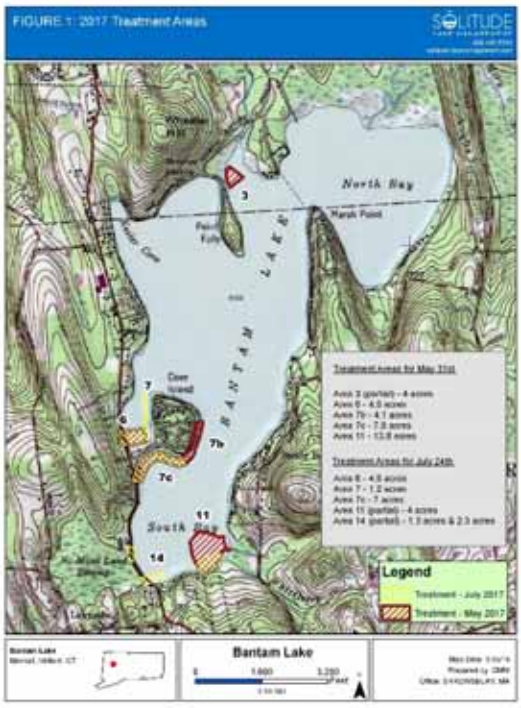
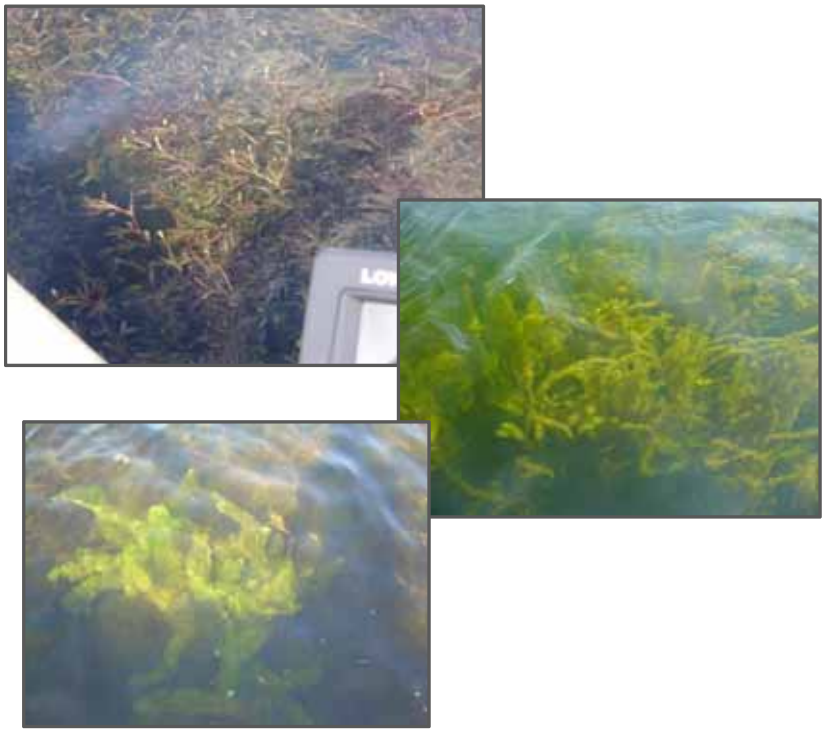
Bantam Lake – Aquatic Management Program

2017 Final Report January 2018





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Introduction

Bantam Lake is considered one of the most valuable fishery and recreational resources in the State and it is the largest natural lake in Connecticut. The lake contains two State listed, rare and endangered aquatic plant species: slender-leaf watermilfoil (*Myriophyllum alterniflorum*) and water marigold (*Bidens beckii*). While the lake undoubtedly supports a diverse population of beneficial aquatic plant species, there is also a significant presence of non-native and invasive weeds, including Eurasian watermilfoil (*Myriophyllum spicatum*), curlyleaf pondweed (*Potamogeton crispus*), southern waternymph (*Najas guadalupensis*), fanwort (*Cabomba caroliniana*) and water chestnut (*Trapa natans*). These species in particular threaten the lake's habitat and recreational use.

The current vegetation management program at Bantam Lake, initiated in 2006, has been ongoing now for twelve years. SOLitude Lake Management and Northeast Aquatic Research had been working with the Bantam Lake Protective Association (BLPA) even before the start of the current program to monitor, assess, plan and manage nuisance aquatic vegetation at Bantam Lake as well as evaluate water quality. Early techniques included weed harvesting and hydro-raking, but due to the increasing presence of invasive species, a decision was made to implement a more comprehensive plant management program, which included the use of herbicides. After much planning with the BLPA, the CT Department of Energy and Environmental Protection (DEEP) and other parties, treatments began in 2006. These efforts have been largely successful in managing invasive plant species.

Adjustments have been made over the years to meet changing conditions and insure the overall success of the program. These changes included adding/adjusting management areas, modifying survey & treatment timing and moving to a biannual treatment effort. Fanwort in particular has potential to be an aggressive invader at Bantam Lake. Historically, the fanwort infestation in the lake has been limited to the northern edge of the North Bay and the Outlet Cove although scattered occurrences in other areas of the lake have been observed and hand-pulled. Extensive diver hand-harvesting over the years has practically eliminated the Outlet Cove infestation and reduced the infestations in North Bay. Unfortunately, the Bantam River and Little Pond upstream of the lake are heavily infested with fanwort (and Eurasian milfoil), which has served as a constant source of plant fragments and potential spread. In 2013 & 2016, the Bantam River and Little Pond were treated with Clipper (flumioxazin) herbicide to reduce the infestation.

This report summarizes the Aquatic Management Program at Bantam Lake in 2017, including the documentation of pre & post treatment inspections, description of the treatment protocol & efforts, discussion of other management tasks and presentation of recommendations for 2018.

Summary of Management Plan

The Management Plan has been carried out using the same general approach over the twelve years of the program. Based on pre-treatment plant surveys conducted by NEAR and Solitude, herbicide treatment areas were designated to target problematic weeds in the lake, primarily *Myriophyllum spicatum* and *Potamogeton crispus*, with some selected, high-use areas targeted for the control of other Pondweeds (*Potamogeton spp.*) and naiads, mainly *Najas guadalupensis*. Selection of areas took into account the location of state listed plants and nearby public wells.

As has been the practice since 2008, the plan includes two separate treatments, better matching the growth patterns of the target plants. The first treatment (usually in early June) targets mainly areas of milfoil and curlyleaf pondweed while the second treatment (usually in mid-late July) targets later emerging plants such as naiad. Treatment areas and dates are set based on direct observation of the lake plant populations during pre-treatment surveys in May and early July. A final survey in September serves to assess the efficacy of the 2nd treatment and document late season plant growth in the management areas.

Implementation of Treatment

Each year, the lake's plant population is directly observed during the spring, mid-summer and fall. The observations made during these surveys are used to determine treatment date(s) (if any) for each management area, and which type of treatment(s) should be administered. Two herbicide treatments were conducted in the 2017 season on May 31st & July 24th. A final fall survey in October served to assess the efficacy of the treatment and document late season plant growth in the management areas.

Following extensive notification of the pending chemical treatments to the public, including resident mailings, newspaper notices and shoreline posting, the following areas of the lake were treated as depicted in Table 1 (below) and Figure 1. Dominic Meringolo, a Supervisory Level Applicator assisted by a field technician, performed the treatments from Solitude's specially designed Airboat, equipped with a sub-surface spray boom and GPS guidance system.

Table 1 – 2017 Treatment Details

Date	Areas Treated	Herbicides Used
May 31st	3 (partial), 6, 7b, 7c, 11	Reward (diquat)
July 24th	6, 7, 7c, 11 (partial), 14 (partial)	Reward (diquat) & Aquathol-K (endothall)

Herbicide Testing

Per conditions on the 2017 CT DEEP permit, no treatments were performed near active public drinking water wells, therefore not well testing was required.

Algae Management

Due to ongoing issues with nuisance algae blooms, treatment of the lake with copper sulfate was included in this year's program. Based on monitoring conducted by NEAR and following discussion with the BLPA, two half-lake copper sulfate algaecide treatments were conducted on July 24th and August 8th. These treatments worked well to control an impending bloom and helped to maintain desirable water clarity through the latter portion of the summer recreational period.

Aquatic Plant Surveys

The plant survey methodology for this project was initially approved by DEEP as part of the "Authorization for Incidental Taking of Endangered or Threatened Species", which was submitted to the

State in support of the DEEP herbicide permit application. Dominic Meringolo with Solitude and Dr. George Knoecklein (NEAR) again performed the plant surveys as they did in past years. A series of 167 data points were located with a Trimble Differential GPS (DGPS) unit, in and adjacent to the management areas (Table 2). Points were set along transects that bisected the treatment areas such that most transects had at least one point that was located outside of the potential treatment area. Transects were located so that the potential treatment areas were bracketed by observations points. Both the treatment area and the area around the outside of the treatment area were surveyed. The points used this year were the same as last year.

The following data was collected at each point, 1) latitude/longitude, 2) water depth, 3) plant species present, 4) % cover of each species, 5) approximate biovolume. At each point, vegetation data was collected using a weed rake and underwater video camera. The weed rake was used to bring plant specimens into the boat for identification, while the underwater camera was used to estimate the percent cover and the relative biovolume of each species at the point. Biovolume is measured on a scale of 0-5 with: 1 = low growing, mostly within a few inches of the bottom, 2 = some height in the water column but less than half the water column, 3 = tall growth better than half the water column, 4 = growth to the water surface, 5 = topped out, matted growth and/or floating leaf plants. Percent cover is an estimate of the abundance of a plant species in a given area while the percent occurrence is calculated from the number of points where the plants was observed divided by the total points in the area.

There were ten survey areas, South Bay, Marina Cove, Deer Island, West Shore, Keeler Cove/North Shore, Outlet Cove, North Bay, Marsh Point, South Bay Extension and Southwest Bay. Each area was visited twice during the 2017 season. The pre-treatment visit occurred on May 3rd, and the post treatment survey was conducted on October 6th. Figures 2-11 show the location of the data points at each of the ten survey areas in Bantam Lake. Figure 12 & 13 show summaries of pre & post treatment conditions at Bantam Lake. The following is a discussion of the survey data.

