maintenance of Salem's modern road system. The state's road system had deteriorated from lack of use following construction of the railroad network. The Good Roads Movement was an effort to improve New Hampshire's local roads in order to facilitate increasing automobile traffic. Kinzler advocated modern petroleum-based paving materials, using them to pave most of the town's roads in the 1920s-30s.

The property's history is also an interesting illustration of the "professionalization" of town government in New Hampshire, moving from the efforts of individuals – at times in their homes – to a more formal municipal organization. The property is located on the south side of Cross Street, west of I-93 near Exit 1. The eligible boundary for the Kinzler House includes 5.8 acres along Cross Street and I-93.

Windham

The George F. Armstrong House (WND0085) is located on the north side of Range Road (86 Range Road) between the north and southbound lanes of I-93. The

property was determined to be eligible for the National Register of Historic Places under Criterion C in 1992 as one of the best examples of a late 19th century vernacular wood-framed, gable-front dwelling in Windham. It is a significant farm complex including barn, barnyard, and connected sheds. The 1992 eligible boundary encompassed the house and its domestic setting, and extended to parcel 17G/30 to include the Armstrong barn and barnyard, resulting in an eligible parcel of 3.91 acres. Since then, the barn, barnyard, and connected sheds once associated with the house have been converted to a restaurant and extensively altered and expanded. The new boundary of the eligible property now includes only the footprint of the house and its character-defining domestic space (primarily its front and east side yard), but excluding the much-altered barn.

The Robert Armstrong House (WND0086) is located on the north side of Range Road (88 Range Road), between the north and southbound lanes of I-93. The property is eligible for the National Register under Criterion C as a very fine local example of an early Federal period 2 1/2 story, 5-bay, one room deep dwelling. It is further distinguished by the high quality, integrity and originality of its interior features and finishes. It also retains some historic landscape features, including two large trees which frame the roadside view and define its dooryard. Later 19th century additions to rear are in the nature of "connected architecture," a reflection of its history as a farmhouse. The eligible boundary for the Armstrong House is limited to the footprint of the dwelling and its domestic space.

Indian Rock (WND0206) is a large natural boulder with a circular depression on top traditionally held to be the site where Native American inhabitants of the Windham area pounded corn. The rock is located in the woods on the north side of Indian Rock Road in Windham, on the old road bed for what is now NH Route 111. The rock was first mentioned in L.A. Morrison's 1883 history of Windham. A preservation committee was formed by the town in 1932 and a bronze commemorative plaque was placed on the rock by the town in 1933. The impetus for commemorating the rock may have been the heavy construction going on along Indian Rock Road at the time. Windham turned Indian Rock Road over to state control in 1932 and several campaigns of road work straightened the route from its original, winding path.

Indian Rock is eligible for the National Register under Criteria Consideration F, representing the early 20th century Colonial Revival movement's interest in colonial history and desire to preserve relicts of that history. The erection of the plaque on the rock is symbolic of the value Windham residents put on the former Native American population of the area. The rock is mentioned as an important historic landmark in every townwide historical publication since 1883. The eligible boundary for Indian Rock is the immediate setting of the rock between it and Route 111, incorporating the pathway from the road and the wooded surroundings.

The George Dinsmore House (WND0033), located on the south side of Indian Rock Road (82 Indian Rock Road) on the shore of Cobbetts Pond, was determined eligible for the National Register in 1994 under Criterion C as a "distinctive and well-executed local example of the Craftsman Style executed in stone, reflecting the strong influence the construction of Searles Castle had on the architecture of the area." The eligible boundary is limited to a 1.1-acre parcel along Indian Rock Road, which encompasses the dwelling, stone outbuildings, and mature trees that reinforce the historic setting of the property.

The Searles Castle Historic District (WND-D1) was determined eligible for the National Register under Criterion C in 1994. The district is roughly bounded by Searles Road on the east, NH Route 111A on the south, and Indian Rock Road (NH Route 111) and I-93 on the west. The northern boundary runs between Searles Road and I-93 to encompass approximately 95 acres. The Searles Castle Historic District is significant as the best surviving example of the artistic collaboration between architect Henry Vaughan and his patron, Edward Searles. The pair sought to create an idealized environment, a "kingdom of architecture and landscape," which expressed the qualities of a spiritual and aesthetic retreat through use of the Gothic Revival style. The buildings and structures within the district express an archaeological correctness in the architect's use of Gothic elements, rustic stone construction, and the ecclesiastical qualities of the interiors. The surrounding grounds offer a sense of seclusion and picturesque qualities.

Londonderry

The Woodmont Orchards Historic District (LON-D1) is eligible for the National Register under Criterion A for its historic associations with the commercial apple growing industry and with the significant contributions of Rosencrans Pillsbury and William Lievens to the industry. In the 20th century, apple growing quickly outpaced all other agricultural pursuits in Londonderry and the region. Woodmont is the largest of five commercial orchards remaining in town today and continues to be owned and operated by the Lievens family. The eligible boundary for the orchard covers 196 acres on both sides of Pillsbury Road west of I-93.

Although not yet fifty years old, **The Robert J. Prowse Memorial Bridge (LON0116)** is eligible for the National Register of Historic Places under Criterion C through Criterion Exception G for its importance in the history of New Hampshire bridge engineering. The bridge carries Ash Street/Pillsbury Road over I-93 between Exits 3 and 4. Only four steel rigid frame bridges have been identified in New Hampshire: this one, designed as early as 1958 and built ca. 1962; Route 10 over the Ashuelot River in Gilsum, designed by the NH Highway Department in 1935; the Canal Street approach to the Notre Dame Bridge in Manchester, designed by J.R. Worcester and Co. of Boston in 1936 and demolished ca. 1988, and the East Side Road bridge over I-393 in Concord, built ca. 1978. The Gilsum bridge was determined to be eligible in 1999. The eligible boundaries for the Robert J. Prowse Bridge are limited to the bridge footprint.

The Reed Paige Clark Homestead (LON0114) is eligible for the National Register of Historic Places under Criteria A and C. It is significant under Criterion A for agriculture as a connected farm complex with fields defined by dry-laid granite walls. It is eligible under Criterion C as an extremely well-preserved example of connected farm architecture, executed in stone in the Greek Revival style. The homestead is located on the corner of Stonehenge and Perkins Roads west of I-93. The eligible boundary encompasses 114.4 acres, the majority of which is located south of Stonehenge Road, abutting the west side of I-93.

The Shepard House (LON0103), built ca. 1952 at 99 Rockingham Road, is individually eligible for the National Register of Historic Places under Criterion C as a well-defined example of the Ranch style and form. The eligible boundary covers the entire 9-acre lot. A ca. 1970 rear addition does not appear to overwhelm the house's original design intent. The Shepard House is one of a number of ranch houses built in a post-war subdivision called Meadow Estates laid out on both sides of Rockingham Road in 1947.

The Moody House (LON0117), built ca. 1952 at 113 Rockingham Road, is individually eligible for the National Register of Historic Places under Criterion C as a well-defined and extremely well preserved example of the Ranch style and form. Even its period landscaping and setting are intact. The eligible boundary covers the entire 1.4-acre lot. The Moody House is one of a number of ranch houses built in a post-war subdivision called Meadow Estates laid out on both sides of Rockingham Road in 1947.

The Gearty House (LON0105), located on the west side of Rockingham Road (117 Rockingham Road), is less than fifty years old but is of such exceptional significance that it is eligible for the National Register under Criterion C and Criterion Exception G as a well-defined example of ranch style form. The eligible boundary covers the entire 1.5-acre Gearty House lot. The Gearty House is one of a number of ranch houses built in a post-war subdivision called Meadow Estates laid out on both sides of Rockingham Road in 1947.

Manchester

The Charles R. Clark House (MAN0010), located at 2081 Bodwell Road, is eligible for the National Register under Criterion C as a rare representation of stone masonry construction in Manchester. It is one of only two known stone houses in Manchester. The rough stone work is well executed. The house has a distinctive intersecting hall plan. The property is located on the northwest side of Bodwell Road, just over the Manchester border. The eligible boundaries for the property cover approximately 17-acres of land between Bodwell Road and Cohas Brook.

The Manchester Low Service Waterworks Historic District (MAN-D1) is eligible for the National Register under Criteria A and C.

The Manchester Low-Service Pumping Station, an excellent example of High Victorian Gothic architecture, was designed in 1872 by the nationally prominent engineer John Thomas Fanning (1837-1911). J. T. Fanning was a nationally recognized engineer, architect, and author, whose career warrants recognition.

The Manchester Waterworks also gains significance as the first mechanically powered municipal water supply system in New Hampshire. Although today termed a "low service" system, the Manchester Waterworks would have provided "high service" by nineteenth-century standards, utilizing hydromechanically-powered pumps to raise water from the 250-foot elevation of Lake Massabesic to a 16-million-gallon reservoir elevated at 350 feet, about 150 feet above the elevation of Elm Street. The reservoir on Mammoth Road is part of the original water supply system, being connected to the pumping station by a 7000-foot force main through which 2.8 to 5.7 million gallons were pumped each twenty-four hours.

The Manchester Low Service Waterworks Historic District is a linear district, reaching from Lake Massabesic on the eastern end, through the canal system to the pumping station on Bodwell Road, and along the force main to the Manchester City Reservoir on Mammoth Road to the west. The district encompasses approximately fifty-five acres.

3.11 Socio-Economic Resources

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3.11.1 Demographics

The five study area communities fall within two different counties and three different labor market/metropolitan statistical areas. Derry, Londonderry, Salem, and Windham are located in Rockingham County, and Manchester is located in Hillsborough County. Derry, Salem, and Windham are part of the NH portion of the Lawrence, MA Primary Metropolitan Statistical Area (PMSA)[31]; Londonderry is part of the Nashua Primary Metropolitan Statistical Area (PMSA)[32]; Manchester is part of the Manchester Primary Metropolitan Statistical Area (PMSA)[33]. Manchester, Derry and Londonderry are part of the Southern New Hampshire Regional Planning Commission, and Windham and Salem are part of Rockingham Regional Planning Commission. Population, housing, employment, and wage information for these areas is presented and analyzed below.

▼

[31] The other communities in the NH portion of the Lawrence, MA PMSA are Atkinson, Brentwood, Danville, East Kingston, Hampstead, Kingston, Newton, Plaistow, Sandown and Seabrook.

[32] The other communities in the Nashua PMSA are Amherst, Brookline, Hollis, Hudson, Litchfield, Merrimack, Milford, Mont Vernon, Nashua and Wilton.

[33] The other communities in the Manchester MSA are Allenstown, Auburn, Bedford, Candia, Goffstown and Hooksett.

3.11.1.1 Population

Derry, Londonderry, and Windham each experienced substantial population growth over the 1970's and 1980's. Average annual growth in these three communities during these periods ranged from 6 to 15 percent. The populations of Londonderry and Windham roughly tripled between 1970 and 1990, with Londonderry growing from approximately 5,300 to 19,800 people and Windham increasing from 3,000 to 9,000 people. Derry's population more than doubled over the same period, increasing from approximately 11,700 to 29,600. Between 1990 and 2000 growth slowed for all five communities, with an average annual growth rate slightly under 2 percent (see Table 3.11-1 Population).

Average annual population increases during the 1970's and 1980's in these three communities were substantially higher than for Rockingham County (nearly 3 percent) or the state as a whole (2 percent). Derry and Londonderry also experienced the greatest absolute growth of the five study area communities, increasing by 17,900 and 14,400 people respectively between 1970 and 1990. Between 1990 and 2000, growth was slower, with absolute growth of approximately 4,400 and 3,500 respectively.

In Salem, population growth was more moderate during the 1970's (nearly 2 percent average annual change) and 1980's (less than 1 percent), falling below average annual growth rate for Rockingham County in both decades. The 1990's have seen Salem's growth rate rebound to nearly 1 percent, in keeping with the rate for Rockingham County's as a whole. Manchester also experienced relatively slow growth during this period, with average annual percent growth of approximately ½ percent during the 1970's and less than 1 percent during the 1980's. This was substantially below average annual growth rates in Hillsborough County (2.4 percent during the 1970's and 2.1 percent during the 1980's) and the state as a whole (2.5 percent during the 1970's and 2.0 percent during the 1980's). Manchester's average annual growth rate has remained low during the 1990's, at less than 1 percent, though it is in less variance with Hillsborough County (at 1 percent) and the state as a whole (less than 1 percent than in earlier decades) (see Table 3.11-1 Population). Absolute growth of 7,343 for Manchester in the 1990's, however, is the largest for this time period, matching the absolute growth of Derry and Londonderry in the 1970's.

