Bantam Lake – Aquatic Management Program

2018 Final Report December 2018

Prepared For:

Prepared By:

SŌLitude Lake Management
590 Lake Street
Shrewsbury, MA 01545

&

Northeast Aquatic Research

SŌLITUDE
LAKE MANAGEMENT

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Introduction

Bantam Lake Protective Association (BLPA) has contracted Northeast Aquatic Research (NEAR) and Solitude Lake Management (Solitude) to manage invasive aquatic vegetation in Bantam Lake. Beginning in 2006, our team has been judiciously utilizing aquatic herbicides to control the invasive aquatic plants; Eurasian milfoil *(Myriophyllum spicatum)*, curly-leaf pondweed (*Potamogeton crispus*), and fanwort *(Cabomba caroliniana)* in Bantam Lake and Bantam River.

Invasive aquatic plants are controlled with herbicides in 10 select zones or areas (Figure 1, Table 1). Each area is surveyed twice a year, in spring and fall, to ascertain the need for treatments and the effects of the treatments in the fall. Surveys were conducted on May 2, 2018 and September 17, 2018 by Northeast Aquatic Research and Solitude Lake Management. This report summarizes the Aquatic Management Program at Bantam Lake in 2018, including the documentation of pre & post treatment inspections, description of the treatment protocol & efforts, discussion of other management tasks and presentation of recommendations for 2019.

History

Northeast Aquatic Research (NEAR) conducted initial aquatic plant surveys, for invasive species in 1998, a full littoral native species census in 2002, and state protected species in 2004. The survey data provided information necessary to draft an action plan to guide the Bantam Lake Protective Association in finding control measures for the dense weeds and spread of invasive species. In 2005, the CT DEEP issued a permit allowing for treatment in selected areas to control Eurasian milfoil and large-leaf pondweed bed. Annual herbicide treatments in began in 2006.

Bantam Lake contains two State listed, rare and endangered aquatic plant species: slender-leaf watermilfoil (*Myriophyllum alterniflorum*) and water marigold *(Bidens beckii).* While the lake supports a diverse population of beneficial native aquatic plant species, there is also a significant presence of non-native and invasive weeds, including Eurasian watermilfoil curly-leaf pondweed fanwort and water chestnut (*Trapa natans*).

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 shoreline of the North Bay and the Outlet Cove, although scattered occurrences in other areas of the lake have been observed and hand-pulled. Previous diver hand-harvesting has practically eliminated the Outlet Cove infestation so that the only substantial beds of fanwort remaining are located in North Bay. Unfortunately, the Bantam River and Little Pond upstream of the lake are also heavily infested with fanwort (and Eurasian milfoil), which has served as a constant source of plant fragments and potential spread. In 2013, 2014 & 2016, the Bantam River and Little Pond were treated with Clipper (flumioxazin) herbicide to reduce the infestation. In 2018, the Bantam River and Little Pond were not treated due to minimal observed fanwort growth.

Summary of Management Plan

Management of aquatic plants in Bantam Lake has followed the same methodology for thirteen years. A pre- and post-treatment survey are conducted jointly by NEAR and Solitude where the same observation sites are visited each year. The herbicide treatment areas were designated to target problematic weeds in the lake, primarily Eurasian milfoil and curly-leaf pondweed in the early season treatment, with some selected, high-use areas targeted for the control of large-leaf pondweed *(Potamogeton amplifolius)* other pondweeds robust pondweeds and naiads, mainly southern naiad *(Najas guadalupensis)* with treatment later in the season. Selection of areas takes into account the location of state listed plants and nearby public wells.

Implementation of Treatment

Each year, the lake's plant population is directly observed during the spring survey in May and a cursory survey sometime in July. 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 to manage aquatic plants (**Figure 1**) and one treatment to control algae were conducted in the 2018 season. The first treatment was conducted on May 22nd, when Areas #1, 1a, 3, 4, 6, 7c and 11 were treated with Tribune (diquat). The second treatment was conducted on July 26th, when Areas #6, 7, 7c, 12 and 14 were treated with diquat & endothall. Area 1a was treated with diquat only. A half-lake copper sulfate treatment was performed on this day as well. A final fall survey in September served to assess the efficacy of the treatment and document late season plant growth in the management areas.

Extensive notification to the public, including resident mailings, newspaper notices and shoreline posting preceded all chemical treatments. Treatments were performed from Solitude's specially designed Airboat and Jon boat, equipped with a sub-surface spray boom and GPS guidance system.

Herbicide Testing

As a condition on the DEEP permit, testing of nearby water supply wells was required pre & post treatment. Sample collection and analysis were coordinated by the BLPA. No detectable concentrations of the permitted chemicals (diquat & endothall) were found in either the pre or post treatment well sampling.

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. Josh Perry with Solitude and Dr. George Knoecklein and other staff from NEAR again performed the plant surveys this year. A series of 168 data points were located with a Trimble Differential GPS (DGPS) unit, in and adjacent to the survey areas. 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 waypoints used this year were the same used in all prior surveys.

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 are ten survey areas (Table 1), 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 2018 season. The pre-treatment visit occurred on May 2nd, and the post treatment survey was conducted on September 17th.

Figures 2-11 show the location of the data points at each of the ten survey areas in Bantam Lake. Appendix 2 presents the data collected at each point. Figure 12 & 13 show summaries of pre- & post-treatment conditions at Bantam Lake.

Plants are listed in each table using scientific names to maintain consistency with prior reports but discussions refer to the plants using common names for ease of reading. All species mentioned in this report are listed with both common and scientific names in Table 2.

Table 1 – Number of Observation Points in Each Treatment Area

Treatment Area	***# of Observation Points***
South Bay (Area 11)	28
Marina (Area 7c)	15
Deer Island (Areas 7, 7a, & 7b)	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**

***Table 2* – Common and scientific names of aquatic plants described in this report**

Common Name	***Scientific Name***
Invasive Species	
Eurasian Milfoil	*Myriophyllum spicatum*
Fanwort	*Cabomba caroliniana*
Water chestnut	*Trapa natans*
Native Species	
Water marigold	*Bidens beckii*
Slender-leaf milfoil	*Myriophyllum alterniflorum*
Southern naiad	*Najas guadalupensis*
Common water weed	*Elodea canadensis*
Coontail	*Ceratophyllum demersum*
Stonewort	*Nitella*
Musk grass	*Chara*
White water Lily	*Nymphaea odorata*
Yellow water Lily	*Nuphar variegata*
Large-leaf pondweed	*Potamogeton amplifolius*
White-stem pondweed	*Potamogeton praelongus*
Grassy pondweed	*Potamogeton gramineus*
Robbin's pondweed	*Potamogeton robbinsii*
Leafless milfoil	*Myriophyllum tenellum*
Large bladderwort	*Utricularia macrorhiza*
Tape grass	*Vallisneria americana*
Yellow star grass	*Zosterella dubia*

South Bay (Area 11)
Target Plants: Curly-leaf pondweed
Herbicide(s) Applied: Diquat (May 22nd)

During the 2018 pre-treatment survey, a small amount of curly-leaf pondweed was present in South Bay. Only four other species were found in the area, all of which are native and were present at a low % occurrence. During the September post-treatment survey, no invasive species were found in the area. Between the spring and fall surveys, southern naiad increased from 75% to 93% occurrence and remained at approximately 50% cover during both surveys. Five other species were present in the area in September, each present at a low % occurrence and low to moderate density.

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

South Bay						
Species Name	% Occurrence		Avg. % Cover		Avg. Growth Form	
	5/2/18	9/17/18	5/2/18	9/17/18	5/2/18	9/17/18
Nothing present	21	7	NA	NA	NA	NA
Ceratophyllum demersum	0	4	0	20	0	2
Elodea canadensis	4	0	30	0	1	0
Najas guadalupensis	75	93	49	56	1	2
Nitella sp.	11	11	14	4	1	1
Nuphar variegata	0	4	0	30	0	5
Nymphaea odorata	0	4	0	30	0	5
Potamogeton amplifolius	7	7	59	5	1	2
Potamogeton crispus	11	0	37	0	2	0

Marina Cove (Area 7c)
Target Plants: Curly-leaf pondweed
Herbicide(s) Applied: Diquat (May 22nd), Diquat & Endothall (July 26th)

Similar to the pre-treatment results from both 2016 and 2017, Southern naiad was the most abundant species in Marina Cove, followed by Curly-leaf pondweed (40% occurrence) and Stonewort (47% occurrence). While no curly-pondweed was present in September, several other species had appeared in the area, including lilies, white stem pondweed, and tape grass In October, southern naiad had increased to 93% occurrence but was growing at a low density – just 15% average cover. In 2017, Filamentous algae was present in nearly half of Marina Cove during the post-treatment survey. This year, no filamentous algae was found in the area during either of the surveys.

