The 2016 USACE Mitigation Guidance also provides recommendations for additional in-lieu fee payments for vernal pools that would be partially impacted or that would have impacts to their CTH that reduce their vernal pool value but do not cause a complete loss of function. Value loss is determined by scoring the landscape portion of the USACE "Vernal Pool Characterization" form for wetlands with encroachments in their CTH (Table 4.12-5) and identifying any pools whose current values drop from high to medium, high to low, or medium to low under the built condition. Based on GIS analysis, modeling, and USACE review, four vernal pools would be affected sufficiently to drop in value due to project impacts but would likely continue to function as vernal pools (VPs 3, 9, 46 and 64). The vernal pool value loss is the difference between the before and after value factors. For example, if a high value VP (value of 65,000) drops to a medium value VP (value of 39,000), the loss value of 26,000 is entered in the ARM fund calculator (65,000 – 39,000 = 26,000). Low value vernal pools do not need to be evaluated. Using this guidance, the total area to be mitigated for indirect impacts to the four vernal pools that have been evaluated to have dropped one value level would be 4 X 26,000 or 104,000 square feet (2.39 acres). In February of 2019, EPA and USACE (the Agencies) issued a proposed rule redefining "Waters of the U.S." under the CWA. Under this rule, nonadjoining wetlands that do not have a continuous surface connection to a jurisdictional water, including some vernal pools, would no longer fall under federal jurisdiction, and secondary or indirect impacts would no longer require mitigation. However, all indirect vernal pool impact and mitigation calculations in this document are based on the 2016 guidance (the current guidance at the time the SDEIS and this FEIS were prepared). The mitigation details could change during permitting depending on future regulatory and guidance changes.

The ARM fund payment that would result from the construction of the preferred alternative was calculated based on the conceptual level design plans to be $3,662,871.22 (Table 4.12-7). Other potential avenues for wetland mitigation include land preservation and the SPIP. NHDOT is currently investigating the mitigation suitability of a parcel of land in Derry adjacent to a Town Forest, which has the support of the Derry Conservation Commission. The SPIP is a partnership with NHDOT and NHDES that would use mitigation funds to address culverts within the Project watershed that have inadequate aquatic organism passage or structural condition. NHDOT is evaluating several stream crossings for applicability under this program. Preservation of a suitable property or participation in the SPIP would be expected to lower the ARM fund payment accordingly.

4.13 Groundwater

4.13.1 Affected Environment

The study area for aquifers is shown in Figure 4.13-1 and is the same as the study area for surface waters and water quality. The study area for groundwater wells is based on a 1,300-foot buffer, which corresponds to a minimum radius for WHPAs. A WHPA as defined in RSA 485-C:2 is the "surface and subsurface area surrounding a water well or wellfield, supplying a public water system (PWS), through which contaminants are reasonably likely to move toward and reach such water well or wellfield." The WHPA for individual wells varies in radius from 1,300 feet to 4,000 feet, depending on the status of the WHPA delineation (preliminary versus refined) and the maximum daily amount of water withdrawn from the well. WHPAs are delineated preliminarily by a radius centered on a wellhead location (preliminarily a 1,300-foot radius for wells producing less than 7,200 gallons per day (gpd) up to a 4,000-foot radius for wells

producing greater than 57,600 gpd). A WHPA is then refined for each well by either setting a fixed radius around the wellhead of 4,000 feet (for wells producing less than 57,600 gpd) or defining an area through a groundwater modeling study using the "flow net" technique during a 180-day period of continuous permitted withdrawals (see Env-Dw 302.11 and Env-Dw 305.11).

