Long-Term Variable Milfoil Management and Control Plan for LAKE POTANIPO Brookline, New Hampshire Hillsborough County

Prepared by: New Hampshire Department of Environmental Services (DES),
in consultation with the
New Hampshire Fish and Game Department (F&G)
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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. 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 Lake Potanipo in Brookline, New Hampshire in 2002. Since this time, variable milfoil has become dense in several locations of shallow shoreline habitat around the pond. Figure 1 illustrates the distribution of variable milfoil infestations in this waterbody.

Following is a summary of each area indicated in Figure 1:

Area 1- Located at the southern end of the lake, Area 1 covers 19.82 acres. Variable milfoil grows in dense clumps throughout this stretch of shoreline, and is present at about 50% cover.

Area 2- This infestation covers the northwestern shoreline and part of an inlet located in the northwest corner of the lake. The area covers approximately 10.17 acres, and variable milfoil is present at a 50%-65% cover level.

Area 3- This area is located on the northeast shoreline near a children's camp. It covers an area of approximately 8.87 acres with variable milfoil present at approximately 65% cover in this zone.

In terms of the impacts of the variable milfoil in the system, there are several (27) houses around the shoreline of Lake Potanipo, with mostly seasonal cottages, though there are a few year-round

dwellings. There is also one large (500 acres) back lot with lake rights. Many of these lots abut areas of dense variable milfoil growth, particularly in Area 1. Areas 1 and 3 encompass documented swimming areas and Area 1 abuts a public access ramp. Area 2 is a location that receives a lot of fishing activity, and thus possible means of fragmenting and further spreading the variable milfoil.

Lake residents have expressed frustration with the exotic plant growth, citing fouling of their swim beaches, swim impairments, and concerns about the whole pond being choked with the invasive plant. Additionally, the children's camp (Camp Tevya is located on the shoreline along Area 3) has cited use impairments of the swim area, and concerns about child entanglement in dense variable milfoil growth areas.

The invasive plant infestation in this pond has increased exponentially in the past years, with only a few rooted plants found in 2002. DES biologists predict that in less than 10 years the entire littoral zone of the pond will be dominated by variable milfoil. As the infestation continues to expand, rhizomatous growth and fragments will continue to expand the infested areas at an increasingly faster rate/

PURPOSE

In August 2007, the Town of Brookline requested matching funds from the Department of Environmental Services to conduct an aquatic plant control project during the spring of 2008 to control areas infested with variable milfoil.

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 Lake Potanipo and the social and ecological impacts of the milfoil infestation. The intent of this strategic plan is to eradicate variable milfoil from Lake Potanipo over time through the use of Integrated Pest Management Strategies (IPM). 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 aquatic plant management plan for Lake Potanipo outlines actions to eradicate variable milfoil (*Myriophyllum heterophyllum*, referred to as "variable milfoil" in this plan) while

maintaining native plant communities whenever variable milfoil control actions are being implemented.

The goal for Lake Potanipo is the eventual eradication of variable milfoil from the system using an Integrated Pest Management Approach. To achieve this goal, we recommend the following:

1) To reduce the overall acreage and percent cover of variable milfoil in Area 1 from 19.82 acres and 50% cover in 2008, with the use of 2,4-D, to less than 2 acres and 20% cover,. to allow for the integration of non-herbicide approaches to control variable milfoil.

2) To reduce the overall acreage and percent cover of variable milfoil in Area 2 from 10.17 acres and 50-65% cover to less than 1 acre and 20% cover with the use of 2,4-D in 2008.

3) To reduce the overall acreage and percent cover of variable milfoil in Area 3 from 8.87 acres and 65% cover to less than 5 acre and 15% cover with the use of 2,4-D in 2008.

4) An herbicide treatment in 2010 is also recommended if needed to follow up on the 2008 treatment. The summer of 2009 will be spent monitoring re-growth and coordinating non-chemical control option.

To maintain a Weed Watcher program and Lake Host Program for the pond.

Town Support

The Town of Brookline has been very supportive of variable milfoil control efforts in Lake Potanipo. This is one of two (Melendy Pond is the other) infested waterbodies in the town at this point, and the town officials recognize the need to protect other nearby waterbodies.

The town has been supportive financially by offering matching funds for herbicide applications, including a proposal for matching funds in 2008 and future years for herbicide applications and diver time.

Lake Potanipo Association Support

Lake Potanipo residents are working to form a group of volunteers that can serve as Weed Watchers on the lake. DES will provide training and technical support for the newly formed group.

WATERBODY CHARACTERISTICS

The following table summarizes basic physical and biological characteristics of Lake Potanipo.

