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Clyde River Wetlands Natural Community Mapping Project - Final Report

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I. INTRODUCTION

The first significant natural community survey of the Clyde River wetlands occurred in the summer of 1998 as part of a comprehensive inventory of wetlands throughout the Lake Memphremagog watershed. Prepared for the Vermont Nongame and Natural Heritage Program (VT NNHP), that project identified many rare or uncommon natural communities and plant species, including two plants previously unknown from Vermont. One of these species – common arrow-grass (*Triglochin maritima*) – was found along the Clyde River. In their final report the authors identified the upper Clyde River wetlands as one of the four most significant complexes in the Memphremagog watershed, and a priority area for conservation efforts (Engstrom et al. 1999).

Recognizing the need for greater understanding, recognition, and protection of the extremely significant upper Clyde River wetlands, Eric Sorenson (VT NNHP), Jayson Benoit (NorthWoods), and Ben Copans (Vermont DEC), discussed in 2009 a project that would combine more detailed natural community mapping with landowner outreach. The project became possible in spring 2010, when FY10 Section 604(b) Water Quality funding was made available to the Northeastern Vermont Development Association (NVDA). The NorthWoods Stewardship Center, which has conducted a range of biological inventory and water quality studies in the Lake Memphremagog watershed since 1998, was then contracted by NVDA to complete the project. Initial work began on the project in late summer of 2010, and was completed in June 2011.

Project Goals

- Identify priority wetlands within the upper Clyde River watershed
- Complete natural community mapping within these wetlands, in coordination with the Vermont Agency of Natural Resources
- Provide the results of natural community mapping to the Vermont Nongame and Natural Heritage Program and NVDA, and
- Provide outreach through one public presentation and through letters to wetland landowners

II. METHODS

Phase 1

The project was completed in two phases. Phase 1 involved project scoping and preparation, including initial GIS mapping of the wetlands and contacting of landowners. The portion of the Clyde River wetlands extending from the Five Mile Square Road in Brighton (Essex County) Vermont, to the Buck Flats Route 105 Bridge in Charleston (Orleans County) was first identified as the project focus area. This decision was based on the findings of previous inventory work (Engstrom et al. 1999), which noted a concentration of significant community types in this section,

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as well as project funding. Initial delineation of natural communities within this roughly four-mile section of wetlands was accomplished with ArcView v.9.2 software and a variety of data layers acquired from the Vermont Center for Geographic Information (VCGI), the Vermont Agency of Natural Resources (ANR), and the Natural Resources Conservation Service (NRCS), as well as data previously collected by the NorthWoods Stewardship Center. The principle data utilized for this phase were 2008 NAIP Color Infra Red 1-meter resolution aerial imagery, 2008 Border Region True Color 0.3-meter resolution aerial imagery, Vermont Significant Wetland Inventory (VSWI), Vermont ANR Ecological Occurrence data for the Clyde River (Feb 2010), and Orleans County soils data (NRCS).

Using the above datasets for reference, distinctive vegetative cover type areas were delineated throughout the section of wetlands that fell within the VSWI polygon. Preliminary natural community types were also designated where possible, based on the aerial photography and limited field truthing. Using this method, 213 polygons totaling 902 acres were delineated (Map 1). Open water areas were not mapped.

During phase 1, wetland ownerships and landowner mailing addresses were obtained from Charleston and Brighton town clerks and landowners were contacted in writing. This letter explained the goals and anticipated timeline for the project and requested notification if the landowner did not wish that this work be completed on their property. Of 28 letters sent, one was returned undeliverable and one landowner refused access.

