

December 7, 2010

Lake Oversight Committee
Town of Holland
27 Sturbridge Road
Holland, MA 01521

**Re: 2010 Aquatic Plant Management Program Report at Hamilton Reservoir - Holland,
MA & Union, CT**

Dear Members of the Lake Oversight Committee:

The following report was prepared to summarize the results of the 2010 Aquatic Management Program that was performed at Hamilton Reservoir.

Over the past three years, the management program has focused on controlling invasive variable watermilfoil (*Myriophyllum heterophyllum*) weed and spot-treatment of waterlilies (*Nymphaea*) and watershield (*Brasenia schreberi*). While the overall cover and density of milfoil throughout the lake has been somewhat reduced over the past two years, milfoil was still moderately distributed throughout the littoral (shallow water) zone of the reservoir and could be found in considerable densities throughout a number of the coves and shoreline areas in 2010. Without herbicide treatment, recreational uses (i.e.; swimming, boating and fishing) would be greatly impaired and the overall habitat of the reservoir for fish and wildlife would be degraded.

In 2008 we also “spot chemically treated” small areas of both floating waterlilies and watershield. Watershield and waterlilies are native plants which provide some valuable habitat and cover; therefore, treatment was limited to residential shorefront swim/beach and other high use areas. No treatment was necessary or performed in 2009. In 2010 a second treatment was performed to control watershield and lily growth in high use areas.

A very small area of invasive common reed (*Phragmites*) was chemically treated in 2008; however, no treatment was warranted or performed in 2009 or 2010. The invasive potential of this plant still presents a significant threat to the remainder of the reservoir and therefore its growth and expansion will need to be closely monitored every year. A chronology of the activities performed at Hamilton Reservoir in 2010 is provided on the next page:

2010 Aquatic Plant Management Program at Hamilton Reservoir:

- Order of Conditions Extension Received 3/26/10
- MA DEP approved License to Apply Chemicals issued on 4/28/10
- CT DEP approved permit issued on..... 4/24/09
- Milfoil pre-treatment inspection performed on..... 6/07/10
- Milfoil treatment using Reward (diquat) herbicide performed on..... 6/17/10
- Water quality sample collection & analyses..... 6/7 & 8/18/10
- Post-treatment inspection and late season survey performed on 8/18/10
- Waterlily and watershield treatment with Aquapro (glyphosate) herbicide performed on
..... 9/15/10
- Pilot tapegrass treatment with Reward (diquat) and Nautique (copper carbonate) 9/15/10
- Year End Report 12/10

Early-Season Milfoil Pre-Treatment Inspection

On June 7th an Aquatic Control Biologists, Peter Beisler and a Field Technician, surveyed the entirety of the Hamilton Reservoir littoral zone to document the density and distribution of variable milfoil (*Myriophyllum heterophyllum*) and make note of other invasive and native plant species. As in the past, techniques that were employed to locate and identify the submersed vegetation included the use of a “throw-rake”, Aqua-Vu underwater camera system and surface observations. The areas where milfoil was found were mapped and estimates of cover were recorded. In general, milfoil was observed in the same coves that it has been historically found in. The highest density milfoil (95% cover) was again observed in the shallow southern-most cove in the south basin. In most other areas of milfoil throughout the lake, milfoil density ranged from 10-65% cover. The native vegetation continues to be dominated by ribbonleaf pondweed (*Potamogeton epihydrus*), tapegrass (*Vallisneria americana*), watershield and a macro-algae called stonewort (*Nitella*).

Milfoil Treatment:

Based on the results of the pre-treatment inspection, the chemical treatment of milfoil was conducted on June 17th 2010 by Aquatic Control Biologists and State (MA and CT) Certified Applicators, Gerald Smith and a Field Technician (Figure 1). Areas of watermilfoil were chemically treated with the USEPA/MA & CT registered aquatic herbicide, Reward (active ingredient Diquat). The treatment was performed from Aquatic Control’s Airboat, equipped with a tank and calibrated pump/spraying system for the application. The concentrated liquid herbicide was first diluted with lake water in the 100 gallon spray-tank onboard the Airboat and then injected subsurface through weighted hoses to all targeted areas of milfoil growth. This subsurface injection reduces the possibility of aerial drift of the herbicide. This treatment proceeded smoothly and without incident.

As in the past, notification was given to the Town, the Association and all other required parties prior to treatment. In addition to this notification, both the MA and CT shoreline of the reservoir

was thoroughly posted by HRA with printed signs, warning of the pending treatment and any use or re-entry restrictions.

Milfoil post-treatment inspection and late-season survey:

On August 18th a late season survey of Hamilton Reservoir was performed. The objectives of this survey were to determine the effectiveness of the 2010 milfoil treatment, record potential watershed treatment areas (figure 2), document the native vegetation distribution (figures 3 and 4) throughout the reservoir and plan for treatment requirements in 2011.

The overall cover of milfoil in September was greatly reduced from pre-treatment conditions. However, sparse or single milfoil plants were observed scattered throughout some areas of the littoral zone of both basins. In the northern basin, some 6 or 7 areas of mostly scattered to light milfoil re-growth and 4 small isolated patches of less than 10 plants were observed. In the southern basin, 4 small isolated patches of less than 10 milfoil plants were observed and light regrowth (10-20% cover) had returned to the cove located to the south of Pine Tree Drive and to the north of Hamilton Drive. The area/cove in CT situated to the south of where the eastern inlet stream enters, was found to contain moderate to dense milfoil. Constant water inflow from that stream post-treatment makes this a difficult area to obtain effective or summer-long control of milfoil. Reward is a contact herbicide and thus primarily affects the foliage of the milfoil plants, leaving the root systems relatively in-tact. Due to this property of Reward, it is not uncommon to see some re-growth of milfoil late in the season. The longer duration milfoil control that might be achieved with a systemic herbicide, such as 2,4-D, cannot be permitted for use at Hamilton Reservoir due to the presence of nearby shallow wells. Overall, control of variable milfoil throughout the lake was good for the majority of the summer season. Native plant cover observed during the late summer survey was dominated by tapegrass, ribbon-leaf pondweed, bladderwort, quillwort (*Isoetes*), stonewort, naiad (*Najas flexilis*), watershed and with sparse yellow waterlilies.

Watershield and pilot tapegrass treatment Program:

Based on the results of the late season survey a map was generated delineating the location and treatment priority of watershed and lily growth in both basins (figure 2). Through consultation with the Lake Oversight Committee 41 areas were selected for watershed treatment.

The chemical treatment of watershed with Aquapro (glyphosate) was conducted on September 15th 2010 by Aquatic Control Biologists and State (MA and CT) Certified Applicators, Gerald Smith and a Field Technician. The day of the treatment was breezy at times and as such certain exposed treatment areas were not treated so as to avoid drift and to only treat where the management efforts were likely to be effective (figure 5 and 6).