General Lake Information	
Lake area (acres)	169.9
Watershed area (acres)	15,481.5
Shoreline Uses (residential, forested, agriculture)	Residential, forested, children's camp
Max Depth (ft)	25.1

Mean Depth (ft)	13.5
Trophic Status	Mesotrophic
Color (CPU) in Epilimnion	22
Clarity (ft)	10.9
Flushing Rate (yr^{-1})	10.7
Natural waterbody/Raised by Damming/Other	Natural / Dam
Plant Community Information Relative to Management	
Invasive Plants (Latin name)	*Myriophyllum heterophyllum*
Infested Area (acres)	Approximately 39 acres
Distribution (ringing lake, patchy growth, etc)	Three major areas along the northern and southern shorelines. Four small points of sparse growth north of area 1 as denoted in Figure 1.
Sediment type in infested area (sand/silt/organic/rock)	Sandy/organic/silty
Rare, Threatened, or Endangered Species in Waterbody (according to NH Natural Heritage Inventory)	Brook floater (Endangered) Fern-leaved false foxglove (Threatened) Banded Sunfish (no listing)
Area of Littoral Zone (acres)	77.6
Area of Profundal Zone (acres)	61.3
Area of Macrophyte Coverage (native or otherwise) of Plants in Littoral Zone	46.6
% of Littoral Zone with Macrophyte Cover	60
% of Macrophyte cover comprised of invasives	83
% of Littoral Zone with Variable Milfoil Cover	50

An aquatic vegetation map and key from an August 16, 2007 survey by the DES Biology Section is shown in Figure 2. A bathymetric map is shown in Figure 3.

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

Lake Potanipo is managed for warmwater species under general regulations. Fish species present include chain pickerel, largemouth bass, golden shiner, yellow perch, bluegill, common white sucker, black crappie, rainbow trout, brook trout, brown trout, brown bullhead, yellow bullhead and pumpkinseed.

Fishing pressure is heavy in this pond, in addition to heavy recreational boat use. Most areas of the pond are used for fishing, particularly the northern and northeastern portions. Some of the areas indicated as prime fishing habitat by local fishing enthusiasts do fall within zones that are heavily impacted by variable milfoil growth (particularly Area 2 and 3 in Figure 1). This could result in increased fragmentation of the plants and further spread of the variable milfoil around the pond.

Potential fish species of concern include the banded sunfish and swamp darter. The New Hampshire Natural Heritage Bureau also lists the brook floater as a species of concern, with an 'endangered' designation. There are no designations for the banded sunfish or the swamp darter.

Less than one-quarter of the waterbody will be actively treated using aquatic herbicides in spring 2008. The balance of the waterbody, including shoreline stretches with natives vegetation, will be unimpacted by the herbicide treatment.

RECREATION USES AND ACCESS POINTS

Lake Potanipo is used for numerous recreational activities, including boating, fishing, swimming, and water skiing by both pond residents, campers at Camp Tevya, and transient boaters.

Figure 4 illustrates the location of the public access site. There is one designated public access for boats on the southeastern side of the pond, adjacent to the town beach. Motor boats, as well as kayaks and canoes can use this facility. In addition to transient boaters, there are generally 2-5 powerboats out on the lake on most weekdays, and about 20-30 boats out on the lake on the weekends. There are roughly between 2-10 non-motorized craft that use the lake on a daily basis. Figure 5 illustrates the typical boat paths for the pond.

There is one public (town) beach and one private camp beach on the pond (also called "designated beach"). 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 beach, there are a few small private swim beaches located on private properties around the pond. There are 17 floating docks and swim platforms around the pond as well. Figure 6 shows the locations commonly used for swimming, and the locations of swim platforms and docks on Lake Potanipo.

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 Lake Potanipo is characterized by a mix of native and non-native (variable milfoil) plant growth (Figure 2). Native species include a mix of floating plants (yellow and white lilies, floating heart, watershield), emergent plants (grassy arrowhead, spike rush, pickerelweed, 3-way sedge, pipewort, cattail, water lobelia, meadow beauty, arrow arum, purple iris), and submergent plants (bladderwort, pondweed, tapegrass, tape-like bur-reed, grassy spike rush, mermaid weed). Native plant communities are mixed around the entire lake, and are characterized as 'common/abundant' by the DES.

According to the NH Natural Heritage Bureau, there is a record of a state threatened fern-leaved foxglove located on the rocky/sandy shoreline in the northeast corner of the pond. Natural Heritage biologists have indicated that the herbicide application in this area should be set back slightly from the shoreline, to ensure that no overspray of the herbicide occurs on shore. An aquatic treatment will not affect this plant, however.

HISTORICAL CONTROL ACTIVITIES ON THIS WATERBODY:

Contractor	Management Type:	Treatment Date	Treatment Area (acres)
Aquatic Control Technology, Inc.	Chemical: Diquat	May 21st 2003	45
Aquatic Control Technology, Inc.	Chemical: Diquat	May 26th 2004	45
Aquatic Control Technology, Inc.	Chemical: Diquat	May 25th 2005	40

MILFOIL MANAGEMENT OPTIONS

The control practices used should be as specific to 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 Lake Potanipo. The following table summarizes DES' control strategy recommendations for Lake Potanipo.