Water supply wells are also subject to a sanitary protective area (Env-Dw 302.10; Env-Dw 303.09; Env-Dw 305.10) that is defined by a protective area centered on the wellhead and sized according to production volume from 150 feet (for wells producing less than 14,400 gpd) up to 400 feet (for wells producing greater than 144,000 gpd). Within the sanitary protective area there are restrictions for certain uses and activities; e.g., discharges are not allowed from roadways, parking lots, stormwater structures, or areas with fertilizer or pesticide application (Env-Dw 302.10; Env-Dw 303.09; Env-Dw 305.10). The sanitary protective area rules have the potential to affect Project design, particularly the placement of stormwater structures, and will need to be considered during the final design phase. There are further rules for private water supply wells including the requirement to maintain a sanitary protective area of at least 75 feet for wells producing up to 750 gpd (Env-Wq 1008.08). The NH Water Well Board rules (We 100 through We 1000) include setback criteria of 75 feet for private wells to property boundaries and roadways and 50 feet from state highway ROW (We 602.05(e)). Setback distances to private wells will need to be reviewed during final design as discussed further in Section 4.13.3. During final design, the location of roadway alignments, ROW, and stormwater structures will be reviewed to ensure the Project is in conformance with all NH rules requiring protection of groundwater resources and adheres to the NHDES guidance document *Recommendations for Groundwater Protection Measures When Siting or Improving Roadways* (NHDES, 1995), discussed in Section 4.13.3, including restrictions within WHPAs, sanitary protective areas, and setback distances.

The groundwater resources identified in the study area include both fine-grained and coarse-grained stratified-drift aquifers and public wells (Stekl and Flanagan, 1992). Stratified-drift aquifers are characterized as sand and gravel deposits and were formed as a result of glacial activity during the late Pleistocene epoch (between approximately 18,000 and 10,000 years ago) (Kelsea and Gove, 1994). These types of geologic deposits typically are highly permeable and make up the most productive aquifers in the region (Stekl and Flanagan, 1992). Figure 4.13-1 presents mapped stratified drift aquifers in the study area.

Information pertaining to potential groundwater sources within the study area was obtained from the NH Geographically Referenced Analysis and Information Transfer System (GRANIT) and based on data obtained from USGS. NH GRANIT is a statewide geographic database maintained by the UNH and the New Hampshire Office of Energy and Planning, and it is developed and maintained by the UNH Institute for the Study of Earth, Oceans, and Space in Durham. Data from this source identifying areas of high, medium, and low transmissivity within the stratified drift areas were delineated on Project mapping to depict areas of sensitivity for groundwater resources (Figure 4.13-1). Transmissivity is an indirect measure of the potential yield of available water within the aquifer and is based on the permeability and thickness of the saturated deposits. The higher the transmissivity value, the greater the potential yield, and therefore the greater the resource value, for the specific aquifer area.

As Figure 4.13-1 shows, much of the Project study area includes aquifer areas with potential transmissivity values characterized as low (less than 1,000 square feet per day [square feet/day]). An area of medium (1,001–2,000 square feet/day) to high (2,001–4,000 square feet/day)

transmissivity is present south of Alternative F. This area is located in proximity to the Beaver Brook stream corridor and extends south outside the study area. This medium to high transmissivity area is part of a large stratified drift aquifer.

Public and Private Water Supply

Water is supplied to public and private entities in the study area by a combination of municipal surface water supply and public and private wells. Much of the population living within the study area receives drinking water from Manchester Water Works via a network of pipelines. The source of this water is Lake Massabesic located to the north of the study area in Manchester, NH. In addition to Manchester Water Works, Pennichuck East Utility, Inc. (PEU) provides water to portions of Londonderry and Derry from a variety of sources. The rest of the water supply in the study area is provided by public and private wells, as discussed below.

Public Wells

The New Hampshire Safe Drinking Water Act (RSA 485:1-a) defines a PWS as any piped water system used for human consumption, if such system has at least 15 service connections or regularly serves an average of at least 25 individuals daily for at least 60 days out of the year. These PWSs can be further divided as described below.

- **Community water systems** serve at least 15 service connections used by year-round residents or regularly serve at least 25 residents (i.e., municipal systems, condominiums complexes, mobile home parks).
- **Non-community water systems** include PWSs that are not community water systems (i.e., they do not service residences), but service 15 or more connections and 25 or more people in a non-transient or transient facility.
- **Non-transient facilities** are defined as those facilities that serve 15 or more connections or 25 or more of the same people at least 180 days per year. Examples of non-transient facilities include schools, offices, and day-care facilities.
- **Transient facilities** are those facilities that provide 15 or more service connections or service 25 or more different people at least 60 days per year. Examples of transient facilities include restaurants, hotels/motels, campgrounds, and convenience stores.

