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environmental consulting & engineering services

October 15, 2019

Mr. Peter Collins
Chairman
Lake Quinsigamond Commission
106 Maple Street
Shrewsbury, Massachusetts 01545

Re: Lake Quinsigamond Permit Compliance Monitoring – 2019
ESS Project No. L199-001

Dear Mr. Collins:

ESS Group, Inc. (ESS) is pleased to present this report on the 2019 monitoring program at Lake Quinsigamond. This report provides a summary of our findings with regard to aquatic biology conditions in the lake, as well as recommendations for the implementation of the 2020 management program.

BACKGROUND

Approvals and Permits

In May and June 2018, the Lake Quinsigamond Commission (LQC) received approvals from the Conservation Commissions of the Shrewsbury, Grafton, Worcester as well as the Massachusetts Natural Heritage and Endangered Species Program (NHESP) to proceed with implementation of the Lake Quinsigamond Long-term Vegetation Management Plan (ESS 2016). This included management of aquatic invasive plant species using water level control, chemical controls, and physical controls as conditioned by the approving agencies.

A summary of the permits and approvals issued by these agencies is provided below:

- NHESP issued a final decision approving the Lake Quinsigamond Long-term Vegetation Management Plan with conditions on May 23, 2018 (NHESP Tracking No. 06-20539).
- The Worcester Conservation Commission issued an Order of Conditions (OOC) for the Lake Quinsigamond Long-term Vegetation Management Plan on June 11, 2018 (DEP File No. 349-1200).
- The Shrewsbury Conservation Commission issued an OOC for the Lake Quinsigamond Long-term Vegetation Management Plan on June 12, 2018 (DEP File No. 285-1803).
- The Grafton Conservation Commission issued an OOC for the Lake Quinsigamond Long-term Vegetation Management Plan on June 12, 2018 (DEP File No. 164-0952).

Management Completed in 2019

The LQC contracted with SOLitude Lake Management (SLM) to undertake chemical treatments of aquatic invasive plants using diquat dibromide and flumioxazin (trade name Clipper), as well as glyphosate for treatment of sacred lotus (*Nelumbo nucifera*). Under this contract, SLM completed treatment of aquatic invasive plant beds in Management Zones A and C during September 2019.

FIELD MONITORING PROGRAM

ESS conducted the 2019 field program on October 8 and 9 to capture post-treatment conditions during the growing season. This program included a biological survey of Lake Quinsigamond to assess the effect of herbicide treatment on the target and non-target species.

Water quality monitoring in 2019 was conducted separately by the City of Worcester and results are not included in this report.

The approach and results of the biological monitoring are presented in greater detail below.

Biological Monitoring

Approach

ESS used a sub-meter accurate DGPS receiver to navigate to and record biological data at 235 sampling locations. For consistency, this included 230 sampling locations established during the 2017 baseline aquatic vegetation survey (ESS 2017), along with an additional 5 stations.

At each survey location, ESS identified submerged, floating, and emergent aquatic plants, determined the extent of invasive plant infestations, and assigned the location an overall cover and biovolume classification. Surveys were conducted using aquatic plant survey rakes and/or an underwater camera, as appropriate. Supplemental field notes and sketches were also collected to help document field conditions.

Point survey results and field notes/sketches were used to create maps of overall aquatic plant cover and biovolume, as well as the density of individual target species for the entire lake. Based on prior survey data, target species included the following exotic and nuisance aquatic plants:

- Fanwort (*Cabomba caroliniana*)
- Variable-leaf milfoil (*Myriophyllum heterophyllum*)
- Eurasian milfoil (*Myriophyllum spicatum*)
- Brittle naiad (*Najas minor*)
- Sacred lotus (*Nelumbo nucifera*)
- Curly-leaf pondweed (*Potamogeton crispus*)

However, ESS also searched for pioneer infestations of any new aquatic invasive plants, particularly those that are known from upstream waters (e.g., water chestnut [*Trapa natans*]).

Results

Aquatic plant cover extended over approximately 207 acres of the lake (Figure 1), which is somewhat reduced from 2018 (Table A). Plant cover was present mainly along the immediate shoreline in the northern portion of Lake Quinsigamond but was more extensive to the south, where large contiguous plant beds were frequently observed, especially in the untreated areas north of Route 20.

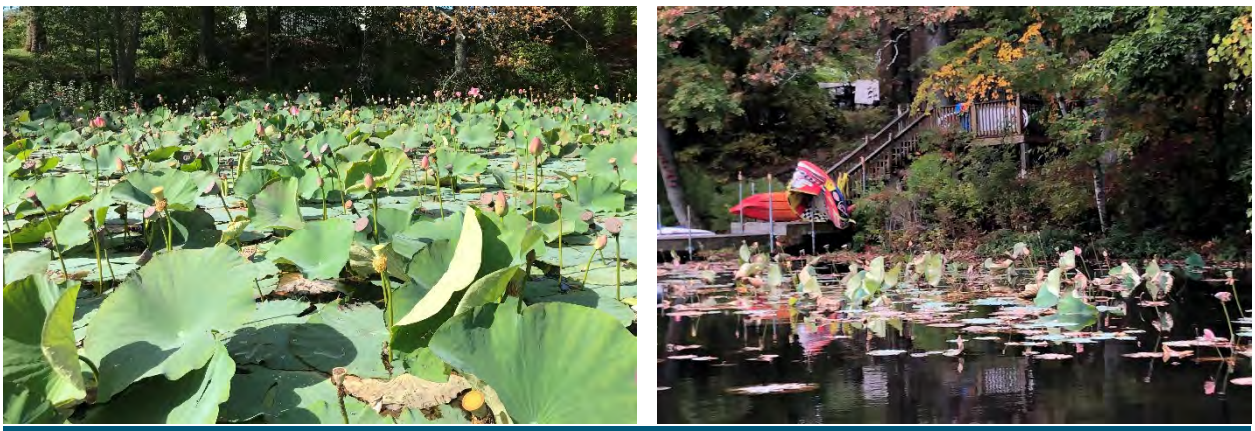
As in 2018, plant biovolume demonstrated similar patterns to plant cover; it was highest in the untreated areas north of the Route 20 and expanded slightly in this area. South of Route 20, biovolume remained low to moderate (Figure 2).

