

**Long-Term Variable Milfoil Management and Control Plan for
Mountain View Yacht Club - LAKE WINNIPESAUKEE
Gilford, New Hampshire
Belknap County**

Prepared by: New Hampshire Department of Environmental Services (DES),
in consultation with the
New Hampshire Fish and Game Department (F&G)
March 2007

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 Winnepesaukee in the late 1960s, and it can be found heavily infesting the area of Mountain View Yacht Club in Gilford. This entire 9-acre marina area is infested with between 50%-75% variable milfoil cover. Milfoil growth is found throughout the marina area in varying densities. Figure 1 shows a map of the infestation, and Figure 2 shows an aerial photograph of the yacht club. The heaviest growth is located along the southern shoreline, near the edges and adjacent to the boat docks where the water depths are shallower.

In terms of the impacts of the variable milfoil in the system, boat traffic through the marina is hindered by dense growths of variable milfoil (even the propellers on larger boats can be impacted by exotic aquatic plant growth), so the infestation is an impairment to a place of business and to the access and recreational use of Lake Winnepesaukee from this access point.

At this time, there are no data and no observable problems with the biological integrity of the aquatic community as a result of the variable milfoil infestation; however, no biological integrity surveys have been conducted as part of this plan preparation. The Mountain View Yacht Club is located in a dredged basin where the Gunstock River enters Lake Winnepesaukee, and it is therefore an artificially created embayment to the lake.

PURPOSE

The purposes of this exotic aquatic plant management and control plan are to outline a strategy for controlling variable milfoil growth with a new formulation of the aquatic herbicide Triclopyr, referred to as Renovate On Target Flake (OTF). Renovate OTF is a systemic herbicide similar to 2,4-D, that has been showing good target specificity in the laboratory in controlling variable milfoil. SePRO Corporation, the distributor of Renovate OTF, has offered to pay for part of the cost of the chemical and for sampling and analysis, with matching funds from the Mountain View Yacht and DES. Because the area of Mountain View Yacht Club is relatively small in size and artificial in nature, it makes for a good location to conduct a field trial with this herbicide. More information on the herbicide itself is included in Appendix C of this document.

Additional goals of this management 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 Mountain View Yacht Club and the social and ecological impacts of the milfoil infestation.

The intent of this strategic plan is to control variable milfoil in Mountain View Yacht Club over time through the use of Integrated Pest Management Strategies (IPM), where appropriate and feasible in a busy marina setting. 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

Because of the expansive size of the overall variable milfoil infestation within Lake Winnepesaukee, DES recognizes that eradication of variable milfoil in the lake system as a whole is unlikely, both due to the degree of fragmentation of the plants and subsequent spread, but also due to the overall cost of attempting a lake-wide eradication project on this lake.

For Mountain View Yacht Club, DES proposes to work with the yacht club to perform variable milfoil management practices to minimize the recreational, ecological, human health, business, and aesthetic impacts caused by dense growths of this invasive plant, while maintaining the overall integrity of native plant communities whenever variable milfoil control actions are being implemented.

Specifically, the goals are as follows:

- 1) In 2007, reduce the overall percent of variable milfoil bottom growth in the yacht club embayment from 9 acres and 65-75% cover to less than 1 acre and 15% cover with the use of Triclopyr (Renovate OTF).
- 2) Additional herbicide treatments may be needed in future years (no less than every two years) to maintain the variable milfoil infestation at or below a level of 15% cover.
- 3) If the Renovate OTF treatment does not achieve the targeted areal and percent coverage reductions, DES will yield preferential funding to the Mountain View Yacht Club for a 2008 herbicide treatment. The need for a 2008 treatment will be based on an August/September site inspection by DES biologists.

Mountain View Yacht Club Support

Mountain View Yacht Club has worked with DES to conduct management practices in the past. Maintaining ingress and egress is critical for the yacht club, and variable milfoil management is a priority.

WATERBODY CHARACTERISTICS

Table 1 summarizes basic physical and biological characteristics of Mountain View Yacht Club.