FEASIBILITY EVALUATION FOR CONTROL ALTERNATIVES

Control Method	Use on Lake Potanipo
Restricted Use Areas	Not recommended as variable milfoil patches are too widely distributed throughout pond.
Hand-pulling	DES recommends that the individual stems or small patches of variable milfoil should be hand pulled when encountered, particularly those to the east of the town beach. DES also recommends that the lake residents follow up the herbicide application with hand-pulling of re-growth, if that re-growth is small and scattered. DES can conduct a Weed Watcher training on Lake Potanipo for interested individuals, to help them better identify variable milfoil.
Mechanical Harvesting/Removal	For Lake Potanipo, 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	For Lake Potanipo, 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	For Lake Potanipo, herbicide use is recommended as primary treatment due to extent of infestation. The aquatic herbicide 2,4-D is recommended in 2008. Diquat was previously used, but because it does not target the rooting systems, re-growth was inevitable.
Extended Drawdown	Drawdown is not an effective control method for variable milfoil.
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	In order to allow for a healthy stand of mixed native aquatic vegetation, as well as areas of bare substrate in the shallows, a 'No Control' option is not recommended. There are still many areas of the lake that are not infested with variable milfoil, and to maintain a well-distributed stand of native aquatic vegetation in these areas, variable milfoil control in Lake Potanipo is recommended.

EXOTIC AQUATIC PLANT CONTROL PLAN

An evaluation of the size, location, and type of variable milfoil infestation, as well as the waterbody uses was conducted by DES during September 21, 2006. Based on the evaluation, the following control actions are recommended:

Year	Treatment Type	Responsible Party	Schedule
2008	2,4-D treatment of variable milfoil in Areas 1, 2, and 3 in Lake Potanipo. Diquat could be used as an alternative herbicide, if necessary.	Aquatic Control Technology, Inc.	May
	Monitoring for re-growth	Lake residents/DES	June through September
	Benthic barrier placement	DES	As appropriate
	Follow-up plant inspection	DES	August/September
2009	Monitoring for re-growth	Lake residents/DES	June through September
	Benthic barrier placement/suction harvesting	DES	As appropriate
	Follow-up plant inspection	DES	August/September
2010	2,4-D treatment of variable milfoil in Areas 1, 2, and 3 in Lake Potanipo. Diquat could be used as an alternative herbicide, if necessary. Herbicide treatment to be conducted only if needed, as determined by fall 2009 plant survey.	TBD	May
	Monitoring for re-growth	Lake residents/DES	June through September
	Benthic barrier placement	DES	As appropriate
2011	Monitoring for re-growth	Lake residents/DES	June through September
	Benthic barrier placement	DES	As appropriate
2012	Monitoring for re-growth	Lake residents/DES	June through September
	Benthic barrier placement	DES	As appropriate

Year	Treatment Type	Responsible Party	Schedule
	Site assessment and remapping of variable milfoil infestation	DES	August/September
2013	Update and revise Long-Term Variable Milfoil Control Plan	NH DES, F&G, and interested parties	Fall

- Approximately 39 acres of the waterbody will be impacted by the herbicide treatment (approximately 23% of the surface area).

- The Department of Agriculture will impose standard short-term use restrictions for specified days depending on the use (irrigation, contact, etc) and the herbicide used. The shoreline will be posted and public notice will be made.

- The treatment will be timed appropriately so that herbicide concentrations are low or non-detectable by the time Camp Tevya opens. Aquatic Control Technology, Inc. will select an appropriate treatment date.

- By recommending follow-up management practices that utilize integrated plant management strategies such as benthic barrier placement and hand-pulling re-growth, variable milfoil re-growth or population expansion can be slowed.

- Based on the types of native plants that are mixed in with the stands of variable milfoil (Figure 2) where herbicide application is recommended there are no significant impacts to native plant communities. It is expected that a well distributed stand of native aquatic plants will remain following herbicide application. *It is important to note that the herbicide will not affect all of the plants in the lake, and that many of the native plants will continue to grow throughout and after the herbicide application.*

- 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 outline here, 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 1- Map of Milfoil Infestation

