Natural Community Assessment for the Pondicherry Division of the Silvio O. Conte National Fish and Wildlife Refuge, Jefferson, Whitefield, and Carroll, Coos County, New Hampshire

Report accompanying the natural community map created for the U.S. Fish and Wildlife Service, Silvio O. Conte National Fish and Wildlife Refuge

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Introduction

This brief report accompanies the natural community mapping for the Pondicherry Division lands of the Silvio O. Conte National Fish and Wildlife Refuge collectively spanning about 6,440 acres in Jefferson, Whitefield, and Carroll, New Hampshire. The primary goal of this project was to inventory and map natural communities across the Pondicherry Division lands according to the New Hampshire state natural community classification with cross-walking to the International Vegetation Classification.

We provide a brief landscape overview, mapping methodology and GIS layers produced (Table 1), and summaries of the variety and significance of observed natural communities, rare species, and invasive species. We also include some observations on land use and the challenges of accurate mapping of certain natural communities, particularly in uplands. We conclude with a brief set of ecological management recommendations.

Table 1. ArcGIS shapefiles and layer files that accompany this report.

Shapefile name	Description
Pondicherry_Natcoms_NHSP83_v1_master15	natural community polygons with state ranks and element occurrence ranks and IVC associations

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Rare_Exotic_PlantSpecies_PDC_final	waypoint file of rare and invasive plant observations
WayptsFBE_2018_2019_PDC_Merge	all Engstrom's waypoints collected during field work
Lapin_wpts_Pondi_All	all Lapin's waypoints collected during field work
WayptsMJP_2019_2019	all Peters' waypoints collected during field work
PDC_NHNHB_ElementOccurrence_clip_12232019_final	NH Natural Heritage Bureau rare species and exemplary natural community data clipped to the Refuge boundaries, as of 23 Dec. 2019

Landscape Overview

Terrain and Recent Land Use History

The Pondicherry Division lands (Refuge) are a distinctive low basin of boreal extension spruce-fir forest and associated open and forested peatlands. The basin is located just 16 kilometers (10 miles) northwest of the Presidential Range, New Hampshire and northeastern North America's highest terrain. From the open wetlands and ponds, one sees spectacular views of forested mountain slopes and summits spanning over 1,400 meters (4,593 feet) of elevation, all the way up to the open alpine of the Mt. Washington massif.

Refuge terrain is level to gently undulating in the basin, and moderately sloping on the portions of Cherry Mountain and Bray Hill. Hazens Pond outlet marks the low point at 317 meters (1,040 feet) above sea level at the far southwestern part of the lands, 4 kilometers (2.5 miles) east of Whitefield, NH. Highest elevations on Pondicherry Division lands are 450 meters (1,476 feet), the elevation at both the northern boundary on Bray Hill and the southern boundary on the slopes of Cherry Mountain/Owls Head. The lowland basin is topographically rather well defined by Cherry Mountain to the south, Prospect Mountain and Mount Pleasant to the north, Mounts Starr-King and Waumbek to the northeast, and the Dalton Range to the west. The basin lies 250 meters (820 feet) to nearly 1,000 meters (3,280 feet) below these summits and the many low mountains and large hills that ring the lowland.

Heavy logging and numerous utility and transportation corridors crisscross Refuge lands. The most recent logging operations, in the mid-to-late 1990s, resulted in a nearly entire clear-cutting of the lowland spruce-fir forest and some of the forested wetlands. Operations were enabled by establishment and revamping of an extensive access network for skidders and log trucks. These fragmenting features have altered hydrology in many places on the Pondicherry Division lands. Additionally, railroad grades and transmission powerline rights-of-way divide the landscape into numerous sections. Several railroad grades and logging roads have been converted to recreational trails. Other transportation infrastructure, two state highways—NH Routes 115 and 116—and two town roads—Hazen and Whipple roads—also divide and border the Refuge lands.

Hydrology

The majority of the Refuge is in the Johns River watershed, while a far eastern area, less than one-quarter of Refuge lands, lies in the Israel River watershed. Both rivers flow directly into the Connecticut River, approximately 13 kilometers (8 miles) straight-line from Cherry Pond. From a watershed perspective, the refuge occupies a good portion of the Johns River headwaters. While a number of mountain streams, cascade into the basin from the slopes of Cherry Mountain and Bray Hill, the wetlands and waters of Pondicherry are largely fed by prolific groundwater seepage.

Three ponds are prominent features of the Pondicherry Basin—Cherry, Little Cherry, and Mud—along with the Deadwater, a three-kilometer (1.9-mile) stretch of wetland along a slowly flowing reach of the Johns River. Each of the ponds is ringed by open peatland—bog and poor-to-intermediate fen—with the greatest expanse around Cherry Pond, the largest of the three. Additional small-stream surface waters are well distributed across the landscape. They host beaver ponds and associated wetland meadows and shrub swamps. A short time-series of aerial photography, from the mid-1990s to 2015, illustrates dynamic changes to the streams and riparian zones. Since the heavy logging and access network construction of the 1990s, there has been a proliferation of beaver impoundments, in part due to the ease of blocking culverts on the logging roads. Flooding some forested swamps and riparian

strips, the beaver impoundments have created meadows with a diverse assemblage of herbaceous plants and scattered shrubs. The basin's largest wetlands are forested and wooded shrub swamps, mostly nutrient-poor (black spruce dominated) but including some nutrient-enriched swamps (northern white cedar and/or black ash dominated).

Geology

The bedrock of the Refuge is mostly plutonic granitic rocks of Ordovician Period ages (445-490 million years ago (mya)). These ages and rock types are characteristic of the broader surrounding landscape, with changeover to younger rock types in the Northern Presidentials (Silurian (415-445 mya) and Devonian (355-415 mya) metamorphic and plutonic rocks). Also, the summit portions of the higher nearby mountains—Cherry, Starr-King and Waumbek—are yet much younger plutonic bedrock of the Jurassic Period (145-200 mya).

Principal bedrock formations are plutonic and associated volcanic rocks of the Oliverian Plutonic Suite 2.[2] From Little Cherry Pond southward, two formations predominate, a biotite granite and a hornblende-biotite granite. From Little Cherry northward onto Bray Hill is a porphyritic biotite quartz syenite. Semi-rich sugar maple forest and hardwood seepage forest depict zones of nutrient enrichment associated with this latter rock type, and seepage forest and cedar swamp south of Cherry Pond indicate enrichment in the hornblende-biotite formation.

