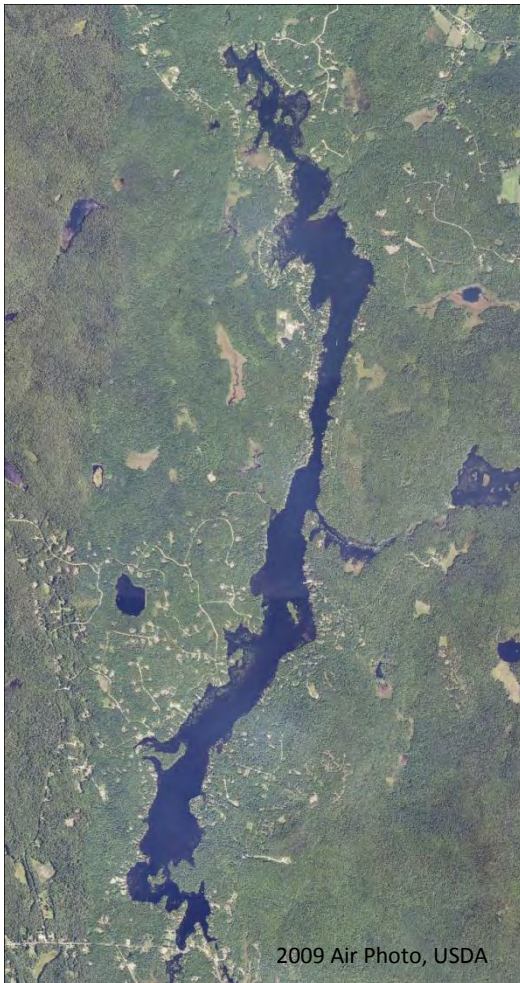

Lake Inventory and Management Plan for Highland Lake, Washington/Stoddard, NH



October 2010

Prepared for the
Highland Lake Unified Association

Prepared by
Upper Valley Lake Sunapee
Regional Planning Commission
10 Water Street, Suite 225
Lebanon, NH 03766



Table of Contents

1) Comprehensive Lake Inventory

Appendix A – Tabulation of Lake Values

Appendix B – Active Watercraft Surveys, 2010

Appendix C – Wildlife Species in the Highland Lake Watershed

2) Highland Lake Management Plan

Appendix A – Results of Public Values Assessment Survey

Appendix B – Reference Materials on Economic Impacts Associated with Invasive Aquatic Plant Infestations in New Hampshire's Lakes

Acknowledgements

Many thanks to Joe van Shaick for coordinating this project for the Highland Lake Unified Association and to Jacquie Colburn, Lakes Coordinator at the New Hampshire Department of Environmental Services, for her technical expertise and careful review of the inventory and plan.

Funding for this project was provided by the New Hampshire Department of Environmental Services through Section 604(b) of the Clean Water Act with funds appropriated by the American Recovery and Reinvestment Act of 2009.

Comprehensive Lake Inventory for Highland Lake, Washington/Stoddard, New Hampshire

Summary of Findings

Prepared by Upper Valley Lake Sunapee Regional Planning Commission, 2010

Purpose and Methods of the Comprehensive Lake Inventory

The Lakes Management and Protection Program at New Hampshire Department of Environmental Services (NHDES) developed the Comprehensive Lake Inventory (CLI) in order to promote lake and watershed management planning. Completing the CLI establishes a baseline of quantitative, objective and standardized information about a lake and its watershed.

The CLI's purpose is to organize information in a non-technical format accessible to the layperson and to serve as a planning and educational tool. It is not a substitute for detailed assessments of a specific impact to a lake, but rather is intended as a first step in developing a broad-based lake or watershed management plan.

The CLI is organized by specific characteristics commonly evaluated when developing a lake management plan. For each characteristic, there is a series of questions and a listing of multiple-choice answers for each question. The CLI also includes a basic assessment methodology. A score has been assigned to particular questions to ascertain each of these values as follows:

- Recreational Value, ranked from 1 – 5, with 1 being the lowest level of recreational value and 5 being the highest level of recreational value.
- Unique or Outstanding Value, ranked from 1 – 5, with 1 being few unique features or little outstanding value and 5 being many unique features or most outstanding value.
- Susceptibility to Impairment, ranked from 1 – 5, with 1 being the lowest level of susceptibility and 5 being the highest level of susceptibility.

There are 20 questions for each value, with a maximum total of 100 points. Appendix A shows the tabulation for each value.

This report is a summary of the results from the inventory and assessment of Highland Lake.

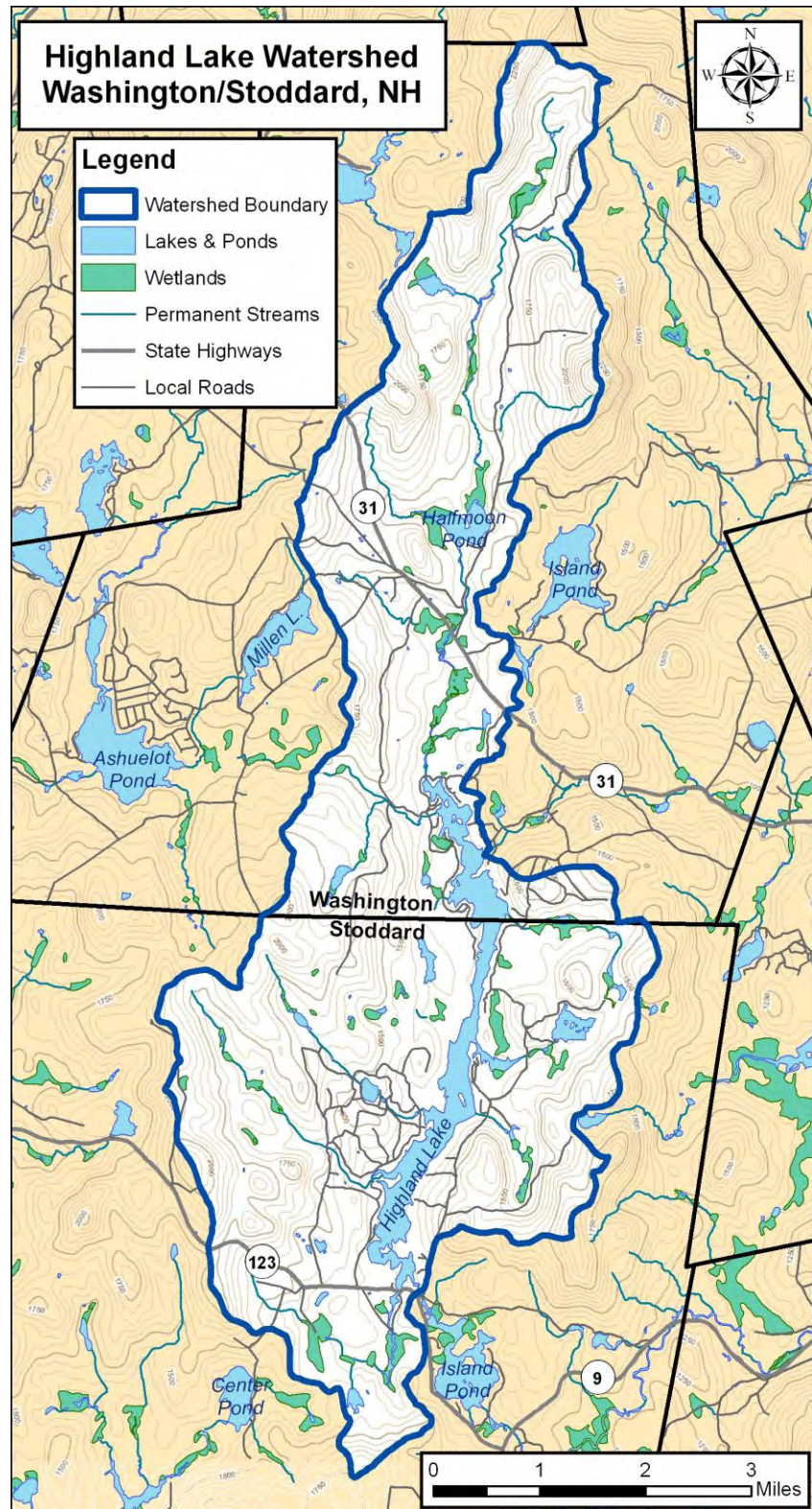
Geographic Location and Context

Highland Lake is located in the western part of New Hampshire and lies within the Town of Washington in Sullivan County and the Town of Stoddard in Cheshire County (Map 1).

The lake is 712 acres in size, and its watershed drains just over 19,000 acres, or 29.7 square miles.

The lake is accessible from Route 9, a major transportation corridor between Keene and Concord, as well as state highways Route 31 and Route 123.

Highland Lake is in the headwaters of the Contoocook River watershed, which is part of the Merrimack River basin.



Map 1. The watershed of Highland Lake in Washington and Stoddard, NH.

Assessment of Recreational Value

“A lake with a high level of recreational value is one that provides and/or supports a variety of passive and active recreational activities. Recreational activities on these lakes can range from swimming and canoeing to powerboat racing. Given the lake’s characteristics, number and type of craft and/or activity, the degree of development in the watershed, and the water quality of the lake, the management plan should include appropriate guidelines to ensure that the lake is not impaired by excessive or inappropriate on-water activities.”

Highland Lake ranks moderate-high for recreational value based on the methodology of the Comprehensive Lake Inventory, with 71 out of 100 points.

While in a rural setting, Highland Lake’s southern boat launch is less than five miles from NH Route 9, a major transportation corridor between Keene and Concord. Within a 30-mile radius of the southern boat launch, there are an estimated 542,219 year-round residents, including the cities of Claremont, Concord, Keene and Manchester.

