Black Lake Eurasian Watermilfoil Management Plan

Photo courtesy of Black Lake Chamber of Commerce

***Prepared for*:**

Black Lake Invasive Weeds Committee
Hammond, NY

***Prepared by*:**

Quantitative Environmental Analysis, LLC
Liverpool, NY

July 14, 2008

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Table of Contents

List of Tables

List of Figures

List of Appendices

EXECUTIVE SUMMARY

This Black Lake aquatic nuisance species management plan was developed by Quantitative Environmental Analysis, LLC (QEA) of Liverpool, NY on behalf of the Black Lake Invasive Weed Committee. This management plan focuses on the methods of eradicating Eurasian watermilfoil from Black Lake and returning its designated uses of swimming, boating, and fishing to levels experienced prior to the invasion of this exotic plant species. This management plan has been developed in accordance with New York State Department of Environmental Conservation (NYSDEC) protocols described in the *Primer on Aquatic Plant Management in New York State* (NYSDEC 2005).

Black Lake is a 7,761 acre lake located in the Towns of Hammond, Morristown, Oswegatchie, Macomb, Rossie, and DePeyster in the St. Lawrence River region of New York State. Seasonal camps and 27 tourist cottage, cabin, and campground businesses occupy the lake shoreline, and its waters are used heavily for recreational fishing, boating, and swimming. Tourism generated approximately $7 million in the Black Lake area in 2005. However, the recreational quality of the lake has declined in recent years due to increasing areal distribution and density of macrophyte species, specifically Eurasian watermilfoil (*Myriophyllum spicatum*). This species quickly grows to the water surface early in the growing season, forming a canopy that shades out beneficial native species. Declining recreational quality in the lake has begun negatively impacted tourism in the area.

Removal of Eurasian watermilfoil from the lake will take a concerted multi-year effort and will affect large areas of the lake due to its current widespread distribution. To effectively remove the species from Black Lake, while maintaining native aquatic macrophyte habitat for fish, an integrated treatment approach is required, employing three methods: hand harvesting, suction harvesting, and benthic barriers. These removal efforts should be prioritized to achieve the most benefit for the fisheries and for the recreational use of the lake. Cost for total removal of all Eurasian watermilfoil in Black Lake is estimated at $20 to $30 million. Finally, monitoring of aquatic macrophytes (density and distribution) and the fisheries should be conducted to assess the efficacy and utility of the management program.

SECTION 1
INTRODUCTION

This Black Lake aquatic nuisance species management plan was developed by Quantitative Environmental Analysis, LLC (QEA) of Liverpool, NY on behalf of the Black Lake Invasive Weed Committee. This management plan focuses on the methods of eradicating Eurasian watermilfoil from Black Lake and returning its designated uses of swimming, boating, and fishing to levels experienced prior to the invasion of this exotic plant species. This management plan has been developed in accordance with New York State Department of Environmental Conservation (NYSDEC) protocols described in the *Primer on Aquatic Plant Management in New York State* (NYSDEC 2005).

1.1 BACKGROUND

Black Lake is a 7,761 acre lake located in the Towns of Hammond, Morristown, Oswegatchie, Macomb, Rossie, and DePeyster in the St. Lawrence River region of New York State (Figure 1-1). The lake is 19.5 miles long, 2.7 miles wide at its widest point, and has an average depth of 8 feet (NYSDEC 2008a). The lake is classified by the NYSDEC as a Class B waters suitable for primary and secondary contact recreation, fishing, and fish propagation. The lake is a linear, fluvial system with many shallow bays and islands at its southern end. Black Lake is fed primarily by the Indian River, in addition to several creeks, at its southwestern end. The outlet of the lake, located at its northeastern terminus, discharges into the Oswegatchie River. Twenty-seven tourist cottage and campground operations and many private camps occupy the lake shoreline, and its waters are used heavily for recreational fishing, boating, and swimming. Tourism revenues generated by Black Lake businesses were estimated at approximately $7 million by the Black Lake Association in 2005 (Dashnaw 2008a).

While Black Lake remains a prime, natural, sport fishery, the recreational quality of the lake has declined in recent years due to the increasing areal distribution and density of macrophyte species, specifically Eurasian watermilfoil (*Myriophyllum spicatum*). Moreover, the recent invasion of zebra mussels (*Dreissena polymorpha*; NYSDEC 2007) has exacerbated the

macrophyte problem in Black Lake. Zebra mussels filter phytoplankton and other waterborne particulates resulting in higher water clarity and increased light penetration which allows macrophytes to grow at greater water depths than they would in the absence of zebra mussels.

1.2 HISTORY OF INVASIVE PLANT GROWTH

Eurasian watermilfoil is the only invasive aquatic plant species currently identified in Black Lake. This species was identified in the lake during plant surveys completed as part of the Citizens Statewide Lake Assessment Program (CSLAP) in 1990 and 1991, which was the last time plant surveys were performed in the lake (NYSDEC 2007). The qualitative weed growth and recreational assessments for Black Lake in 2006, performed as part of the CSLAP program, were the least favorable since the mid-1990s (NYSDEC 2007). These metrics assess the density of aquatic macrophytes and the recreational quality of the lake, respectively. Currently, Eurasian watermilfoil occupies approximately 3,235 acres in the lake (Dashnaw 2008b); either in combination with other species or as a monoculture. Preliminary distribution and percent cover information are displayed in Figures 1-2a and 1-2b. Of the 3,235 acres of Eurasian watermilfoil beds in the lake, 1,864 acres are identified as having 60% cover by this species and 1,371 acres are identified as having 90 to 100% cover.

Eurasian watermilfoil is a submersed aquatic macrophyte with a well developed root system and finely dissected leaves (Figure 1-3). This species, native to Europe, Asia, and northern Africa, was introduced to North America possibly as early as 1885, but perhaps as late as the 1940s. Since its introduction, this species has spread across much of the continent, growing to nuisance proportions in many of the lakes where it has become established and is most abundant in eutrophic water bodies (Madsen et al. 1991). Eurasian watermilfoil is essentially evergreen with a large number of overwintering stems. This large overwintering biomass allows the species to reach the water surface before other macrophytes. Once shoots reach the surface they branch profusely to form a dense canopy, shading the area below. Eurasian watermilfoil grows across wide ranges of depth (1 to 10 m) and water clarity. In turbid waters, the species is limited to shallow areas where it survives by photosynthesizing in its surface canopy. This species reproduces almost exclusively by vegetative propagation in North

America both by stem fragmentation and stolon (horizontal stem) formation. Eurasian watermilfoil is spread between lakes largely by transport of fragments on recreational boats (Smith and Barko 1990).