The far western corners of Pondicherry have a fourth rock type—metamorphic rocks of the Ammonoosuc Volcanics Formation, not of plutonic origin. There is too small a section of these rocks in the Refuge to detect any patterns of enrichment or other geologic influences on the flora and natural communities.

Soils

Soils are largely mapped as associations rather than individual soils series. This grouping of types is indicative of the small-scale heterogeneity and complexity of glacial and post-glacial landscape processes in the basin and on the lower

[2] Lyons, J.B., Bothner, W.A., Moench, R.H., and Thompson, J.B., Jr. 1997. Bedrock geologic map of New Hampshire: U.S. Geological Survey, scale 1:250000.

hillslopes. The soils formed in a wide variety of ice- and water-laid glacial deposits, including basal and melt-out tills as well as outwash; small areas of recent alluvium parent material also occur. The whole range of soil drainage classes is found on the Refuge.

The lowland matrix is mostly mapped as very stony loams and fine sandy loams of the gently sloping Sunapee-Moosilauke-Monadnock association (Table 2). These series range from well to poorly drained. In many places the lowland spruce-fir forest grows atop a jumble of surficial boulders. Waumbek fine sandy loam is the other common soil of the lowland forest matrix.

Table 2. Overview of soils of the Pondicherry Division of Silvio O. Conte National Fish and Wildlife Refuge.

Association or Series	Texture	Drainage class	Parent Material	Geographic/Natural Community Relationships
Sunapee-Moosilauke-Monadnock	Very stony loams & Fine sandy loams	Well to poorly drained	Melt-out till & Outwash	Lowland forest matrix
Waumbek	Fine sandy loam	moderately well drained	Stony or sandy till	Lowland forest matrix & Bray Hill
Bucksport	Muck, very deep	Very poorly drained	Decomposed organics	Basin wetlands
Peacham	Mucky peat	Poorly drained	Decomposed organics over dense till	Basin wetlands
Wonsqueak	Muck	Very poorly drained	Decomposed organics over loamy subsoil	Basin forested wetlands
Pondicherry	Muck	Very poorly drained	Decomposed organics over sand and gravel	Basin forested wetlands
Pillsbury-Peacham-Peru	Fine sandy loams & Mucky peat	Well to very poorly drained	Shallow to moderate depth of decomposed organics over dense till	Mountain lower slopes

Wetlands in the basin feature several somewhat poorly to very poorly drained soils types, including Bucksport muck and Peacham mucky peat in the open peatlands, and Wonsqueak and Pondicherry mucks in the forested wetlands.

On the south side of the Refuge, Cherry Mountain/Owls Head's lower slopes are moist to wet; much area is mapped as the gently sloping, very stony Pillsbury-Peacham-Peru association. The extensive seepage slope abutting Moorhen Marsh is a notable landscape feature. It features muck soils of the Bucksport, Wonsqueak and Pondicherry series.

At the north end of the Pondicherry lands, Bray Hill displays a wide variety of upland soils that generally range from moderately well drained to excessively drained, but also include drainageways of somewhat poorly to poorly drained depressions on the lower slopes. Moderately well drained series include Peru, Waumbek, Skerry, and Sunapee fine sandy loams. Hermon sandy loam is excessively drained, and Moosilauke loam is on the other end of the moisture spectrum.

Mapping Methodology

Natural community mapping was conducted using a three-phased approach involving landscape analysis, inventory field work, and final mapping and documentation.

The initial phase involved gathering and reviewing existing aerial imagery, geologic, soils, and topographic (LiDAR) data to inform and guide field work. The Refuge staff provided substantial background literature and digital data. Dave Govatski, head of Friends of Pondicherry, provided on the ground orientation to the Refuge and its access points at the start of field work in September 2018. He also shared additional background literature and graciously loaned his hardcopy historical aerial photographs of the Refuge to the project team.

Field work was conducted in September 2018 and from June-September 2019. Field work involved observation point sampling along meander transects to document the vegetation, soils, hydrology, and physiographic characteristics of the landscape. Descriptive observations were recorded in field books referenced to GPS point data collected in the field. All of this field information was used to designate natural community types and identify their boundaries.

Upon completion of field work we started production of a natural community GIS map layer. This process involved the analysis, interpretation, and interpolation of our field observations and GPS data in the context of remote sensing data, including existing aerial imagery, soils, and topographic data. We relied particularly on the following sources: LiDAR derived hillshade, slope, and 1ft contours; and high-resolution color and color infrared NH statewide aerial

imagery from 2010/2011 and 2015. All of these datasets are available online as web mapping services through NH Granit Statewide GIS Clearinghouse (http://www.granit.unh.edu/data/onlinemapservices/webservices.html), except the LiDAR slope and contour data, which were provided by Jeremy Goetz (Conte NFWR forester, Nulhegan Basin Division).

During this process field observations were translated into natural community map units (polygons) that were assigned to NH natural community types with reference to Sperduto and Nichols (2011)[3] and Sperduto and Kimball (2011).[4] In some cases additional sub-types or variants were mapped and described to better capture conditions on the ground. Some named variants are described within Sperduto and Nichols (2011), and, as with the work in the Nulhegan Basin Division of the Refuge,[5] we created additional variants as needed. A few additional land cover types were also designated to capture conditions, such as open water and artificial openings, which are not part of the state community classification. State natural community types were cross-walked, or translated, into International Vegetation Classification Associations[6] using a cross-walk spreadsheet provided to us by the New Hampshire Natural Heritage Bureau (NHNHB). The state-level ecological significance of all occurrences of wetland natural community systems was evaluated using NHNHB and NatureServe rank specifications and element occurrence guidelines.[7]

[3] Sperduto, Daniel. D. and William F. Nichols. 2011. Natural Communities of New Hampshire. 2nd Ed. NH Natural Heritage Bureau, Concord, NH. Pub. UNH Cooperative Extension, Durham, NH.

[4] Sperduto, Daniel D. and Ben Kimball. 2011. The Nature of New Hampshire. University of New Hampshire Press, Durham, NH.

[5] Lapin, Marc, and Brett Engstrom. 2002. Natural Communities and Rare Vascular Plants of West Mountain Wildlife Management Area and Nulhegan Basin Division of the Silvio O. Conte National Fish and Wildlife Refuge, Essex County, Vermont. Report to the U.S. Fish and Wildlife Service, VT Agency of Natural Resources, The Nature Conservancy, VT Housing and Conservation Board, and VT Land Trust.

