Long-Term Variable Milfoil Management and Control Plan for OSSIPEE LAKE SYSTEM Ossipee/Freedom, New Hampshire Carroll County

Prepared by: New Hampshire Department of Environmental Services (DES), with input from the Ossipee Lake Alliance (OLA)
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PROBLEM STATEMENT

Exotic aquatic plants pose a threat to the ecological, aesthetic, recreational, and economic values of lakes and ponds (Luken & Thieret, 1997, Halstead, 2000). According to the 2006 Section 305(b) and 303(d) Consolidated Assessment and Listing Methodology (CALM), "exotic macrophytes are non-native, fast growing aquatic plants, which can quickly dominate and choke out native aquatic plant growth in the surface water. Such infestations are in violation of Env-Ws 1703.19, which states that surface waters shall support and maintain a balanced, integrated and adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region" (DES, 2006).

Though exotic aquatic plants can negatively impact an aquatic system, native aquatic plants are beneficial to the aquatic ecology of waterbodies, and are thus not a focus of management efforts in this waterbody. Diverse assemblages of native aquatic plants are a source of oxygen to the system, they provide stabilizing root systems to minimize erosion and turbidity, and they provide food and habitat for aquatic life.

Variable milfoil (*Myriophyllum heterophyllum*) became established in Ossipee Lake in the mid to late 1990s. Variable milfoil was first documented in Broad Bay in 1995, and then a few years later in Leavitt Bay (Phillips Brook area) in 2003. Milfoil has also been document in Portsmouth Cove (between Broad and Leavitt Bays), in the outlet channel, and most recently, in Causeway Cove (a.k.a. Pickerel Cove). Figure 1 illustrates the historic variable milfoil infestations on the waterbody. Figure 1b illustrates control actions from 2011, and Figure 1c illustrates control actions that are proposed for 2012. These are expected to be regular control areas until the infestations are reduced or eradicated. Following is a summary of each site:

Causeway Cove (a.k.a. Pickerel Cove)- Causeway Cove is a small shallow cove on the south side of the channel connecting Ossipee Lake with Broad Bay. Variable milfoil was newly reported in this cove in 2009, and a site inspection by DES in September 2009 confirmed the presence of small to medium sized patches distributed throughout the cove, with some patches combining to form moderately dense growth. Maximum water depth is about 6 feet and mean depth is roughly 3.5 feet in the cove. Sediments are silty/sandy throughout most of the cove, and silty/organic near the wetland and the southern end.

Portsmouth Cove- Portsmouth Cove is located on the south side of the channel connecting Broad Bay and Leavitt Bay. This is an area of historic milfoil growth, with plant densities

scattered in some areas of the cove to dense in others. Maximum depth of the cove is 11-12 feet, and mean depth is about 5 feet. The substrate is sandy/silty with areas of cobble and rock. Hand-pulling efforts in this area have greatly reduced variable milfoil to a few persistent stems, but the infestation is not widespread based on a November 2009 site inspection.

Phillips Brook- Phillips Brook is a tributary that flows into the south side of Leavitt Bay. The channel is roughly 15-20 feet wide with a mean depth of roughly 2.5 feet and a maximum depth of about 4 feet. The bottom sediments are silty/sandy and support a very dense stand of variable milfoil. Milfoil extends up the channel roughly 250 feet from the lake edge, and then extends into the lake basin forming stands around a sandy/silty delta at the mouth of the stream, roughly 175 feet into the lake basin, following the contours of the delta.

Outlet Stream- Small patches and single stems of variable milfoil have been found in the outlet channel of the lake below the bridge separating Effingham from Fredom. The area has been managed by placement of benthic barriers and diving.

Upstream Sources- The Danforth Ponds, located to the north of the Ossipee Lake System, flow in a southerly direction and empty into the north end of Broad Bay. Milfoil in the Danforth system is dense and widespread, particularly in the middle basin. Efforts at milfoil control were stepped up in 2010 in the Danforth Ponds, and there was more commitment in 2011 and beyond to continue to reduce milfoil in that chain of lakes.

Impacts of the infestation are felt by the commercial business along the shores of the lake, including marinas, campgrounds and other facilities, as well as a number of property owners of private seasonal and year round residences. By and large there are many areas of Ossipee Lake that do not have any problems with milfoil, including the main basin of Ossipee Lake. It is a large system with a number of basins, given to having a sandy substrate which is not optimal for milfoil growth. Areas with higher silt or organic content in the bottom sediments are more prone to growth. Though the infestation of variable milfoil is small relative to the size of the lake system, allowing the infestation to continue unmanaged only serves to put other parts of the Ossipee Lake system and downstream waterbodies at higher risk of infestation due to generation of fragments from infested areas.

PURPOSE

The purposes of this exotic aquatic plant management and control plan are:

1. To identify the waterbody's beneficial use areas, including essential aquatic habitat, designated conservation zones, swimming areas, boat access sites, and boating use areas;
2. To present the aquatic macrophyte distribution map, including both native and exotic species;
3. To identify short-term and long-term exotic aquatic plant control goals that protect and conserve the lake's beneficial uses;
4. To recommend exotic plant control actions that meet the goals outlined in this plan; and
5. To recommend monitoring strategies to determine the success of the control practices over time in meeting the goals.

This plan also summarizes the current physical, biological, ecological, and chemical components of Ossipee Lake and the social and ecological impacts of the milfoil infestation.

The intent of this strategic plan is to outline activities to reduce the overall acreage and percent cover of variable milfoil in the Ossipee Lake system over time through the use of Integrated Pest Management Strategies (IPM), and to maintain this reduced level over time. Appendix A details the strategies available for waterbodies with exotic species, and provides more information on each of the activities that are recommended within this plan.

GOALS/OBJECTIVES OF MILFOIL CONTROL ACTIONS

The long-term goal for Ossipee Lake is to reduce the overall acreage and percent cover of variable milfoil in the system using an Integrated Pest Management Approach.

Town Support

The Towns of Ossipee and Freedom are very supportive of protecting the lakes in this area and are aware of the milfoil problem. The Town of Ossipee has spent more than $15,500 since 2005 for diver pulling in Phillips Brook, Leavitt Bay, and Portsmouth Cove. In addition, the Town of Ossipee Conservation Commission has funded Lake Host Program workers at the Pequawket Trail boat launch every year since 2006 for a total financial investment of over $10,000 through 2009, matched in additional funding by the NH Lakes Association grants.

Ossipee Lake Alliance

The Ossipee Lake Alliance (OLA) is a well-established lake association for this system. In addition to being active in outreach and educational activities for the lake and watershed they have taken an active role in coordinating milfoil-related activities. The OLA has done much education and outreach about invasives, has posted signage and educational materials that pertain to invasives, and has offered financial support for the Lake Host Program. The lake association also promotes participation in the statewide Weed Watcher Program to enhance early detection activities throughout the Ossipee Lake system.

WATERBODY CHARACTERISTICS

The following table summarizes basic physical and biological characteristics of OSSIPEE LAKE:

General Lake Information	
Lake area (acres)	3,090
Watershed area (acres)	209,510.6
Shoreline Uses (residential, forested, agriculture)	Residential, forested, commercial
Max Depth (ft)	61.05
Mean Depth (ft)	28.05
Trophic Status	Oligotrophic
Color (CPU) in Epilimnion	27.5
Clarity (ft)	11.2
Flushing Rate (yr^{-1})	4.6

Natural waterbody/Raised by Damming/Other	Natural w/Dam
Plant Community Information Relative to Management	
Invasive Plants (Latin name)	*Myriophyllum heterophyllum*
Infested Area (acres)	0 acres (none at this time)
Distribution (ringing lake, patchy growth, etc)	n/a
Sediment type in infested area (sand/silt/organic/rock)	n/a
Rare, Threatened, or Endangered Species in Waterbody (according to NH Natural Heritage Inventory)	Several species and habitats of concern (see Appendix C for a table containing the full list)

The following table summarizes basic physical and biological characteristics of BROAD BAY:

General Lake Information	
Lake area (acres)	463.6
Watershed area (acres)	224,340.9
Shoreline Uses (residential, forested, agriculture)	Residential, forested, commercial
Max Depth (ft)	73.6
Mean Depth (ft)	27.4
Trophic Status	Oligotrophic
Color (CPU) in Epilimnion	26
Clarity (ft)	19.8
Flushing Rate (yr^{-1})	34.1
Natural waterbody/Raised by Damming/Other	Natural w/Dam
Plant Community Information Relative to Management	
Invasive Plants (Latin name)	*Myriophyllum heterophyllum*
Infested Area (acres)	Area of Causeway Cove (a.k.a. Pickerel Cove), see figures for historic and current expanse of plant.
Distribution (ringing lake, patchy growth, etc)	Small to moderate patches of varying densities in indicated cove
Sediment type in infested area (sand/silt/organic/rock)	Silty/Sandy with areas of more organic substrate
Rare, Threatened, or Endangered Species in Waterbody (according to NH Natural Heritage Inventory)	Kettle Hole Bog System (between Broad Bay and Leavitt Bay) Common loon (*Gavia immer*)

The following table summarizes basic physical and biological characteristics of LEAVITT BAY:

General Lake Information	
Lake area (acres)	176.1
Watershed area (acres)	227,267.7
Shoreline Uses (residential, forested, agriculture)	Residential, forested, commercial

Max Depth (ft)	42.2
Mean Depth (ft)	11.2
Trophic Status	Oligotrophic
Color (CPU) in Epilimnion	20.5
Clarity (ft)	13.2
Flushing Rate (yr^{-1})	221.3
Natural waterbody/Raised by Damming/Other	Natural w/Dam
Plant Community Information Relative to Management	
Invasive Plants (Latin name)	*Myriophyllum heterophyllum*
Infested Area (acres)	Area of Phillips Brook = 6.4 acres
Distribution (ringing lake, patchy growth, etc)	Dense in stream channel and around boundary of silty/sandy delta at mouth of stream in lake basin, see figures for historic and current expanse of plant.
Sediment type in infested area (sand/silt/organic/rock)	Silty/sandy
Rare, Threatened, or Endangered Species in Waterbody (according to NH Natural Heritage Inventory)	Pondweed (*Potamogeton pusillus* ssp *gemmiparus*) (in Leavitt Bay stream) Common loon (*Gavia immer*)

The following table summarizes basic physical and biological characteristics of BERRY BAY:

General Lake Information	
Lake area (acres)	145.4
Watershed area (acres)	230233.1
Shoreline Uses (residential, forested, agriculture)	Residential, forested, commercial
Max Depth (ft)	38.3
Mean Depth (ft)	12.2
Trophic Status	Mesotrophic
Color (CPU) in Epilimnion	21
Clarity (ft)	14.9
Flushing Rate (yr^{-1})	254
Natural waterbody/Raised by Damming/Other	Natural w/Dam
Plant Community Information Relative to Management	
Invasive Plants (Latin name)	*Myriophyllum heterophyllum*
Infested Area (acres)	Scattered stems in outlet channel, see figures for historic and current expanse of plant.
Distribution (ringing lake, patchy growth, etc)	Sparse, localized
Sediment type in infested area (sand/silt/organic/rock)	Rocky/cobbly
Rare, Threatened, or Endangered Species in Waterbody (according to NH Natural Heritage Inventory)	Long-leaved redtop-panicgrass (*Coleataenia longifolia ssp. longifolia*)

An aquatic vegetation map and key from a survey by the DES Biology Section is shown in Figure 2a-d. A bathymetric map is shown in Figure 3a-d.

BENEFICIAL (DESIGNATED) USES

In New Hampshire, beneficial (designated) uses of our waterbodies are grouped into five general categories: Aquatic Life, Fish Consumption, Recreation, Drinking Water Supply, and Wildlife (CALM). Of these, Aquatic Life and Recreation are the ones affected by the presence of invasive plants like variable milfoil.

AQUATIC LIFE

The goal for aquatic life support is to provide suitable chemical and physical conditions for supporting a balanced, integrated and adaptive community of aquatic organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of the region.

FISHERIES AND WILDLIFE

Ossipee Lake is managed for landlocked salmon and rainbow trout (both stocked species) and secondarily for lake trout. Ossipee Lake also contains Brook trout, chain pickerel, large and smallmouth bass, yellow and white perch, common white suckers, brown bullheads, cusk, sunfish spp., common and golden shiners, and rainbow smelt. Successful landlocked salmon reproduction occurs in the Bearcamp River, a large tributary to Ossipee Lake.