General Lake Information	
Embayment area (acres)	9
Max Depth (ft)	10
Mean Depth (ft)	5
Shoreline Uses (residential, forested, agriculture)	Yacht club/docks
Plant Community Information Relative to Management	
Invasive Plants (Latin name)	<i>Myriophyllum heterophyllum</i>
Infested Area (acres)	9
Distribution (ringing area, patchy growth, etc)	Abundant in entire embayment
Sediment type in infested area (sand/silt/organic/rock)	Sand/silt
Rare, Threatened, or Endangered Species in Lake Winnepesaukee (based on NH Heritage Bureau database) <i>Note: data are for the lake as a whole, not for the specific artificial embayment that is the focus of this management plan.</i>	<p>Vertebrate species State/Federal Notes</p> <p>Common Loon (<i>Gavia immer</i>) State Threatened</p> <p>Purple Martin (<i>Progne subis</i>) State Endangered</p>

BENEFICIAL (DESIGNATED) USES

In New Hampshire, beneficial (designated) uses of our waterbodies are categorized into five general areas: Aquatic Life, Fish Consumption, Recreation, Drinking Water Supply, and Wildlife (CALM).

Of these, Aquatic Life and Recreation are the two categories that can be affected by the presence of exotic species 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.

The Mountain View Yacht Club is located in a dredged basin where the Gunstock River enters Lake Winnepesaukee, and it is therefore an artificially created embayment to the lake.

FISHERIES AND WILDLIFE

The principal fisheries of Lake Winnepesaukee include both warm and coldwater species. Coldwater species of primary interest are; landlocked Atlantic salmon, lake trout, and rainbow trout; coldwater species of less interest are lake whitefish, round whitefish (species of concern in Wildlife Action Plan), burbot, brook trout, and rainbow smelt.

Warmwater species of primary interest are; largemouth bass, smallmouth bass, white perch, yellow perch, chain pickerel, black crappie, brown bullhead, and bluegill. The bass fishery is extremely popular with anglers as numerous fishing tournaments are held on the lake each year.

Numerous warmwater species are present in littoral areas of the lake and constitute the prey fish sought by larger gamefish (warmwater). These species include; banded killifish, common shiner, common white sucker, creek chubsucker, bridle shiner (species of concern in Wildlife Action Plan), fallfish, golden shiner, pumpkinseed, redbreast sunfish, rock bass, slimy sculpin, and yellow bullhead.

The American eel, a catadromous species, reside up to 4-9 years in our inland lakes, such as Lake Winnepesaukee, where they reach sexual maturity and migrate down the rivers and outlets of our large lakes to the Atlantic Ocean.

The Mountain View Yacht Club is located in a dredged basin where the Gunstock River enters Lake Winnepesaukee, and it is therefore an artificially created embayment to the lake. This is a place of business with regular boat traffic. There is no fishing allowed in this area.

RECREATIONAL USES AND ACCESS POINTS

Lake Winnepesaukee is used for numerous recreational activities, including boating, fishing, swimming, and water skiing by both lake residents and transient boaters. The Mountain View Yacht Club is located in a dredged basin where the Gunstock River enters Lake Winnepesaukee, and it is therefore an artificially created embayment to the lake. Because of the nature of this artificially created area, there are no recreational activities that take place in this area, other than ingress and egress to and from the yacht club.

Boating lanes through the marina are impaired as a result of dense variable milfoil growth, and fragments are frequently created by boat propellers.

MACROPHYTE EVALUATION

Unfortunately, due to the late nature of this request for treatment, DES was not able to conduct a site assessment of this area to prepare an aquatic plant map. The areas of infestation were mapped by the contractor working on the project, but no maps were created for native plant communities.

As part of the special project aimed at evaluating the effectiveness of the proposed aquatic herbicide, Triclopyr, DES will plan to work with a biologist from SePRO Corporation to map the aquatic plant community and to quantitatively assess the aquatic plant community, before and after the herbicide application in the spring/summer.

There are no records with the Natural Heritage Bureau of any rare, threatened, or endangered plants in Lake Winnepesaukee.

HISTORICAL CONTROL ACTIVITIES ON MOUNTAIN VIEW YACHT CLUB:

Contractor	Management Type	Treatment Date	Treatment Acres	Effectiveness
ACT	Diquat	6/10/91	9	Seasonal control
ACT	Diquat	6/25/92	9	Seasonal control
ACT	2,4-D	6/8/93	9	Provided 2-3 years of control
ACT	Diquat	6/6/96	9	Seasonal control
ACT	Diquat	6/10/97	9	Seasonal control
ACT	2,4-D	6/8/99	9	Provided 2-3 years of control
ACT	2,4-D	7/9/02	9	Provided 2 years of control
Lycott	Diquat	2004	9	
ACT	2,4-D	6/2/05	9	Provided 2 years of control

MILFOIL MANAGEMENT OPTIONS

The control practices used should be as specific to variable milfoil as feasible.