Table 2 – Number of Observation Points in Each Treatment Area

Treatment Area	***# of Observation Points***
South Bay (Area 11)	28
Marina (Area 7c)	15
Deer Island (Area 7, 7a-b)	26
West Shore (Area 12)	10
North Shore (Area 4)	18
Outlet Cove (Area 3)	15
North Bay (Area 1)	25
Marsh Point (Area 13)	11
South Bay Extension (Area 11a)	6
Southwest Bay (Area 14)	13
Total	**167**

South Bay (Area 11)
Target Plants: Curlyleaf Pondweed, Naiad
Herbicide(s) Applied: Reward (May & July)

Potamogeton crispus (curly-leaf pondweed) was present at a medium level in this area during the May survey, but despite not being particularly dense, it was the second most dominant species found in the pre-treatment survey. During the October post-treatment survey, no *crispus* was found in South Bay. *Najas guadalupensis* (southern naiad) increased in the area between May and October, but was the dominant species in South Bay during both the May and October surveys. *Potamogeton amplifolius* (large-leaf pondweed) was present at a low level (just a few waypoints) in May and had spread slightly by October. There was a significant amount of filamentous algae present in May but none was found in October. *Myriophyllum spicatum* (Eurasian milfoil) remained absent from South Bay in 2017. Filamentous algae was present in approximately half of the treatment area in May, but none was found in October.

Table 3 – % occurrence and average % cover for species found at South Bay

South Bay						
Species Name	% Occurrence		Avg. % Cover		Avg. Biovolume	
	5/3/17	10/6/17	5/3/17	10/6/17	5/3/17	10/6/17
Nothing Present	21	4	NA	NA	NA	NA
Ceratophyllum demersum		4		10		NA
Elodea nuttallii	7		13		2	
Filamentous algae	46		35		NA	NA
Najas guadalupensis	75	93	56	52	1	2
Nitella sp.	14		8		1	
Nuphar varegata		7		70		NA
Potamogeton amplifolius	11	18	38	82	3	5
Potamogeton crispus	29		20		3	
Potamogeton gramineus		4		NA		4
Sagittaria graminea		4		NA		1
Vallisneria americana		7		NA		3

Marina Cove (Area 7c)
Target Plants: Curlyleaf pondweed, Naiad, Largeleaf pondweed
Herbicide(s) Applied: Reward (May) & Reward/Aquathol-K (July)

During the 2017 pre-treatment survey, crispus was present at a relatively low level (20% occurrence) and no *crispus* was present in October. In comparison, in 2016, crispus was present at half of the survey points in May and by late September it covered the entire treatment area. In place of the *crispus, Najas guadalupensis* was very abundant throughout the season, covering nearly the entire area. Similar to the 2016 results, *Nitella* and *crispus* were the second most dominant species in May and *Potamogeton amplifolius* was present at a low level in both May and October. All the species except *Najas guadalupensis* were only present at one or two waypoints in October. Filamentous algae was present in just under half of the treatment area.

Table 4 - % occurrence and average % cover for species found at Marina Cove

Marina Cove						
Species Name	% Occurrence		% Cover		Avg. Biovolume	
	5/3/17	10/6/17	5/3/17	10/6/17	5/3/17	10/6/17
Nothing Present						
Ceratophyllum demersum		7		20		NA
Chara	7		5	NA	1	
Filamentous algae	40		31		NA	
Najas guadalupensis	87	93	40	32	1	2
Nitella sp.	27	7	18	15	1	1
Nuphar varegata		13		75		NA
Nymphaea odorata		13		83		NA
Potamogeton amplifolius	13	13	8	15	2	3
Potamogeton crispus	20		40		3	
Potamogeton praelongus		7		20		3

Deer Island (Area 6, 7, 7a, 7b)
Target Plants: Curlyleaf pondweed, Naiad, Largeleaf pondweed
Herbicide(s) Applied: Reward (May) & Reward/Aquathol K (July)

In May, no plants were growing in just under 50% of this area. In the rest of the treatment area, the most dominant species were *Najas guadalupensis*, *Nitella sp*., and Filamentous algae, each present at a medium % occurrence. In October, *Najas guadalupensis* remained the most dominant species, and had spread throughout more of the area. *Vallisneria americana* (tape grass) was not present in May but it appeared later in the season and by October it was present at a moderate % occurrence and was the second most dominant species in the treatment area. Compared to 2016, more *Potamogeton amplifolius* was present at equal, relatively low densities in both the pre- and post-surveys. In contrast, less *Potamogeton crispus* was present this season than in 2016 with the species growing at only three waypoints in May and completely absent from the area in October.

Table 5 - % occurrence and average % cover for species found at Deer Island

Deer Island						
Species Name	% Occurrence		% Cover		Avg. Biovolume	
	5/3/17	10/6/17	5/3/17	10/6/17	5/3/17	10/6/17
Nothing Present	42	23	NA	NA	NA	NA
Ceratophyllum demersum		4		5		3
Chara		12		33		2
Filamentous algae	23		30		NA	
Najas guadalupensis	35	62	40	56	1	3
Nitella sp.	31		34		1	
Nymphaea odorata		15		70		NA
Potamogeton amplifolius	19	19	9	28	2	3
Potamogeton berchtoldii	4		1		2	
Potamogeton crispus	12		8		3	
Potamogeton gramineus		15		53		3
Potamogeton praelongus		4		10		4
Potamogeton robbinsii	4		5		2	3
Vallisneria americana		31		25		2

West Shore (Area 12)
No Treatment

During the May survey, *Chara sp.* was the only species found in this treatment area. It was present in 50% of the treatment area, and in the areas where it was growing, it was at a very low density. No plants were present in the other 50% of the area. In October, several more species were present, although most were present at a very low density. *Najas guadalupensis* was the only abundant species, covering nearly the entire area. All the other species found in October were present at a very low density. Potamogeton amplifolius was only found at two waypoints and no *Potamogeton crispus* was found during the September survey. Small but fairly dense *Nymphaea odorata* and *Nuphar variegata* (white and yellow lily) patches were also present in this area.

Table 6 - % occurrence and average % cover for species found at West Shore

West Shore						
Species Name	% Occurrence		% Cover		Avg. Biovolume	
	5/3/17	10/6/17	5/3/17	10/6/17	5/3/17	10/6/17
Nothing Present	50		NA		NA	
Ceratophyllum demersum		7		20		
Chara	50		9		1	2
Najas guadalupensis		93		32		3
Nitella sp.		7		15		NA
Nuphar varegata		13		75		NA
Nymphaea odorata		13		83		NA
Potamogeton amplifolius		13		15		4
Potamogeton praelongus		7		20		NA

Keeler Cove – North Shore Results (Area 4)
No Treatment

In both May and October, no plants were growing in approximately one third of the treatment area. *Najas guadalupensis* was the dominant species in this treatment area in May, present in half of the area. *Potamogeton amplifolius* was the second most dominant species, at 22% occurrence. The remaining species were very sparse. In October, Keeler Cove/North Shore contained the highest species richness (the greatest number of species) of all the treatment areas. Najas guadalupensis remained present in half the treatment area, but *Potamogeton amplifolius* and *Vallisneria americana* were also present in approximately half the treatment area. Several other species were present in this area in October, but each species was only growing at one or two waypoints. *Potamogeton crispus* was not found in this treatment area in either of the surveys.

Table 7 - % occurrence and average % cover for species found at Keeler Cove - North Shore

North Shore						
Species Name	% Occurrence		% Cover		Avg. Biovolume	
	5/3/17	10/6/17	5/3/17	10/6/17	5/3/17	10/6/17
Nothing Present	39	33	NA	NA	NA	NA
Bidens beckii		6		15		NA
Ceratophyllum demersum	6		15		2	
Chara	17	6	7	50	1	NA
Elodea canadensis	6		5		NA	
Filamentous algae	6		60		NA	
Myriophyllum spicatum	6	6	5	30	NA	NA
Najas guadalupensis	50	50	49	78	1	2
Nuphar varegata		6		NA		NA
Nymphaea odorata		11		88		NA
Potamogeton amplifolius	22	56	56	49	3	3
Potamogeton gramineus		11		28		NA
Potamogeton robbinsii		6		70		NA
Sagittaria graminea		11		10		NA
Utricularia macrorhiza	6	6	5	NA	2	NA
Utricularia purpurea		6		NA		NA
Vallisneria americana		50		14		2
Zosterella dubia		6		50		NA

Outlet Cove Results **(Area 3)**
Target Plants: Eurasian milfoil
Herbicide(s) Applied: Reward (May)

Najas guadalupensis was the most dominant species in Outlet Cove in both May and October. During the pre-treatment survey, more species were present in Outlet Cove than in any of the other treatment areas. However, other than Najas guadalupensis, all the other species were only found at one or two waypoints. *Najas flexilis* was present in this area in May and while only present at one waypoint, this species was only found in this treatment area and in North Bay in 2017. Eurasian milfoil was observed at low occurrence in both the May and October surveys. In October, *Nymphaea odorata* and *Vallisneria americana* were the second most dominant species in Outlet Cove, both growing in just under one third of the treatment area. The remaining species were present at low densities.

Table 8 - % occurrence and average % cover for species found at Outlet Cove

Outlet Cove						
Species Name	% Occurrence		% Cover		Avg. Biovolume	
	5/3/17	10/6/17	5/3/17	10/6/17	5/3/17	10/6/17
Nothing Present	15	27	NA	NA	NA	NA
Ceratophyllum demersum	15	13	10	25	NA	3
Chara		13		33		1
Filamentous algae	8		NA		NA	
Myriophyllum spicatum	8	7	30	15	3	NA
Najas flexilis	8		10		NA	
Najas guadalupensis	62	60	34	52	1	2

Nuphar varegata		20		60		
Nymphaea odorata	15	27	23	38	NA	NA
Potamogeton amplifolius	8	7	60	50	NA	NA
Potamogeton crispus	8	7	25	NA	NA	NA
Potamogeton robbinsii	15	13	45	55	2	NA
Utricularia macrorhiza	15		8		2	NA
Vallisneria americana		27		9		NA

North Bay (Areas 1, 1a)
No Treatment

In May no plants were present in over one third of North Bay. *Najas guadalupensis* was the most dominant species, present at 44% occurrence. The remaining species in this area were present at only one or two waypoints. *Potamogeton crispus* was present in May, but at only one waypoint and no crispus was found in October. There were more species present in October, but *Najas guadalupensis* remained the most abundant species and had spread to 80% occurrence. *Myriophyllum spicatum* was present in this area in October at a 52% occurrence but at a low density. *Potamogeton amplifolius* was present at a moderate occurrence and moderate density.

Table 9 - % occurrence and average % cover for species found at North Bay

North Bay						
Species Name	% Occurrence		% Cover		Avg. Biovolume	
	5/3/17	10/6/17	5/3/17	10/6/17	5/3/17	10/6/17
Nothing Present	36	12	NA	NA	NA	NA
Ceratophyllum demersum		4		3		3
Chara	4		5		1	
Elodea canadensis		12		4		1
Filamentous algae	4		NA		NA	
Myriophyllum spicatum		52		5		5
Najas flexilis	4		5		NA	
Najas guadalupensis	44	80	17	51	1	2
Nymphaea odorata		8		10		3
Potamogeton amplifolius	8	32	7	38	NA	4
Potamogeton crispus	4		10		2	
Potamogeton gramineus		24		75		5
Potamogeton praelongus	8	4	23	10	4	NA
Sagittaria graminea	8	4	8	NA	1	NA
Vallisneria americana		48		16		2
Zosterella dubia		16		55		NA

Marsh Point (Area 13)
No Treatment

Consistent with results from recent years, very few species were growing in Marsh Point in 2017. However, no *crispus* was found during either of the surveys, while in 2016, this invasive was present at a moderate level during the post-treatment survey. In both May and October, no plants were growing in a large portion of the treatment area. In May, *Najas guadalupensis* was the most abundant species.