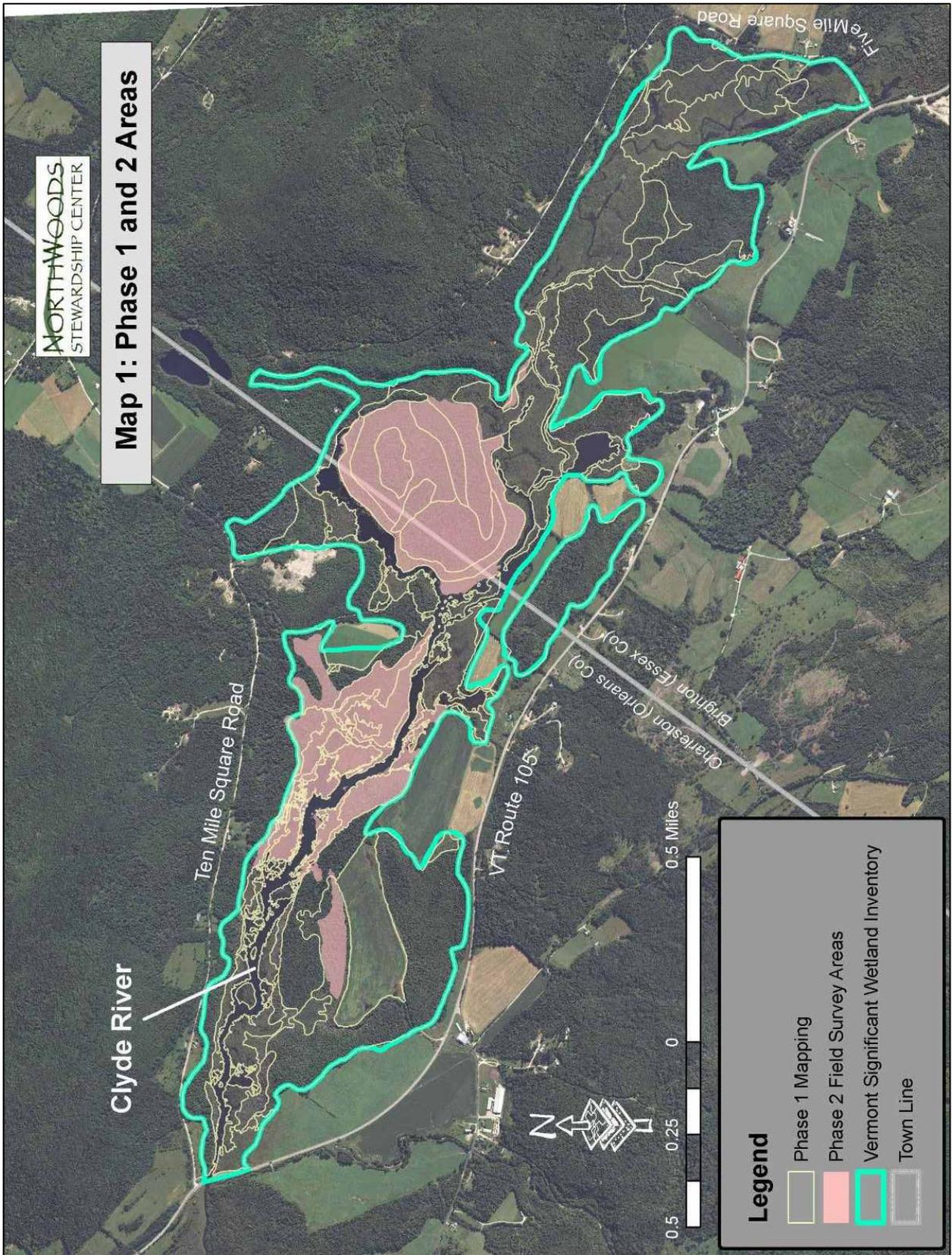
Phase 2

Using preliminary mapping from phase 1, existing Vermont Ecological Occurrence data for the wetlands, and the 1998 Lake Memphremagog Inventory report (Engstrom et al 1999), two sections of the wetlands were initially identified as priorities for follow up fieldwork, based on the extent, quality, and/or diversity of significant natural communities present. A third priority area was later added after fieldwork for a separate NorthWoods project identified a significant natural community within the target area that was not characterized in past studies (Map 1).

The priority wetland areas flagged for phase 2 field assessments were;

- the forested wetlands at the outlet of Webster brook
- the large intermediate fen and associated open wetlands west of the Charleston/ Brighton town line, *and*
- a black spruce swamp and woodland bog south of the Clyde River

Phase 2 field surveys were conducted on foot and by canoe in fall 2010 (Webster brook area) and in May 2011 (remaining areas) by Jayson Benoit of the NorthWoods Stewardship Center, with assistance from Land Management Interns Rob Sullivan and Meghann Carter. The preliminary polygons generated in phase 1 were amended on printed copies of the aerial imagery in the field. When rain or unclear imagery precluded this method, boundaries were delineated digitally using a Garmin 76csx GPS unit and later transferred to ArcView in the office. General descriptions were made of the sites visited, following NNHP natural community datasheet criteria (2009 version), and plant species were inventoried at a total of 42 representative plots. Additional notes, photographs, and GPS points were taken at points of special interest, including locations with rare species or potential threats (invasive species, etc). Evidence of wildlife within the natural



communities was also noted. Data were later entered and compiled in ArcView v.9.2 and Microsoft Excel.

In addition to the field mapping, phase 2 also included two educational outreach components. The first was a public presentation that took place at the NorthWoods Stewardship Center on Saturday, June 11th. The purpose of this presentation was to introduce the public to the unique values of the Clyde River wetlands, to the goals and results of the inventory project, and to various tools that are available to safeguard these and other wetlands. The presentation was advertised via the NorthWoods website, our e-newsletter (1,000+ subscribers), our printed newsletter, press releases in area newspapers, and through special e-mail notifications. Due to inclement weather, only two people attended the program, though other paddles scheduled for later in the summer will also incorporate information from the project to reach a broader audience.

The second outreach component was a follow up informational letter to wetland landowners, describing outcomes of the project and actions that landowners can take to preserve the unique values of these wetlands. This letter was sent to the 27 landowners contacted prior to the phase 2 work, and a copy is included with this report.

III. MAPPING RESULTS

Buck Flats Intermediate Fen Wetland Complex

This survey area encompassed the portion of wetlands extending from approximately 0.25 miles to 0.9 miles downstream of the Brighton/Charleston town line. The centerpiece of this area is a vast open intermediate fen on the north side of the channel that stretches unbroken across more than 13 acres. This natural community is rare (S2) in Vermont and is globally uncommon.

The state has the best examples in New England and the examples found in the Buck

Flats portion of the Clyde River are among the largest and highest quality in Vermont (Thompson and Sorenson 2000; Engstrom et al. 1999). As throughout the Clyde River wetlands, this feature occurs within a diverse complex of other wetland natural community types summarized below.

The floodplain and wetlands are narrowest at either end of this section, where they are roughly 800 feet across, while in the middle portion they span a distance of more than 2,000 feet between upland areas.



A-ranked Intermediate Fen natural community with Dollof mountain beyond.