Table 3.11-1
Population

Comments	1970	1980	1990	2000	Absolute Change 1970-1980	Average Annual Change 1970—1980	Absolute Change 1980-1990	Average Annual Change 1980-1990	Absolute Change 1990-2000	Average Annual Change 1990-2000
Salem	20,142	24,124	25,746	28,112	3,982	1.98%	1,622	0.67%	2,366	0.92%
Windham	3,008	5,664	9,000	10,720	2,656	8.83%	3,336	5.89%	1,720	1.91%
Derry	11,712	18,875	29,603	34,021	7,163	6.12%	10,728	5.68%	4,418	1.49%
Londonderry	5,346	13,598	19,781	23,263	8,252	15.44%	6,183	4.55%	3,455	1.75%
Manchester	87,754	90,936	99,332	107,006	3,182	0.36%	8,396	0.92%	7,343	0.74%
Rockingham County	138,950	190,345	245,845	277,359	51,395	3.70%	55,500	2.92%	31,514	1.28%
Hillsborough County	223,941	276,608	335,838	380,841	52,667	2.35%	59,230	2.14%	45,003	1.34%
New Hampshire	737,578	920,475	1,109,117	1,235,876	182,897	2.48%	188,642	2.05%	126,669	1.14%

Source: 1970 U.S. Census
1980 U.S. Census
2000 U.S. Census

3.11.1.2 Housing

Table 3.11-2 depicts the Year 2000 number of housing units in each of the five study area communities, as well as Rockingham County, Hillsborough County, and the state as a whole. Manchester has the most housing units with 45,892 units, followed by Derry with 12,735 units, Salem with 10,866 units, Londonderry with 7,718 units and Windham with 3,906 units.

The most substantial average annual growth in housing units over the 1980-1990 decade was experienced by Windham, (9 percent), Derry (6 percent), and Londonderry (5 percent). Generally these figures were higher than average annual percent growth in the County (3 percent) or the state (3 percent) over the same period. From 1990-2000, however, these average annual growth rates dropped, to an average rate of about 1 percent.

Table 3.11-3 depicts housing units by type for each of the study area communities. While each of the five communities offers a range of housing types, the 1996 housing mix in Manchester and Derry is characterized by relatively large percentages of multi-family units, 63 percent and 46 percent respectively. At the other end of the spectrum, Windham is comprised predominantly of single family homes (91 percent) (see Table 3.11-2. Total Housing Units and Table 3.11-3. Housing Units by Type.)

3.11.1.3 Employment

The City of Manchester is a major regional employment center, providing approximately 55,850 jobs to area residents as of 1990. Salem also has a substantial economic base, with 15,400 jobs. Derry and Londonderry, with smaller employment bases, provided approximately 6,400 jobs and 5,600 jobs in 1990. Windham has the smallest employment base of the five study area communities, with 1,300 jobs (see Table 3.11-4. 1990 Average Annual Employment.)

The principal economic sectors within Rockingham County and Hillsborough County include trade, services, and manufacturing. In 1990, trade accounted for 32 percent of employment in Rockingham County, while services accounted for 25 percent, and manufacturing for 17 percent. By 1996, trade grew to 34 percent and services to 29 percent, while manufacturing dropped to 15 percent of the total from 1990 in Rockingham County. In Hillsborough County manufacturing employment played a larger role than in Rockingham County, with 27 percent of employment, followed by services and trade, each with 25 percent. By 1996, however, dominance had reversed in Hillsborough County with service jobs representing 29 percent, trade at 24 percent and manufacturing at 23 percent. (see Table 3.11-5. 1990 and 1996 Average Annual Employment.)

Table 3.11-2
Total Housing Units

	All Housing Units			Average Annual Change	
Comments	**1980**	**1990**	**2000**	**1980-1990**	**1990-2000**
Salem	8,848	9,897	10,866	1.2%	0.9%
Windham	1,726	3,327	3,906	9.3%	1.7%
Derry	7,280	11,869	12,735	6.3%	0.7%
Londonderry	4,584	6,739	7,718	4.7%	1.5%
Manchester	35,869	44,361	45,892	2.4%	0.4%
Rockingham County	76,115	100,479	113,023	3.2%	1.3%
Hillsborough County	101,208	135,622	149,961	3.4%	1.1%
New Hampshire	386,381	502,247	547,024	3.0%	0.9%

Source: 1980 U.S. Census
2000 U.S. Census
1990 U.S. Census and 1996 estimates as published in Current Estimates and Trends in New Hampshire's Housing Supply, Update: 1996, NH Office of State Planning, 1997, and Corrections to Current Estimates and Trends in New Hampshire's Housing Supply, Update: 1996, NH Office of State Planning, 1998

Table 3.11-3
Housing Units-By Type

	All Housing Total		Single Family			Multi-Family			Mobile Homes		
Community	1990 Number	1996 Number	1990 Number	1996 Number	1996 %	1990 Number	1996 Number	1996 %	1990 Number	1996 Number	1996 %
Salem	9,897	10,672	6,710	7,300	68%	2,321	2,506	23%	866	866	8%
Windham	3,327	3,708	3,031	3,384	91%	284	312	8%	12	12	-
Derry	11,869	12,737	5,549	6,355	50%	5,747	5,807	46%	573	575	5%
Londonderry	6,739	7,411	4,395	4,991	67%	1,754	1,828	25%	590	592	8%
Manchester	44,361	45,316	15,306	16,318	36%	28,569	28,507	63%	486	491	1%
Rockingham County	100,479	109,110	61,121	68,406	63%	30,508	31,556	29%	8,850	9,148	8%
Hillsborough County	135,622	144,131	71,819	79,198	55%	59,104	60,011	42%	4,699	4,922	3%
New Hampshire	503,541	534,111	297,448	322,567	60%	162,998	166,523	31%	41,801	45,021	8%

Source: 1990 U.S. Census and NH Office of State Planning estimates as published in "Current Estimates and Trends in New Hampshire's Housing Supply, Update: 1996", NH Office of State Planning, December 1997; Corrected February 1998

Table 3.11-4
1990 Average Annual Employment

	Salem		Windham		Derry		Londonderry		Manchester	
Sector	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Manufacturing	4,025	26%	174	13%	1,456	23%	1,035	19%	9,510	17%
Construction and Mining	395	3%	234	18%	360	6%	509	9%	1,476	3%
Trans., Comm. and Utilities	473	3%	31	2%	191	3%	481	9%	2,878	5%
Trade	5,849	38%	420	32%	1,550	24%	1,740	31%	14,769	26%
Finance, Insurance and Real Estate	457	3%	74	6%	250	4%	191	3%	6,000	11%
Government	645	4%	-		644	10%	-		3,672	7%
Service and Other	3,556	23%	388	29%	1,926	30%	1,604	29%	17,545	31%
Totals	15,400		1321		6,377		5,560		55,850	

Source: 1990 Profile, Employment and Wage Data, NH Employment Security, Economic and Labor Market Information Bureau, 1992
1990 County Profile, Employment and Wage Data, NH Employment Security, Economic and Labor Market Information Bureau, 1992

Similarly, manufacturing, services, and trade are the most important economic sectors within the Manchester PMSA, Nashua PMSA, and NH portion of the Lawrence, MA PMSA. Services are the primary industry in the Manchester PMSA with 32 percent of 1996 employment, up from 30 percent in 1990. In the NH portion of the Lawrence-Haverhill, MA PMSA, trade is the principal industry, with 37 percent of employment in 1996, up from 35 percent in 1990. In the Nashua PMSA, manufacturing is the predominant industry, with 31 percent of employment in 1996, down from 37 percent in 1990 (see Table 3.11-5. 1990 and 1996 Average Annual Employment).

In 1990, the trade, services, and manufacturing sectors constitute the primary economic sectors within the five individual I-93 study area communities, with the exception of Windham, where construction and mining plays a stronger economic role (18 percent) than manufacturing (13 percent). In Derry and Manchester, services and trade are the most important employment sectors. The services and trade sectors account for 30 percent and 24 percent respectively of employment in Derry, and 31 percent and 26 percent, respectively, of employment in Manchester. In Londonderry and Windham, trade and services played the strongest economic roles. Trade accounted for 31 percent of employment in Londonderry and 32 percent of employment in Windham, while services comprised 29 percent of employment in both Londonderry and Windham. In Salem, trade was the strongest sector, with 38 percent of employment, followed by manufacturing with 26 percent (see Table 3.11-4. 1990 Average Annual Employment).

While Manchester had experienced an economic downturn in the late 1980's, similar to New England as a whole, during the mid-1980s, Manchester was ranked first nationally in terms of business climate by U.S. News and World Report. During this same period, Inc. Magazine ranked the Manchester-Nashua area eighth out of fifty of the nation's fastest growing cities based on a four-year pattern of job generation, business start-ups, and number of rapidly growing firms. In fact, between 1990 and 1996, the Manchester PMSA generated approximately 18,900 jobs, an average annual growth rate of 4.3 percent.

In Londonderry, substantial increases in the number of job opportunities occurred during the 1970s and 1980s due to industrial growth in the Manchester Airport area, commercial development along NH 102 and NH 28, and increases in local government employment necessitated by dramatic population growth. The majority of additional manufacturing sector job growth in Londonderry is expected to occur in the existing industrially zoned areas near the Manchester Airport in the northwest corner of town. New commercial job growth is expected to occur in proximity to NH 102, NH 28 near Exit 5, and between the Derry town line and the east side of I-93 south of NH 28. Development in these areas continues to be supported by Londonderry's 1997 Master Plan.

Table 3.11-5
1990 Average Annual Employment

Sector	Rockingham County		Hillsborough County		Manchester PMSA		NH Portion Lawrence-Haverhill PMSA		Nashua PMSA	
	Number	%	Number	%	Number	%	Number	%	Number	%
Manufacturing	15,430	17%	43,543	27%	11,104	15%	7,347	21%	30,930	37%
Construction and Mining	5,094	6%	6,036	4%	3,338	5%	1,986	6%	2,968	4%
Trans., Comm. And Utilities	4,143	5%	6,729	4%	3,566	5%	1,868	5%	2,233	3%
Trade	29,584	32%	40,344	25%	20,237	28%	12,369	35%	20,768	25%
Finance, Insurance and Real Estate	5,820	6%	11,372	7%	8,040	11%	1,134	3%	3,235	4%
Government	8,343	9%	11,296	7%	5,089	7%	2,986	8%	5,941	7%
Service and Other	22,949	25%	40,682	25%	21,803	30%	7,772	22%	18,523	22%
Totals	91,363		160,002		73,177		35,462		84,598	

Source: 1990 Profile, Employment and Wage Data, NH Employment Security, Economic and Labor Market Information Bureau, 1992
1990 County Profile, Employment and Wage Data, NH Employment Security, Economic and Labor Market Information Bureau, 1992

1996 Average Annual Employment

Sector	Rockingham County		Hillsborough County		Manchester PMSA		NH Portion Lawrence-Haverhill PMSA		Nashua PMSA	
	Number	%	Number	%	Number	%	Number	%	Number	%
Manufacturing	16,260	15%	40,304	23%	13,203	14%	6,324	16%	26,988	31%
Construction and Mining	1,209	1%	5,764	3%	4,000	4%	2,038	5%	2,795	3%
Trans., Comm. and Utilities	5,576	5%	6,213	4%	5,368	6%	1,131	3%	2,159	3%
Trade	36,289	34%	42,294	24%	22,749	25%	15,214	37%	21,892	25%
Finance, Insurance and Real Estate	4,843	5%	10-,789	6%	7,709	8%	1,006	2%	3,300	4%
Government	11,406	11%	17,265	10%	9,950	11%	3,806	9%	7,470	9%
Service and Other	30,713	29%	51,163	29%	29,091	32%	11,087	27%	21,581	25%
Totals	106,266		173,792		92,070		40,604		86,185	

Source: 1996 Profile, Employment and Wage Data, NH Employment Security, Economic and Labor Market Information Bureau, 1998

Table 3.11-6
1990 Average Weekly Wages
Private Employment

Sector	Salem	Windham	Derry	Londonderry	Manchester	Rockingham County	Hillsborough County	New Hampshire.
Manufacturing	732.02	461.96	477.78	564.06	546.64	622.56	650.27	569.01
Non-Manufacturing	378.22	389.37	338.90	415.69	423.84	-	-	-
Tot Priv't Empl	474.74	398.93	374.18	443.31	445.90	428.77	481.04	432.37

Source: New Hampshire Employment and Wages by Cities and Towns 1990, NH Employment Security, Economic and Labor Market Information Bureau, 1992

1996 Average Weekly Wages
Private Employment

Sector	Salem	Windham	Derry	Londonderry	Manchester	Rockingham County	Hillsborough County	New Hampshire.
Manufacturing	854.24	646.72	609.50	784.43	651.76	763.56	800.35	699.88
Non-Manufacturing	460.86	478.46	448.90	490.72	542.40	-	-	-
Tot Priv't Empl	526.62	494.18	489.20	542.81	562.08	528.95	590.55	531.68

Source: 1996 County Profile, Employment and Wage Data, NH Employment Security, Economic and Labor Market Information Bureau, 1998

1990-1996 Annual Average Change in Average Weekly Wages
Private Employment

Sector	Salem	Windham	Derry	Londonderry	Manchester	Rockingham County	Hillsborough County	New Hampshire.
Manufacturing	2.8%	6.7%	4.6%	6.5%	3.2%	3.8%	3.9%	3.8%
Non-Manufacturing	3.6%	3.8%	5.4%	3.0%	4.7%	-	-	-
Tot Priv't Empl	1.8%	4.0%	5.1%	3.7%	4.3%	3.9%	3.8%	3.8%

Salem's economic base experienced substantial expansion during the late 1980s. Between 1986 and 1989, Salem approved 24 retail projects, 31 industrial projects, 15 office projects, and the Rockingham Mall which was expected to account for 150 stores and 4 major anchors, and generate approximately 2,000 jobs. While currently developing at a slower pace, approved projects in 1997 and 1998 have included 7 retail projects, 4 industrial projects, 5 office buildings, 2 restaurants and 2 day care operations.