Potamogeton amplifolius was the only other species found in May and was only present at one waypoint. Filamentous algae was also present at one waypoint in May. In October, Filamentous algae had spread to a few more waypoints and *Potamogeton gramineus* and *Vallisneria americana* were also found at a medium level in this treatment area.

Table 10 - % occurrence and average % cover for species found at Marsh Point

Marsh Point						
Species Name	% Occurrence		% Cover		Avg. Biovolume	
	5/3/17	10/6/17	5/3/17	10/6/17	5/3/17	10/6/17
Nothing Present	73	45	NA	NA	NA	NA
Filamentous algae	9		5		NA	
Najas guadalupensis	18	45	5	58	1	3
Potamogeton amplifolius	9	18	20	10	NA	2
Potamogeton gramineus		36		70		5
Vallisneria americana		27		47		3

South Bay Extension (Area 11a)
No Treatment

No *Potamogeton crispus* was found in 2017, while in 2016, a moderate amount of *crispus* was present in May and in late September it covered nearly the entire treatment area. In 2017, *Najas guadalupensis* was the most dominant species in both May and October, covering most of the treatment area, and the percent occurrence of this species remained the same between the two surveys. The only other plant species found in this area in May was *Sagittaria graminea*, which was only present at 1 waypoint. Filamentous algae was also present in May. In October, no *Sagittaria graminea* (grassy arrowhead) was present, but *Potamogeton amplifolius*, *Potamogeton gramineus* (variable leaf pondweed) and *Vallisneria americana* were observed at a low to medium occurrence.

Table 11 – % occurrence and average % cover for species found at South Bay Extension

South Bay Ext.						
Species Name	% Occurrence		% Cover		Avg. Biovolume	
	5/3/17	10/6/17	5/3/17	10/6/17	5/3/17	10/6/17
Nothing Present	17	17	NA	NA	NA	NA
Filamentous algae	33		5		NA	
Najas guadalupensis	83	83	41	77	1	3
Potamogeton amplifolius		33		70		3
Potamogeton gramineus		17		NA		NA
Sagittaria graminea	17		5		NA	
Vallisneria americana		67		55		2

Southwest Bay (Area 14)
Target Plants: Naiad, Largeleaf Pondweed
Herbicide(s) Applied: Reward & Aquathol-K (July)

Najas guadalupensis was present in approximately half of the treatment area in May. *Elodea nuttallii* (western waterweed) and *Potamogeton praelongus* (whitestem pondweed) were the only other species present in May and both were only found at one or two waypoints. Slightly less *Najas guadalupensis*

was present in September, although it remained the most dominant species. More species were growing in this area in September, including *Potamogeton amplifolius*, which was found at only two waypoints but both beds were medium to high density.

Table 12 - % occurrence and average % cover for species found at South West Bay

South West Bay						
Species Name	% Occurrence		% Cover		Avg. Biovolume	
	5/3/17	10/6/17	5/3/17	10/6/17	5/3/17	10/6/17
Nothing Present	31	54	NA	NA	NA	NA
Ceratophyllum demersum		15		12		2
Elodea nuttallii	15		15		1	
Filamentous algae	46		23		NA	
Najas guadalupensis	46	38	67	20	1	2
Nuphar varegata		8		80		NA
Nymphaea odorata		8		10		NA
Potamogeton amplifolius		15		80		5
Potamogeton praelongus	8	8	15	10	NA	3

Vegetation Results Summary

- A moderate amount of *Potamogeton crispus* was present in the lake in May 2017. It was present in half of the treatment areas, but was growing at a low density in all the areas where it was found. Crispus had greatly increased in abundance by the time of the treatment on May 31st. Crispus was only found in one treatment area during the post-treatment survey, and at a very low density. Similar to 2016, *Myriophyllum spicatum* was only found in three of the treatment areas and within these areas, it was present at a very low density.
- *Najas guadalupensis* was present at a medium to very high density during both the pre- and post-treatment surveys in almost all of the treatment areas. However, the *guadalupensis* beds were generally not very dense.
- Filamentous algae was present in several treatment areas but there was not enough to be cause for concern at this time.
- *Potamogeton amplifolius* was very sparse or absent in the treatment areas during the pre-treatment survey. However, it was moderately dense in most treatment areas during the post-treatment survey.
- The treatment conducted in May targeted primarily areas of *Potamogeton crispus* and worked well to control these plants. In September, crispus was only found in Outlet Cove and at only one waypoint.
- During the 2017 season, the coverage and density of aquatic plants remained at acceptable levels. The invasive species remained at a low to moderate density and the most abundant species, *Najas guadalupensis*, is a native that does not grow in particularly dense beds and rarely become a nuisance.

- Significant mid-late summer algal blooms are common at Bantam Lake in many of the past seasons. Besides the inherent potential nuisance and adverse effects of these blooms, the resulting reduction in water clarity is likely a major contributing factor to changes in the plant assemblage over the course of the summer.

- Treatments are working well to significantly reduce populations of invasive plants on a seasonal basis, which reduces their ability to spread and impact use of the lake. Localized treatments of native vegetation like naiad and pondweed are successfully preventing problematic levels of growth in higher use areas without eliminating these plants entirely and maintaining adequate plant cover for fish & wildlife habitat. Species richness data in 2017 was among some of the highest since the program began in 2006 (Table 12)

Table 13 – Native Species Richness (# of species) by Survey Area (2006-2017)

Year	South Bay	Marina	Deer Island	North Shore	Outlet Cove	North Bay
2006	8	-	10	14	9	12
2007	6	8	7	11	5	15
2008	7	8	9	9	7	12
2009	8	6	6	12	8	11
2010	8	7	10	19	10	12
2011	8	8	11	15	10	14
2012	9	8	9	13	9	13
2013	9	7	9	15	13	14
2014	10	7	10	11	11	12
2015	10	9	9	17	13	11
2016	10	10	10	13	15	16
2017	11	10	13	19	16	15

- Due to the timing of the quantitative surveys, the plant data tables may not be fully indicative of the changes in plant populations as a result of the herbicide treatments, particularly for naiad. The May survey occurred early in the growing season and well before the plants typically reach their full biomass. The treatments served to reduce, but not eliminate native plants like naiad, therefore preventing the plants from appreciably increasing in density and biomass. In many cases, the late September/early October survey data is actually very similar to May, especially in terms of biovolume. In many cases, with no herbicide treatment, plant biomass would have filled much of the water column and “topped-out” by mid-late summer.

- Existing populations of state-listed species appear to be fairly stable, but are not specifically quantified through this project due to the relative location of the treatment/survey areas. In fact, the treatment areas were designated to avoid the major beds of the state listed plants. A good indication that the treatments are not adversely affecting the state-listed species can be seen in North Bay, where extensive beds of both water marigold and slender watermilfoil continue to flourish just to the north of the treatment area.

Management of Fanwort (Cabomba)

In 2008, Connie Trolle, BLPA President as Project Manager and Dr. Knoecklein began implementing a fanwort study and control program, which started utilizing grant funding from the State in 2010. During the initial year of the project, tasks included installing fragment barriers and benthic (bottom) barrier in and around the fanwort infestation located near the Bantam River inlet and both suction and manual hand-harvesting by divers. In 2011 & 2012, floating fragment barriers were deployed and diver assisted suction harvesting (DASH) was performed. Diver harvesting continued in 2013. In recent years, fanwort growth has been minimal and generally present within established beds of native species, so no significant in-lake efforts have been needed. Future monitoring and management as needed will be vital to prevent the spread of fanwort in Bantam Lake and should be continued.

The infestation of fanwort in the Bantam River and Little Pond has long been a concern as it presents a constant source of plant fragments and potential spread into Bantam Lake. Previous to the registration of Clipper (flumioxazin) herbicide in 2011, there were no other products that would provide effective control of fanwort in this situation. At the time, Sonar (fluridone) was the only herbicide that worked on fanwort, but its slow mode of action and the extended contact time required for effective control precluded its use in the Little Pond/Bantam River system where water volume turnover was higher.

While Clipper was available for use in Connecticut starting in 2011, its use at Bantam Lake was purposely delayed in order to allow for some experience to be obtained at other Connecticut waterbodies. Following a period of two years where Clipper was successfully utilized at a number of waterbodies in the state, it was decided to implement it use at Bantam in 2013. Clipper is a contact herbicide that provides excellent seasonal control of fanwort, but needs to be implemented on an annual basis to maintain desirable conditions in subsequent years. Experience with Clipper at other lakes suggests that it may provide a cumulative reduction in the fanwort infestation after successive years of treatment.

The treatment of Little Pond and the Bantam River in 2013 yielded excellent results with a near 100% reduction in fanwort biomass following treatment (See 2013 Year-End Report). In 2014, surveys of the river and Little Pond revealed no observable fanwort biomass until late July/early August and then primarily in Little Pond only. A small area of fanwort re-growth was observed in the River adjacent to the beaver dam near the inlet to the main lake. Also starting in 2014, three areas of the lake with sizeable, known infestation of fanwort were also slated for treatment. The treatment that year was conducted in August and yielded good results in the limited treatment areas that were observed.

In 2017, no fanwort was observed in the lake treatment areas. The Bantam River and Little Pond were not surveyed this year due to a dam repair project that limited access. However, fanwort was found at the mouth of the river and along the shoreline of Bantam Lake near the mouth of the Bantam River inlet.

Recommendations for 2018

The targeted nuisance plant treatment program at Bantam Lake continues to be very successful, in large part due to the close cooperation received from BLPA, DEEP, the Towns and lake residents. This past year's program did not result in significant adverse effects to most native vegetation including state listed plants. No adverse effects of treatment on fish/wildlife that inhabit Bantam Lake were observed or reported.

Spot or partial treatment (as required) within the same areas is recommended for 2018 (See Figure 14). Final treatment area recommendations will be discussed with the Association following the pre-treatment survey(s). We suggest keeping the two-treatment approach as well, including a mid- summer survey to designate areas for the second round of treatment, if needed. This approach would minimize recreational impairment and optimize timing of control for the different target plants based on their growth patterns. Where the initial treatment over the last few years has increasingly targeted curlyleaf pondweed, which emerges quite early in the season, we may consider scheduling the treatment somewhat earlier in 2018 especially considering that the current DEEP permit is valid through the 2018 season. Treating the plants earlier, before they reach full growth and maturity, will help to reduce the amount of biomass treated and may also help to begin reducing the curlyleaf infestation over time.