A post-treatment inspection of the watershed treatment areas was conducted on October 5th, by Aquatic Control Biologists Gerald Smith and Peter Beisler. In general greater than 50% control was observed in the treatment areas with some areas showing 80-90% control. The reduced efficacy can be attributed to the unfavorable weather conditions, on the day of the treatment.

At no time throughout the course of this management program did we either observe or receive any reports of negative affect of treatment on fish or other aquatic life and wildlife.

Water Quality Monitoring Program:

Water quality monitoring of Hamilton Reservoir was continued in 2010. This monitoring adds to the current database and helps to further establish base-line conditions by which to gage future changes in the lake's water quality over time and also to serve as an early warning sign of potential problems or pollution entering the lake. The program consists of the collection of water samples from each lake basin for water chemistry analysis, monitoring of water clarity, and monitoring water temperature and dissolved oxygen levels (figure 7). Two sample rounds were collected at Hamilton Reservoir – one round on June 7th and a late summer round on August 18th. The early June sampling round is indicative of late spring conditions and reflects the lake quality before the intensive summer, recreational season begins. The late summer sampling round, may serve to show change in lake water quality following summer use. Results from the laboratory analysis of water quality are presented in Table 1. Graphical representations of the water quality results for the last two years are attached. Copies of the original laboratory reports are provided at the end of the report.

Surface-grab water samples were taken from one foot below the water's surface. All samples were analyzed for the following parameters: pH, Alkalinity, Turbidity, Ammonia Nitrogen, Nitrate-Nitrogen, Total Phosphorus, True and Apparent Color and E. Coli Bacteria. Table 1 presents the results of the water quality analysis. Our interpretation of the results follows.

TABLE 1 – 2010 Water Quality Analysis Results

Location	Date	pH (S.U.)	Alkalinity (mg CaCO ₃ /L)	Turbidity (NTU)	Kjeldal Nitrogen (mg/l)	Ammonia Nitrogen (mg/l)	Nitrate Nitrogen (mg/l)	Total Phosphorus (mg/l)	True Color (Pt-Co)	Apparent Color (Pt-Co)	E. Coli (org/100ml)	
North Basin	Site 1	6/7/10	6.83	7.4	1.1	<0.1	<0.05	<0.1	0.012	14	18	60
		8/18/10	6.93	9.2	1.2	<0.1	<0.05	<0.1	0.013	12	19	<10
	Site 2	6/7/10	6.83	7.5	1.05	<0.1	<0.05	<0.1	0.01	14	18	30
		8/18/10	6.99	9.4	1.2	0.4	<0.05	<0.1	0.014	12	22	<10
South Basin	Site 1	6/7/10	6.74	9.4	2.1	<0.1	<0.05	<0.1	0.017	18	30	20
		8/18/10	7.1	10.8	2.1	0.1	<0.05	<0.1	0.02	40	64	20
	Site 2	6/7/10	6.76	10	2.8	<0.1	0.055	<0.1	0.021	30	42	60
		8/18/10	7.01	12.6	1.8	<0.1	<0.05	<0.1	0.017	20	33	10
Desirable or Permissible Limits		6.0 – 8.5	>20	<5	<1	<0.5	<0.3	<0.03	n/a	n/a	<230	

pH – The pH scale ranges from 0-14, where 0 is extremely acidic, 7 is neutral, and 14 is the most basic. In general, a range of 6.0-8.5 is desired to maintain a healthy aquatic habitat. At pH levels outside this range, reproduction of certain species of fish and other aquatic life may be impaired. The pH values obtained at Hamilton Reservoir were all within the desired range for fish and other water uses. However, there did appear to be an increase in the pH between the June and August samples, particularly in the South Basin. Changes in pH levels such as this can be caused by a number of factors including changes in water levels, weather patterns, algal density and/or run-off inputs.

Alkalinity – Alkalinity is the measure of the buffering capacity of a waterbody against acid additions, such as acid rain and pollution. Values that are below 20-mg CaCO₃/l are generally indicative of a lake or pond that is more susceptible to a decline in pH. All the alkalinity levels in the Reservoir were less than the desired value. This is likely naturally occurring and a result of the soils and geology in the area rather than any pollution source. These results are consistent with the results observed in 2009 and show that the reservoir is more susceptible to acid emissions and precipitation.

Turbidity – Turbidity is the measure of the amount of light refractive, suspended particles in the water column. Turbidity values can range from less than one to hundreds of units. Typically in unpolluted fresh water ponds, turbidity rarely rises above 5.0 NTU. All of the readings in 2010 were within the desired range.

Ammonia-Nitrogen – Ammonia-nitrogen is the result of decomposing nitrogenous matter. In the presence of oxygen, ammonia is readily converted to inorganic nitrate nitrogen which is readily consumed by aquatic plants and algae. The higher the water temperature the faster this conversion takes place. The low levels of ammonia obtained from the samples in 2010 indicate that the ammonia nitrogen released from the decomposing organic matter was quickly converted to nitrate-nitrogen. The June sample round from the South Basin, Site 2 was slightly higher than other samples, but should not be cause for concern.

Nitrate-Nitrogen – Nitrate-nitrogen is the end product of the nitrogen cycle during aerobic decomposition and is available to aquatic plants as a nutrient source. High concentrations of nitrate may indicate fertilizer or septic system inputs, and can stimulate nuisance algae and plant growth. In general, values above 0.3 mg/l are sufficient to support nuisance algal blooms. All of the values for the two sampling rounds were below detectable levels.

Total Phosphorus – Phosphorus is generally considered to be the “limiting nutrient” or the single nutrient available in the least supply relative to the growth requirements for plant and algae growth. A value of greater than 0.03 mg/l is considered to be adequate to stimulate excessive plant and algae growth. All of the sampling rounds were desirably below the 0.03 mg/l threshold.

Color – “Apparent” color is the color of the water caused by both suspended and dissolved matter in the water, whereas, “True” color is due to the substances that are in solution only with the water. Apparent color is determined directly from the water sample, while “true” color is realized after the water has been filtered and the suspended particles have been removed. The color values obtained from Hamilton Reservoir in 2010 indicate that most of the color originates from substances in solution such as tannic acid. Tannic acid imparts a somewhat darker “tea color” to the water but it is largely of natural origin and not a pollutant. The color content typically increases throughout the course of the summer as the water temperature warms and the release of tannic acid from bottom sediments is accelerated.

E. Coli Bacteria – Coliform bacteria are naturally occurring in pond systems as well as resultant from human and animal inputs. E.Coli is an indicator of the presence of human or animal waste

inputs. In general, acceptable single sample values in “swimmable waters” for E. coli are less than 235 organisms per 100 ml. All E. coli bacteria tests were well within these acceptable limits.