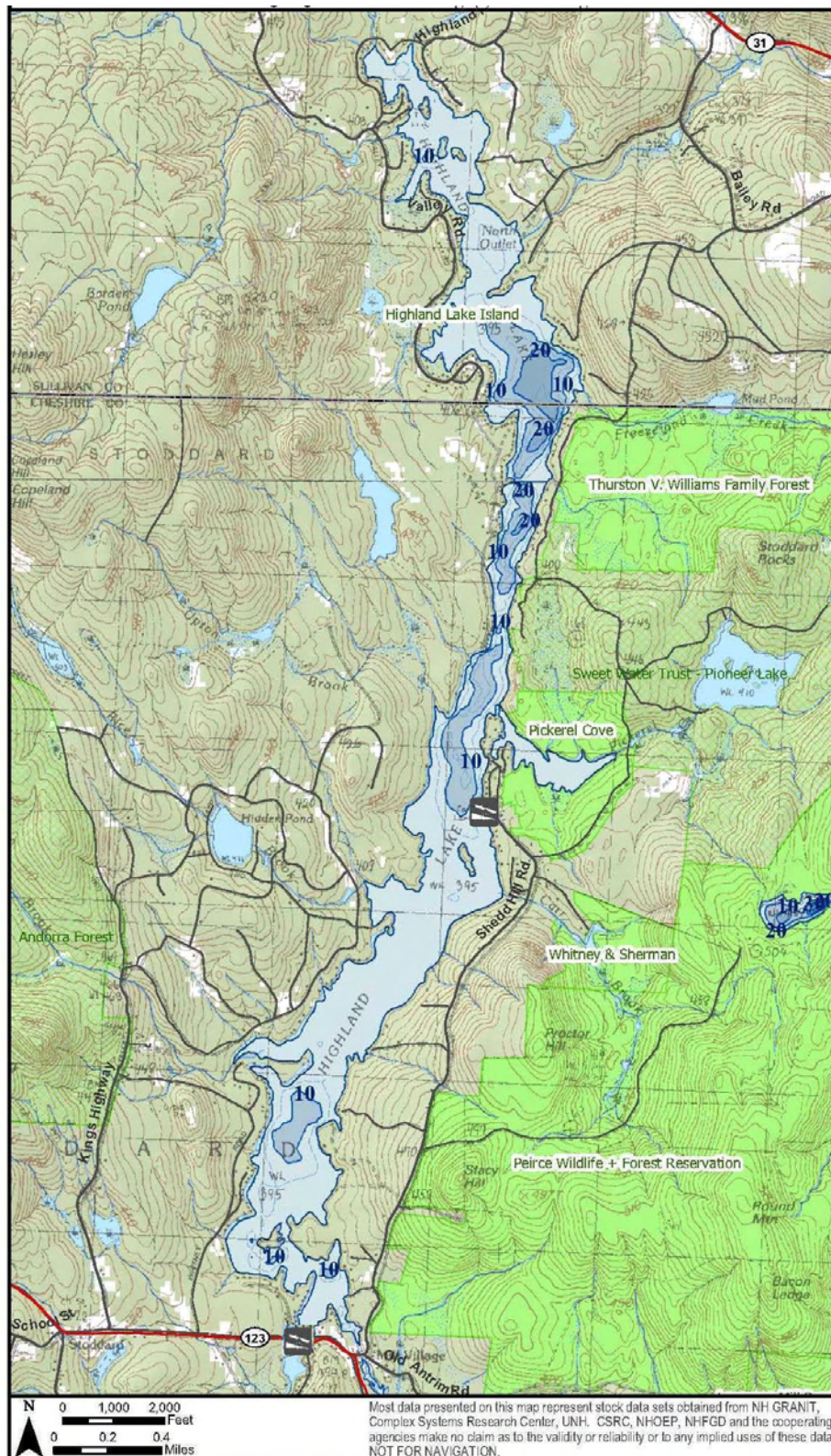
The physical and water quality characteristics of Highland Lake make it attractive for recreation, as it is large (712 acres), has many embayments, and has seven islands. 2009 records from the Volunteer Lake Assessment Program (VLAP) show that the water clarity is good (2.1-3.5 meters). VLAP records also show that the chlorophyll-a concentration supports a thriving aquatic community, but is not excessively high (2.68 – 4.18 µg/L in 2009.) There are a number of specialized wildlife habitats in Highland Lake, including the numerous shallow coves and embayments providing breeding and rearing habitat for fish, reptiles, amphibians and other aquatic life (Map 2).

Highland Lake is attractive for recreation for the numerous lakefront residents. The dominant land use along the shoreline is residential development (Map 3), but the watershed remains almost entirely undeveloped and forested. The undeveloped watershed creates a rural aesthetic with several scenic views of the nearby hills and mountains. Islands and exposed rocks in the lake also contribute to its scenic character.

There are no special legal restrictions on speed limit or ski craft operations for Highland Lake. The lake does have several no-wake zones at narrow channels (North Narrows, South Channel and South Outlet Channel) as well as Pickerel Cove on the east side of the lake. There is one marina and two public boat launches on Highland Lake. Four road associations (Highland Lake Association, Highland Haven, Hidden Lake and Whitney Road) maintain their own beaches for members; Idle Times Campground in Washington also has a beach for its guests.

Motorized watercraft dominates lake recreation on summer weekends, with non-motorized paddling and sailing representing about 20% of recreational use. 2010 weekend surveys estimate a moderately high usage of the lake (roughly one watercraft every 10 acres) during peak summer

Map 2. Bathymetric Map of Highland Lake, New Hampshire Fish and Game Department



use. For Highland Lake, a density of one watercraft every 10 acres translates to 71 boats being actively used at one time on the 712-acre lake. Survey results are included as Appendix B.

Fishing for warmwater game fish is also popular, including small and large-mouth bass, horned pout, white perch, black crappie and pickerel. Highland Lake hosts eight or nine fishing tournaments a year. Outside of fishing tournaments, fishermen tend to be more dispersed; 2010 weekend surveys estimate roughly one fisherman for every 20 acres (low-density).

For Highland Lake, the characteristics of particular note (those that scored highest on the CLI) relating to the lake's recreational value are:

- The close proximity to Route 9, a major transportation corridor,
- The shoreline configuration, i.e. the numerous coves and embayments,
- The specialized habitats in the lake, i.e. shallow coves and embayments,
- The large number of fishing tournaments,
- The lack of power boat and ski craft restrictions,
- The vast areas of undeveloped land in the watershed, and
- The scenic and natural views from the lake.

These characteristics may be the most important to consider when addressing recreation concerns or in the development of a lake management plan.

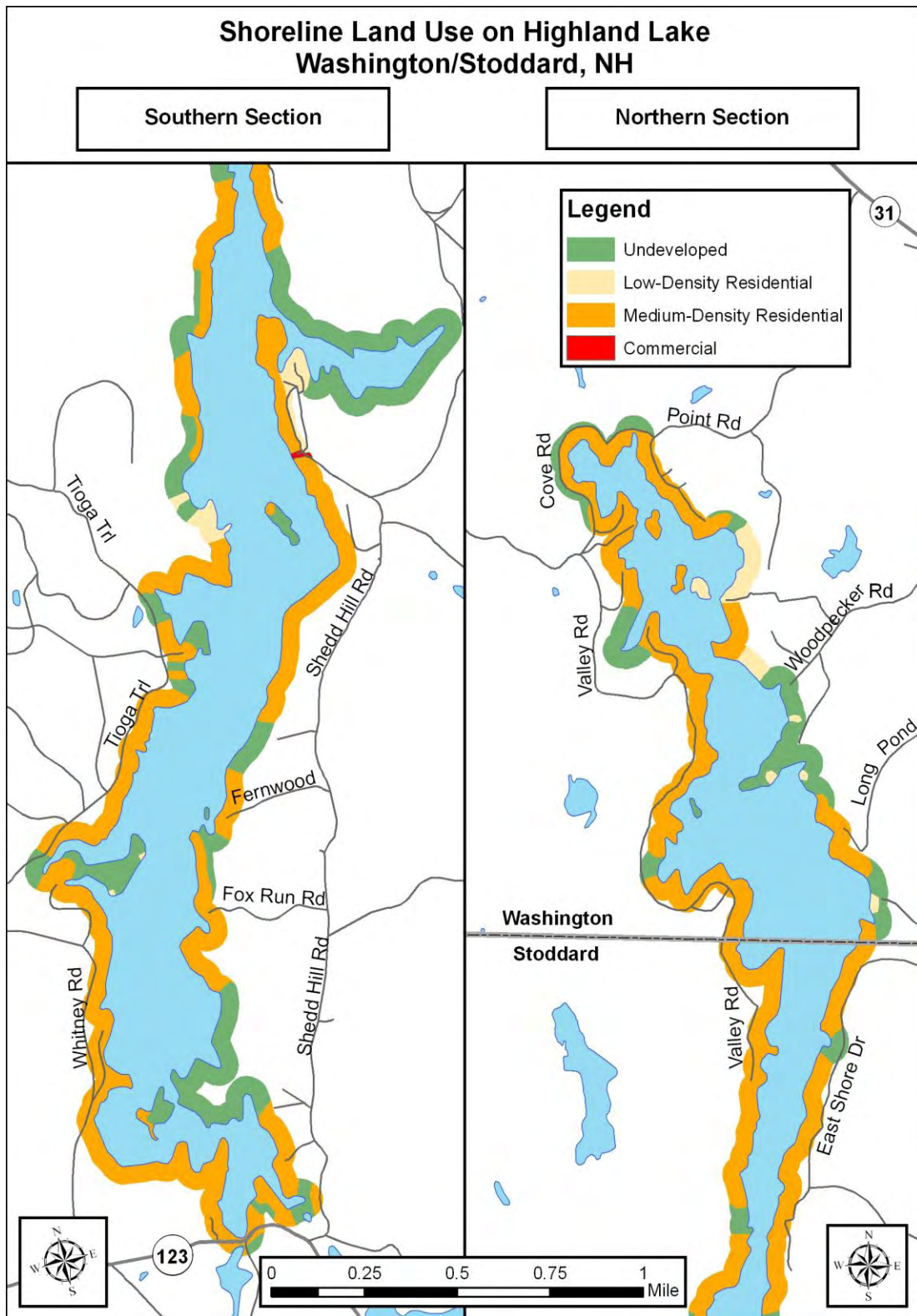
Assessment of Unique or Outstanding Value

“A lake scoring high in this category will have many unique features or outstanding natural or cultural features. Based on these criteria, there are a limited number of such lakes in the state. These lakes will require restrictions on the intensities and types of uses permitted on the lake, on the shoreline, and within the watershed, so as to maintain the integrity of the lake environment and lake experience. These lakes are worthy of special designation.”