[6] USNVC [United States National Vegetation Classification]. 2019. United States National Vegetation Classification Database, V2.03. Federal Geographic Data Committee, Vegetation Subcommittee, Washington DC. [usnvc.org].

[7] NH Natural Heritage Bureau. 2015. Rank Specifications for Wetland Systems in New Hampshire; NH Natural Heritage Bureau. Undated. rank_specs_summary.pdf; NatureServe. 2014. Ecological Element Occurrence (EO) Delimitation Guidance.

Natural Community Summary

The Pondicherry Division lands are approximately two-thirds upland forest and one-third wetland types (Table 3). The bulk of the wetland, 20% of the Refuge acreage, is forested swamp natural communities, and 5% of the terrain is non-forested peatlands. Nutrient-poor forested swamps, black spruce swamp, and those with greater nutrient availability, northern hardwood-black ash-conifer swamp, each cover about 5% of Refuge lands.

Lowland spruce-fir forest covers slightly over half of the Refuge. The wet-mesic/hydric variant is actually a wetland forest, for the bulk of it would certainly delineate as wetland according to federal methodology. Due to the recent history of heavy logging in the basin, we mapped most of the lowland spruce-fir forest as successional, and much more detailed field work would be needed to determine whether the land is the upland mesic variant or the wet-mesic/hydric wetland spruce-fir forest. Therefore, even more of the Refuge is actually wetland forest than is shown in Table 3.

Among the non-forested peatland natural communities, shrubby types are most common. Mountain-holly—black spruce wooded fen, alder wooded fen and sweet gale-meadowsweet-tussock sedge fen are the most extensive shrub peatland natural communities. These, along with leatherleaf-black spruce bog, are abundant in the Deadwater and Cherry Pond areas. The open peatlands dominated by moss or moss-sedge carpets—what generally people see as "bogs"—ring the three ponds and border parts of the Deadwater. These open peatlands are not extensive in area, but are a very characteristic and much cherished part of the boreal-basin natural communities of Pondicherry.

We mapped all of the leatherleaf-black spruce bog in the Pondicherry Division as the labrador tea - *Sphagnum fuscum* variant. Though not all occurrences were visited nor evaluated for this variant, it was observed several times and is presumed to be the predominant variant given the Refuge's location in northern New Hampshire.

Marsh habitat covers 4% of the Pondicherry lands. Of this 3.4% is mixed tall graminoid—scrub-shrub marsh, the natural community typing used for the

bulk of “beaver wetlands.” Beaver activity was greatly enhanced by the access network construction of the 1990s; in a more “natural hydrologic situation,” the marsh acreage would be substantially smaller.

Northern hardwood seepage forest is mapped on 5.8% of the Refuge. We acknowledge that this might be an overestimate by 1 to 1.5%. Of course not all areas were visited, and parts of the Cherry Mountain/Owls Head slopes that we mapped as seepage forest based on LiDAR, topographic and neighboring natural community information may not be influenced as much by groundwater seepage.

The cross-walk from New Hampshire natural community types and variants mapped at the Refuge to International Vegetation Classification (IVC) associations is found in Appendix 1. This is an imperfect correlation of units where in some cases different NH natural community types cross-walk to a single IVC association and where one state type or variant correlates to several IVC associations. In the latter case, we chose the correlation which best fit the description of the state natural community type or variant.

Based on an evaluation of our mapping work, two of the four wetland natural community system occurrences found at the Refuge are exemplary, or significant at the New Hampshire state level: black spruce peat swamp system and poor level fen/bog system (Appendix 2). The latter is already in the NHNHB database as exemplary. The natural communities that comprise all four systems are attributed as to which system they belong in the natural community map shapefile. The exemplary systems are highlighted in Table 3. The Refuge’s two other wetland systems – forest seep/seepage forest and drainage marsh-shrub swamp – are ranked as questionably exemplary. Both warrant more field work, and analysis by NHNHB. Even though possibly over-mapped, the seepage systems are extensive and represent a significant portion of the wetlands at the Refuge. Furthermore, their condition is very likely to improve over time if managed for their ecological values.

Table 3. Natural community summary for the Pondicherry Division of Silvio O. Conte National Fish and Wildlife Refuge.
Green shading indicates community types present in Exemplary Natural Community System Occurrences. *Numeric codes, including variants, follow NHNHB documentation except 50+ and a, b, c variant codes created by the authors.

NC_Var Code*	NH Natural Community Name	Variant Name	S Rank	Poly Count	Total Acres	Min Poly (Ac)	Max Poly Size (Ac)	Ave. Poly Size (Ac)	% of Division
	Uplands			**125**	**4131**				**64.3%**
10.4_	Lowland spruce - fir forest	(no variant assigned)	S3	25	90.4	0.1	16.1	3.6	1.4%
10.4_a		Mesic/Well-drained Mossy Lowland Spruce-Fir Forest	S3	18	341.9	0.1	131.8	19.0	5.3%
10.4_b		Wet-mesic/Hydric Mossy Lowland Spruce-Fir Forest	S3	10	192.1	0.9	63.8	19.2	3.0%
10.4_c		Mesic/Wet-mesic (not mossy) Successional Lowland Spruce-Fir-Red Maple (-Aspen) Forest	S3	52	2946.4	0.1	712.5	56.7	45.8%
12.1_c	Northern hardwood - spruce - fir forest	Successional Northern hardwood - spruce - fir forest	S4	10	244.4	1.9	163.5	24.4	3.8%
12.2_	Sugar maple - beech - yellow birch forest	(no variant assigned)	S5	6	196.5	9.0	99.9	32.7	3.1%
12.2_c		Successional Sugar maple - beech - yellow birch forest	S5	1	24.4	24.4	24.4	24.4	0.4%
18.1_	Rich mesic forest		S3	1	0.3	0.3	0.3	0.3	<0.1%
18.5_	Semi-rich mesic sugar maple forest		S3S4	2	94.1	2.7	91.4	47.1	1.5%
	Wetlands			**323**	**2115**				**32.9%**
20.5_	Red maple - *Sphagnum* basin swamp		S4	4	6.2	0.5	2.8	1.6	0.1%
21.1_a	Black spruce swamp	Typic variant	S3	26	254.2	0.1	33.2	9.8	4.0%
21.1_b		Black spruce - larch - rhodora swamp	S3	11	106.6	0.6	19.4	9.7	1.7%
21.2_1	Red spruce swamp	Typic variant	S3	1	1.4	1.4	1.4	1.4	<0.1%
21.2_2		Red spruce - hardwood - violet variant	S3	2	67.8	21.4	46.5	33.9	1.1%
23.1_	Northern hardwood - black ash - conifer swamp		S3	37	303.8	0.3	50.1	8.2	4.7%
23.2_	Larch - mixed conifer swamp		S3	34	218.4	0.2	46.3	6.4	3.4%
23.3_	Northern white cedar - balsam fir swamp		S2	5	51.9	5.7	17.5	10.4	0.8%
23.7_	Northern hardwood seepage forest		S3	29	370.6	0.3	100.8	12.8	5.8%
25.2_	Subacid forest seep		S3S4	2	0.9	0.2	0.7	0.5	<0.1%
29.1_	Alder alluvial shrubland		S3	1	0.5	0.5	0.5	0.5	<0.1%