Temperature / Dissolved Oxygen Testing

A YSI 550A temperature/dissolved oxygen meter was used to establish a water temperature and dissolved oxygen profile on two occasions during the 2010 season. The results are presented in Table 2.

TABLE 2 – 2010 TEMPERATURE / DISSOLVED OXYGEN TESTING RESULTS

Depth	Parameter	6/7/2010				8/18/2010			
		North Site 1	North Site 2	South Site 1	South Site 2	North Site 1	North Site 2	South Site 1	South Site 2
Surface	Temp °C	24	23.7	23.2	22.3	25.2	25.1	25.1	26
	DO	7.02	7.21	7.09	7.74	8.46	8.54	8.87	8.26
2.0 foot	Temp °C	24	23.7	23.3	22.3	24.9	25	25.1	25.3
	DO	6.96	7.2	7.06	7.74	8.35	8.19	8.74	8.16
4.0 foot	Temp °C	23.7	23.5	23.3	22.2	24.9	24.8	24.9	25.1
	DO	6.88	7.15	7.03	7.6	8.17	8.13	8.73	8.17
6.0 foot	Temp °C	23.5	23.4	23.2	---	24.7	24.7	24.8	25.1
	DO	6.96	7.16	7.03	---	8.16	8.13	8.64	8.08
8.0 foot	Temp °C	23.4	23	23.1	---	24.7	24.7	24.5	25
	DO	7.04	6.96	7	---	2.6	8.11	<1	<1
10.0 foot	Temp °C	23.2	22.8	22.8	---	---	24.6	---	---
	DO	7.03	6.93	6.95	---	---	<1	---	---

--- = Bottom (no measurement)

The results indicate good oxygenation throughout the water column during both sampling rounds. Oxygen levels during the 2010 late season sampling were lower than the levels during the 2009 late season sampling. This is likely due to the warmer temperature experienced throughout the 2010 summer season. When analyzing these results, it is important to remember that dissolved oxygen levels greater than ~ 3.0 mg/l are generally considered adequate to sustain a warm-water fish population. Biological Oxygen Demand (BOD) near the pond bottom was represented by a sharp decrease in dissolved oxygen at the sediment water interface. BOD is the result of the aerobic breakdown of organic material by naturally occurring microbes.

TABLE 3 – 2010 SECCHI DISK RESULTS (Ft.)

Sampling Station		6/7/2010	8/18/2010	2010 Average
North Basin	Site 1	7.3	8.4	7.85
	Site 2	6.6	9.3	7.95
South Basin	Site 1	6.1	5	5.55
	Site 2	5.1	4.4	4.75

The Secchi disk (water clarity) readings (Table 3) from the North Basin were good during both of the sampling rounds. The Secchi disk results from the South Basin were lower, particularly during the August sampling round and approaching the State’s recommended minimum of 4 feet of clarity for waters that are used for swimming. Close attention should be paid on this in future management years. However, the water clarity readings taken throughout 2010 were slightly higher than the 2009 readings.

Management Recommendations for 2011:

Milfoil will return to a degree in 2011 and as such, a treatment program similar to that of 2010 will be required.

It will again be important for HRA to fund the chemical treatment of watermilfoil throughout the lake as well as the more intensive plant surveys and reporting work that we’ve performed since taking over the management work on the lake in 2008. In addition to treating watermilfoil, we would recommend the re-treatment of the waterlily and watershield treatment areas which were treated this year. Unfavorable weather conditions interfered with the efficacy of the treatment and likely resulted in a reduced level of control. We will also be available to treat wild celery and/or ribbon-leaf pondweed should these species become a significant nuisance and warrant treatment.

The results of this year’s testing did not reveal any abnormalities in water quality that are alarming or warrant immediate attention. One must remember, however, that one or two rounds of water quality test results are but a “snap-shot” of lake quality at a given moment in time. Water quality can and often will change throughout the course of the year or from year to year. The water testing and lake surveys serve to provide a valuable long-term database for the lake. This information can be particularly valuable in the event of a change in water quality or should questions or concerns arise from lake residents or other users of the lake. We feel the current testing program with two sampling rounds per year is adequate but is the minimum program that we would recommend.

If you have any questions regarding the content of this report or require any additional information please do not hesitate to contact the office. We look forward to working with you in 2010 and the years to come.

Sincerely,

Aquatic Control Technology, Inc.



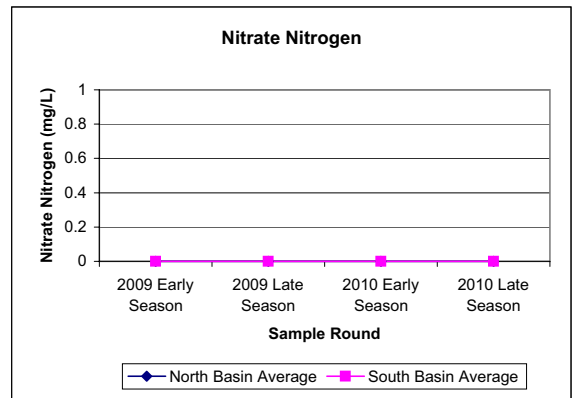
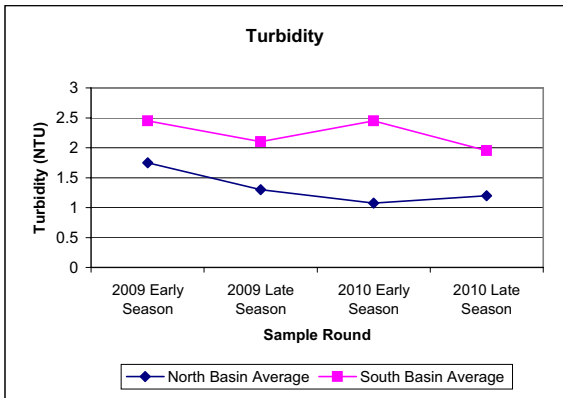
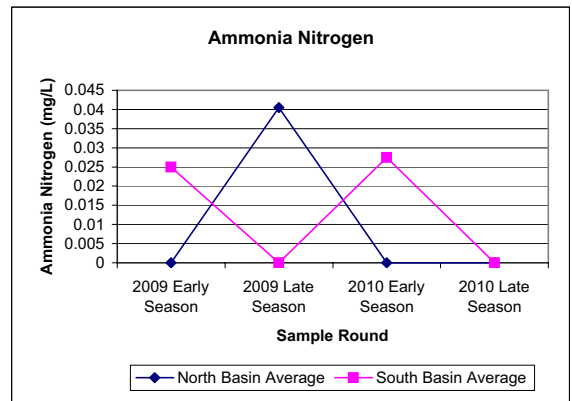
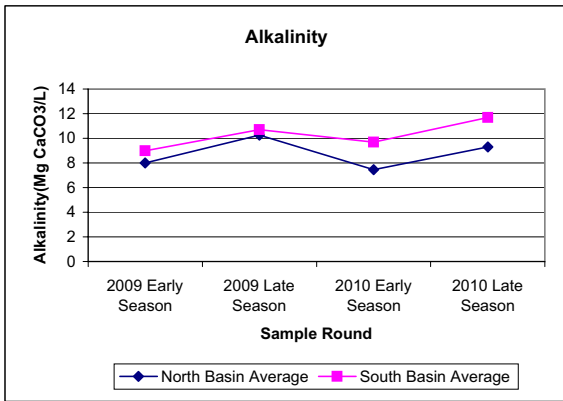
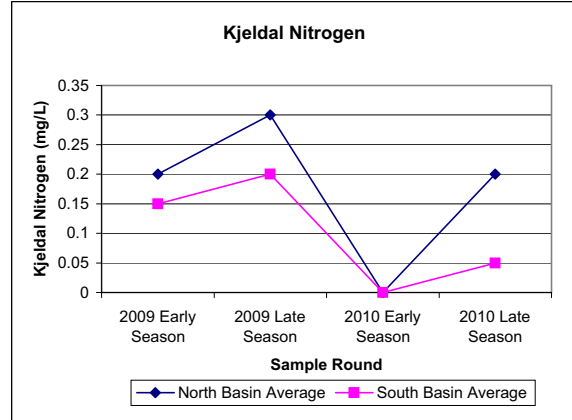
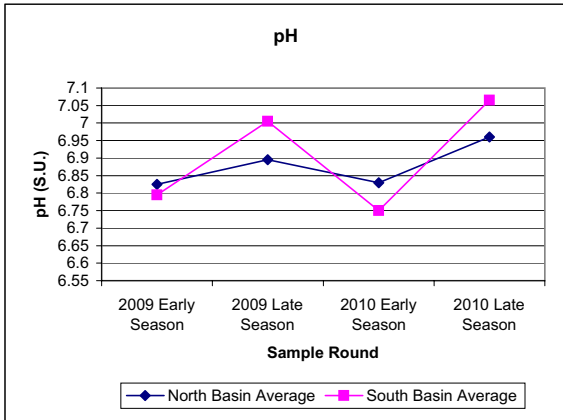
Erika Haug
Biologist