Highland Lake ranks moderate-high for unique or outstanding value based on the methodology of the Comprehensive Lake Inventory, with 68 out of 100 points.

Highland Lake is situated in a unique location as a relatively large lake in the headwaters of the large Merrimack River drainage basin. The water level has been raised by damming to 1,294 feet, turning three separate ponds into a long, relatively shallow lake with three basins. The dam at the southern end of the lake supported the development of Stoddard's Mill Village, now a historic area. 2009 VLAP records show good water clarity (2.1-3.5 meters.)

Map 3. Shoreline Land Use along Highland Lake, developed from 2009 aerial photo interpretation, Stoddard E-911 road map and Washington Natural Resources Inventory maps.



The most outstanding characteristic of Highland Lake is its wildlife diversity. There are nine species of warmwater fish, 15 species of reptiles and amphibians, 26 species of aquatic or water-dependent birds and six species of aquatic or water-dependent mammals (listed in Appendix C). Many of these animals rely on the numerous shallow coves and embayments that provide food and cover. In addition, the Highland Lake watershed supports five exemplary natural communities identified by the New Hampshire Natural Heritage Bureau. Of particular note is the Common Loon; unpaired loons and visiting breeding pairs frequent the lake but loons have not attempted nesting since the 1990's, according to records from the Loon Preservation Committee.

The Highland Lake watershed is also particularly unique due to large tracts of land that have been protected from development. Almost 40% of the watershed is protected from development by public ownership or conservation easement (Map 4), and the local land use ordinances contain multiple protections for open space, wetlands and shorelands, all of which serve to protect water quality. The undeveloped nature of the watershed contributes to the exceptional scenic character of Highland Lake.

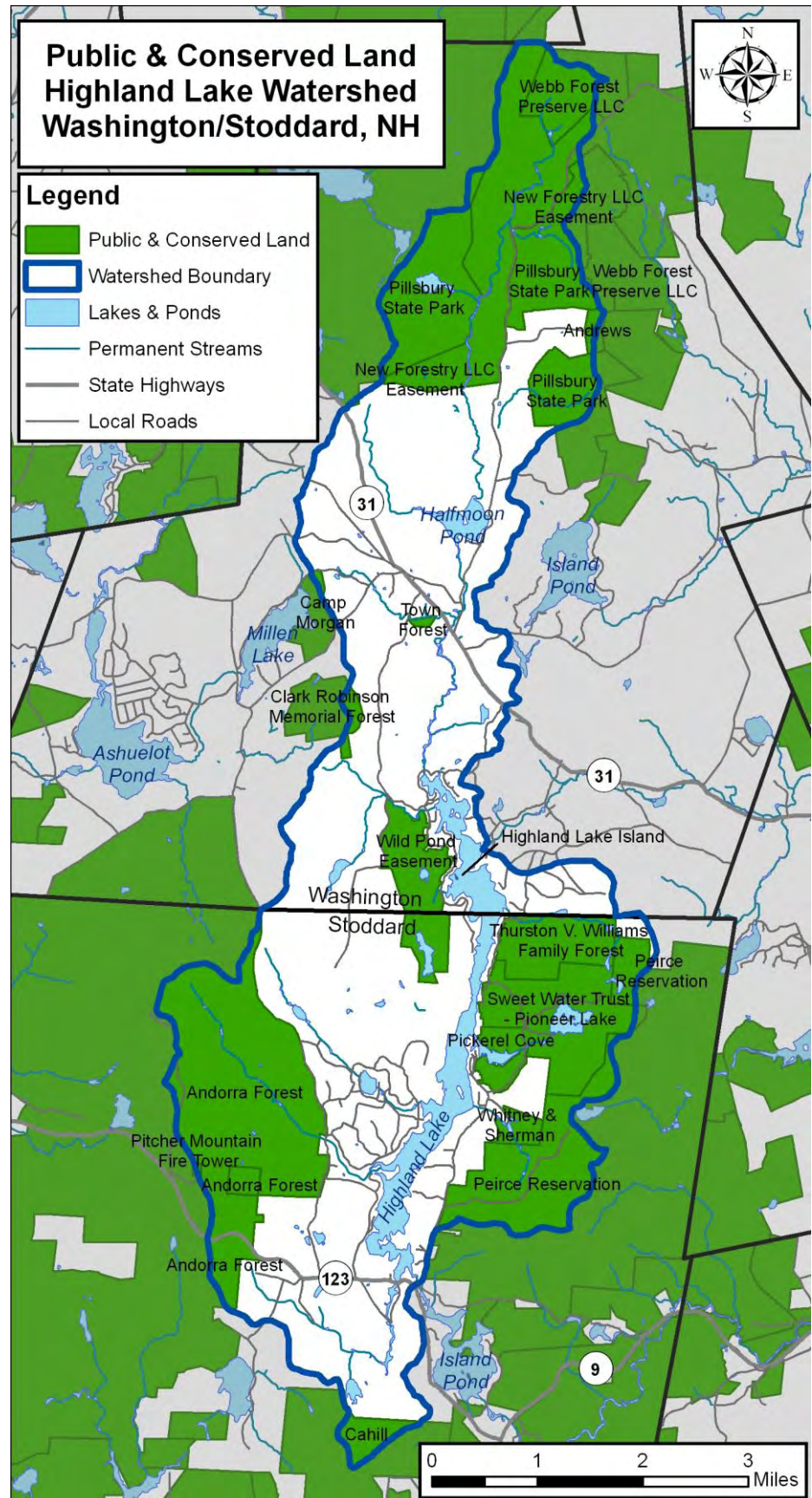
The long-standing volunteer monitoring programs on Highland Lake that conduct water quality testing and boater education about invasive species also contribute to its unique value.

For Highland Lake, the characteristics of particular note (those that scored highest on the CLI) relating to the lake's unique or outstanding value are:

- Wildlife species diversity, in particular amphibians, reptiles and birds,
- The specialized habitats in the lake, i.e. shallow coves and embayments,
- Exemplary natural communities in the watershed;
- Participation in VLAP and the Lake Host Program,
- Exceptional local land use regulatory measures, and
- The scenic and natural views from the lake.

These characteristics may be the most important to consider when addressing the unique character and intrinsic value of Highland Lake or in the development of a lake management plan.

Map 4. Public and conserved land in the Highland Lake watershed.



Assessment of Susceptibility to Impairment

“A lake with a high susceptibility to impairment is one that is vulnerable to detrimental changes or impacts or is threatened or stressed by one or more factors. Due to these factors, the lake is at or near a threshold of impairment. The threats may be potential, or they may already be present. These lakes warrant attention by the appropriate cooperating lake stewards to correct or mitigate the threats. The development and implementation of a management plan with prescribed actions and remedies must focus on the specific problems which have been identified.”

Highland Lake ranks low-moderate for susceptibility to impairment based on the methodology of the Comprehensive Lake Inventory, with 55 out of 100 points.

Protecting water quality is of utmost importance to the value of New Hampshire’s lakes. Recreational uses, lakefront property values, aesthetics and a well-functioning ecosystem all depend on clean water. The current water quality of Highland Lake is good, however, there is no guarantee that the lake will remain so. Protecting and preserving healthy ecosystems remains an ongoing process.

Highland Lake is currently a mesotrophic lake, or a lake with a moderate amount of nutrients and productivity. NHDES survey records show Highland Lake’s trophic status has been stable over the past thirty years. The lake has not suffered any recorded historic pollution releases directly to the lake, unlike many lakes closer to industrial or urbanized areas.

Three important water quality parameters are all within a “good” or “average” range, based on 2009 VLAP sampling at North and South Stations on the lake. Trends show improvement in these three parameters over the twenty-plus year period of VLAP records.

Key Water Quality Metric	Threshold for Water Quality	Highland Lake’s 2009 Status
Total Phosphorus	10-20 µg/L (average)	11-20 µg/L
Chlorophyll-a Concentration	0 - 5 mg/m ³ (good)	2.68 – 4.68 mg/m ³
Transparency (Secchi depth)	2 -4.5 meters (good)	2.68 - 4.18 m

There are several natural risk factors based on the physical configuration and biological status of the lake. Highland Lake is a shallow lake (5.25 ft average depth) with a very high proportion of shoal areas (87% of the lake is less than 15 ft deep). The shallow depth allows light to penetrate through the water, which promotes vegetative growth. In the event that phosphorus loads increase to the lake (phosphorus acts as a lake fertilizer), these shallow areas could become overgrown with aquatic weeds. Additionally, invasive aquatic plants introduced to the lake could easily establish in these shallow areas.

Other natural features of Highland Lake serve to dampen the risk of impairment. A model of lake flow completed for the NHDES lake trophic reports estimates that Highland Lake flushes itself

more than twice per year, which means that the lake can flush out and rebound more quickly from pollution events. This also indicates that any management strategies taken to reduce nutrient inputs to the lake should have rapid results relative to other lakes with slower flushing rates. Another important physical characteristic is the ratio between the watershed area and the lake area. Typically, water quality decreases when the watershed area is far greater than the lake's area, as more pollutants can be carried from the land into streams and ultimately into the lake. The watershed/lake area for Highland Lake is 26:1, which ranks as moderate.