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

Marina Cove						
Species Name	% Occurrence		Avg. % Cover		Avg. Growth Form	
	5/2/18	9/17/18	5/3/17	10/6/17	5/3/17	10/6/17

Nothing_present	7	0	NA	NA	NA	NA
Chara sp	0	13	0	18	0	2
Cyanomat-Lyngbya	0	20	0	15	0	1
Najas guadalupensis	60	93	43	15	2	2
Nitella sp	47	7	30	5	1	1
Nuphar variegata	0	20	0	30	0	5
Nymphaea odorata	0	13	0	25	0	5
Potamogeton crispus	40	0	35	0	5	0
Potamogeton praelongus	0	7	0	85	0	4
Vallisneria americana	0	7	0	45	0	3

Deer Island (Areas 6, 7a, 7b)
Target Plants: Curly-leaf pondweed
Herbicide(s) Applied: Diquat (May 22nd, Area 6 only), Diquat & Endothall (July 26th, Area 6, 7 only)

During the pre-treatment survey, curly-leaf pondweed was present at two waypoints, growing at a moderate density. This is less than was found during the 2017 pre-treatment survey and less still compared to the 2016 survey. In addition, Southern naiad was present at approximately 50% occurrence and cover. Large-leaf pondweed, White-stem pondweed and filamentous algae were all present at a low occurrence and density. During the post-treatment survey Southern naiad had spread through more of the management area but remained at approximately the same density. Both white and yellow lilies appeared in the area, as well as Grassy pondweed and Tape grass. Cyanomat/Lyngbya was also found at two waypoints in September. No invasives were present in this area during the post-treatment survey.

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

Deer Island						
Species Name	% Occurrence		Avg. % Cover		Avg. Growth Form	
	5/2/18	9/17/18	5/2/18	9/17/18	5/2/18	9/17/18
Nothing present	27	19	NA	NA	NA	NA
Chara sp	4	0	40	0	1	0
Cyanomat-*Lyngbya*	0	8	0	8	0	1
Filamentous algae	8	0	3	0	1	0
Najas guadalupensis	46	73	49	42	1	2
Nitella sp	19	8	42	5	1	1
Nuphar variegata	0	15	0	18	0	5
Nymphaea odorata	0	15	0	18	0	5
Potamogeton amplifolius	12	8	14	18	1	2
Potamogeton crispus	8	0	40	0	3	0
Potamogeton gramineus	0	8	0	40	0	2
Potamogeton praelongus	4	0	10	0	3	0
Vallisneria americana	0	12	0	6	0	2

West Shore (Area 12)
Target Plants: Large-leaf pondweed
Herbicide(s) Applied: Diquat & Endothall (July 26th)

No invasive species were found in West Shore Area in the 2018 season. During the pre-treatment survey, no plants were growing in over half of the area. Musk grass, Southern naiad and Large-leaf pondweed were the only species growing in the area, present at low to moderate occurrence and density. In 2017, Musk grass was the only species present during the pre-treatment survey. In September, half the area remained void of aquatic plants. Southern naiad and Large-leaf pondweed were still present at moderate occurrence and low density. Tape grass also appeared in the area at 20% occurrence but was very sparse in the areas where it appeared. No white or yellow water lilies were present in West Shore in 2018 during either survey, despite having been documented in the area during last year's post-treatment survey.

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

West Shore						
Species Name	% Occurrence		Avg. % Cover		Avg. Growth Form	
	5/2/18	9/17/18	5/2/18	9/17/18	5/2/18	9/17/18
Nothing present	60	50	NA	NA	NA	NA
Chara sp	10	0	30	0	1	0
Najas guadalupensis	40	30	1	5	1	1
Potamogeton amplifolius	20	10	17	20	2	2
Vallisneria americana	0	20	0	2	0	1

Keeler Cove – North Shore Results (Area 4)
Target Plants: Eurasian milfoil
Herbicide(s) Applied: Diquat (May 22nd, partial)

Similar to the results from 2017, no plants were present in approximately one third of the treatment area during both the pre- and post-treatment surveys. Eurasian milfoil was found in Keeler Cove/North Shore in 2017. However, this year, Eurasian milfoil was present at one point in Keeler Cove/North Shore during the pre-treatment survey, at a moderate density. No Eurasian milfoil was found in the area during the post-treatment survey. Southern naiad was present in approximately 60% of the treatment area and a moderate density during both surveys.

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

Keeler Cove - North Shore						
Species Name	% Occurrence		Avg. % Cover		Avg. Growth Form	
	5/2/18	9/17/18	5/2/18	9/17/18	5/2/18	9/17/18
Nothing present	28	33	NA	NA	NA	NA
Myriophyllum spicatum	6	0	20	0	1	0
Myriophyllum tenellum	11	0	8	0	1	0
Najas guadalupensis	67	61	58	35	1	2
Nuphar variegata	0	11	0	40	0	5

Nymphaea odorata	6	11	30	40	1	5
Potamogeton amplifolius	39	33	45	28	1	3
Potamogeton robbinsii	0	6	0	70	0	2
Vallisneria americana	0	22	0	6	0	2

Outlet Cove Results **(Area 3)**
Target Plants: Eurasian milfoil
Herbicide(s) Applied: Diquat (May 22nd, partial)

Eurasian milfoil was present at one waypoint in Outlet Cove during the pre-treatment survey. Southern naiad was present in approximately half of the treatment area waypoints with 72% average cover. White water lily, Large-leaf pondweed, and Large bladderwort where the other species present in the area in May. In September, Southern naiad increased slightly, to 67% average cover, but the patches were slightly less dense. Several other native species were present in the area but most at only one or two waypoints. No Eurasian milfoil was present during the post-treatment survey.

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

Outlet Cove						
Species Name	% Occurrence		Avg. % Cover		Avg. Growth Form	
	5/2/18	9/17/18	5/2/18	9/17/18	5/2/18	9/17/18
Nothing present	15	27	NA	NA	NA	NA
Ceratophyllum demersum	0	13	0	25	0	2
Myriophyllum spicatum	8	0	25	0	3	0
Najas guadalupensis	54	67	72	43	1	2
Nuphar variegata	0	7	0	80	0	5
Nymphaea odorata	23	7	73	80	2	5
Potamogeton amplifolius	8	0	10	0	1	0
Potamogeton gramineus	0	7	0	5	0	2
Potamogeton robbinsii	0	7	0	90	0	2
Utricularia macrorhiza	8	0	1	0	1	0
Vallisneria americana	0	20	0	4	0	2

North Bay (Areas 1, 1a)
Target Plants: Curly-leaf pondweed, Eurasian milfoil
Herbicide(s) Applied: Diquat (May 22nd, July 26th (Area 1a only))

In May, Curly-leaf pondweed was found at just one waypoint and was very sparse, same as results from the 2017 pre-treatment survey. Eurasian milfoil was very sparse in the area, at a moderate % occurrence. All other species present in the area were native. Southern naiad was by far the most abundant species in the area, present at a high occurrence (76%) and moderate density. Large-leaf pondweed was present at a moderate occurrence (28%), and all other species in the area were found at just one waypoint. In September, North Bay had the highest species richness of any treatment area during either the pre- or post-treatment surveys (9 species). No invasive species were present in the

area. Southern naiad remained the most abundant species but had decreased slightly to 68% occurrence. Grassy pondweed and Tape grass both appeared in North Bay in September, present at a moderate occurrence but low density. All the other species in the area during the post-treatment survey were present at a low occurrence.

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

North Bay						
Species Name	% Occurrence		Avg. % Cover		Avg. Growth Form	
	5/2/18	9/17/18	5/2/18	9/17/18	5/2/18	9/17/18
Nothing present	16	16	NA	NA	NA	NA
Ceratophyllum demersum	0	12	0	6	0	2
Chara	0	4	0	5	0	1
Elodea canadensis	4	0	30	0	1	0
Megalodonta beckii	0	4	0	3	0	2
Myriophyllum spicatum	28	0	4	0	3	0
Najas guadalupensis	76	68	52	30	1	2
Nuphar varegata	0	8	0	40	0	5
Nymphaea odorata	0	4	0	5	0	5
Potamogeton amplifolius	28	0	56	0	2	0
Potamogeton crispus	4	0	5	0	1	0
Potamogeton gramineus	0	32	0	5	0	2
Potamogeton praelongus	4	8	50	75	4	2
Potamogeton robbinsii	4	4	1	3	1	1
Vallisneria americana	0	32	0	6	0	2
Zosterella dubia	0	4	0	3	0	1

Marsh Point (Area 13)
No Treatment in 2018

Consistent with results from recent years, very few species were growing in Marsh Point in 2018. It also had the fewest species of all the treatment areas. Similar to 2017, Southern naiad and Large-leaf pondweed were the only species present in May, both growing at a low % occurrence. In September, Southern naiad had spread slightly but was less dense. The only other species present in September was Tape grass, found at just one waypoint. No invasive species were found at Marsh Point in 2018. Filamentous algae was present in Marsh Point in 2017 but no algae was found in this area in 2018.