1.3 IMPAIRED LAKE USES

Primary and secondary contact recreation within Black Lake has been inhibited by the presence of dense beds of Eurasian watermilfoil. During periods of high aquatic vegetation density, recreational uses, including boating, swimming, and fishing have been impeded (NYSDEC 2007). Activity at camps and businesses surrounding the lake was reportedly reduced by 25% in 2007 due to the high density of aquatic vegetation, which made it difficult or impossible to boat or fish in some areas of the lake (St. Lawrence County Fisheries Advisory Board 2007). Reduced recreational quality is a great concern to the surrounding communities because of the large tourism revenue (approximately $7 million in 2005) generated by users of the Lake (Dashnaw 2008a). Fewer visits to Black Lake mean less money flowing into the North Country economy.

The effects of Eurasian watermilfoil on the plant and fish communities of Black Lake are mixed. While Black Lake continues to support a diverse fish community (VanMaaren 2008), the expansion of Eurasian watermilfoil in Black Lake has the potential to displace more beneficial native plant species. Eurasian watermilfoil would not be expected to have a significant negative impact on the fish community unless its arrival caused a significant change in total plant biomass or covered gravel spawning beds used by salmonid and centrarchid species (Smith and Barko 1990); this does not appear to be the case in Black Lake. However, the expansion of Eurasian watermilfoil in Black Lake has the potential to displace more beneficial native plant species. Specifically, the plastic growth form and high overwintering biomass of Eurasian watermilfoil allows it to overtop and shade out other aquatic species in a wide range of depths and water clarity (Smith and Barko 1990; Madsen et al. 1991).

1.4 EVALUATION OF ENDANGERED, THREATENED, SPECIES OF CONCERN

There are two state threatened fish species known to populate Black Lake: lake sturgeon (*Acipenser fulvescens*) and mooneye (*Hiodon tergisus*). Lake sturgeon is classified as threatened by the American Fisheries Society in all of the states where they occur (NYSDEC 2008b). There is a remnant population of lake sturgeon in Black Lake and the Oswegatchie River. Moreover, NYSDEC stocked juveniles from hatcheries in the system in 2000. There currently is no evidence that lake sturgeon reproduce in Black Lake, although adults are observed occasionally and the stocked juveniles are observed annually. Some of the juveniles released in 2000 had grown to 40 inches in length by 2003 (Zollweg et al. 2003).

Mooneye has been recorded from Black Lake in limited numbers. This species is on the decline statewide, possibly due to competition from introduced species (NYSDEC 2008c).

1.5 FISHERIES

Black Lake has been a popular sport fishing location for many years. Numerous game species are found in Black Lake including largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieu*), walleye (*Sander vitreus*), northern pike (*Esox lucius*), black crappie (*Pomoxis nigromaculatus*), yellow perch (*Perca flavescens*), bluegill (*Lepomis macrochirus*), rock bass (*Ambloplites rupestris*), muskellunge (*Esox masquinongy*), brown bullhead (*Ameiurus nebulosus*), longnose gar (*Lepisosteus osseus*), redhorse sucker (*Moxostoma valenciennesi*), bowfin (*Amia calva*), and channel catfish (*Ictalurus punctatus*). Walleye were almost extirpated from the lake by the late 1970s, but stocking programs have helped to increase their numbers in recent years (Black Lake, NY Chamber of Commerce 2008). Creel surveys, in 1996 and 2004, and periodic gill netting conducted in Black Lake by the NYSDEC indicate that the Lake fishery remains diverse and healthy. The average size of fish caught increased and the population of largemouth and smallmouth bass increased during the period between the two creel surveys (VanMaaren 2008).

SECTION 2
MANAGEMENT HISTORY AND OBJECTIVES

2.1 MANAGEMENT HISTORY

Past management efforts in Black Lake have been limited to mechanical harvesting (New York State Federation of Lake Associations and NYSDEC 2005). The Black Lake Association and other community groups organized large mechanical harvesting efforts in the 1970s and 1980s, with smaller-scale, homeowner-led harvesting efforts taking place in recent years (Beschle 2008). Mechanical harvesting provides short-term relief from high density macrophyte canopy cover; long-term reduction in canopy density is now desired.

Currently, there is no formal management plan for Black Lake; however, the lake is managed in accordance with the recreational uses of the lake, through fish community monitoring and enforcement of catch size limits by the NYSDEC (VanMaaren 2008) and Eurasian watermilfoil harvesting efforts by the community (Beschle 2008). This aquatic nuisance species management plan focuses on the management of the lake for recreational uses including swimming, boating, fishing, and aesthetics while maintaining or improving the ecological health of the lake. It has been developed in accordance with NYSDEC protocols described in the *Primer on Aquatic Plant Management in New York State* (NYSDEC 2005). The Black Lake Invasive Weed Committee, which is comprised of multiple public and private entities, is the primary group involved with the development of this management plan.

2.2 MANAGEMENT OBJECTIVES

2.2.1 Extent of Preferred Management

The preferred management method(s) for Eurasian watermilfoil growth should be applied to the entire area of Black Lake to reduce the potential for recolonization of treated areas. Removal of Eurasian watermilfoil from the lake will take a concerted multi-year effort and will

affect large areas of the lake due to its current widespread distribution. Total removal of Eurasian watermilfoil is desired from each target area to reduce the ability of the plant to reestablish from adjacent untreated areas. However, the removal methods used should be selective in removing only the target species, leaving native aquatic macrophytes undisturbed wherever possible. Due to the nature of plant growth, removal should be targeted for the late spring and summer months for several years until a large proportion (or all) of the plants are removed. Maintenance monitoring will likely be required in subsequent years to prevent future reestablishment.

2.2.2 Expected Use Benefits

Removing Eurasian watermilfoil from Black Lake should improve boating, fishing, and swimming conditions and the aesthetic qualities for lakeshore residents and other recreational users of the lake. Habitat quality for native aquatic macrophytes should improve as the extent of Eurasian watermilfoil decreases, benefiting the fisheries.

2.2.3 Critical Areas to Protect

Due to the importance of macrophyte cover to the lake fishery, Eurasian watermilfoil removal method(s) should be selective in nature. That is, removal methods should target Eurasian watermilfoil plants only. Nonselective removal methods may unnecessarily impact the fisheries of the lake by removing important cover for juvenile fish and potentially impact their growth and survival.

SECTION 3
MANAGEMENT ALTERNATIVES

There are multiple physical, mechanical, chemical, and biological control methods that are commonly used to control nuisance aquatic plant populations such as Eurasian watermilfoil. The sub-sections below evaluate available control methods in relation to the unique characteristics of Black Lake and Eurasian watermilfoil. The advantages and disadvantages of each method are summarized in Table 3-1 after the method summaries. At the end of this section, the preferred management control method(s) will be outlined. Information on individual control alternatives, unless otherwise noted, has been summarized from *A Primer on Aquatic Plant Management in New York State* (NYSDEC 2005).