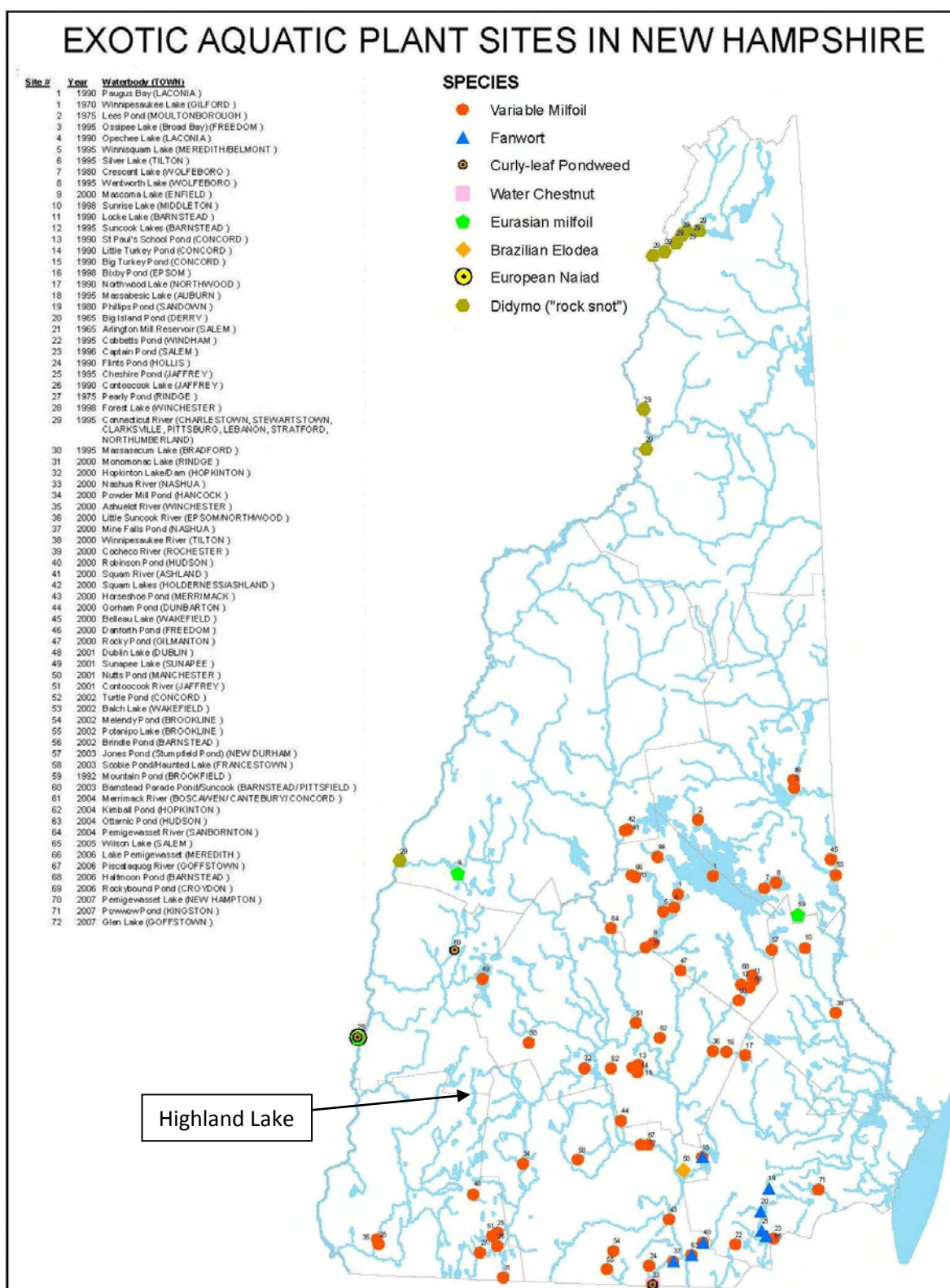
Human activities also play a critical role in a lake's susceptibility for water quality impairment. For Highland Lake, over 500,000 people live within an hour's drive of the lake and recreational use is moderately high. Motorized watercraft is by far the dominant type of boat (~80% of all watercraft on peak summer weekend days). These characteristics increase the likelihood for introducing invasive species to the lake as well as the potential for oil and gas pollution. Incompletely burned gasoline, particularly from older two-cycle boat engines, also contributes benzene, MtBE and other toxic chemicals to the lake.

Fortunately, Highland Lake does not currently have an infestation of invasive plant or animal species and the nearest pond with such an infestation, Powder Mill Pond in Hancock, is more than 10 miles away. Because of the moderately high recreational use of the lake, the Lake Host Program at the two public boat launches plays a key role in minimizing the risk of accidental transfer of invasive plants from other lakes in New Hampshire or surrounding states (Map 5).

Residential development along the lake's shoreline and the associated impervious surfaces (roofs, driveways, and patios) increases the risk of water quality impairment. Roughly 65% of the immediate shoreland (within 250 feet of the water's edge) is medium-density residential development, with the remaining 35% either undeveloped or low-density residential (Map 3). Impervious surfaces cover an estimated 7% on the shoreline, as calculated using a land use-based model developed by the Center for Watershed Protection. Shoreline development increases stormwater runoff to the lake, which can carry phosphorus, salt and other pollutants. Stormwater runoff can also increase erosion and add layers of sediment to the lake bottom. Residential lawns attract geese, and significant flocks of geese can cause water quality problems and *E. coli* outbreaks.

While much the development is pre-existing, state laws, in particular the CSPA, and local land use ordinances in Washington and Stoddard now have provisions to limit new development and protect the remaining natural shorelines. In contrast to the shoreline, the watershed remains roughly 97% undeveloped, with 40% of total watershed acreage protected from development. Local land use regulations contain numerous provisions to help protect water quality. These characteristics decrease the risk of water quality impairment due to increasing watershed development.

Map 5. New Hampshire Lakes with Exotic Species, New Hampshire Dept of Environmental Services



Map Document: (H:\BIOLOGY\EXOTICS\Maps\ExoticUpdates\UpdateMilfoilMapwList.mxd) 3/20/2008

For Highland Lake, the characteristics of particular note (those that scored highest on the CLI) relating to the lake's susceptibility to impairment are:

- High proportion of shallow or shoal areas that are susceptible to pollutant loading and
- Moderately high recreational use by motorized watercraft.

These characteristics may be the most important to consider when addressing water quality concerns or threats on Highland Lake.

In addition, several studies have shown that water quality begins to decline once 10% of a watershed has been converted to impervious surfaces, such as pavement, building roofs and compacted soil (Center for Watershed Protection, 1998, Rapid Watershed Planning Handbook). While the watershed is currently 97% undeveloped and 40% is permanently protected from development, future land development and the resulting increase in impervious surfaces may foster a long-term future susceptibility to water quality impairment.

Highland Lake Comprehensive Lake Inventory - Appendix A

RECREATIONAL VALUE Attribute and Associated Questions	Recorded Points	Possible Points
1. Geographic, Spatial and Demographic Information		
Proximity to major transportation corridors (> 5 miles to major roadway)	5	5
Total year-round resident population within 30-mile radius (542,219 people)	4	5
2. Physical Waterbody Characteristics		
Surface water area (712 acres)	4	5
Shoreline configuration/shape (score of 4.2)	5	5
Island presence/absence (7 islands)	3	5
3. Water Quality Characteristics		
Secchi disc transparency (2.08-3.5 meters)	2	5
4. Biological/Ecological Characteristics		
Algal abundance (2.68-4.18 µg/L chlorophyll-α)	4	5
Specialized habitats, breeding or rearing areas (5 named shallow coves)	5	5
5. Recreational Characteristics		
Type of watercraft use (76-100% power : 0-24% non-power)	1	5
Average watercraft density on lake (1 watercraft per 5-15 acres)	2	5
Private marine service/docking facilities (1 marina)	2	5
Recreational fishing (multiple warm water species)	2	5
Fishing tournaments/derbies (8-9 per year)	5	5
Angler Usage (1 angler per >10 acres)	1	5
Boat launches and access sites (2 public boat launches)	2	5
Other recreation and support facilities (5 private beaches)	4	5
6. Restrictions or Prohibited Uses		
Power boat restrictions (none)	5	5
Ski craft restrictions (none)	5	5
9. Watershed Characteristics		
Watershed development and land use (<10% developed; >90% undeveloped)	5	5
10. Visual/Aesthetic Characteristics		
Scenic or natural features of interest visible from waterbody (>3 features)	5	5
TOTAL SCORE FOR RECREATIONAL VALUE	71	100

A high score indicates that the waterbody has a high recreational value.

Score Sheet from the NH Comprehensive Lake Inventory 2010, 3rd edition

Highland Lake Comprehensive Lake Inventory - Appendix A

UNIQUE OR OUTSTANDING VALUE Attribute and Associated Questions	Recorded Points	Possible Points
1. Geographic, Spatial and Demographic Information		
Waterbody elevation (1,294 feet above sea level)	3	5
2. Physical Waterbody Characteristics		
Maximum water depth (9.6 meters or 31.5 feet)	2	5
Basin morphometry/number of basins (3 basins)	2	5
Waterbody origin (raised by damming)	2	5
3. Water Quality Characteristics		
Secchi disc transparency (2.08-3.5 meters)	2	5
4. Biological/Ecological Characteristics		
Fish species diversity (9 species)	4	5
Avian species diversity (26 species)	5	5
Mammal species diversity (6 species)	3	5
Reptile & amphibian species diversity (15 species)	5	5
Specialized habitats, breeding or rearing areas (5 named shallow coves)	5	5
Threatened/endangered plants/animals & exemplary natural communities (5)	5	5
7. Unique Characteristics		
Public drinking water supply (not a public water supply)	1	5
Historic features in and around waterbody (2 historic mill sites/areas)	2	5
Educational facilities or sites (none)	1	5
Participant in VLAP, LLMP or other volunteer monitoring program (> 10 years)	5	5
8. Shoreland Characteristics		
Protected land or unavailable for development in shoreland (1-10% protected)	2	5
Local land use regulatory measures within the shoreland (yes, rated exceptional)	5	5
9. Watershed Characteristics		
Protected land or unavailable for development in watershed (26-50% protected)	4	5
Local land use regulatory measures (yes, rated exceptional)	5	5
10. Visual/Aesthetic Characteristics		
Scenic or natural features of interest visible from waterbody (>3 features)	5	5
TOTAL SCORE FOR RECREATIONAL VALUE	68	100

A high score indicates that the waterbody has many unique or outstanding values.