Windham is primarily a bedroom community, illustrated by the subdivision approval of 230 house lots in 1997 and 1998. It has the smallest employment of the five study area communities, with a 1990 average annual employment of 1,320. Employment opportunities in Windham are primarily limited to businesses located along NH 28 and NH 111, in West Windham and Windham Depot, in the town's industrial park off NH 111 near the Salem town line, and at numerous home occupations scattered throughout town.

In Derry, the shoe industry was, for many years, the mainstay of the Town's manufacturing sector. In 1965, this industry accounted for more than 80 percent of Derry's manufacturing employment. Derry has increasingly become a residential suburban community with almost three-quarters of its residents commuting out-of-town to work by 1980. Despite this shift, Derry continues to provide a substantial number of employment opportunities. In 1990, Derry provided approximately 1,450 manufacturing jobs, 1,550 trade sector jobs, and 1,930 services sector jobs.

3.11.1.4 Wages

Table 3.11-6 presents 1990 and 1996 average weekly wages by manufacturing and non-manufacturing sectors for each community within the study area as well as counties. Table 3.11-7 presents the 1993 and 1996 average weekly wages by employment category for labor market statistical areas within which the study area communities lie.

In 1990, Salem had the highest average weekly wages for all employment ($475) of the study area communities, while Derry ($374) had the lowest. By 1996, Manchester had edged above Salem ($562 vs. $527), and Derry remained with the lowest ($489).

1990 and 1996 industry-wide average weekly wages for Derry ($374 and $489) and Windham ($399 and $494) were below that of Rockingham County ($429 and $529) in which they are located. Salem's 1990 and 1996 average weekly wages ($475 and $527 compare to $429 and $529 for the County averages. 1990 and 1996 industry-wide average weekly wages in Londonderry ($443 and $543) were above Rockingham County average wages ($429 and $529). 1990 and 1996 average weekly wages in Manchester ($456 and $562) were below Hillsborough County ($481 and $591) (**Table 3.11-6**).

Table 3.11-7
Average Weekly Wages

Sector	1993 New Hampshire	1993 Manchester MSA	1993 Nashua PMSA	1993 NH Portion Lawrence PMSA	1996 New Hampshire	1996 Manchester MSA	1996 Nashua PMSA	1996 NH Portion Lawrence PMSA
Manufacturing	627.06	589.09	793.18	661.08	699.88	675.65	869.38	740.70
Construction	508.94	534.07	521.74	485.24	577.86	626.12	637.62	596.51
Trans., Comm. and Util.	605.71	675.41	487.45	415.40	660.66	754.31	548.23	499.15
Trade Retail	272.77	272.46	289.12	251.07	298.87	313.03	312.26	278.31
Fin, Insur and Real Est	586.90	624.36	578.50	489.31	676.95	700.31	658.49	599.56
Government	506.77	593.45	600.09	474.18	538.15	626.95	617.76	538.89
Service	446.73	487.26	471.14	478.25	498.53	538.12	544.79	520.68
All Employment	480.11	509.00	570.55	434.60	532.53	**567.46**	**623.37**	**500.71**

Source: 1993 Profile, Employment and Wage Data, NH Employment Security, Economic and Labor Market Information Bureau, 1998
1996 Profile, Employment and Wage Data, NH Employment Security, Economic and Labor Market Information Bureau, 1998

1993-1996 Average Annual Change In Average Weekly Wages

Sector	New Hampshire	Manchester MSA	Nashua PMSA	NH Portion Lawrence PMSA
Manufacturing	3.9%	4.9%	3.2%	4.0%
Construction	4.5%	5.8%	7.4%	7.6%
Trans., Comm. and Util	3.0%	3.9%	4.2%	6.7%
Trade, Retail	3.2%	5.0%	2.7%	3.6%
Fin, Insur and Real Est	5.1%	4.1%	4.6%	7.5%
Government	2.1%	1.9%	1.0%	4.6%
Service	3.9%	3.5%	5.2%	3.0%
All Employment	3.6%	3.8%	3.1%	5.1%

Table 3.11-8
Average Unemployment Wages

Community / Area	1991 Average				Jan – Aug 1998 Average			
	Labor Force	Employment	Unemployment	Unemployment Rate	Labor Force	Employment	Unemployment	Unemployment Rate
Salem	14,240	12,850	1,390	9.8%	16.731	15,918	814	4.9%
Windham	4,000	3,680	320	8.0%	5,738	5,475	263	4.6%
Derry	13,970	12,590	1,380	9.9%	19,154	18,474	668	3.5%
Londonderry	10,120	9,420	700	6.9%	12,449	12,148	301	2.4%
Manchester	58,620	53,930	4,690	8.0%	55,793	54,358	1,435	2.6%
NH Portion								
Lawrence PMSA	54,210	48,910	5,300	9.8%	73,814	70,779	3,035	4.1%
Nashua PMSA	99,160	91,780	7,380	7.4%	104,504	101,869	2,635	2.5%
Manchester PMSA	87,190	80,820	6,370	7.3%	101,690	99,201	2,489	2.5%
Rockingham County	132,160	121,650	10,510	8.0%	151,058	146,003	5,055	3.4%
Hillsborough County	187,580	173,430	14,150	7.5%	202,316	197,240	5,076	2.5%
New Hampshire	635,000	589,000	46,000	7.2%	653,998	635,698	18,300	2.8%

Source: 1991 and 1998 Local Area Unemployment Statistics Report, NH Employment Security, Economic and Labor Market Information Bureau, 3/25/92 and 9/24/98

Average annual wage growth continued in all labor market areas between 1993 and 1996. The range in relative wages for the various employment categories, however, is substantial and also continues. For example, within the Manchester MSA, average annual weekly wages for retail trade were $272.46 in 1993 and $313.03 in 1996, while finance, insurance and real estate's (FIRE) average annual wages were $624.36 and $700.31 for the same time periods. This illustrates a difference of 129 percent between retail and FIRE employment categories in 1990 and 124 percent in 1996.

In summary, manufacturing wages are high in Salem with its manufacturing being related to the Boston metropolitan area. Non-manufacturing wages, on the other hand, are higher in Manchester with its independent economic base.

3.11.1.5 Unemployment Rates

Unemployment rates for 1991, by county and statistical area, as well as for the state as a whole, are presented in Table 3.11-8. Unemployment rates in Rockingham County (8.0 percent) and Hillsborough County (7.5 percent) were slightly higher than for the state as a whole (7.2 percent). While the unemployment rate for the Manchester PMSA (7.3 percent) was slightly higher than for the state (7.2 percent), the unemployment rate for the NH portion of the Lawrence, MA PMSA (9.8 percent) was higher still than for the state. The unemployment rate in the Nashua PMSA was slightly higher than for the state as a whole, at 7.4 percent.

Table 3.11-8 also depicts unemployment rates for each community in the I-93 study area. Derry and Salem, at 9.9 percent and 9.8 percent respectively, had the highest unemployment rates of the five I-93 study area communities. Manchester and Windham had the next highest unemployment rates at 8.0 percent, both above the 7.2 percent statewide average. Londonderry (6.9 percent) was the only study area community that had an unemployment rate lower than for that for the state as a whole.

The January – August 1998 unemployment rates were substantially lower. Unemployment in the five towns ranged from 4.9 percent in Salem and 4.6 percent in Windham to 2.4 percent in Londonderry and 2.6 percent in Manchester. Unemployment in New Hampshire as a whole was 2.8 percent for the same period (see Table 3.11-8).

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3.11.2 Existing Land Use

Existing land use patterns in the vicinity of I-93 are depicted on **Figure 3.11-1**. Locally referenced roads outside the project area are shown on **Figure 1.3-1**. A summary of the land uses for each study area community follows:

3.11.2.1 Salem

Salem has experienced rapid residential and commercial growth in the areas adjacent to Exits 1 and 2 over the past twenty years. While Salem Depot used to be the focal point of development, the areas bounded by I-93 to the west and the Spickett River to the east have now become highly developed. Much of the growth has been residential, making Salem a residential community for employment centers along the I-495 corridor in Massachusetts, such as Lawrence, Lowell, and the greater Boston area.

The major commercial area in Salem is centered along the NH 28 corridor that runs parallel to I-93 on the east through much of Salem. With the opening of the Rockingham Mall in 1991 and the re-opening of Rockingham Park in 1990, the area near the I-93 Exit 1 Interchange and the intersection of Rockingham Park Boulevard with South Broadway (NH 28) has developed as a major commercial center in Salem. A secondary commercial center has also developed along Main Street (NH 97), which intersects NH 28 east of Exit 2.

Industrial development has occurred adjacent to the Interstate in several places. West of Exit 2 industrial uses are found along Keewaydin Drive, Manor Parkway, Northwestern Boulevard and Industrial Parkway. East of the interchange is another industrial facility off Northeastern Boulevard. Much of this area is occupied by the Digital Equipment Corporation facility. Industrial activity is also found along Lowell Road and Garabedian Drive near the Massachusetts border.

The majority of the developed land adjacent to the Interstate is single-family residential. The more densely developed areas tend to be in three locations -- two east of the Interstate and one west. Near Exit 1 there is an area bounded by the Interstate, Rockingham Park Boulevard and South Broadway (NH 28). Most of the development occurs off Kelly and Hagop Roads, as well as Haigh Avenue. Several of these areas are quite close to the Interstate. Across the Interstate to the west is another major residential area that includes the Salem Street area and a substantial development in the area of Cross Street. The Cross Street residential area is also very close to the Interstate. Further north on the east side of the Interstate is a residential area that closely follows South Policy Street. After crossing Main Street, the residential area expands to cover much of the area between North Policy Street and North Broadway (NH 28). A final residential area is found near the Windham town line on either side of the Interstate along Brookdale Road and South Shore Road, adjacent to Canobie Lake.

3.11.2.2 Windham

Windham is a suburban town that serves as a residential community for employment centers in Nashua, Manchester, Lawrence, Lowell, Haverhill, and the greater Boston area. Most of Windham's commercial businesses are located along NH 28 and

NH 111. Business centers serving neighborhoods are scattered throughout the town. Windham's industrial uses are concentrated in the town's industrial park, located on Industrial Drive off NH 111 approximately 3/4 mile east of I-93 Exit 3.

The majority of developed land in Windham in close proximity to I-93 consists of residential land uses. The densest single family residential development is found around Cobbetts Pond, south of NH 111 and west of I-93; and between I-93 and Canobie Lake, to the east of I-93. The Cobbetts Pond/NH 111 neighborhood consists of a dense mix of seasonal homes, and cottages converted to year-round use. The residential neighborhood on the northwest shore of Canobie Lake comprises single family homes on 1/2- to 1-acre lots. Most of these homes were built after 1950. A relatively dense multi-family/condominium residential development is located just south of Exit 3 on Locust Road, adjacent to the west side of I-93 south of NH 111A (Range Road) and east of Cobbetts Pond.

The Jennys Hill area, off Searles Road east of I-93 where Searles Castle is located, is characterized by large lot single-family year-round homes built primarily during the 1980s. Clusters of residential development are also located in Windham Depot, just south of the Derry town line and east of I-93; along Morrison Road south and east of Windham Depot; and along North Lowell Road and County Road on the west side of I-93 south of Windham Depot. A few residences are also located in the median area along NH 111A (Range Road).

Commercial land uses within and adjacent to the study area are concentrated at Exit 3; between the northbound and southbound lanes of I-93, west and east of I-93 along NH 111 and NH 111A and along NH 111A (Range Road) in the I-93 median area. Industrial land use in the Windham portion of the study area is limited primarily to the Town's industrial park at Wall Street off NH 111, west of Exit 3.

3.11.2.3 Derry

Derry's town center, the most densely developed area, is located approximately 1 mile east of I-93 Exit 4, surrounding the intersection of NH 102 (Broadway) and NH 28. Derry is a suburban residential community characterized by a mix of single family, multi-family, and mobile home development. The Town's commercial uses are concentrated primarily in Derry's central business district, located just east of Exit 4 along NH 102.

Developed land in proximity to the Derry portion of the I-93 study area consists primarily of residential uses. Residential uses, which are in closest proximity to I-93, include the "Derryfield Road neighborhood" (located in the triangle formed by Kendall Pond Road, Fordway Extension, and the east side of I-93), Tracy Drive, and a cul-de-sac off of Beacon Hill Road on the west side of I-93.

Other important land uses in proximity to the Derry portion of I-93 include the town's sewage treatment lagoons located on the Derry-Londonderry town line, immediately to the east of I-93; and a number of agricultural uses and open fields located to the east and west of I-93, north of the Derry-Windham town line.

3.11.2.4 Londonderry

Londonderry is characterized primarily by single family residential and agricultural land uses, with concentrated areas of commercial and industrial enterprises as well as some multi-family development. The largest residential developments in Londonderry are located along the town's north-south axis roads including Parmenter and Boyd Roads (from NH 102 south to the Hudson town line), High Range Road (from NH 102 north to Alexander Road), Mammoth Road (from NH 102 south to Beaver Brook), and Hardy and Gilcreast Roads (from Bancroft Road south to Beaver Brook).