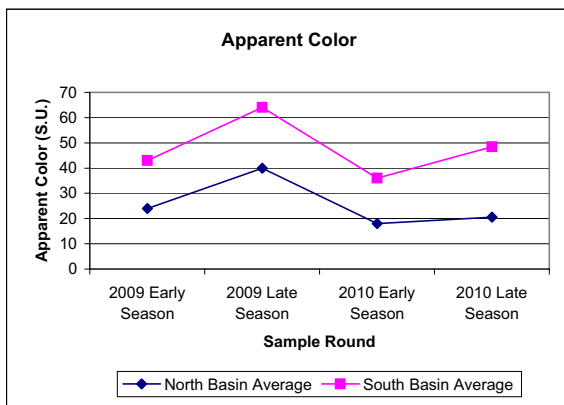
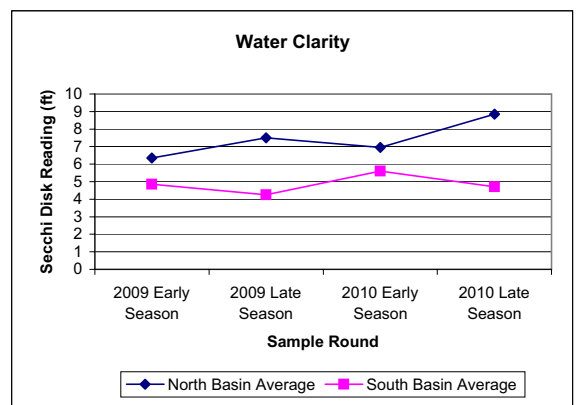
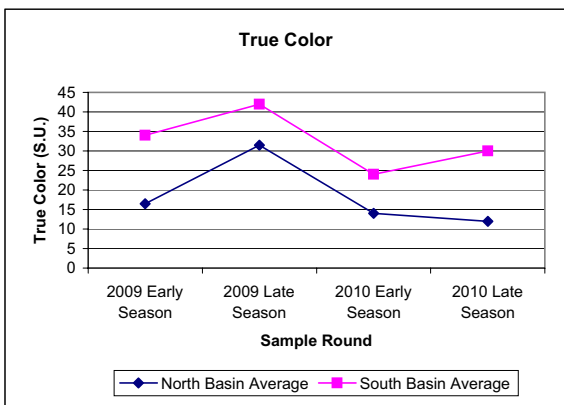
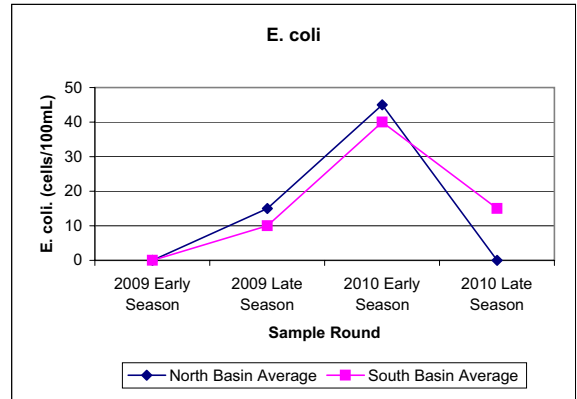
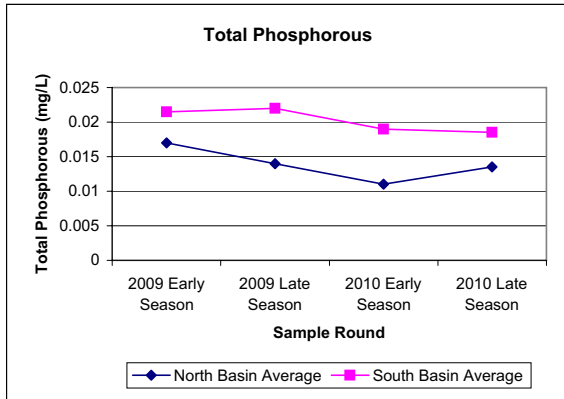
Gerald N. Smith
President/Aquatic Biologist