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 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 in Mountain View Yacht Club. The following table summarizes DES' control strategy recommendations for Mountain View Yacht Club.

FEASIBILITY EVALUATION FOR CONTROL ALTERNATIVES

Control Method	Use in Mountain View Yacht Club
Restricted Use Areas	This is a commercial business, and therefore a Restricted Use Area is not practical.
Hand-pulling	DES recommends that the individual stems or small patches of variable milfoil along the shoreline and docking structures be pulled by yacht club staff or hired divers to slow the rate of regrowth following herbicide application.
Mechanical Harvesting/Removal	Mechanical Harvesting is not a viable option due to the threat of fragmentation and further spread.
Benthic Barriers	Benthic barriers are recommended for small patches of variable milfoil; however, due to the fact that this area is a marina, benthic barriers may not be feasible due to water depths and the threat of the barriers becoming entangled in propellers.
Herbicides	For Mountain View Yacht Club, herbicide use is recommended as primary treatment due to the extent of infestation. We recommend the use of Triclopyr (Renovate OTF formulation) for the treatment, with 2,4-D as an alternative.
Extended Drawdown	For Mountain View Yacht Club, this is not a recommended or feasible strategy due to lack of a nearby impoundment structure. It would not be practical to drain lake Winnepesaukee to control the milfoil at this site.
Dredge	Not recommended due to the high cost of such a project. It has been proven that dredging actually enhances variable milfoil growth in most cases. Additionally, this is a dredged basin that was formed to create the docking area for the yacht club.
Biological Control	There are no approved biological controls for variable milfoil at this time in New Hampshire.
No Control	A 'no control' option is not recommended. Variable milfoil is impacting a commercial business on the lake, and ingress/egress/docking are being impaired by the dense growths of this plant.

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 2006. Based on the evaluation, the following control actions are recommended for Mountain View Yacht Club:

Year	Treatment Type	Responsible Party	Schedule
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Year	Treatment Type	Responsible Party	Schedule
2007	Conduct site assessment and map (quantitatively and qualitatively) the aquatic plant community within the Mountain View Yacht Club embayment.	DES/SePRO Corporation	First week of June
	Triclopyr (Renovate OTF) treatment of Mountain View Yacht Club, for a total of 9 acres.	Aquatic Control Technology, Inc.	June
	Hand-removal of variable milfoil to slow overall regrowth	Contract divers or yacht club staff	June/July
	Conduct site assessment and map (quantitatively and qualitatively) the aquatic plant community at this site	DES/SePRO Corporation	July/August
2008	2,4-D treatment of Mountain View Yacht Club only if 2007 Renovate treatment did not successfully reduce growths of variable milfoil (as determined in July/August 2007 site assessment and plant mapping)	Licensed contractor	June
	Hand-removal of variable milfoil to slow overall regrowth	Contract divers or yacht club staff	June/July
2009	Hand-removal of variable milfoil to slow overall regrowth, if needed	Contract divers or yacht club staff	June/July
2010	Hand-removal of variable milfoil to slow overall regrowth, if needed	Contract divers or yacht club staff	June/July
	Conduct site assessment and map variable milfoil growth at this site if 2011 treatment is requested by yacht club	DES	August
2011	Herbicide treatment of Mountain View Yacht Club if needed, and based off from DES site assessment if requested in 2009	Licensed contractor	May/June
2012	Update and revise Long-Term Variable Milfoil Control Plan	NH DES, F&G, and interested parties	Spring 2012

TREATMENT APPROACH

Treatment Area

Treatment of the entire 9-acre marina area is proposed.

Herbicide formulation

Renovate OTF (triclopyr flake) is proposed. The systemic action of this herbicide should provide multiple year milfoil control. It is also selective for dicot species and native monocot

species should be preserved following treatment. If Renovate OTF is not approved for use, then Navigate (2,4-D granular) is listed as an alternate herbicide.

- PREFERRED: Renovate OTF – triclopyr 10% a.e. – EPA Reg. No. 67690-42: Renovate OTF (On Target Flakes) will be applied to the entire 9 acre marina area. Renovate OTF will be applied at rate of 140-162 pounds per acre (1.3 – 1.5 ppm) based on manufacturer’s recommendations.
- ALTERNATE: Navigate – 2,4-D BEE granular – EPA Reg. No. 228-378-8959: Navigate will be applied to the entire 9 acre marina area. Navigate will be applied at rate of 100 pounds per acre.