Since the fanwort in Little Pond, the Bantam River and the several infested areas of the main lake were not treated in 2017, we recommend surveying these areas in 2018 and treat these areas if needed. Reduction of the biomass is important to help reduce the potential for spread into other areas of the lake. We also understand that a plan is being developed to possibly address a large source of fanwort upstream of Bantam Lake in Timber Lake. We strongly encourage and agree with that effort.

Continued monitoring and treatment of nuisance algae blooms is also recommended for 2018. After the unfortunate closure of the lake for a short time in 2016, which disrupted the annual waterski show, having the ability to manage blooms of cyanobacteria in a timely fashion to preserve recreational uses is obviously very important. The treatments conducted in 2017 showed that timely monitoring and treatment with a low dose of copper sulfate can meet this goal in the short-term. The BLPA should also continue investigation longer term solutions to address nutrient loading.

Appendix 1 – Figures

FIGURE 1: 2017 Treatment Areas

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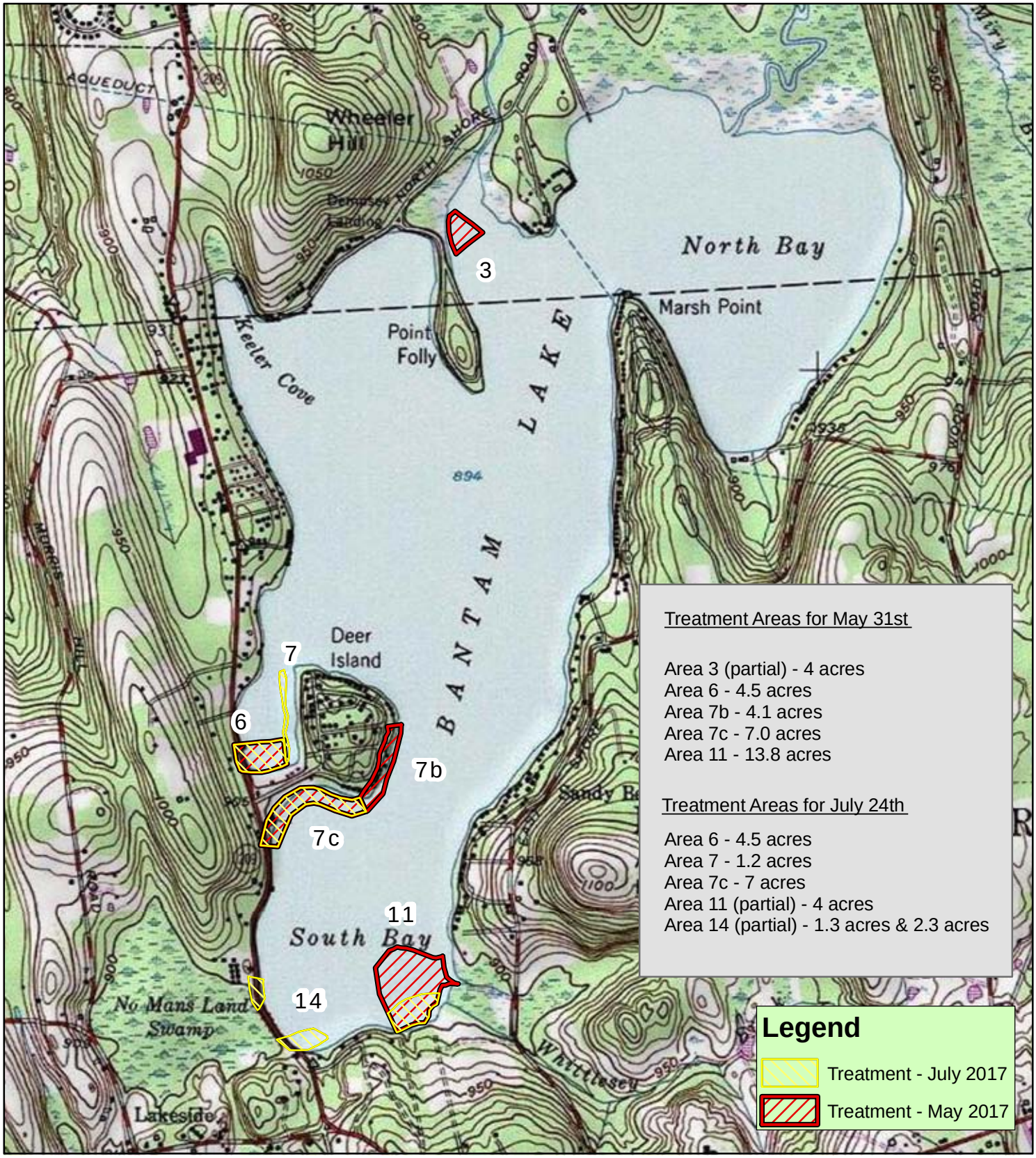
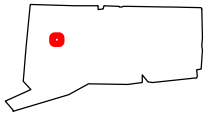


Bantam Lake
Morris/Litchfield, CT



Bantam Lake

0 1,600 3,200 Feet

1:19,200

N

Map Date: 1/15/18
Prepared by: DMM
Office: SHREWSBURY, MA

FIGURE 2: South Bay Survey Points

SOLITUDE LAKE MANAGEMENT
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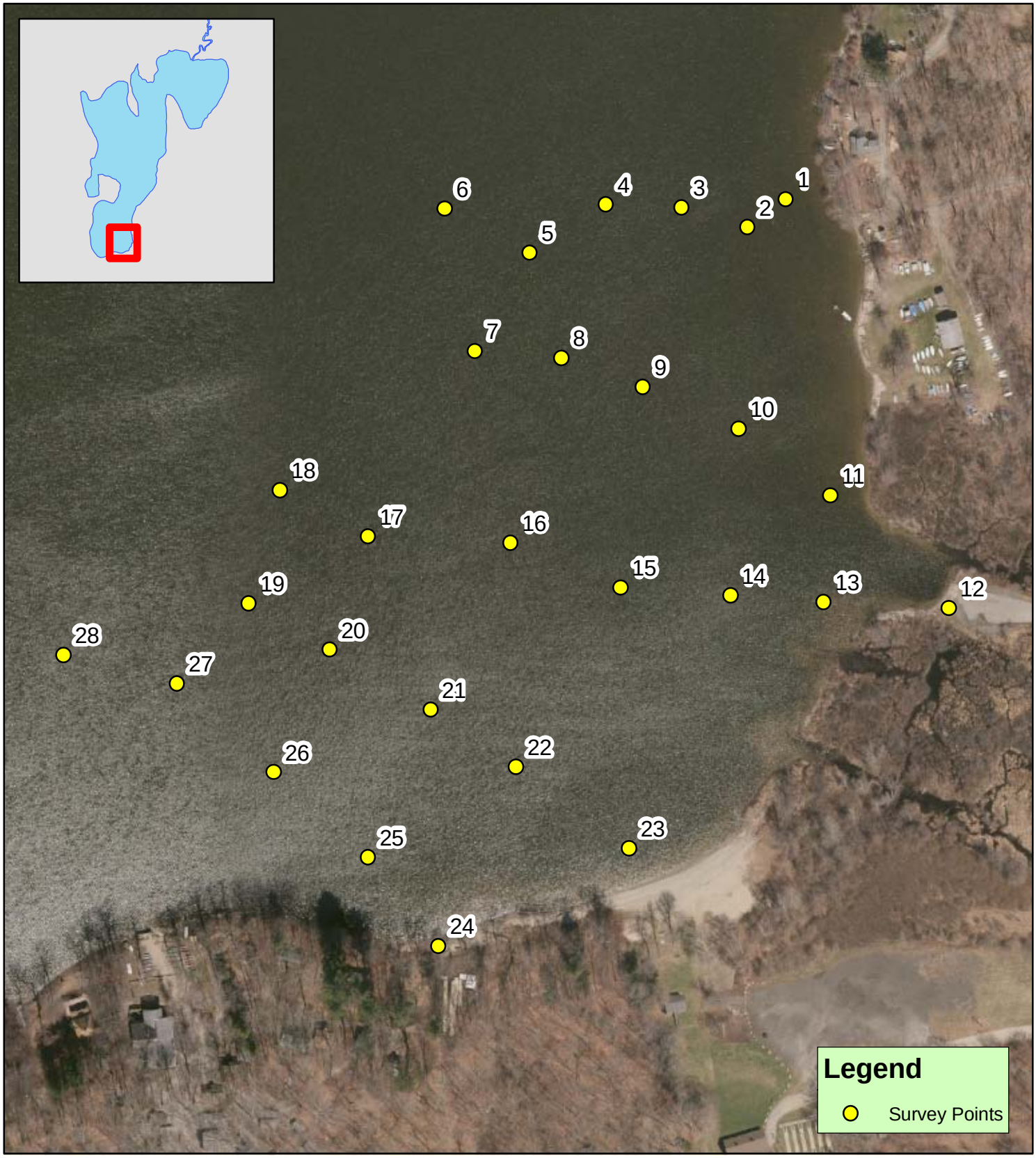
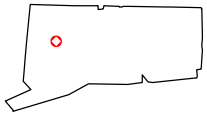