Table A. Comparison of Aquatic Plant Extent, 2017 to 2019

Biological Parameter	2017 Baseline Extent (Acres)	2018 Post-treatment Extent (Acres)	Difference 2017-2018 (Acres)	2019 Post-treatment Extent (Acres)	Difference 2018-2019 (Acres)
Total Aquatic Plant Cover	310	276	-34	207	-69
Very High (75%+) Aquatic Plant Biovolume	125	68	-57	69	+1
Total Fanwort Cover	87	37	-50	5	-32
Total Variable-leaf Milfoil Cover	16	10	-6	6	-4
Total Eurasian Milfoil Cover	237	136	-101	35	-101
Total Brittle Naiad Cover	1	9	+8	1	-8
Total Sacred Lotus Cover	0.5	0.7	+0.2	0.1	-0.4
Total Curly-leaf Pondweed Cover	1	3	+2	0	-1

Outside of Management Zone B, the aquatic plant community at Lake Quinsigamond was dominated by native species for the first time this year. The most widespread native species were, in descending order, water celery (*Vallisneria americana*), white water lily (*Nymphaea odorata*), bigleaf pondweed (*Potamogeton amplifolius*), and thinleaf pondweed (*P. pusillus*), although many others were also present (Table B).

Target exotic species growth in Lake Quinsigamond appeared to be substantially reduced from prior levels for most species, as summarized in Table A. All target species decreased in extent in 2019.



Sacred lotus beds decreased substantially from 2018 (left) to 2019 (right).

The observed growths for each exotic species in 2019 were as follows:

- Fanwort covered approximately 5 acres, mostly as sparse growths, although denser beds were also present in southern areas just north of Route 20 (Figure 3). A few sprigs of live fanwort also persisted south of Route 20.
- Variable-leaf milfoil covered approximately 6 acres near and south of Route 20 (Figure 4).
- Eurasian milfoil continued to be the most widespread exotic species in the lake, covering approximately 35 acres (Figure 5). Although it is still extensive and dense in some portions of Management Zone B (e.g., Half Moon Bay), it was not found at all in Management Zones A or C.
- Brittle naiad covered approximately 1 acre in Management Zone B (Figure 6). Populations of this species often vary substantially from year to year, even in the absence of active management. Given the erratic nature of this species, it is considered a secondary target of the management and monitoring programs.
- Sacred lotus covered approximately 0.1 acres as dense growth just south of the Route 20 bridge (Figure 7). The bed was substantially reduced in size and vigor from 2018.
- Curly-leaf pondweed was not detected in this year's survey. However, this species typically matures in June and is usually difficult to detect by late summer. Therefore, fluctuations in late summer/early fall curly-leaf pondweed beds are not necessarily indicative of changes in the actual population of this species.
- Exotic water chestnut was last observed as floating rosettes in Lake Quinsigamond in 2016; it has not since been observed during ESS's surveys.

Table B. Aquatic Vegetation Present in Lake Quinsigamond

Scientific Name	Common Name	Dominant Growth Type	Native or Exotic	Detected in 2019?	Detected in Prior Year(s)?
Algae sp.	Filamentous Algae	Submerged	Native	Yes	Yes
Brasenia schreberi	Watershield	Floating-leaved	Native	Yes	Yes
Cabomba caroliniana	Fanwort	Submerged	Exotic	Yes	Yes
Ceratophyllum demersum	Coontail	Submerged	Native	Yes	Yes
Elodea canadensis	Canadian Waterweed	Submerged	Native	Yes	Yes
Elodea nutallii	Western Waterweed	Submerged	Native	No	Yes
Lemna minor	Common Duckweed	Floating-leaved	Native	No	Yes
Myriophyllum heterophyllum	Variable-leaf Milfoil	Submerged	Exotic	Yes	Yes
Myriophyllum humile	Low Milfoil	Submerged	Native	No	Yes
Myriophyllum spicatum	Eurasian Milfoil	Submerged	Exotic	Yes	Yes
Najas flexilis	Slender Naiad	Submerged	Native	Yes	Yes

Scientific Name	Common Name	Dominant Growth Type	Native or Exotic	Detected in 2019?	Detected in Prior Year(s)?
Najas minor	Brittle Naiad	Submerged	Exotic	Yes	Yes
Nelumbo nucifera	Sacred Lotus	Emergent	Exotic	Yes	Yes
Nitella sp.	Stonewort	Submerged	Native	Yes	Yes
Nuphar lutea variegata	Yellow Water Lily	Floating-leaved	Native	Yes	Yes
Nymphaea odorata	White Water Lily	Floating-leaved	Native	Yes	Yes
Phragmites australis	Common Reed	Emergent	Exotic	Yes	Yes
Pontederia cordata	Pickerelweed	Emergent	Native	Yes	Yes
Potamogeton amplifolius	Bigleaf Pondweed	Floating-leaved	Native	Yes	Yes
Potamogeton crispus	Curly-leaf Pondweed	Submerged	Exotic	No	Yes
Potamogeton epihydrus	Floating-leaf Pondweed	Floating-leaved	Native	Yes	Yes
Potamogeton natans	Floating Pondweed	Floating-leaved	Native	Yes	Yes
Potamogeton nodosus	Longleaf pondweed	Floating-leaved	Native	No	Yes
Potamogeton perfoliatus	Clasping-leaf Pondweed	Submerged	Native	Yes	Yes
Potamogeton pusillus	Thinleaf Pondweed	Submerged	Native	Yes	Yes
Potamogeton robbinsii	Robbins' pondweed	Submerged	Native	Yes	Yes
Potamogeton spirillus	Spiral Pondweed	Floating-leaved	Native	No	Yes
Utricularia macrorhiza	Common Bladderwort	Submerged	Native	No	Yes
Utricularia radiata	Little Floating Bladderwort	Floating-leaved	Native	No	Yes
Vallisneria americana	Water Celery	Submerged	Native	Yes	Yes