NC_Var Code*	NH Natural Community Name	Variant Name	S Rank	Poly Count	Total Acres	Min Poly (Ac)	Max Poly Size (Ac)	Ave. Poly Size (Ac)	% of Division
29.2_	Alder - dogwood - arrowwood alluvial thicket		S4	1	0.3	0.3	0.3	0.3	<0.1%
31.1_	Tall graminoid meadow marsh	(no variant assigned)	S4	3	7.7	0.3	5.9	2.6	0.1%
31.1_2		Tussock sedge variant	S4	1	2.6	2.6	2.6	2.6	<0.1%
31.1_3		Bulrush variant	S4	2	8.2	2.3	5.9	4.1	0.1%
31.2_	Mixed tall graminoid - scrub-shrub marsh		S4S5	38	215.9	0.1	35.5	5.7	3.4%
31.3_	Sedge meadow marsh		S4	5	5.3	0.4	2.8	1.1	0.1%
32.1_	Emergent marsh		S5	2	7.5	0.8	6.7	3.7	0.1%
32.2_	Cattail marsh		S4	2	20.8	6.3	14.5	10.4	0.3%
33_	Aquatic bed		S5	2	32.8	1.6	31.2	16.4	0.5%
35.2_	Alder seepage thicket		S3	22	100.9	0.2	30.8	4.6	1.6%
39.1_	*Sphagnum rubellum* - small cranberry moss carpet		S3	8	4.9	0.1	2.7	0.6	0.1%
39.4_	Bog rosemary - sedge fen		S3	8	15.7	0.4	4.6	2.0	0.2%
40.1_	Leatherleaf - sheep laurel shrub bog		S2S3	3	6.3	0.9	4.1	2.1	0.1%
40.2_2	Leatherleaf - black spruce bog	Labrador tea - *Sphagnum fuscum* variant	S3	16	40.4	0.3	13.7	2.5	0.6%
41.2_	Mountain holly - black spruce wooded fen		S3	9	93.5	0.3	59.7	10.4	1.5%
42.1_	Sweet gale - meadowsweet - tussock sedge fen		S4	19	63.4	0.0	16.1	3.3	1.0%
42.2_	Wire sedge - sweet gale fen		S3	4	1.8	0.2	0.8	0.5	<0.1%
44.1_	Winterberry - cinnamon fern wooded fen		S4	4	7.1	0.6	4.5	1.8	0.1%
44.5_	Alder wooded fen		S3S4	20	92.5	0.2	15.7	4.6	1.4%
45.1_	Floating marshy peat mat		S3S4	2	4.7	0.3	4.4	2.3	0.1%
	Other Landcover Types			**41**	**182**				**2.8%**
50_	Open Water		NR	4	1.4	0.1	0.9	0.3	<0.1%
55_	Vernal pool		NR	1	0.1	0.1	0.1	0.1	<0.1%
100_	Artificial Openings		NR	32	175.7	0.2	25.4	5.5	2.7%
101_	Developed		NR	4	5.1	0.3	3.9	1.3	0.1%
Totals				**489**	**6427**				**100%**

Lowland Spruce-Fir Forest Variants

The New Hampshire classification includes a single natural community type "Lowland spruce -fir forest" with no described variants. We have found this to be inadequate to represent the inherent diversity of this matrix forest type of low basins of northern New England, such as the Pondicherry and Nulhegan Basins. Thus, for this project we have followed the classification and mapping convention used in the Nulhegan Basin. Brief descriptions of the mapped variants follow. When the natural community map specifies no variant letter, this indicates that we did not visit the area and were not confident from photo interpretation of the variant type.

Variant a. Mesic/Well-drained Mossy Lowland Spruce-Fir Forest. This type is adequately described by the 'typic' natural community description found in Sperduto and Nichols (2011).

Variant b. Wet-mesic/Hydric Mossy Lowland Spruce-Fir Forest. In the Pondicherry Basin, the wet-mesic to hydric type can be seen as ecologically lying between lowland spruce-fir forest variant 'a' and black spruce or larch-mixed conifer swamp. As we stated in the Nulhegan report, "Perhaps the most distinctive difference is the presence of bog mosses (*Sphagnum* spp.) in the hollows of the wet-mesic variant." This is in contrast to the mesic moss carpet dominated by Schreber's moss (*Pleurozium schreberi*). Soils of the wet variant range from shallow sapric peat (up to about 20 cm deep) to silt loam with reduced matrix color. The underlying soil is usually very rocky in the Pondicherry basin, and always contains a dense layer that impedes drainage.

Variant c. Mesic/Wet-mesic (not mossy) Successional Lowland Spruce-Fir-Red Maple (-Aspen) Forest. In some cases, former land use, be it clearing for pasture or repeated logging, has led to a successional status where the forest may not even contain spruce or fir. Usually there is some fir and often spruce as well, but not always. The regeneration of a coniferous lowland forest to deciduous cover results in buildup of leaf litter that "smothers" the moss carpet. In the successional variant, moss, herbaceous, and low shrub flora can appear more like an acidic northern hardwood or northern hardwood-spruce-fir forest than a coniferous forest. We are unsure how long (if ever?) the recovery to a

more characteristic moss, herb, shrub and tree vegetation would take. Numerous forest generations seem likely, since the germination microsites and the very local seed sources have been heavily transformed. In the Nulhegan report, "Mixed red Maple-Aspen Variant" was used for this deciduous tree-dominated successional type.

Black Spruce Swamp Variants

Variant a. Black Spruce Swamp. This variant refers the 'typic' natural community description found in Sperduto and Nichols (2011).