Londonderry's largest concentration of commercial uses is located along NH 102 between Mammoth Road and the Derry town line in the vicinity of I-93 Exit 4. The town's industrial uses are concentrated in the vicinity of I-93 Exit 5 and in Londonderry's northwest corner in the Manchester Airport area. A large area of industrially zoned land (that is currently undeveloped) is located between I-93 and the Londonderry/Derry town line, located northeast of Exit 4 on I-93. Should a local project to construct a new interchange (known as Exit 4A) be successful, this industrially zoned area would be an important industrial area as well.

In addition to residential, commercial, and industrial development, agriculture is an important land use in Londonderry. While land used for agricultural purposes is spread throughout town, the largest concentrations of active agricultural land are located west of I-93 between Pillsbury Road and NH 102. A large tract of agricultural land is located adjacent to the west side of I-93 just north of Exit 4. This tract, the Woodmont Orchards, is roughly 400 acres in size.

3.11.2.5 Manchester

Manchester serves as an employment, shopping, and service center for surrounding communities. The City is generally characterized by high-density commercial, industrial, and residential urban development in the City's central core area, surrounded on the fringes by suburban residential development. Land uses range from single family homes and neighborhood businesses to high rise multi-family housing, regional malls, and industrial facilities. The areas east of I-93 and south of I-293, as well as Manchester's northwest corner, are the City's least developed sectors. Much of the area east of I-93 is part of the Massabesic Lake watershed, which serves as a water supply for Manchester and surrounding communities. A large percentage of this watershed land is owned by the Manchester Water Works.

Developed land in proximity to the I-93 study area consists of single family and townhouse condominium development. The largest concentrations of residential development, which lie in closest proximity to I-93, are located between Bodwell Road and the east side of the Interstate. This development includes Tall Pines, Woodedge Estates, Newton Meadow, The Briars, Cohas Station and Sundance Gardens apartments and/or townhouse condominiums. East of the Interstate between Bodwell Road and the City line, a number of residential developments have recently been constructed or approved. Existing residential developments in this area include East Meadow townhouse condominiums; Foxwood Village (single-family homes) on Pheasant Lane; as well as single family housing on Megan Drive, Wildflower Drive and Morning Glory Drive.

On the west side of I-93, the densest residential development is located between Bryant Road and the Interstate. Most of the land west of I-93 and south of Crystal Lake and Corning Road is currently undeveloped.

With the exception of a farm in the southwest quadrant of the I-93/I-293 Interchange, there are no known farms or agricultural uses within the vicinity of the Manchester portion of the I-93 study area.

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3.11.3 Zoning

Zoning controls the potential use of land by limiting use to those which are allowed, or are conditionally allowed, and by promulgating development standards which, in turn, affect the cost and economics of development. Land within the I-93 study area is zoned for a variety of residential, commercial, and industrial uses with varying lot size, frontage, and other requirements. Zoning districts adjacent to I-93 within each town are described briefly below and depicted on **Figure 3.11-2**, Generalized Existing Zoning.

3.11.3.1 Salem

The Town of Salem is divided into thirteen (13) zoning districts:

- Rural
- Residential
- Garden Apartments
- Mobile Homes
- Recreational
- Commercial A
- Commercial-Industrial B
- Commercial-Industrial C
- Highway-Commercial
- Industrial
- Business Office District I
- Business Office District II
- Limited Community Shopping District

The majority of the land in proximity to the Salem portion of the I-93 corridor is zoned Commercial-Industrial B and Residential. More specifically, the area south of

Rockingham Park Boulevard is zoned Rural or Residential, with the exception of the land which lies between the Spickett River and the Massachusetts state line east of I-93. This area is zoned Highway Commercial. The area adjacent to I-93 between Rockingham Park Boulevard and Brookdale Road is zoned Commercial-Industrial B. The area on either side of Rockingham Park Boulevard is zoned Commercial-Industrial C and a Residential District is sandwiched between this district and the Commercial-Industrial B District adjacent to the Interstate. One of the Town's two industrial districts along Commercial Drive and Northwestern Boulevard is located immediately south of Brookdale Road on the west side of I-93. The area between Brookdale Road and the Windham town line is zoned Rural and Residential.

The generalized purposes of these zones within the I-93 corridor may be characterized as follows:

- *Rural*: Single family residential with 2-acre minimum lot size
- *Residential*: Single family residential with ½-acre minimum lot size
- *Commercial-Industrial B*: Retail, office, manufacturing, assembly, storage uses.
- *Commercial-Industrial C*: Retail, office, manufacturing, assembly, storage uses and child care.
- *Highway Commercial*: Retail and office uses.
- *Industrial*: Office, research, assembly, manufacturing, hotel uses.

3.11.3.2 Windham

The Town of Windham has ten zoning districts:

- Rural
- Residence A
- Residence B
- Residence C
- Neighborhood Business District
- Business Commercial District A
- Business Commercial District B
- Business Commercial District C
- Limited Industrial District
- Historic District

Much of the Windham portion of the study area is zoned Rural. Areas zoned Residence A include the Cobbetts Pond and Canobie Lake shorelines and the Camelot Road/Sheffield Street area between North Lowell Road (Bridge Street) and I-93. Commercially zoned districts include the Windham Depot Neighborhood Business District at the Derry town line; a Business Commercial District B between the northeastern end of Cobbetts Pond and the west side of I-93 at Exit 3; and a Business Commercial District C zone in the median area south of NH 111 at Exit 3. In addition, Business Commercial District A zones are located in the median area north of NH 111 at Exit 3, on the north side of NH 111 west of the Interstate at Exit 3, and on the north and south sides of NH 111A east of I-93. Within the I-93 corridor, the Historic District includes the Searles School.

The generalized purposes of these zones within the I-93 corridor may be characterized as follows:

- *Rural*: Single family residential with 50,000 square feet minimum lot size (in agricultural landscapes).
- *Residence A*: Single family residential with 50,000 square feet minimum lot size (in residential landscapes).
- *Neighborhood Business District*: Retail, office, restaurant uses.
- *Business Commercial District A*: Business that serves the motoring and transient public.
- *Business Commercial District B*: Business that serves the public.
- *Business Commercial District C*: Business and industrial uses.
- *Historic District*: Historic Commission reviews required.

3.11.3.3 Derry

The Town of Derry has the following seven zoning districts within the study area:

- Low/Medium Density Residential
- Medium/High Density Residential
- Manufactured Housing Park Development
- Office Business District
- General Commercial
- Industrial I
- Industrial IV

The area west of I-93 between the Londonderry and Windham town lines is zoned Low/Medium Density Residential. The entire east side of I-93 through Derry is zoned Industrial to a depth of at least 1,000 feet (Sections 1.260 and 1.280 in the Derry Zoning Ordinance), except for one Medium/High Density Residential district south of Kendall Road. Derry's border with Londonderry, east of I-93, is primarily a combination of Medium/High Density Residential and Industrial, except for NH 102 that is fronted by the Office Business District.

The generalized purposes of these zones within the I-93 corridor may be characterized as follows:

- L*ow/Medium Density Residential*: Single family with 2-acre minimum lot size.
- *Medium/High Density Residential*: Single and multi-family with 1-acre minimum lots.
- *Office Business District*: Small retail, office and single family uses.
- *Industrial I*: Manufacturing and open uses, like gravel pits.
- *Industrial IV*: Retail, manufacturing and open uses, like gravel pits.

3.11.3.4 Londonderry

The Town of Londonderry has nine zoning districts:

- Agricultural-Residential
- Residential-II
- Multi-Family Residential-III
- Commercial-I
- Commercial-II
- Commercial-III
- Industrial-I
- Industrial-II
- Conservation

While the majority of the Londonderry portion of the I-93 study area is zoned Agricultural-Residential (AR-I), the Londonderry portion of the study area also includes land zoned for higher density residential, commercial, industrial, and conservation uses. The area between I-93 and the Derry town line at Exit 4 is zoned Commercial-II; the area immediately west of I-93 at Exit 4 is zoned Commercial-I, II and III. The area just south of Exit 5 and NH 28 between the Derry town line and Stonehenge Road is zoned Commercial-II. Land zoned for industrial use includes Industrial-I districts between I-93 and the Derry town line immediately north of Ash Street (east of Exit 4), and the area just northeast of Exit 5. The only Industrial-II district in the I-93 study area is located east of the highway at Exit 5, along the Boston and Maine Railroad. Beaver Brook crosses I-93 near the Derry town line and is zoned Conservation.

The generalized purposes of these zones within the I-93 corridor may be characterized as follows:

- *Agricultural-Residential:* Agricultural and single family uses.
- *Commercial I:* General business uses.
- *Commercial II:* Automotive related uses.
- *Commercial III:* Office uses.
- *Industrial I:* General industrial uses.
- *Industrial II:* General industrial and automotive repair uses.
- *Conservation:* Structures prohibited.

3.11.3.5 Manchester

The City of Manchester has nine residential districts, four business districts, four industrial districts, two civic districts, and one mixed-use district that includes the Millyard Historic District. The Manchester portion of the I-93 study area is zoned residential. More specifically, the area west of I-93 and south of Crystal Lake is zoned Residential Suburban (R-S), with the exception of the Bryant Road/Skyline Drive area which is zoned One-Family (R-1A). The area north of Crystal Lake to I-293 is zoned One-Family (R-1B). The area east of I-93, between Bodwell Road and the highway, is zoned Multi-family (R-3) and One-Family (R-1A) from just south of

the Bodwell Road/Cohas Avenue/Hermit Road intersection north to I-293. East of Bodwell Road is a combination of residential zones, both single and multi-family.

The generalized purposes of these zones within the I-93 corridor may be characterized as follows:

- *Residential-Suburban*: Single family residential with 40,000 s.f. minimum lot sizes.
- *One Family (R-1A):* Single family residential with 12,500 s.f. minimum lot sizes.
- *One Family (R-1B):* Single family residential with 7,500 s.f. minimum lot sizes.
- *Multi Family (R-3):* One and two family residential with 5,000 s.f. minimum lots.

The City does not anticipate any zoning district boundary changes within the I-93 study area.

■

3.11.4 Public Utilities

In addition to zoning controls, land development is influenced by the provision of public utilities. Water service relates to potential development density. With public water service, the economics for a higher development density and for non-residential uses desiring a higher level of fire protection are assisted. Development, particularly single family residential development, is not prohibited by the lack of a public water supply. Lack of sewer service combined with soil conditions, on the other hand, may prohibit higher densities due to the large amount of land required for disposal. Additionally, economics plays a part. Without a public system, the development itself must be of a large enough scale to cover the economic cost of a private sewer system. Lastly, natural gas service, which is provided by private corporations, has little affect on housing. It may, however, be an incentive for certain types of industrial and other larger non-residential developments.

3.11.4.1 Salem

The Town of Salem provides drinking water for public distribution throughout its developed area. Excluded, therefore, is the southwestern corner toward Pelham and the northeast area, north of Bluff Road and North Main Street.

Sewerage collection is provided in the center and southeast sections of town. Flow is to, and the treatment is at, the Greater Lawrence Sanitary District in Massachusetts.

Natural gas service, provided by Keyspan Energy Delivery, is available in the South Broadway/I-93 area, on Main Street east to the Municipal offices on Geremonty Drive, in the industrial area west of Exit 2, including Industrial Way, Manor Parkway, Stiles Road and Keewaydin Drive, west a short distance on NH 38 (Lowell Road), and south on Cross Street to serve the industrial area on Garabedian Drive.

3.11.4.2 Windham

The Town of Windham provides neither water or sewer service. The Pennichuck Waterworks, Inc. purchased and now operates several private water systems previously owned by the W & E Water Company. These systems are located in separated neighborhood developments, along NH 111A (Lowell Road) and extending on both sides of the Interstate, in the area of Rock Pond Road further south on NH 111A, on Bridge Street north of the Town Office, and off Fordway on the southern border with Derry. There is neither public sewer service nor natural gas service in Windham.

3.11.4.3 Derry

The Town of Derry purchases water from Londonderry, (that having been purchased from Manchester) and provides for its public distribution throughout the developed area of town east of the Interstate and south down Beacon Hill Road, west of the Interstate.

Public sewer service is provided throughout the built-up area between the Interstate and NH 28 (South Main Street), to the east of the Interstate.

Natural gas service is provided by Keyspan Energy Delivery, along a portion of NH 28 (Rockingham Road), Crystal Avenue and Birch Street, to industrial users just to the west, along most of Tsienneto Street, along Pinkerton Street, and a portion of NH 102 (East Broadway) between NH 28 and NH 28A.

3.11.4.4 Londonderry

The Town of Londonderry is provided water service by both the City of Manchester and Pennichuck Waterworks, depending upon location. Current water service from Manchester is in the airport area and along Litchfield Road to the south, east across Grenier Field Road, to the northeast up Auburn Road and to the southeast down NH 28 (Rockingham Road) to the Derry town line. Pennichuck Waterworks, in turn, serves the southern half of Londonderry, with current service in the southeastern quarter of Londonderry, south of the electric transmission lines paralleling Shasta Drive, west of I-93, and north of South Road.

Public sewer service is found in northwest Londonderry, the area of the airport, east along Grenier Field Road, along Mammoth Drive, Rockingham Road and to the industrial area, just east of I-93 Exit 5. Sewer service extension is planned to go south down Mammoth Road to Pillsbury Road. Public sewer service is also provided on both sides of I-93, Exit 4, serving commercial and industrial uses.