Public well information was obtained from NHDES' Groundwater Protection Bureau and Drinking Water Supply Protection Bureau. The locations and associated data for individual public wells and their WHPA, if applicable, were uploaded into the Project GIS system to confirm the number of wells and associated WHPAs located within the Project study area. Fourteen public wells have WHPAs intersecting an Alternative corridor or are within 1,300 feet of an Alternative if no WHPA applies. Figure 4.13-1 shows this information and the previously discussed aquifer areas.

A total of 17 PWSs, and their associated WHPAs, if applicable, were identified within the study area (Table 4.13-1; Figure 4.13-1). Of these, NHDES lists 9 as active wells,[18] and 8 as inactive wells. The active wells include 9 community wells: 7 in Derry and 2 in Londonderry.

Among the 8 inactive wells identified by NHDES within the study area, 2 are community wells, 2 are non-community, transient wells, and 4 are non-community, non-transient wells. A total of 7 of the inactive wells are in Derry (2 community; 3 non-community, non-transient; and 2 non-community, transient), and 1 non-community, non-transient inactive well in Londonderry).

Several of the larger active community well systems (in terms of the number of service connections) include condominium complexes and subdivision homeowners' associations in the study area, including: Barkland Acres Association in Derry (Well Nos. 1 and 2), Morningside Drive in Derry (Well Nos. 7 and 8) and PEU Springwood Hills in Londonderry (Well Nos. 16 and 17). These community water systems are all located within the study area. Three wells with 3,600-foot radius WHPAs (Well nos. 12, 13, and 14) serve a subdivision off NH 102 in the northeast corner of the study area, identified as Rand Shephard Hill.

Table 4.13-1. Summary of Public Water Supply Wells near the Project Alternatives

Well No.	Facility Name	Status	System Type	Well Head Protection Radius (feet)
Derry				
1	Barkland Acres Assoc	A	C	1,500
2	Barkland Acres Assoc	A	C	1,500
3	Betley Chevrolet-Buick Inc	I	P	n/a
4	Cat-O-Nine Tails	I	N	n/a
5	Derry Day Care	I	P	n/a
6	Evco Water System	I	C	n/a
7	Morningside Drive Water Assoc	A	C	1,500
8	Morningside Drive Water Assoc	A	C	1,500
9	Old County Water Systems	I	C	n/a
10	Sonshine Day Care	I	P	n/a
11	Trinity Assembly of God	I	N	n/a
12	Rand Shephard Hill	A	C	3,600
13	Rand Shephard Hill	A	C	3,600
14	Rand Shephard Hill	A	C	3,600
Londonderry				
15	Adventures In Learning Daycare	I	P	n/a

[18] For this FEIS, the phrase "active well" refers to those wells that are being used for drinking water. This includes those systems whose system status and source status are both listed by NHDES as active.

Well No.	Facility Name	Status	System Type	Well Head Protection Radius (feet)
16	PEU/Springwood Hills	A	C	n/a
17	PEU/Springwood Hills	A	C	n/a

Notes: System Type Codes: C – community; N – non-community transient; P – non-community non-transient. Status: I – inactive; A – active. Active wells are those wells that are being used for drinking water and listed by NHDES as having both an active system status and an active source status.

The Town of Derry has several wells shown in Figure 4.13-1 that are located in the aquifer south of NH 102 in the Beaver Brook stream corridor. These wells are shallow and are no longer used as drinking water sources. According to the Derry Water Department, these wells were abandoned in the 1980s (Tom Carrier, Derry Water Department, pers. comm., August 2006).

Private Wells

Information on private wells was obtained from NHDES' Drinking Water and Groundwater Bureau. NHDES reports that approximately 65,000 of 130,000 reported wells have been georeferenced and are included in the GIS data. Since 2007, NHDES has required the locations of new wells be reported on a well completion form submitted to NHDES (NHDES, 2016f). Private wells do not have regulatory WHPAs, but wells within 1,300 feet of the Build Alternatives were counted in the following summary.