Application Schedule

Treatment is tentatively scheduled for Tuesday, June 19, 2007.

A slightly later treatment date is preferred to allow for DES to better evaluate the impacts to non-target species.

Application Methods

Renovate OTF (triclopyr flake) and/or Navigate (2,4-D granular) will be applied using a calibrated spreader and possibly a granular blower mounted on the bow of a conventional spray boat.

Water Sources

There is no known direct use of the lake water or any private wells in direct proximity to the treatment area. Mountain View Yacht Club has two public wells (GIS OneStop PWS ID 0887110-001 & 0887130-001) located within 250 feet of the treatment area. We request the Division of Pesticide Control seek a waiver from DES Water Supply for an aquatic herbicide application with the set back distance of a public well, as provided for in Pes. 507.07 NH Code of Administration Rules.

CONSIDERATIONS FOR SELECTED MANAGEMENT PRACTICE

- Approximately 9 acres of the cove will be targeted by the herbicide treatment (essentially the entire artificial embayment that contains the yacht club). Targeted applications can be achieved by boat.
- Renovate OTF is a new formulation of Triclopyr. This systemic herbicide is registered for use in New Hampshire. DES is partnering with Aquatic Control Technology, Inc. and SePRO Corporation to conduct this field trial to evaluate target specificity of the herbicide with variable milfoil, and to qualitatively and quantitatively evaluate the effectiveness of the herbicide on target and non-target plants. SePRO Corporation is paying for part of the cost of the herbicide, and the lake association is paying the contractor fees for the project. DES is

contributing cash towards the cost of the herbicide treatment, and is working with SePRO Corporation to conduct the plant community assessments and follow-up monitoring.

- We are requesting that if Triclopyr is not permitted for use, that 2,4-D be used as an alternative.
- The Department of Agriculture will impose standard short-term use restrictions for specified days depending on the waterbody uses (irrigation, contact, etc) and the herbicide label. The shoreline will be posted and public notice will be made.
- By recommending follow-up management practices annually after the herbicide application (generally hand-removal of variable milfoil), we will employ an integrated plant management approach so that variable milfoil re-growth or population expansion can be slowed. The ultimate goal of this project is to reduce variable milfoil growth to maintain the designated uses of the embayment and yacht club.
- Data collected from this study will be invaluable in determining the effectiveness of this formulation of Triclopyr on variable milfoil in New Hampshire. Data from this study will be used to help in determining if this product will be a more reasonable substitute for 2,4-D use in New Hampshire.