Natural gas is provided by Keyspan Energy Delivery to serve the airport area and extend down NH 28, crossing the Interstate at Exit 5 and continuing to Derry.

Natural gas service has recently been provided along Old Derry Road in the northeast corner of Londonderry, by extension south from Bodwell Road in Manchester.

3.11.4.5 Manchester

Manchester provides water service throughout its developed area. This includes the lightly developed area west of I-93, south of I-293 and east of the Mall of New Hampshire and Huse Road.

Sewer service is provided throughout the developed area of central Manchester, north of I-293 and west of I-93. Service extends east of I-93 to serve the East Industrial Park Drive, just north of Island Pond Road and for one 3,300-foot section of South Mammoth Road, south of I-293 and west of I-93. There is also a private force main serving the southern-most subdivision (Rosegate Farm) off Bodwell Road, to the east of I-93.

Natural gas service by Energy North, in the area of the I-93 corridor, comes from East Industrial Park Drive, south along Cohas Avenue, and then along Bodwell Road to the Londonderry town line.

3.11.4.6 Other Utility Services

The Tennessee Gas Transmission Line runs north from Pelham on the Massachusetts border through Manchester. Its closest point to I-93 within the study area is approximately one mile west of Exit 5 in Londonderry where it approximately follows NH 128 (Mammoth Road), crossing from one side to the other.

Major electrical transmission lines cross the Interstate in several locations, all in Londonderry. From south to north, these include a single set of lines just north of Pillsbury Road, four sets of lines just south of Stonehenge Road, and a single set of lines just north of Exit 5.

3.11.4.7 School Bus Routes

Laidlaw Transportation operates four school bus routes for the Town of Derry's Special Education Program that utilize I-93 between Exits 1 and 3, although the morning southbound buses will on occasion detour to local streets to skirt traffic problems to which they have been alerted. The Interstate is also utilized for sporting events and field trips, and by Manchester bus drivers to get to the beginning of a scheduled bus route. Beginning in the fall of 2002, this transportation for Derry's Special Education Program will be provided by a different company.

■

3.11.5 Community Environment

3.11.5.1 Community Facilities

A variety of community facilities are located within or near the municipalities that comprise the I-93 study area. These facilities are described briefly below for each community. The facilities near I-93 are identified in Table 3.11-9 and shown on **Figure 3.11-3**.

Salem

Most of Salem's community facilities are located outside the I-93 study area. Many are clustered in the town center along Main Street (NH 97) and Geremonty Drive, east of I-93. Exceptions to being distant from the Interstate are two schools, the abandoned sewage treatment facility, and the public works yard.

Police

The Salem Police Station is located on Veterans Memorial Parkway approximately 1 mile east of Exit 1, on the east side of NH 28.

Table 3.11-9
Community Facilities in the Interstate 93 Study Area and Vicinity

Salem	Fisk School Soule School Public Works Facility
Windham	Searles Chapel and Conference Center
Derry	Waste Water Treatment Transfer Station Public Works Garage
Londonderry	Town Offices Old Hill Graveyard Sewer Pump Station
Manchester	Green Acres Elementary School Green Acres Middle School Stowell Cemetery

Fire

Salem has three full-time manned stations -- the Central Fire Station off Main Street, the North Station in North Salem, and the South Salem Station on Lawrence Road. None of these facilities are located close to the study area.

Schools

Salem has five neighborhood elementary schools (grades 1 - 6) -- Soule School, North Salem School, Fisk School, Haigh School, and Barron School; a junior high school (grades 7-8); and a senior high school. Growth has been accommodated through school additions and a sixth elementary school that is being proposed for the northeast section of Town. While none of these facilities are located within the gprimary study area, Soule School and Fisk School are located in the near vicinity. Soule School is at the intersection of Clough Crossing Road and Kelly Road just south of Exit 1, which is about 1,500 feet east of the Interstate. Fisk School is on Main Street (NH 97) approximately 2,500 feet east of the Interstate and Exit 2.

Municipal Buildings

The Salem Municipal Building, which houses the town's administrative offices, is located in the Town Center Complex on Geremonty Drive, west of Exit 2 and outside the study area. The Municipal Court Building is located in the Town Center Complex adjacent to the Town offices.

Post Office

There are two post offices located in Salem. One, on South Broadway, serves Salem . The other, on East Broadway, serves North Salem.

Hospitals

There are no hospitals in Salem.

Libraries

The Kelley Library is located at the corner of Main Street and Geremonty Drive outside the study area.

Public Works

The Public Works Department is housed at the Cross Street facility just south and east of Exit 1, and immediately adjacent to I-93.

Wastewater Treatment Facility

The wastewater treatment plant was located off South Broadway (Route 28) adjacent to the Spickett River in the south end of town, about 500 feet east of I-93. This facility has now been abandoned and Salem has joined the Greater Lawrence Sanitary District (GLSD).

Windham

Most of Windham's municipal facilities are located in the Church Street—North Lowell Road area off NH 111, approximately one mile west of Exit 3. None of these facilities, except Searles School and Chapel, are located in the study area.

Police

The Windham Police Station had been located west of North Lowell Road on NH 111. A new Police Station has been constructed and is occupied on Fellows Road, the south side of NH 111, opposite North Lowell Road.

Fire

The Windham Fire Department is currently located in the town center next to the Town Hall.

Schools

Two elementary schools -- Golden Brook (grades 1-4) and Center School (grades 4-6) -- and a middle school (grades 7-8) are located in Windham. The Town currently sends its high school students to Salem High School. All of these facilities are located outside the primary study area.

The Windham Cooperative Kindergarten, which used to be located in the Searles Chapel and Conference Center, is a private, non-profit kindergarten and nursery school for children ages 3-6. The kindergarten has now moved to the old Police Station, just west of North Lowell Road on NH 111.

Castle College, a private facility, east of Exit 3, has been closed.

Town Offices

The Windham town offices are located in two buildings in the town center on North Lowell Road, west of I-93.

Post Office

The Post Office is located on Cobbetts Pond Road, that runs between Lowell Road and NH 111A at the south end of Cobbetts Pond. This facility is located outside the primary study area.

Hospitals

There are no hospitals in the Town of Windham.

Libraries

The Nesmith Library was located in the town center on North Lowell Road. A new Nesmith Library has been constructed on Fellows Road, on the south side of NH 111, opposite North Lowell Road.

Museum

The old library building in the town center on North Lowell Road has become the Town's museum.

Other Public Buildings

The Searles Chapel and Conference Center was formerly known as the Searles School, opened in 1909. This facility is located about ½ mile from I-93, on the south side of NH 111, east of Exit 3. This facility is an historic building and includes space for public gatherings, as well as grounds for a soccer field.

Derry

With the exception of the wastewater treatment facility, the solid waste transfer facility, and the public works yard, Derry's community facilities are well outside the I-93 study area.

Police

The Derry Police Department is located near Ross' Corner, east of I-93.

Fire

Derry's central fire station is located on East Broadway. The original fire station is on West Broadway in the center of West Derry, and the Island Pond Fire Station is on the corner of Warner Hill Road.

Schools

Derry has six public schools -- Derry Village School, Floyd Elementary School, Grinnell School, South Range School, Hood Junior High School and West Running Brook Middle School. Pinkerton Academy, also located in Derry, is a private educational facility, contracted by Derry and adjacent communities to provide high school education.

Municipal Building

Some municipal offices are located at the former U.S. Postal Service Building at the corner of Broadway and Crystal Avenue and others are located at 40 Fordway. The Adams Memorial Building on Broadway is used for meeting room facilities and as the Town Office. The District Court that had been in the Adams Memorial Building has been replaced with a new facility on Manning Street.

Libraries

Derry's main Public Library is located on Broadway just west of Crystal Avenue. Taylor Library is located in East Derry.

Hospitals

Parkland Hospital Medical Clinic is located on Parkland Drive, off Birch Street in Derry. This facility is located approximately one mile east of Exit 4.

Post Office

During February 1999, the main Derry Post Office opened at a new location, Tsienneto Road and NH 28 Bypass. Its prior location on Crystal Avenue was a rented facility and remains as a private commercial use. A second post office facility is located on East Derry Road.

Public Works

The Public Works Department is located at 40 Fordway, about ¾ mile east of the Interstate.

Wastewater Treatment Facility

Derry's wastewater treatment facility is located on the Derry-Londonderry town line west of Beaver Brook, immediately east of I-93, just south of Exit 4. This site, at a slightly greater distance from the Interstate, includes Derry's solid waste transfer facility.

Londonderry

Most of Londonderry's municipal facilities are located on Mammoth Road (NH 128). These facilities are well outside the primary study area. Closer to the Interstate are the Town Office and Old Hill Graveyard.

Police

The Police Department is located on Mammoth Road, in what had previously been the Town Office. The school's administrative offices remain at this location.

Fire

Londonderry has three fire stations: the Central Station, on Mammoth Road north of the Library and Town Hall; North Station, on Mammoth Road three miles north of Central Station; and South Station, on Buttrick Road two miles south of Central Station.

Schools

Londonderry has three elementary schools: Matthew Thornton on Mammoth Road near Town Hall; South School, off South Road; and North School, on Rock Road. Londonderry Middle School and Londonderry High School are located on Mammoth Road (NH 128) near Town Hall.

Municipal Building

Londonderry Town Offices are located at 50 Nashua Road (NH 102), approximately ½ mile west of Exit 4.

Post Office

The Post Office is on NH 102, outside the study area.

Libraries

The Leach Library is next to the Police Station on Mammoth Road.

Hospitals

There are no hospitals in Londonderry.

Highway Department

The Londonderry Highway Department is housed in the Town Garage on High Range Road.

Pump Station

The Charleston Avenue sewer pump station is located between Charleston Avenue and the Interstate.

Cemeteries

There are two cemeteries close to I-93. Old Hill Graveyard is on the western side of Hovey Road, north of Exit 4, about 2,000 feet west of the Interstate. Holy Cross Cemetery is a private cemetery and is located on the eastern side of Gilcreast Road, south of Exit 4, about 800 feet west of the Interstate.

Manchester

Manchester is the most urbanized of the five I-93 study area communities. Many municipal facilities are concentrated in downtown Manchester, and others are scattered throughout the City. Community facilities include police, fire, school, hospital, library, and post office facilities. Manchester's southeast quadrant is one of the City's least developed areas. Thus, few community facilities are located in this area.

Community facilities located closest to the I-93 study area are; Stowell Cemetery, between Bodwell Road and the east side of I-93; and Green Acres Elementary and Middle Schools, located just north of I-293 and west of I-93, where these two highways meet.

Police

Police services are provided to the City from one main station house in downtown Manchester.

Fire

The City of Manchester operates nine fire stations located throughout the City. The Harvey Road Station, west of I-93 and south of I-293 on Harvey Road, is closest to the study area. This station provides first response to the southern and eastern portions of the City. The Fire Department has proposed the construction of two new stations. One of these stations is proposed for the City's southeast area, to be located east of I-93 and just north of I-293 at the intersection of East Industrial Park Drive and Island Pond Road.

Schools

Manchester's public school system is comprised of 15 elementary schools, a sixth grade only school, four middle or junior high schools, three high schools, and one high-school-level school of technology. Of these schools, Green Acres Elementary and Middle Schools are in closest proximity to the study area. They are situated just north of I-293 and west of I-93, and serve the southeast portion of the City.

City Hall

Manchester's City Hall and City Hall Annex are located in downtown Manchester. Many of the City's administrative offices are in these buildings, serving as the focal point of City government.

Post Office

Manchester's post offices are located downtown and off Goffs Falls Road.

Library

The City's main library, Carpenter Memorial Library, is located in downtown Manchester, while a branch library is located on the City's west side.

Hospital

Hospital facilities in Manchester include Catholic Medical Center, Elliot Hospital and Veterans Administration Hospital, all of which are outside the primary study area.

Cemeteries

The only cemetery close to the Interstate is Stowell Cemetery, located on the western side of Bodwell Road, about 300 feet east of the Interstate.

Airport

Manchester Airport straddles the Manchester/Londonderry municipal boundary west of I-93. It is the largest commercial air traffic facility in New Hampshire. Usage

of the airport is increasing rapidly and continued growth is anticipated. There is a clear need for improved highway access to the airport to accommodate the existing and anticipated future growth of the airport. Highway access improvements have been under study for the last several years. A separate study is evaluating the selection of a corridor for highway access between the airport and the F.E. Everett Turnpike, west of the Merrimack River. Improved access from the east beginning at Exit 5 of I-93 was considered earlier in the study for improved access to the airport, but was dropped because of impacts and public input.

3.11.5.2 Public Parks and Recreation Land

Section 4(f) Lands

Section 4(f) of the Department of Transportation Act of 1966 states "… special effort should be made to preserve the natural beauty of the countryside and public park and recreation lands, wildlife and waterfowl refuges and historic sites." Regulations governing 4(f) implementation specify that there can be no taking of public park or recreation lands or impairment of wildlife and waterfowl refuges or historic sites without a thorough investigation into all prudent and feasible alternatives. Such alternatives may range from project modifications to "no build". If it is determined that no prudent and feasible alternatives exist and that public park or recreation lands, wildlife and waterfowl refuges, or historic sites must be acquired or impaired, the FHWA must demonstrate that implementation of other alternatives would result in extraordinary cost, and/or social, economic, or environmental impacts. In addition, the proposed project or program must include all possible planning to minimize harm to the sites.