See Appendix C for a list of wildlife species of concerns in this system. Most of the species are located within the Ossipee Lake basin where no variable milfoil is present. Other species that fall within proximity to the treatment areas in Causeway Cove and Phillips Brook include the common loon which should not be impacted by these small-scale and isolated control efforts, as well as the brook snaketail and the purple martin, which are much removed from the actual treatment locations.

RECREATION USES AND ACCESS POINTS

As one of the state's largest lakes, Ossipee Lake is used for numerous recreational activities by lake residents and transient boaters and visitors. Access to the lake can be achieved at commercial marina launches (three) around the lake, as well as at one of the public launch sites (two).

There are an estimated 125-160 motorboats on the lake each day (swelling to close to 500 on the weekends), and roughly 60-100 non-motorized craft.

There are several designated beaches around the lake system. A designated beach is described in the CALM as an area on a waterbody that is operated for bathing, swimming, or other primary water contact by any municipality, governmental subdivision, public or private corporation,

partnership, association, or educational institution, open to the public, members, guests, or students whether on a fee or free basis. Env-Wq 1102.14 further defines a designated beach as *"a public bathing place that comprises an area on a water body and associated buildings and equipment, intended or used for bathing, swimming, or other primary water contact purposes. The term includes, but is not limited to, beaches or other swimming areas at hotels, motels, health facilities, water parks, condominium complexes, apartment complexes, youth recreation camps, public parks, and recreational campgrounds or camping parks as defined in RSA 216-I:1, VII. The term does not include any area on a water body which serves 3 or fewer living units and which is used only by the residents of the living units and their guests.*

In addition to the designated beaches, many properties have private beaches, docks, and swim platforms around the lake. These have not been quantified for the purposes of this plan.

Figure 4 shows the locations of access sites, designated beaches, and marinas on Ossipee Lake.

MACROPHYTE EVALUATION

The littoral zone is defined as the nearshore areas of a waterbody where sunlight penetrates to the bottom sediments. The littoral zone is typically the zone of rooted macrophyte growth in a waterbody.

The littoral zone of the basins in the Ossipee Lake system is characterized by a mix of native and non-native (variable milfoil) plant growth (Figure 2a-d).

In Ossipee Lake, native species include a mix of floating plants (floating heart, yellow water-lily, white water-lily, watershield), emergent plants (rush, bur-reed, pickerelweed, sedge, bulrush, three-way sedge, arrowhead, and smartweed), and submergent plants (pondweed). Native plant communities are mixed around the entire lake and are categorized as scattered by DES.

In Broad Bay, native species include a mix of floating plants (yellow and white water-lily, watershield), emergent plants (spike rush, arrowhead, bur-reed, pickerelweed, sedge, cattail), and submergent plants (pondweed, grassy spike rush, bladderwort). Native plant communities are mixed around the entire bay and are categorized as scattered/common by DES. The invasive plant, variable milfoil, has been present in Broad Bay since 1995. There is a kettle hole bog system listed in a review by the Natural Heritage Bureau (NHB) which is within a setback distance from the treatment area in Causeway Cove, but it does not appear to be hydrologically connected (surficially) to Causeway Cove and thus should not be impacted as a result of this treatment. An historical record of mermaid-weed (*Proserpinaca pectinata*) is shown on the NHB map originating from 1975. In a plant survey by DES and NHB during summer 2011, no mermaidweed was found in area that were previously document to support populations of this plant.

In Leavitt Bay, native species include a mix of floating plants (yellow and white water-lily, floating heart), emergent plants (spike rush, three-way sedge, buttonbush, swamp candle, sedge, bur-reed), and submergent plants (quillwort, bladderwort, tape grass, various pondweed species). Filamentous algae was documented in patches on the bottom in various parts of the bay. Native

plant communities are mixed around the entire lake and are categorized as scattered by DES. The invasive plant, variable milfoil, has been present in Leavitt Bay since roughly 2003, and is present primarily in Phillips Brook which enters the bay at the southern end of the basin. An NHB review yielded a 1979 historical record for budding pondweed (*Potamogeton gemmiparus*) in Leavitt Bay stream (Phillips Brook) where management actions are needed. A summer 2011 survey by NHB and DES showed the plant was not present within the treatment zone. As pondweeds are monocots they are not likely to succumb to a 2,4-D treatment. Long-leaved panic grass is listed as present in the channel connecting Leavitt Bay and Berry Bay. This is a monocot species and not susceptible to the herbicide of choice for this project, and it is some distance downstream of the Phillips Brook treatment area.

In Berry Bay, native species include a mix of floating plants (yellow and white water-lily), emergent plants (sedge, swamp candle, three-way sedge, grass sp., arrowhead, bur-reed), and submergent plants (tape grass, pondweed). Filamentous algae was documented in patches on the bottom in various parts of the bay. Native plant communities are mixed around the entire lake and are categorized as scattered by DES. NHB has listed the presence of needle beak sedge (a monocot not susceptible to the herbicide of choice and well downstream of any treatment areas).

See Appendix C for a list of plant and special habitat areas of concern in this system. Most of the species not already listed above are located within the Ossipee Lake basin where no variable milfoil is present, so no management activities will be taking place in that basin. For the species listed as present in the basins where control practices are slated, no impacts are expected as most species are not susceptible to 2,4-D (like the quillworts or monocots).

WELLS AND WATER SUPPLIES

Figure 5 shows the location of wells, water supplies, well-head protection areas, and drinking water protection areas around the Ossipee Lake System. Most appear to be private drinking water supply wells. The applicator will provide more detailed information on the wells and water supplies within proximity to the treatment areas as required in the permit application process with the Division of Pesticide Control at the Department of Agriculture. *Due to DES restrictions for providing water supply data under Homeland Security restrictions, note that the map in Figure 5 cannot be provided on a finer scale than 1:48,000.*

HISTORICAL CONTROL ACTIVITIES IN OSSIPEE LAKE

BASIN	SITE	DATE	METHOD	AREA (ac)	TARGET	CONTRACTOR
BROAD BAY		05-Jun-96	DIQUAT	6		ACT
LEAVITT BAY	PHILLIPS BROOK	16-Jun-04	DIQUAT	4.5	V MILFOIL	LYCOTT
LEAVITT BAY	PHILLIPS BROOK	SUMMER 04	HAND PULL	VARIED	V MILFOIL	CLIFF CABRAL
BROAD/LEAVITT	PORTSMOUTH COVE	SUMMER 04	HAND PULL	VARIED	V MILFOIL	CLIFF CABRAL
LEAVITT BAY	PHILLIPS BROOK	SUMMER 05	HAND PULL	VARIED	V MILFOIL	CLIFF CABRAL
BROAD/LEAVITT	PORTSMOUTH COVE	SUMMER 05	HAND PULL	VARIED	V MILFOIL	CLIFF CABRAL
LEAVITT BAY	PHILLIPS BROOK	SUMMER 06	HAND PULL	VARIED	V MILFOIL	CLIFF CABRAL
BROAD/LEAVITT	PORTSMOUTH COVE	SUMMER 06	HAND PULL	VARIED	V MILFOIL	CLIFF CABRAL
LEAVITT BAY	PHILLIPS BROOK	SUMMER 07	HAND PULL	VARIED	V MILFOIL	CLIFF CABRAL
BROAD/LEAVITT	PORTSMOUTH COVE	SUMMER 07	HAND PULL	VARIED	V MILFOIL	CLIFF CABRAL
LEAVITT BAY	PHILLIPS BROOK	SUMMER 08	HAND PULL	VARIED	V MILFOIL	CLIFF CABRAL
BROAD/LEAVITT	PORTSMOUTH COVE	SUMMER 08	HAND PULL	VARIED	V MILFOIL	CLIFF CABRAL
LEAVITT BAY	PHILLIPS BROOK	SUMMER 09	HAND PULL	VARIED	V MILFOIL	CLIFF CABRAL
BROAD/LEAVITT	PORTSMOUTH COVE	SUMMER 09	HAND PULL	VARIED	V MILFOIL	CLIFF CABRAL
BROAD/LEAVITT/ BERRY	PORTSMOUTH COVE/CAUSEWAY COVE/OUTLET CHANNEL	SUMMER 10	HAND PULL AND DASH	VARIED	V MILFOIL	CLIFF CABRAL
OSSIPEE SYSTEM	PICKEREL COVE, PHILLIPS BROOK, OSSIPEE LAKE MARINA	6/7/2011	2,4-D	12	V MILFOIL	ACT
BROAD BAY	VARIOUS COVES	8/1/2011	HAND PULL	2.5 HOURS, 80 GALLONS	V MILFOIL	DES
BROAD BAY	VARIOUS COVES	8/18/2011	HAND PULL	3.5 HOURS 90 GALLONS	V MILFOIL	DES
BROAD BAY/LEAVITT BAY	VARIOUS COVES	8/29/2011	HAND PULL	3 HOURS 60 GALLONS	V MILFOIL	DES
LEAVITT BAY	NORTHWEST COVE	9/19/2011	DASH	3 HOURS 180 GALLONS	V MILFOIL	DES

MANAGEMENT OPTIONS

The control practices used should be as specific to variable milfoil as feasible. No control of native aquatic plants is intended.

Exotic aquatic plant management relies on a combination of proven methods that control exotic plant infestations, including physical control, chemical control, biological controls (where they exist), and habitat manipulation. Integrated Pest Management Strategies (IPM) are typically

implemented using Best Management Practices (BMPs) based on site-specific conditions so as to maximize the long-term effectiveness of control strategies. Descriptions for the control activities are closely modeled after those prescribed by the Aquatic Ecosystem Restoration Foundation (AERF) (2004). This publication can be found online at http://www.aquatics.org/aquatic_bmp.pdf.

Criteria for the selection of control techniques are presented in Appendix A. Appendix B includes a summary of the exotic aquatic plant control practices used by the State of New Hampshire. DES has evaluated the feasibility of potential control practices on Ossipee Lake. The following table summarizes DES' control strategy recommendations for Ossipee Lake.

FEASIBILITY EVALUATION FOR CONTROL ALTERNATIVES

Control Method	Use on Ossipee Lake System
Restricted Use Areas	Recommended where feasible. Restricted Use Areas (RUAs) are best located where infestations are small and localized and can feasibly be contained. RUAs should be used along with fragment barriers to prevent spread of plants from the restricted area.
Hand-pulling	DES recommends hand-pulling for small patches of growth, as a follow up to larger scale control efforts, and wherever stems of milfoil are isolated enough to yield effective control.
Diver-Assisted Suction Harvesting	Following herbicide application, DES recommends that Diver-Assisted Suction Harvesting be the primary means of further reducing variable milfoil in the lake, where milfoil densities and areas are reduced enough to make this a reasonable and feasible option.
Mechanical Harvesting/Removal	Mechanical harvesting is not recommended due to the threat of spreading variable milfoil to uninfested areas of the lake through the generation of fragments.
Benthic Barriers	DES recommends installing small benthic barriers in areas of re-growth if small patches of variable milfoil re-grow and can adequately be contained by benthic barriers.
Herbicides	The use of a target specific systemic herbicide (like 2,4-D or similar) is recommended for control of variable milfoil where dense patches or areas persist.
Extended or Deep Drawdown	Drawdown is not an effective control method for variable milfoil, nor is it feasible in this waterbody.
Dredge	Not recommended due to nature of exotic plant distribution, the cost, or the ancillary ecological impacts that the dredge could have.
Biological Control	There are no approved biological controls for variable milfoil at this time in New Hampshire.
No Control	Variable milfoil is widespread and still expanding within the Ossipee Lake system. Because the basins are connected by segments of river channel an infestation in one basin could spread

Control Method	Use on Ossipee Lake System
	downstream and infest another basin. Also, Ossipee Lake basin is not infested, and motor boats have the potential for dragging fragments upstream into the main basin of the lake and causing an infestation there, where many RTE species may be at risk. A 'no control' option will foster the further encroachment of this exotic aquatic plant into currently uninfested areas.