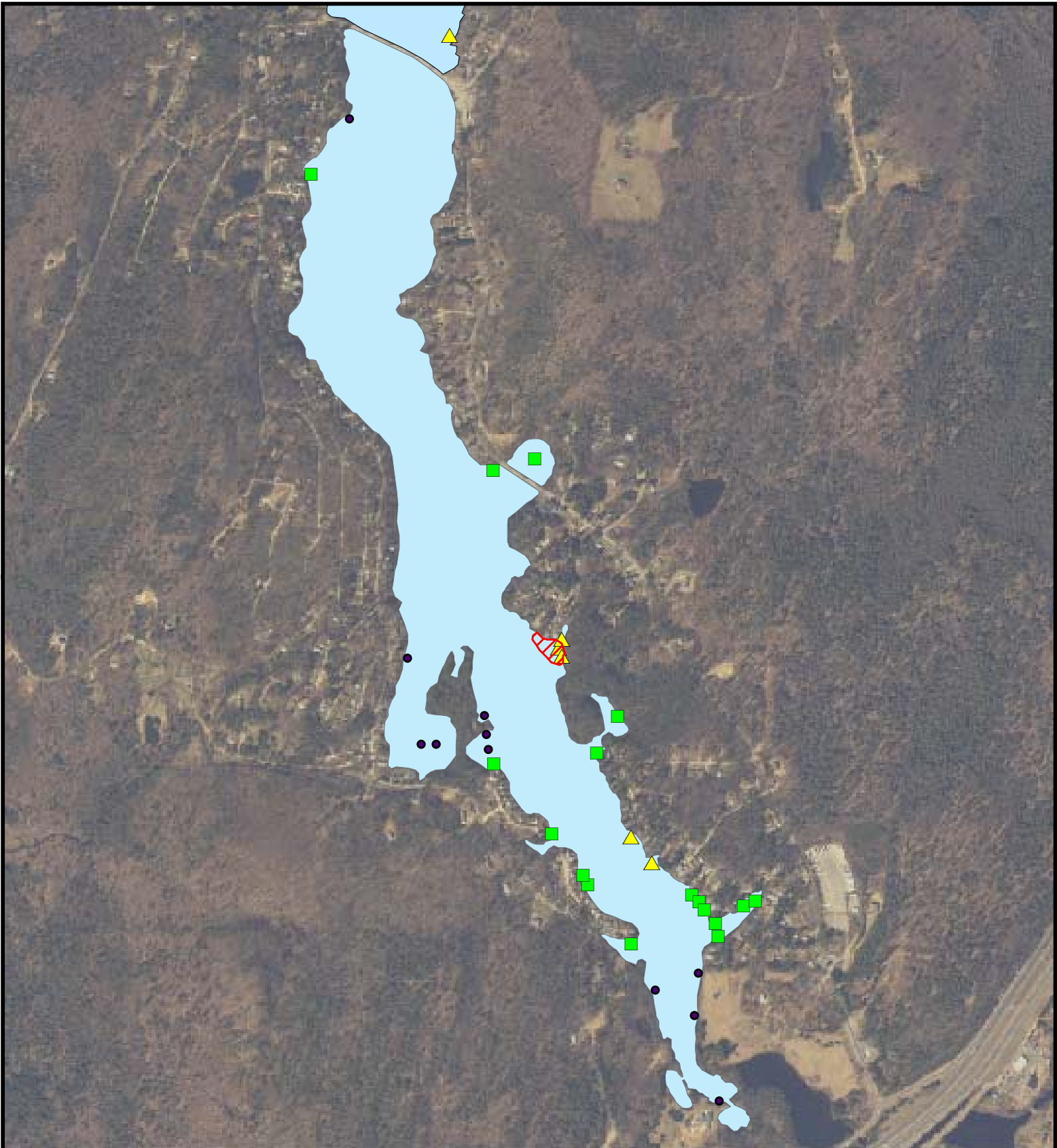
CC: Board of Selectman; Town of Holland

2009 and 2010 Water Quality Data Hamilton Reservoir



** Values below detection levels are displayed as zero.









Hamilton Reservoir

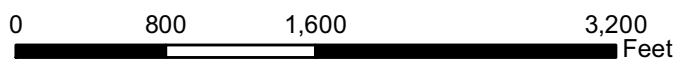
Holland, MA & Union, CT

2010 Watershield Treatment Areas
and Tapegrass Pilot
Treatment Area - South

FIGURE:	TREATMENT DATE:	MAP DATE:
6	9/15/10	11/26/10

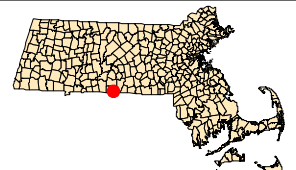
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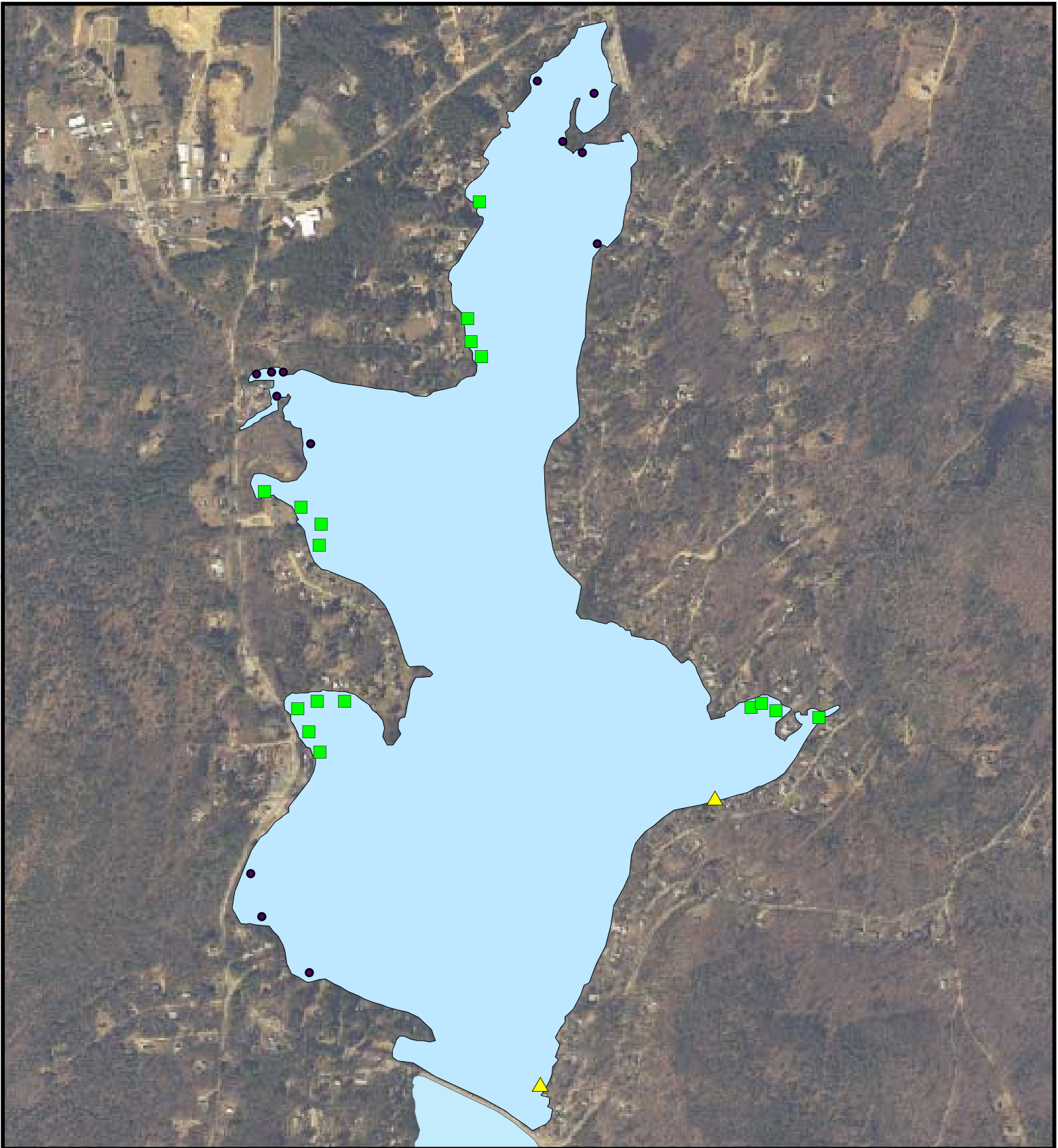
-  Pilot tapegrass treatment area
-  Watershield growth not designated for treatment
-  Watershield not treated due to lack of ideal conditions (wind or wet lily pads)
-  Watershield treated