Variant b. Black Spruce – Larch – Rhodora swamp. This is a variant encountered for the first time by the three authors of this project. It may be unique to the Pondicherry Division. This often deep-peat swamp is characterized by black spruce, in some places also with a mix of larch, that are substantially shorter (10-15 m tall) and somewhat smaller diameter (up to 15 cm dbh) than what is seen in the typic black spruce swamps. The most notable feature of this variant is the very dense (approximately 60% cover or greater) rhodora tall shrub layer. Rhodora very characteristically forms a dense, 1.5-meter tall stratum beneath the rather open tree canopy. Leatherleaf, velvet-leaf and early low blueberries, bog rosemary, and Labrador tea occur in a scattered low shrub layer. Small cranberry may creep along the sphagnum carpet. Three-seeded sedge is the only common herb; few-seeded sedge and cottongrasses are patchily distributed. Some areas may have an abundance of tussock sedge; these tend to be linear bands and may be related to water table or flow differences. What is most unusual about this black spruce swamp variant is the rhodora height and density. Rhodora typically occurs in substantial density only in isolated bands around ponds, streams or open peatlands, and when growing under a tree canopy it normally is widely scattered or in scattered patches and reaches heights of about one meter.

Northern Hardwood Forest Variants

Variant c. Successional Northern Hardwood – Spruce – Fir Forest. All of the upland northern hardwood spruce-fir forest in the Refuge was mapped as the successional variant. These are lower-slope mixed forests that were heavily cut and have regenerated to species including red maple, trembling aspen, black

cherry, paper birch, white pine, balsam fir, and in some cases larch and white spruce. Many of these areas were not prioritized for field visits and were mapped based on aerial imagery and topographic position. From what we saw in areas visited, northern hardwood co-dominants sugar maple and beech are sparse or absent in these successional forests.

Variant c. Successional Sugar Maple – Beech – Yellow Birch Forest. One area of classic northern hardwood forest in successional status was mapped. The area is apparently an old field and has succeeded to balsam fir, white ash, red maple, and yellow birch. The ground flora featured a dense cover of New York fern, which is known to inhibit and delay regeneration of several northern hardwood species.

Vernal pool

The New Hampshire natural community classification does not include vernal pools, for they do not consider them to be true natural communities as they define them in their classification. The Vermont natural community classification does include vernal pools and considers them to be wetlands in the category of "seeps and vernal pools." We follow the Vermont system, and per the scope of this work we have included vernal pools. Just one occurrence that we judged potentially to be a vernal pool was found in the Refuge.

Other Cover Types

Open Water. Open water was mapped in several artificially impounded places alongside transportation corridors. We did not map the open water of beaver ponds since those places can rapidly change from open water to marsh, wet meadow and shrub natural communities. Beaver wetlands, including the open water present at the time of our mapping and the latest aerial imagery, were generally mapped as mixed tall graminoid—scrub-shrub marsh. Little Cherry Pond, the Deadwater, and Mud Pond were mapped as aquatic beds, since they have substantial area of the natural community type within the surface water feature. Cherry Pond was not mapped, as the Refuge boundary did not include the pond itself. If that large pond were to be mapped, it would include open water, aquatic bed, and some floating peatland islands.

Artificial Openings. The artificial openings cover type was used for large areas that remained open into the present. Among these areas are gravel pits, log landings, powerline rights-of-way, railroad bed, and old-field that has not succeeded to a described natural community type.

Developed. A few building and lawn areas are included in the Refuge boundary and were mapped in this category. Additionally, the Refuge boundary shapefile included a section of Whipple Road, which was mapped as developed land.

Land Use Notes and Community Typing Challenges

A history of repeated intensive timber harvesting throughout much of the Refuge area and historical agricultural conversion of some areas (particularly around Waumbek Junction, along the Presidential Range Recreation Trail, Hazen/Airport Road, and the Owl's Head Highway (Route 115)) have transformed the vegetation in ways that sometimes confound natural community identification. In many other landscapes, there are less modified natural communities nearby, occupying areas with similar landscape settings to base mapping on. This is not the case for Pondicherry uplands, however, and most of the upland forest remains in a substantially altered successional composition that obscures natural patterns on the landscape.

Artificial alteration of hydrology is another factor that has altered some parts of the Refuge and obscured (or perhaps permanently changed) community types. Impoundments created by railroad grades and logging trails, often in concert with beaver action, are chief among such alterations. Moorhen and Cedar Marshes are the most evident examples, but numerous other smaller and/or less visible wetlands have been similarly impacted. Generally, the result has been conversion of what appear to have been forested seepage swamps or seepage forests to open marsh or shrub swamp conditions, or in several places to open water. In some cases removal of impounding features would likely restore the original hydrology and eventually promote the recovery of original community types, while other areas maybe have been altered substantially enough (e.g., through altered soil processes) to preclude restoration of predicted prior community types.

Rare Species

Rare species surveys were not the primary focus of this inventory effort, but several state rare (S1 and S2) and uncommon (S3) species were documented in the course of the work. We provide details on all observed species tracked by the NHNHB with state S ranks of S1 to S3, corresponding to state status of Endangered, Threatened, Watch, or Indeterminate. These are summarized in Table 4 with brief occurrence notes. Associated spatial data are provided in the shapefile 'Rare_Exotic_PlantSpecies_PDC_final'. No federally listed species were observed.

Three state-listed rare plants were found: REDACTED. Additionally, four state-tracked uncommon plants were noted: REDACTED (S3 – Watch List), cyperus-like sedge (*Carex pseudocyperus*) (unranked-Indeterminate), pod-grass (*Scheuchzeria palustris*) (S3 – Watch List), and alder-leaved buckthorn (*Rhamnus alnifolia*) (S3 – Watch List).

A few bird species of note were observed during field work. Olive-sided Flycatchers (*Contopus cooperi*), a NH Species of Greatest Conservation Need,[8] were observed on multiple occasions including in the fall of 2018 in a beaver meadow wetland along Slide Brook and June 2019 in the largest swamp complex east of Bray Hill. In September 2019 a female northern harrier (*Circus cyaneus*), a state-endangered breeding bird, was observed hunting over the large, open, mountain-holly—black spruce wooded fen on the east side of the Refuge, north of the railtrail in the Israel River watershed.

[8] New Hampshire Wildlife Action Plan. 2015 Revised Edition. 2015. New Hampshire Fish and Game Department. <https://www.wildlife.state.nh.us/wildlife/wap.html>

Table 4. Rare plants observed on the Pondicherry Division lands.