Intermediate Fen

The dominant natural community type in this portion of the Clyde River wetlands, intermediate fen is found in various conditions differing in hydrology, species composition, and extent. All examples occupy organic peat soils – ranging from poorly decomposed peat 20-50cm thick to deep well-decomposed peat up to 300cm deep over sand (Engstrom et al. 1999). Species found in

varying amounts throughout the sub-types include sweet gale (*Myrica gale*), large cranberry (*Vaccinium macrocarpon*), hairy-fruited sedge (*Carex lasiocarpa*), and buckbean (*Menyanthes trifoliata*). Small cranberry (*Vaccinium oxycoccus*) is found to a lesser extent. Across the wetland



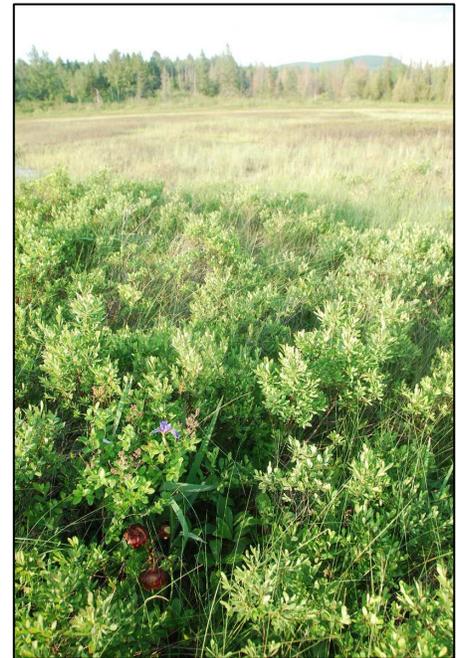
Triglochin maritima

complex intermediate fen ranges from a wet low type (not floating) with characteristics of Sedge Meadow to a higher floating mat type that grades into Sweet Gale Shoreline Swamp. The former type is dominated by hairy-fruited sedge, buckbean, three-way sedge (*Dulichium arundinaceae*), and marsh cinquefoil (*Potentilla palustris*), with only scattered and slightly stunted sweet gale present. Other associates include large cranberry, blue flag iris (*Iris verticillata*), *Sagittaria* sp., other sedge species, including tussock sedge (*Carex stricta*), and in one part of the fen flatleaf bladderwort (*Utricularia intermedia*). The latter type includes more abundant and taller sweet gale, buckbean, and occasional shrubby cinquefoil (*Potentilla fruticosa*). Toward the channel edge this type mixes with the sweet gale shoreline swamp (type three described below), and is mainly distinguished from the sweet gale swamp by having a higher proportion of hairy-fruited sedge. Other species noted include bog sedge (*Carex exilis*), and marsh bedstraw (*Galium palustre*).

Species of special note include a single population of state endangered common arrow-grass, rare bog willow (*Salix pedicellaris*) – scattered throughout the fen, and state endangered mare’s tail (*Hippuris vulgaris*) – found at various locations along the fen edge.

Sweet Gale Shoreline Swamp

This natural community is found scattered throughout the wetlands, with three sub-types noted. The most extensive examples occupy the transition zone between the open intermediate fen peatlands and the red maple- northern white cedar swamps that extend to the edge of the floodplain. These are generally a dense and tall band of sweet gale, with common associates including swamp rose (*Rosa palustris*), leatherleaf (*Chamaedaphne calyculata*), winterberry holly (*Ilex verticillata*), alder-leaved buckthorn (*Rhamnus alnifolia*), and shrubby cinquefoil. The other two sub-types occur along open channel or pool areas and intermix in complex associations with each other, with the intermediate fen, and with other open wetland community types. One is inundated and occupies the thin mat edge, mixing here with deeper marsh vegetation such as bur-reeds (*Sparganium* sp) and pickerelweed (*Pontederia cordata*).



Sweet Gale Shoreline Swamp with Intermediate Fen beyond

The third interesting raised floating mat type has unusual combinations of plants indicating both enriched and nutrient poor environments. This apparent contradiction may be a result of the deeper rooted species gaining access to nutrients from the water below, while shallow rooted plants on the raised mat are excluded from these nutrients. Overall, the flora in these areas

is diverse and vigorous, with a tall “overstory” dominated by 3.5-4 ft sweet gale intermixed with leatherleaf, swamp rose, bog rosemary (*Andromeda glaucophylla*), and occasional shrubby cinquefoil, and hairy-fruited sedge. Beneath this shrub layer is abundant buckbean, with varying amounts of pitcher plant (*Sarracenia purpurea*), round-leaved sundew (*Drosera rotundifolia*), kidney-leaved violet (*Viola renifolia*), marsh bedstraw, marsh St. Johnswort (*Hypericum virginicum*), blue flag iris, northern bugleweed (*Lycopus uniflorus*), marsh fern (*Thelypteris palustris*), tall meadow rue (*Thalictrum pubescens*), spotted jewelweed (*Impatiens capensis*), swamp candles (*Lysimachia terrestris*), swamp milkweed (*Asclepias incarnata*), and large cranberry (*Vaccinium macrocarpon*). The more stable of these floating mats rise over 12” above the surrounding fen and are relatively dry (hunters have built duck blinds on several such sites), while most appear dry but sink below the water line with the weight of a person.

Red Maple- Northern White Cedar Swamp

This natural community type occurs in areas that receive some seasonal flooding and is found both in 10-20 acre stands within the wetlands, as well as in a narrow band along the upland edge. In many areas, northern white cedar has suffered extensive dieback within the past 10-20 years. This is presumed to be due to longer durations of seasonal flooding, as cedar is sensitive to such flooding while its more wet-tolerant associates in these locations – red maple (*Acer rubrum*) and black ash (*Fraxinus nigra*) appear to be stressed, but persisting.

The largest patch of this community occurs southwest of the river, across the channel from the expanse of intermediate fen. Soils are saturated and common cattail (*Typha latifolia*), sensitive fern (*Onoclea sensibilis*), and various sedges (including three-way and tussock) are intermixed with winterberry, wild raisin (*Viburnum cassinoides*), and sweet gale. Other species found here include Robbin’s ragwort (*Senecio robbinsii*), sheep laurel (*Kalmia angustifolia*), a violet (*Viola*) species, Pennsylvania bittercress (*Cardamine pennsylvanica*), and blue flag iris. Cedar dieback is extensive, except for closest to the upland edge, where some trees up to 12” remain alive. A cored 6”dbh black ash was 100 years old while a 11”dbh cedar was over 110 years. Growth in both trees decreased significantly 10-15 years ago. It is unclear to what extent cedar will be able to re-develop in this stand, which may transition to a non-forested wetland.