Figure 1- Map of Milfoil Infestation in Mountain View Yacht Club

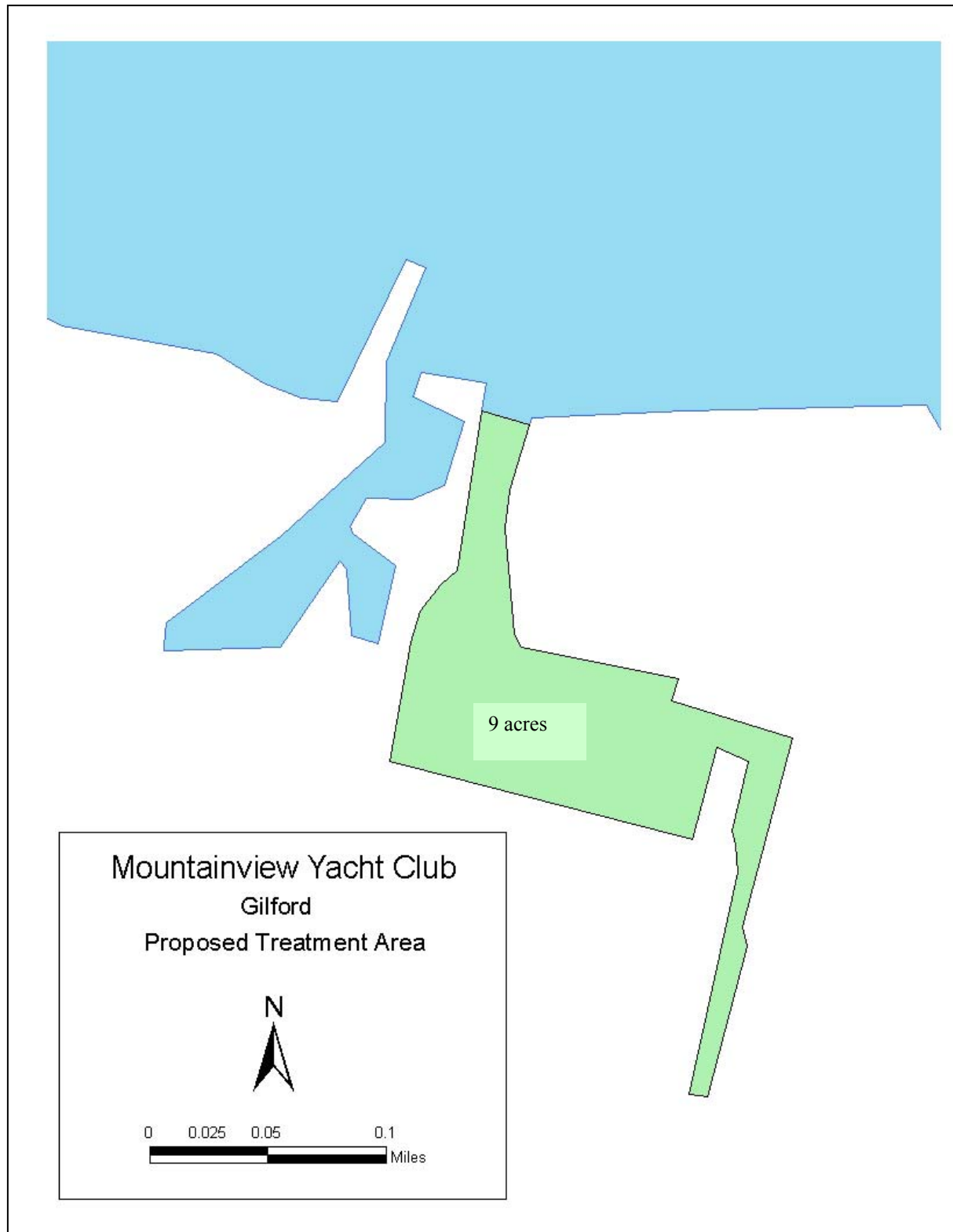


Figure 2- Aerial Photograph of Mountain View Yacht Club



APPENDIX A

Criteria to Evaluate the Selection of Aquatic Plant Control Techniques

NH Department of Environmental Services

Water Division

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.

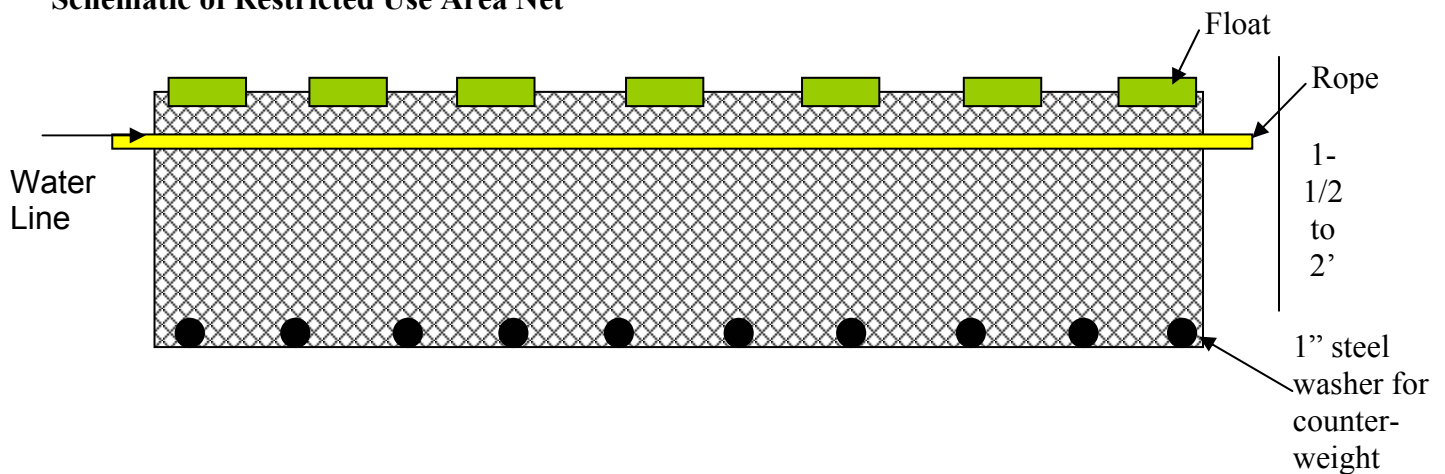
APPENDIX B

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 $>5 \text{ ft}^2$), 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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