Scientific Name	Common Name	S Rank	NH Status	Notes
Carex pseudocyperus	Cyperus-like Sedge	S3	Watch	Noted at 2 sites: edge of Moorhen Marsh and cedar swamp near Mud Pond.
Redacted Species				
Redacted Species				
Redacted Species				
Redacted Species				
Rhamnus alnifolia	Alder-leaved Buckthorn	S3	Watch	Colonies noted in 2 enriched swamps: common in cedar swamp north of Deadwater, scattered in black ash seepage area in Slide Brook vicinity.
Scheuchzeria palustris	Pod-grass	S3	Watch	Substantial colonies of thousands of stems in bog mats on west shore of Little Cherry Pond and north shore of Cherry Pond.

In addition to the rare and uncommon species that we observed at Pondicherry, NHNHB shared their records of a number of rare species from division lands, including four plant species, seven birds, one dragonfly, and a single ecological system. These are summarized in Table 5 and associated spatial data is provided in the shapefile 'PDC_NHNHB_ElementOccurrence_clip_12232019_final'. The plant occurrences from the Bureau's database are all historically known from the Pondicherry area, but only the REDACTED SPECIES was relocated during our surveys.

Table 5. NH Natural Heritage Bureau Database Element Occurrences for Pondicherry Division lands.

Scientific Name	Common Name	NH Status	S Rank	Site	Town	Last Observed	First Observed	EO_ID
Plants								
5 REDACTED SPECIES								
Animals								
8 REDACTED SPECIES								
Ecological Systems								
Poor level fen/bog system		--	S3	Pondicherry		2006		6250

Invasive Species

Exotic species, and particularly those considered invasive, currently have a remarkably low presence within Pondicherry. Exotic grasses and herbs are present or locally dominant along roadsides, the railtrail, railbeds, and in old-field meadow settings, but do not represent a significant management concern in these anthropogenic habitats. Of greater concern are relatively small populations of a number of invasive exotic plants scattered throughout the Refuge, sometimes in relatively remote locales. Invasive plants noted include common barberry (*Berberis vulgaris*), glossy buckthorn (*Frangula alnus*), live-forever (*Hylotelephium telephium*), Morrow's honeysuckle (*Lonicera morrowii*), purple loosestrife (*Lythrum salicaria*), wall-lettuce (*Mycelis muralis*), common forget-me-not (*Myosotis scorpioides*), and common reed (*Phragmites australis*). These are summarized in Table 6 with brief notes about each observed location. The most extensive invasive plant population is purple loosestrife which is widespread in the beaver meadows of Hazens Pond. Associated spatial data are provided in the shapefile 'Rare_Exotic_PlantSpecies_PDC_final'. These species have limited current impact, given their relatively small populations; however, preventative management to remove them is highly recommended to avoid expansion of the infestations. See the management recommendations section for further discussion.

Table 6. Invasive plant observations on Pondicherry Division lands.

Scientific Name	Common Name	Notes
Berberis vulgaris	Common Barberry	A single shrub at the margins of an area of successional seepage forest south of Airport Road.
Frangula alnus	Glossy Buckthorn	A few shrubs in a remote locale in a small section of open canopied cedar swamp with black ash and mountain fly honeysuckle (*Lonicera villosa*) north of Deadwater.
Frangula alnus	Glossy Buckthorn	A few shrubs along the western margin of an open canopied seepage swamp dominated by red maple.
Frangula alnus	Glossy buckthorn	Seedlings noted in alder + red maple, black ash seepage swamp near trail/woods road - mown - which passes across wetland.
Frangula alnus	Glossy Buckthorn	Observed one shrub from edge, but likely more scattered in this large wetland.
Frangula alnus	Glossy Buckthorn	Rare in shrub swamp portion of beaver wetland.

Hylotelelphium telephium	Live-forever	Common along brook through extensive seepage forest.
Lonicera morrowii	Morrow's honeysuckle	Scattered in understory of successional gray birch-quaking aspen-red maple woods with wild raisin, beaked hazelnut, glossy buckthorn, chokecherry, & pear. Sandy soil low hill near Hazen Rd. Clearly old field.
Lonicera morrowii	Morrow's honeysuckle	Few exotic honeysuckle amongst lush tall shrub-herb cover of upland black cherry woods north of railroad bed. Post ag? Hillshade LiDAR show cellar hole like depressions just west of waypoint.
Lonicera morrowii	Morrow's honeysuckle	Uncommon in wet/seepage mixed forest. East side Whipple Rd., close to road.
Lonicera morrowii	Morrow's honeysuckle	Small population in mesic forest scattered in this area to edge of conifer-dominated forest to north.
Lonicera morrowii	Morrow's honeysuckle	Small population in mesic forest scattered in this area and to south/southwest to logging road and powerline.
Lythrum salicaria	Purple Loosestrife	Abundant and widespread throughout the open drained beaver meadows of Hazens Pond.
Lythrum salicaria	Purple Loosestrife	20-30 flowering/fruiting plants on N. side of RR bed, in 20x10m area of alder-dominated shrub swamp. Tall plants - 1.3-2+m. This area ~30m E. of wood span. Pulled plants on side of trail.
Lythrum salicaria	Purple loosestrife	Abundant along wetland/woods edge along Meadows Rd. Larch-red maple-tussock sedge wetland comes right up to edge of road bank, on Meadows Rd. curve. Blue-flag iris and lance-leaved aster common.
Lythrum salicaria	Purple Loosestrife	Counted 120++ mostly flowering plants in Cedar Marsh, most near open water E. of span. 16 flowering plants, most large, multi-stemmed, on beaver dam N. of outlet span for Cedar Marsh, + 1 large plant set back 15m from old RR bed in aldery mixed swamp.
Lythrum salicaria	Purple Loosestrife	One plant observed in beaver wetland on powerline ROW.
Lythrum salicaria	Purple Loosestrife	Observed 2 clumps from edge, but likely more scattered in this large wetland.
Mycelis muralis	Wall-lettuce	Hundreds of fertile stems (w/ fl. buds) on lower, NW-facing slope across stream in small opening, presumably created by deer hunter with stand on N. side of brook. Pulled another plant from along brook below.
Myosotis scorpioides	True Forget-me-not	Carpet in hollows in this part of seepage forest.
Myosotis scorpioides	True Forget-me-not	Appears along/in 1m wide stream with good flow just upstream from extensive mixed seepage forest with grove of cedar. South side of Cedar Marsh.
Myosotis scorpioides	True Forget-me-not	Noted in mixed seepage woodland/swamp with very broken canopy of fir-ash-yellow birch-red spruce-NW cedar-hemlock. In super lush tall fern (cinnamon, sensitive)-horsetail (common) + sedges, grasses, and herbs. Soil: 10cm muck over silty mineral soils.
Phragmites australis	Common Reed	30ft diameter dense colony in a remote area of heavily cutover and disturbed seepage swamp.
Phragmites australis	Common Reed	15x8m patch in woods road crossing seepage swamp exit. Colony located 15m north of waypoint. In small canopy gap.
Phragmites australis	Common Reed	Scattered *Phragmites* among the regeneration and shrubs in cutover forested swamp.