3.1 PHYSICAL CONTROL

3.1.1 Hand Harvesting

Hand harvesting is essentially underwater weeding. This is the most selective method for Eurasian watermilfoil removal, preserving the majority of native aquatic macrophyte species. The entire plant, including the roots, is removed, as opposed to other methods, which remove the upper portion only or leave the root system intact. Hand harvesting also has the lowest equipment expenses of any method. The disadvantages to hand harvesting are that it is very labor intensive and harvesting dense beds can be difficult and time consuming. The largest expense in hand harvesting is labor and total costs are estimated to be $400 to $1,000 per acre. In their Eurasian watermilfoil management plan, the Lake George Park Commission (LGPC) estimated labor costs for hand harvesting at $70 per hour (ENSR International 2005).

3.1.2 Suction Harvesting

In suction harvesting, a SCUBA diver uses a barge-mounted hydraulic dredge to suck up stems, roots, and surficial sediments. This method is selective, though less so than hand

harvesting, and can be more efficient than hand harvesting in dense beds. The primary disadvantage of suction harvesting is that it is more labor intensive than methods that do not require a SCUBA diver, although it is faster than hand harvesting. Suction harvesting does not remove the root system of all the plants, requiring limited hand harvesting in subsequent seasons. Suction harvesting also causes more disruption to the benthic environment than hand harvesting (ENSR International 2005). Costs are higher for suction harvesting due to equipment expenses and the need for an additional SCUBA diver and personnel on the boat to dispose of plant materials. Suction harvesting equipment cost ranges from $20,000 to $30,000 and operations and disposal ranges from $1,000 to $25,000 per acre. The LGPC indicated that suction harvesting equipment can cost up to $50,000, not including purchase of a boat on which it can operate (ENSR International 2005).

3.1.3 Benthic Barriers

Benthic barriers are sheets of non-transparent materials used to shade out entire beds of aquatic macrophytes. This method is partially selective in that barriers can cover specific areas, but they will eliminate all of the vegetation in the patch to which they are applied. This management method is best used to non-invasively eliminate dense monoculture beds of invasive species. Elimination of vegetation beneath the benthic barrier takes approximately one month (ENSR International 2005). The method is also non-toxic, and will therefore, not harm the fisheries. The disadvantage of benthic barriers is that they can eliminate some species of benthic invertebrates and inhibit spawning of warm-water fish. Cost of materials and difficulty of installation preclude its use over large areas; however, areas up to 1 acre have been treated using benthic barriers in Lake George, NY (ENSR International 2005). Additionally, barriers must be removed or cleaned each year, requiring additional labor. Professional installation of benthic barriers with SCUBA divers can range from $10,000 to $25,000 per acre. However, in shallow littoral areas (<6 ft.), tarps can be applied without the aid of SCUBA divers, using readily available materials much more cheaply. Care must be taken to install barriers properly to avoid ballooning or detachment from the bottom.

3.1.4 Drawdown

Drawdown involves lowering the water level in the lake to expose bottom sediments, and thereby kill aquatic macrophytes. Drawdown is a non-toxic method for removal of invasive aquatic plants and can be useful for smaller, hydraulically controlled water bodies. Black Lake does not have a water control structure, making this method inapplicable. Additionally, such a measure would be a severe stressor to the fish community in the lake and would impede recreational boating, swimming, or fishing during the draw down period.

3.2 MECHANICAL CONTROL

3.2.1 Rotovating/Hydroraking

Rotovating, similar to rototilling a field, involves tilling the bottom sediments and removing the invasive plants and their root structures. This method can target specific beds in an area; however, all species in a targeted bed will be removed. In addition, this method disturbs the sediments and can greatly alter the benthic invertebrate and macrophyte community. Disturbance to the sediments also can promote the establishment of disturbance-adapted macrophytes, including Eurasian watermilfoil after treatment. In a fluvial lake, such as Black Lake, the fragmentation caused by this method also could lead to the spread of Eurasian watermilfoil to currently unimpacted areas of the lake. Finally, this method results in high local turbidity levels potentially causing an aesthetic problem for lake-shore residents. If professional services are engaged, cost for this method is approximately $1,500 per acre. If community services are used, equipment purchase costs range from $100,000 to $200,000 and operating costs range from $200 to $300 per acre.

3.2.2 Dredging

Dredging removes the plants and the sediment to a specified depth. Dredging can be useful in removing nutrient-rich sediments in targeted areas along with the entire bed of nuisance plants and may improve boating and fishing conditions by increasing the water depth in areas

that may be too shallow for navigation. However, dredging would not be a viable option for removing nuisance populations of Eurasian watermilfoil over the large area occupied in Black Lake. Dredging would remove all plants and benthic organisms in a given area, regardless of species, removing the habitat and food source for fish. Eurasian watermilfoil also grows over a wide depth range depending on water clarity; therefore, small changes in water depth may not affect its future distribution. Dredging would greatly disturb sediments creating habitat for disturbance-adapted invasive species, such as Eurasian watermilfoil. Finally, dredging if performed improperly could cause high turbidity, nutrient release, algal blooms, and fish kills due to increased oxygen demand caused by sediment resuspension. Costs for dredging vary greatly between $1,000 and $40,000 per acre depending on the depth of excavation, the ease of access, nature of the sediment (i.e., contaminated or not), and the disposal method. If sediments need to be disposed of off-site, costs increase toward the upper end of the range.

3.2.3 Mechanical Harvesting

Mechanical harvesting removes the top portion of aquatic plants, leaving behind the roots and lower vegetative portion of the plant. Consequently, the plants can regenerate and the harvest must be repeated multiple times in a season to maintain the benefits for boating and swimming. This method leaves the benthic community intact and provides habitat for fish. Fragmentation of aquatic plants is the most severe disadvantage of mechanical harvesting. Even though cut plants are collected and removed, fragments may be missed. Eurasian watermilfoil reproduces primarily by vegetative propagules (fragments) meaning that this control method could actually increase the problem rather than decrease it. Equipment costs in 2005 ranged between $100,000 and $200,000 dollars for a harvester and shore conveyer. Operation costs were $200 to $300 per acre.

3.3 BIOLOGICAL CONTROL

3.3.1 Herbivorous Insects

Introduction of herbivorous insects is a non-toxic, unobtrusive form of management for Eurasian watermilfoil. The two insects known to target Eurasian watermilfoil, milfoil weevil (*Euhrychiopsis lecontei*), and an aquatic moth (*Acentria ephemerella*) cause minimal damage to other species of macrophytes and the slow reduction in plant biomass reduces the chance of oxygen reduction due to decomposing vegetation. Additionally, these species are native to the region and would, therefore, not pose an additional invasive species risk. Insect herbivory is much slower than the other methods and will not provide immediate relief from dense beds of Eurasian watermilfoil. Further, results of insect herbivory are not always dramatic and many efforts to use either of these insects for control produced little or no results at all. Stocking efforts to date have cost approximately $1,000 per acre ($1 per insect).