Score Sheet from the NH Comprehensive Lake Inventory 2010, 3rd edition

Highland Lake Comprehensive Lake Inventory - Appendix A

SUSCEPTIBILITY TO IMPAIRMENT Attribute and Associated Questions	Recorded Points	Possible Points
1. Geographic, Spatial and Demographic Information		
Total year-round resident population within 30-mile radius (542,219 people)	4	5
2. Physical Waterbody Characteristics		
Mean water depth (1.6 meters or 5.25 feet)	4	5
Percent shoal area/littoral zone (87% of waterbody is <15 feet in depth)	5	5
Watershed area/lake area ratio (26:1)	3	
Hydraulic flushing rate (waterbody flushes > 2 times per year)	1	5
3. Water Quality Characteristics		
Waterbody trophic status (mesotrophic)	3	5
Total phosphorus concentration (0.011 - 0.020 mg/L)	3	
Secchi disc transparency (2.08-3.5 meters)	4	
Historic point source discharges (no past pollution sources documented)	1	
4. Biological/Ecological Characteristics		
Algal abundance (2.68-4.18 µg/L chlorophyll- α)	2	5
Exotic aquatic plant species (none in lake, nearest lake w/ exotics > 10 miles)	2	5
Exotic aquatic animal species (none in lake, nearest lake w/ exotics > 10 miles)	2	5
5. Recreational Characteristics		
Type of watercraft use (76-100% power : 0-24% non-power)	5	5
Average watercraft density on lake (1 watercraft per 5-15 acres)	4	5
8. Shoreland Characteristics		
Shoreland development and use (51-75% developed, 25-49% undeveloped)	4	5
Percent of impervious surface within the shoreland (5-15% impervious)	3	
Local land use regulatory measures within the shoreland (yes, rated exceptional)	1	5
9. Watershed Characteristics		
Watershed development and land use (<10% developed; >90% undeveloped)	1	5
Protected land or unavailable for development in watershed (26-50% protected)	2	5
Local land use regulatory measures (yes, rated exceptional)	1	5
TOTAL SCORE FOR RECREATIONAL VALUE	55	100

A high score indicates that the waterbody has a high susceptibility for impairment.

Score Sheet from the NH Comprehensive Lake Inventory 2010, 3rd edition

Appendix B. Active Watercraft Surveys - Highland Lake - Summer 2010

Date/Time Sunday June 27, 2010 1-3 pm
 Temperature 70's
 Most Recent Rain Sunday morning
 Current Weather Mix of sun and clouds
 Surveyed By: R. Ruppel, A. Bronstein

Area Surveyed Marina to Blueberry Island

Non-Power Boats	Total	5
Canoes	0	
Kayaks	4	
Rowboats	0	
Sailboats	0	
Electric	1	
Powerboats	Total	19
Outboard	9	
Inboard or I/O	2	
Pontoon	5	
Jetskis (1 person)	0	
Jetskis (multi-person)	3	
# Fishermen	6	

Total # of Boats Surveyed 24
 Approximate Area Surveyed 237 acres
 Watercraft Density ~ 1 boat/10 acres
 Power:Non-Power Boat Ratio ~4:1 79%:21%
 Density of Fishermen ~1 fisherman/40 acres

Date/Time Thursday July 1, 2010 10:30-12:30 pm
 Temperature mid-60's
 Most Recent Rain Intermittent sprinkles during survey
 Current Weather Overcast
 Surveyed By: R. Ruppel, S. Eisenberg, w/ J. van Shaick

Area Surveyed Entire Lake

Non-Power Boats	Total	3
Canoes	1	
Kayaks	2	
Rowboats	0	
Sailboats	0	
Electric	0	
Powerboats	Total	6
Outboard	3	
Inboard or I/O	0	
Pontoon	3	
Jetskis (1 person)	0	
Jetskis (multi-person)	0	
# Fishermen	4	

Total # of Boats Surveyed 9
 Approximate Area Surveyed 712 acres
 Watercraft Density ~ 1 boat/80 acres
 Power:Non-Power Boat Ratio ~2:1 67%:33%
 Density of Fishermen ~1 fisherman/178 acres

Date/Time Sunday August 29, 2010 1-3 pm
 Temperature 70's - low 80's
 Most Recent Rain 1-2 days prior
 Current Weather Mostly sunny
 Surveyed By: R. Ruppel, A. Bronstein

Area Surveyed Rt 123 Boat Launch to Marina

Non-Power Boats	Total	6
Canoes	1	
Kayaks	3	
Rowboats	1	
Sailboats	1	
Electric	0	
Powerboats	Total	38
Outboard	11	
Inboard or I/O	5	
Pontoon	16	
Jetskis (1 person)	0	
Jetskis (multi-person)	6	
# Fishermen	3	

Total # of Boats Surveyed 44
 Approximate Area Surveyed 356 acres
 Watercraft Density ~ 1 boat/8 acres
 Power:Non-Power Boat Ratio ~6:1 86%:14%
 Density of Fishermen ~1 fisherman/118 acres

Appendix C. Wildlife species in the Highland Lake watershed

Fish:

The New Hampshire Freshwater Fishing Guide lists six **warmwater game fish** populations in Highland Lake: large-mouth and small-mouth bass, pickerel, horned pout, white perch and black crappie. Fish population sampling done through 2008 by New Hampshire Fish and Game Department collected the following **non-game species** in the Highland Lake watershed: black-nosed dace, common white sucker, and eastern brook trout.

Birds:

There are at least 26 **waterfowl or other bird species that rely on open water** living on or near Highland Lake. There may be additional bird species present in and around Highland Lake that have not yet been documented. The source of information is New Hampshire eBird, an online database of field records from the birding community; sightings within 5 miles of Highland Lake have been included.

Swimmers	Passerine (Perching)	Waders
American Black Duck	Red-winged Blackbird	Great Blue Heron
Wood Duck	Bobolink	Aerialists
Ring-necked Duck	Barn Swallow	Herring Gull
Mallard	Cliff Swallow	Birds of Prey
Common Loon	Tree Swallow	Bald Eagle
Common Merganser	Common Grackle	Osprey
Hooded Merganser	Palm Warbler	Northern Harrier
Double-Crested Cormorant	Yellow Warbler	Red-Shouldered Hawk
Canada Goose	Alder Flycatcher	Nonpasserine (Land)
	Common Yellowthroat	Belted Kingfisher

Mammals:

Highland Lake and its watershed also provide habitat for at least six **mammal species that rely on water**: beaver, mink, moose, muskrat, raccoon and river otter. The source of information is from the New Hampshire Fish and Game Department harvest records and personal communication with Ted Walski, Wildlife Biologist. There may be additional water-dependent mammal species living in the Highland Lake watershed that have not yet been documented.

Reptiles and Amphibians:

The Volunteer Reptile and Amphibian Assessment Program (VRAAP) has identified 14 **water-dependent species** in the general vicinity of Highland Lake. VRAAP is a volunteer effort to inventory reptile and amphibian populations, coordinated by the New Hampshire Fish and Game Department; there may be additional species that have not yet been documented.

Turtles	Frogs and Toads	Newts & Salamanders
Common Musk Turtle	Bullfrog	Blue Spotted Salamander
Eastern Painted Turtle	Green Treefrog	Jefferson Salamander
Snapping Turtle	Pickerel Frog	Spotted Salamander
Spotted Turtle	Wood Frog	Eastern Newt
Wood Turtle		Red-spotted Newt

Threatened and Endangered Species and Exemplary Natural Communities:

The New Hampshire Natural Heritage Bureau tracks populations of New Hampshire's threatened and endangered species – in the Highland Lake watershed, there are five such species: Common loon, Arethusa, Goldie's fern, Common mare's tail and Farwell's water milfoil.

The Natural Heritage Bureau also identifies "exemplary natural communities" that represent the best remaining examples of New Hampshire's biodiversity. In the Highland Lake watershed are four exemplary natural wetland communities:

- inland Atlantic white cedar swamp,
- medium-level fen system,
- northern hardwood-black ash-conifer swamp, and
- red maple-sphagnum basin swamp.

Highland Lake Management Plan

Prepared by Upper Valley Lake Sunapee Regional Planning Commission, 2010

Highland Lake's Value to the Community

The public values assessment survey conducted in summer 2010 showed clearly that **water quality, recreation and aesthetic value** are the most important values for Highland Lake.

Survey results indicate a strong desire to keep Highland Lake as it is today, or, in other words, a strong desire to maintain the good water quality, recreational values and beautiful scenery enjoyed by current landowners, residents and visitors. Full survey results are in Appendix A.

Protecting Highland Lake's Important Resource Values

Highland Lake is a wonderful location to spend an afternoon, the summer or the entire year; lakeside development and two public boat launches make the lake easily accessible for a variety of lake users. The accessible nature of Highland Lake does make the lake vulnerable to degradation, as certain human activities create the potential for pollution, introduction of exotic species and conflicts over recreational use.

The Comprehensive Lake Inventory and public values assessment identified several overlapping areas of concern particular to Highland Lake's water quality, recreation and aesthetic values. Primary areas of concern were:

- 1) Potential for degradation of water quality;
- 2) Perception of excessive native aquatic plant growth;
- 3) Threat of invasive plant species introduction to the lake;
- 4) Potential for shoreline development to cause erosion and water quality declines;
- 5) Presence of boating obstructions;
- 6) Perception of incompatible recreational uses (motorized vs. non-motorized boating).