Vernal Pools

No natural vernal pools were observed in the field during the natural community inventory. One potential vernal pool is shown on the natural community map based on remote sensing using the 2015 CIR imagery. This pool is located northeast of the east end of the airport. From field observations, a few anthropogenic features appear to be providing small amounts of functional breeding habitat for pool-breeding amphibians. Several areas of ditching along logging roads were found to retain water (or intersect the water table) and had wood frog (*Lithobates sylvaticus*) tadpoles and spotted salamander *(Ambystoma maculatum)* egg masses in June 2019. These areas are across Bailey Road (Route 116) from the Mud Pond access area, within about 200m of the roadside landing area. Furthermore, natural breeding habitats for these species on the Refuge likely include small pools (hollows) within some of the forested swamp communities, and may also include the many small beaver ponds and larger named ponds.

Ecological Management Recommendations

The following brief management recommendations are aimed at increasing the ecological integrity of the natural communities of Pondicherry and of the division landscape as a whole, but are not intended as a comprehensive consideration of all potential management concerns. They are presented in no particular order.

1. *Wetland Hydrology.* Next to the effects of harvesting history, altered wetland hydrology is the most widespread and apparent impact to the ecological integrity of the Refuge ecosystems. This is particularly due to impoundments created by railbeds and logging trails, sometimes in concert with beavers, where they pass through wetlands, typically resulting in the conversion of seepage swamps and seepage forests to open marshes or shrub thicket swamps/wooded fens. The Pondicherry basin's gentle slopes with widespread seepage hydrology make it vulnerable to such hydrologic alterations with even modest impounding features. Thus it is imperative to avoid creating any further such alterations in the course of any trail building or other active management, particularly in areas of seepage wetlands or shallow water tables (such as

wet-mesic or wetter lowland spruce-fir forest areas). Additionally, some existing artificial impoundments may be able to recover their original hydrology and natural community condition through the strategic removal or breaching of impounding structures, including culverts which beaver easily block. These must be evaluated on a case-by-case basis, which is beyond the scope of this study.

2. *Invasives.* As noted above, invasive plants are currently relatively limited in abundance, which makes preventative control measures a good ecological investment despite low levels of present impacts. The prevalence of wetland habitats makes wetland invasives a particular concern. The *Phragmites* colonies are perhaps the highest concern given this species' high potential for habitat alteration. The scattered glossy buckthorn is also concerning, but will be more difficult to eradicate given the dense shrubby nature of much of Pondicherry. Purple loosestrife is currently the most abundant invasive, mainly in the Hazens Pond complex, where it is common, but it does not appear to be radically altering vegetation structure or composition.

3. *Openings.* Open habitats are often created or artificially maintained by habitat managers to benefit particular wildlife. We note that about 175 acres of artificial openings currently exist within the Refuge including powerline rights-of-way, roadsides, railbeds, logging landings, old logging trails, and old-field habitats. This is in addition to many natural open wetland habitats and small-scale wind disturbance openings (blowdowns). In considering the management of these openings we note that open habitats, especially transportation and recreation corridors, are at increased risk of developing invasive plant infestations, thus these areas should receive additional invasives monitoring attention. We also note that over 98 acres of maintained powerline right-of-way openings occur within the Refuge, so additional opening maintenance may not be required to have this habitat type represented in the Refuge. We observed that over 25 acres of the powerline right-of-way appears to be wetland, largely a mixture of cleared seepage forest, seepage swamp, and beaver wetlands. If possible powerline vegetation management should be adapted to minimize impacts to these areas, especially wetland soils and

hydrology. The larger of these wetland sections are coded '1' in the wetland field of the natural community shapefile.

4. *Old Forests.* A history of repeated, intensive harvesting has left the Pondicherry lands with essentially no intact, mature upland forest, let alone any old forest, to provide a clear reference point for the natural composition and structure of these communities. This is unfortunate and cannot be undone. However, we strongly recommend that substantial portions of the Refuge, including matrix lowland spruce-fir and other upland forests, be left without further harvesting to develop into old forest, which may over time begin to recover toward a semblance of its pre-disturbance condition and will be better equipped for resilient functioning in a changing climate.

5. *Monitoring.* Following on the prior recommendation, we recommend the establishment of a permanent monitoring plot network to track and better understand the changes these forests will undergo over time. This will be particularly informative for matrix upland forests that are largely in a range of successional mixed forest conditions dominated by species other than the assumed late successional dominants (spruces). Monitoring plots representing the major wetland types will also be useful to understand change in those systems, which may also have been affected by past harvesting and/or hydrologic change. Monitoring plots will be particularly useful in any areas where attempts to restore pre-disturbance hydrology are made. Photopoint monitoring may be useful to accompany detailed and more quantitative methodologies. There has been much progress in developing analytical techniques that use photography to evaluate change.

6. *Emerald Ash Borer (EAB).* Ashes, both black and white, are surprisingly abundant at Pondicherry for a basin dominated by Lowland Spruce-Fir Forest and acidic peatland systems. These species are most abundant in the extensive wetlands with seepage hydrology, particularly seepage forests and seepage swamps, as well as some enriched alder thickets and Larch-Mixed Conifer Forests transitional to seepage swamp conditions. White ash also occurs in the limited mapped areas of Sugar Maple-Beech-Yellow Birch Forest and Semi-rich Mesic Sugar Maple Forest. Given the

spread of EAB it seems only a matter of time before it reaches the Refuge. While we do not make any active management recommendations in this regard, we do recommend establishment of monitoring plots within ash-rich wetlands and uplands, both to understand changes in these systems and to contribute to efforts to identify 'lingering ash' that may harbor genetic resistance to EAB. The Monitoring and Managing Ash (MaMA) Project[9] may provide a useful framework for pursuing this recommendation.