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

Marsh Point						
Species Name	% Occurrence		Avg. % Cover		Avg. Growth Form	
	5/2/18	9/17/18	5/2/18	9/17/18	5/2/18	9/17/18
Nothing present	82	73	NA	NA	NA	NA

Najas guadalupensis	18	27	25	6	1	1
Potamogeton amplifolius	9	0	100	0	4	0
Vallisneria americana	0	9	0	5	0	2

South Bay Extension (Area 11a)
No Treatment in 2018

During the pre-treatment survey of South Bay Extension, no plants were growing in approximately one third of the area. The other approximately two thirds of the area contained Southern naiad. Stonewort and Large-leaf pondweed were the only other species in the area, each present at one waypoint. Only two species were found in South Bay Extension during the September post-treatment survey. Southern naiad was present at the same % occurrence as in May but was slightly denser. Large-leaf pondweed was still present at one waypoint. No Stonewort was found during the September survey. Filamentous algae was present in this area in 2017 but none was found in 2018.

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

South Bay Extension						
Species Name	% Occurrence		Avg. % Cover		Avg. Growth Form	
	5/2/18	9/17/18	5/2/18	9/17/18	5/2/18	9/17/18
Nothing present	33	17	NA	NA	NA	NA
Najas guadalupensis	67	67	28	38	1	2
Nitella sp	17	0	10	0	1	0
Potamogeton amplifolius	17	17	100	60	2	3

South West Bay (Area 14)
Target Plants: Large-leaf pondweed
Herbicide(s) Applied: Diquat & Endothall (July 26th)

No invasive species were found in South Bay during either the pre- or post-treatment surveys. In May, Filamentous algae and Southern naiad were each present in approximately half of the area. Water weed, White water lily and Large-leaf pondweed were each present at a low % occurrence and low to moderate density. In September, Southern naiad was present at the same occurrence as in May but was growing more densely. Large-leaf pondweed, Yellow water lily and White water lily were each present at one waypoint. No filamentous alga was present in the treatment area in September, but it was replaced by cyanomat-lyngbya covering nearly half the treatment area.

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

South West Bay						
Species Name	% Occurrence		Avg. % Cover		Avg. Growth Form	
	5/2/18	9/17/18	5/2/18	9/17/18	5/2/18	9/17/18
Nothing present	0	8	NA	NA	NA	NA
Cyanomat-Lyngbya	0	46	0	15	0	1

Elodea canadensis	8	0	10	0	1	0
Filamentous algae	46	0	59	0	1	0
Najas guadalupensis	54	54	7	61	1	2
Nuphar variegata	0	8	0	20	4	5
Nymphaea odorata	8	8	40	20	2	5
Potamogeton amplifolius	15	8	35	NA	2	2

Table 13 – Native Species Richness (# of species) by Survey Area (2006-2018)

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
2018	8	7	9	7	9	12

Vegetation Results Summary

- Curly-leaf pondweed was present in 4 of the 10 treatment areas during the May survey, which is fewer than in 2017. Similar to 2016 and 2017, Eurasian milfoil was only found in three of the treatment areas during the pre-treatment survey and within these areas, it was present at a very low density. No Eurasian milfoil or Curly-leaf pondweed was found during the post-treatment survey.

- Southern naiad was present in all of the treatment areas at a moderate to high occurrence and density during both the pre- and post-treatment surveys.

- Filamentous alga was only present in two treatment areas in 2018, the same as the results seen in 2017. In the treatment areas where it was found, it was only present during the pre-treatment survey; no Filamentous alga was found in any of the treatment areas during the post-treatment survey.

- Large-leaf pondweed was present at all treatment areas except Marina Cove during the pre-treatment survey. By September, the species had decreased slightly. It was present in six of the treatment areas and in many of the treatment areas where it was still growing, it was present at a lower occurrence.

- The treatment conducted in June targeted primarily areas of Curly-leaf pondweed and worked well to control these plants. In September, Curly-leaf pondweed was not found in any of the treatment areas in the lake.

- During the 2018 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 Southern naiad, is a native that does not grow in particularly dense beds and rarely becomes 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.

- 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. Although not required in recent years, these activities have been vital in helping prevent the spread of fanwort in Bantam Lake and should be continued as needed

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 faster.

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 or treated in 2017 due to a bridge repair project on Whites Wood Road that restricted access. In 2018, the River and Little Pond were surveyed with only a few small pockets of fanwort found so no treatment was conducted in 2018.

Recommendations for 2019

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 2019 (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 2019 pending receipt of the CT DEEP permit. 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 Curly-leaf pondweed 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 or 2018, we recommend surveying and conducting treatment as needed in these areas for 2019. 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.

Appendix 1 – Figures

FIGURE 1: 2018 Treatment Areas

SOLITUDE LAKE MANAGEMENT
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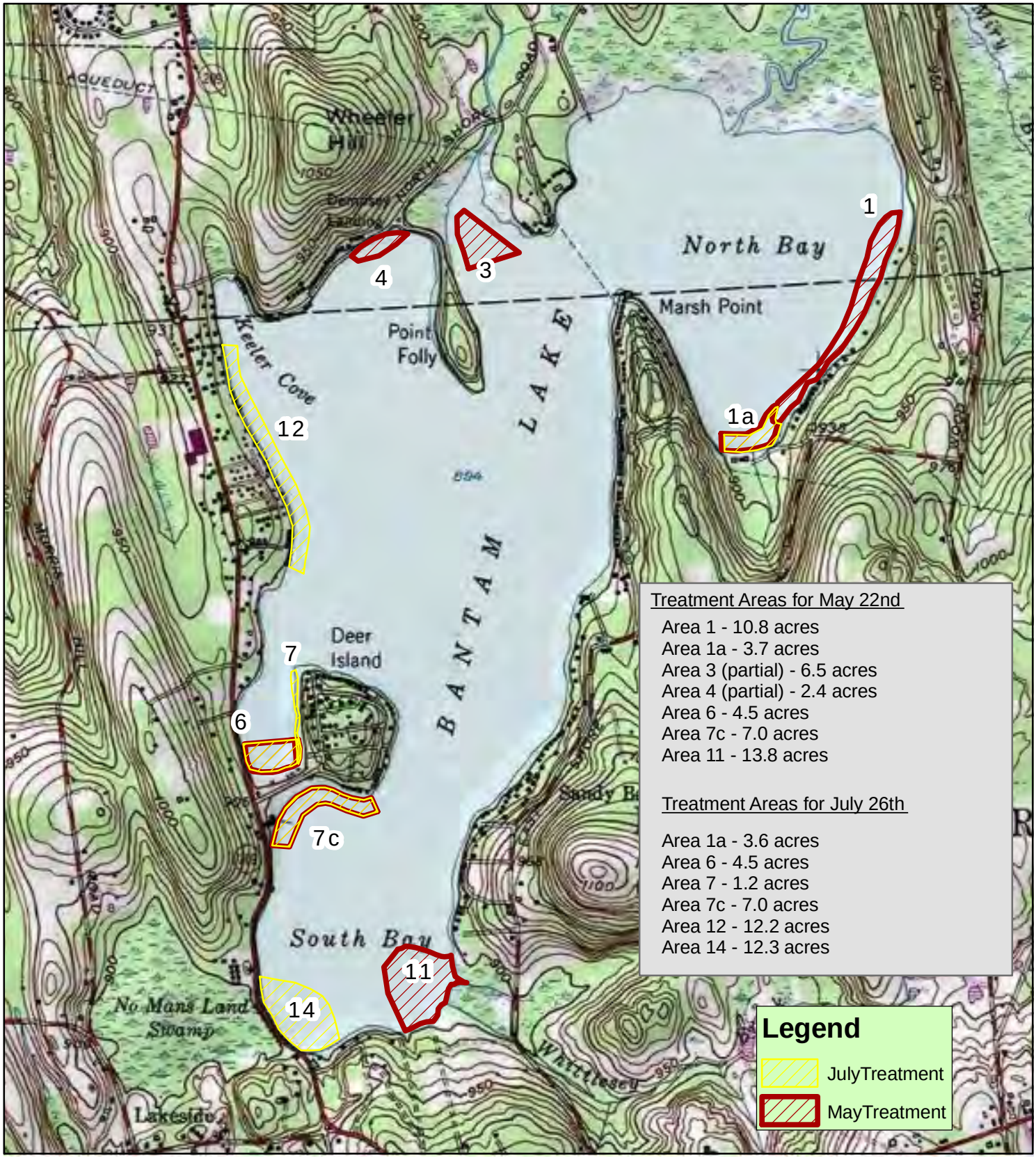
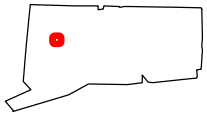