3.3.2 Grass Carp

Grass carp (*Ctenopharyngodon idella*) herbivory is another biological method for removing Eurasian watermilfoil. The benefits of using grass carp are that it involves very little physical labor and the carp are efficient at removing vegetation given time. The primary disadvantage of this method is that grass carp will remove all vegetation in a system over time and actually do not prefer Eurasian watermilfoil as forage, removing more desirable species first. Such a control method would be a detriment to the fish community in the lake. Grass carp prefer moving water and quickly migrate to it when possible, presenting an additional problem for introduction to Black Lake where there is no control structure at the inlet or outlet to prevent migration from the lake. NYSDEC will not issue a permit for stocking this species in any waters where isolation of the grass carp to that waterbody is not guaranteed. Even in lakes where control of the carp is guaranteed, a full environmental impact statement is required. Costs for this control method average between $50 and $100 per acre based on the standard stocking rate allowed by the NYSDEC of 10 to 15 fish per acre.

3.4 CHEMICAL CONTROL

3.4.1 Aquatic Herbicides

Aquatic herbicides are commonly used to eliminate nuisance macrophyte populations in smaller waterbodies. This method can provide both immediate and long-term control of nuisance species depending on the product chosen and the timing of the application. Herbicides also have been shown to be effective on Eurasian watermilfoil. Unfortunately, because aquatic herbicides are not completely species-specific they can have a detrimental affect on other, desirable aquatic macrophytes. Decomposition of the affected plants, if not removed after treatment, can deplete dissolved oxygen in the lake and the release of nutrients can cause algal blooms that will negatively impact both the fish community and the recreational quality of the lake. Use restrictions on the lake after treatment can extend to as much as 30 days, which during the recreational season would be a significant disadvantage. Herbicide application typically costs between $200 and $400 per acre.

3.4.2 Shading Chemicals

Shading chemicals are dyes added the lake surface waters to reduce light penetration, thereby shading out the aquatic macrophytes. These chemicals are non-toxic to humans and most aquatic organisms and have the potential to treat the entire lake in a single year. However, this treatment method is not applicable for removing Eurasian watermilfoil from Black Lake due to the species' growth characteristics. Eurasian watermilfoil is less light sensitive than many other species, forming a surface canopy in low-light conditions and may survive the dye treatment. Moreover, these chemicals may be flushed from Black Lake due to its fluvial nature, and would, therefore, require multiple treatments to maintain the shading effect. Additionally, because these chemicals are very water soluble they must be applied to the entire lake, and would shade out other more desirable (native) species. Chemical dyes for this application are approximately $12.50 per acre-foot of water.

3.4.3 No Action

If no action is taken to remove Eurasian watermilfoil from Black Lake, conditions are not expected to improve. Herbivory by aquatic insects could occur naturally if aquatic moths or milfoil weevil are present in the lake, but can not be guaranteed. Recreational conditions could conceivably become much worse as Eurasian watermilfoil continues to spread under current conditions and zebra mussels continue to increase water clarity, allowing the plant to spread into deeper waters of the Lake than they currently occupy.

Table 3-1. Comparison of methods for removing Eurasian watermilfoil from Black Lake, NY.

Class	Method	Advantages	Disadvantages	Costs
Physical	Hand harvesting	Removes only target plants; low equipment costs	Very labor intensive; harvesting dense beds is inefficient	$400 - $1,000 per acre
Physical	Suction harvesting	Removes only target plants; more effective in medium density beds	Labor intensive; added equipment costs; some difficulty with very dense beds	$20,000 - $30,000 for equipment and $1,000 - $25,000 per acre for operations and disposal of harvested plants
Physical	Benthic barrier	Effective at treating very dense beds	Eliminates some non-target species; may interrupt spawning of some warm-water fish; may eliminate some benthic invertebrates	$10,000 - $20,000 per acre for professional installation
Physical	Drawdown	Can be very effective for smaller water bodies with control structures	Black Lake does not have a control structure.; drawdown would negatively impact the ecosystem and recreational use of the lake	N/A
Mechanical	Rotovating	Both stem and roots are removed	Severe disturbance to sediments can lead to recolonization by invasive species; fragmentation of Eurasian watermilfoil can lead to colonization of new areas	$100,000 - $200,000 for equipment and $200 - $300 per acre for operations; or $1,500 per acre to hire professional service
Mechanical	Mechanical harvesting	Provides habitat for fish; leaves benthic community intact	May have to be repeated more than once each year; fragmentation of Eurasian watermilfoil can lead to colonization of new areas	$100,000 - $200,000 for equipment and $200 - $300 per acre for operations

Class	Method	Advantages	Disadvantages	Costs
Mechanical	Dredging	Removes nutrient-rich sediments with target plants; also deepens areas that may be too shallow for navigation	Removes non-target plants and benthic invertebrates; sediment disturbance can lead to recolonization by invasive species; can cause high turbidity	$1,000 - $40,000 per acre depending on chemical nature of sediment and need for off-site disposal
Biological	Herbivorous insects	Milfoil weevil the aquatic moth target only Eurasian watermilfoil and are native species; slow reduction in plant biomass minimizes chance of increased eutrophication	Slow method; results from introduction are inconsistent	Stocking costs approximately $1,000 per acre
Biological	Grass carp	Very little labor involved; very effective at removing vegetation given time	Removal of non-target species; grass carp prefer moving water and are very likely to migrate from the lake; highly regulated	Stocking costs $50 - $100 per acre
Chemical	Aquatic herbicides	Effective on Eurasian watermilfoil; can provide short- and long-term control	Removal of non-target species; decomposing vegetation can reduce dissolved oxygen and cause algal blooms; use restrictions may be placed on the lake after application	$200 - $400 per acre
Chemical	Shading chemicals	Could treat the whole lake at the same time	Multiple treatments would probably be needed; removal of non-target species; may not be effective on Eurasian watermilfoil	$12.50 per acre-foot of water

3.5 RECOMMENDED ALTERNATIVE(S)

To effectively remove Eurasian watermilfoil from Black Lake, while maintaining native aquatic macrophyte habitat for fish, an integrated treatment approach is required, employing three methods: hand harvesting, suction harvesting, and benthic barriers. Hand harvesting should be performed on lower density beds, where there are fewer than 500 plants per acre. Hand harvesting at this level of density has been shown to be effective for other lakes (Mattson et al. 2004). Suction harvesting should be used on beds of intermediate density or dense beds where concern needs to be taken to preserve non-target species. Suction harvesting is recommended on beds less than 0.25 acres (Mattson et al. 2004). The suction harvesting

equipment can also be used as an aid during hand harvesting for removal of pulled plants. Benthic barriers should be applied to dense monospecific beds of Eurasian watermilfoil where non-target species are not a consideration or can be avoided during application. Benthic barriers have been used on areas up to one acre in Lake George (ENSR International 2005). Follow-up hand harvesting may be needed for some sites treated by benthic barriers or suction harvesting, to remove plants surviving the first treatment. These recommendations are consistent with other successful Eurasian watermilfoil management efforts in New York State (Appendix A).