EXOTIC AQUATIC PLANT CONTROL PLAN

The following control actions are recommended:

Year	Action	Responsible Party	Schedule
2011	Herbicide treatment of Causeway Cove and Phillips Brook	Aquatic Control Technology, Inc.	June or early September
	Fragment barrier placement around Phillips Brook and Causeway Cove if needed (if treatment is scheduled for fall)	DES or OLA	May
	Prevention (Lake Host) activities	OLA	May through September
	Early Detection (Weed Watching) activities	OLA and local Weed Watchers	Once a month from May through September
	Diver-Assisted Suction Harvesting and simple hand harvesting focused on Portsmouth Cove milfoil and any smaller isolated patches of growth in the outlet channel above dam	Weed Control Diver (WCD)	June through September
	Benthic Barrier placement as needed/feasible	DES	TBD
	Fragment barrier removal and storage for winter	DES or OLA	September
	Site assessment and remapping of variable milfoil infestation	DES	August/September
2012	Re-treatment of 2011 areas if needed. Determination will be based on a fall 2011 field survey by DES.	Aquatic Control Technology, Inc.	June or September
	Prevention (Lake Host) and Early Detection (Weed Watching) activities	OLA	May through September
	Diver-Assisted Suction Harvesting and simple hand harvesting when/where needed	Weed Control Diver (WCD)	June through September

Year	Action	Responsible Party	Schedule
	Benthic Barrier placement as needed/feasible	DES	TBD
	Site assessment and remapping of variable milfoil infestation	DES	August/September
2013	Prevention (Lake Host) and Early Detection (Weed Watching) activities	OLA	May through September
	Diver-Assisted Suction Harvesting and simple hand harvesting when/where needed	Weed Control Diver (WCD)	June through September
	Benthic Barrier placement as needed/feasible	DES	TBD
	Site assessment and remapping of variable milfoil infestation	DES	August/September
2014	Prevention (Lake Host) and Early Detection (Weed Watching) activities	OLA	May through September
	Diver-Assisted Suction Harvesting and simple hand harvesting when/where needed	Weed Control Diver (WCD)	June through September
	Benthic Barrier placement as needed/feasible	DES	TBD
	Site assessment and remapping of variable milfoil infestation	DES	August/September
2015	Prevention (Lake Host) and Early Detection (Weed Watching) activities	OLA	May through September
	Diver-Assisted Suction Harvesting and simple hand harvesting when/where needed	Weed Control Diver (WCD)	June through September
	Benthic Barrier placement as needed/feasible	DES	TBD
	Site assessment and remapping of variable milfoil infestation	DES	August/September
2016	Update and revise Long-Term Variable Milfoil Control Plan	NH DES and interested parties	Fall/Winter

- Based on the types of native plants that are mixed in with the stands of variable milfoil where herbicide application is recommended there are no significant impacts to native plant communities expected as a result of this treatment. It is expected that a well distributed stand of native aquatic plants will remain following herbicide application.

- It is important to note that aquatic herbicide applications are conducted in a specific and scientific manner, and that the herbicides that are used can be target-specific when used at appropriate doses/concentrations: this means that the invasive plant can be removed and native plants favored in this type of control practice. *Not all aquatic plants will be impacted as a result of an herbicide treatment.*

- Because this is a natural system that is being evaluated for management, it is impossible to accurately predict a management course over five years that could be heavily dependent on uncontrolled natural circumstances (weather patterns, temperature, etc). This management plan should be considered a dynamic document that is geared to the actual field conditions that present themselves in this waterbody. If circumstances arise that require the modification of part or all of the recommendations outlined herein, all interested parties will be consulted for their input on revisions that may be needed to further the goal of variable milfoil management in the subject waterbody.

Figure 1a- Map of Milfoil Infestation in Ossipee Lake System (2010)