Preventive monitoring and timely actions to address problems are critical to ensure that the important resources of Highland Lake are protected and maintained. This plan presents six management goals to address these areas of concern:

- 1) Monitor water quality and working to identify sources of water quality problems;
- 2) Manage native aquatic plant populations;
- 3) Prevent the introduction of invasive species;
- 4) Protect shorelines to minimize erosion and stormwater runoff;
- 5) Improve navigational safety;
- 6) Monitor trends in recreational boating activity.

Goals and Strategies for Lake Management

Goal 1) Monitor water quality and work to identify sources of water quality problems.

How will this goal protect Highland Lake?

Monitoring water quality creates an important baseline of the lake's condition and can help to identify when pollution is having an impact on the lake. Should water quality monitoring identify a problem, further testing or professional help can identify the source of the pollution and possible ways to correct the problem.

Good water quality sustains all other resource values of the lake, including recreation, wildlife, economic and aesthetic values.

Recommendations for Future Action

- Continue volunteer sampling program to monitor water quality. Highland Lake Unified Association coordinates the Volunteer Lake Assessment Program (VLAP), which has been monitoring lake water quality for over twenty years. Water quality trends, as assessed through VLAP, have remained constant for transparency and total phosphorus and improved slightly for chlorophyll-a, which is excellent.

The New Hampshire Department of Environmental Services has developed Watershed Report Cards for 2010 as part of their biennial surface water quality assessment. The 2010 Watershed Report Card for Highland Lake has identified three factors that may impair or threaten water quality: low dissolved oxygen saturation, low pH, and E. coli bacteria. Volunteer sampling and data collection help to inform these report cards, providing the ability to track and address potential impairments over time.

- Continue to publicize the results of water quality testing to homeowners, local road associations, town officials and lake visitors, through newsletters, town annual reports and other mechanisms.
- Conduct specialized sampling, when recommended by the VLAP staff, to assess specific areas of concern. For example, road salt washing into tributaries or directly into the lake is a topic of rising concern around New Hampshire. The chloride released when road salt dissolves can harm aquatic plants and disrupt the lake's food chain and ecosystem. VLAP staff has recommended further sampling for conductivity and chloride in Highland Lake and its tributaries, which may help to identify potential problems with road salt application.

Goal 2) Manage native aquatic plant populations.

How will this goal protect Highland Lake?

Highland Lake has extensive areas of shallow water (less than 15 feet in depth) where aquatic plants thrive. These plants are beneficial to the ecosystem, in that they absorb nutrients and provide aquatic habitat to many species, including warm water game fish. Excessive plant growth can have negative impacts to recreation, particularly powerboating and swimming.

Recommendations for Future Action

- Continue to educate lake users on preventing the spread of native aquatic plants. Highland Lake Unified Association has published a navigational map showing areas of native plant beds, recommending to boaters that they remove plants from propellers prior to exiting a weed bed.
- Continue to educate lake homeowners on the importance of native plants to the lake ecosystem. While native vegetation may foul boat propellers and deter swimmers, its removal impacts wildlife and also creates empty lake bottoms that provide an opportunity for invasive plants to become established. In New Hampshire, removal of aquatic vegetation requires a permit. The New Hampshire Department of Environmental Services has published a helpful fact sheet entitled “Aquatic Plants and Their Role in Lake Ecology.”
- Educate lake homeowners on lawncare options and stormwater control methods that can reduce the input of nutrients to the lake. Aquatic plant growth is stimulated through excess nutrients washing from the land into the water. The New Hampshire Department of Environmental Services recently published “A Homeowner’s Guide to Stormwater Management” that provides general directions for installing erosion and stormwater control measures.
- Work with the New Hampshire Department of Environmental Services to identify information and management needs with regard to native aquatic plant populations. There may be opportunity to conduct vegetation surveys and develop a management plan.

Goal 3) Prevent the introduction of invasive species

How will this goal protect Highland Lake?

Invasive plants pose many problems for an ecosystem, in terms of displacing native species, degrading habitat, altering the amount of lake vegetation, and disrupting nutrient cycling and flows. If it should occur that invasive plants are introduced to Highland Lake, the lake is particularly susceptible to a widespread infestation due to its large areas of shallow water that provide suitable habitat for invasive plants. Once established, invasive plants are extremely difficult, if not impossible, to eradicate, and management techniques have limitations in either effectiveness or cost. Preventing invasive species from becoming established in the waterbody avoids ecosystem damage and costly management techniques.

Recommendations for Future Action

- Continue the Lake Host™ courtesy boat inspection program at both public boat launches to prevent the introduction of exotic aquatic plants. Funding this program continues to be a challenge for lake associations statewide. Education and monitoring efforts are another case where “an ounce of prevention is worth a pound of cure” as the costs of a Lake Host™ program are far less than the cost of treating or controlling an infestation of invasive aquatic plants. Appendix B includes talking points from New Hampshire Lakes Association on seeking funding to support a Lake Host™ program as well as recent information on the potential economic impacts from invasive species infestation, including the costs of invasive species control and declines in property values.
- Continue and seek to expand the Weed Watchers program. With the number of shallow coves in Highland Lake, a robust Weed Watchers group of volunteers may divide the task of early detection of invasive aquatic plants.
- Continue to incorporate information on invasive species threats into the lake association newsletter and town reports. The New Hampshire Department of Environmental Services has produced numerous fact sheets and brochures about invasive species that can be used for educational purposes; New Hampshire Lakes Association is also a source for the latest information on invasive species.

Goal 4) Protect shorelines to minimize erosion and stormwater runoff.

How will this goal protect Highland Lake?

Water that runs over lawns, yards, driveways, and roadways carries fertilizer, lawn chemicals, pet waste, soil, sand, salt, and automotive byproducts into waterbodies. Stormwater runoff increases as impervious surfaces increase, and impervious surfaces increase as existing homes, outbuildings, and driveways are expanded and as open fields and forests are converted to residential uses. Preventing, slowing and dissipating overland flow of stormwater allows pollutants to drop out of the water or be absorbed by plants before entering waterbodies.

Recommendations for Future Action

- Continue homeowner education efforts on shoreline landscaping that minimizes erosion and runoff. There are three excellent publications on this topic:
 - “Landscaping on the Water’s Edge” by the University of New Hampshire’s Cooperative Extension;
 - “A Homeowner’s Guide to Stormwater Management” by the New Hampshire Department of Environmental Services;
 - “Help Protect New Hampshire’s Lakes – A Guide to Lake Stewardship” by the New Hampshire Lakes Association.

In addition, geese can become a nuisance on grassy areas on the shoreline and contribute to water pollution; NH Lakes Association recently published an excellent article in their Spring 2010 newsletter on discouraging geese from the shoreline, including recommendations for shoreline plantings.

- Support land conservation projects on lake shorelines and tributaries to Highland Lake.
- Consider pilot projects for installing rain gardens or other stormwater management structures. In 2007, the NH Lakes Association began a Lakes Conservation Corps program where high-school students work to install erosion control structures, in cooperation with local lake associations. These projects serve to reduce erosion and improve water quality, and also help to educate the public on the importance and practicality of these structures.

Erosion control and stormwater management projects on lakes relatively near to Highland Lake include the Lake Sunapee Protective Association’s offices in Sunapee, the Eastman Community Association’s South Cove Activity Center on Eastman Lake in Grantham, and French’s Park on Lake Massasecum in Bradford.

- Consider a bulk purchasing program for lawn care products or native plants for lake shorelines. One way to accomplish this is to organize a “Shrub Your Shores Day” where a local nursery would sell native plantings at a reduced cost to shoreline property owners.

Goal 5) Improve navigational safety.

How will this goal protect Highland Lake?

Improving boating safety will support all lake users' recreational enjoyment of Highland Lake. Identifying and marking hazards may prevent boating accidents and near-misses, as will public education on the various no-wake zones and other navigational restrictions on the lake.

Recommendations for Future Action

- Continue to work with Marine Patrol on marking navigational hazards. As needed, make revisions to and enlarge the navigational chart to reflect the placement of new markers.
- Disseminate information on additional navigational hazards that may be present during low-water periods via boat launch bulletin boards, newsletters and word-of-mouth.
- Continue public education efforts on safe boating practices and regulations. Current efforts include the Lake Hosts distributing Safe Boating decals and the navigational chart identifies channel marker and hazard locations. Additional efforts may include adding "headway speed only" areas to the navigational map or a demonstration of a 150-ft distance from the shoreline.



Goal 6) Monitor trends in recreational boating activity.

How will this goal protect Highland Lake?

Lake recreation surveys provide important baseline information on the types, numbers and patterns of boating. This information can be used to monitor trends and changes in boating activity and is invaluable in addressing potential conflicts between recreational uses, such as motorized and non-motorized boating.

Recommendations for Future Action

- Conduct a stationary boating survey and at least one active boating survey each year. Active boating surveys should be conducted during a variety of fair-weather days, such as holiday weekends, non-holiday weekends, and mid-week days, to gain an accurate assessment of boating activity patterns. In 2010, one stationary watercraft survey and three active boating surveys were completed.
- Report survey results and any trends evident from the information; coordinate with the Lakes Coordinator at the New Hampshire Department of Environmental Services on interpretation of results and identification of trends.

Figure 1. Safe Boating decal, New Hampshire Lakes Assn.

Appendix A. Results of Public Assessment Survey

The public assessment survey was distributed on July 25, 2010 at the Annual Meeting of the Highland Lake Unified Association. Survey options were to return the survey at the meeting, mail in a survey or to take the survey online.

Number of Survey Respondents – 23

Question 1 - What is most important to you about Highland Lake?

- Water Quality (11 responses)
- Recreation – general, includes boating, swimming, fishing, the marina (11 responses)
- Aesthetics – scenic beauty, natural setting (9 responses)
- Motorized Boating (4 responses)
- Boating Speed/Safety (4 responses)
- Swimming (3 responses)
- Non-motorized Boating (2 responses)
- Fishing (2 responses)
- Weed Control (2 responses)
- Large size of lake (2 responses)
- Waterskiing (1 response)
- The Marina (1 response)
- Property Value (1 response)
- Fish and Wildlife (1 response)
- Intrinsic Value of “Home” (1 response)

Question 2 – How would you like to see Highland Lake in 10 years? What are your concerns for its future?