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Hamilton Reservoir

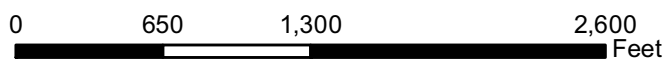
Holland, MA & Union, CT

2010 Watershield Treatment Areas
and Tapegrass Pilot
Treatment Area - North

FIGURE:	TREATMENT DATE:	MAP DATE:
5	9/15/10	11/26/10

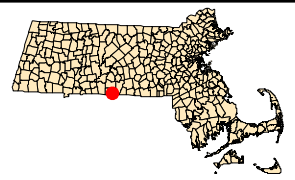
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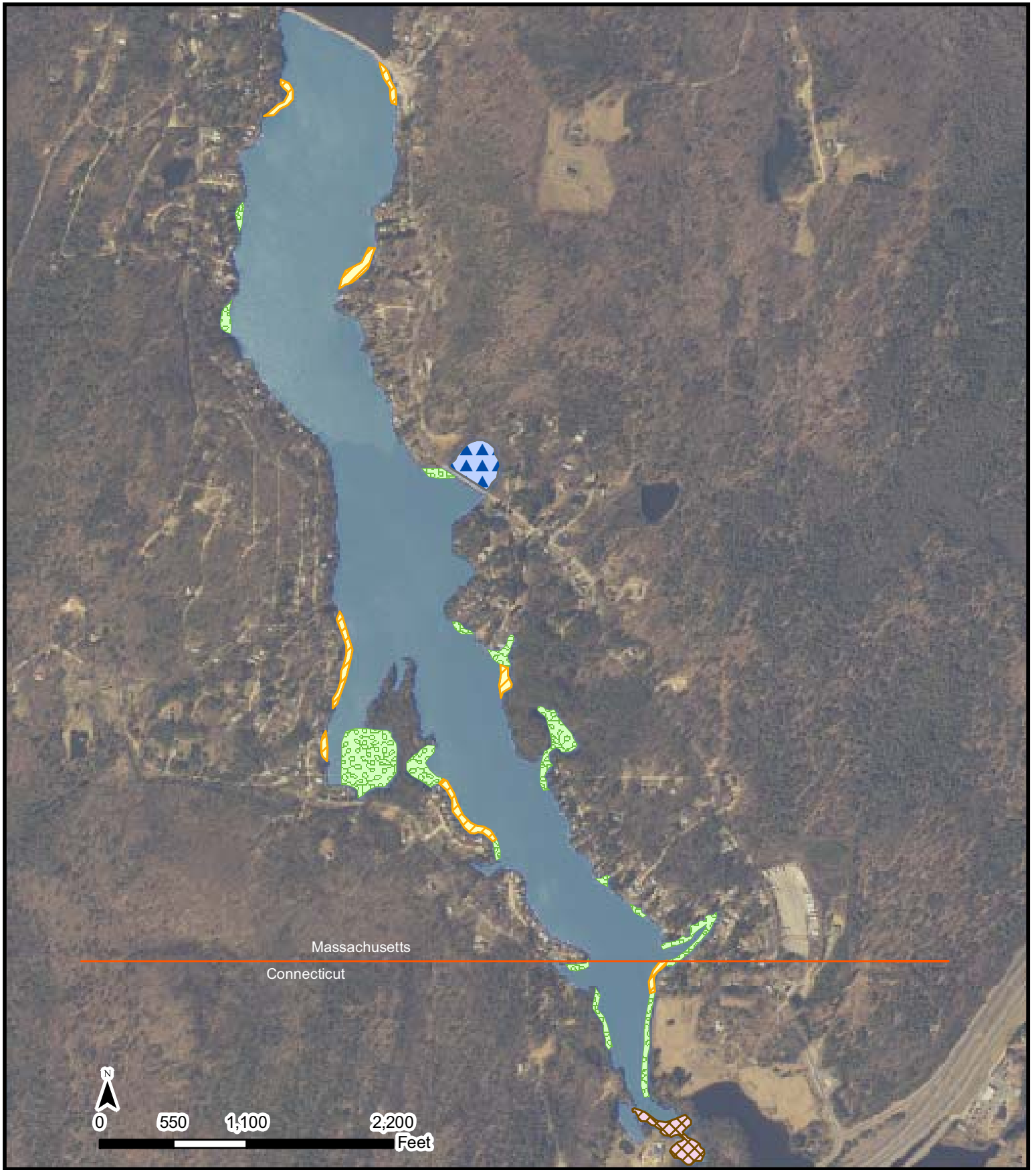
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Hamilton Reservoir - South Basin

Late-Season Plant
Composition and Cover

Holland, MA
Union, CT

FIGURE:	SURVEY DATE:	MAP DATE:
4	8/18/10	11/29/10

Legend

-  Light to moderate cover of tapegrass, ribbon-leaf pondweed and bladderwort
-  Moderate to dense cover of milfoil with lesser amounts of bladderwort, ribbonleaf pondweed and lilies
-  Watershield dominant with lesser amounts of milfoil, tapegrass, ribbonleaf pondweed and bladderwort
-  Moderate cover of milfoil and watershield

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Hamilton Reservoir - North Basin

Late-Season Vegetation Distribution
Holland, MA

Legend

-  Tapegrass, ribbon-leaf pondweed, bladderwort, quillwort and Naiad with occasional sparse/scattered civer of milfoil.
-  Moderate cover of milfoil with lesser amounts of tapegrass and bladderwort
-  Light to moderate watershed with tapegrass ribbonleaf pondweed, bladderwort and a few isolated patches of milfoil