A variant of this natural community – shrubby red maple- northern white cedar woodland also occurs between the upland edge and the fen, north of the Clyde River channel. This variant begins on the fen margin as a mainly mixed shrub community, with only scattered stunted red maples, and a species mix indicative of enrichment from seasonal flooding; winterberry, sweet gale, speckled alder (*Alnus incana*), and swamp rose. Some sedge-dominated openings and understory areas occur within this type with tussock sedge and three-way sedge most abundant. Closer to the upland edge true red maple- northern white cedar woodland occurs with a scattered canopy to roughly 45 feet. Shrubs are still abundant but species composition shifts to more acidic condition indicators such as mountain holly (*Nemopanthus mucronatus*), wild raisin, and sheep laurel. Scattered black chokeberry (*Aronia melanocarpa*) is also present. Northern white cedar and other swamp canopy associates (black ash, red spruce (*Picea rubens*), balsam poplar (*Populus balsamifera*), paper birch (*Betula papyrifera*)) appear as one moves further away from the river. The cedar edge appears to be shifting back here as well, as the outer band of this species has died within the past 10-15 years in many areas. The tamarack (*Larix laricina*) component has also experienced widespread dieback, presumably from the recent high populations of the eastern larch

beetle that have impacted much of northeastern Vermont. Portions of this community were logged approximately 30 years ago and may succeed gradually back to a closed canopy red maple-northern white cedar swamp type.

A well-developed example of Red Maple-Northern White Cedar Swamp links the Northern White Cedar Swamp and the shrubby woodland variant, with a red maple canopy at 55 feet (diameters to 11" dbh) and a lower northern white cedar canopy at 35 feet (to 20" dbh), and with black ash, red spruce, balsam fir (*Abies balsamea*), and paper birch as other lesser canopy species. A history of windthrow is evident and the pit and mound topography is well developed, creating micro-habitats for a diverse understory flora. This includes on the well-drained hummocks more upland herbs such as wild sarsaparilla (*Aralia nudicaulis*), Canada mayflower (*Maianthemum canadense*), wild oats (*Uvularia sessifolia*), goldthread (*Coptis groenlandica*), and intermediate wood fern (*Dryopteris intermedia*). In the wet hollows and surrounding areas are common wetland plants such as sensitive fern, cinnamon fern (*Osmunda cinnamomea*), blue flag iris, marsh marigold (*Caltha palustris*), water purslane (*Ludwigia palustris*), northern bugleweed, marsh cinquefoil (*Potentilla palustris*), and swamp candles. A diverse but scattered shrub layer includes leatherleaf, winterberry, sheep laurel, mountain holly, American mountain ash (*Sorbus Americana*), wild raisin, red-osier dogwood (*Cornus stolonifera*), and American fly-honeysuckle (*Lonicera canadensis*).

A trash dump estimated to be over 30 years old lies along about 150 feet of the shrubby red maple-northern white cedar woodland/ upland edge. This includes several half submerged 50-gallon drums, old oil cans, etc. Other small parts of this community type have been flooded by beavers and are transitioning to open wetland.

Northern White Cedar Swamp

This community type was found at the ends of long fingers of wetland soils extending far into surrounding uplands. These areas have been logged within the past 40-60 years and the existing forests are largely 4-9" dbh, within scattered older remnant canopy cedars up to 15" dbh. Other scattered trees in the emerging canopy include black ash, yellow birch (*Betula allegheniensis*), and eastern hemlock (*Tsuga Canadensis*), with balsam fir and cedar regeneration below. A low density of shrubs includes American fly-honeysuckle, yew (*Taxus canadensis*), and dwarf raspberry (*Rubus pubescens*), and the herb layer includes partridgeberry (*Mitchella repens*), dewdrop (*Dalibarda repens*), staircase moss (*Hylocomium splendens*), creeping snowberry (*Gaultheria hispidula*), and starflower (*Trientalis borealis*).

A small example of the boreal acidic variant of this community lies along the south wetland edge and is bordered by lowland spruce-fir forest. This site has evidence both of enrichment from seasonal flooding (winterberry, sweet gale), and acidic boreal associates (black spruce (*Picea mariana*) with northern white cedar, sheep laurel, pitcher plant, and mountain holly). Rare shining rose (*Rosa nitida*) is present at the fen edge.

Forested Wetland Complex South of the Clyde River

Black Spruce Swamp/ Black Spruce Woodland Bog/ Northern White Cedar Swamp

This complex lies roughly 300 feet south of the Clyde River's open wetlands and was not described in the 1998 wetlands inventory. The most notable area is a long tapering lowland basin

up to 300 feet wide and 1,600 feet long that features a Black Spruce Swamp ring surrounding a small (2-acre) but high quality example of Black Spruce Woodland Bog. To the south, the Black Spruce Swamp borders a small area of Northern White Cedar Swamp. A large (35 acre) cornfield is adjacent to this forested wetland complex to the south and along this border approaches to within 15 feet of the wetland edge in many locations. Much of this field was cleared of forest within the past ten years and converted to cornfield, including some filling of the black spruce swamp. This field presents a high threat to the long-term integrity of the wetlands, mainly through potential inputs of fertilizer, manure, and sediments. A large part of the cornfield drains to the wetland, where a small colony of the invasive common reed (*Phragmites australis*) has gained a foothold. This complex appears to grades into other wetland types to the west, but that area was not surveyed.