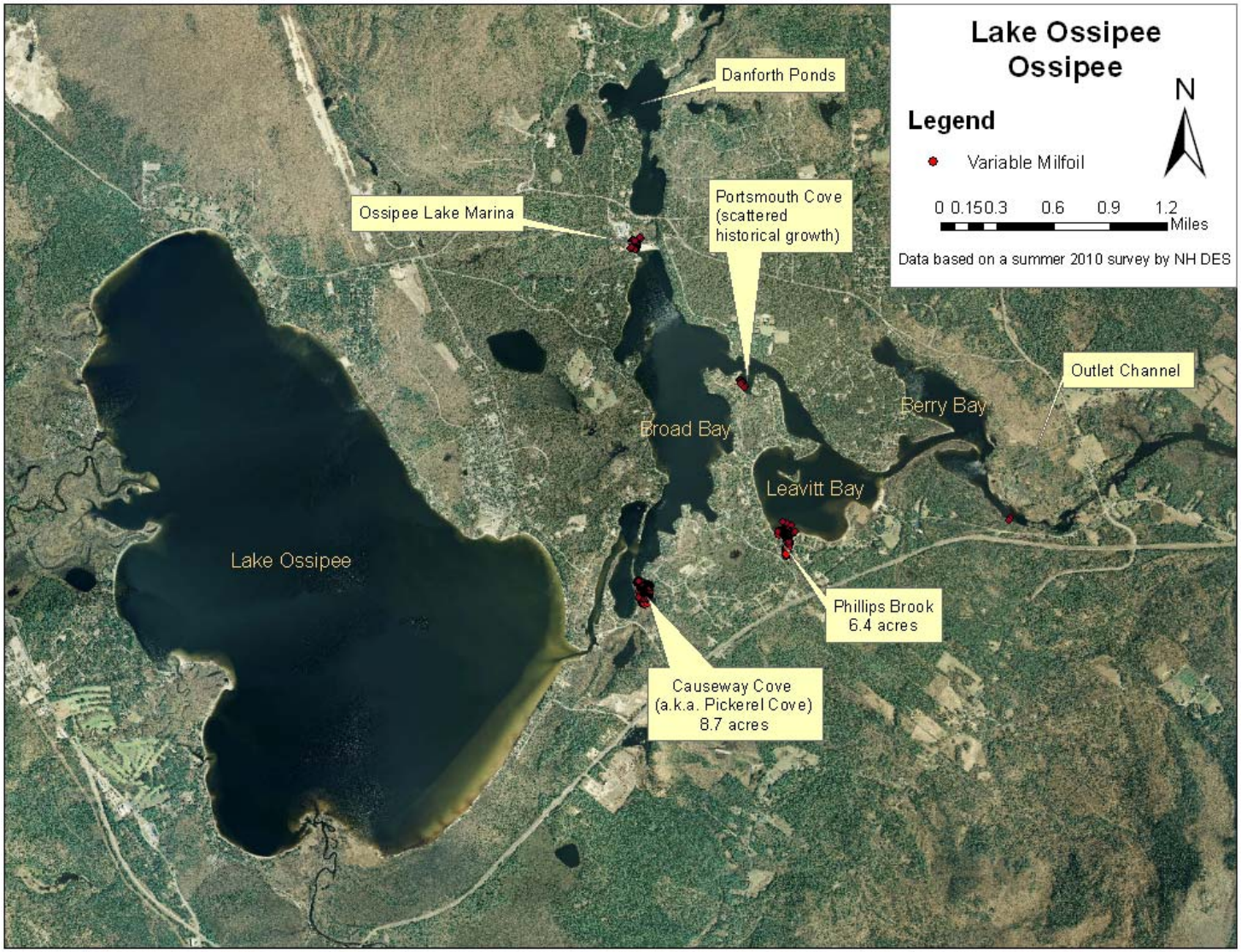


Figure 1b- Ossipee Lake System 2011 Treatment Areas

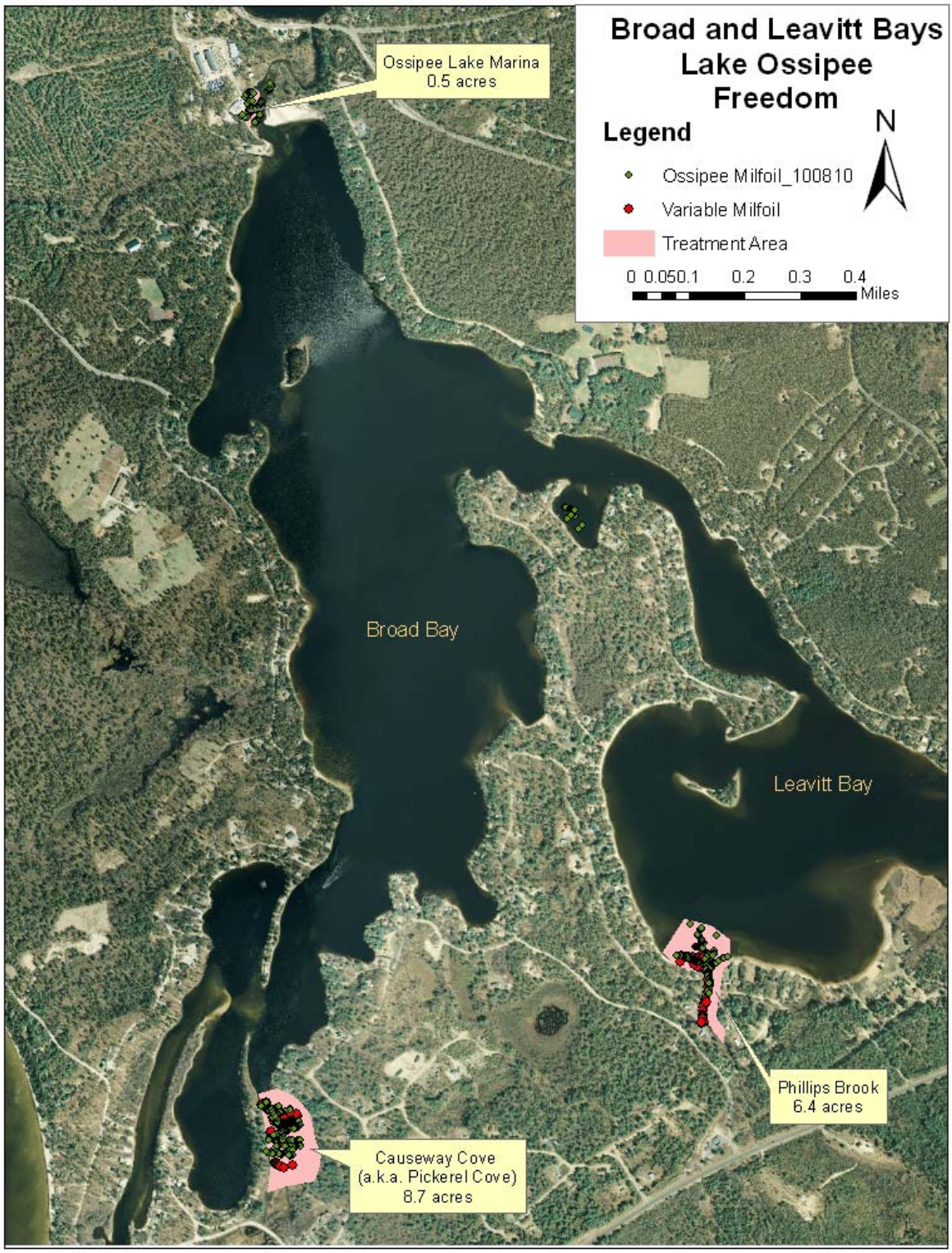


Figure 1c- Ossipee Lake System 2012 Control Areas

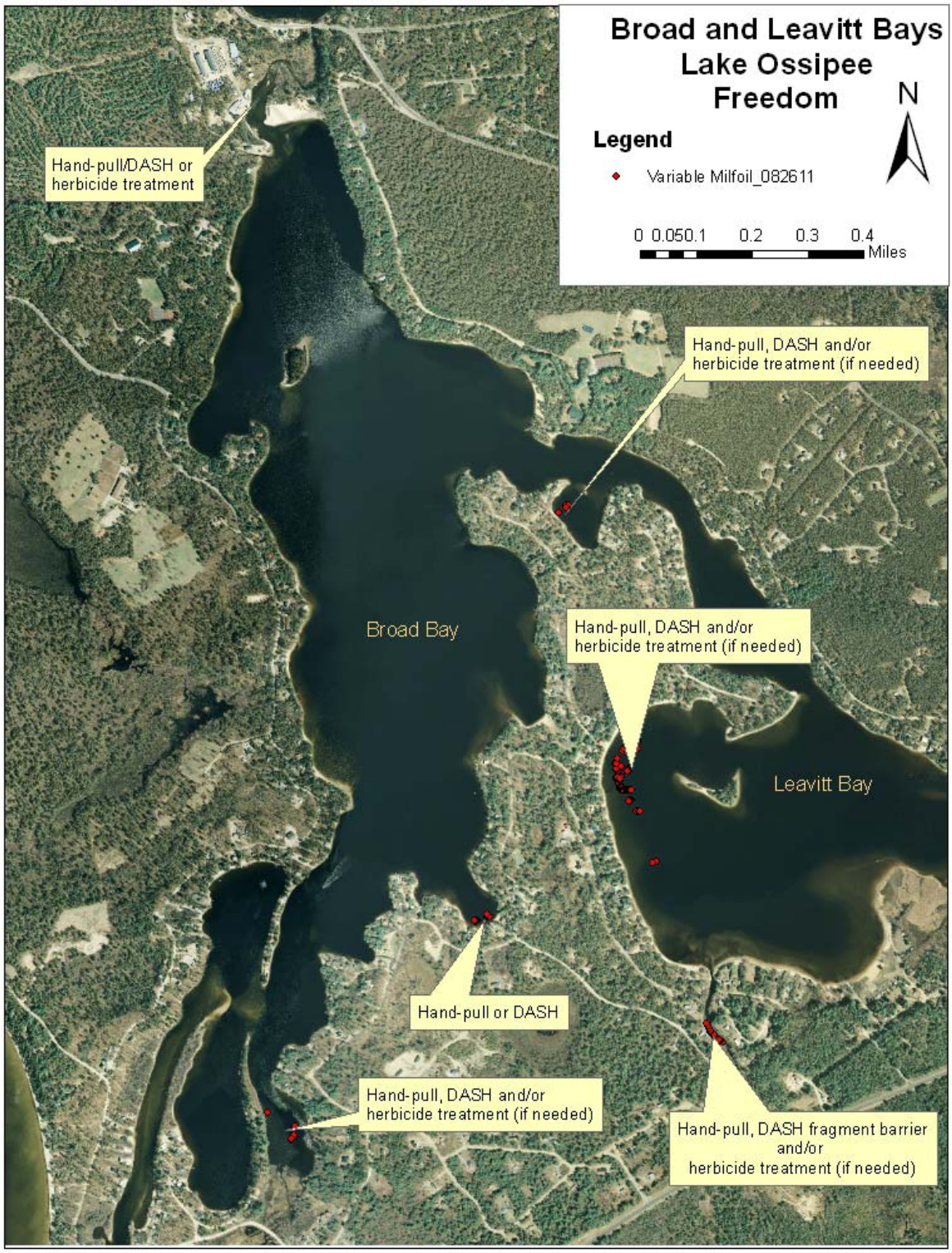
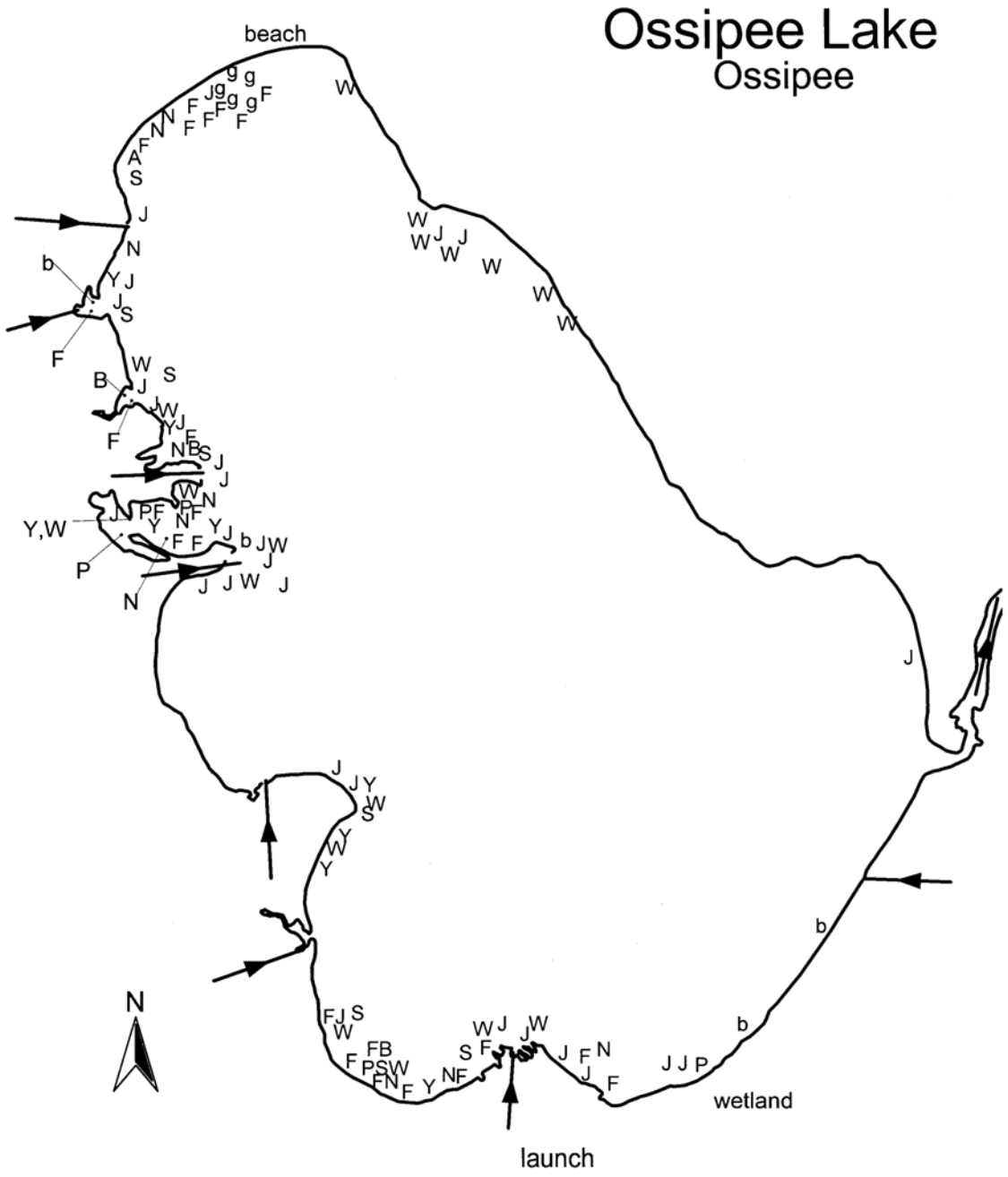
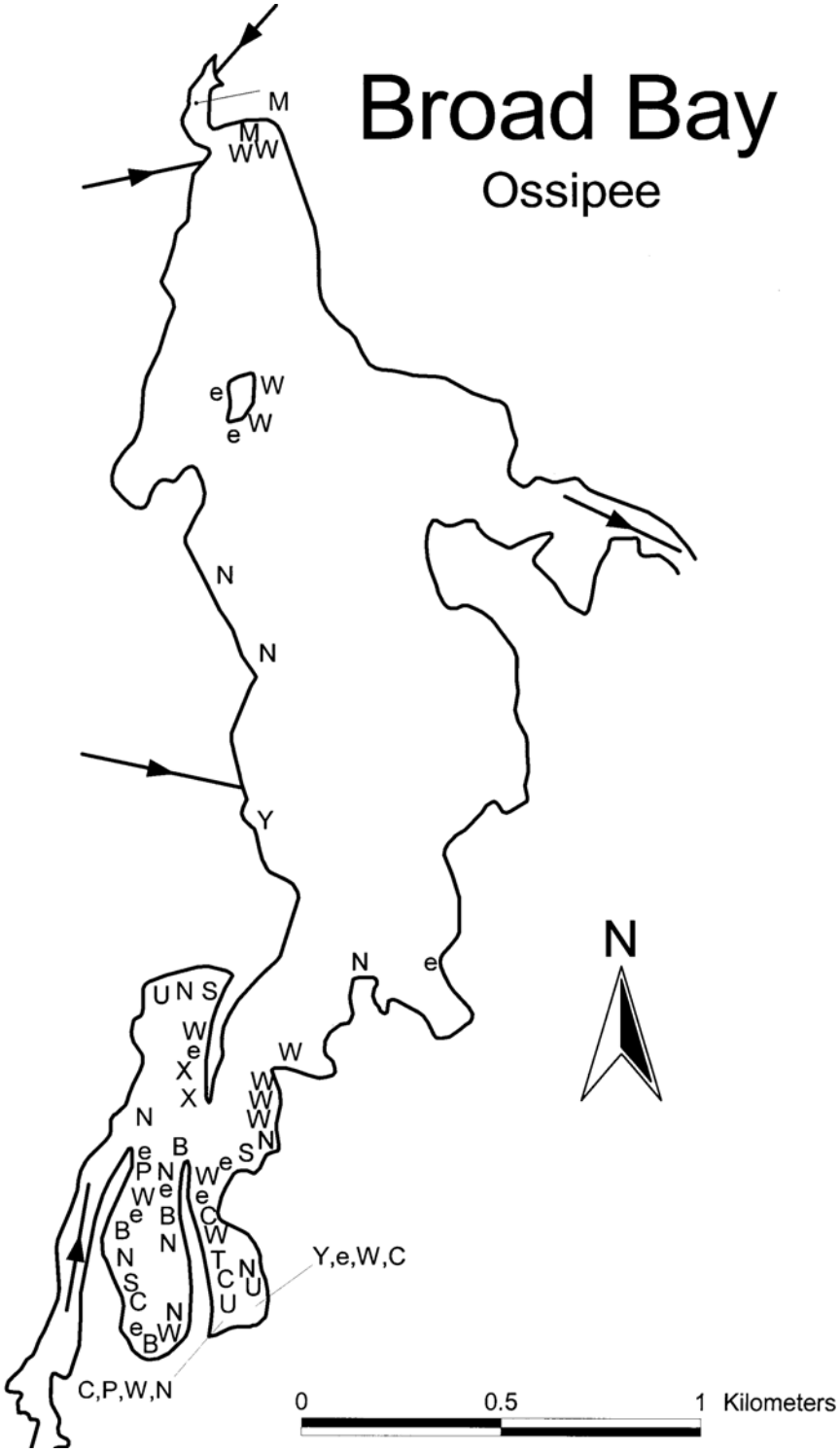


Figure 2a- Aquatic Vegetation Map and Key (Ossipee Lake)



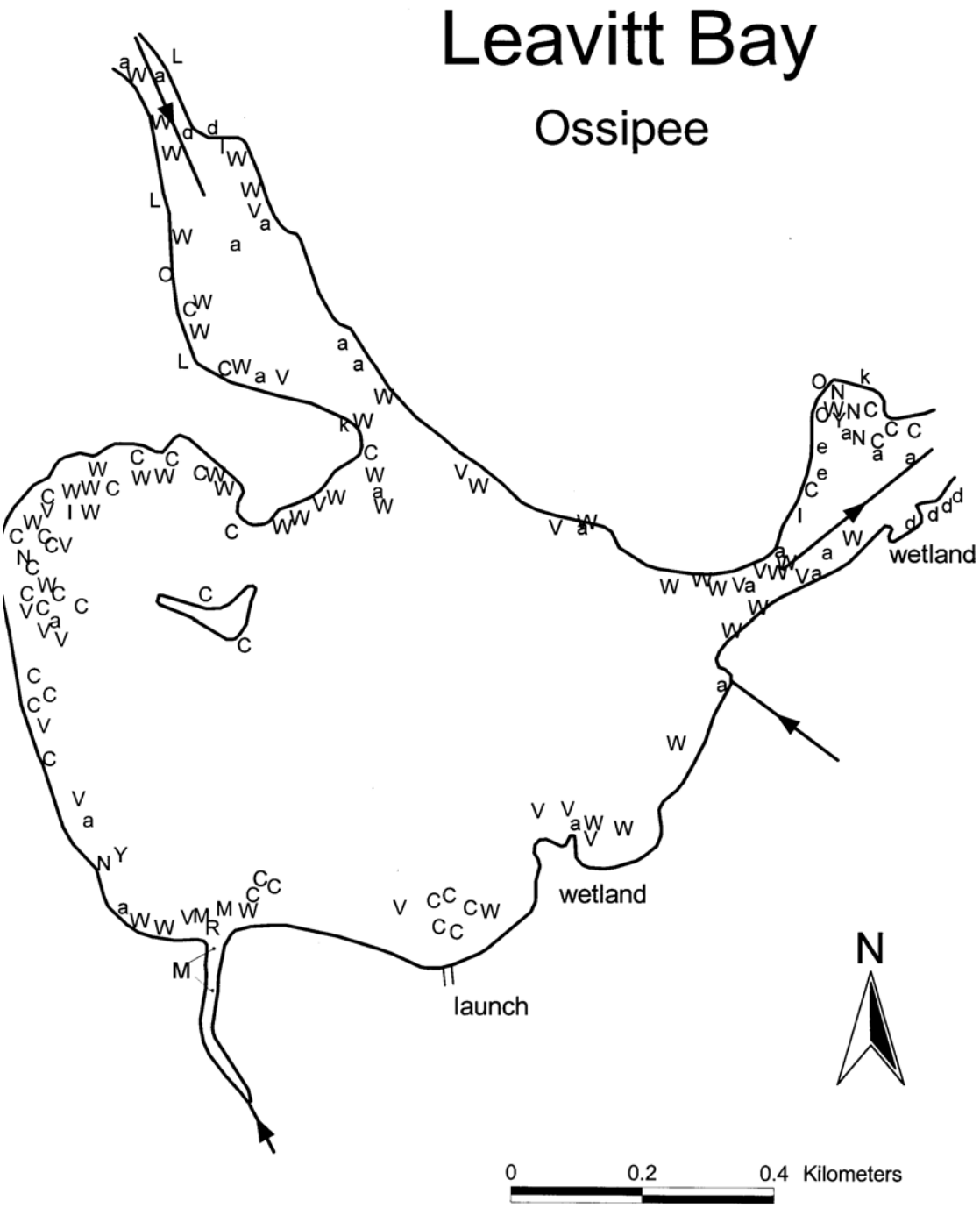
LAKE: OSSIPEE LAKE		TOWN: OSSIPEE	DATE: 8/13/03
KEY	PLANT NAME		ABUNDANCE
	GENERIC	COMMON	
J	Juncus	Rush	Scattered
F	Nymphoides cordatum	Floating heart	Scattered
Y	Nuphar	Yellow water lily	Sparse
W	Potamogeton	Pondweed	Scattered
S	Sparganium	Bur reed	Sparse
N	Nymphaea	White water lily	Sparse
B	Brasenia schreberi	Water shield	Sparse
P	Pontederia cordata	Pickerelweed	Sparse
C	Cyperaceae	Non-flowering sedge	Sparse
b	Scirpus	Bulrush	Sparse
d	Dulichium arundinaceum	Three-way sedge	Sparse
A	Sagittaria	Arrowhead	Sparse
g	Polygonum	Smartweed	Sparse