Bantam Lake
Morris/Litchfield, CT



Bantam Lake

0 160 320 Feet

1:2,400

N

Map Date: 1/15/18
Prepared by: DMM
Office: SHREWSBURY, MA

FIGURE 3: Marina Cove Survey Points

SOLITUDE LAKE MANAGEMENT
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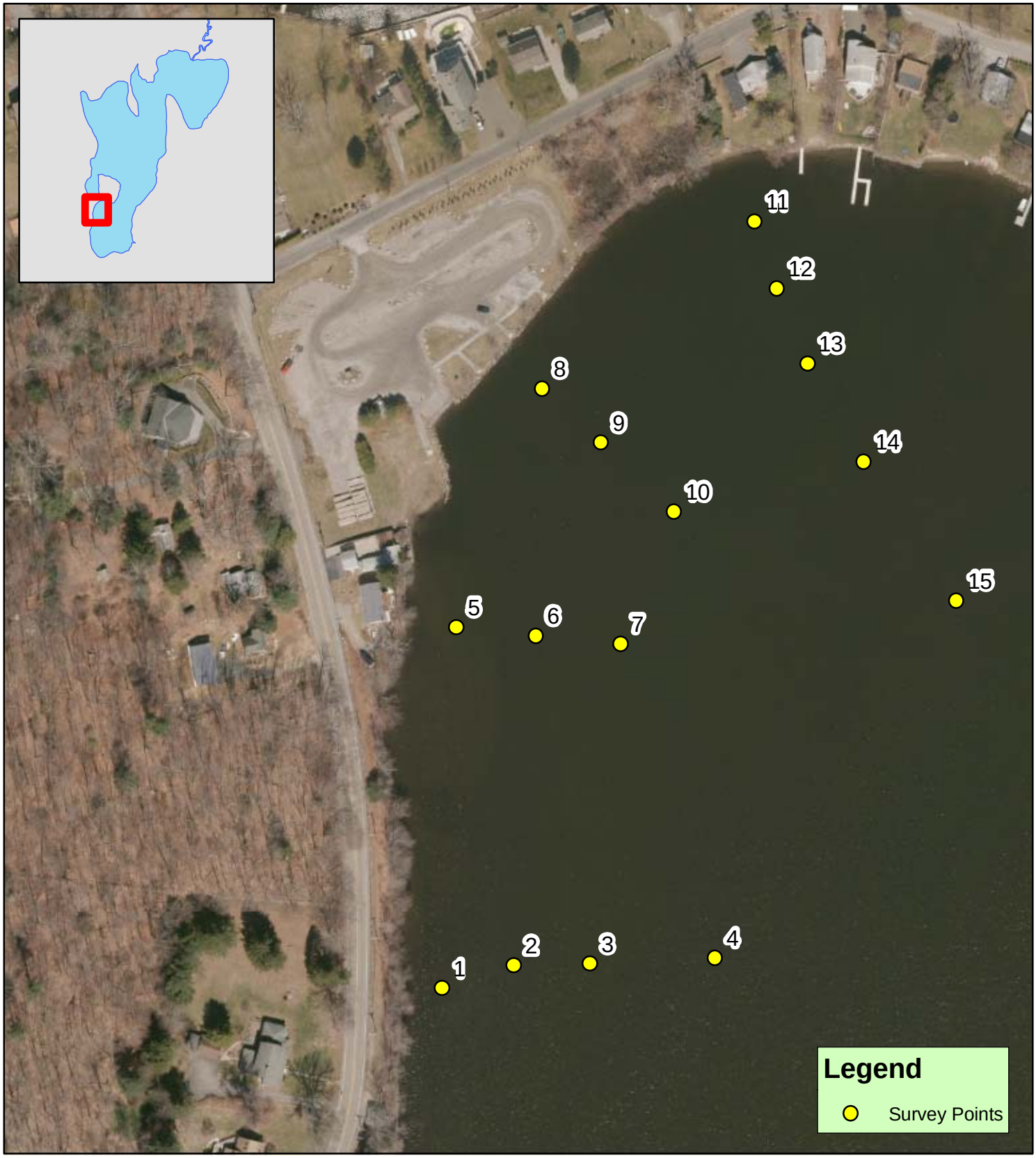
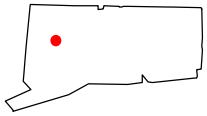


Bantam Lake
Morris/Litchfield, CT



Bantam Lake

0 130 260 Feet

1:2,000

N

Map Date: 1/15/18
Prepared by: DMM
Office: SHREWSBURY, MA

FIGURE 4: Deer Island Survey Points

SOLITUDE LAKE MANAGEMENT
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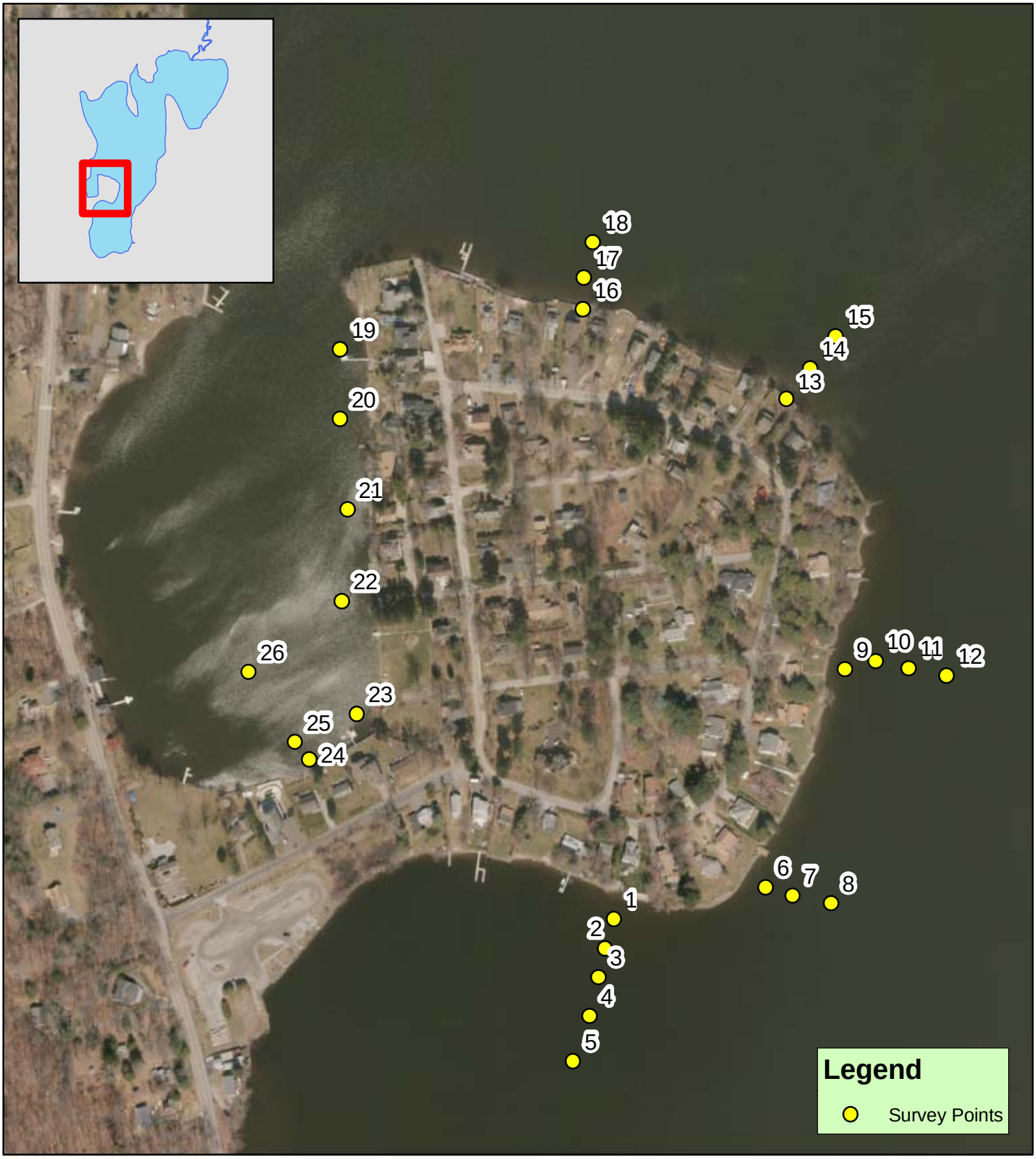
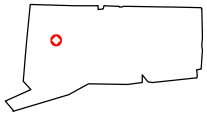


Bantam Lake
Morris/Litchfield, CT



Bantam Lake

0 270 540 Feet

1:3,906

N

Map Date: 1/15/18
Prepared by: DMM
Office: SHREWSBURY, MA

FIGURE 1: West Shore Survey Points

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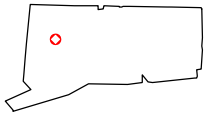
Bantam Lake
Morris/Litchfield, CT



Bantam Lake

0 260 520 Feet

1:3,906

N

Map Date: 1/15/18
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FIGURE 6: Keeler Cove/North Shore Survey Points

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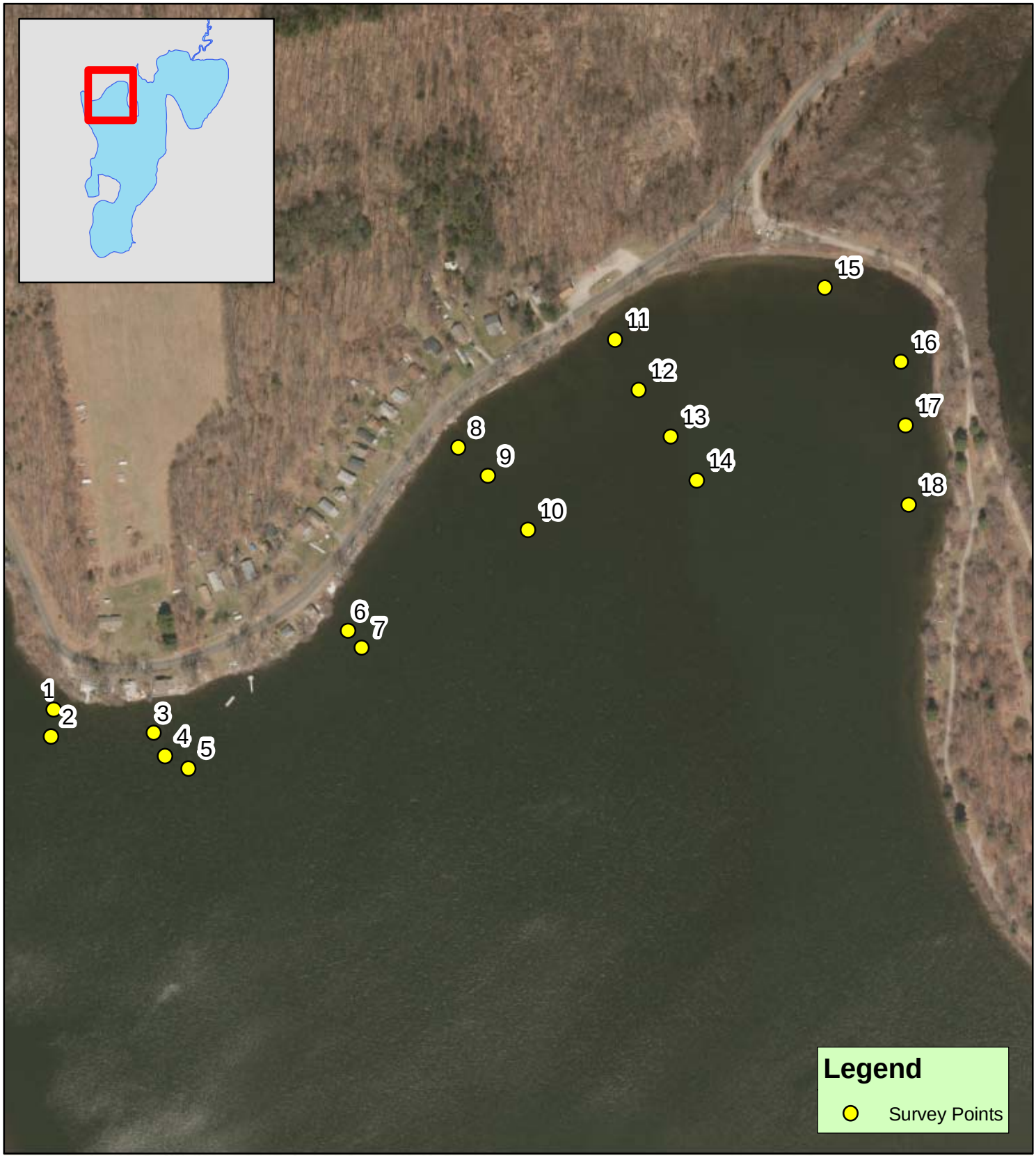
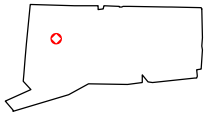