Bantam Lake
Morris/Litchfield, CT



Bantam Lake

0 1,600 3,200 Feet

1:19,200

N

Map Date: 12/06/18
Prepared by: JMP
Office: SHREWSBURY, MA

FIGURE 2: South Bay Survey Points

SOLITUDE LAKE MANAGEMENT
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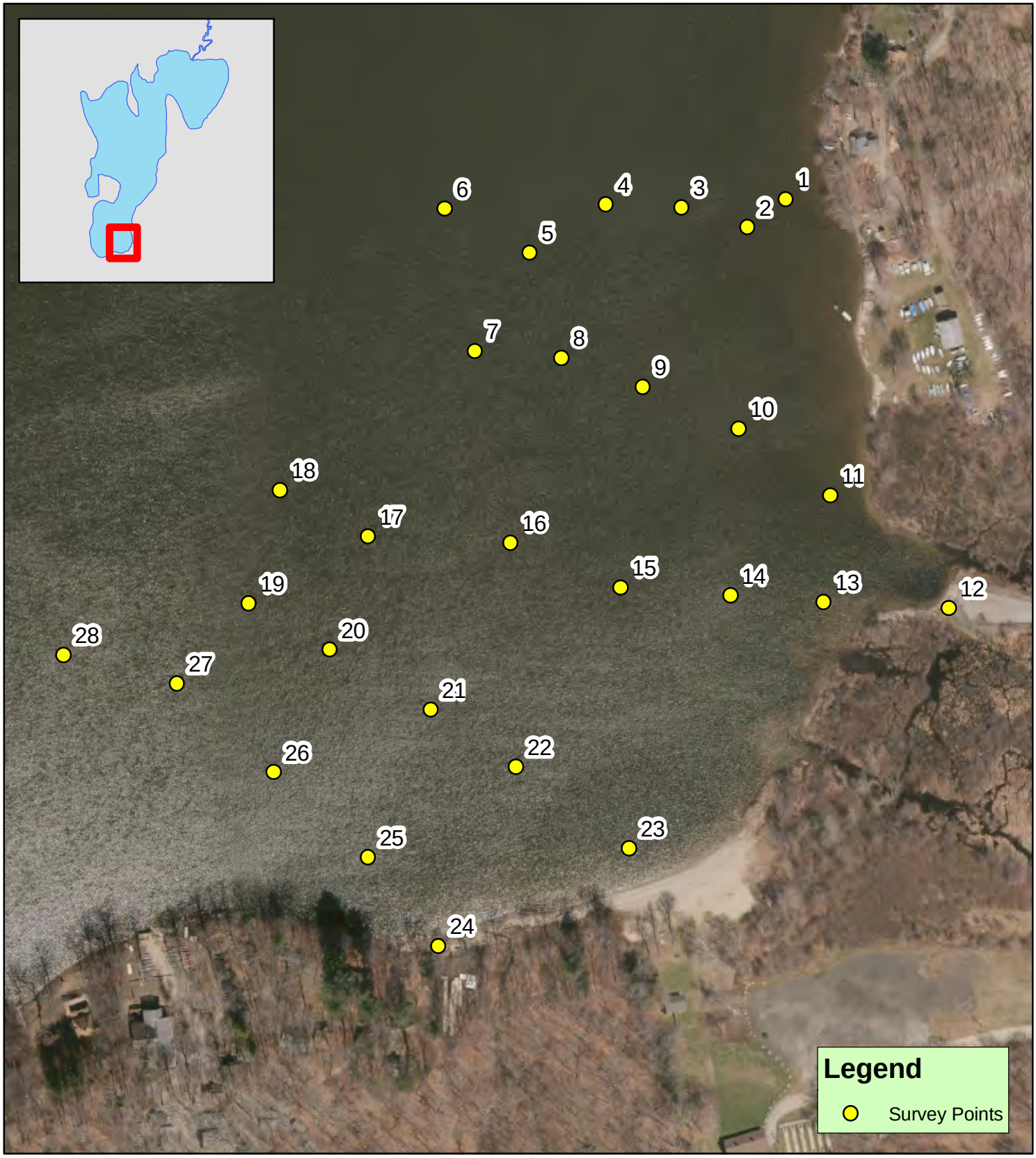
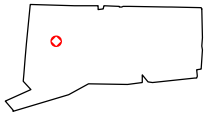


Bantam Lake
Morris/Litchfield, CT



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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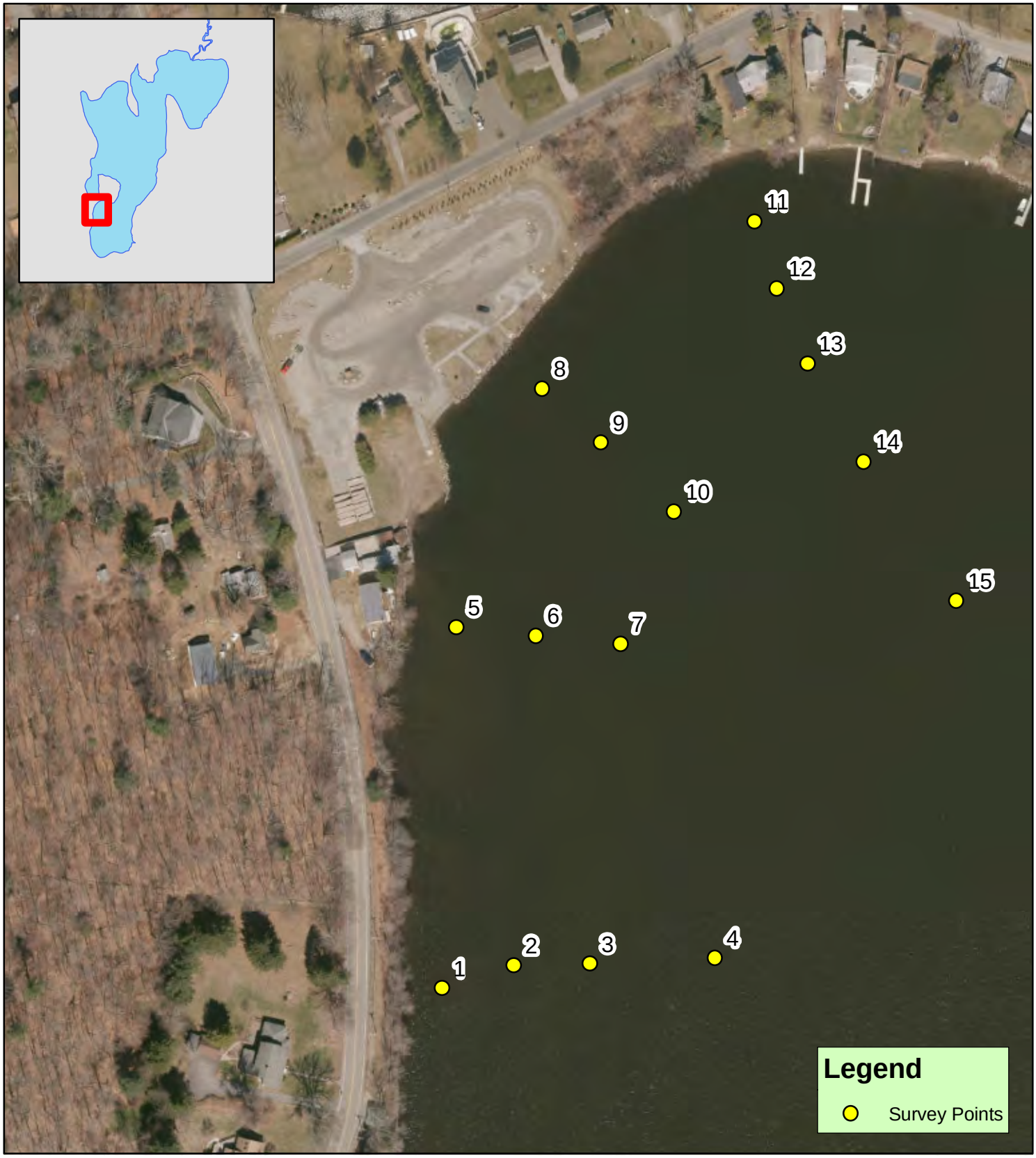
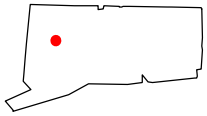