Figure 2b- Aquatic Vegetation Map and Key (Broad Bay)



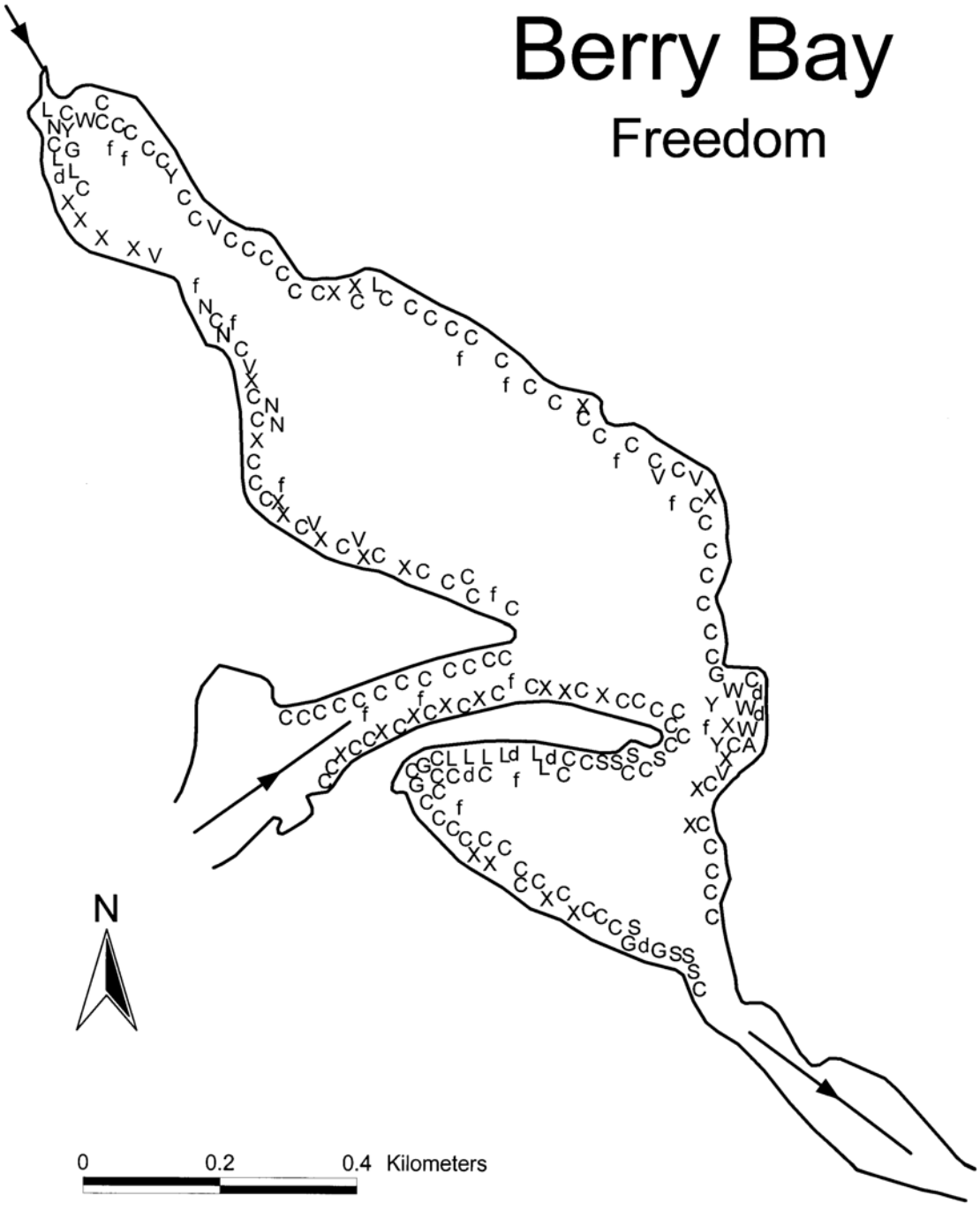
LAKE: BROAD BAY		TOWN: OSSIPEE	DATE: 8/11/03
KEY	PLANT NAME		ABUNDANCE
	GENERIC	COMMON	
e	Eleocharis	Spike rush	Scattered
W	Potamogeton	Pondweed	Scattered
A	Sagittaria	Arrowhead	Sparse
N	Nymphaea	White water lily	Scattered
Y	Nuphar	Yellow water lily	Sparse
X		Bottom growth	Scattered
S	Sparganium	Bur reed	Scattered
U	Utricularia	Bladderwort	Sparse
P	Pontederia cordata	Pickerelweed	Sparse
C	Cyperaceae	Non-flowering sedge	Scattered
B	Brasenia schreberi	Water shield	Sparse
T	Typha	Cattail	Sparse
M	Myriophyllum heterophyllum	Water milfoil	Scattered

Figure 2c- Aquatic Vegetation Map and Key (Leavitt Bay)



LAKE: LEAVITT BAY		TOWN: OSSIPEE	DATE: 7/30/03
KEY	PLANT NAME		ABUNDANCE
	GENERIC	COMMON	
e	Eleocharis	Spike rush	Sparse
I	Isoetes	Quillwort	Sparse
d	Dulichium arundinaceum	Three-way sedge	Sparse
O	Cephalanthus occidentalis	Buttonbush	Sparse
L	Lysimachia terrestris	Swampcandle	Sparse
k	Carex	Sedge	Sparse
C	Cyperaceae	Non-flowering sedge	Scattered
U	Utricularia	Bladderwort	Scattered
Y	Nuphar	Yellow water lily	Sparse
N	Nymphaea	White water lily	Sparse
M	Myriophyllum heterophyllum	Water milfoil	Sparse
V	Vallisneria americana	Tape grass	Scattered
R	Potamogeton robbinsii	Robbins pondweed	Sparse
W	Potamogeton spp.	submerged pondweed	Scattered
a	Potamogeton amplifolius	Bass weed	Scattered
F	Nymphoides cordatum	Floating heart	Sparse
f	Potamogeton spp.	pondweed w/ floating leaf	Sparse
S	Sparganium	Bur reed	Sparse
		Filamentous algae	Scattered

Figure 2d- Aquatic Vegetation Map and Key (Berry Bay)



LAKE: BERRY BAY		TOWN: FREEDOM	DATE: 8/6/03
KEY	PLANT NAME		ABUNDANCE
	GENERIC	COMMON	
C	Cyperus	Sedge	Scattered
X		Sterile thread-like leaf	Scattered
V	Vallisneria americana	Tape grass	Scattered
N	Nymphaea	White water lily	Sparse
L	Lysimachia terrestris	Swampcandle	Sparse
d	Dulichium arundinaceum	Three-way sedge	Sparse
G	Gramineae	Grass family	Sparse
Y	Nuphar	Yellow water lily	Sparse
W	Potamogeton	Pondweed	Sparse
A	Sagittaria	Arrowhead	Sparse
S	Sparganium	Bur reed	Sparse
f		Filamentous algae	Scattered

Figure 3a- Bathymetric Map (Ossipee Lake System)

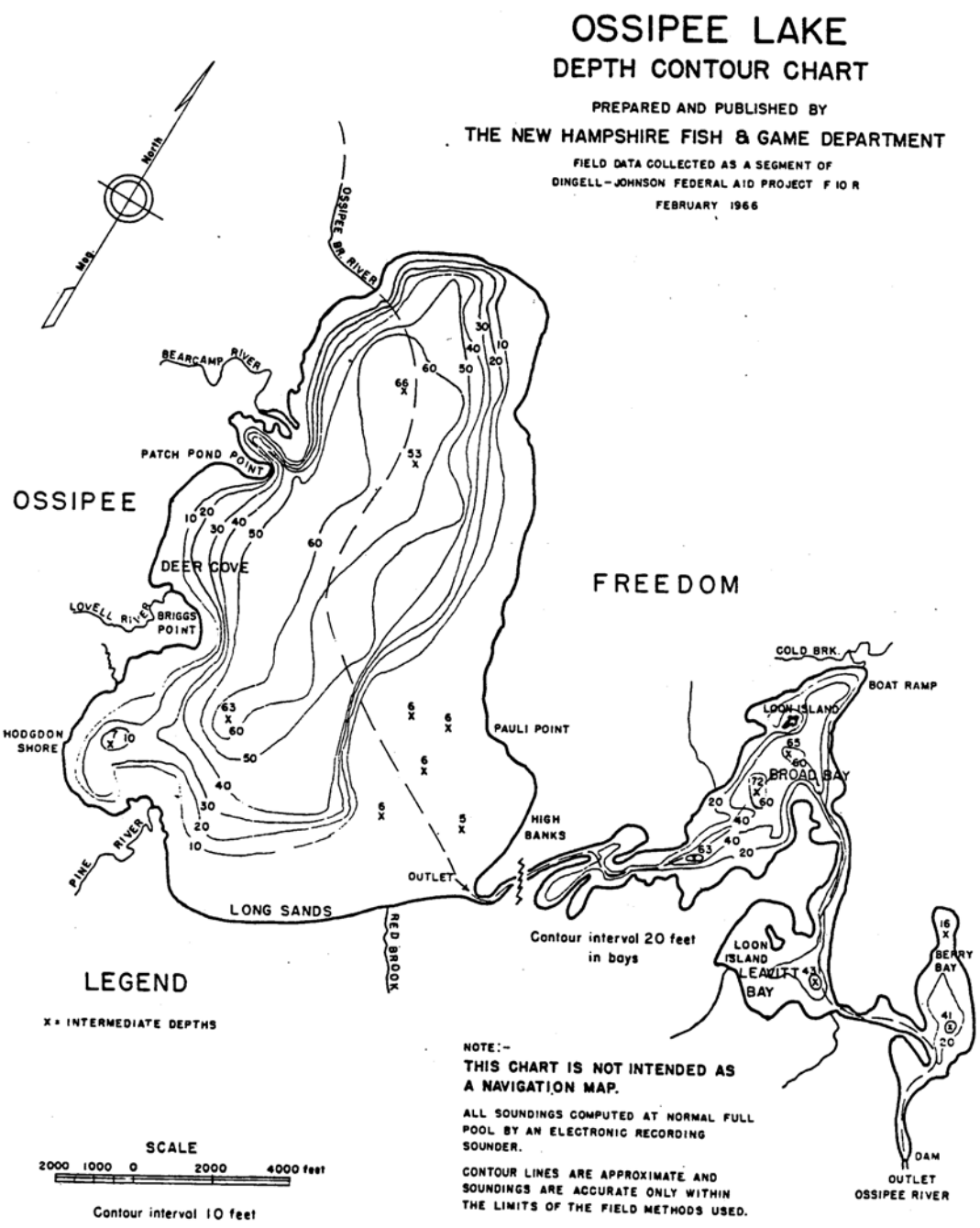


Figure 3b- Bathymetric Map (Broad Bay)