Park and recreational areas within or adjacent to the I-93 study area are listed in Table 3.11-10 and shown in **Figure 3.11-3**, and briefly described by community. (See Cultural Resource Section for addition 4(f) sites, as well as Chapter 6.

Salem

There is one potential 4(f) park/recreation area in Salem located in proximity to I-93. It is located in Salem on the south side of NH 38 (Lowell Road), about 2,500 feet west of the Interstate. Hedgehog Park, a 28.6-acre park, is used for a variety of canoeing, fishing, swimming, ice-skating, picnicking, horseshoes, volleyball, tetherball, and other recreational activities.

Another recreational facility, owned by the State, is the trail created from a portion of the Boston & Maine Railroad's former right-of-way. This trail begins at the Rockingham Park Boulevard, parallels NH 28 (North Broadway) and continues north into Windham. The Rockingham Recreational Trail is not a potential 4(f) facility in Salem because it is owned by the NH Department of Transportation (NHDOT) as a future transportation corridor, and is on loan to NH Department of Resources and

Economic Development (NHDRED) for recreational purposes, until such time transportation improvements are needed.

One private recreational facility, located in the I-93 study area, is the Canobie Lake Fish and Game Club, located on the north side of NH 38 (Lowell Road) opposite Hedgehog Park. Since this club is not a public facility, it is not considered a 4(f) property. Canobie Lake Amusement Park, another private recreational facility, is located on the east side of Canobie Lake, outside of the study area, and is not a 4(f) property.

Windham

Searles Chapel and Conference Center, formerly the Searles School, represents both an historic building and a recreational resource (soccer field) protected by Section 4(f). It is located east of Exit 3. Neither the building nor the soccer field will be impacted by improvements to I-93.

As in Salem, the Rockingham Recreational Trail, owned by the State, is a trail created from a portion of the Boston & Maine Railroad's former right-of-way. This trail continues from the town of Salem, through Windham Depot, to the Town of Derry. This trail is not a potential 4(f) facility, as it is owned by the NHDOT as a future transportation corridor, and is on loan to NHDRED for recreational purposes, until such time transportation improvements are needed.

There was also another railroad right-of-way, sections of which were abandoned in 1935 and 1942, running from Hudson to the northeast, through Windham Depot. This right-of-way owned by the State of New Hampshire has been approved for transfer to Windham, but as of 2002 had not received Town Meeting acceptance. This corridor is not a 4(f) property.

Duncan's Beach in Windham, at the eastern end of Cobbetts Pond, is a private beach and is not, therefore, a 4(f) facility.

Derry

4(f) Properties in Derry include two recreation trails, located east of the I-93 study area. One is an un-named recreational trail, referred to as the B & M Corridor, generally running from the southwest to the northeast in the southern portion of Derry. The other is a portion of another un-named recreational trail. This trail, a continuation of the Rockingham Recreational Trail generally paralleling the Interstate and referred to as the Recreational Corridor, was purchased by the Town from the railroad and is that portion of the Boston & Maine former railroad right-of-way from the Windham town line through the center of Derry and north to Madden Road. The portion of this right-of-way that continues north from Madden Road to the Londonderry town line was not purchased by NHDOT as it shortly runs into the Interstate where it has been blocked. This short northerly portion is still privately owned and is not, therefore, a potential 4(f) facility.

Londonderry

There are no park/recreation facilities identified within the general I-93 study area that could be potential 4(f) properties.

In Londonderry, the abandoned Boston and Maine former railroad right-of-way, owned by NHDOT, is cut off from the south by I-93 and severed by private land sales along the corridor. The right-of-way is not part of the Rockingham Recreational Trail, although it may be used unofficially for recreation.

Manchester

Two City-owned park/recreational facilities are located near the I-93 study area in Manchester: Crystal Lake Park (18.5 acres), at the intersection of Bodwell Road and Corning Road, just several hundred feet west of I-93, and the playing fields at Green Acres Elementary and Middle Schools, just north of I-293 and west of I-93. Crystal Lake Park is a multi-use recreational area used primarily for swimming and boating

Two privately owned recreational facilities are also located in the I-93 study area but are not subject to 4(f) criteria. These include: (1) the Boy Scouts of America's Camp Carpenter (135 acres according to Manchester Planning Department 1981 survey form) located in Manchester approximately ¼ mile east of I-93, at the end of Blondin Road and surrounding the southern half of Long Pond; and, (2) Melody Pines Day Camp, operating June to Labor Day, located on the southern shore of Crystal Lake.

Section 6(f) Lands

Section 6(f) lands are defined as lands that have been acquired or improved with funds provided by the federal Land and Water Conservation Act. The U.S. Department of the Interior, National Park Service has jurisdiction over these lands. Section 6(f) lands cannot be converted to another use without replacement by land that is of comparable value and use. The NH Department of Resources and Economic Development (DRED), Division of Parks and Recreation, maintains a list of lands acquired or improved with Land and Water Conservation Funds in New Hampshire. A review of DRED's files indicate that two properties located in the I-93 study area qualify as Section 6(f) properties; they are Hedgehog Park in Salem and Crystal Lake Park in Manchester.

Hedgehog Park is a 28.6-acre park surrounding Hedgehog Pond. It is located in Salem on the south side of NH 38 (Lowell Road), about 2,500 feet west of the Interstate. This 28.6-acre park is used for a variety of recreational activities including canoeing, fishing, swimming, ice skating, picnicking, horseshoes, volleyball, and tetherball.

Crystal Lake Park is a 18.5-acre public property located on the north end of Crystal Lake at the intersection of Bodwell Road and Corning Road, just several hundred feet

west of I-93. This park is a multi-use recreational area used primarily for swimming and boating.

Table 3.11-10
Public Parks and Recreation Areas, Section 4(f) Properties and 6(f) Lands in the Study Area and Vicinity

Salem	Hedgehog Park	4(f) and 6(f)
Windham	Searles Chapel and Conference Center (soccer field)	4(f)
Derry	B & M Railroad Corridor	4(f)
	Recreational Corridor	4(f)
Londonderry	None	
Manchester	Green Acres Elementary and Middle Schools playing fields	4(f)
	Crystal Lake Park	4(f) and 6(f)

Open Space Lands

The City of Manchester's Open Space and Recreation Map was produced in 1998 by the Southern New Hampshire Planning Commission for the New Hampshire Land Conservation and Investment Program. There are seven areas listed in Manchester on the Open Space Map. The only one located adjacent to the study area is Great Cohas Swamp. It is located west of I-93 between NH 28A (South Mammoth Road) and NH 28 (South Willow Street), and is adjacent to the Great Cohas Brook. It is outside the I-93 corridor study area. This swamp, however, is in the process of being protected through conservation easements resulting from Manchester's development permit granting process and the efforts of the NH Fish and Game Department.

There are no other listed areas in or near the I-93 study area.

3.11.5.3 Commuting Patterns

To understand the potential impact improvements to I-93 may have on the surrounding area, consideration must be given to each community's place within the larger economic environment and to the commuting patterns of the region.

Manchester and its suburbs, due in part to distance and travel time, is largely a self-contained urban economic area, less affected by the Boston Metropolitan area than the remainder of the study corridor. A listing of major manufacturers by location illustrates this economic fact. Manchester, itself, has more job opportunities (59,413)

than resident employees (50,999). Even still, 37% of its resident employees work outside of Manchester. As a center of an urban economic area, the majority of the commuting from Manchester is to surrounding towns, with only 6% of its resident employees commuting to Massachusetts. Manchester's physical development of vacant parcels, as well as its redevelopment, will be much more dependent upon its own economy, and less affected by improvements to this Interstate segment. (See Table 3.11-11 Selected Commuting Patterns and Table 3.11-12 Major Manufacturers by Location.)

The other towns along this Interstate corridor, however, are more tightly related to the Boston metropolitan area, and are what are typically termed as "bedroom communities". The number of Londonderry, Derry, Windham and Salem resident employees that commute to jobs out-of-town range from 69% to 83%, more than double the rate for Manchester. At the northern end of this corridor, the commuting destination is split, with 39% of the commuters going to Massachusetts and 61% remaining in the surrounding towns. This relationship appears to be directly related to the distance of the town from the Massachusetts border. Starting at the more distant town of Londonderry and progressing through Derry, Windham and Salem, the percentage of resident commuters that commute to Massachusetts are 39%, 50%, 55%, and 83%, respectively.

This high rate of Salem resident commuting exists, even as Salem appears to have almost as many jobs in-town as it has resident employees. This appears to be an indication that Salem has become a hybrid economic area, functioning both as a local economic center and as a bedroom community for the Boston metropolitan area. In general, therefore, the Interstate's impact on the development of vacant residential parcels of its corridor towns appears to be related to its real and perceived travel capacity toward the Boston metropolitan area and its many employment opportunities. This would probably be true regardless of the parcel's location from the Interstate, as long as travel time is not perceived to be substantially extended.

Vacant land zoned for nonresidential development within this interstate corridor will also be affected. Non-residential development closely related to the Boston metropolitan area economy (for example, manufacturing one step removed from university research) would attempt to maintain a reasonable proximity relative to time and distance to the Boston metropolitan area. Direct access at interchanges will not be critical, but accessibility for employees and materials will be important. These industries historically were the types of non-residential uses that first migrated to MA 128, then I-495, and more recently into border towns like Salem. As Salem has fewer opportunities, industrial development pressure tends to move northward to Windham, as is currently being reported. Non-residential developments serving a regional population base such as retail facilities, on the other hand, will focus on that population base and desire more direct access to the interstate when considering their locations. These population-based developments deal with location opportunities, visibility and ease of access, with the later developments requiring less direct exit access.

Some of the commuting patterns outside the primary corridor are also likely affected by this Interstate, though much less so. The towns abutting the study area to the north such as Bow, Hooksett, Candida, Raymond and Auburn show high commuting rates (80 to 87%), although with only 8 to 15% commuting to Massachusetts. This is most likely due to the intervening opportunities of both Concord and Manchester. To the western side of the corridor, Goffstown and Bedford have the same high commuting rates, with only 7 to 10% traveling to Massachusetts. As with the northern most towns, there are many intervening employment opportunities.

The towns east of the Interstate corridor, Chester, Sandown, Danville, Hampstead and Atkinson show similarly high commuting rates (80 to 92%), but with 32 to 59% of commuters traveling to Massachusetts. These towns have fewer in-town jobs, and their residential growth may be affected by I-93, though NH 125's proximity to Interstate 495 through Plaistow provides an alternative access to the Boston metropolitan area.

On the western side of the corridor closer to Massachusetts, Merrimack, Litchfield and Hudson have high commuting rates (70-94%), with 19-38% of commuters traveling to Massachusetts. This commuting pattern, however, is most likely affecting the F.E. Everett Turnpike, more easily accessed than I-93.

Also to the west is Pelham with a 79% commuting rate, and with 72% of commuters going into Massachusetts. However, census specific destinations of Lowell and Dracut (69%) are more than twice as numerous as those of Andover and Boston (31%). The travel direction from Pelham to Lowell and Dracut is away from I-93; and because of road patterns, travel from Pelham to Andover and Boston more than likely joins I-93 within Massachusetts.

Table 3.11-11
Selected Commuting Patterns

Town	# Jobs In Town	# Resident Employees	% In-Town Jobs/ Employee	# Resident Employees Commute Out of Town	% Resident Employees Commute Out of Town	# Resident Employees Work in Massachusetts	% Resident Employees Commute to Massachusetts	% Resident Commuters Commute to Massachusetts
Manchester	59,413	50,999	116.5%	19,192	37.6%	3,163	6.2%	16.5%
Salem	13,727	14,095	97.4%	9,676	68.6%	8,019	56.9%	82.9%
Windham	1,725	4,726	36.5%	3,922	83.0%	2,149	45.5%	54.8%
Derry	6,817	16,409	41.5%	13,089	79.8%	6,584	40.1%	50.3%
Londonderry	6,605	10,660	62.0%	8,536	80.1%	3,340	31.3%	39.1%
Bow	2,242	2,948	76.1%	2,584	87.0%	375	12.7%	14.5%
Hooksett	5,976	4,821	124.0%	3,858	80.0%	195	3.3%	5.1%
Candida	985	1,859	53.0%	1,617	87.0%	130	7.0%	8.0%
Raymond	1,821	4,298	42.4%	3,462	80.5%	520	12.1%	15.0%
Auburn	725	2,179	33.3%	1,882	86.4%	258	11.8%	13.7%
Chester	401	1,455	27.6%	1,169	80.3%	375	25.8%	32.1%
Sandown	354	2,207	16.0%	1,960	88.8%	977	44.3%	49.9%
Danville	242	1,351	17.9%	1,245	92.2%	636	47.1%	41.1%
Hampstead	1,449	3,554	40.8%	2,962	83.3%	1,770	49.8%	59.8%
Atkinson	589	2,890	20.4%	2,638	91.3%	1,566	54.2%	59.4%
Goffstown	3,467	7,550	45.9%	6,069	80.4%	424	5.6%	7.0%
Bedford	10,046	6,581	152.7%	4,845	73.6%	465	7.1%	9.6%
Merrimack	12,311	12,569	98.0%	8,838	70.3%	2,210	17.6%	25.0%
Litchfield	464	3,025	15.3%	2,854	94.3%	556	18.4%	19.5%
Hudson	10,469	10,932	95.8%	8,044	73.6%	3,091	28.3%	38.4%