Bantam Lake
Morris/Litchfield, CT



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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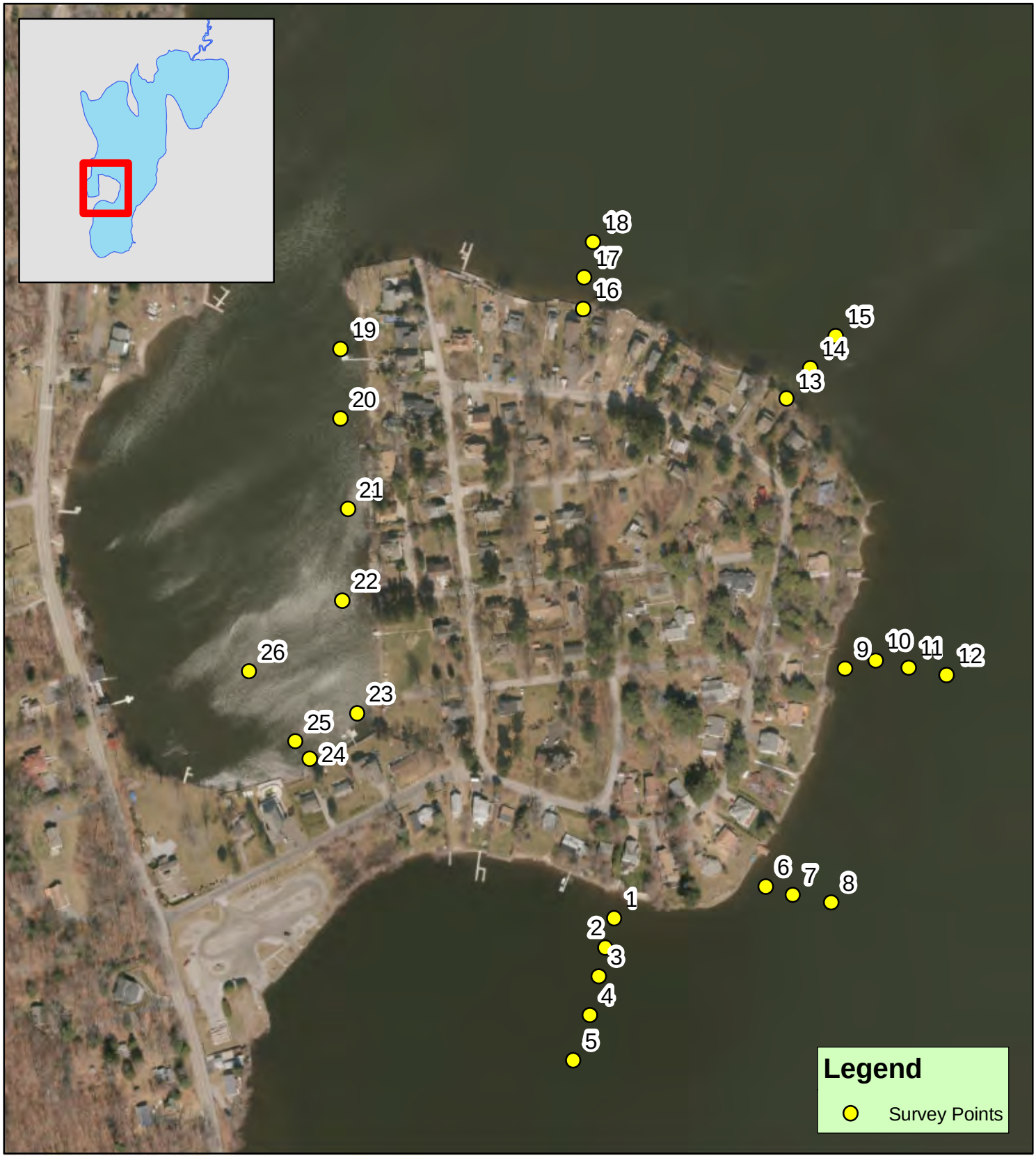
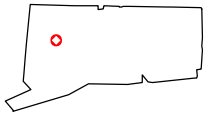


Bantam Lake
Morris/Litchfield, CT



Bantam Lake

0 270 540 Feet

1:3,906

N

Map Date: 1/15/18
Prepared by: DMM
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FIGURE 5: West Shore Survey Points

SOLITUDE LAKE MANAGEMENT
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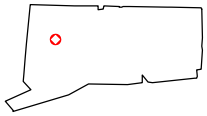
Bantam Lake
Morris/Litchfield, CT



Bantam Lake

0 260 520 Feet

1:3,906

N

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

FIGURE 6: Keeler Cove/North Shore Survey Points

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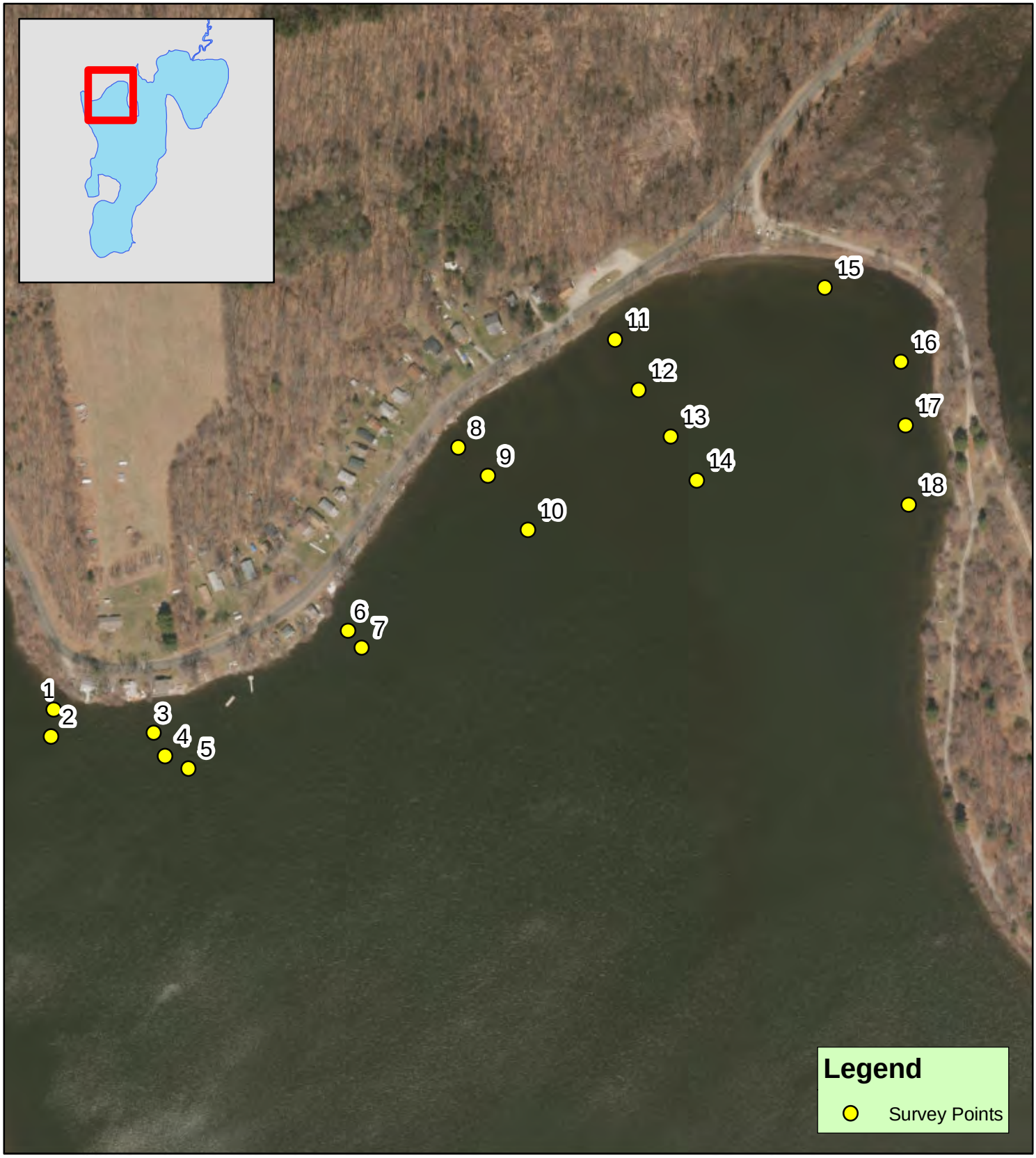
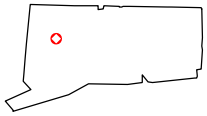