Bantam Lake
Morris/Litchfield, CT



Bantam Lake

0 270 540 Feet

1:3,906

N

Map Date: 1/15/18
Prepared by: DMM
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FIGURE 7: Outlet Cove Survey Points

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LAKE MANAGEMENT
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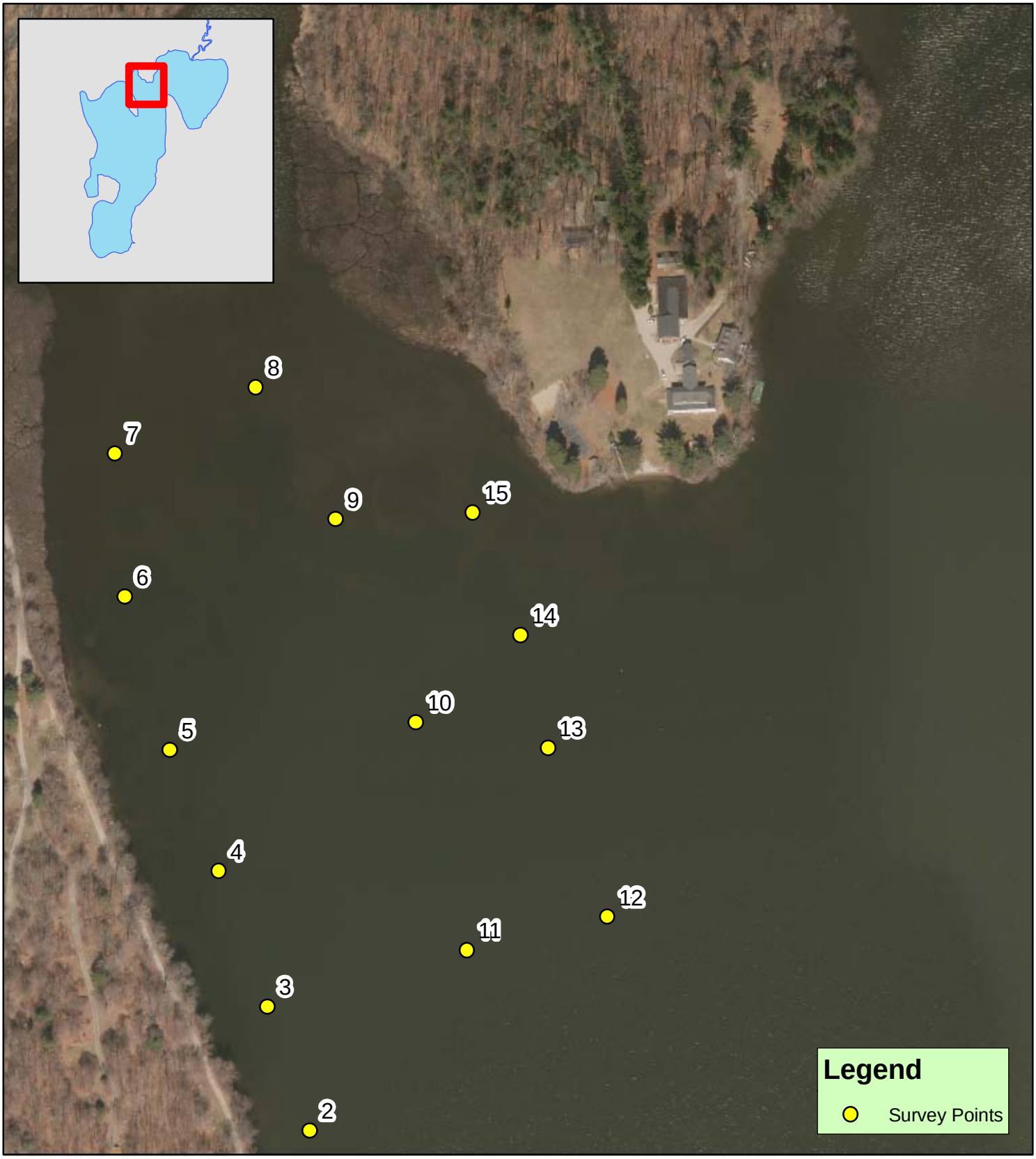
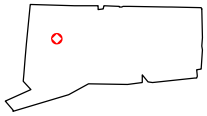


Bantam Lake
Morris/Litchfield, CT



Bantam Lake

0 210 420 Feet

1:3,000

N

Map Date: 1/15/18
Prepared by: DMM
Office: SHREWSBURY, MA

FIGURE 8: North Bay Survey Points

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LAKE MANAGEMENT
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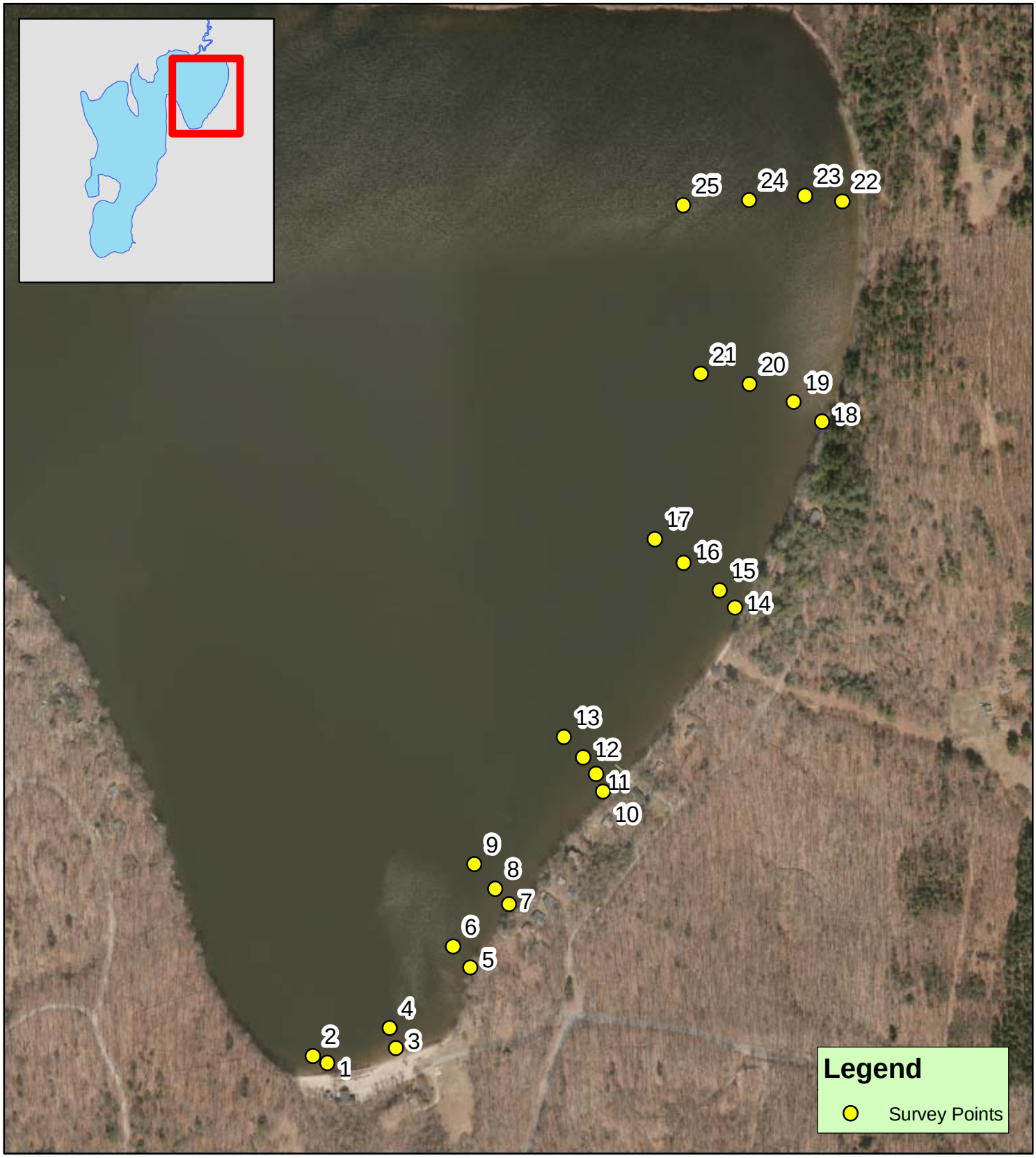
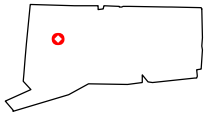


Bantam Lake
Morris/Litchfield, CT



Bantam Lake

0 440 880 Feet

1:5,859

N

Map Date: 1/15/18
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FIGURE 9: Marsh Point Survey Points

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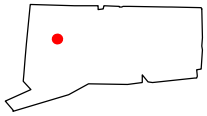
Bantam Lake
Morris/Litchfield, CT



Bantam Lake

0 230 460 Feet

1:3,000

N

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FIGURE 10: South Bay Extension Survey Points