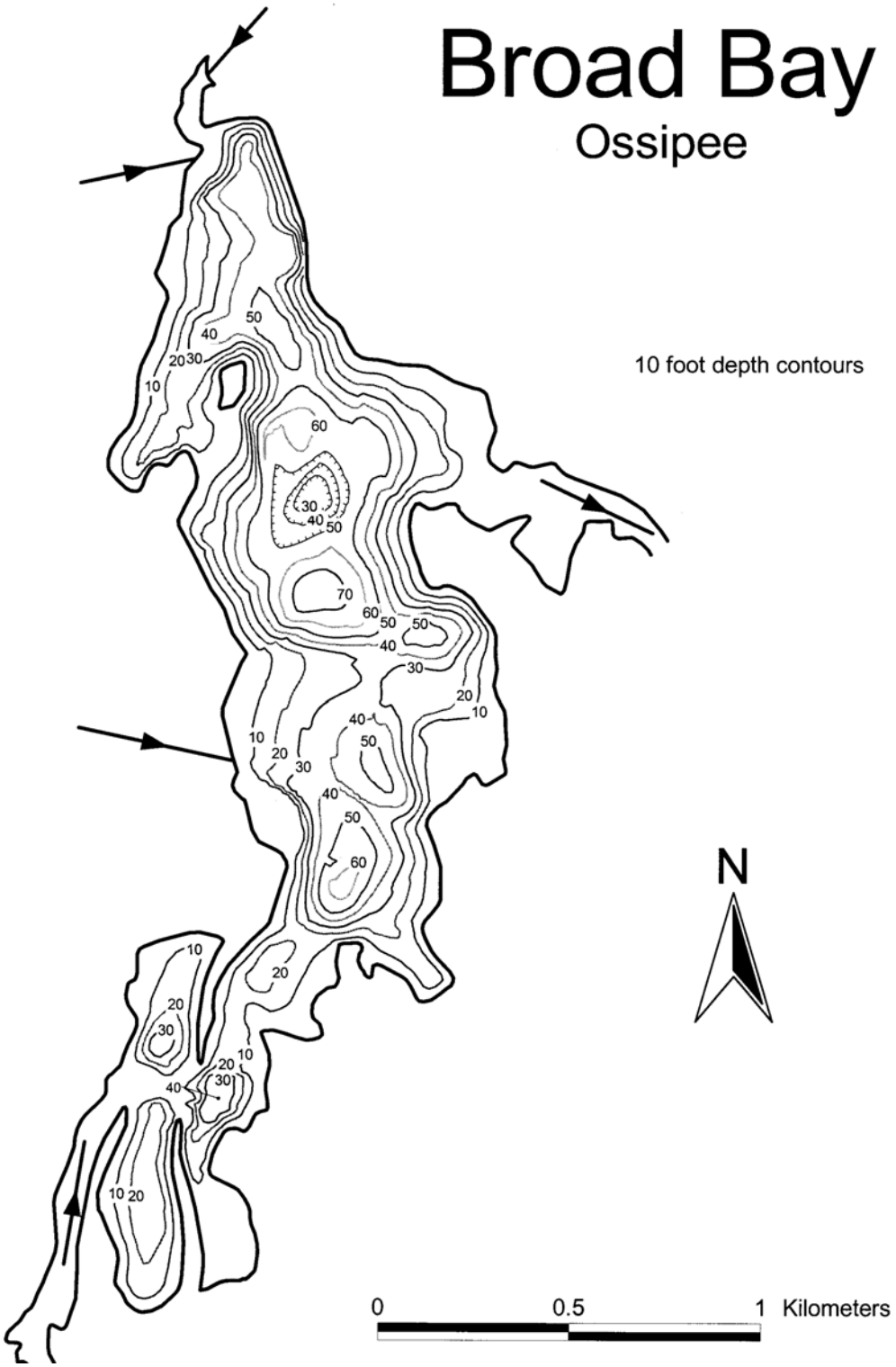


Figure 3c- Bathymetric Map (Leavitt Bay)

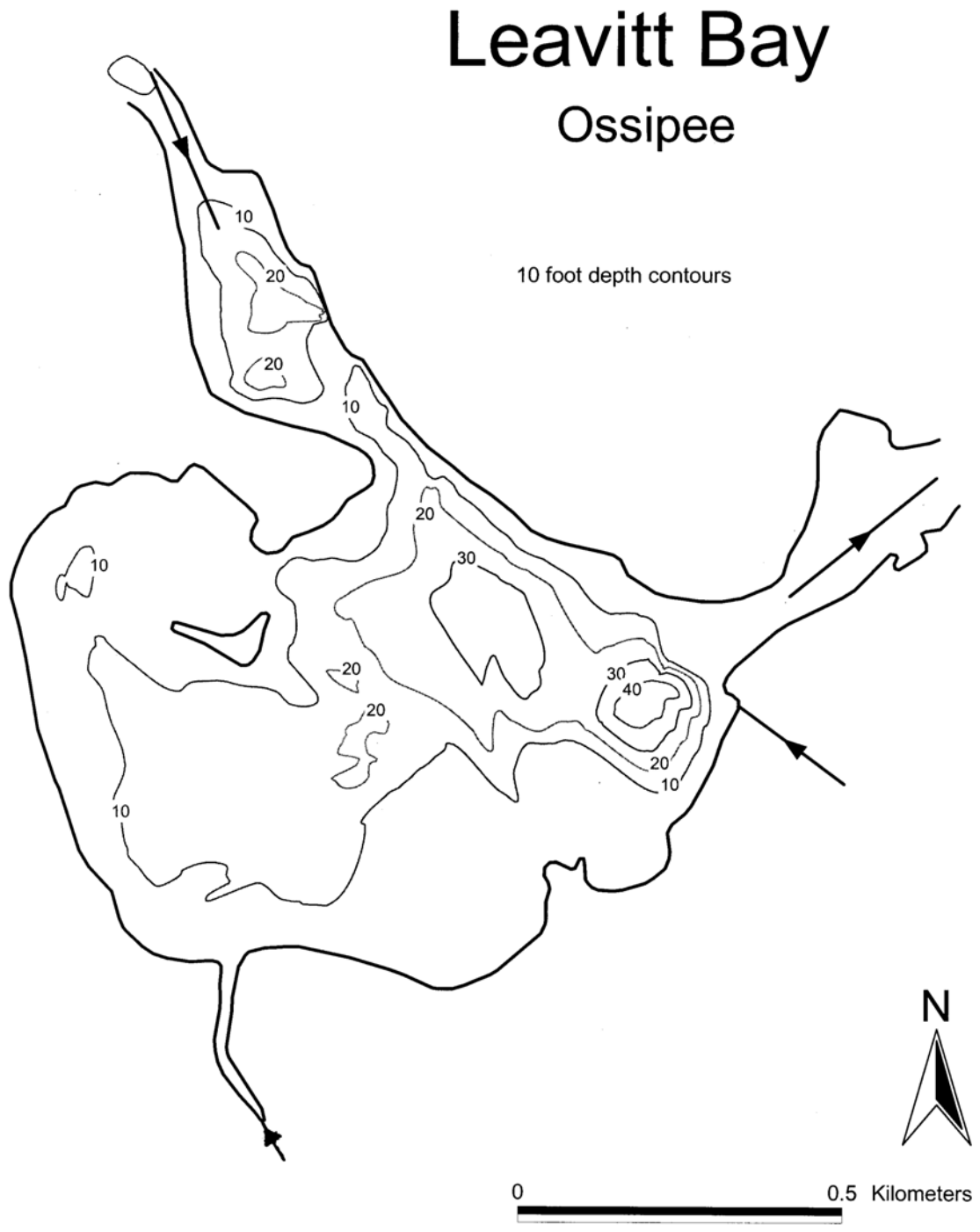


Figure 3d- Bathymetric Map (Berry Bay)