Bantam Lake
Morris/Litchfield, CT



Bantam Lake

0 270 540 Feet

1:3,906

N

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

FIGURE 7: Outlet Cove Survey Points

SOLITUDE LAKE MANAGEMENT
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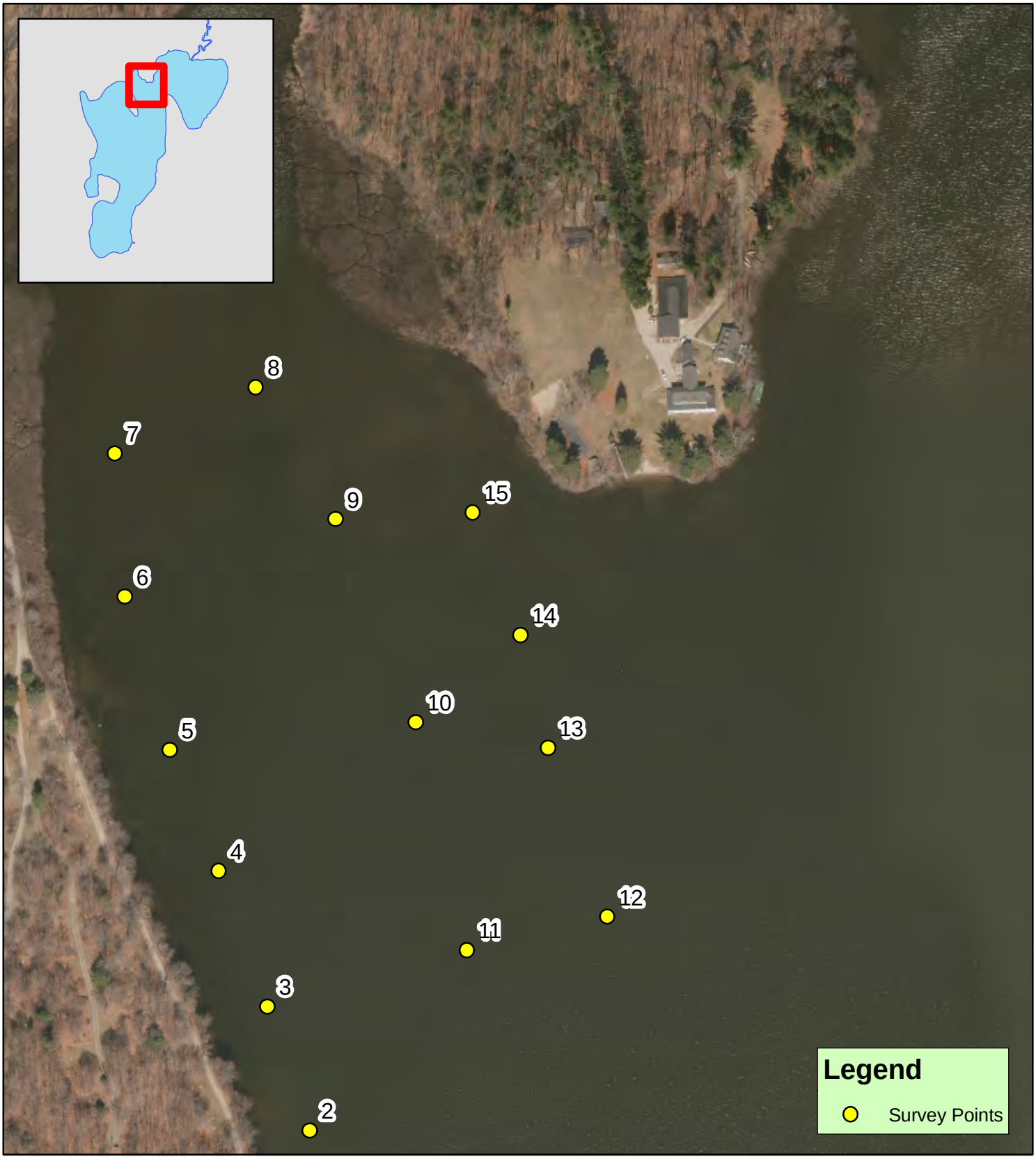
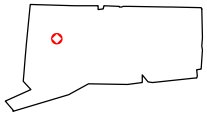


Bantam Lake
Morris/Litchfield, CT



Bantam Lake

0 210 420 Feet

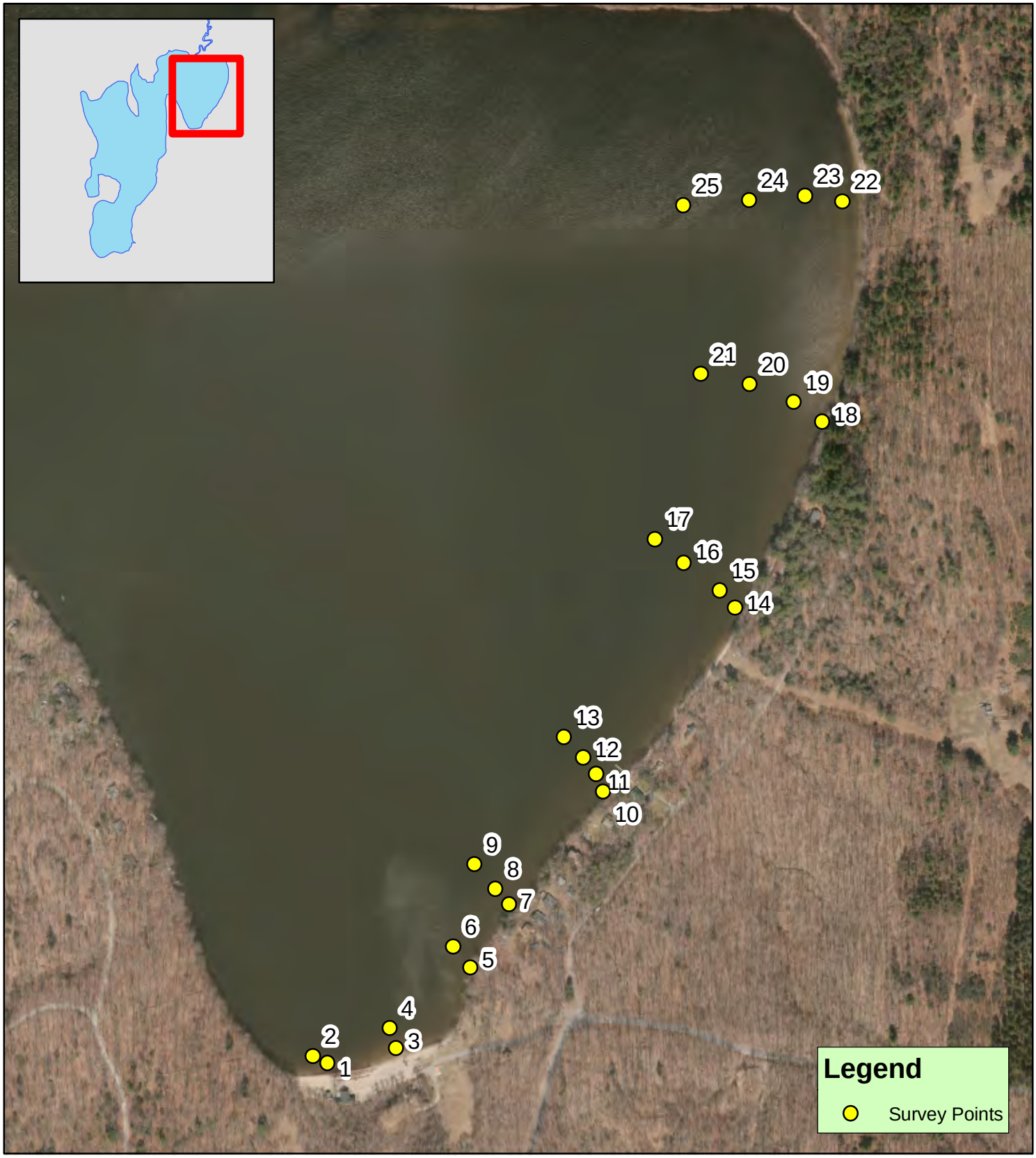
1:3,000

N

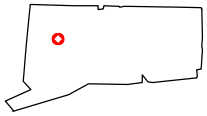
Map Date: 1/15/18
Prepared by: DMM
Office: SHREWSBURY, MA

FIGURE 8: North Bay Survey Points

SOLITUDE
LAKE MANAGEMENT
888.480.5253
solitudelakemanagement.com



Bantam Lake
Morris/Litchfield, CT



Bantam Lake

0 440 880 Feet

1:5,859

N

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

FIGURE 9: Marsh Point Survey Points

SOLITUDE LAKE MANAGEMENT
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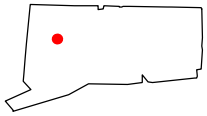
Bantam Lake
Morris/Litchfield, CT



Bantam Lake

0 230 460 Feet

1:3,000

N

Map Date: 1/15/18
Prepared by: DMM
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FIGURE 10: South Bay Extension Survey Points

SOLITUDE LAKE MANAGEMENT
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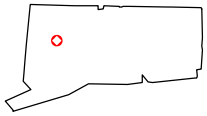
Bantam Lake
Morris/Litchfield, CT