- Lake to stay the same (8 responses)
- Remove obstructions (5 responses)
- Maintain good water quality (4 responses)
- Protect shorelines, avoid new development (4 responses)
- Control weeds (4 responses)
- Fewer or no motorized boats (3 responses)
- Maintain natural/scenic qualities, aesthetics (2 responses)
- No invasive species (2 responses)
- Reduce boat speeds (1 response)
- No jet skis (1 response)
- Control fishing tournaments (1 response)
- Dredge to increase depth (1 response)
- Concerns about dam work (1 response)
- Larger boat launch on Route 123 (1 response)
- More active marina (1 response)

Question 3 – What can the community do to protect Highland Lake?

Continue water quality monitoring (8 responses)

Continue with invasive species monitoring (8 responses)

Engage in water quality education (5 responses) – includes septic inspections, use of “green” detergents/fertilizers, general education

Be active in associations, encourage road associations’ membership in HLUA (4 responses)

Septic inspections (2 responses)

Address stormwater runoff (2 responses)

Enforce boating regulations (2 responses)

Comply with/improve enforcement of land use/environmental regulations (2 responses)

Dredging (2 responses)

Increase boating regulations, i.e. jet ski ban, limit horsepower (1 response)

Work on land conservation (1 response)

Limit raft anchoring in the middle of the lake (1 response)

Maintain/restore water levels through dam repair work (1 response)

Appendix B. Reference Materials on Economic Impacts Associated with Invasive Aquatic Plant Infestations in New Hampshire's Lakes

Summary of recent press coverage regarding property value losses on Lake Winnepesaukee in the Town of Moultonborough:

In summer 2010, Peter Jensen, chairman of the Moultonborough milfoil committee, told the New Hampshire Union Leader that shorefront property owners are having difficulty selling their properties where exotic milfoil has infested the nearby waters. "People see the milfoil and won't buy it. In some places, the properties are worth 10 to 40 percent less than they would normally be. Unless it's controlled, we could see a sharp drop in property values."

The costs to contain and manage the milfoil populations in the lake continue to rise for Moultonborough and other towns on Lake Winnepesaukee. In 2010, the Town of Moultonborough established a \$200,000 milfoil control trust fund. Also in 2010, the Towns of Moultonborough, Tuftonboro and Wolfeboro have contributed the purchase of equipment that will be shared by the three towns to control the milfoil infestation. In addition to grant funding received through the New Hampshire Lakes Association, each of the three towns committed \$5,000 to enable the purchase of two diver-assisted suction harvesting machines. These machines will be used in the fall of 2010 following an application of the herbicide 2-4-D.

Source: *Milfoil sinking property values along Winnepesaukee*, August 18, 2010, New Hampshire Union Leader

Table 2-3
DES Exotic Aquatic Plants Program: Plant Control Techniques

Action	Effectiveness	Specificity to Target	Advantages	Disadvantages	Cost*
Hand Pulling (Physical)	Removes a few individual plants at a time	High	Good for localized areas/ few plants Plants physically removed from waterbody	Labor intensive Good for small infestations only. Not practical when plant growth is dense	Labor Costs vary depending upon contractor costs or staff time but can range from \$25-\$150 per hour.
Diver assisted Suction Harvesting	Can target growths of exotic aquatic plants	Medium to High	Excellent for small patches or sparse widespread infestations	Labor Intensive, expensive.	Costs vary from \$5,000 to \$35,000 per acre.
Mechanical Harvesting (Physical)	Removes large amounts of vegetation at a time	Not specific	Rapidly removes vegetation from area Removes plants physically from waterbody	Residual plant fragments could cause regrowth Removes beneficial native vegetation along with the exotics. Could increase turbidity, ultimately affecting other aquatic life Does not remove roots	Ranges widely depending on plant density, location, disposal, etc. \$350-\$1500 per acre
Hydro-raking (Physical)	Removes large amounts of vegetation at a time	Not specific	Rapidly removes vegetation Removes roots to prevent rapid regrowth. Removes plants physically from waterbody	Residual plant fragments could cause regrowth Could increase turbidity, ultimately affecting other aquatic life Removes beneficial native vegetation along with the exotics.	Ranges widely depending on plant density, location, and disposal. \$350-\$2500 per acre

Action	Effectiveness	Specificity to Target	Advantages	Disadvantages	Cost*
Permeable Benthic Barrier (Physical)	Used for very small infestations	Specific to area where barrier is located Impacts all plants under barrier	Compresses plants to sediments and prevents likelihood of fragmentation by wind, wave, or anthropogenic means	Labor intensive Requires frequent barrier cleaning or re-staking Does not physically remove plants from waterbody May cause sediment/water oxygen depletion May impact non-target species such as fish	\$0.60-\$1.22 per square foot or(\$25,000-\$50,000 per acre)
Herbicides (Chemical)	Herbicides which are taken up by root systems (systemic herbicides) more effective than contact herbicides	Most chemicals have target plants for which they are most effective Varying application rates can increase target specificity	Chemical can eliminate exotic plant infestation if done at correct time, and if correct concentration is used Relatively rapid effect Can be target specific	Chemicals added to waterbody May impact non-target species Could be environmentally damaging by impacting non-target species, if not applied per label restrictions	Varies with chemical and size of treatment area ~\$350-450/acre for 2,4-D ~\$250-350/acre for Diquat Plan for approximately \$2000 or more of additional fees for permitting and sample/analysis
Drawdown (Habitat Manipulation)	Somewhat effective if repeated frequently	Not specific	Could control density of vegetation due to plant die off from desiccation or freezing	Impacts non-target plants Impacts fish, amphibians, insects, and other aquatic organisms	Low cost if dam or other means of drawing down water is available

Action	Effectiveness	Specificity to Target	Advantages	Disadvantages	Cost*
Drawdown (cont.)	More effective if drawdown maintained for long time period		Can be cost effective	Drastically changes entire waterbody ecology	
Dredging (Habitat Manipulation)	Effective in removing plants from localized area where dredge takes place	Not specific	<p>Completely removes all plant material</p> <p>Removes nutrient laden sediments</p> <p>Removes seed bank</p>	<p>Drastically changes entire waterbody ecology Impacts non-target plants and animals</p> <p>Could cause excessive turbidity</p> <p>Must wait for waterbody to fill after dredging</p>	\$16,000-32,000 per acre
Insects, bacteria, or viruses that infect and kill or weaken target plants (Biological)	<p>List specific organisms and targets.</p> <p>Effective against target plants</p>	Specific	<p>Insects, bacteria, or viruses used in this method are typically specific to target plant. Their life cycles revolve around particular plant species</p> <p>Does not affect other non-target plants</p>	<p>May cause decline in oxygen as plant material decays</p> <p>Many biological controls are themselves exotic</p> <p>Still experimental</p>	<p>Cost of insects</p> <p>Monitoring cost high</p>

*Costs are averages determined from data obtained from "Draft Generic Environmental Impact Report" for Massachusetts, and from Aquatic Control Technology, Inc. Fact Sheet.

Local Funding is Needed to Support Your Local Lake Host™ Program!

Help protect your community and your local lakes and ponds from the spread of devastating exotic invasive aquatic plants!

LOCAL FUNDING TO SUPPORT YOUR LOCAL LAKE HOST™ PROGRAM IS CRITICAL FOR 2009!

- For the 2009 Lake Host™ grant program, it is anticipated that NH LAKES will have a level or reduced amount of grant funding compared to 2008 to support local Lake Host™ Programs and that more groups will apply for grant funding than have applied in previous years; therefore, local groups will likely receive *reduced* Lake Host™ Program payroll grant awards in 2009.
- If local groups plan to operate their local Lake Host™ Program at the same level as in previous years, or expand their program compared to previous years, securing local funding to supplement their payroll grant from NH LAKES to pay Lake Hosts will be necessary.



HOW YOUR GROUP CAN SECURE LOCAL FUNDING TO SUPPORT YOUR LOCAL LAKE HOST™ PROGRAM:

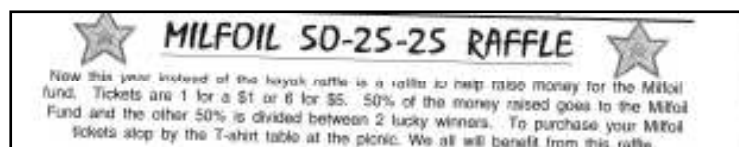
- Encourage your municipal budget committee to include funding for your local Lake Host™ Program in the municipal annual budget. Contact NH LAKES if you would like a letter of support to bring to your municipal officials. *(Refer to the talking points provided in this document.)*
 - In 2007, approximately 25% of the groups participating in the Lake Host™ Program received funding from their municipality to supplement their payroll grant from NH LAKES to pay Lake Hosts to staff ramps. Participating groups received funding ranging from \$200 to \$7,000 with the median level of funding being approximately \$2,000.
- Submit a warrant article requesting that the town voters at the annual town meeting approve the dedication of municipal funds to the local Lake Host™ Program.
 - Contact your municipal office to find out the requirements and deadlines for warrant article submission.
 - Refer to information provided by NH LAKES for example warrant article language.
 - In the months, weeks, days, and even the hours leading up to the town meeting, educate the voters about why they should support the local Lake Host™ Program. *(Refer to the talking points provided in this document.)*
 - Write letters of support to the local paper.
 - Display educational posters in support of the Lake Host™ Program in public meeting places.
 - Meet with local groups to discuss the importance of the local Lake Host™ Program. *(Contact NH LAKES if you are interested in receiving a Lake Host™ Program PowerPoint presentation.)*
 - At Town Meeting, distribute flyers and set up signs about the importance of the local Lake Host™ Program.