MANAGEMENT RECOMMENDATIONS FOR 2020

Management recommendations for 2020 are based on this year's observed conditions in Lake Quinsigamond, the permit/review filings submitted to state and local agencies, and the subsequent project approvals/conditions received. The key recommendations specific to vegetation management are summarized below:

1. Continue **winter drawdown** program, as feasible, starting in early November 2019. This may help control remaining fanwort, Eurasian milfoil, and variable-leaf milfoil beds in the shallowest areas.
2. Continue **glyphosate treatment of sacred lotus beds** to further reduce the extent and density of the infestation and prevent expansion.
3. Implement **spot treatments of fanwort and exotic milfoil regrowth, as needed, in Management Zones A and C**. This may include treatment with contact herbicides, such as diquat and Clipper

or, where fanwort growth is confined to quiescent coves, treatment with the systemic herbicide Sonar. If Clipper is selected for use in 2020, it may only be applied to areas where it was not applied in 2019, due to specific state regulations governing its use. There is no such restriction on diquat or Sonar application.

A basin-wide Sonar treatment is not currently considered to be cost-effective for Management Zone A or C, given the large areas/volume of both portions of the lake without target plant growth. Therefore, this approach is not recommended for implementation in 2020.

4. Explore the possibility of completing an **herbicide pilot study** in Half Moon Bay. A new systemic herbicide (trade name ProcellaCOR) is now available for use in Massachusetts. This herbicide appears to be very effective on select target species, such as Eurasian milfoil, while presenting very low risk to native pondweed (*Potamogeton*) species. Should the LQC desire to pursue this action (or any other management action in Management Zone B), NHESP would need to be consulted. ESS recommends conducting outreach about the potential for a pilot study to NHESP this winter, so that the LQC has the opportunity to act on the outcome in the coming year. If approved by NHESP, the LQC would also need to consult with the Shrewsbury Conservation Commission to determine whether an amended Order of Conditions would also be required to implement the pilot study.

5. Be prepared to conduct **hand harvesting** where the LQC cannot or does not wish to use herbicides to control nuisance aquatic plant beds. For example, hand harvesting is often the best way to eradicate pioneer infestations of new exotic species.

   Although ESS did not observe water chestnut at Lake Quinsigamond in 2019, hand harvesting is ideal for addressing isolated or scattered growths, should they emerge in 2020. The timing of hand harvesting should focus on the late June to early August period, prior to seed drop.

6. Continue with the ongoing **water quality and biological monitoring program** to meet permit conditions in 2020. At a minimum, this should include three rounds of water quality monitoring (one during drawdown, one following refill of the lake, and one toward the end of the growing season) at the six established monitoring stations. It should also include post-treatment vegetation mapping, ideally in September.

   These monitoring actions are recommended not only to meet permit conditions but also to evaluate the success of the management program and provide the information necessary to support modifications, as needed.

REFERENCES

[ESS] ESS Group, Inc. 2016. Amended Lake Quinsigamond Long-term Vegetation Management Plan. Prepared for the Lake Quinsigamond Commission.

[ESS] ESS Group, Inc. 2017. October 2017 Aquatic Plant Mapping Survey. Prepared for the Lake Quinsigamond Commission.

[ESS] ESS Group, Inc. 2018. Lake Quinsigamond Permit Compliance Monitoring – 2018. Prepared for the Lake Quinsigamond Commission.