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

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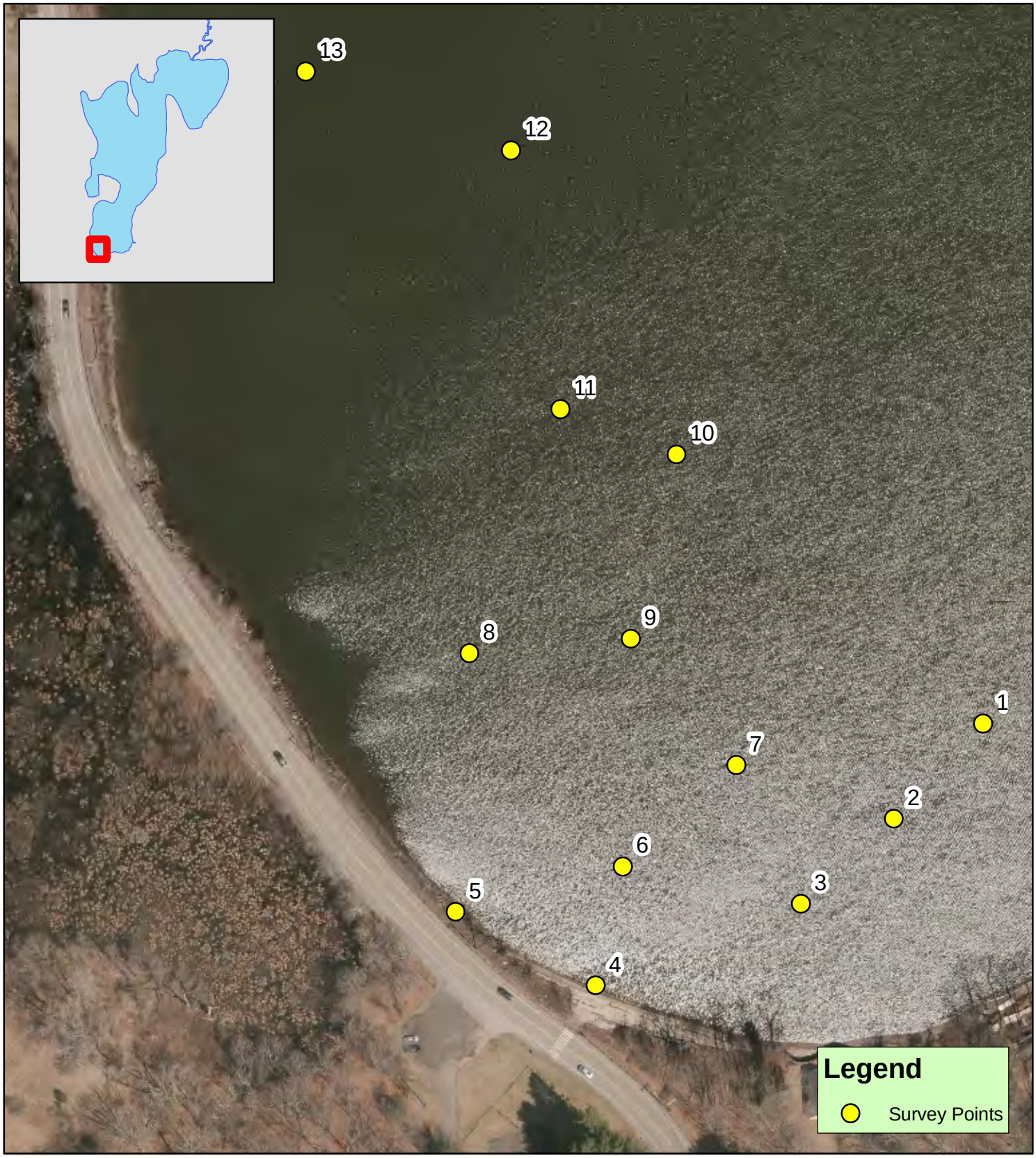
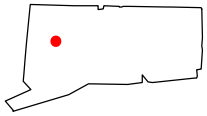


Bantam Lake
Morris/Litchfield, CT



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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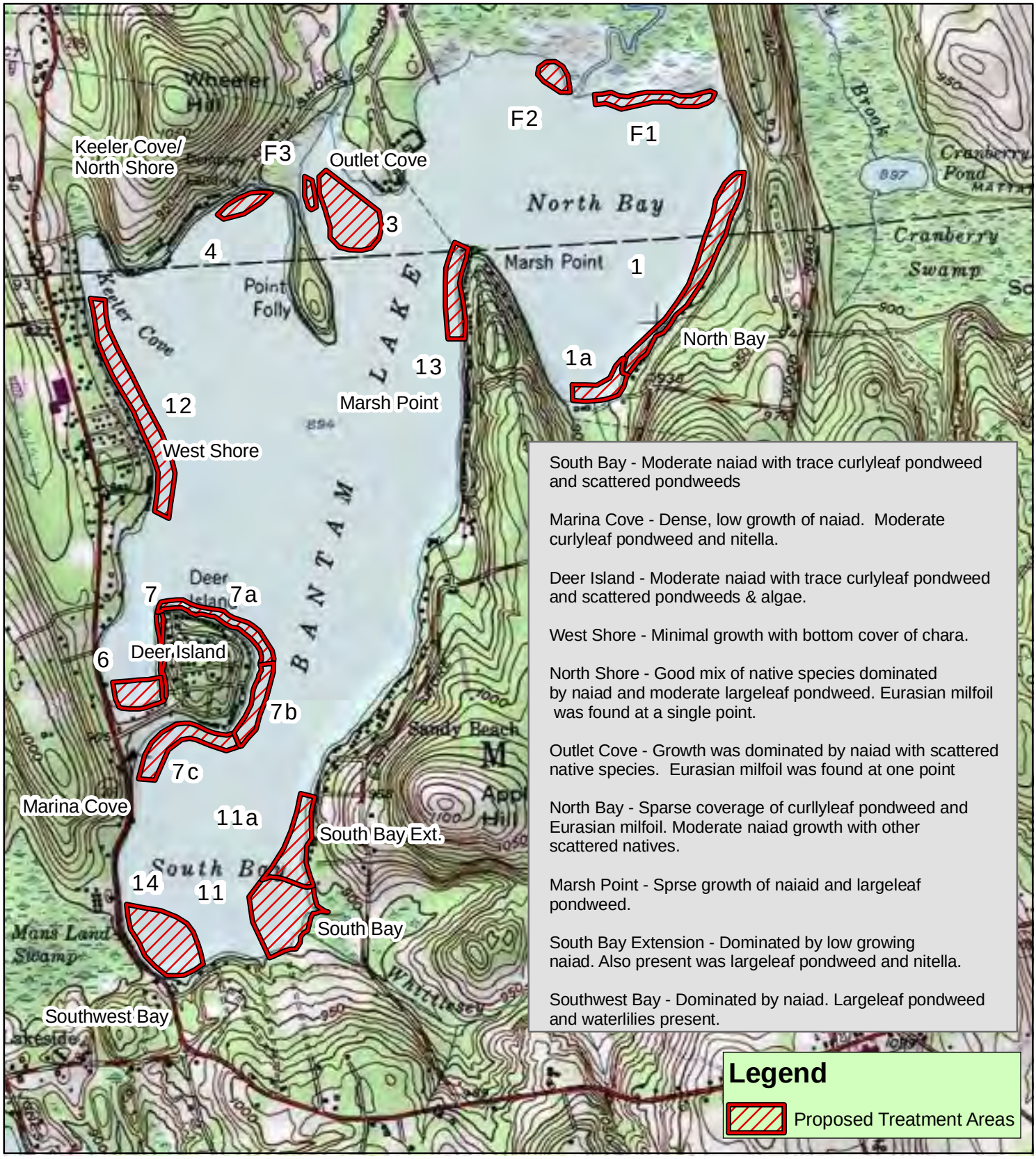


South Bay - Moderate naiad with trace curlyleaf pondweed and scattered pondweeds

Marina Cove - Dense, low growth of naiad. Moderate curlyleaf pondweed and nitella.

Deer Island - Moderate naiad with trace curlyleaf pondweed and scattered pondweeds & algae.

West Shore - Minimal growth with bottom cover of chara.

North Shore - Good mix of native species dominated by naiad and moderate largeleaf pondweed. Eurasian milfoil was found at a single point.

Outlet Cove - Growth was dominated by naiad with scattered native species. Eurasian milfoil was found at one point

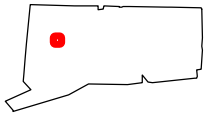
North Bay - Sparse coverage of curllyleaf pondweed and Eurasian milfoil. Moderate naiad growth with other scattered natives.

Marsh Point - Sprse growth of naiaid and largeleaf pondweed.

South Bay Extension - Dominated by low growing naiad. Also present was largeleaf pondweed and nitella.

Southwest Bay - Dominated by naiad. Largeleaf pondweed and waterlilies present.