SOLITUDE
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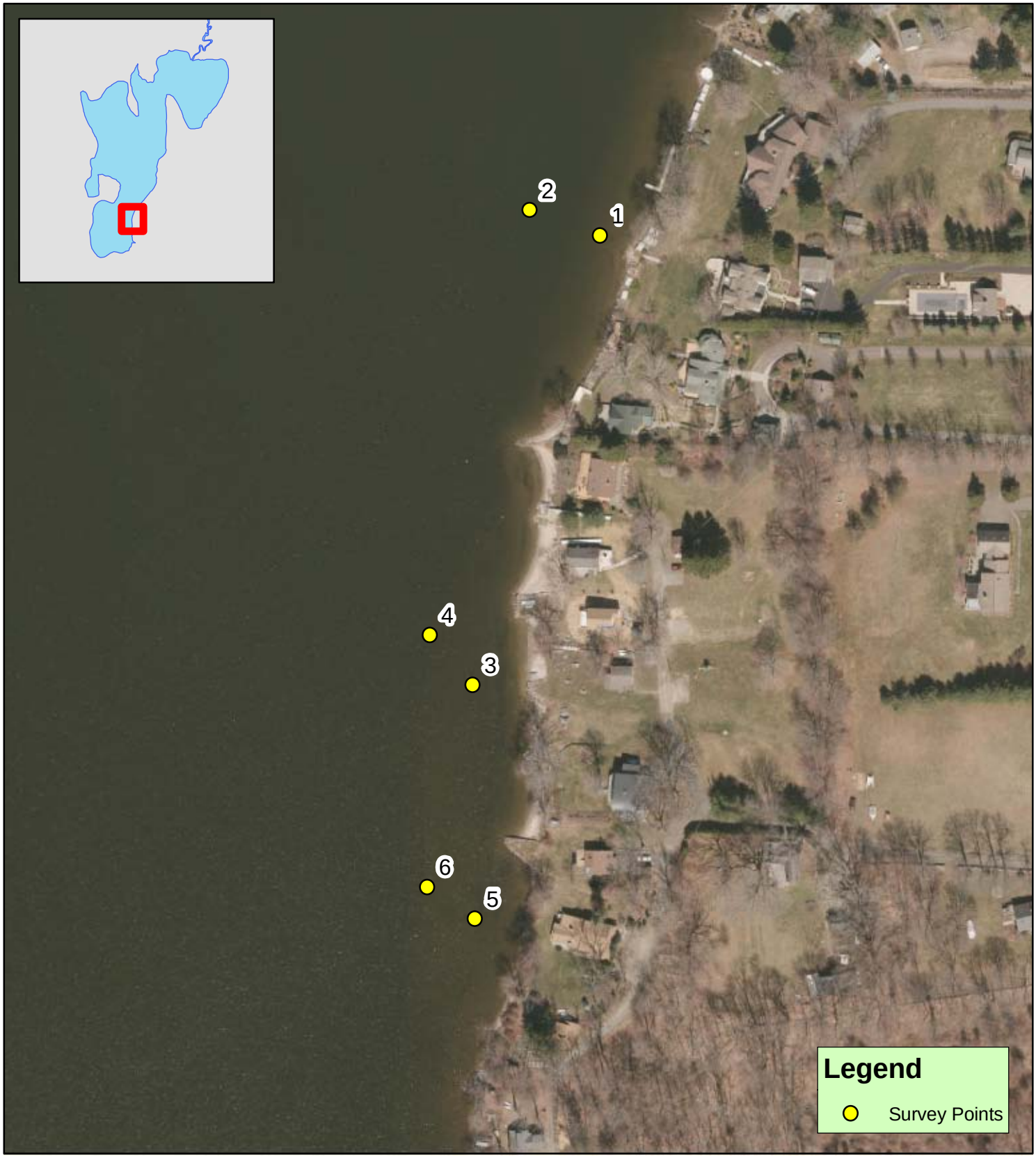
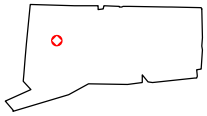


Bantam Lake
Morris/Litchfield, CT



Bantam Lake

0 150 300 Feet

1:1,920

N

Map Date: 1/15/18
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FIGURE 11: Southwest Bay Survey Points

SOLITUDE LAKE MANAGEMENT
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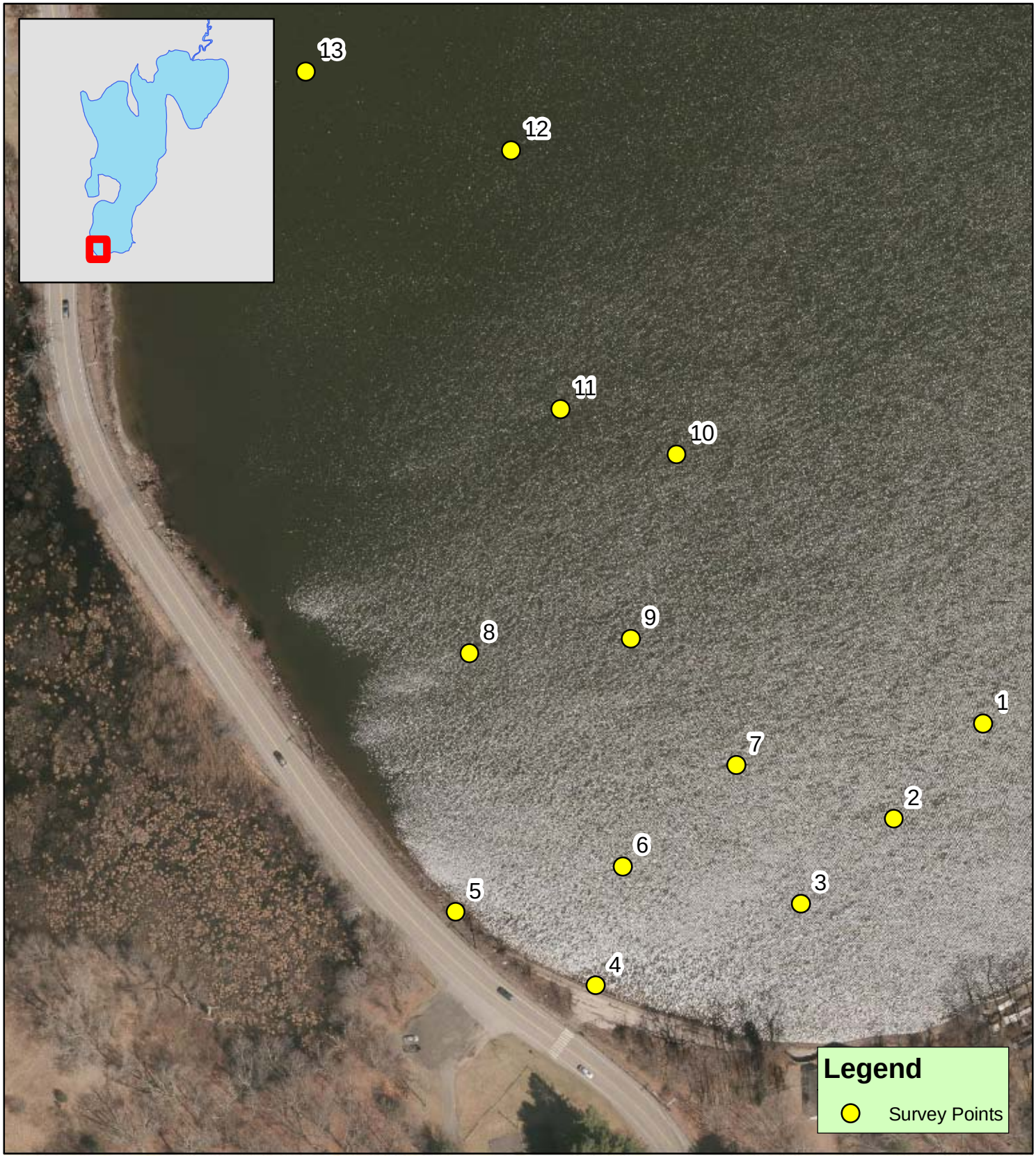
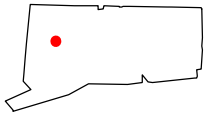


Bantam Lake
Morris/Litchfield, CT



Bantam Lake

0 120 240 Feet

1:1,536

N

Map Date: 1/15/18
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FIGURE 12: Pre-Management Conditions

SOLITUDE LAKE MANAGEMENT
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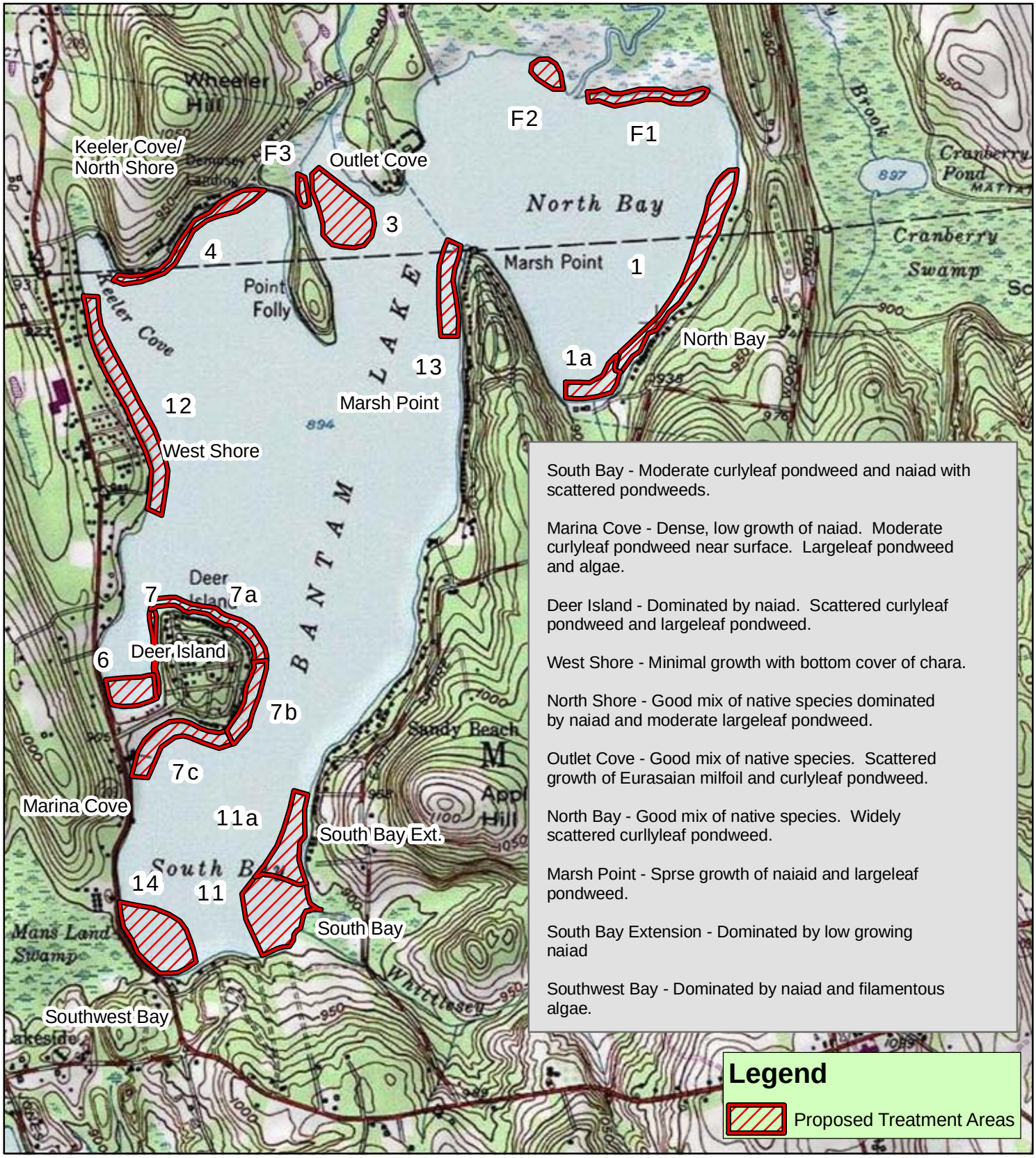


South Bay - Moderate curlyleaf pondweed and naiad with scattered pondweeds.