The Black Spruce Swamp includes a 45-foot canopy of black spruce, with tamarack also fairly common and red maple, white pine (*Pinus strobus*), and red spruce present but not common. There are well developed hummocks and hollows – cloaked in *Sphagnum* mosses and creeping snowberry, and areas of standing water occur at the east end of the stand. Cinnamon fern is common and a well-developed shrub layer features mainly mountain holly to 9 ft, with some wild raisin, sheep laurel, and at times a dense low coer of velvet leaf blueberry (*Vaccinium myrtilloides*). Other plants include three-seeded sedge (*Carex trisperma*), pitcher plant, dewdrop, bunchberry (*Cornus canadensis*), and goldthread. A cored 6”dbh red spruce in the swamp had 64 growth rings at breast height and growth slowed rapidly approximately 21 years ago.

In the central Black Spruce Woodland Bog area a patchy canopy cover ranges from 20 to 70% of 25-30 ft black spruce, and 45 ft tamarack. Both species are scattered through the understory. Less mountain holly is present here, but Labrador tea (*Ledum groenlandicum*), velvet leaf blueberry, bog laurel (*Kalmia polifolia*), and sheep laurel form a dense low shrub layer. Other species include wild raisin, pitcher plant, round-leaved sundew, various *Sphagnum* species, three-leaved Solomon’s seal (*Smilacina trifolia*), small cranberry (*Vaccinium oxycoccus*), wintergreen (*Gaultheria procumbens*), three-seeded sedge, and a cottongrass (*Eriophorum* species). The rare dwarf mistletoe (*Arceuthobium pusillum*) is widespread throughout the bog and an estimated 10% of the black spruce show health impacts from this parasitic plant that range from “witches broom” deformities to mortality.



Black Spruce Woodland Bog (above) and dwarf mistletoe (below).



Webster Brook Wetland Complex

Webster Brook is a small tributary that drains from the north, emptying into the Clyde River just east of the Brighton/Charleston town line. The Clyde River floodplain widens considerably here to

3,300 feet and the adjacent uplands (north) are diversified by a mix of impressive glacial features that include two intact eskers, a (mined) recessional moraine and kettle ponds. Lying around the stream outlet and in a large basin to the west are an incredible diversity of open and forested natural community types, as well as several floodplain backwater areas. Given the time constraints of the project we focused our surveys mainly in the forested wetlands west of Webster Brook.

From surrounding open wetlands, the forested wetland area begins with a periphery of sweet gale shoreline swamp that quickly grades into a red maple-northern white cedar swamp. A part of this swamp includes a relatively open (20-60% canopy) woodland variant that is thought to be unique to the Clyde River valley (Engstrom et al. 1999). Moving toward the center of the forested complex is a band of the boreal acidic variant of northern white cedar swamp, which itself transitions into a black spruce swamp core area. This pattern in community types reflects the subtle gradient in nutrient availability that is linked to the relative frequency of seasonal flooding, with fewer nutrients and greater acidity occurring in the interior areas farthest from the river. Although trees 80-130 years old are not uncommon in this swamp complex, the area has seen several logging entries over the past century, and within the past 10-15 years extensive dieback of northern white cedar around the edge of the complex and of black spruce and tamarack in much of the core area. The causes of the dieback are not clear, though changing hydrology is a possible culprit with the cedar, and dwarf mistletoe and eastern larch beetle are considered likely causes in the black spruce and tamarack (respectively). One result of these impacts is a proliferation of red maple in the understory, intermixed with lesser amounts of the other primary tree species, and it remains to be seen to what extent the community types, or their extent, may or may not be affected over the long term.

Red Maple-Northern White Cedar Swamp

The type occurs in a band inside of the sweet gale periphery of the complex, in areas that were last logged circa 1950 (south) and circa 1970 (remaining areas). In the older areas, a 35-40 foot canopy of 5-10" dbh cedar and red maple dominates, with some residual cedars at least 100 years old more scattered. Other less common canopy associates are black ash, paper birch, and tamarack. A well-developed shrub layer and understory plants reflect the influences of seasonal flooding with speckled alder, winterberry, wild raisin, sheep laurel, mountain holly, leatherleaf, royal fern (*Osmunda regalis*), turtlehead (*Chelone glabra*), northern bugleweed, marsh marigold, marsh fern, blue flag lily, Joe-pie weed (*Eupatorium maculatum*), swamp candles, swamp milkweed, marsh cinquefoil, and various sedges co-occurring with goldthread, Canada mayflower, dwarf raspberry, and partridgeberry.

The woodland variant of this community occurs in the central/western part of the complex, where the canopy opens to 20-60% cover of cedar and red maple, over a dense understory including the above shrub and herb species noted above, as well as alder-leaved buckthorn, sweet gale, black chokeberry, and patches of tussock sedge. In the interior part of this area and nearly to the backwater edge to the north, acidic/boreal plants begin to appear within this red maple- northern white cedar type, including scattered black spruce, pitcher plant, bog laurel, and Labrador tea.

Several smaller upland-edge examples of red maple-northern white cedar swamp community type occur east of the Webster Brook drainage, and include in the understory poison ivy (*Toxicodendron radicans*)— an unloved plant that is nevertheless notable this far north in the state.

A patch of the potentially invasive herb true forget-me-not (*Myosotes scorpioides*) also occurs here.

Northern White Cedar Swamp (Boreal Acidic Variant)

This natural community occupies a transition zone between the more frequently flooded (and enriched) Red Maple- Northern White Cedar swamp closer to Webster Brook and the slightly drier, more acidic Black Spruce Swamp to the northwest. Northern white cedar shares the canopy with red maple, tamarack, and occasional black spruce. Canopy trees here are generally 4-9" dbh (originating from logging around 1945-1950), though more recently logged areas and scattered larger cedars up to 16" dbh and over 130 years old also occur. The herb and shrub layer is fairly well developed and diverse, with speckled alder, winterberry, wild raisin, dwarf raspberry, turtlehead, royal fern, northern bugleweed, *Virginia* creeper (*Parthenocissus quinquefolia*), arrow-leaved tearthumb (*Polygonum saggitatum*), marsh fern, marsh marigold, cinnamon fern, three-seeded sedge, and others. Plants indicative of the community's acidic character include sheep laurel, velvetleaf blueberry, leatherleaf, Labrador tea, wintergreen, and mountain holly. The uncommon native shrub mountain fly honeysuckle (*Lonicera villosa*) also occurs sporadically.