Bantam Lake
Morris/Litchfield, CT



Bantam Lake

0 1,900 3,800 Feet

1:20,000

N

Map Date: 12/06/18
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Office: SHREWSBURY, MA

FIGURE 13: Post-Management Conditions

SOLITUDE LAKE MANAGEMENT
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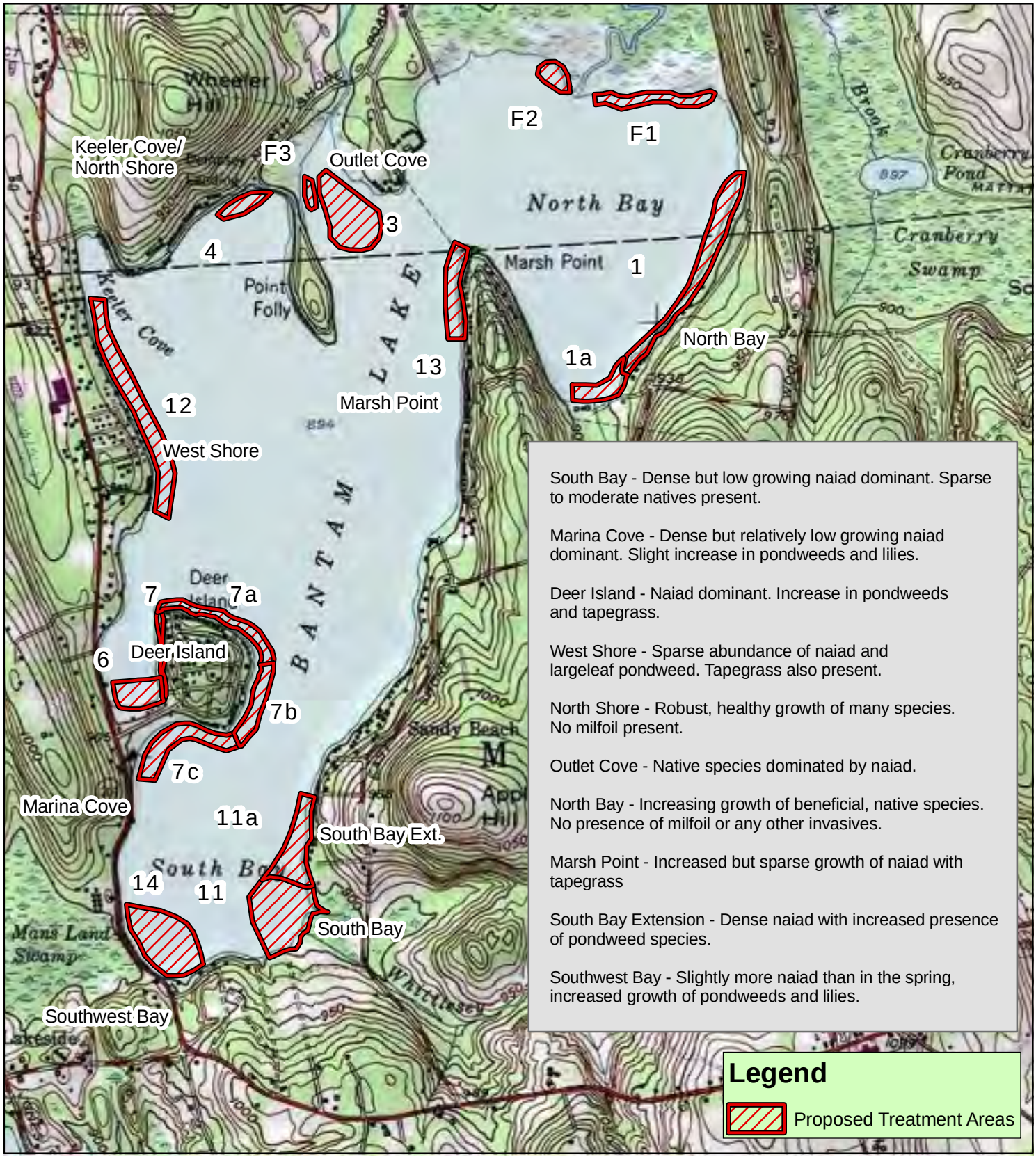


South Bay - Dense but low growing naiad dominant. Sparse to moderate natives present.

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 - Sparse abundance of naiad and largeleaf pondweed. Tapegrass also present.

North Shore - Robust, healthy growth of many species. No milfoil present.

Outlet Cove - Native species dominated by naiad.

North Bay - Increasing growth of beneficial, native species. No presence of milfoil or any other invasives.

Marsh Point - Increased but sparse growth of naiad with tapegrass

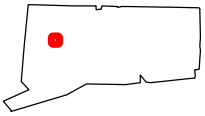
South Bay Extension - Dense naiad with increased presence of pondweed species.

Southwest Bay - Slightly more 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: 12/06/18
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FIGURE 14: Proposed 2019 Treatment Areas

SOLITUDE LAKE MANAGEMENT
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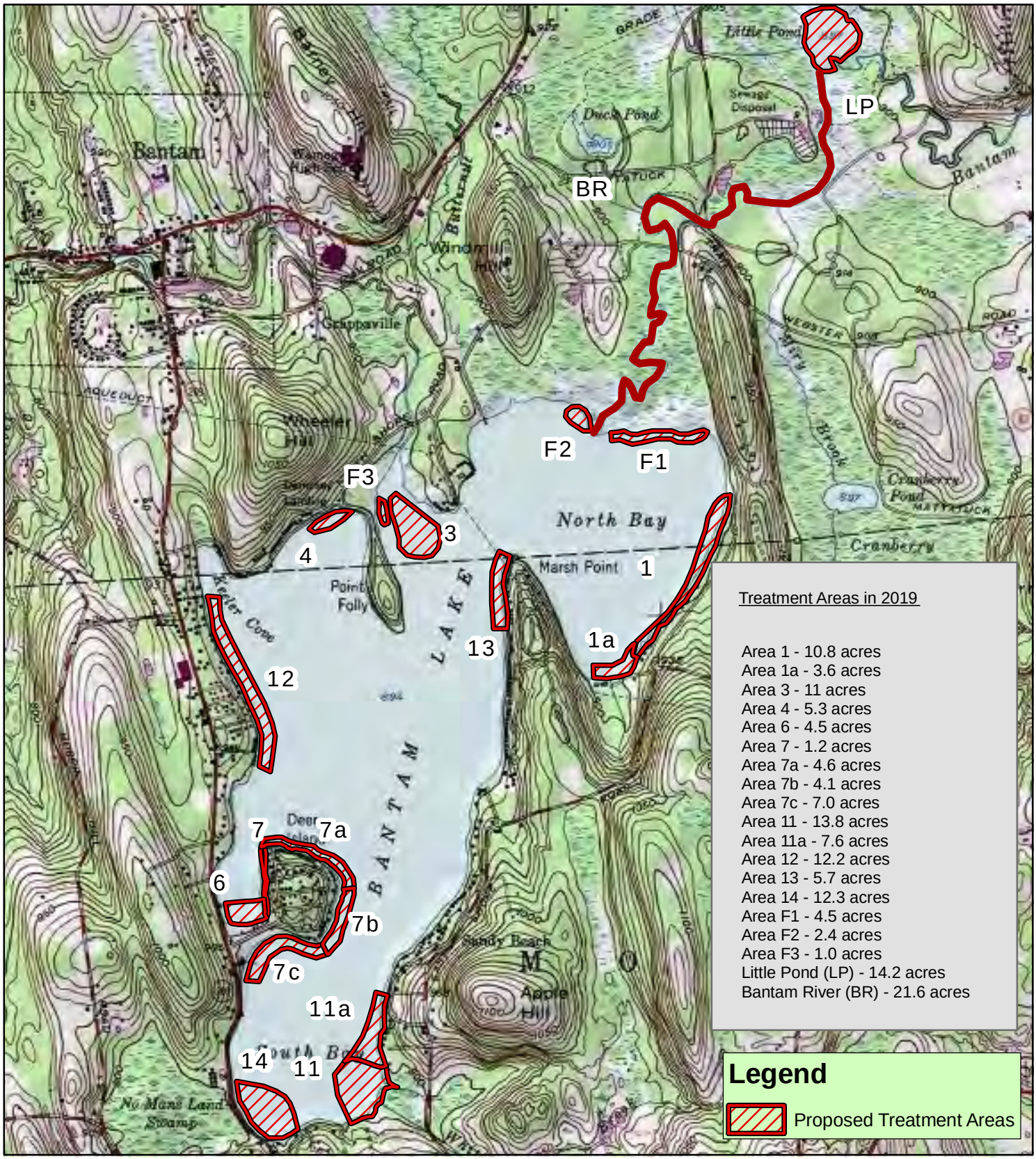
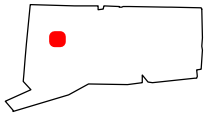


Bantam Lake
Morris/Litchfield, CT



Bantam Lake

0 2,300 4,600 Feet

1:25,000

N

Map Date: 12/06/18
Prepared by: JMP
Office: SHREWSBURY, MA