A total of 117 private wells (77 in Derry and 40 in Londonderry) were identified near the Alternative corridors with the majority listed as drilled bedrock wells. Private well numbers are estimated and taken from NHDES' inventory of private wells. The number of private wells was not verified and could be higher than what is presented here. Of the 117 private wells, 102 are listed as domestic wells with 67 located in Derry and 35 located in Londonderry. One is listed as a commercial well in Londonderry; three are listed as agricultural wells (two in Derry and one in Londonderry); and 11 are listed as test/exploration wells (eight in Derry and three in Londonderry). Table 4.13-2 summarizes this information. To protect private rights, Figure 4.13-1 does not show the locations of private wells.

Table 4.13-2. Summary of Private Water Supply Wells Located in the Study Area

Well Use Type	Derry	Londonderry	Totals
Domestic	67	35	102
Commercial	0	1	1
Agricultural	2	1	3
Test/Exploration	8	3	11
TOTALS	77	40	117

Note: Private well number estimates are from the NHDES inventory and are not verified.

Groundwater Quality

PWSs are required to routinely test water quality and submit results to NHDES as part of their PWS permit compliance and are an excellent source for local groundwater data in the absence of site-specific groundwater monitoring. Readily available PWS compliance data were accessed from the NHDES Onestop website (accessed July 18, 2019), and consumer confidence reports were reviewed to determine current groundwater quality conditions in the Project area. Road and highway projects have the potential to introduce contaminants to groundwater through surface runoff and the stormwater system. Although groundwater recharge and stormwater infiltration systems can be highly effective at removing certain pollutants of concern typically associated with runoff from roadways, such as TSS and nutrients, other roadway pollutants, notably chlorides from road salt, are highly mobile in the environment and are not significantly removed from stormwater through infiltration practices or biological processes. Given the greatest impact to groundwater quality from the Project is likely to be chlorides, this analysis focuses on the current chloride levels in the Project area.

PWS compliance data were obtained from NHDES Onestop and system consumer confidence reports, as available, for all of the active wells in the Project area, including Well Nos. 1 and 2 (Barkland Acres Association); Well Nos. 7 and 8 (Morningside Drive Water Association); Well Nos. 12, 13, and 14 (Rand Shephard Hill); and Well Nos. 16 and 17 (PEU/Springwood Hills). A total of 12 separate sampling events for the above wells were reported between 2001 and 2018 where chloride was analyzed and reported on Onestop (two events for PEU/Springwood Hills from 2018 were summarized from the system consumer confidence report accessed 7/18/19 at https://pennichuck.com/pdf/CCR-J7.pdf). Chloride values ranged from 37 to 183 mg/L with a median value of 77 mg/L and a mean value of 96 mg/L. For comparison, the secondary maximum contaminant level for chloride in drinking water is 250 mg/L. None of the reported PWS compliance data exceeded the secondary maximum contaminant level for chloride in the Project area, and no meaningful temporal trends were seen in this limited dataset. The highest chloride levels reported were from the Barkland Acres system (Well Nos. 1 and 2), with all four of the samples reported having values greater than 120 mg/L. Table 4.13-3 summarizes chloride data from PWS compliance reports.

Table 4.13-3. Summary of PWS Chloride Sampling Results in Project Area

PWS	Barkland Acres (Well Nos. 1 and 2)[a]	Morningside Drive Water Association (Well Nos. 7 and 8)[a]	Rand Shephard Hill (Well Nos. 12, 13, and 14)[a]	Springwood Hills (Well Nos. 16 and 17)[b]
Chloride Concentration (Date of Sample)	183 mg/L (11/14/2001)	69 mg/L (9/13/2011)	37 mg/L (8/25/2010)	53 mg/L (2018)
Chloride Concentration (Date of Sample)	140 mg/L (11/6/2007)	84 mg/L (9/17/2014	47 mg/L (7/17/2013)	56 mg/L (2018)
Chloride Concentration (Date of Sample)	122 mg/L (11/22/2013)	122 mg/L (9/12/2017)	63 mg/L (7/27/2016)	-

PWS	Barkland Acres (Well Nos. 1 and 2)[a]	Morningside Drive Water Association (Well Nos. 7 and 8)[a]	Rand Shephard Hill (Well Nos. 12, 13, and 14)[a]	Springwood Hills (Well Nos. 16 and 17)[b]
Chloride Concentration (Date of Sample)	174 mg/L (11/19/2016)	-	-	-

[a] Data from NHDES Onestop at https://www.des.nh.gov/onestop/index.htm (accessed on July 18, 2019.).
[b] Data from Pennichuck Water Works at https://pennichuck.com/pdf/CCR-J7.pdf (accessed on July 18, 2019).