Source: New Hampshire Commuting Patterns: 1990 Census, NH Employment Security, Economic and Labor Market Information Bureau, August 1994, Revised November 1997

Table 3.11-12
Major Manufacturers by Location

Company	Address	# Employees	Product
Salem			
Cornucopia Beverages, Inc.	S. Broadway	72	Soft drinks
Data Electronic Devices, Inc.	Bridge Street	50	Contract manufacturer
Hadco Corporation	Manor Parkway	1,700	Printed circuits
Hydroflow, Inc.	Northwestern Blvd.	32	Liquid filtration system
Key Packaging Industries	Garabedian Dr	200	High density plastic blown sheeting
Klein Associates, Inc.	Klein Drive	39	Side scan sonar
Magna Computer Corporation	Keewaydin Dr	57	Computer products
Memtec Corporation	Keewaydin Dr	30	Tape storage devices and wire harness accessories
Micro-Precision Technologies	Manor Pkwy	35	Thick and thin film hybrid circuits
Parlex Corporation	Industrial Way	100	Hybrid thick film product
Salem Screen Printers, Inc.	Delaware Drive	600	Printing
Standex International	Manor Parkway	5,000	Electronic assembly
T L G, Inc.	Keewaydin Dr	30	Portable electronic tactical systems
Turner's Dairy Inc.	Brady Avenue	30	Milk/ice cream mix
Univex Corporation	Old Rockingham	100	Food preparing machine
Windham			
Semiconductor Circuits, Inc.	Range Road	100	Power supplies
Derry			
Dynaco	Tinkham Drive	120	Multilayer and rigid flex circuits
Eastern Rainbow, Inc.	Derry Ind Park	60	Color separations
Galluzzo, Anthony, Corp., The	Chester Road	30	Architectural millwork
Gentex Corporation	Tinkham Ave	35	Electro-acoustic microphones
Hadco Corporation	Manchester Rd	525	Printed circuit boards
McCord Winn	Tinkham Ave	100	Automobile fuel pumps
Merrimack Valley Wood Prod	Derry Ind Park	125	Millwork
Treasure Masters, Inc.	Treasure Lane	200	Gifts, fragrance, jewelry import/export
Londonderry			
AM Technology	Industrial Drive	33	Contract manuf: PCB board assembly
Cadec Systems, Inc.	Perimeter Road	60	In-vehicle computer
Lamont Labs, Inc.	Grenier Field Rd	100	Cleaning chemicals
Nu-Cast, Inc.	Grenier Field Rd	36	Aluminum invest castings
P M C Corporation	Harvey Road	50	Thermocouple and high temperature wire and cable
Prototype Circuits, Inc.	Delta Drive	32	Printed circuit board
Rally Products, Inc.	Hillside Avenue	30	Safety glasses
Surprenant, Albert H.	Harvey Road	50	Kynar and tefzel wire wrap products

Table 3.11-12 (Continued)

Company	Address	# Employees	Product
Londonderry (cont.)			
Uni Cast	Industrial Drive	110	Aluminum invest castings
Workplace Systems, Inc.	Mammoth Road	39	Modular steel system
Manchester			
Amherst International Corp.	Commercial St	78	Vinyl/anti-static products
Anchor Electric	Bedford Street	150	Meter mounting and service entrance equipment
Arcadian Manufacturing Co.	Elm Street	40	Plastic heel finishers
Armtec Industries	French Drive	235	Aircraft/industrial fire, pressure, wind sensors/systems
Automatic Data Processing	Gay Street	40	Payroll processing
Blake's Creamery, Inc.	Milford Street	48	Milk, cream products
Budd Food Incorporated	Somerville St	55	Frozen meat pies
Carol Cable Company	McGregor St	450	Electronic cord sets
Caron Box and Lumber	Baker Street	35	Wooden shakes, skids and pallets
Center Services, Inc.	Titus Avenue	250	Contract assembly/packaging
Colortronix	South Willow	35	Color separation
Crosfield Hastech, Inc.	Commercial St	200	Graphic systems for newspapers
Cummings, Lew A., Co., Inc	Canal Street	90	Book and commercial printers
Cushcraft Corporation	Perimeter Road	100	Communication and television antennas
Danais, John, Co.	Shasta Street	30	Laundry and dry cleaning supplies
Deka Research and Develop.	Commercial St	80	Medical equipment and environmental control
Disogrin Industries	Grenier Field	300	Polyurethane seals, wheels and custom molding
Dupont Chemicals	Commercial St	190	Electronics
E P E Corporation	Commercial St	200	Electronic parts/equipment
Easter Seals Society of NH	Auburn Street	225	Contract assembling
Electropac	Willow Street	100	Circuit boards
EPE Technology	Commercial St	115	Pick and place systems, wire wrapping equipment
Felton Brush, Inc.	Wilson Street	160	Industrial appliance bushes
Fiber Processing Corporation	Perimeter Road	36	Recycle wool/other fiber
Fort Howard Corporation	Gay Street	200	Injection molding
G T E Corporation	Willow Street	680	HID lamps
Granite State Manuf Co., Inc.	Joliette Street	105	Electro-mechanical contract mfg
Granite State Packing Co.	Hancock Street	175	Meat packing
Granite Telcom Corporation	Industrial Pk Dr	30	Telecommunication call processing products
H & O Dental Laboratory	Gay Street	70	Dental appliances
Harvey Industries	Huse Road	270	Replacement windows and doors

Table 3.11-12 (Continued)

Company	Address	# Employees	Product
Manchester (cont..)			
Hermsdorf Fixture, Mfg. Co.	Franklin Street	110	Store fixtures
Hermsdorf Plastics	March Avenue	40	Custom injected molded plastic
Hitachi Cable Manuf, Inc.	Holt Avenue	105	Non-ferrous wire forgings
Itan Corporation	Commercial Street	50	Vision inspection systems
Jac Pac Foods	Hancock Street	275	Portion control meat
Jewell Electronics Instruments	Grenier Field	150	Digital panel meters, seisonic meters
K R L Electronics	Bouchard Street	85	Wire wound and power resisters
Kalwall Corporation	Candida Road	275	Fiberglass skylights and wall panels
Keller Products, Inc.	Union Street	90	Plastic//wood molding
Kered Clothing, Inc.	Commercial St	65	Contract stitching
Klarmann Rulings, Inc.	PO Box	30	Recticles for optical instruments
Ladesco, Inc.	Dow Street	75	Coil winding
Lafayette Beverages, Inc.	Pepsi Road	110	Soft drinks
Lane Construction Corp., The	Dunbarton Road	40	Bituminous asphaltic concrete
Laurier, Inc.	Industrial Pk Dr	30	Dispensers, hybrid die bonders, chip sorters
Leighton Machine Co.	Rogers&Hayw'd	75	Knitting/custom machines
Manchester Knitted Fashions,	Commercial St	425	Knitted outerwear
Metal Works, Inc.	Gay Street	145	Precision sheet metal
Micro Communications, Inc.	PO Box	30	Waveguide and coaxial RF components
Moore Business Forms & Sys.	Brown Avenue	260	Business forms
New Hampshire Plastics, Inc.	Bouchard Street	100	Plastic sheet extruder
New Hampshire Sunday News	William Loeb Dr	300	Newspaper
Nylon Corporation of America	Sundial Avenue	70	Nylon resins
Protapac Co., Inc.	Willow Street	100	Printed circuit board
R C D Components, Inc.	Industrial Pk Dr	385	Wire wound, precision, specialty resisters
R M Corp.	Zackary Street	36	Circuit board assembly
Signals Communications Corp.	Perimeter Road	75	Communication antennas
Snow-Nabstedt Power Trans.	Joliette Street	100	Industrial power transmissions with reduction gearing
Structures Unlimited, Inc.	Union Street	60	Swimming pool enclosures, structural skylights
Summa Four, Inc.	Sundial Avenue	80	Telephone central office switching peripheral equipment
Summit Packaging Systems, Inc.	Ammon Drive	300	Aerosol valves, contract injection molding
Sweetheart Plastics, Inc.	Gay Street	200	Disposable food containers
T J F Beverages, Inc.	Industrial Drive	170	Soft drink bottler
Therrien A. W. Co.	Hayward Street	35	Sheet metal/ roofing

Table 3.11-12 (Continued)

Company	Address	# Employees	Product
Manchester (cont..)			
Union Leader Corp.	William Loeb Dr	300	Newspaper
Velcro U S A, Inc.	Brown Avenue	650	Hook and loop fasteners
Winwood Sportswear, Inc.	Commercial St	50	Sportswear
Zytronics, Inc.	Tirrell Road	60	Electronic power

Source: George D. Hall Company, Directory of New England Manufactures 1993 – 1994, 1993.

3.12 Hazardous Materials

This section discusses the potential for encountering petroleum and/or hazardous material release areas within the work limits of the alternatives under consideration.

■

3.12.1 Introduction

The identification of confirmed or potential contaminated sites relative to the proposed alternatives is important for the following reasons:

- Potential financial and long-term environmental liability associated with the State's acquisition of a contaminated property;
- Potential delays during construction resulting from discovery of unanticipated subsurface contamination;
- Design changes that may be required as a result of property contamination;
- Defining appropriate Department of Environmental Services (DES) or EPA response actions that may be required to remediate contamination;
- Defining appropriate health and safety provisions to protect workers and sensitive receptors during construction; and
- Demolition of structures that may contain asbestos and other regulated building materials.

■

3.12.2 Methodology

To assess the potential presence of petroleum or hazardous material releases, searches of available environmental databases were performed. The databases provide information related to confirmed release sites and sites that may have the potential for encountering contamination. Additional sources of information were consulted, which included the following:

- Department of Environmental Services, Waste Management Division, list of "CERCLIS Sites" (March 26, 1992);
- Department of Environmental Services, Waste Management Division, list of hazardous waste generators (September 18, 1992);
- Department of Environmental Services, Groundwater Protection Bureau, listing of sites (July 2, 1992); and
- Site reconnaissance of project corridor to identify suspect properties not identified in environmental databases.

Based on the databases, findings and subsequent field reconnaissance, 82 properties were identified within an approximate 1,000-foot radius of the I-93 corridor between Salem and Manchester. Table 3.12-1 includes the summary of the 82 properties. The locations of the properties identified in Table 3.12-1 are shown on **Figure 3.12-1**.

Table 3.12-1
Confirmed or Potential Contaminated Sites within Approximately 1,000 Feet of I-93 Corridor

City	NHDES ID Number	Site Address	Database	Status	ID*
Salem	NHD986474351	Industrial Way	RCRA-VG	NA	20
Salem	**NHD986468676**	**Raymond Avenue**	**RCRA-VG**	**NA**	**10**
Salem	NHD980525646	Pelham Road	RCRA-SG	NA	35
Salem	NHD981071459	Garabedian Drive	RCRA-SG	NA	3
Salem	NHD986472728	Industrial Way	RCRA-SG	NA	21
Salem	NHD986474377	Raymond Avenue	RCRA-SG	NA	11
Salem	**NHD039129440, 0-110941, 199209021**	**Northeastern Boulevard**	**RCRA-SG, UST (1998), GPB**	**LUST, AST**	**25**

Table 3.12-1 (continued)

City	NHDES ID Number	Site Address	Database	Status	ID*
Salem	911003	Lowell Road	GPB	Site Eval	5
Salem	**NHD073976904, 0-110568, 88011**	**Northeastern Boulevard**	**RCRA-LG, UST (1998), GPB**	**Haz Waste, LUST, Site Eval**	**26**
Salem	**NHD980523732**	**Keewaydin Drive**	**RCRA-SG**	**NA**	**15**
Salem	**NHD120550967**	**Lowell Road**	**RCRA-SG SPILLS (1998), UST (1998)**	**NA**	**60**
Salem	NHD981214315, NHD980668156, 840522, 198405022	Manor Parkway	RCRA-VG, RCRA-LG, GPB (1992) RCRA-SG (1998), Haz Waste, UST (1998)	Haz. Waste	23
Salem	NHD986473122	Industrial Way	RCRA-VG	NA	22
Salem	8405023	Pelham Road	GPB	Site Eval	18
Salem	NA	Raymond Avenue	NA	NA	81
Salem	**840527**	**Keewaydin Drive**	**GPB**	**Haz. Waste**	**14**
Salem	840524	Lowell Road	CERCLIS GPB	Land/ Unlined	7
Salem	0-112829	Main Street	UST	NA	12
Salem	NHD982747347	Pelham Road	RCRA-SG	NA	19
Salem	NHD980525430	Keewaydin Drive.	RCRA-SG	NA	16
Salem	**NHD986471779**	**Industrial Way**	**RCRA-VG**	**NA**	**61**
Salem	NHD986484061	Rockingham Park Blvd.	RGRA-SG	NA	9
Salem	0-114680	Rockingham Park Blvd.	UST	NA	9
Salem	0-113610, 199509022	Rockingham Park Blvd.	UST, GPB	LUST	9
Salem	**NHD500003553, 199003010**	**Cross Street**	**RCRA-SG, GPB**	**LUST**	**4**
Salem	198710007	Lowell Road	GPB	SEPT/LAG, Haz Waste	17
Salem	**8405033, 0-114121**	**Garabedian Drive**	**CERCLIS GPB, UST (1998)**	**Haz Waste**	**1**