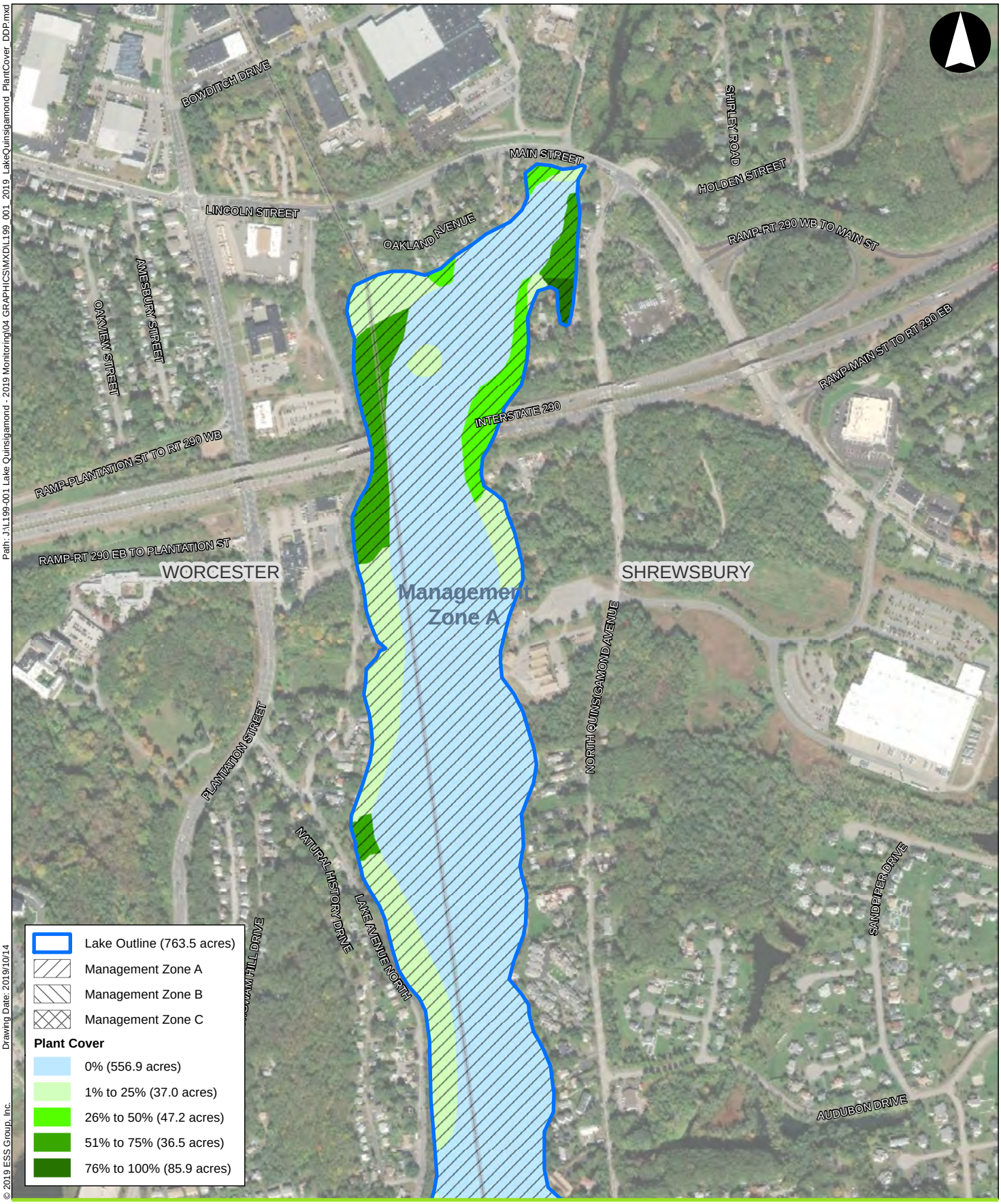
We appreciate the opportunity to continue to serve the Lake Quinsigamond Commission. Please contact Matt Ladewig at (401) 330--1204 if you have any questions.

Sincerely,

ESS GROUP, INC.

Matt Ladewig, CLM
Senior Scientist

Attachments



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Path: J:\L199-001 Lake Quinsigamond - 2019 Monitoring\04 GRAPHICS\MXD\L199_001_2019_LakeQuinsigamond_PlantCover_DDP.mxd

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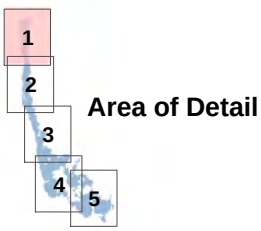
0 350 700 Feet

Lake Quinsigamond Monitoring

Shrewsbury, Worcester & Grafton, Massachusetts

1 inch = 700 feet

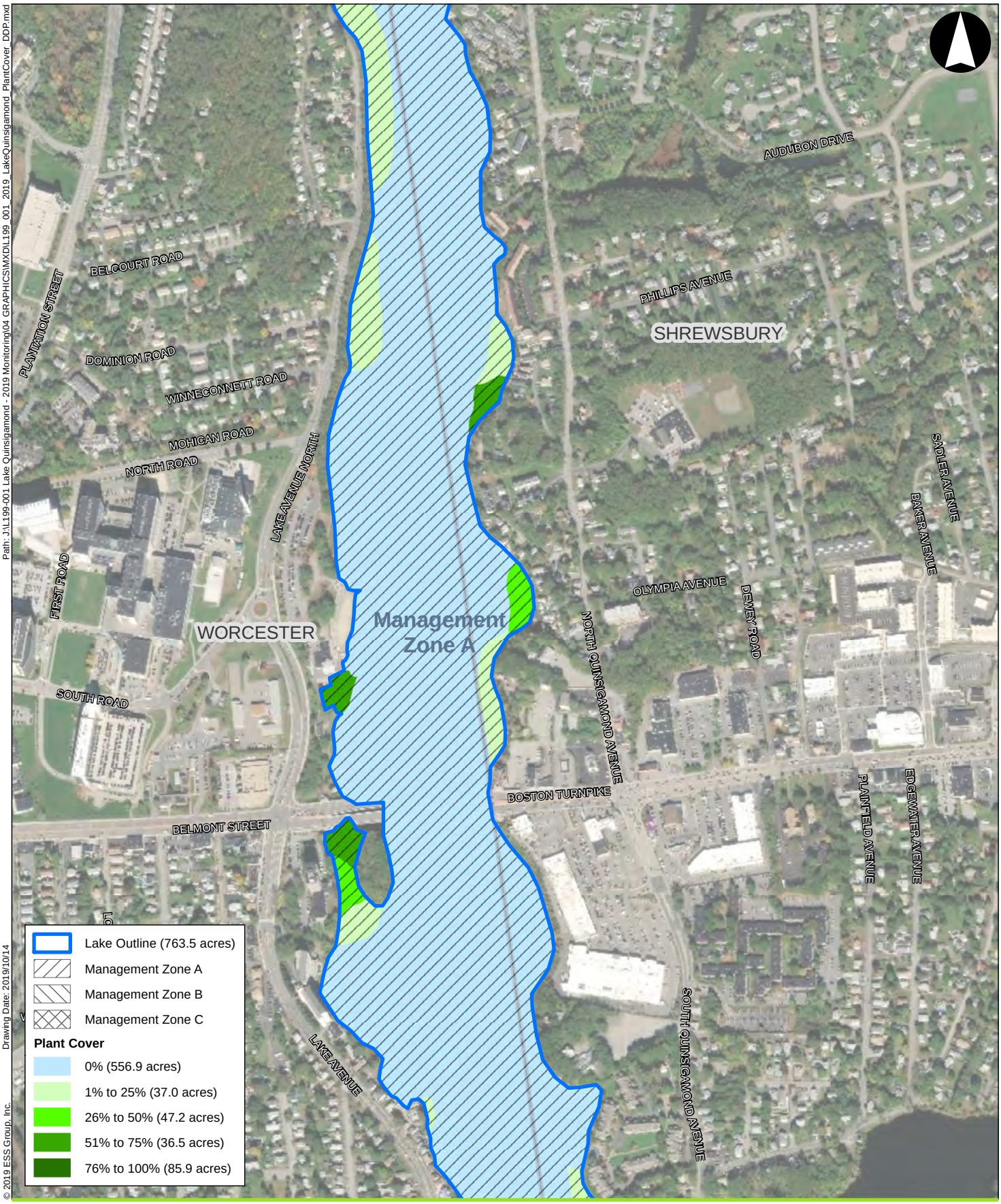
Source: 1) ESRI, World Imagery, 2018
2) ESS, Field Survey, October 2019