Lonicera villosa

Black Spruce Swamp

The best expression of this natural community is a 9.5-acre area in the north-central part of the complex. A 50-60 foot closed canopy of 70-100 year old black spruce with tamarack occurs over a shrub layer made up of Labrador tea, leatherleaf, wild raisin, sheep laurel, winterberry, and the low small cranberry. In the understory, hummocks and hollows are cloaked in Schreber's moss (*Pleurozium schreberi*) and sphagnum species, with bunchberry, goldthread, and pitcher plant, among other herbs. Another 18 acres of forest to the south and east shares the same acidic understory indicator plants, but has a much thinner overstory due to past logging and more recent dieback of the black spruce and tamarack (noted above). Roughly 50-60% canopy remains, made up of black spruce, tamarack, and red maple, with fewer cedar. The shrub layer includes bog



Dieback in black spruce swamp

laurel, *Rhodora* (*Rhododendron canadense*), Labrador tea, wild raisin, speckled alder, black chokeberry, mountain holly, and moderately dense tamarack, red maple, balsam fir, and black spruce saplings (with some northern white cedar). Based on the existing overstory and the relative vigor of the regenerating species, this community may be transitioning to a boreal acidic form of the red maple-northern white cedar type. A half acre patch of the invasive common reed also occurs within the logged area and should be controlled before spreading to more of the wetland, particularly areas where the crown has thinned.

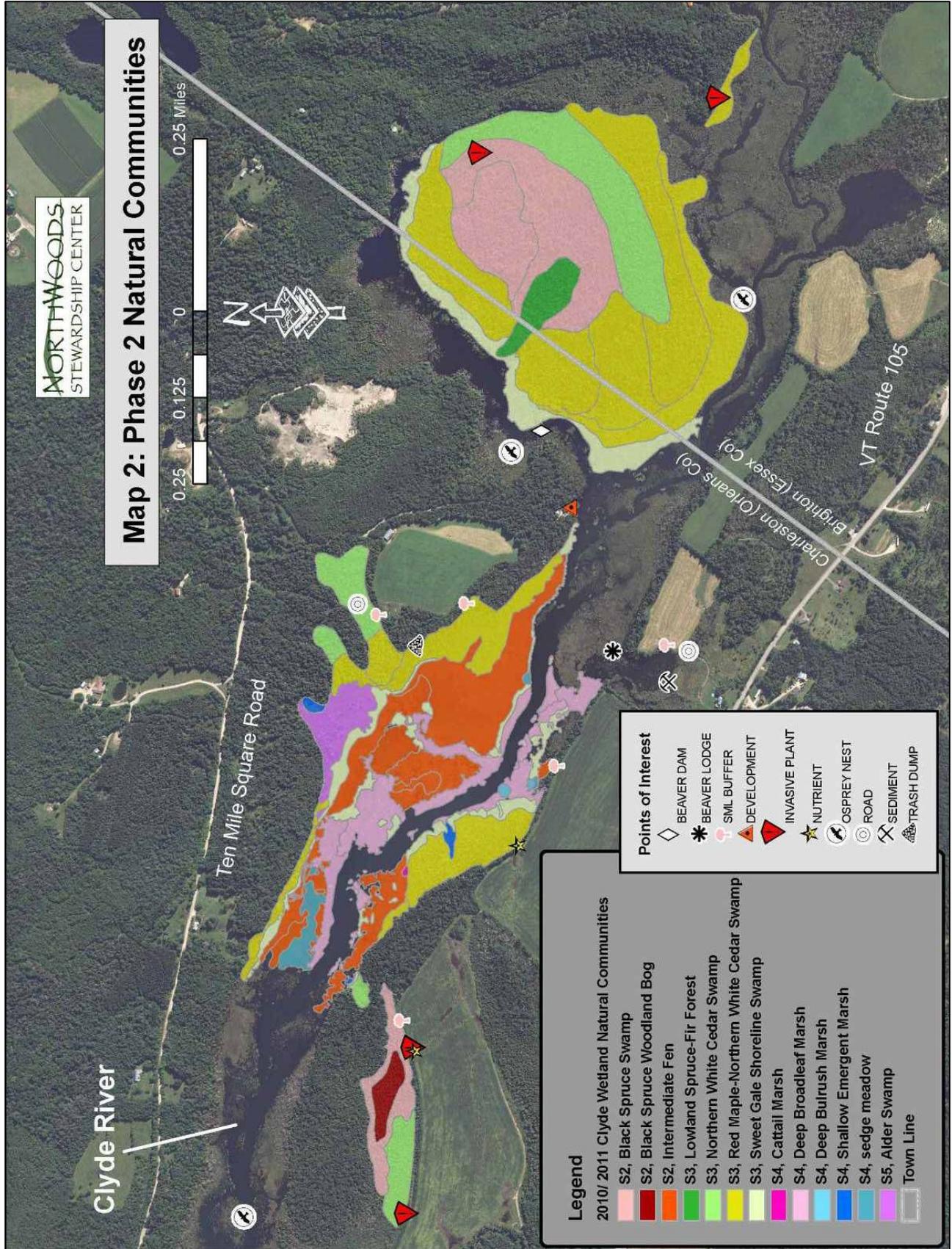
Conclusions:

Four overarching conclusions were reinforced by the project:

- 1) The wetlands within the study area contain both significant and relatively high quality natural community types and rare species populations – including several new findings.
- 2) The most notable asset is the overall diversity and extent of wetlands contained within the complex as a whole, which conveys important buffering value to the individual rare community types and species within.
- 3) Though these wetland communities are generally intact and functioning, a number of threats are evident and current protections may be insufficient to ensure their long term integrity.