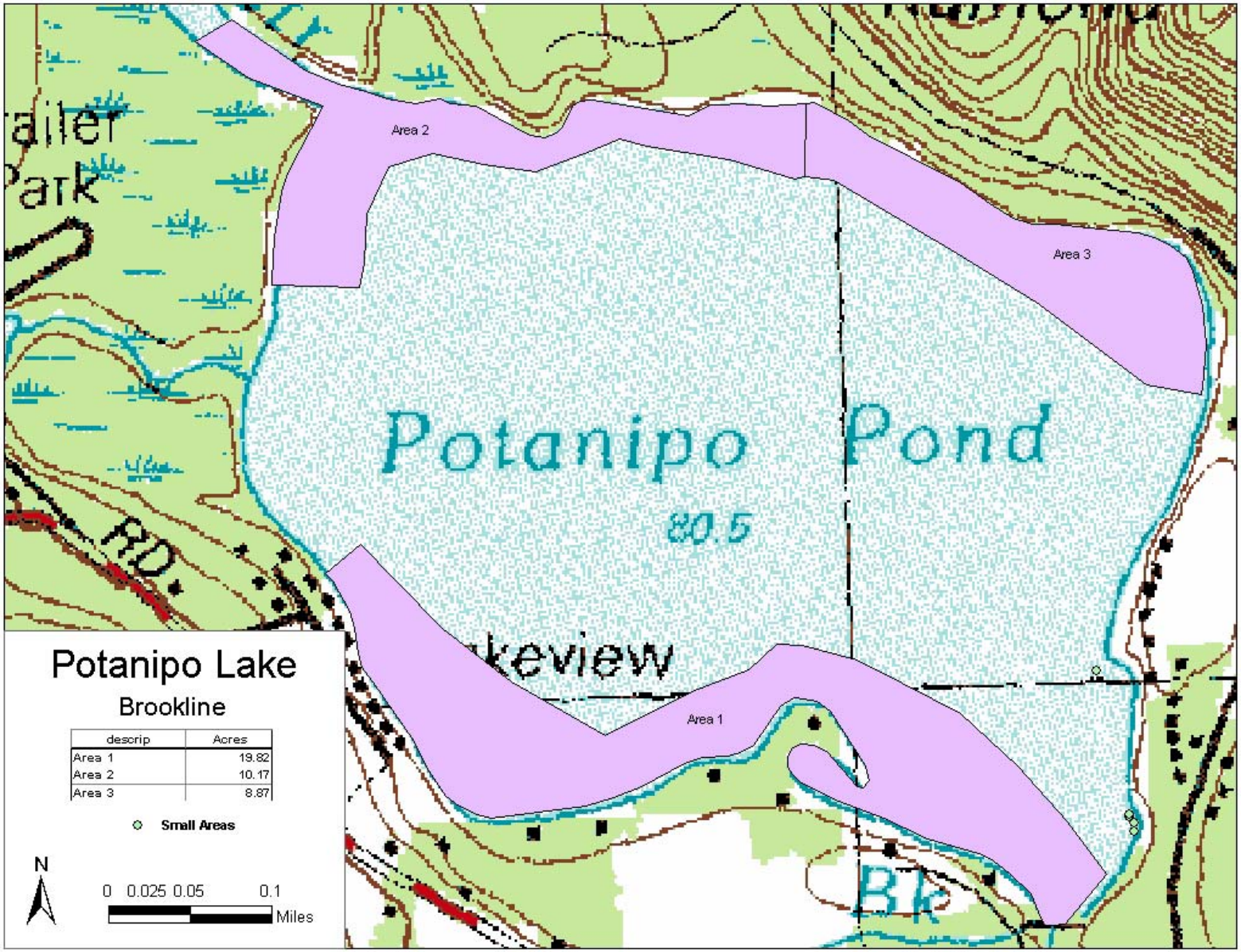
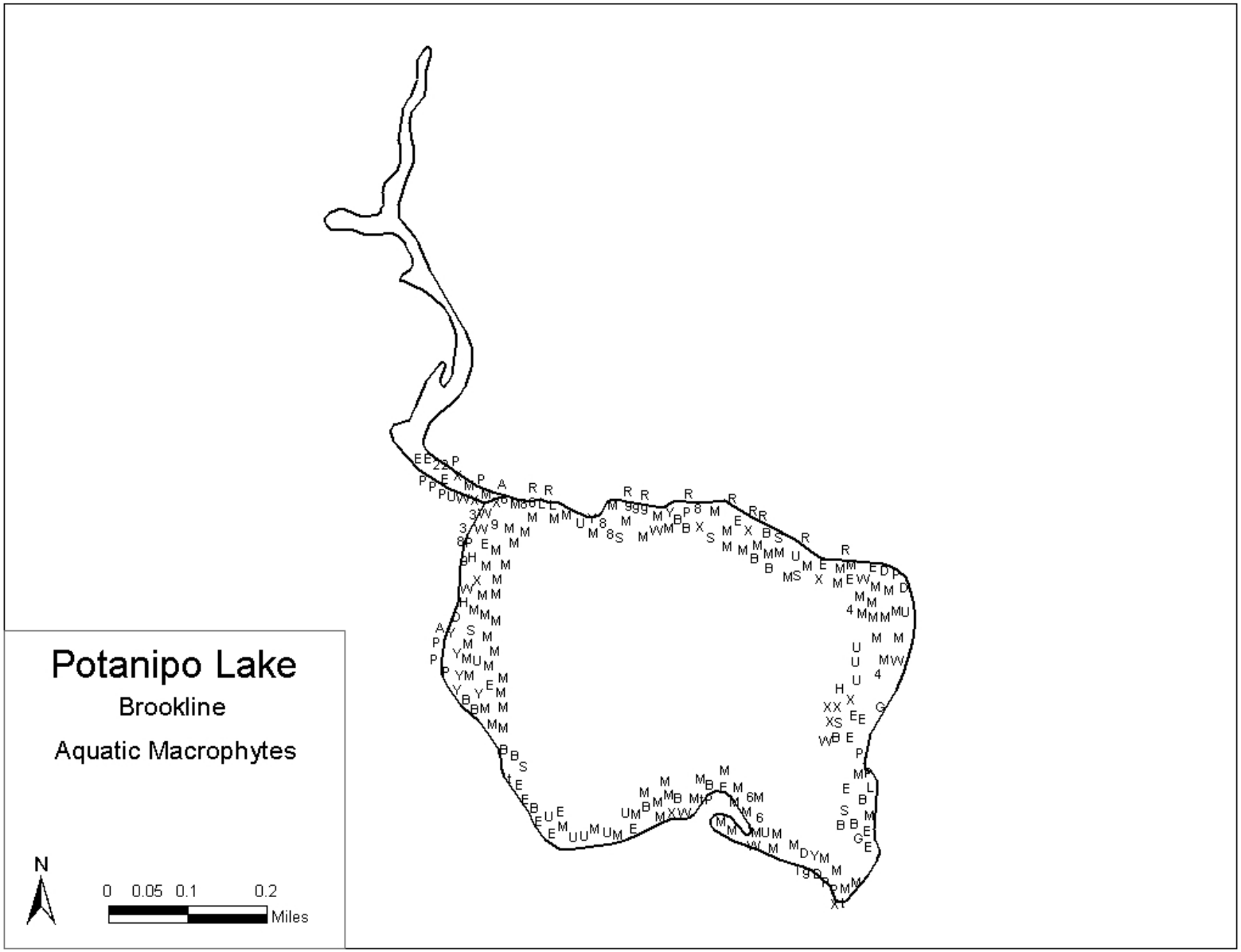