Area of Detail

Plant Cover
October 8th & 9th, 2019

Figure 1



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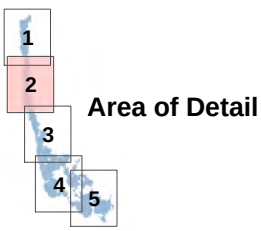

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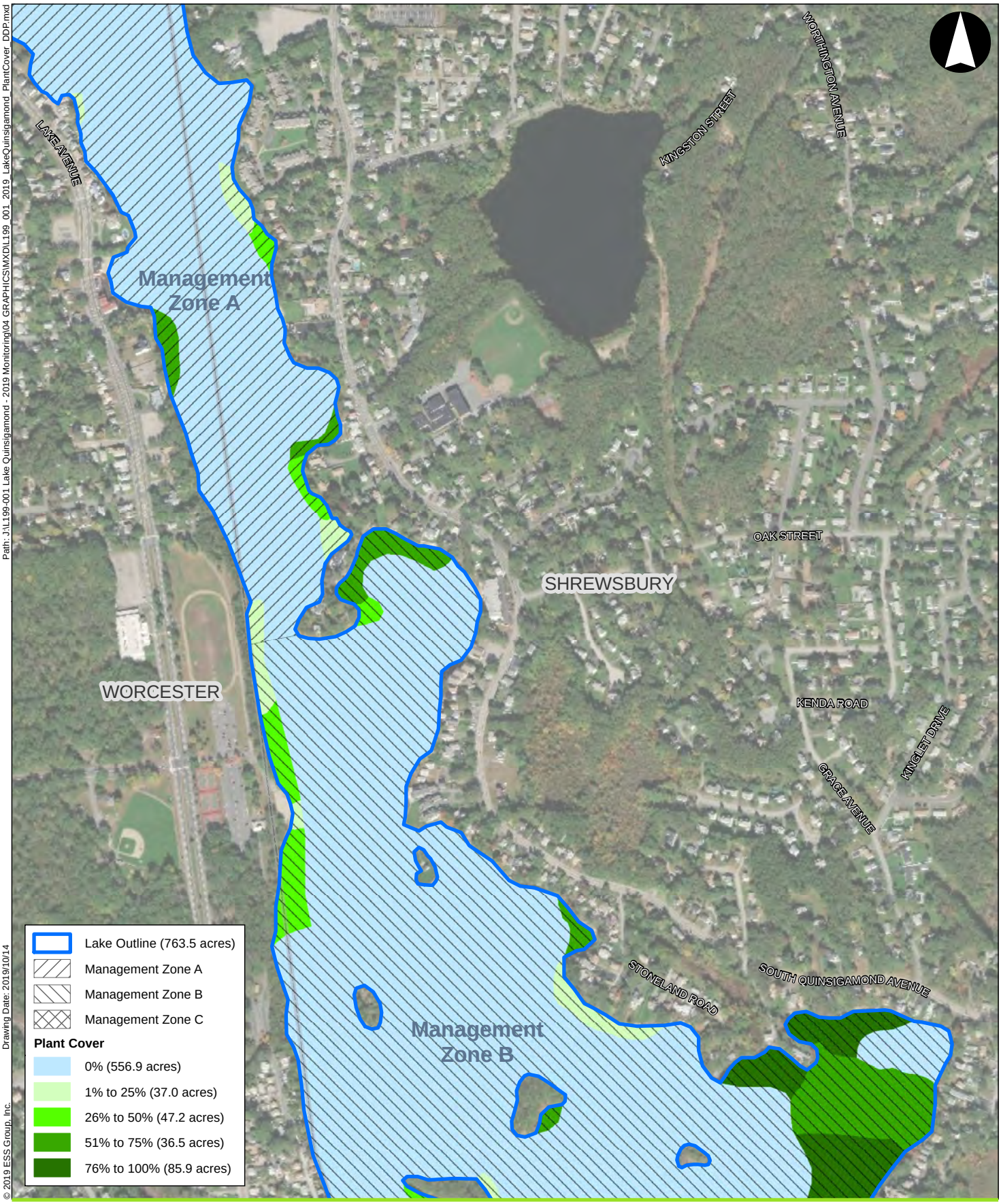