A total of 212 acres of the Clyde River wetlands were surveyed and mapped for this project (Table 1 and Map 2). Of the resulting natural communities mapped, 89% are currently considered rare (S2) or uncommon (S3) in Vermont. The most significant individual natural community is intermediate fen, which is a rare type in Vermont and globally uncommon. The extent of intermediate fen found within the study area is unique in Vermont and hosts a number of rare species. The black spruce swamp and black spruce woodland bog are also rare natural communities statewide, of which good examples occur within these wetlands. Among the uncommon community types, several variations exist within the study area that are unique- in one case possibly only occurring along the Clyde River (Engstrom et al. 1999).

Table 1: Mapping Project Results		Condition Ranking			Grand Total
		A	B	Not Ranked	
State Status	Natural Community				
S2	Black Spruce Swamp		31.8		31.8
	Black Spruce Woodland Bog		2.1		2.1
	Intermediate Fen	<u>28.5</u>	<u>1.8</u>		<u>30.3</u>
	S2 Total:	28.5	35.7		64.1
S3	Lowland Spruce-Fir Forest (well drained variant)		4.3		4.3
	Northern White Cedar Swamp		25.7		25.7
	Red Maple-Northern White Cedar Swamp		59.2	16.9	76.1
	Sweet Gale Shoreline Swamp	<u>14.7</u>	<u>3.0</u>	<u>0.0</u>	<u>17.8</u>
	S3 Total:	14.7	92.3	17.0	123.9
S4	Cattail Marsh		0.1		0.1
	Deep Broadleaf Marsh	13.1	2.2		15.3
	Deep Bulrush Marsh		0.3		0.3
	sedge meadow	2.1	0.3		2.4
	Shallow Emergent Marsh		<u>0.7</u>		<u>0.7</u>
S4 Total:	15.3	3.5		18.8	
S5	Alder Swamp		<u>4.9</u>		<u>4.9</u>
	S5 Total:		4.9		4.9
Grand Total		58.4	136.3	17.0	211.7



Most of the forested wetlands are in some stage of recovery from past logging and were ranked as in B-condition (Vermont Nongame and Natural Heritage Program natural community ranking criteria), but none appear to have been permanently altered. Several of these wetlands would be A-condition if they had wider buffers from nearby agricultural lands. The open wetlands have no significant evidence of disruption, but include many small or unbuffered examples and were therefore also ranked as B-condition. Several larger and well-buffered examples of intermediate fen and sweet gale shoreline swamp were ranked as A-condition.

Summary of Significant Findings:

Note: Specific data (GPS, GIS, locations, photos, etc) from this project will be provided to the Vermont Nongame and Natural Heritage Program.

- **Intermediate Fen (S2, A-ranked):** This project expanded upon the initial discovery of several plants of the state-endangered Common arrow-grass in 1998 (Popp, pers comm.), identifying a population consisting of an estimated 500+ plants over an area of at least 0.7 acres. This population was located in a complex of raised sweet-gale dominated floating mat close to the river channel that had characteristics of both intermediate fen and sweet gale shoreline swamp natural communities. This was the only location where common arrow-grass was noted, despite the abundance of similar habitats in other parts of the fen. Other rare plant species found to be fairly common in various parts of the fen were bog willow (*Salix pedicellaris*) and bog sedge (*Carex exilis*).
- **Black Spruce Woodland Bog (S2, B-ranked):** A 2-acre area of this rare natural community, not noted in the 1998 wetlands inventory, was discovered and mapped along with an adjacent Black Spruce Swamp community. Rare dwarf mistletoe (*Arceuthobium pusillum*) was found to occur throughout the woodland bog community.
- **Other rare plants:** State endangered mare's tail (*Hippuris vulgaris*) was observed in summer 2010 forming extensive beds in low water around the edges of the intermediate fen and sweet gale shoreline swamp mapped in this project. During the mapping phase in spring 2011 these populations were mostly submerged and therefore were not mapped. Uncommon mountain fly honeysuckle (*Lonisera villosa*) was observed in several parts of the boreal acidic variant of northern white cedar swamp in the Webster Brook forested wetland complex in fall 2010.
- **Wildlife:** Evidence of wildlife use of the wetlands and their adjacent forested buffers was abundant, including recent use by black bear, moose, river otter, muskrat, and deer. NorthWoods has documented 126 species of birds in these wetlands since 1998 and several state-listed species were observed during the project; osprey (nesting), pied-billed grebe (SC), rusty blackbird (SC), merlin, and sora (SC).

Wetland Health and Protection:

The natural communities found within the study area are sensitive to a variety of impacts that include; invasive plant species, conversion to other land uses, rutting through equipment use, repeated logging, runoff from agricultural lands, insufficient vegetated buffers, changes in hydrology (nutrient levels and quantity/frequency of flooding), impoundments, and trampling (Thompson and Sorenson, 2000). Specific existing or potential threats were noted during the

fieldwork and referred to in this report or in the accompanying maps and GIS shapefiles. The key concerns and threats are summarized here.

❖ **Hydrology:**

Widespread mortality among the established canopy trees- particularly northern white cedar and white pine – in forested wetlands bordering the open wetlands suggests possible changes in the hydrologic regime in this section of wetlands in the recent past. Limited coring of remaining living trees in this zone shows rapid growth declines between 1990 and 1995, though more samples should be taken to confirm whether this time sequence is widespread. Flood tolerant species like red maple and black ash also show a pattern of top dieback and subsequent re-growth from lower branches that may be related. Aerial photography from the 1940s seems to support this theory, as the wetlands appear less inundated at that time and mortality in the forested wetland edges less widespread. If a broad change in hydrology has occurred or is occurring, this could influence the extent and distribution of many of the wetland natural communities.