7. *Data Gaps.* Finally, we note that despite much effort there remain some areas of the Refuge where we were not able to field verify our natural community mapping. These areas are generally indicated as 'not visited' within the natural community shapefile "Description" fields. We recommend additional field work be undertaken to verify and refine these areas to enhance the comprehensiveness of the Refuge mapping.

[9] https://www.monitoringash.org/ash-eab-surveys/

Appendix 1. New Hampshire natural community types and map codes cross-walked to International Vegetation Classification Associations and codes.

NC_Var Code	NH Community Name with Variants	IVC ELCODE	IVC Common Name
10.4_	Lowland spruce - fir forest	CEGL006273	Low-Elevation Spruce - Fir Forest
10.4_a	Mesic/Well-drained mossy lowland spruce-fir forest variant	CEGL006273	Low-Elevation Spruce - Fir Forest
10.4_b	Wet-mesic/Hydric mossy lowland spruce-fir forest variant	CEGL006273	Low-Elevation Spruce - Fir Forest
10.4_c	Mesic/Wet-mesic (not mossy) successional lowland spruce-fir-red maple (-aspen) forest variant	CEGL006505	Successional Mixed Spruce - Fir - Hardwood Forest
12.1_c	Successional northern hardwood - spruce - fir forest variant	CEGL006267	Transitional Northern Hardwood - Red Spruce Forest
12.2_	Sugar maple - beech - yellow birch forest	CEGL006631	Northern Hardwood Forest
12.2_c	Successional Sugar maple - beech - yellow birch forest variant	CEGL006631	Northern Hardwood Forest
18.1_	Rich mesic forest	CEGL006636	Northern Sugar Maple - Ash Rich Mesic Forest
18.5_	Semi-rich mesic sugar maple forest	CEGL006211	Semi-rich Northern Hardwood Forest
20.5_	Red maple - Sphagnum basin swamp	CEGL006226	Hemlock - Hardwood Swamp Forest
21.1_	Black spruce swamp	CEGL006098	Black Spruce Swamp Woodland
21.1_a	Black spruce swamp	CEGL006098	Black Spruce Swamp Woodland
21.1_b	Black spruce - larch - rhodora swamp variant	CEGL006098	Black Spruce Swamp Woodland
21.2_	Red spruce swamp	CEGL006312	Northern Appalachian Spruce - Fir Swamp Forest
21.2_2	Red spruce swamp: Red spruce - hardwood - violet variant	CEGL006312	Northern Appalachian Spruce - Fir Swamp Forest
23.1_	Northern hardwood - black ash - conifer swamp	CEGL006502	Northern Hardwood - Hemlock Seepage Swamp Forest
23.2_	Larch - mixed conifer swamp	CEGL006312	Northern Appalachian Spruce - Fir Swamp Forest
23.3_	Northern white cedar - balsam fir swamp	CEGL006007	Northern White-cedar Peatland Swamp Forest
23.7_	Northern hardwood seepage forest	CEGL006380	Hardwood - Conifer Seepage Forest
25.2_	Subacid forest seep	CEGL006193	Golden-saxifrage Forested Seep
29.1_	Alder alluvial shrubland	CEGL006062	Alluvial Alder Thicket
29.2_	Alder - dogwood - arrowwood alluvial thicket	CEGL006062	Alluvial Alder Thicket

NC_Var Code	NH Community Name with Variants	IVC ELCODE	IVC Common Name
31.1_	Tall graminoid meadow marsh	CEGL005448	Laurentian & Northeast Bluejoint Wet Meadow
31.1_2	Tall graminoid meadow marsh: Tussock sedge variant	CEGL006412	Eastern Upright Sedge Wet Meadow
31.1_3	Tall graminoid meadow marsh: Bulrush variant	CEGL006349	Northeastern Woolgrass Wet Meadow
31.2_	Mixed tall graminoid - scrub-shrub marsh	CEGL006519	Mixed Graminoid Wet Meadow
31.3_	Sedge meadow marsh	CEGL006412	Eastern Upright Sedge Wet Meadow
32.1_	Emergent marsh	CEGL006191	Northeastern Leafy Forb Marsh
32.2_	Cattail marsh	CEGL006153	Eastern Cattail Marsh
33_	Aquatic bed	CEGL002386	Water-lily Aquatic Wetland
35.2_	Alder seepage thicket	CEGL006546	Gray Alder - Arrow-wood / Bluejoint Shrub Swamp
39.1_	*Sphagnum rubellum* - small cranberry moss carpet	CEGL006135	Oligotrophic Peatland Moss Lawn
39.4_	Bog rosemary - sedge fen	CEGL006524	Few-seed Sedge - Leatherleaf Fen
40.1_	Leatherleaf - sheep laurel shrub bog	CEGL006514	Near-Boreal Dwarf-shrub Poor Fen
40.2_	Leatherleaf - black spruce bog	CEGL006513	Leatherleaf Boggy Fen
40.2_2	Leatherleaf - black spruce bog: Labrador tea - *Sphagnum fuscum* variant	CEGL006513	Leatherleaf Boggy Fen
41.2_	Mountain-holly - black spruce wooded fen	CEGL006158	Northern Peatland Shrub Swamp
42.1_	Sweet gale - meadowsweet - tussock sedge fen	CEGL006512	Sweetgale Mixed Shrub Fen
42.2_	Wire sedge - sweet gale fen	CEGL006302	Medium Fen
44.1_	Winterberry - cinnamon fern wooded fen	CEGL006395	Red Maple Wooded Fen
44.5_	Alder wooded fen	CEGL006158	Northern Peatland Shrub Swamp
45.1_	Floating marshy peat mat	undetermined	undetermined
50_	Open Water	N/A	N/A
55_	Vernal pool	CEGL006453	Eastern Woodland Vernal Pool
100_	Artificial Openings	N/A	N/A
101_	Developed	N/A	N/A

Appendix 2. Summary attributes and ranks for wetland natural community system occurrences at Pondicherry NFWR, NH

Natural Community System Occurrence	Total acres	# polygons	Size Rank	Condition Rank	Context Rank	Condition/ context average	EO Rank	Exemplary?	Minimum condition/ context ave. rank to be exemplary
1. black spruce peat swamp (S2S3)	813	106	A	B	BC	B	B	Yes	C
2. poor level fen/bog (S3)	132	57	A	A	BC	A	A	Yes	C
3. forest seep/seepage forest (S4)	341	90	A	BC	BC	BC	B?	?	B
4. drainage marsh - shrub swamp (S5)	306	306	A	BC	BC	BC	B?	?	B