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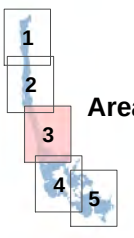

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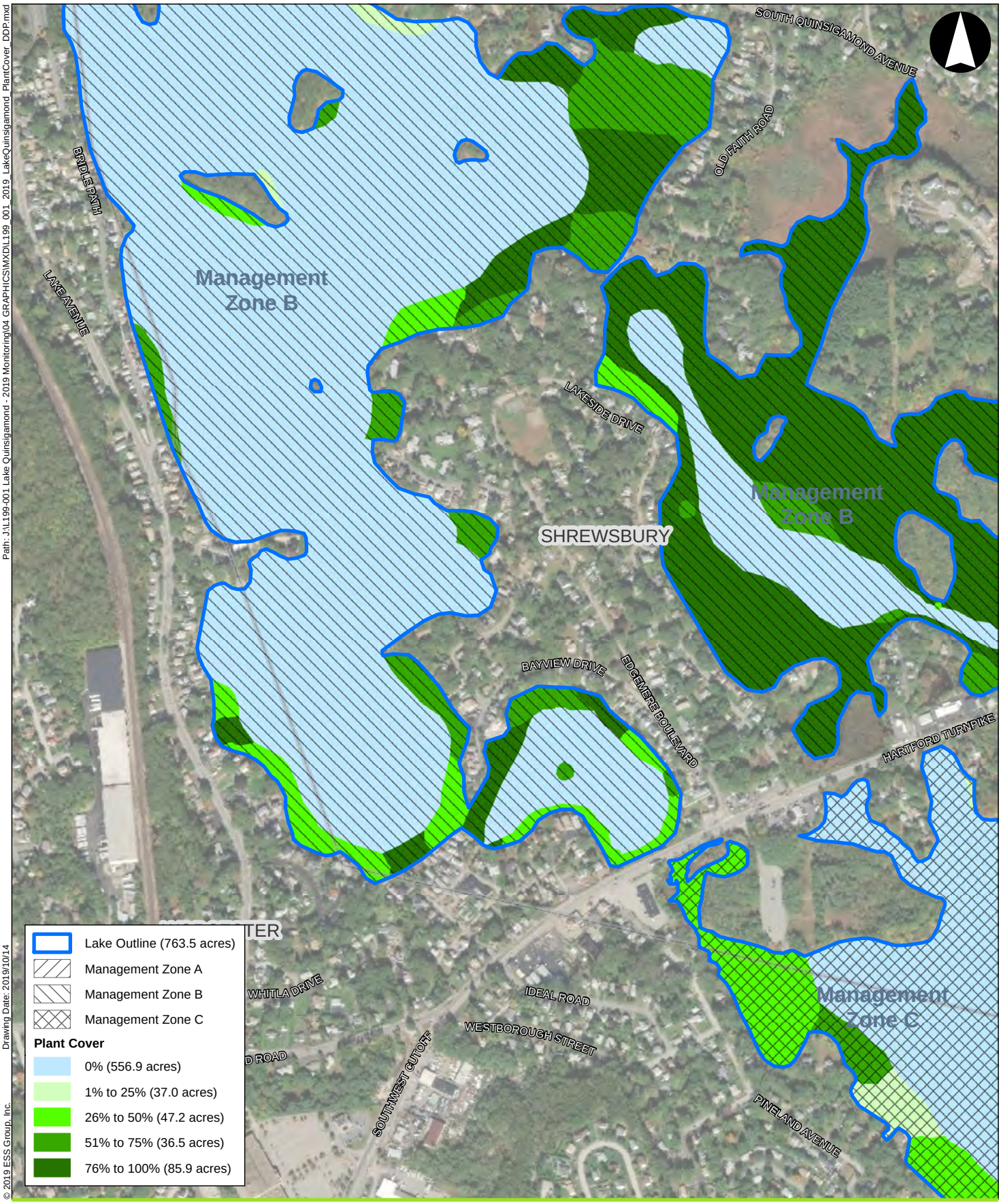

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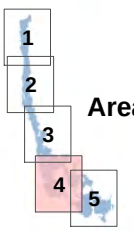