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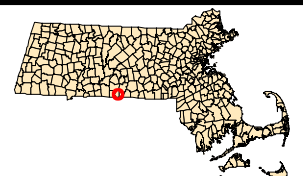
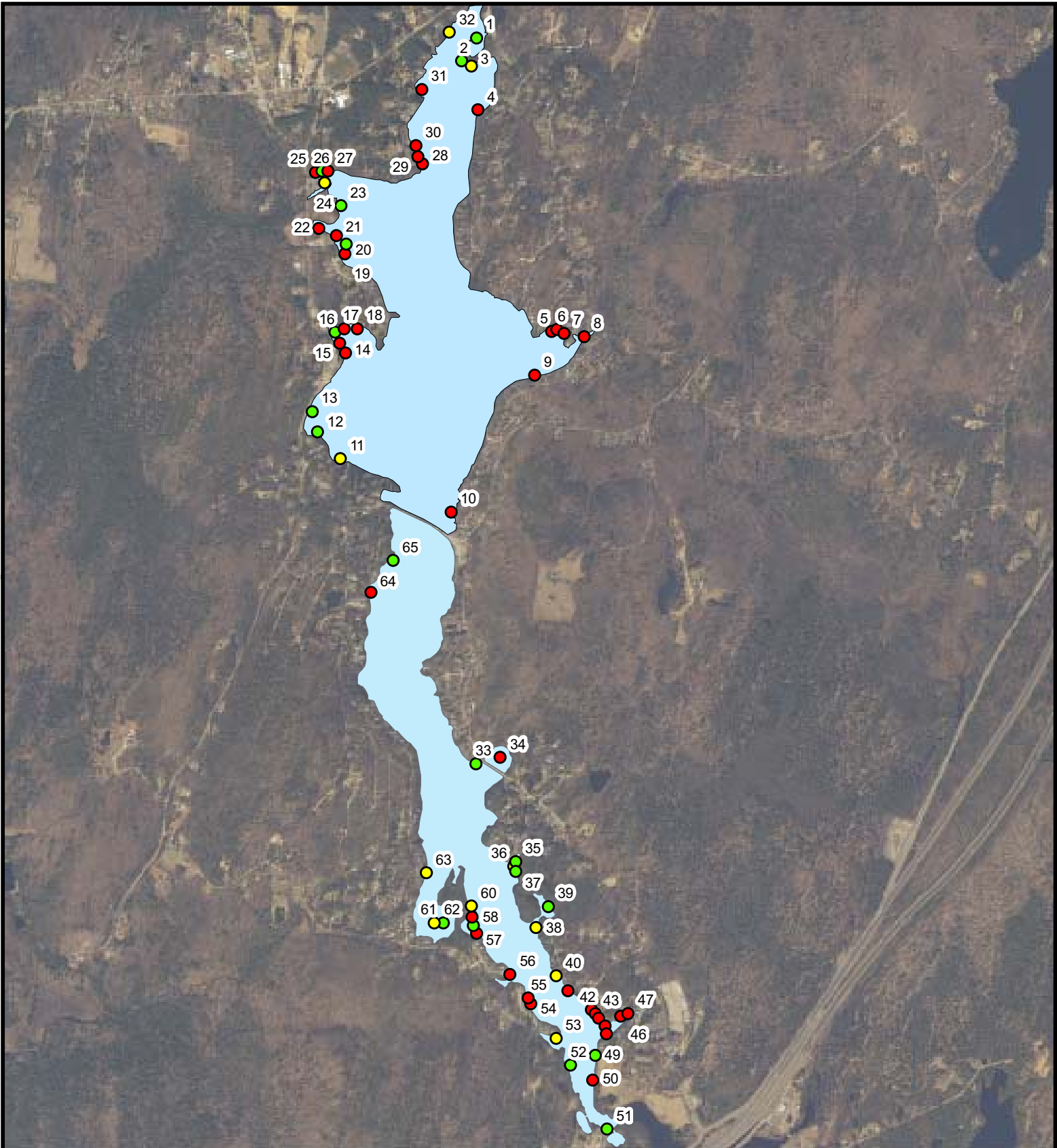


FIGURE:	SURVEY DATE:	MAP DATE:
3	8-18-10	11-26-10



Hamilton Reservoir

Holland, MA & Union, CT

2010 Watershed
Areas

Legend:

Priority

- High
- Moderate
- Low



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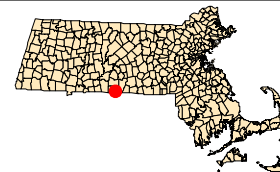
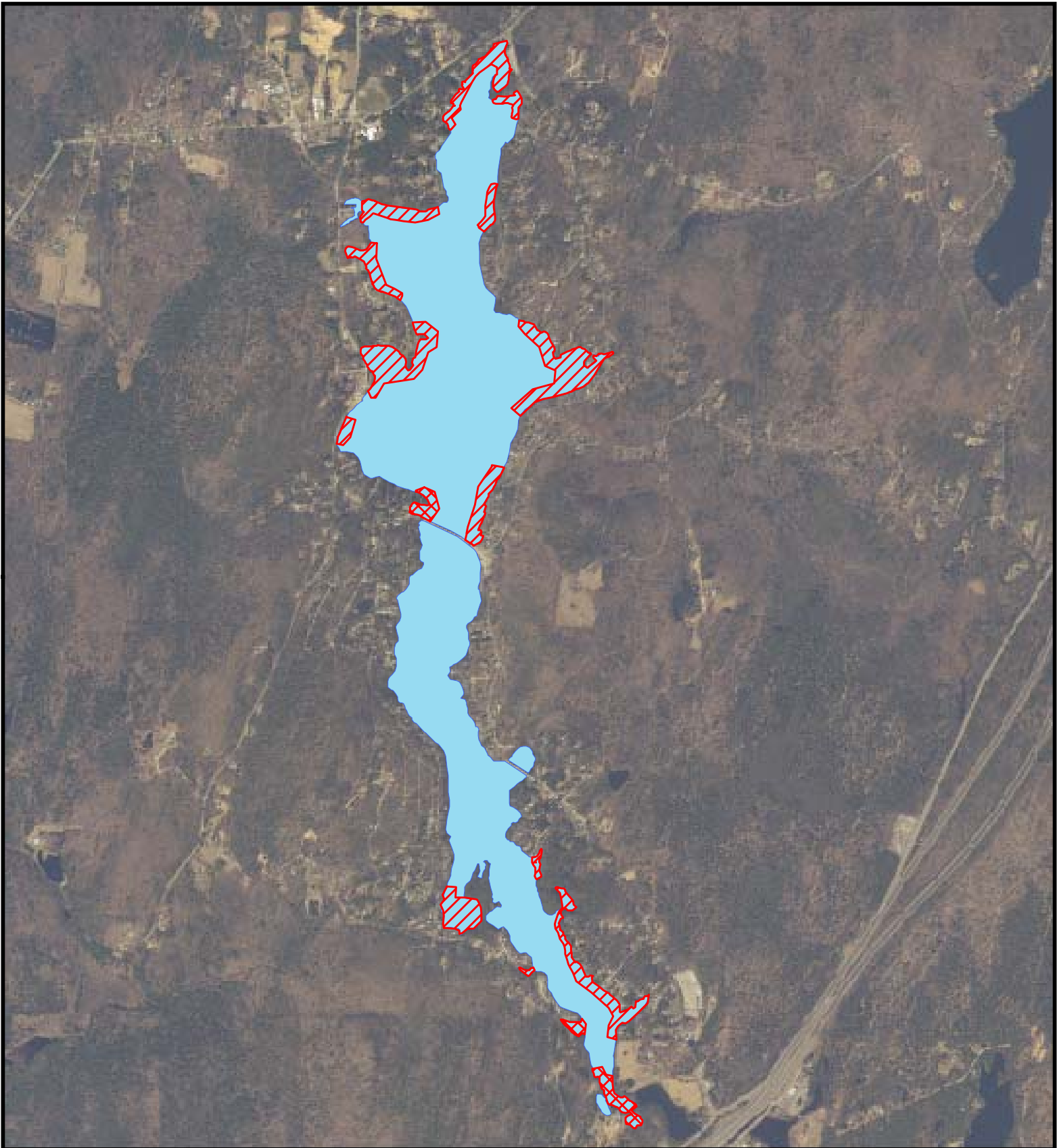