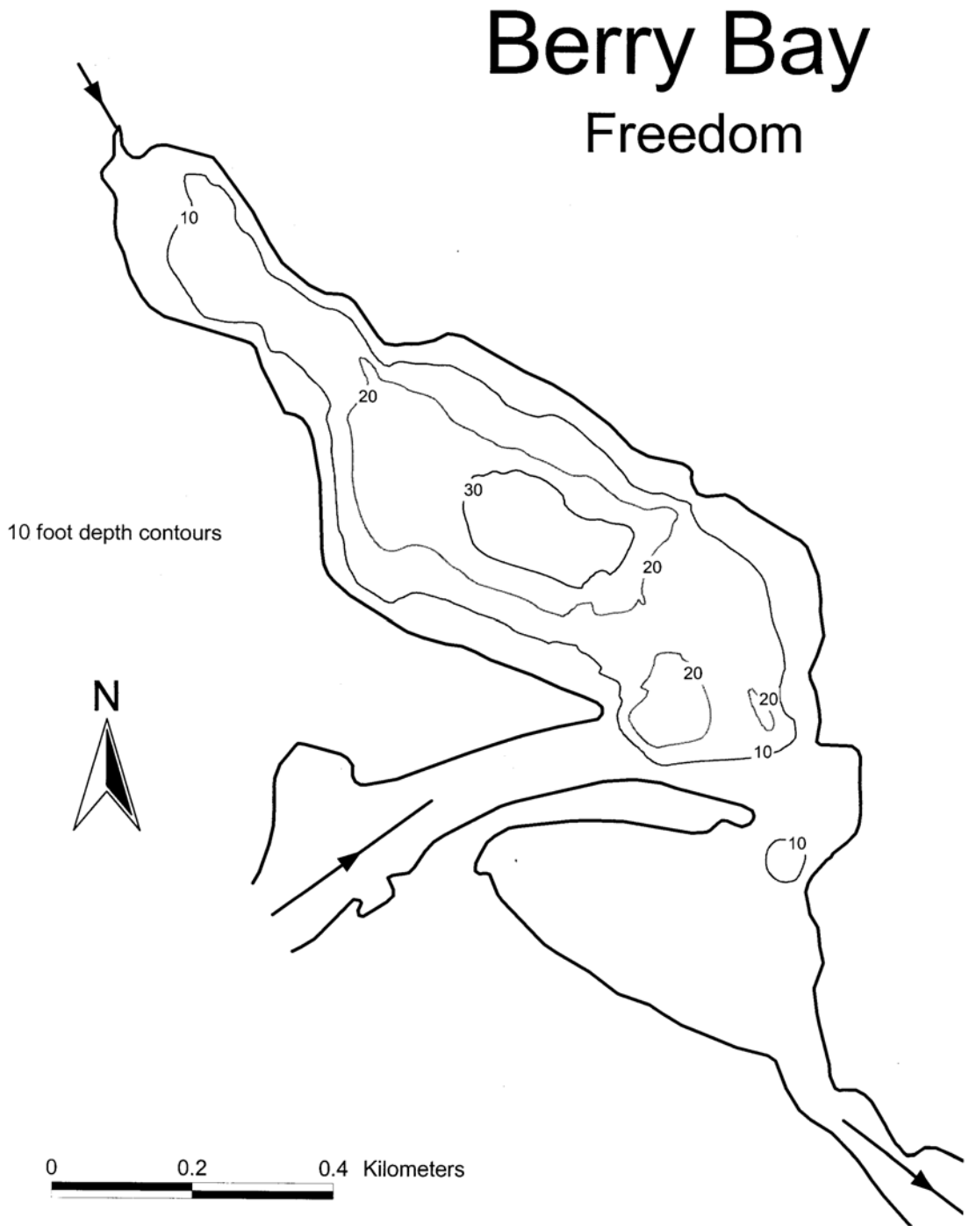


Figure 4- Ossipee Lake System Designated Beaches and Access Sites

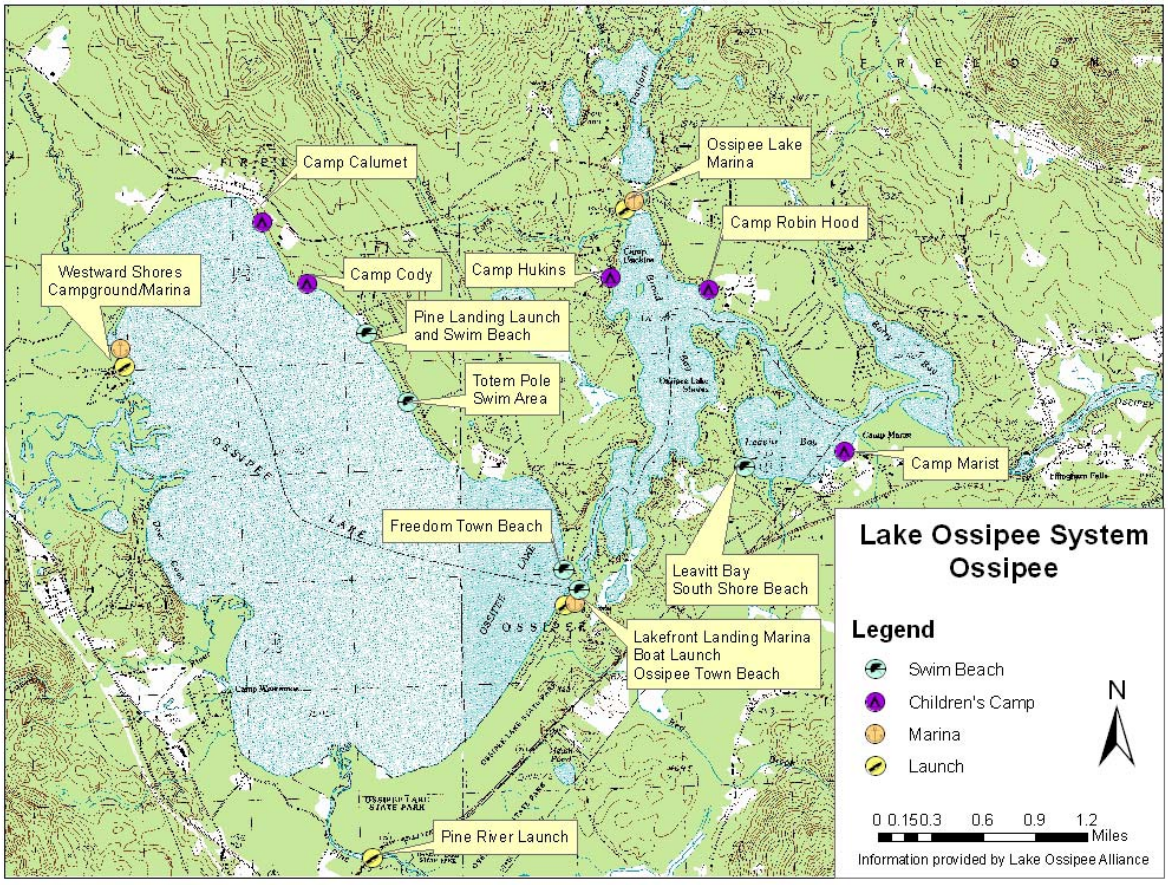
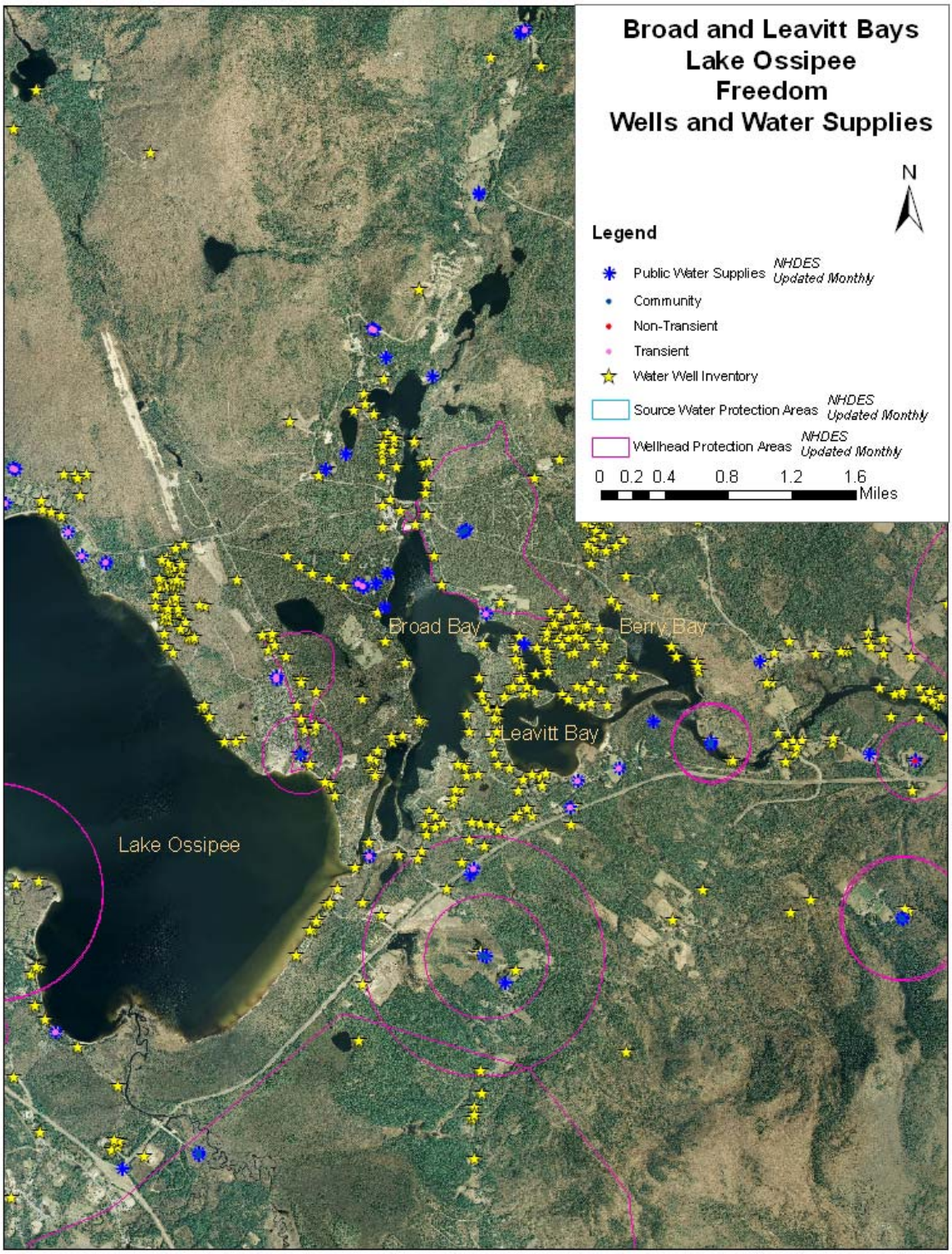


FIGURE 5- WELLS AND WATER SUPPLIES



APPENDIX A

CRITERIA TO EVALUATE THE SELECTION OF AQUATIC PLANT CONTROL TECHNIQUES

Preliminary Investigations

I. Field Site Inspection

- Verify genus and species of the plant.
- Determine if the plant is a native or exotic species per RSA 487:16, II.
- Map extent of the plant infestation (area, water depth, height of the plant, density of the population).
- Document any native plant abundances and community structure around and dispersed within the exotic/nuisance plant population.

II. Office/Laboratory Research of Waterbody Characteristics

- Contact the appropriate agencies to determine the presence of rare or endangered species in the waterbody or its prime wetlands.
- Determine the basic relevant limnological characteristics of the waterbody (size, bathymetry, flushing rate, nutrient levels, trophic status, and type and extent of adjacent wetlands).
- Determine the potential impacts to downstream waterbodies based on limnological characteristics (water chemistry, quantity, quality).

Overall Control Options

For any given waterbody that has an infestation of exotic plants, one of three options will be selected, based on the status of the infestation, the available management options, and the technical knowledge of the DES Limnologists who have conducted the field work and who are preparing this plan. The options are as follows:

1) Eradication: Herbicide application targeted at exotic aquatic plant to be eradicated, to either eradicate the plant or to reduce overall biomass to a point where alternative non-chemical strategies may be used. This action will be followed by thorough annual monitoring for regrowth and the use of non-chemical actions to achieve the eradication.

2) Containment: The aim of this approach is to limit the size and extent of the existing infestation. An herbicide application may be used to reduce specified areas down to a percent cover of the exotic species so that it can be maintained or contained with alternative management strategies, including Restricted Use Areas, benthic barriers, and others. Subsequent herbicide applications may be necessary if the target species shows exponential growth and further spread.

3) No action. If the infestation is too large, spreading too quickly, and past management strategies have proven ineffective at controlling the target exotic aquatic plant, DES, in consultation with others, may elect to recommend 'no action' at a particular site. All efforts will instead be made towards containment of the target species to that specific waterbody, so that downstream migration of the plant can be prevented.

If eradication or control is the recommended option to pursue, the following series of control techniques may be employed. The most appropriate technique based on the determinations of the preliminary investigation will be selected.

Guidelines and requirements of each control practice are detailed below each alternative.

A. Hand-Pulling

- Can be used for exotic or native species.
- Can be used if infestation is in a small localized area (sparsely populated patch of up to 5' X 5', single stems, or dense small patch up to 2' X 2').
- Can be used if plant density is low, or if target plant is scattered and not dense.
- Can be used if the plant could effectively be managed or eradicated by hand-pulling a few scattered plants.
- Use must be in compliance with the Wetlands Bureau rules.

B. Mechanically Harvest or Hydro-Rake

- Can not be used on plants which reproduce vegetatively by fragmentation (e.g., milfoil, fanwort, etc.) unless containment can be ensured.
- Can be used only if the waterbody is accessible to machinery.
- Can be used if there is a disposal location available for harvested plant materials.
- Can be used if plant depth is conducive to harvesting capabilities (~ <7 ft. for mower, ~ <12 ft. for hydro-rake).
- Funds are available for repeated harvesting activities in that season.
- A navigation channel is required through dense plant growth.

C. Chemical Treatment

- Can be used if application of chemical is conducted in areas where alternative control techniques are not optimum due to depth, current, use, or type of plant.
- Can be used for treatment of exotic plants where fragmentation is a high concern.
- Can be used where species specific treatment is necessary due to the need to manage other plants (rare or endangered that will not be impacted by chemical treatment).
- Can be used if other methods used as first choices in the past have not been effective.
- A licensed applicator should be contacted to inspect the site and make recommendations about the effectiveness of chemical treatment as compared with

other treatments.

D. Restricted Use Areas (per RSA 487:17, II (d))

- Can be used for exotic species only.
- Can be established in an area that effectively restricts use to a small cove, bay, or other such area where navigation, fishing, and other activities may cause fragmentation to occur.
- Can not be used when there are several "patches" of an infestation of exotic aquatic plants throughout a waterbody.
- Can be used as a temporary means of control.

E. Bottom Barrier

- Can be used for exotic or native species.
- Can be used in small areas, preferably less than 10,000 sq. ft.
- Can be used in an area where the current is not likely to cause the displacement of the barrier.
- Can be used early in the season before the plant reaches the surface of the water.
- Can be used in an area to compress plants to allow for clear passage of boat traffic.
- Can be used in an area to compress plants to allow for a clear swimming area.

F. Drawdown

- Can be used if the target plant(s) are susceptible to drawdown control.
- Can be used in an area where bathymetry of the waterbody would be conducive to an adequate level of drawdown to control plant growth, but where extensive deep habitats exist for the maintenance of aquatic life such as fish and amphibians.
- Can be used where plants are growing exclusively in shallow waters where a drawdown would leave this area "in the dry" for a suitable period of time (over winter months) to control plant growth.
- Can be used in winter months to avoid encroachment of terrestrial plants into the aquatic system.
- Can be used if it will not significantly impact adjacent or downstream wetland habitats.
- Can be used if spring recharge is sufficient to refill the lake in the spring.
- Can be used in an area where shallow wells would not be significantly impacted.
- Reference RSA211:11 with regards to drawdown statutes.

G. Dredge

- Can be used in conjunction with a scheduled drawdown.
- Can be used if a drawdown is not scheduled, though a hydraulic pumping dredge should be used.

- Can only be used as a last alternative due to the detrimental impacts to environmental and aesthetic values of the waterbody.

H. Biological Control

- Grass carp cannot be used.
- Exotic controls, such as insects, cannot be introduced to control a nuisance plant.
- Research should be conducted on a potential biological control prior to use to determine the extent of host specificity.