Table 3.12-1 (continued)

City	NHDES ID Number	Site Address	Database	Status	ID*
Salem	NHD986474203	Rockingham Park Boulevard	RCRA-SG	NA	9
Salem	NHD988470193, 0-114753	Manor Parkway	RCRA-SG, UST (1998)	NA	24
Salem	NHD095513602, 199311018, 93-495	Lowell Road	RCRA-SG (1992), RCRA-VG (1998), UST (1998), GPB, SPILLS (1998)	LUST	8
Windham	880838	Range Road	GPB	Haz Waste/ WM	28
Windham	**900731**	**Off Searles Road**	**GPB**	**Spray irrig, UWW/LAG**	**32**
Windham	900801, 0-112563, 0-112114	NH 111	GPB, UST	LUST/UIC	30
Windham	NA	NH 111	NA	NA	82
Windham	NA	Range Road	NA	NA	78
Windham	NA	Range Road	NA	NA	77
Windham	**920509, 0-113880**	**NH 111**	**GPB, UST**	**LUST**	**31**
Windham	**901048, NHD000845636, 0-113907**	**NH 111/I93**	**GPB, RCRA-VG, UST**	**ODD**	**29**
Derry	920620	Kendall Pond Road	Spill/RLS	Closed	34
Derry	8706012, NHD980523328, 198706001	Kendall Pond Road	CERCLIS, GPB, RCRA-SG, LUST	LAND/ Unlined	33
Derry	NHD981070972 840136, 0-113467	Broadway Street	RCRA-SG GPB, UST (1998)	LUST	33
Derry	**840135**	**Bridge Street**	**GPB**	**UWW LAG**	**37**
Derry	NHD981884240	Aiken Street	RCRA-SG	NA	41
Derry	871220	Bridge Street	GPB	Transfer Station	36
Derry	NHD00084626	Aiken Street	RCRA-SG	NA	42

Table 3.12-1 (continued)

City	NHDES ID Number	Site Address	Database	Status	ID*
Derry	NA	NH 102	UST	NA	74
Derry	NA	NH 02	UST	NA	75
Derry	NA	Kendall Pond Road	NA	NA	80
Londonderry	481258	Liberty Drive	ERNS	NA	55
Londonderry	**0-113761**	**West Broadway**	**UST**	**NA**	**38**
Londonderry	0-110807	Liberty Drive	UST	NA	62
Londonderry	**NHD012040275 900817**	**NH 102**	**RCRA-SG GPB**	**LUST**	**40**
Londonderry	NHD986469427	Symmes Drive	RCRA-VG	NA	58
Londonderry	NHD98648395 53659, 199606052	Symmes Drive	RCRA-SG ERNS, GPB	AST, LUST	63
Londonderry	NHD981203284	Rockingham Road	RCRA-SG	NA	68
Londonderry	NHD982198475	Liberty Drive	RCRA-SG	NA	53
Londonderry	**0-114012, 199407075**	**Londonderry Road**	**UST, GPB**	**AST**	**46**
Londonderry	890758	Independence & Liberty Drive	GPB	Holding tank	54
Londonderry	**920328**	**Route 93, vicinity Exit 5**	**GBP**	**SPILL/ RLS**	**57**
Londonderry	**NHD982749970 840329**	**Londonderry Road**	**RCRA-SG GPB**	**UIC**	**45**
Londonderry	NHD982202509	Londonderry Road	RCRA-SG	NA	44
Londonderry	NHD986485803	Garden Lane	RCRA-SG	NA	48
Londonderry	**NHD982193062, D50157**	**Route 102**	**RCRA-SG, ERNS**	**NA**	**50**
Londonderry	**NA**	**Route 102**	**UST**	**NA**	**50**
Londonderry	NHD081250367	Stonehedge Road	RCRA-SG	NA	51
Londonderry	**NHD986481877 910217**	**Route 102**	**RCRA-SG GPB**	**LUST**	**39**

Table 3.12-1 (continued)

City	NHDES ID Number	Site Address	Database	Status	ID*
Londonderry	NA	Londonderry Road	NA	NA	76
Londonderry	NHD986474211, 449532, R51258, 448596	Londonderry Road	RCRA-SG (1992), RCRA-VG (1998), ERNS	NA	43
Londonderry	**NHD043160605**	**Ash Street**	**RCRA-SG**	**NA**	**47**
Londonderry	530973, 199804014	Rockingham Road	ERNS, GPB	Transformer, Spill / RLS	52
Londonderry	NA	Rockingham Road	UST	NA	67
Londonderry	NHD062004569, 199004008, 93-316	Route 102	NPL, GPB, SPILLS	CERCLA	64
Londonderry	NHD986471076, 199502042	Perimeter Road	RCRA-SG/LG, GPB	HOLDTANK/RLS	56
Londonderry	0-111372	Route 102	UST	NA	49
Londonderry	NA	Independence Drive	NA	NA	69
Londonderry	NA	I-93	Spill	NA	70
Londonderry	NA	Route 102	UST	NA	71
Londonderry	NA	Route 102	NA	NA	72
Londonderry	NA	Route102	UST	NA	73
Londonderry	**0-114599**	**Route 28**	**UST**	**NA**	**66**
Manchester	880520	Mammoth Road	GPB	NA	79
Manchester	NHD052017787	Island Pond Rd.	RCRA-VG	NA	59

Notes: Bolded rows represent properties for which ISA's were performed.

GPB – Groundwater Protection Bureau
UIC – underground injection control,
LUST – leaking underground storage tank
UST – underground storage tank
RCRA – Resource Conservation and Recovery Act
SG – small quantity generator
VG – very small quantity generator
LG – large quantity generator
AST – aboveground storage tank
WM – waste management
RLS – Release
SLU – Sludge
LAG – Lagoon
UWW – Untreated Wastewater
ERNS – Environmental Release Notification System
ODD – Oil Discharge and Disposal/Cleanup Fund Site
Land/Unlined – Unlined Landfill
NA –Not Available / Not Applicable
* - See **Figure 3.12**-1 for Site locations.

From this list, 22 properties were selected for Initial Site Assessments (ISAs) to be conducted. The properties were selected based on an approximate 500-foot distance from the I-93 corridor, a limited site reconnaissance (windshield survey), information obtained from files reviewed at the NHDES related to State Hazardous Waste Sites (SHWSs), and current property use (i.e., gasoline stations, automotive repair facilities). The 22 sites are shaded in Table 3.12-1.

■

3.12.3 Summary of Initial Site Assessment (ISA) Findings

Individual Site Assessments (ISAs) are initial investigations, using primarily local, state and federal data bases and files to determine whether a property may be contaminated. The results of the ISA's were documented in a comprehensive report dated February 2002. A summary of the ISA findings for each of the 22 properties is included in the following Table 3.12-2.

Table 3.12-2
Summary of ISA Findings

City	Site Name/Address	ISA Findings	Figure 3.12-1 ID
Salem	Raymond Avenue	2 RCRA Generators, no violations reported.	10
Salem	Northeastern Boulevard	UST Site, RCRA Generator, no violations reported, Remediation completed in 1996.	26
Salem	Northeastern Boulevard	UST Site, RCRA Generator, no violations reported, Remediation completed in 1994.	25
Salem	Keewaydin Drive	RCRA Generator, no violations reported.	15
Salem	Lowell Road	UST Site, RCRA Generator, no violations reported.	60
Salem	Keewaydin Drive	Active Remediation Site, currently under a Groundwater Management Permit.	14
Salem	Industrial Way	RCRA Generator, no violations reported.	61
Salem	Cross Street	LUST Site, RCRA Generator, USTs removed, Diesel contamination in soil and groundwater.	4
Salem	Garabedian Drive	Currently under an ISA being conducted by Jacques Whitford Company.	1

Table 3.12-2 (continued)

City	Site Name/Address	ISA Findings	Figure 3.12-1 ID
Windham	Off Searles Road	Wastewater treatment system on-site, Active Remediation Site, currently under a Groundwater Management Permit.	32
Windham	Route 111	LUST Site, MTBE in bedrock potable water well, Groundwater Management Zone not yet established.	31
Windham	Route 111	LUST Site, Active Remediation Site, currently under a Groundwater Management Permit,.	29
Derry	Bridge Street	Former landfill capped, wastewater lagoons reconstructed, currently under Groundwater Management Permit.	37
Londonderry	West Broadway	UST Site, 7 USTs installed in 1985 and all 7 removed in 1995.	38
Londonderry	Route 102	LUST Site in 1993, no detectable contaminant concentrations in 1994, TCE in groundwater from former upgradient dry-cleaner.	40
Londonderry	Londonderry Road	UST Site, permanently closed USTs in 1986.	46
Londonderry	Route 93, vicinity of Exit 5	5,000 – 7,000-gallon gasoline spill in I-93 median in 1996. Spilled to frozen ground, remediation completed in 1996.	57
Londonderry	Londonderry Road	Commercial / Light Industrial building on septic system.	45
Londonderry	Route 102	UST Site, several USTs closed in 1994 with no available documentation. Auto repair facility on a septic system until 1995.	50
Londonderry	Route 102	LUST Site, Active Remediation Site, currently under a Groundwater Management Permit.	39
Londonderry	Ash Street	Auto Repair Facility on a septic system since 1977.	47
Londonderry	Rockingham Road	UST Site, 2 spills in 1997 and 2000, both spills are listed as “Closed”.	66

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3.12.4 Potential Building Acquisition and Demolition

In addition to addressing properties that may be contaminated as a result of a release of petroleum or hazardous materials, the project alternatives may also include the

acquisition of property that would require the demolition of existing buildings and structures. The buildings may contain regulated materials that require removal prior to demolition. Based on the age of the buildings, regulated materials may include the following:

- Asbestos
- Lead-based paint
- Polychlorinated biphenyls (PCBs) within fluorescent light ballasts
- Electrical transformers that may contain PCB dielectric oil
- Mercury-containing fluorescent light bulbs
- Mercy thermostats
- Miscellaneous containers of oil or hazardous materials
- Refrigerants (air conditioners, refrigerators)
- Hydraulic lifts
- Aboveground storage tanks
- Underground storage tanks

Based on a review of the proposed alternatives, 49 properties contain up to 55 structures that may require demolition. The 49 properties that could be affected by any of the alternatives are listed in Table 3.12-3.

Table 3.12-3
Buildings that may Require Demolition

NH DOT Parcel ID	Address	Property Use	Structure(s)	Figure 3.12-1 ID
Salem				
S10	Valeska Lane	Residential	House, Garage	NA
S17	Cross Street	Residential	House, Garage	NA
S37	Cross Street	Residential	House	NA
S38	Brady Avenue	Residential, Vacant	Building	NA
S42	Williston Road	Residential	House	NA
S43	Williston Road	Residential	House	NA
S60	Lowell Road	Residential	House	NA
S69	Lowell Road	Residential	House	NA
S78	Pelham Road	Residential	House	NA
S81	Main Street	Commercial	Building	NA

Table 3.12-3 (continued)

NH DOT Parcel ID	Address	Property Use	Structure(s)	Figure 3.12-1 ID
S151	Fairmont Road	Residential	House	NA
S152	Fairmont Road	Residential	House	NA
S153	Fairmont Road	Residential	House	NA
S154	Fairmont Road	Residential, Vacant	House	NA
S155	Boyer Lane	Residential	House, Garage	NA
S156	Fairmont Road	Residential, Vacant	House	NA
S157	Fairmont Road	Residential	House	NA
S158	Fairmont Road	Residential	House	NA
S169	Boyer Lane	Residential	House	NA
S173	Raymond Avenue	Industrial	Building	81
S178	Trolley Lane	Residential	House	NA
S182	Trolley Lane	Residential	House, Structure	NA
Windham				
W35	NH 111	Commercial	Building	82
W42	NH 111	Commercial	Shed	NA
W43	NH 111	Commercial	Building	NA
W44	NH 111	Commercial	Building	31
W45	NH 111	Residential	House	NA
W46	NH 111	Residential, Vacant	House	NA
W47	NH 111	Residential, Vacant	House	NA
W95	NH 111	Commercial	Building	NA
W99	NH 111	Commercial	Building	29
W100	NH 111	Commercial	Building	NA
Windham cont.				
W103	NH 111A	Commercial	Three Buildings	NA
W104	NH 111A	Commercial	Building	78
W105	NH 111A	Commercial	Building	NA
W106	NH 111A	Commercial	Building	77
Derry				
D10	Spinnaker Drive	Residential	House	NA
D11	Spinnaker Drive	Residential	House	NA

Table 3.12-3 (continued)

NH DOT Parcel ID	Address	Property Use	Structure(s)	Figure 3.12-1 ID
Londonderry				
L37	Trolley Car Lane	Residential	House	NA
L75	Rockingham Road/ Symmes Drive	Commercial	Building	NA
L79	Rockingham Road	Commercial	Building	68
L80	Rockingham Road	Commercial, Vacant	NA	NA
L81	Rockingham Road	Commercial	Building	67
L82	Rockingham Road	Commercial	Two Buildings	52
L130	Rockingham Road	Commercial	Building	66
L174	Londonderry Road	Commercial	Building	76
L178	Reo Lane	Residential	House	NA