Given the large areal extent of Eurasian watermilfoil growth in the Lake full eradication may be difficult. Removal efforts will need to take place over multiple years and should be prioritized to achieve the most benefit for the fisheries and for the recreational use of the lake. Removal should occur first in areas of high boat traffic to reduce fragmentation and spread of Eurasian watermilfoil and in areas that would most benefit the fish, such as spawning beds. Specific plans for removal can only be made after more detailed mapping of distribution and density of macrophytes has been completed. To help limit recolonization of Eurasian watermilfoil, removal should be followed by planting of native species, either seeds or tubers. Harvested areas should be monitored and treated again if reinvasion occurs. In addition, a comprehensive watershed management plan should be developed that would help reduce eutrophication in the Lake, thereby reducing its suitability for Eurasian watermilfoil.

3.5.1 Estimated Costs for Recommended Alternative

Costs for the selected alternative vary considerably depending on the total acreage harvested using each method. Purchase of suction harvesting equipment is a one-time expense ($20,000 to $50,000) and benthic barrier materials can be reused for multiple beds if maintained properly. Costs for a boat to support the harvesting efforts are approximately $35,000. Harvested plant materials can be composted and used as a soil additive, but transport and composting will incur additional costs. Table 3-2 outlines the estimated costs for total eradication of Eurasian watermilfoil using the selected remedy. These estimates do not include the capital expenditures required to buy harvesting equipment or a boat. The acreages for hand harvesting assume that half of the area displayed as “60%” cover in Figures 1-2a and 1-2b would

be harvestable by hand. All of the areas displayed with greater than 90% cover were assumed to be too dense for hand or suction harvesting. The costs for benthic barrier installation assume professional installation. Costs per acre will be lower if barriers are installed using volunteer labor in shallow areas.

Table 3-2. Cost planning estimates for total removal of Eurasian watermilfoil from Black Lake, NY.

Treatment Method	Acres to be Treated	Cost per Acre Range	Assumed Cost per Acre	Estimated Cost[1]
Hand harvesting	932	$400 - $1,000	$700	$652,400
Suction harvesting	932	$1,000 - $25,000	$13,000	$12,116,000
Benthic barrier - professional installation	1371	$10,000 - $25,000	$10,000[2]	$13,710,000
Total	**3235**			**$26,478,400**
			Say	**$20-30 MM**

Notes:
[1]The cost per acre was estimated using the median cost for hand and suction harvesting and the lower end of the cost range for benthic barrier installation.
[2]The lower end of the cost range for benthic barrier was assumed because barrier materials can be reused, defraying some costs.

3.5.2 Permits Required for Recommended Alternative

Some permits may need to be obtained to perform these management activities. Hand harvesting is not a regulated activity in most of the State, though some NYSDEC regional offices may require a permit or approval for large scale removal. Suction harvesting regulations are similar to those for dredging operations and will require a permit from the NYSDEC and possibly from the United States Army Corps of Engineers. Benthic barriers are not a regulated activity in most of the state, although some NYSDEC regional offices may require a permit or approval for disruption of fish habitat or covering large areas of the lake bottom. Additionally, because there is a large area of forested wetland on the southern shore of Black Lake a wetland permit will be needed if disturbance of the wetland is anticipated (NYSDEC 2005).

SECTION 4
PRE-, DURING- AND POST-TREATMENT ACTIONS PLANNED

4.1 MONITORING (ONGOING AND FUTURE)

4.1.1 Aquatic Plants

Aquatic plant growth has been monitored, in some form, as part of the CSLAP program since 1988. Macrophyte growth is qualitatively measured annually, where macrophyte growth is categorized as not visible, below surface, at surface, dense at the surface, or present in all shallow areas. Additionally, qualitative plant surveys were conducted in parts of Black Lake in 1990 and 1991 to determine the dominant macrophyte species in the lake (NYSDEC 2007).

The distribution of Eurasian watermilfoil and other macrophytes within Black Lake needs to be established to plan specific removal actions and for use as a baseline against which future distributions can be compared. Plant surveys should be integrated into the CSLAP program. The extent of aquatic vegetation beds in the lake should be mapped, with the species in each bed indicated, and a qualitative assessment of density (e.g., trace, sparse, medium, or dense) provided. An environmental professional trained in the identification of aquatic plants may be required to train the volunteers initially. This mapping process should be repeated each year, as part of the CSLAP program, during the period of maximum macrophyte growth to track the growth of Eurasian watermilfoil lakewide. Volunteers should note the presence of Eurasian watermilfoil wherever it occurs, whether it is an individual plant or bed, so that removal actions may be undertaken. Additionally, personnel involved in harvesting activities should make quantitative assessments of Eurasian watermilfoil density during harvesting and follow-up visits. One 0.25 m^2 quadrat should be sampled per acre and the number of Eurasian watermilfoil stems per quadrat and the coordinates of the quadrat should be recorded. This information can then be used to quantitatively determine the efficacy of the harvesting program in treated areas.

4.1.2 Water Quality

The trophic status of the lake is currently monitored by volunteers as part of the CSLAP, including: water temperature; clarity (secchi depth); conductivity; pH; color; phosphorus; nitrogen; chlorophyll-a; and calcium. In addition, qualitative water quality assessments of the lake are conducted, classifying the lake according to the following categories (NYSDEC 2007):

- crystal clear;
- not quite crystal clear;
- definite greenness;
- high algae; or
- severe high algae.

These parameters should be sufficient to assess whether the water quality of the lake is being negatively affected by Eurasian watermilfoil management activities. Participation in the CSLAP program should continue in the future.

4.2 EARLY RESPONSE

During and after management, it will be essential to quickly respond to newly established populations of Eurasian watermilfoil. The first key to early response is the education of residents and users of the lake on the identification of this plant. Second, the new population must be quickly removed, to prevent further spread of the plant.

4.2.1 Educational Program

Lake-side residents and users of the lake should be educated on the identification of Eurasian watermilfoil. The easiest way to non-resident users of the lake is to place signs and pamphlets at boat ramps with pictures of milfoil in its various growth forms and its leaf morphology along with information on its detrimental effects on the lake environment. Lake-side residents can be informed by delivering the same pamphlets to their residences. These

pamphlets could also be left in public areas of rental properties to inform other short-term visitors who may not use boat launches.

4.2.2 Removal - Hand Pulling

Whenever a new Eurasian watermilfoil location is identified, whether single plants or small beds, that location should be slated for hand pulling during that year. Using hand pulling to eliminate new beds has been a mainstay of the Lake George Park Commission's Eurasian watermilfoil management strategy and can be the most effective way to prevent further spread to new, or previously cleared, areas of the lake (ENSR International 2005). Identification of new beds can be performed by volunteers in the CSLAP program or by users of the lake informing the Black Lake Association.