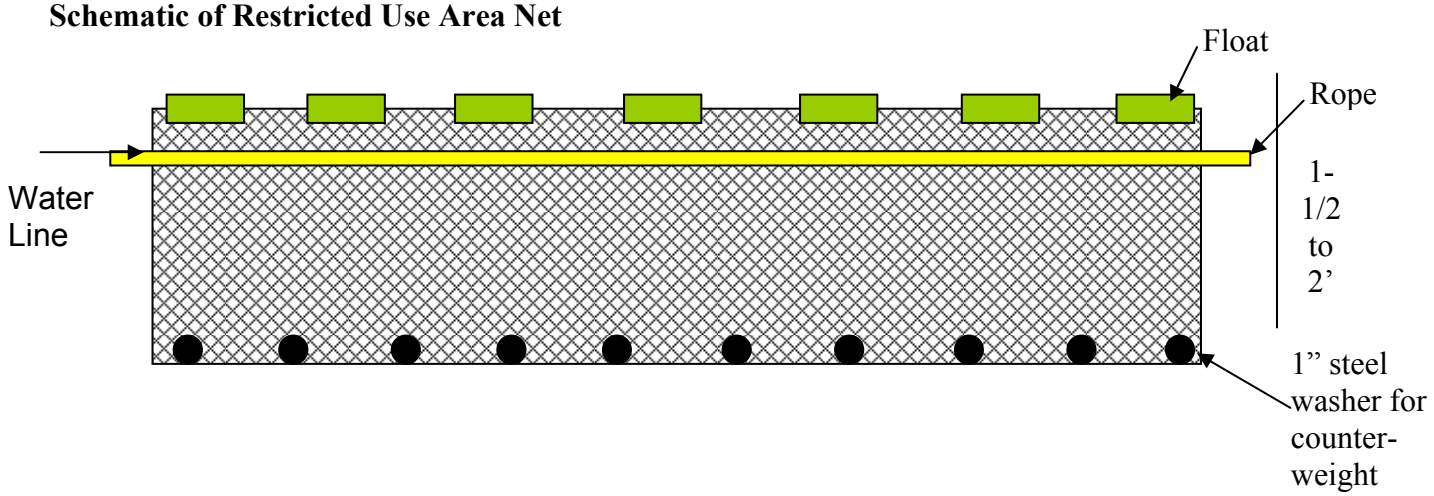
APPENDIX B

SUMMARY OF CONTROL PRACTICES USED IN THE STATE OF NEW HAMPSHIRE FOR EXOTIC AQUATIC PLANTS

Restricted Use Areas:

Restricted Use Areas (RUAs) are a regular control option for lakes with small, contained infestations of exotic plants, limited to small patches or embayments. This is often the case in waterbodies with newly-discovered infestations. RUAs restrict access to all recreational activities in a delineated area to minimize plant fragmentation and thereby reduce the spread of milfoil. As an additional method of protection from fragment migration, RUAs are encircled with a shallow net that is suspended vertically in the water column. The net is approximately 1.5-2.0 feet in height. The top of the net is set to extend four inches above the surface of the water, while the remainder is positioned below the surface of the water (see figure below). This configuration prevents the movement of fragments from infested areas to uninfested areas. Due to the size and nature of net construction, there is no impediment to fish migratory patterns or spawning activities.

Schematic of Restricted Use Area Net



Hand-pulling:

When infestations of exotic aquatic plants begin as single scattered stems or small patches, DES biologists SCUBA dive to hand-pull the plants (and DES can train other certified divers to also perform this management practice). Guidelines for determining feasibility and effectiveness for hand-removal are site specific, but generally sparsely populated patches of up to 5' X 5', single stems, or dense small patch up to 2' X 2' are reasonable.

The whole plant including the roots should be removed in this process, while leaving the beneficial native species intact. This technique works best in softer sediments, with shallow rooted species and for smaller, scattered infestation areas. When hand pulling nuisance species, the entire root system and all fragments of the plants must be collected since small root or stem fragments could result in additional growth of the species. The process must be repeated often to control re-growth of the exotic plants. For a new infestation, hand-pulling activities are typically

conducted several times during the first season, with follow-up inspections for the next 2-5 years or until no re-growth is observed. This control practice has proven successful in many waterbodies.

Diver Assisted Suction Harvesting

Diver Assisted Suction Harvesting (DASH) is a method whereby a diver works to hand remove exotic plants from the bottom sediments, and rather than depositing them into a dive bag for containment, they are fed into a suction tube that brings the materials topside for containment, de-watering, and disposal. This method can allow for larger-scale removal projects and potentially lower turbidity than simple diving and hand-removal with a dive bag.

Generally, the DASH unit is comprised of a floating platform that is set up with a suction pump and associated hoses, and some type of catchment basin that is lined with fine mesh net to entrain the plants and to filter the water through and back into the lake.

A team comprised of one or two divers and one or two topside tenders are needed to operate the DASH unit.

Mechanical Harvesting

The process of mechanical harvesting is conducted by using machines which cut and collect aquatic plants. These machines can cut the plants up to twelve feet below the water surface. The weeds are cut and then collected by the harvester or other separate conveyer-belt driven device where they are stored in the harvester or barge, and then transferred to an upland site.

The advantages of this type of weed control are that cutting and harvesting immediately opens an area such as boat lanes, and it removes the upper portion of the plants. Due to the size of the equipment, mechanical harvesting is limited to water areas of sufficient size and depth. It is important to remember that mechanical harvesting can leave plant fragments in the water, which if not collected, may spread the plant to new areas. Additionally harvesters may impact fish and insect populations in the area by removing them in harvested material. Cutting plant stems too close to the bottom can result in re-suspension of bottom sediments and nutrients. This management option is only recommended when nearly the entire waterbody is infested, and harvesting is needed to open navigation channels through the infested areas.

Benthic Barriers (a.k.a. bottom barriers):

When a small infestation of exotic aquatic plants occurs in clusters of growth (generally areas >5 sq. ft.), as opposed to scattered stems, a permeable fiberglass screen can be placed over the area of infested lake sediments. The permeable fabric screening allows for gas release from the sediments while effectively blocking sunlight and compressing the plants into the sediment, inhibiting photosynthesis and eventually killing the plant. Occasionally, in some lakes, gas release from the sediments or boating activity cause the uplifting of screening. Benthic barriers can effectively control small infestations of less than approximately 10,000 square feet.

Benthic barriers have two basic applications. These practices are used to cover pioneering infestations and prevent the spread of the plant. Bottom barriers are installed across small portions of lake bottoms infested with invasive aquatic plants. The disadvantage of benthic barriers is their non-selectivity and limitation of cover to less than 10,000 square feet. Additionally, these physical barriers prevent the growth of all vegetation, which is a necessary component of fish and wildlife habitat.

Bottom barriers are attached to the bottom of a water body by re-bar attached to the edges and across the middle of the material. Bottom barriers are transported to the shoreline adjacent to where installation is to occur. They are then cut to fit the treatment site and rolled onto a length of pipe. Divers carry the roll into the water at the start of the treatment site and secure one edge of the material to the lake bottom. The divers then roll out the remainder of the material and continue to secure it to the bottom sediments. This process is repeated until the plants in the treatment are covered.

Bottom barriers are generally considered for small localized areas rather than lakewide application. Bottom barriers provide 100% control of this weed in areas where they are installed. They also provide long-term control. An ongoing maintenance operation is required to inspect the bottom barrier and clear the mats of sediment buildup.

Benthic barriers are not recommended for application in river systems, as flow can easily uplift the barrier.

Targeted Application of Herbicides:

The use of chemicals, such as herbicides, for the control of noxious and nuisance plant species represents one of the most widely known and effective management options available. Herbicide control of invasive aquatic plants is often the first step in a long-term integrated control program. In the last 15 to 20 years the use and review of herbicides has changed significantly in order to accommodate safety, health, and environmental concerns. Currently no herbicide product can be labeled for aquatic use if it has more than a one in a million chance of causing significant harmful effects to human health, wildlife, or the environment. Because of this, the number of effective and U.S. Environmental Protection Agency (EPA) approved herbicides for aquatic weeds are limited. In most cases the cost and time of testing and registration, rather than environmental issues, limits the number of potentially effective compounds.

All herbicide applications in New Hampshire are performed under permits issued by the New Hampshire Department of Agriculture, Division of Markets and Food, Bureau of Pesticide Control.

Two herbicides have been used in New Hampshire for the control of milfoil. Diquat (trade name Reward), the most often-used herbicide, is a contact herbicide that can generally provide one season of control for milfoil. Because this herbicide does not target the root systems, the plants eventually re-grow from established roots.

The second herbicide, 2,4-D (trade name Navigate or Aqua Kleen), is a systemic herbicide. It is absorbed into the sediments and taken up through the root system, killing both the roots and the plant biomass above the sediments.

The aquatic herbicide SONAR has been used in New Hampshire to control growths of fanwort. The chemical acts by limiting photosynthesis when chlorophyll-a is affected by the active ingredient of the herbicide.

Extended Drawdown

Water drawdown is used for control of some species of aquatic macrophytes. Drawdown requires some type of mechanism to lower water levels, such as dams or water control structures and use is thus limited. It is most effective when the drawdown depth exceeds the depth or invasion level of the target plant species.

In northern areas, drawdown will result in plant and root freezing during the winter for an added degree of control. Drawdown is typically inexpensive and has intermediate effects (2 or more years). However, drawdown can have other environmental effects and interfere with other functions of the water body (e.g. drinking water, recreation, or aesthetics). Drawdown can result in the rapid spread of highly opportunistic annual weed species, which in most cases is the plant that is targeted for control.

Drawdowns have been used in the past for plant control. In theory, the drying of the plants in the summer, or the freezing of the plants in the winter, will eliminate or limit plant growth. However, milfoil often forms a more succulent terrestrial form during drawdown conditions and the succulent form of the plant can remain viable for long periods of time without submergence, making the practice ineffective. This strategy can be used for control of some native plant species.

Dredging

Dredging is a means of physical removal of aquatic plants from the bottom sediments using a floating or land-based dredge. Dredging can create a variety of depth gradients creating multiple plant environments allowing for greater diversity in plant, fish, and wildlife communities. However due to the cost, potential environmental effects, and the problem of sediment disposal, dredging is rarely used for control of aquatic vegetation alone.

Dredging can take place in two fashions, including drawdown followed by mechanical dredging using an excavator, or using a diver-operated suction dredge while the water level remains up.

Biological Control

There are no approved biological controls for submersed exotic aquatic plant at this time in New Hampshire.

APPENDIX C
RARE, THREATENED, AND ENDANGED SPECIES AND AREAS OF CONCERN WITHIN OSSIPEE LAKE (provided by the NH Natural Heritage Program)

Wildlife			
purple martin	SC	Ossipee Lake, NW shore	
spotted turtle	T	Heath Pond Bog	
Exemplary Natural Communites and Systems			
Sandy pond shore system	--	Ossipee Lake Natural Area	
Twig-rush sandy turf pond shore	--	Ossipee Lake Natural Area	
Sweet gale - speckled alder shrub thicket	--	Ossipee Lake Natural Area	
Bulblet umbrella-sedge open sandy pond shore	--	Ossipee Lake State Park	
Hudsonia inland beach strand	--	Ossipee Lake	
Kettle hole bog system	--	Broad Bay / Leavitt Bay, between	
Poor level fen/bog system	--	Pine River, east of	
Medium level fen system	--	Ossipee Lake, south of	
Temperate minor river floodplain system	--	Pine River	
Plant Species			**Habitat Comments**
Asclepias amplexicaulis (Blunt-leaved Milkweed)	T	Ossipee Lake	sandy pond shore
Euthamia caroliniana (Grassleaf Goldenrod)	E	Ossipee Lake	sandy pond shore
Betula pumila (Swamp Birch)	E	Ossipee Lake, south of	medium level fen system
Hudsonia ericoides (Golden Heather)	T	Ossipee Lake	sandy pond shore
Hudsonia tomentosa var. intermedia (Hairy Hudsonia)	T	Ossipee Lake Natural Area	sandy pond shore
Lupinus perennis (Wild Lupine)	T	Ossipee Lake	sandy pond shore
Bartonia iodandra (Purple screwstem)	--	Ossipee Lake	wet peat and sand
Proserpinaca pectinata (Mermaidweed)	E	Ossipee Lake Natural Area	aquatic and bog
Eleocharis tuberculosa (Tubercled Spike-rush)	E	Ossipee Lake, south shore	wet peat and sand
Eriophorum angustifolium (Narrow-leaved Cotton-grass)	E	Heath Pond Bog	poor level fen/bog system
Rhynchospora capillacea (Needle Beak Sedge)	E	Robbins Cove, Berry Bay	fen or bog
Panicum rigidulum ssp. pubescens (Long-leaved Panic Grass)	E	Robbins Cove, Berry Bay	fen, bog, or seep
Potamogeton nodosus (Knotty Pondweed)	E	Pine River	aquatic
Potamogeton pusillus ssp. gemmiparus (Budding Pondweed)	E	Bearcamp River Cove	aquatic
Potamogeton pusillus ssp. gemmiparus (Budding Pondweed)	E	Leavitt Bay Stream	aquatic
Isoetes lacustris (Large-spored Quillwort)	E	Deer Cove	aquatic
Lycopodiella appressa (Slender Bog Clubmoss)	E	Ossipee Lake Natural Area	bog or twig-rush community

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