Marina Cove - Dense, low growth of naiad. Moderate curlyleaf pondweed near surface. Largeleaf pondweed and algae.

Deer Island - Dominated by naiad. Scattered curlyleaf pondweed and largeleaf pondweed.

West Shore - Minimal growth with bottom cover of chara.

North Shore - Good mix of native species dominated by naiad and moderate largeleaf pondweed.

Outlet Cove - Good mix of native species. Scattered growth of Eurasaian milfoil and curlyleaf pondweed.

North Bay - Good mix of native species. Widely scattered curllyleaf pondweed.

Marsh Point - Sprse growth of naiaid and largeleaf pondweed.

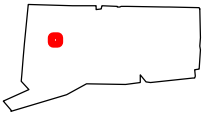
South Bay Extension - Dominated by low growing naiad

Southwest Bay - Dominated by naiad and filamentous algae.

Legend

Proposed Treatment Areas

Bantam Lake
Morris/Litchfield, CT



Bantam Lake

0 1,900 3,800 Feet

1:20,000

N

Map Date: 1/15/18
Prepared by: DMM
Office: SHREWSBURY, MA

FIGURE 13: Post-Management Conditions

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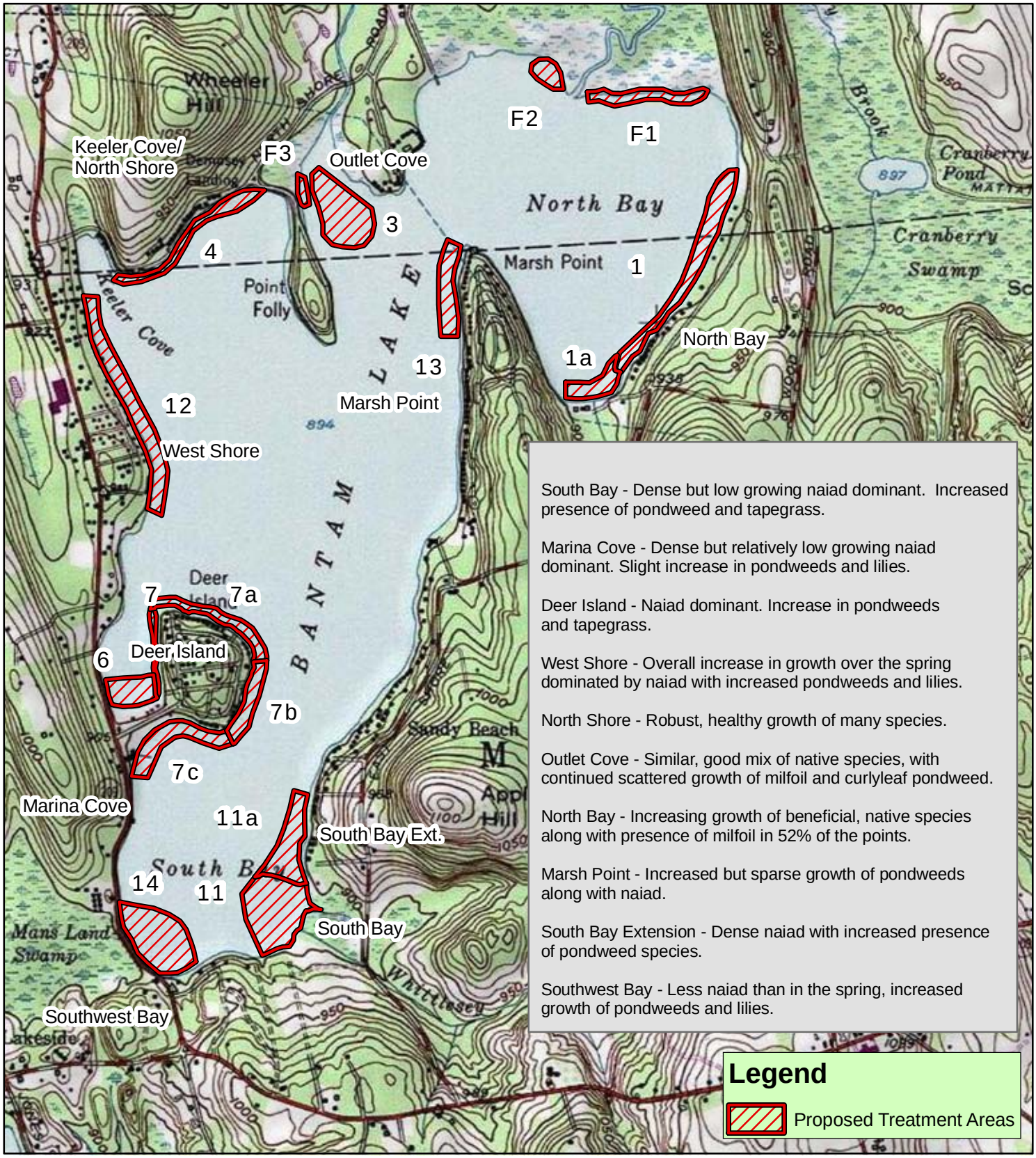


South Bay - Dense but low growing naiad dominant. Increased presence of pondweed and tapegrass.

Marina Cove - Dense but relatively low growing naiad dominant. Slight increase in pondweeds and lilies.

Deer Island - Naiad dominant. Increase in pondweeds and tapegrass.

West Shore - Overall increase in growth over the spring dominated by naiad with increased pondweeds and lilies.

North Shore - Robust, healthy growth of many species.

Outlet Cove - Similar, good mix of native species, with continued scattered growth of milfoil and curlyleaf pondweed.

North Bay - Increasing growth of beneficial, native species along with presence of milfoil in 52% of the points.

Marsh Point - Increased but sparse growth of pondweeds along with naiad.

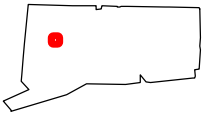
South Bay Extension - Dense naiad with increased presence of pondweed species.

Southwest Bay - Less naiad than in the spring, increased growth of pondweeds and lilies.

Legend

Proposed Treatment Areas

Bantam Lake
Morris/Litchfield, CT



Bantam Lake

0 1,900 3,800 Feet

1:20,000

N

Map Date: 1/15/18
Prepared by: DMM
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FIGURE 14: Proposed 2018 Treatment Areas

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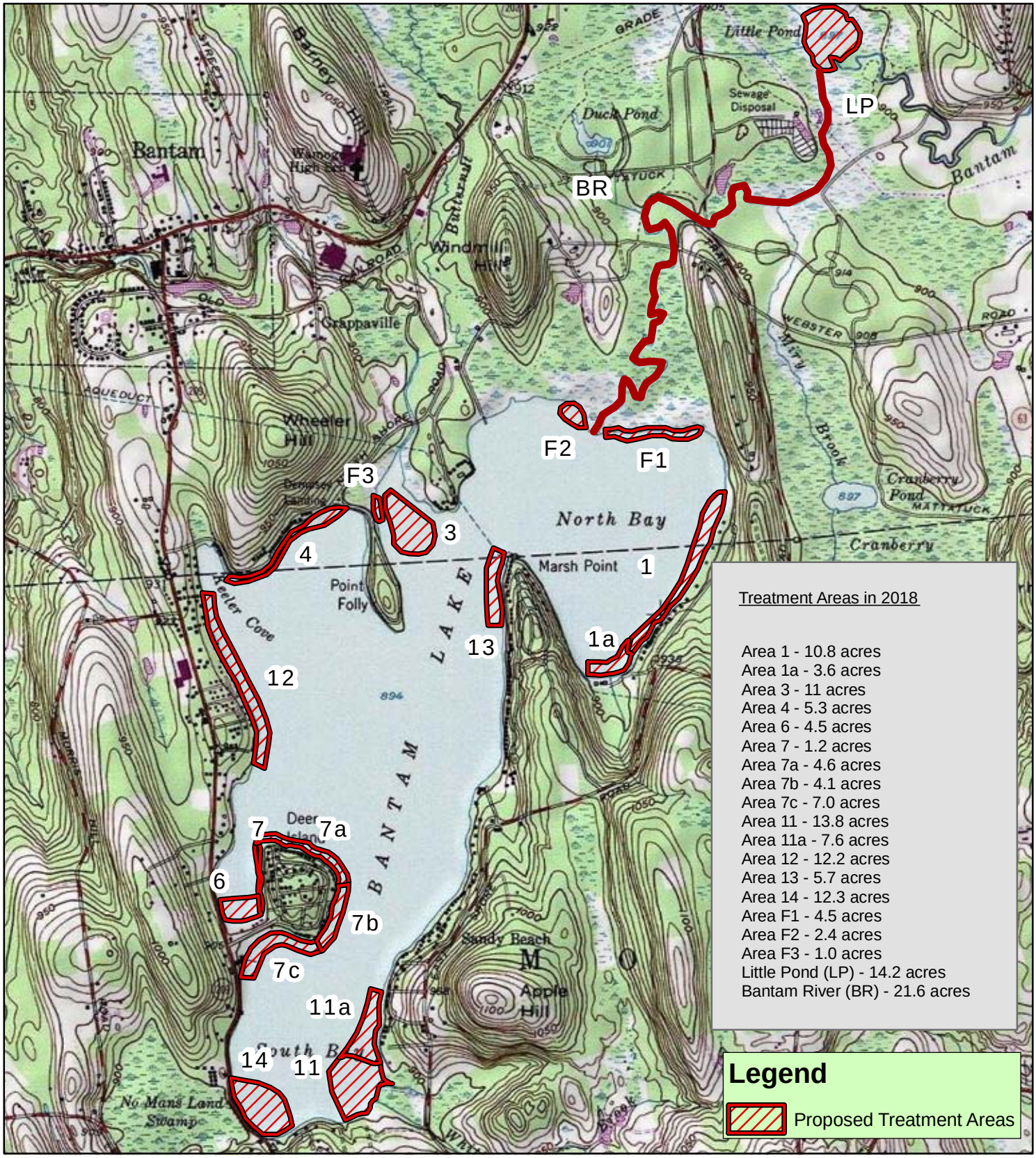
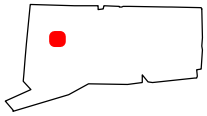


Bantam Lake
Morris/Litchfield, CT



Bantam Lake

0 2,250 4,500 Feet

1:25,000

N

Map Date: 1/15/18
Prepared by: DMM
Office: SHREWSBURY, MA