Figure 2- Aquatic Vegetation Map and Key



Symbol	Common Name	Latin Name
B	Watershield	*Brasenia schreberi*
M	Variable water-milfoil	*Myriophyllum heterophyllum*
G	Grassy arrowhead	*Sagittaria graminea*
V	Tapegrass	*Vallisneria americana*
S/4	Tape-like bur-reed	*Sparganium sp.*
E	Grassy spike-rush	*Eleocharis sp.*
U	Bladderwort	*Utricularia*
W	White water-lily	*Nymphea*
P	Pickerelweed	*Pontedaria cordata*
H	Floating heart	*Nymphoides cordata*
X	Pondweed	*Potamogeton sp.*
Y	Yellow water-lily	*Nuphar*
D/3	Three-way sedge	*Dulichium arundinaceum*
8	Spike rush	*Eleocharis sp.*
9	Pipewort	*Eriocaulon*
T	Cattail	*Typha*
L	Water lobelia	*Lobelia dortmanna*
R	Meadow beauty	*Rhexia sp.*
A	Arrow arum	*Peltandra virginica*
I	Blue-flag iris	*Iris versicolor*
2	Mermaid-weed	*Proserpinaca palustris*

Figure 3- Bathymetric Map of Lake Potanipo, Brookline

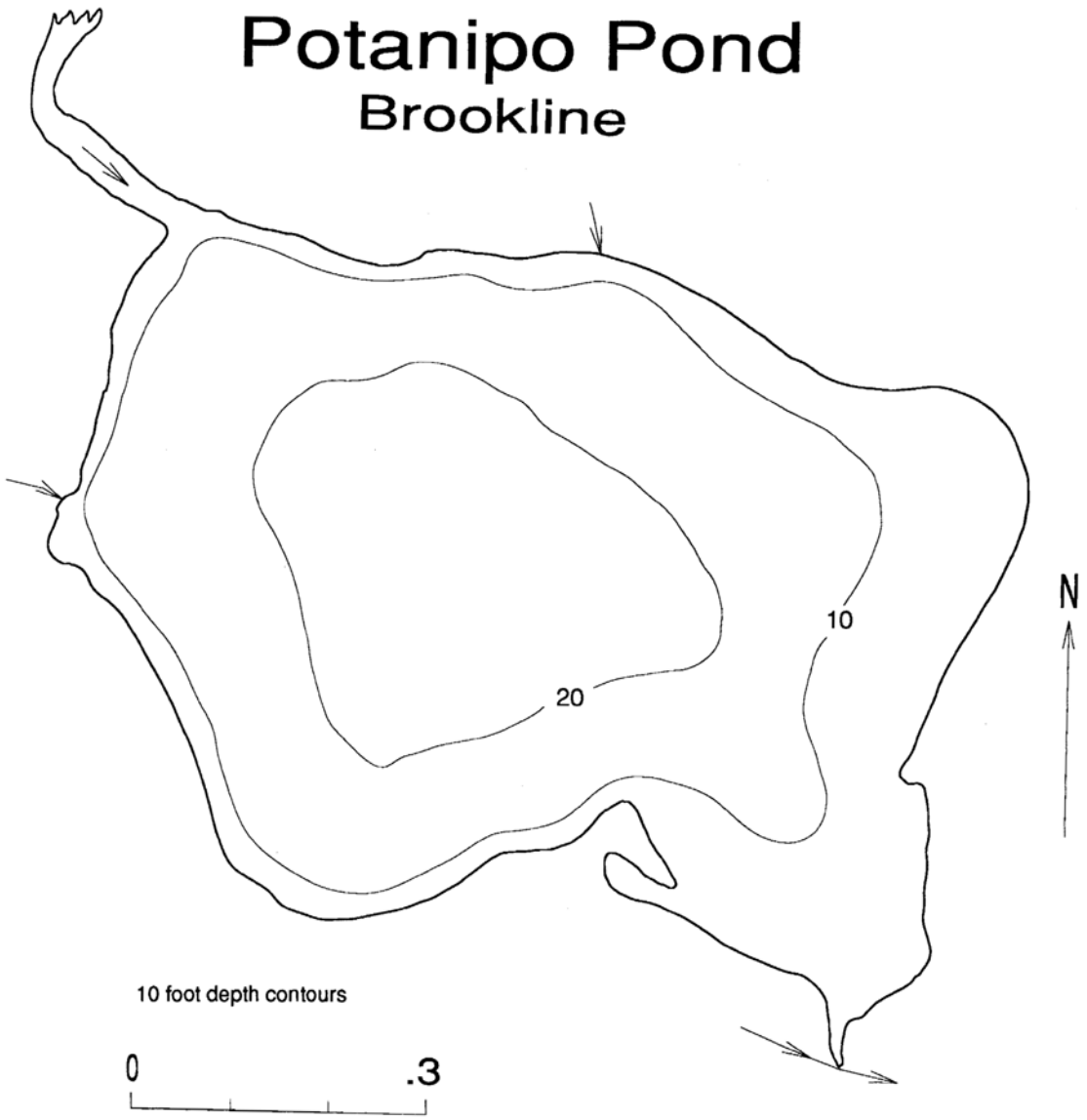


Figure 4- Public Access Points

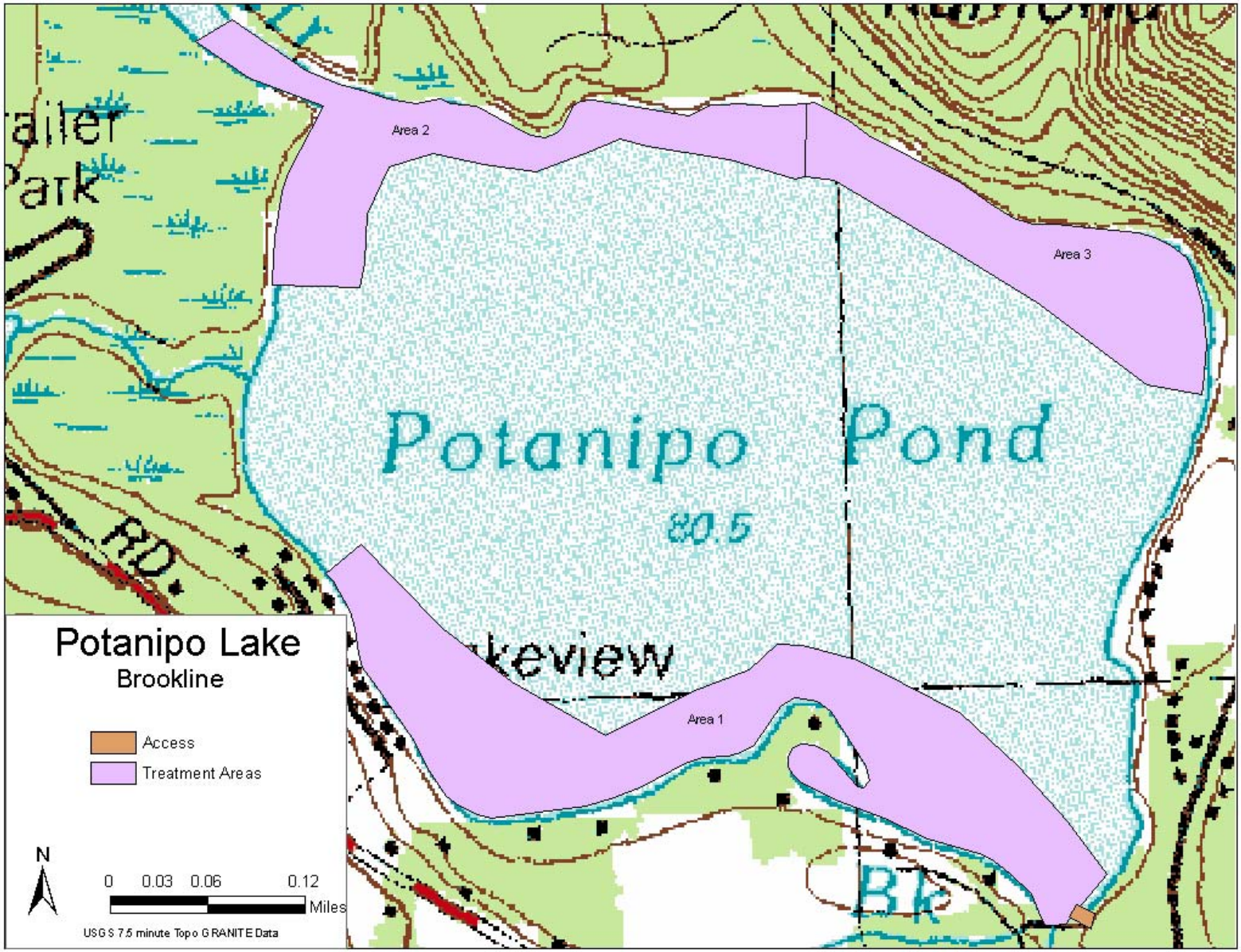


Figure 5- Common Boat Paths

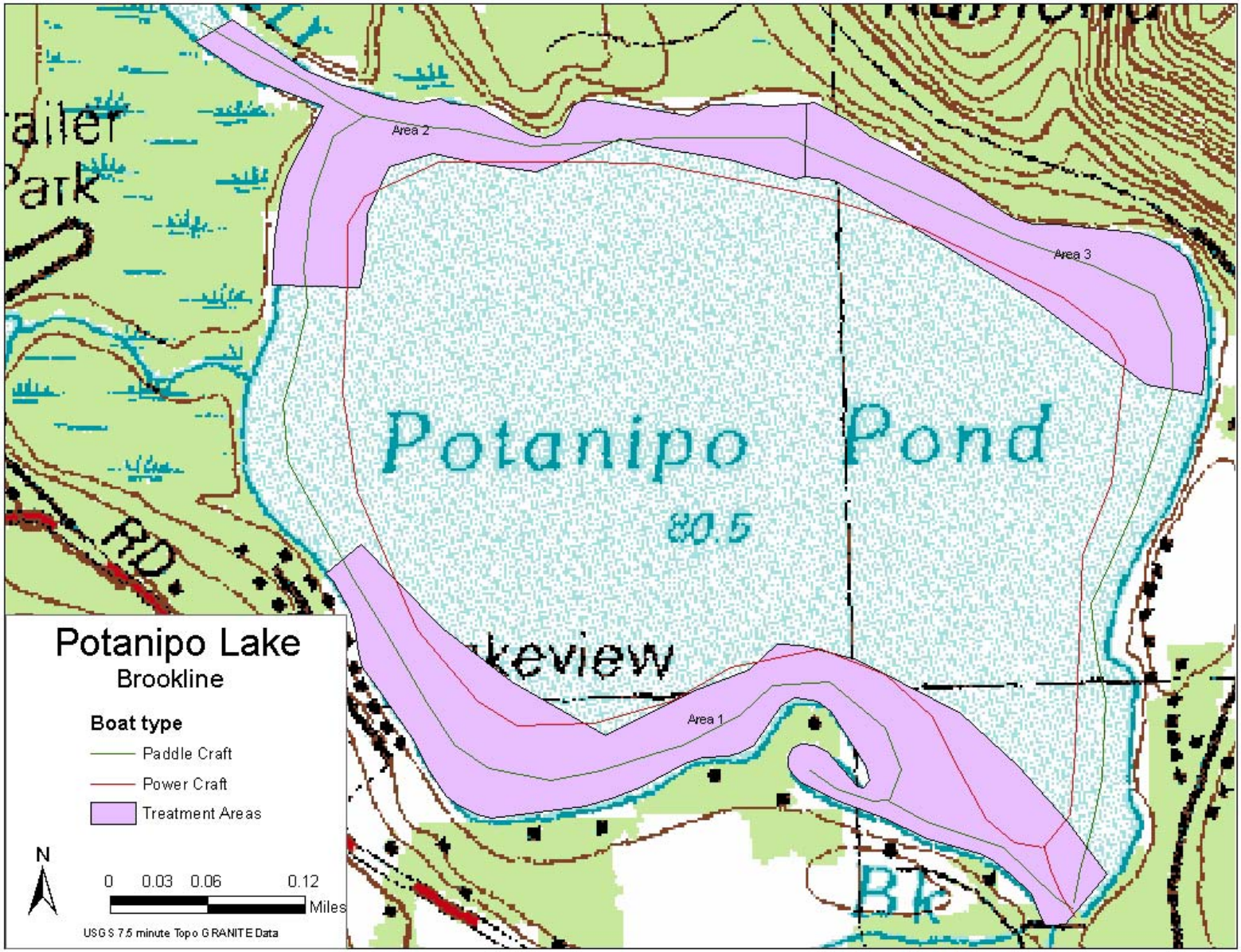
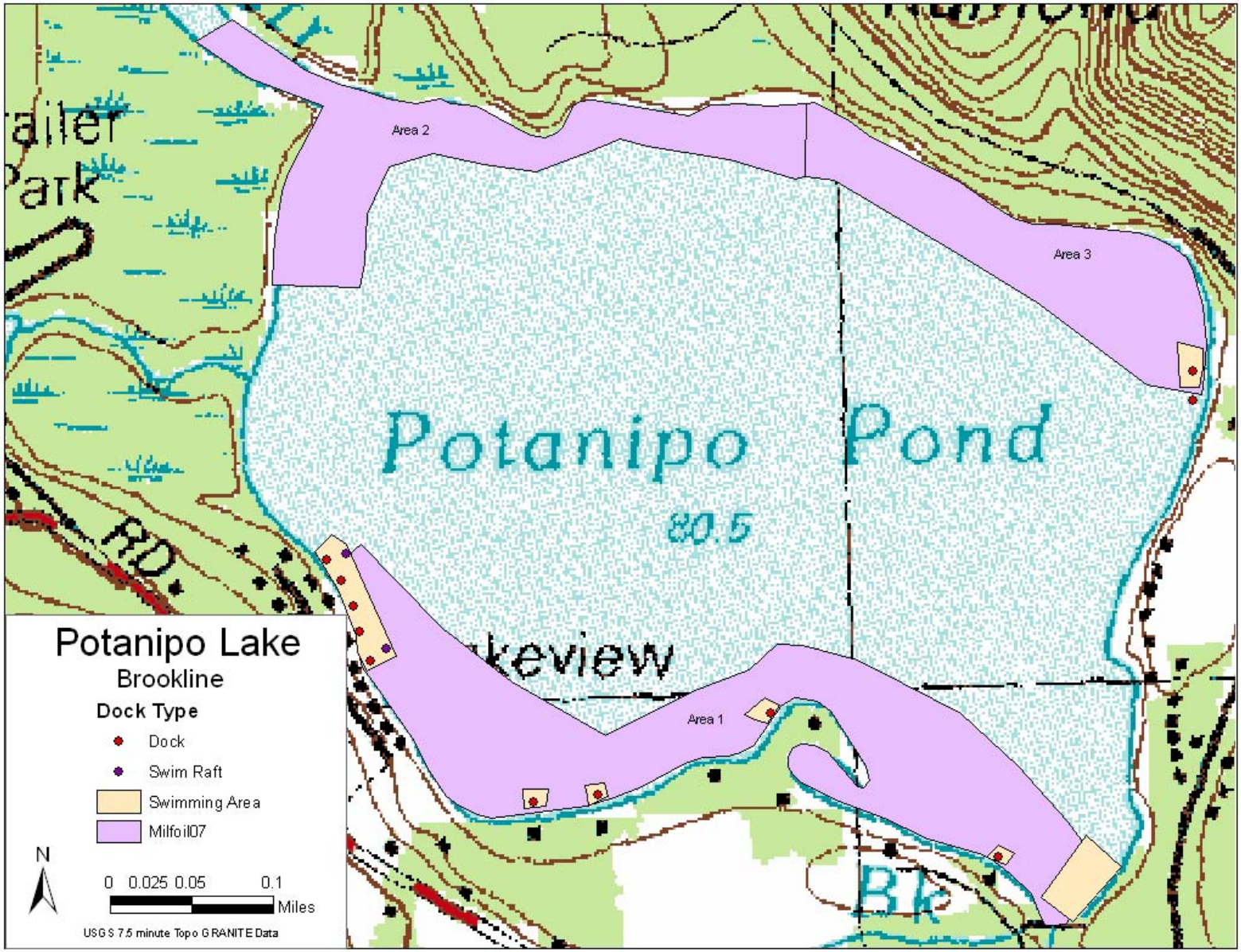