- Encourage local businesses owners, particularly those affected by lake-related tourism, to provide financial support to the local Lake Host™ Program. *(Refer to the talking points provided in this document.)*
 - Provide recognition to local businesses that support the program, perhaps with a “Thank You” ad in a local paper, and/or putting up a “Thank You” sign at the launch while your Lake Hosts are on duty.
- Encourage individual members of your lake or pond association to donate financially to the local Lake Host™ Program. *(Refer to the talking points provided in this document.)*
 - Some members of your association may not want to volunteer their time by staffing a ramp as a volunteer Lake Host but might want to donate financially so that paid Lake Hosts are able to staff the ramp for longer periods of time.
 - Suggest that individual association members sponsor a paid Lake Host for a shift.
 - Suggest that cove associations, road associations, or other groups of neighbors/ members sponsor paid coverage at a ramp for a weekend, or even a week.
 - Let individuals know that their financial contributions to the local Lake Host™ Program are tax deductible charitable contributions.
 - Provide recognition to individuals and groups that support the program.

- Raise awareness and funding for local Lake Host Program at community events.

- Include a Lake Host float in your annual lake association street parade or boat parade
- Staff a Lake Host booth at your town’s annual fair and include a donation jar.
- Have an association yard sale and donate a portion of the proceeds to the local Lake Host™ Program.
- Have a raffle at your annual association meeting and donate a portion of the proceeds to the local Lake Host™ Program.



- When you send out your group’s annual membership renewal notices, include an option for members to donate specifically to the Lake Host™ Program at your lake.



Why Local Groups Should Support Their Local Lake Host™ Program

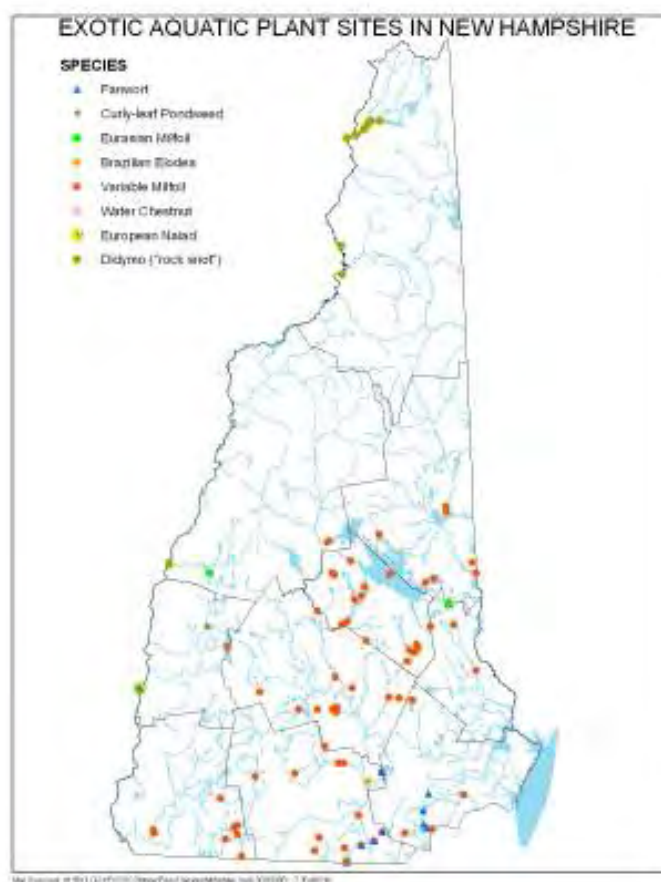
Talking points provided by NH LAKES (September 2008)

THE IMPORTANCE OF NEW HAMPSHIRE'S LAKES AND PONDS

- New Hampshire is home to approximately 1,000 lakes and ponds and these resources enhance the New Hampshire quality of life for its residents and its visitors in many ways.
- Lakes and ponds provide aesthetic, ecological, recreational, and economic values to the local community and to the overall state of New Hampshire.
- Recreational opportunities on New Hampshire's freshwater bodies (including lakes, ponds, rivers and streams) such as boating, fishing and swimming translate to millions of dollars in sales and income and thousands of full-time and seasonal jobs in the state. (Sources: *Estimates of Select Economic Values of New Hampshire Lakes, Rivers, Streams and Ponds, Phase II Report*, June 2003. *The Economic Impact of Potential Decline in New Hampshire Water Quality: The Link Between Visitor Perceptions, Usage and Spending*, Phase IV Report, May 2007. Available for download at www.nhlakes.org.)
- If visitors to New Hampshire's water bodies perceived declines in water clarity and purity (which includes the presence of exotic aquatic plant infestations), this would result in \$51 million in lost sales, \$18 million in lost income and 800 lost jobs overall in New Hampshire. (Source: *The Economic Impact of Potential Decline in New Hampshire Water Quality: The Link Between Visitor Perceptions, Usage and Spending*, Phase IV Report, May 2007. Available for download at www.nhlakes.org.)
- Waterfront property owners on lakes, rivers, streams and ponds pay an estimated \$247 million per year in property taxes which is a significant source of income to the local and statewide economy. (Source: *Estimates of Select Economic Values of New Hampshire Lakes, Rivers, Streams and Ponds, Phase II Report*, June 2003. Available for download at www.nhlakes.org.)

STATUS OF EXOTIC INVASIVE AQUATIC SPECIES IN NEW HAMPSHIRE

- 71 water bodies in New Hampshire are infested with exotic aquatic plants, some of these water bodies are infested with more than one exotic species. The status of water bodies with exotic infestations are as follows:
 - 63 with variable milfoil
 - 3 with Eurasian milfoil
 - 9 with fanwort
 - 3 with European naiad
 - 4 with curly-leaf pondweed
 - 1 with Brazilian elodea
 - 1 with water chestnut



(Source: New Hampshire Department of Environmental Services, May 2008.)

- The main way exotic invasive aquatic plants spread from lake-to-lake in New Hampshire is through the transportation of plant fragments from infested water bodies to uninfested water bodies on boats and trailers.

EXOTIC AQUATIC PLANT INFESTATIONS CAUSE MANY PROBLEMS

- Exotic aquatic plant infestations make recreation in and on lakes and ponds dangerous and unpleasant.
- Exotic aquatic plant infestations disrupt the ecological balance of lakes and ponds.
- Exotic aquatic plant infestations reduce shoreline property values through the reduction of aesthetic and recreational uses of the water body.
 - The presence of exotic milfoil on an average-sized New Hampshire lake of 2,036 acres would reduce shoreline property values of an average house by approximately 16%. (Source: New Hampshire Department of Environmental Services funded University of New Hampshire study.)
- The reduction of shoreline property values caused by an exotic plant infestation is not just a problem for shoreline property owners; it is a serious problem for all non-shoreline property owners in a municipality.
 - As tax revenue generated from shoreline property values decreases with an exotic infestation, tax revenue from non-shoreline property may need to increase.
 - Non-shoreline property owners who recreate on the lake or pond via public access sites will have less pleasant/reduced recreational experiences in/on the infested water body.
- The cost of managing and controlling an exotic invasive aquatic infestation in a water body quickly becomes a local problem.
 - There is currently no method to completely eradicate an exotic invasive aquatic plant infestation.
 - The control of exotic invasive aquatic plant growth and spread is a continual time, labor, and financially-intensive management process.
 - Presently, the New Hampshire Department of Environmental Services (DES) pays for the first year of the management of a newly discovered exotic invasive aquatic plant infestation.
 - After the first year of management, DES relies on local groups (lake association, municipality) to apply for limited grant funding to manage the infestation. The demand for DES grant funding typically exceeds the amount available.
 - Local groups (municipality, tax payers, lake associations) typically end up paying for a substantial portion of the management after the first year of management.
 - The cost, frequency, and type of management activities depend on the infestation size and certain water body characteristics. *(Estimated costs are provided in the table below.)*



Estimated Costs of Exotic Invasive Aquatic Plant Management Techniques *(per treatment event)*

Management Technique	Estimated Cost
Hand-pulling	Depends on contractor costs or DES staff availability
Mechanical Harvesting	\$350 - \$1,500 per acre
Hydro-raking	\$350 - \$2,500 acre
Bottom Barrier	\$0.61 - \$1.22 per square foot or \$25,000 - \$50,000 per acre
Chemical Treatment	\$200 - \$1,000 per acre
Dredging	\$16,000 - \$32,000 per acre

(Source: NH Department of Environmental Services at www.des.nh.gov/wmb/exoticspecies/management.htm)

THE NH LAKES LAKE HOST™ PROGRAM PROTECTS YOUR LOCAL LAKES AND PONDS FROM THE SPREAD OF EXOTIC INVASIVE AQUATIC SPECIES!

- NH LAKES Lake Host™ Program Background:
 - The NH LAKES Lake Host™ Program is a courtesy boat inspection program created and administered by NH LAKES in cooperation with local groups through which trained paid and volunteer Lake Hosts staff public motorized boat access sites to:
 - Educate visiting boaters about the problem of exotic aquatic plants.
 - Conduct courtesy boat and trailer inspections to remove all plant fragments.
 - Show boaters where to look for plant hitchhikers and encourage them to always conduct self-inspections before and after leaving a water body.
 - Send suspicious plants to the New Hampshire Department of Environmental Services for identification.
 - NH LAKES Lake Host™ Program Successes (2002 – 2008)
 - 237,888 courtesy boat inspections conducted (as of 9/7/08).
 - 515 “saves” made (as of 9/1/08). (A “save” is made when a piece of exotic aquatic plant is removed from a boat or its trailer before entering or after leaving a water body).
 - No new lakes participating in the Lake Host™ Program have been listed as being infested with an exotic aquatic plant.
- The ultimate goal of each local Lake Host™ Program should be to have every boat ramp in every municipality staffed by a Lake Host seven days a week during daylight hours during the entire boating season.
- “An ounce of prevention is worth a pound of cure!”



**For more information, contact:
NH LAKES
84 Silk Farm Road
Concord, New Hampshire 03301
(603) 226-0299**

info@nhlakes.org www.nhlakes.org