4.3 SOURCE MANAGEMENT

Users of the lake should be educated on the deleterious effects of Eurasian watermilfoil on the lake environment and the various ways it is introduced to lakes. Signs and pamphlets will be placed at boat ramps with pictures of milfoil in its various growth forms and its leaf morphology, along with information on its detrimental effects on the lake environment. These materials will prompt users to voluntarily inspect their boats and props for the presence of plants from previous lakes they may have visited. Water hoses should be provided at boat launches and marinas so that any plant materials can be washed off on land before the boat enters the water.

4.4 EVALUATION OF EFFICACY

The efficacy of the program should be assessed annually to determine if management efforts should continue. The primary assessment should be whether Eurasian watermilfoil is being effectively managed by the methods chosen. This can be determined by the plant monitoring methods identified previously and evaluating if Eurasian watermilfoil beds have been eliminated or reduced in density. The fisheries should be evaluated each year to determine if the

management is having effects, positive or negative, on fish populations. A simple approach can be taken initially, involving angler diaries in which the users of the lake will indicate their fishing location, the number of anglers, the species caught, and the number of each species. This information can be used to track changes in the sport fish population. Finally, user surveys can be used to evaluate whether people perceive an improvement in the recreational quality of the lake in treated areas. The angler and user surveys can be left in the same locations as the informational materials, with a box for their deposition upon return. The results of these efficacy assessments should be reported to the NYSDEC regional office to inform them of the current status of the lake.

SECTION 5
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FIGURES

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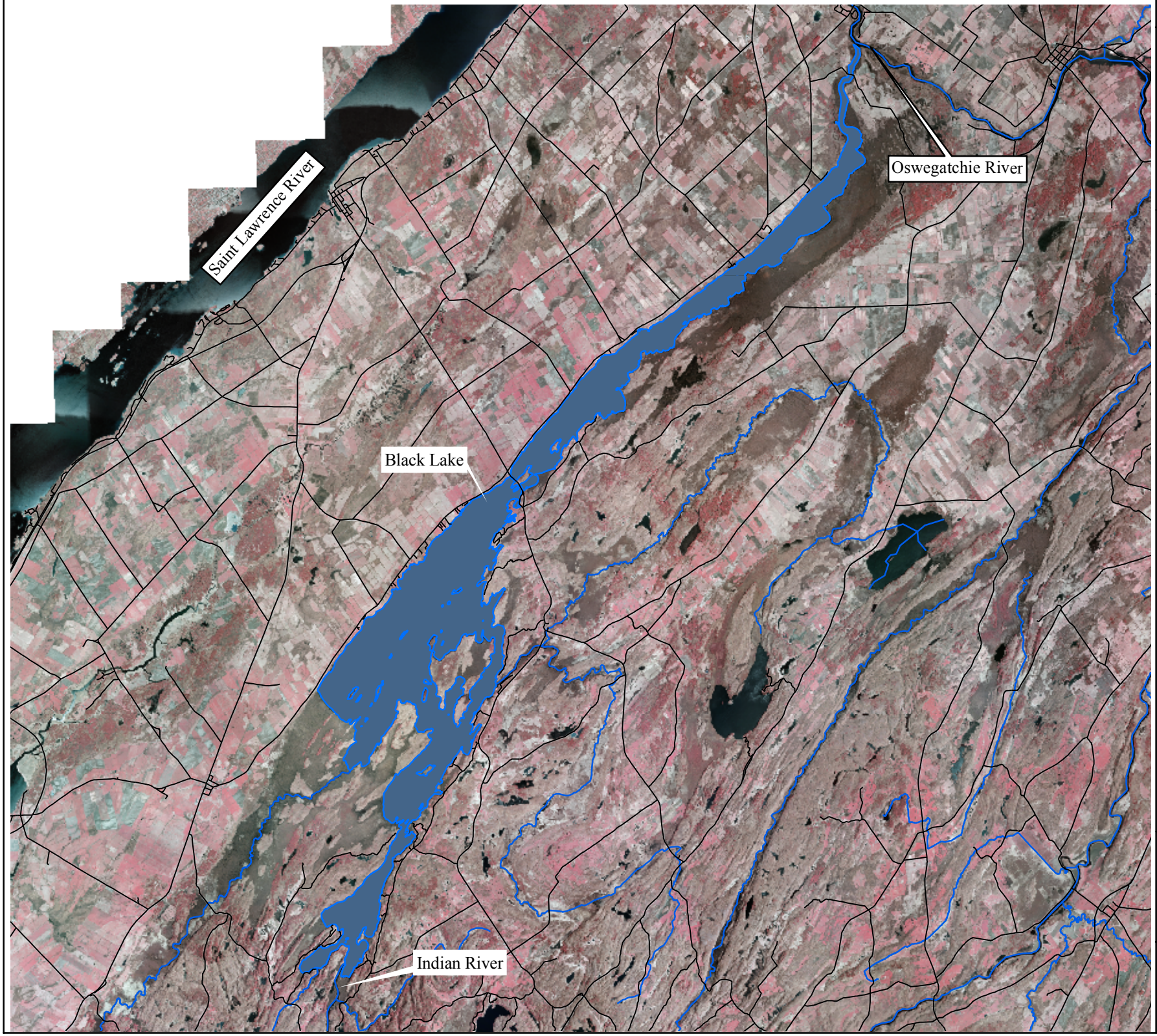

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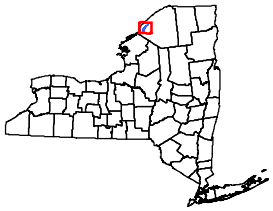

SCALE

0 1 2 Miles

LEGEND

- Roads
- Black Lake
- NHD Hydrography

Note: Aerial photos are color infrared photography taken in 2003.