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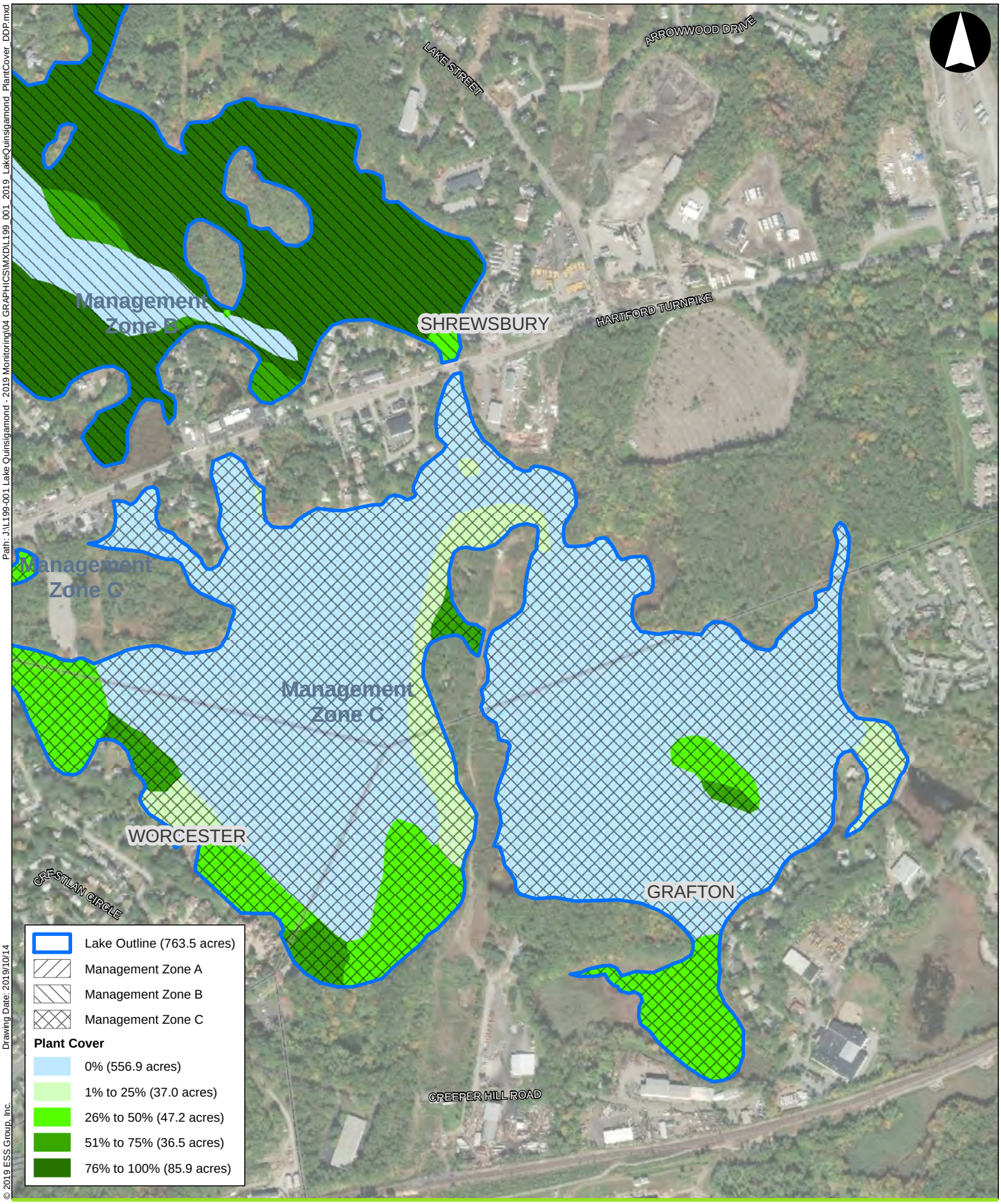

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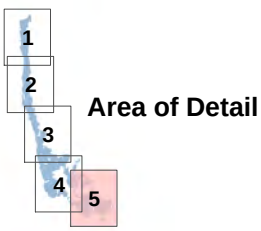

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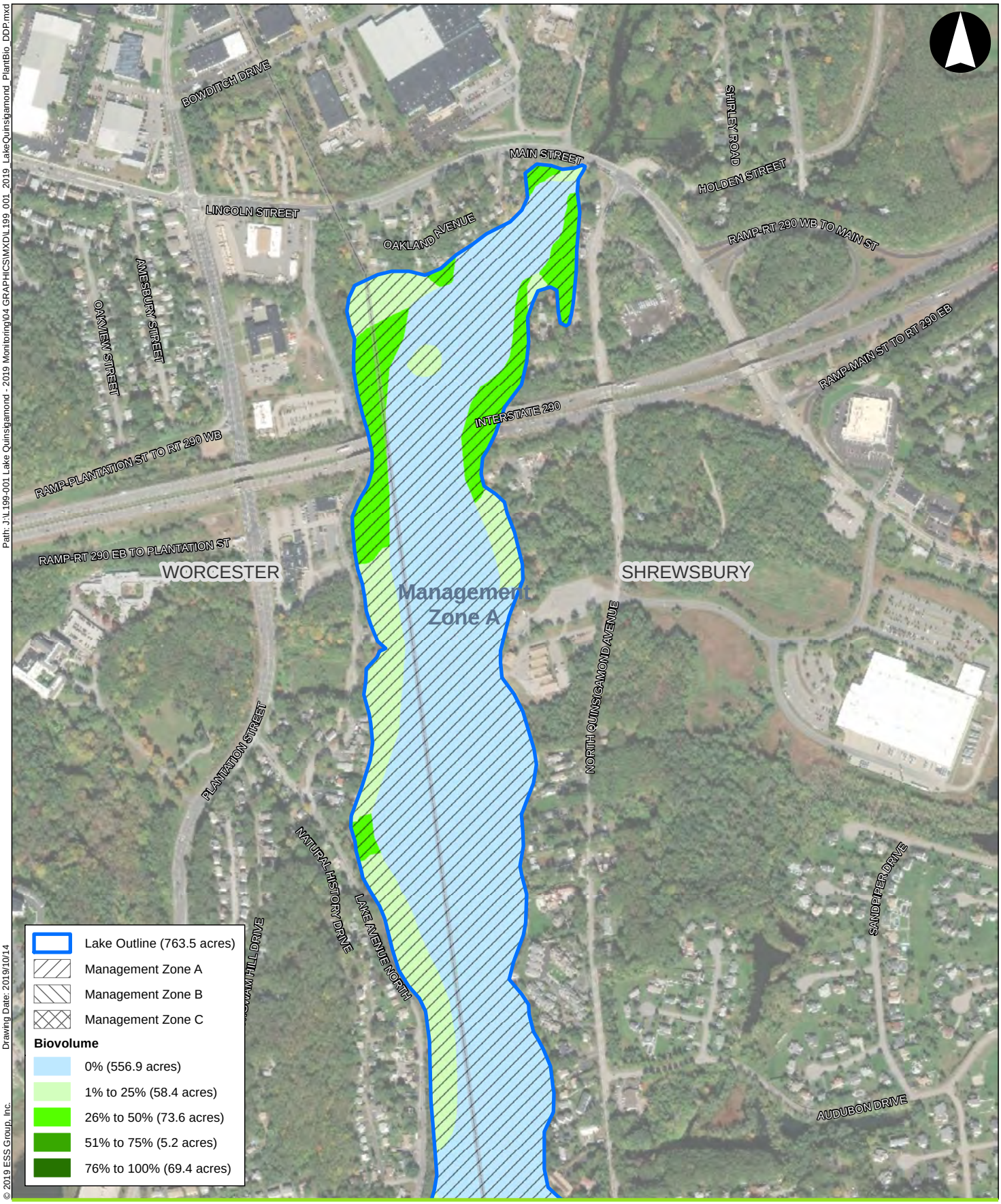