FIGURE:	SURVEY DATE:	MAP DATE:
2	8-18-10	8-20-10



Hamilton Reservoir

Holland, MA & Union, CT

2010 Milfoil Treatment
Areas - South

FIGURE:	SURVEY DATE:	MAP DATE:
1	6/7/10	6/9/10

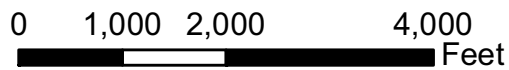
Legend:



Moderate milfoil coverage treated with Reward

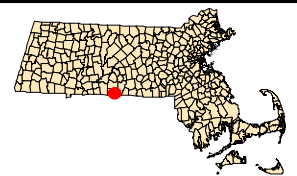


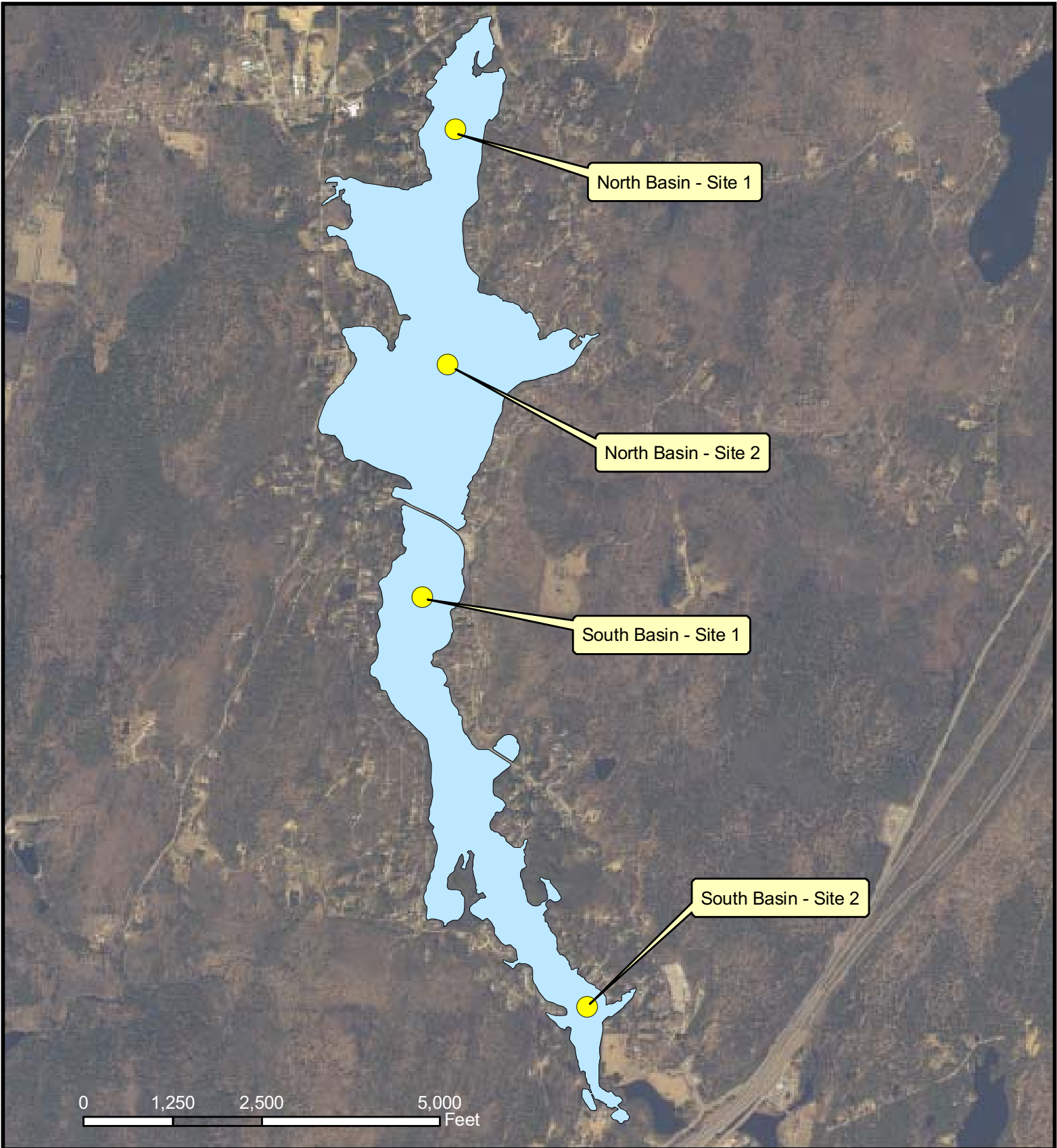
Moderate to heavy milfoil coverage treated with Reward



 **AQUATIC CONTROL TECHNOLOGY, INC.**

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Hamilton Reservoir

Holland, MA / Union, CT

Water Quality Sampling
Site Location Map

Legend:

- Site Location of: Water sample collection, Temperature/Dissolved Oxygen reading & Secchi disk reading



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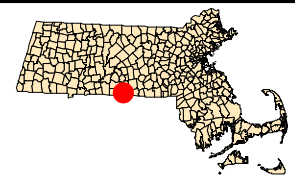


FIGURE:	SURVEY DATE:	MAP DATE:
7	---	11/25/09