Figure 1-1.
Black Lake, NY
Regional Location

QEA
Quantitative Environmental Analysis, LLC

BLKmil July 2008

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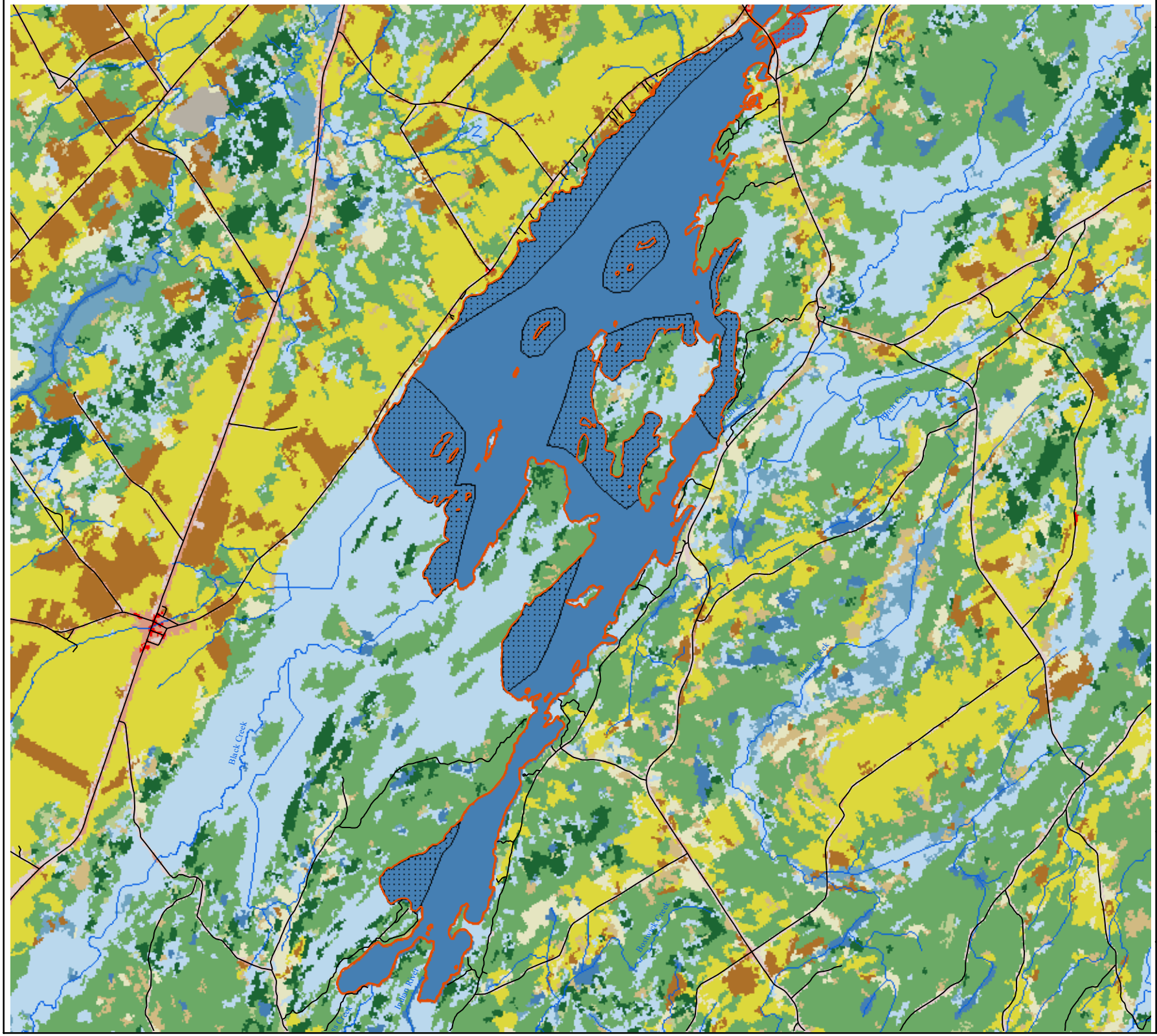

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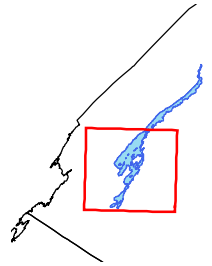

SCALE

0 0.5 1 Miles

LEGEND

- Roads
- NHD Hydrography
- Black Lake

Eurasian watermilfoil Percent Cover

- 60%
- > 90%

NLCD Landcover

- open water
- developed, vacant land
- low intensity urban
- medium intensity urban
- high intensity urban
- barren land
- deciduous forest
- evergreen forest
- mixed forest
- scrub/shrub
- grassland
- pasture
- cultivated crops
- woody wetland
- herbaceous wetland

Figure 1-2a. Eurasian watermilfoil distribution in Black Lake and surrounding land-use: south

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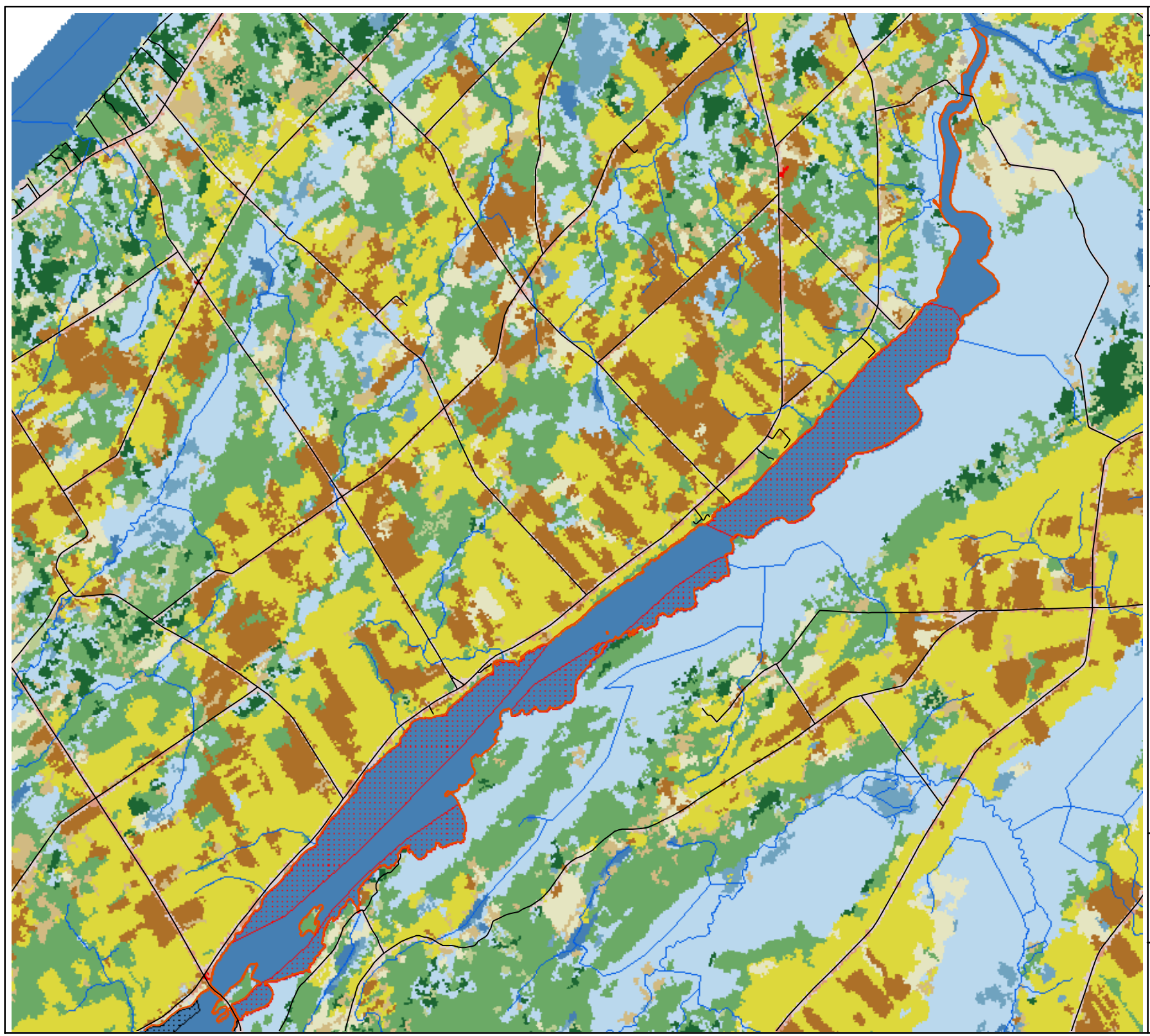