Figure 6- Swim Areas, Docks, and Swim Rafts



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 maintain 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 habits 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.

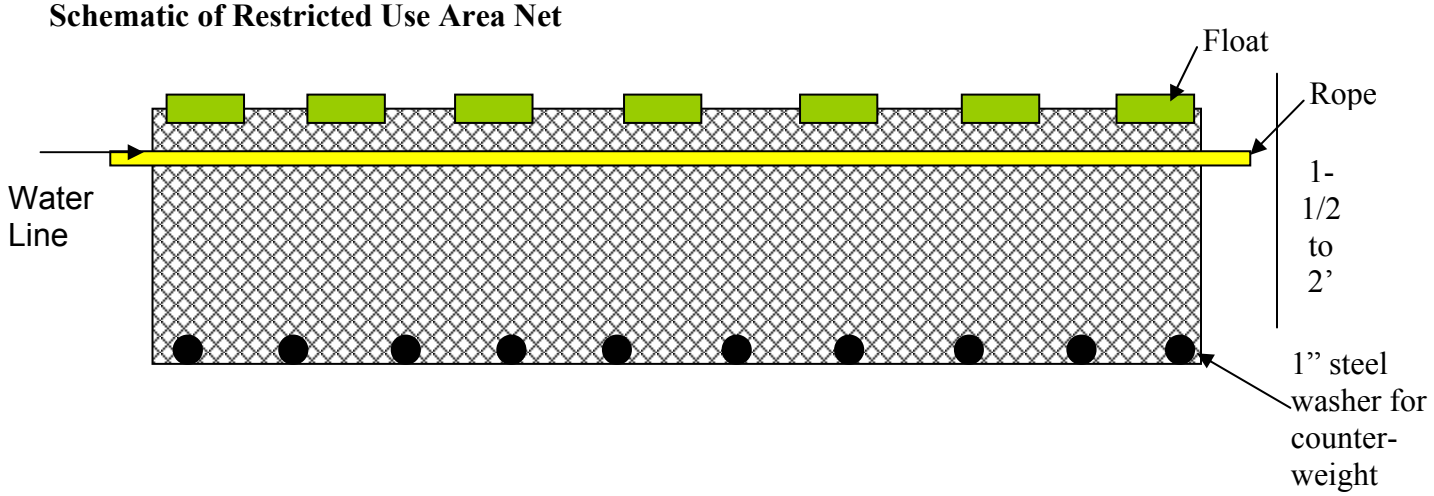
APPENDIX B

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 effective 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.

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:

When a small infestation of exotic aquatic plants occurs in clusters of growth (generally areas >5 ft^2), 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. Label restrictions for aquatic application currently limit its use in New Hampshire to waterbodies with no water intakes, and with no wells adjacent to the shoreline.

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 lakes 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 to fashion, 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.

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