❖ **Buffers:**

Naturally vegetated wetland buffers currently range from hundreds of feet in some areas to less than 25 feet in others. Though most of the areas surveyed for this project have adequate buffers, notable exceptions occur where adjacent farm fields abut the wetland edge. The potential for manure or fertilizer inputs that could alter the wetland communities is especially a concern in the adjacent cornfields south of the channel. The buffer here is as little as 10 feet next to the Black Spruce Swamp and some of the open wetlands, and natural drainages in these large fields direct the runoff clearly toward several points of contact with the wetlands.

❖ **Invasive Plants:**

Only two areas of invasive plants were observed within the wetlands- a half-acre colony of common reed in the Webster Brook forested wetlands, and a patch of true forget-me-not in a red maple- northern white cedar swamp at the upland edge (east of Webster Brook). Several other occurrences of Phragmites however were noted in open fields adjacent to the wetlands (Map 2), and these are at high risk of expanding into the wetland communities. Sections of the Clyde River upstream of the Five Mile Square Road also host scattered populations of the highly invasive purple loosestrife (*Lythrum salicaria*). The NorthWoods Stewardship Center has been controlling these populations through manual removal over the past decade with some success, and continued control and monitoring efforts should be a high priority.

Other impacts or threats noted include logging (rutting and/or changes in species composition), sediment inputs from tributaries, roads crossing wetlands, historic trash dumps, and conversion of wetlands – or adjacent buffer forest – to agricultural use. As these wetlands become more recognized and utilized for their recreational values, impacts such as trampling of sensitive plants or collection could become concerns, though the difficulty of access posed by the peat/muck soils, thick vegetation, and downed logs help to limit this impact.

Recommendations:

Due to limited funding, this project was necessarily only an initial step toward complete inventory and mapping of the upper Clyde River wetland natural communities. The project accomplished

phase 1 mapping of all of the wetlands between Five Mile Square Road and the Route 105 bridge at Buck Flats in Charleston, and phase 2 field surveys/mapping of 24% of these wetlands. Future work should focus on field surveys in the remaining wetlands, with the goals of delineating the existing natural communities, documenting rare species, and noting significant other values and/or concerns. A comprehensive inventory, followed by periodic status monitoring every 5-10 years, will be valuable to guide long term conservation of these high value wetlands. Cultivation of local volunteers and active landowner stewards would allow for a more frequent and cost-effective monitoring while also sowing seeds for other conservation efforts on private lands.

The entire area is privately owned, and the wetlands are currently afforded limited protection under Vermont Class 2 wetland rules. These require a 50-foot buffer between development and the wetlands, but allow for agricultural and timber harvest use within certain requirements. Through the efforts of the landowners, much of the area encompassed by this project has additional recognition and protection through conservation liens held and overseen by the Vermont Land Trust and Vermont’s Use Value Appraisal (UVA) Program. Management plans for these properties updated since the recent changes to the UVA program in 2009 have designated the wetland areas as Ecologically Sensitive Treatment Areas (ESTAs), with special management guidelines that exclude timber harvest and require some monitoring for invasive species and other threats. In the absence of other protection mechanisms, this example serves as an excellent model for other landowners in the watershed, where such protections are lacking.

Table 2: Recommendations for Next Steps – Upper Clyde River Wetlands

Category	Recommendation	Potential Resources
Assessment	Complete field surveys and Nat.Comm. mapping of wetlands	Water Quality grants (604b, Watershed Grants, etc), NorthWoods Stewardship Center (NWSC), VT NNHP, consulting ecologists
Recognition/Protection	Pursue Class 1 wetland designation	Same as above
	Enrollment under UVA ESTA categories	Landowners, NWCS, Consulting Foresters
	Conservation fee-ownership or easements for highest value wetlands and surrounding buffer areas	Landowners, Vermont Land Trust, TNC, land protection private foundations (various)
Education	Public lecture series/ outings	NWSC, VT NNHP, special presenters
Threat mitigation	Invasive plant monitoring and manual removal – Phragmites/ purple loosestrife	Landowners, Volunteer groups, NRCS- EQIP/WHIP, NWSC, VT Aquatic Nuisance Grant, Ecosystem Restoration Grant, Other grant sources
	Native species buffer plantings	Landowners, Volunteer groups, NWSC, NRCS- CREP, Orleans NRCD- Trees for Streams, NWSC, Ecosystem Restoration Grant, other grant sources
	Address concerns along tributary streams that are result in sediment/nutrient inputs or impact hydrology	NWSC/ VT DEC (Stream Geomorphic Assessments and identified priority areas), Better Backroads grants (culvert retrofits/ stormwater inputs), NRCS- CREP or Orleans NRCD- Trees for Streams (buffer plantings)

In addition to ecological assessments and lien or legislative protections, ongoing education is needed to underscore the unique value and sensitivity of the wetlands, and to identify the ways that community members and visitors can best steward these resources. Finally a number of specific threat mitigation opportunities exist that should be addressed through landowner outreach and

various grant and cost share conservation programs. Table 2 summarizes our recommendations for future efforts in these wetlands.

References Cited:

Engstrom, Brett, M. Lapin, R. Popp, M. Ferguson, and E. Sorenson. 1999. *An Ecological Inventory of the Wetlands of the Lake Memphremagog Watershed in Vermont (and associated international drainages)*. Produced for the Vermont Nongame and Natural Heritage Program, Waterbury, VT.

Thompson, Elizabeth, and E. Sorenson. 2000. *Wetland, Woodland, Wildland – A Guide to the Natural Communities of Vermont*. University Press of New England.