4.13.2 Environmental Consequences

Groundwater

No Build Alternative

Because the No Build Alternative would not involve any new construction, no impacts on groundwater above the existing conditions would be anticipated.

Build Alternatives

None of the Build Alternatives would cross an area that includes a high transmissivity aquifer, but all the alternatives overlap with the lowest transmissivity recognized by NHDES in its aquifer mapping (0–1,000 square feet/day). Public water systems are located in proximity to Alternatives A, B, C, and D with WHPAs overlapping the alternative footprints. As with any new development, there could be roadway-related environmental impacts, including the contamination of the groundwater source for these water supplies. Groundwater impacts can arise from infiltration of contaminated runoff from the road surface, spills of hazardous materials, and application of roadway de-icing salt. The potential for these types of impacts is typically estimated by comparing the proximity of newly paved surfaces and calculating the additional paved surface to be added within the WHPA associated with each well. Generally, as the distance between a water supply source and a proposed roadway system decreases, the potential for impacts increases. Similarly, as the amount of newly paved surface increases, the potential for contamination also increases.

A summary of potential impacts on groundwater associated with each Build Alternative is discussed below and included in Table 4.13-44.

Table 4.13-4. Summary of Impacts on Groundwater Resources by Alternative

Resource	A	B	C	D	F
Aquifers, 0–1,000 square feet/day[a]	23.17	13.56	32.67	37.66	19.15
Aquifers, 1,000–2,000 square feet/day	0.00	0.00	0.00	0.00	0.16
Direct impacts on public water supply wells	None	None	None	None	None
Public WHPAs[b]	6	5	5	6	0

Resource	A	B	C	D	F
WHPAs new impervious, acres[c]	0.27	1.16	1.16	0.22	0
Private wells (number)[d]	0	2	2	0	0
Private wells (number within 150 feet)[d,e]	21	16	14	18	4

[a] Aquifer impacts are identified as acreage of the alignment footprint that overlaps statewide transmissivity rate aquifer mapping.
[b] The number of WHPA impacts does not identify that there are several overlapping WHPAs.
[c] The acreage of WHPA footprint overlap is not counted separately for each well.
[d] Private well numbers are estimated from NHDES inventory and are not verified.
[e] Private wells do not have regulated WHPAs. However, the metadata for the NH Water Well Inventory (NHDES 2016d) stipulates that their margin of error is ±150 feet for well locations. Given this margin of error, and to help in identifying the proximity of the alignments to private wells, wells within 150 feet of the alternatives were also tabulated.