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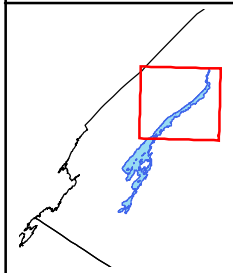

SCALE

0 0.5 1 Miles

LEGEND

- Roads
- NHD Hydrography
- Black Lake

Eurasian watermilfoil Percent Cover

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- developed, vacant land
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- barren land
- deciduous forest
- evergreen forest
- mixed forest
- scrub/shrub
- grassland
- pasture
- cultivated crops
- woody wetland
- herbaceous wetland

Figure 1-2b. Eurasian watermilfoil distribution in Black Lake and surrounding land-use: north

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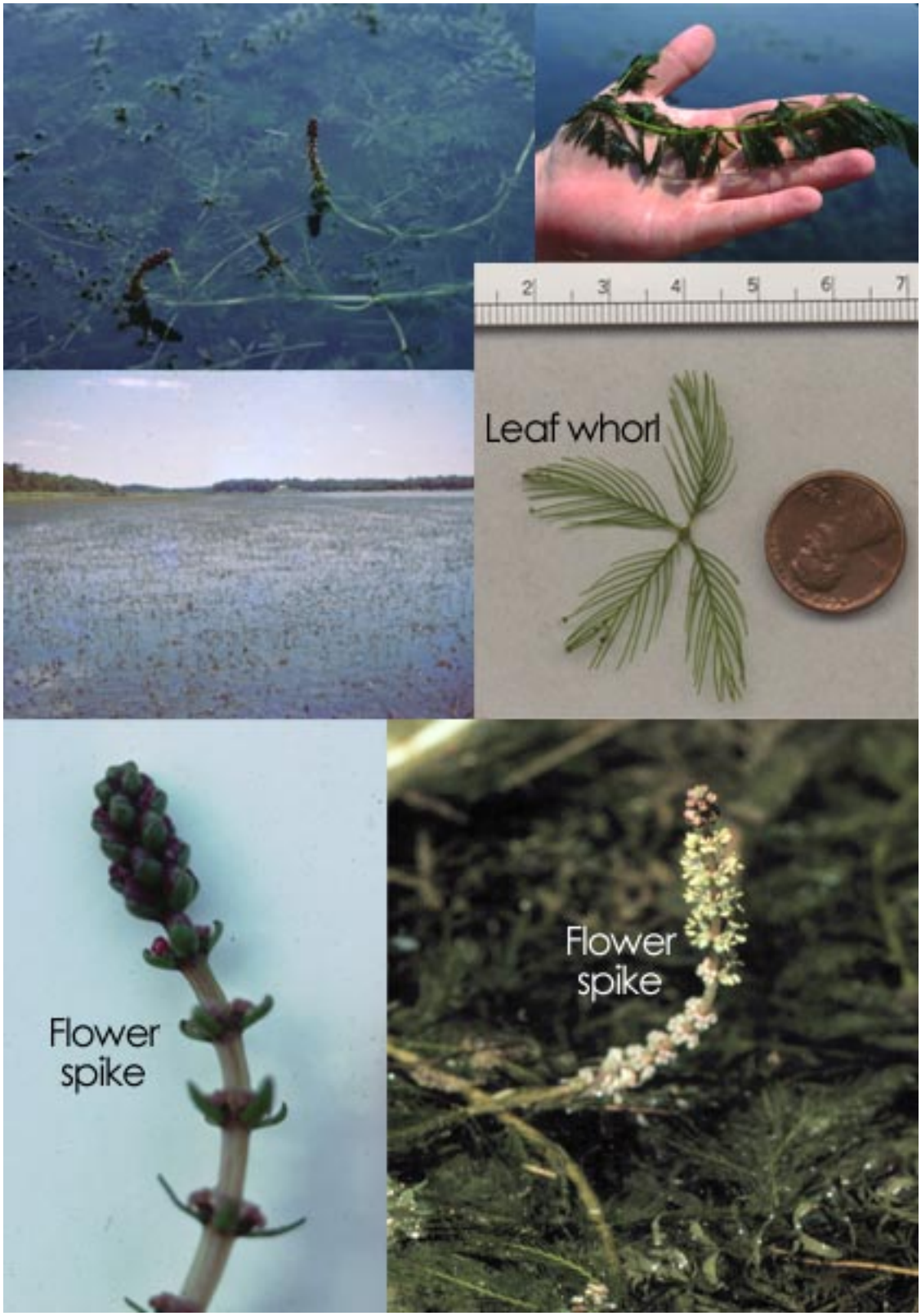

Figure 1-3. Schematic showing the growth form and physical characteristics of Eurasian watermilfoil (Maryland DNR 2008).

APPENDIX A
SELECTED EURASIAN WATERMILFOIL EXPERIENCE IN NEW YORK STATE

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APPENDIX A
SELECTED EURASIAN WATERMILFOIL EXPERIENCE IN NEW YORK STATE

Lake George, New York State

Lake George is located in the southeastern corner of the Adirondack Park. Its overall length is 31.7 miles, maximum depth is 190.3 ft. and average depth is 59.1 ft. Eurasian watermilfoil was first detected in Lake George in 1985. Management of the species began in 1987 after it became clear that the plant was spreading rapidly and could become a problem. The approach taken in Lake George has been a combination of hand harvesting in low density areas; suction harvesting in mid-density areas; and benthic barriers in areas of high density, monospecific milfoil growth. The Lake George Park Commission also had originally proposed the use of the herbicide Sonar® in its current management plan, but this was rejected due to concern about possible impacts on protected plant species. To date, 148 Eurasian watermilfoil sites have been identified in Lake George, 136 have been managed, and 112 of these have been cleared (ENSR International 2005).

Fulton Chain of Lakes, New York State

The Fulton Chain of Lakes, in Herkimer and Hamilton Counties in the Adirondack Park, has dense growths of Eurasian watermilfoil in Fifth, Sixth, and Seventh Lakes. The Fulton Chain of Lakes Association, the Towns of Inlet and Webb, and the two counties have been combating its growth in the three lakes since 2006 using hand and suction harvesting. Their efforts have succeeded at reducing density of Eurasian watermilfoil in harvested beds by 90% between 2006 and 2007. The coalition of groups has received a matching fund grant from New York State for 2008-2010 (Smith and Stafford 2008).