Alternative A

The preferred alternative footprint overlaps six WHPAs. However, as previously noted and depicted in Figure 4.13-1, several of these public wells are located near each other and therefore share largely overlapping WHPAs that occupy much of the same land area. Roadway and intersection improvements on existing alignment would result in 0.27 acre of new impervious area within six WHPAs (Barkland Acres, Well Nos. 1 and 2, Morningside Drive, Well Nos. 7 and 8, and Rand Shephard Hill, Well Nos. 13 and 14, but not Well No. 12) that encompass Tsienneto Road, connections to five intersecting roads (Fieldstone Drive, Horseshoe Drive, Morningstar Drive, Scenic Drive and Beaver Drive), and the northern end of the Alternative on NH 102. Tsienneto Road travels through the area where four WHPAs overlap (WHPAs associated with Well Nos. 1, 2, 7, and 8) for a distance of 2,940 linear feet, all of which would involve wider pavement and the addition of sidewalks. Approximately 128 linear feet of the preferred alternative crosses two of three overlapping WHPAs associated with the Rand Shepard Hill development (Well Nos. 12, 13, and 14) at the northern end of the Alternative on NH 102, with a minimal expansion of pavement proposed for this segment of the preferred alternative. The new impervious area proposed within each WHPA includes 0.22 acre in the Well No. 7 WHPA, 0.22 acre in the Well No. 8 WHPA, 0.21 acre in the Well No. 1 WHPA, 0.21 acre in the Well No. 2 WHPA, <0.01 acre in the Well No. 14 WHPA, and 0 acre in the Well No. 3 WHPA. The estimated population served by PWSs with a WHPA overlapped by the preferred alternative footprint is 358 based on the PWS well data provided by NHDES. A population of 80 is served by Well Nos. 1 and 2, a population of 80 is served by Well Nos. 7 and 8, and a population of 158 is served by Well Nos. 12, 13, and 14. No private wells would be affected by the preferred alternative, but the alignment is within 150 feet of 21 private wells. Approximately 128 linear feet of the preferred alternative crosses two of three overlapping WHPAs associated with the Rand Shepard Hill development (Well Nos. 12, 13, and 14) at the northern end of the Alternative on NH 102, with a minimal expansion of pavement proposed for this segment of the preferred alternative. The new impervious area proposed within each WHPA includes 0.53 acre in the Well No. 7 WHPA, 0.52 acre in the Well No. 8 WHPA, 0.48 acre in the Well No. 1 WHPA, 0.48 acre in the Well No. 2 WHPA, 0.01 acre in the Well No. 14 WHPA, and 0.00 acre in the Well No. 3 WHPA. The estimated population served by PWSs with a WHPA overlapped by the preferred alternative footprint is 358 based on the PWS well data provided by NHDES. A

population of 80 is served by Well Nos. 1 and 2, a population of 80 is served by Well Nos. 7 and 8, and a population of 158 is served by Well Nos. 12, 13, and 14. No private wells would be affected by the preferred alternative, but the alignment is within 150 feet of 21 private wells.

Alternative B

This Alternative would require construction of a new roadway alignment within the WHPAs of Well Nos. 1 and 2, with 1.16 acres of new pavement and approximately 1,560 linear feet of new roadway. An estimated population of 80 is served by Well Nos. 1 and 2 according to PWS well data provided by NHDES. The footprint of Alternative B overlaps with two private wells as mapped by USGS and is within 150 feet of 16 private wells.

Alternative C

The portion of the Alternative C alignment that would be in proximity to active public water systems follows the same corridor as Alternative B. Consequently, 1.16 acres of new pavement within the WHPAs of Wells no. 1 and 2 would be constructed. An estimated population of 80 is served by Well Nos. 1 and 2 according to PWS well data provided by NHDES. Alternative C overlaps with two private wells as mapped by USGS and is within 150 feet of 14 private wells. Alternative C is also within 250 feet of community wells 16 and 17, which do not have WHPAs associated with them.

Alternative D

Alternative D would have virtually identical impacts on WHPAs as discussed for Alternative A, although impacts for Alternative A reflect a more advanced design than the values for the other alternatives for consistency with state and federal permit applications. The Alternative D footprint overlaps no private wells and is within 150 feet of 18 private wells. Alternative D is also within 250 feet of community wells 16 and 17, which do not have WHPAs associated with them.

Alternative F

Alternative F would not result in any impacts on existing wells or WHPAs. It is within 150 feet of 4 private wells.

4.13.3 Mitigation

Groundwater resources have the potential to be impacted by construction and operation of the Project, including spills and releases of hazardous and non-hazardous materials and stormwater runoff. Hazardous materials spills resulting from construction of the Project will be addressed during the permitting and construction phase through the required Stormwater Pollution Prevention Plan. Hazardous material spills during operation of the Project will be handled by the local authority (e.g., emergency response team) in accordance with all NHDES requirements. Mitigation measures for potential non-hazardous roadway pollutant impacts to groundwater resources will conform to NHDES rules for protection of groundwater resources, including maintaining setback distances from private wells and avoiding development within sanitary protective areas as presented in Section 4.13.1, and will be consistent with NHDES' *Recommendations for Groundwater Protection Measures When Siting or Improving Roadways* (NHDES, 1995). This document provides recommendations for structural and non-structural BMPS to protect groundwater based on the proximity of the roadway to a WHPA for wells serving community and nontransient, non-community public wells, locally designated

groundwater protection areas, and high value aquifers reserved for future water supply. A summary of the groundwater protection measures recommended in NHDES (1995) is presented in Table 4.13-5.

Table 4.13-5. Summary of Groundwater Protection Measures from NHDES' Recommendations for Groundwater Protection Measures When Siting or Improving Roadways

Protection Level	Level 1	Level 2	Level 3	Level 4
Applicability	Statewide	• Wellhead protection areas • Locally designated groundwater/aquifer protection areas • GA1 areas	• Within 1,000 ft. of Large C or P well • Within 500 ft. of a small C or P well	• Within 400 ft. of a large C or P well • Within 200 ft. of a small C or P well
Exceptions	Where higher level measures apply	• Where a competent impermeable layer exists between groundwater protection area and road's drainage area • Level 3 or 4 areas	• Where a competent impermeable layer exists between well screen and road's drainage area • Bottom of well is above elevation of highway • Overburden well and WHPA does not include highway drainage area • Level 4 areas	• Where bottom of well is above highway elevation
Stormwater treatment BMPs (e.g., grassed swales)	X	X		
Non-structural measures		X	X	X
Lined grassed swales. Lined snow storage areas. Runoff diverted to extent possible			X	
Raised railings			X	X
Closed drainage system outletting outside Level 4 area				X

Source: NHDES (1995)

As discussed in Section 4.13.1, several public drinking water supply sources have WHPAs located within the Project area, including Barkland Acres Association in Derry (Wells No. 1 and 2), Morningside Drive in Derry (Wells No. 7 and 8), PEU/Springwood Hills in Londonderry (Wells Nos. 16 and 17), and Rand Shephard Hill (Well Nos. 12, 13, and 14). The operators of the Barkland Acres Association, Morningside Drive, and PEU/Springwood Hills public water supplies will be contacted by NHDOT during the final design process.

During final design, private water supply wells will be inventoried using the latest available water well data from NHDES and field verified to the extent possible to determine potential Project encroachment on setback distances specified in NHDES rules. Affected WHPAs will be reviewed during final design with respect to NHDES recommendations (NHDES, 1995) and Project proximity to sanitary protective areas will be determined. If setbacks or other groundwater protection criteria are not met as a result of construction or operation of the Project, it may be appropriate to consider further actions. Mitigating actions may include changes to the stormwater system design consistent with NHDES' recommendations (NHDES, 1995), water quality testing to establish baseline and post-construction water quality, and/or well replacement or compensation for well replacement costs under the NHDOT well replacement program. The NHDOT well replacement program was developed to replace, repair, or pay damages for water supplies that have been affected by construction or maintenance operations on the state highway system, primarily as a result of contamination from road salt. While the program is primarily intended to mitigate road salt contamination of private drinking water supplies, it has also been used to mitigate other adverse effects to private water supplies due to NHDOT actions. NHDOT intends to mitigate any Project related construction or operations damages to private water supplies along state highways through the well replacement program. For private wells along town-maintained roadways any Project-related effects to water supplies will require consideration of well replacement by the town of jurisdiction.

4.14 Aquatic Life and Essential Fish Habitat

4.14.1 Affected Environment

The study area for aquatic life and Essential Fish Habitat (EFH) corresponds to the previously defined study area for surface water and water quality.

Aquatic Life

Lakes and Ponds

Beaver Lake

Beaver Lake, located in Derry, has a history of management for both warm water and cold water fish species by the New Hampshire Fish and Game Department (NHFGD) (Connor and O'Loan, 1993). Beaver Lake is known to have populations of smallmouth bass (*Micropterus dolomieu*), largemouth bass (*Micropterus salmoides*), horned pout/brown bullhead (*Ameiurus nebulosus*) white perch (*Morone americana*), yellow perch (*Perca flavescens*), eastern chain pickerel (*Esox niger*), American eel (*Anguilla rostrata*), bluegill (*Lepomis macrochirus*), black crappie (*Pomoxis nigromaculatus*), brook trout (*Salvelinus fontinalis*), and rainbow trout (*Oncorhynchus mykiss*) (NHFGD, 2016a; NHFGD, 2017). NHFGD manages Beaver Lake for both brook trout and rainbow trout and last completed stocking for these species in 2016 (NHFGD, 2016b). Brook