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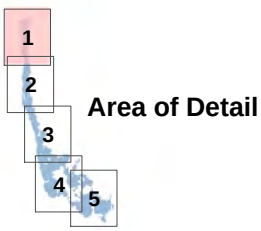
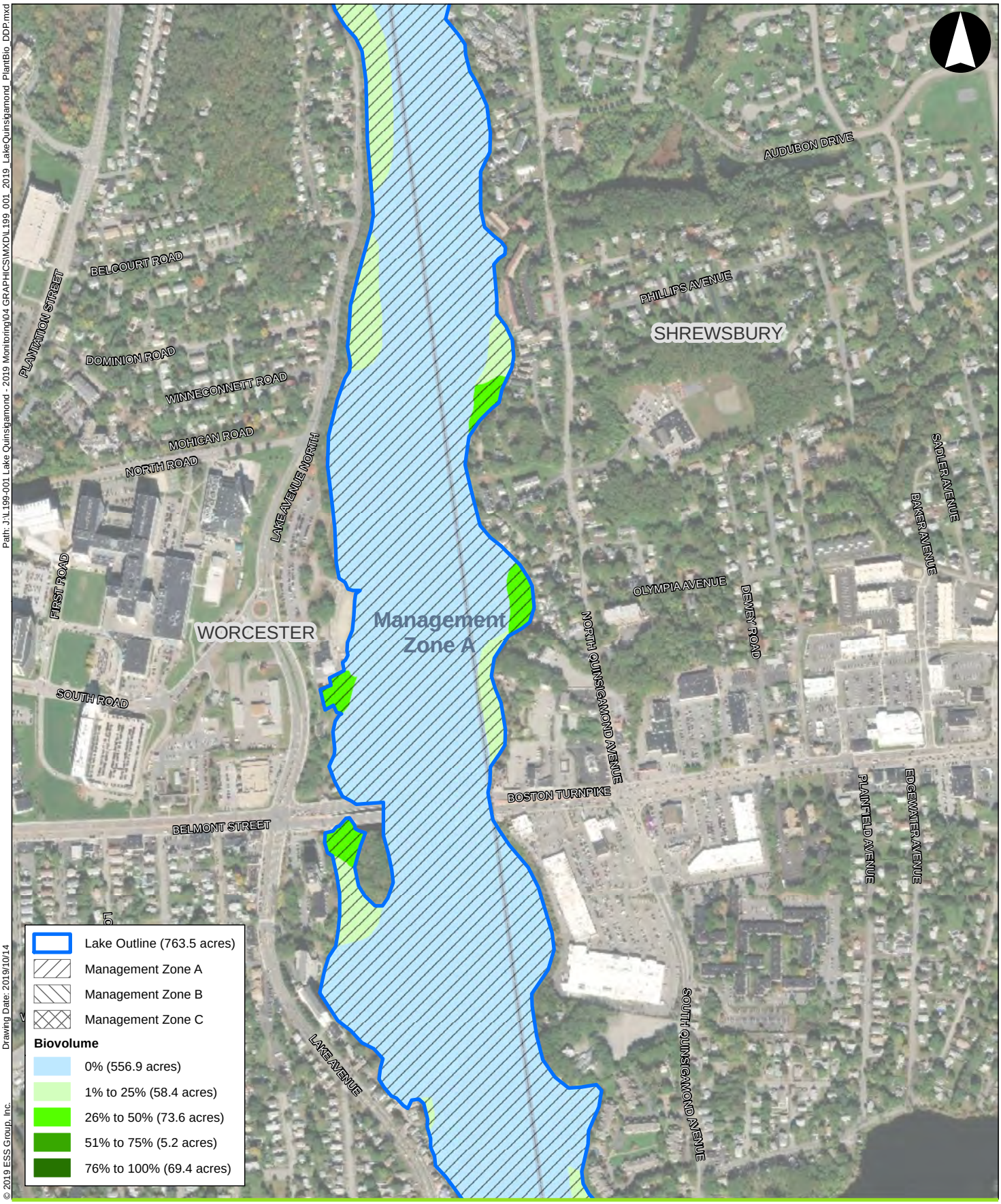


Area of Detail

Plant Biovolume
October 8th & 9th, 2019

Figure 2



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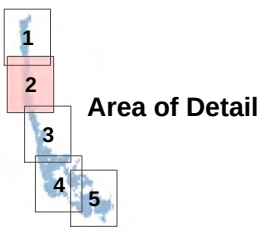

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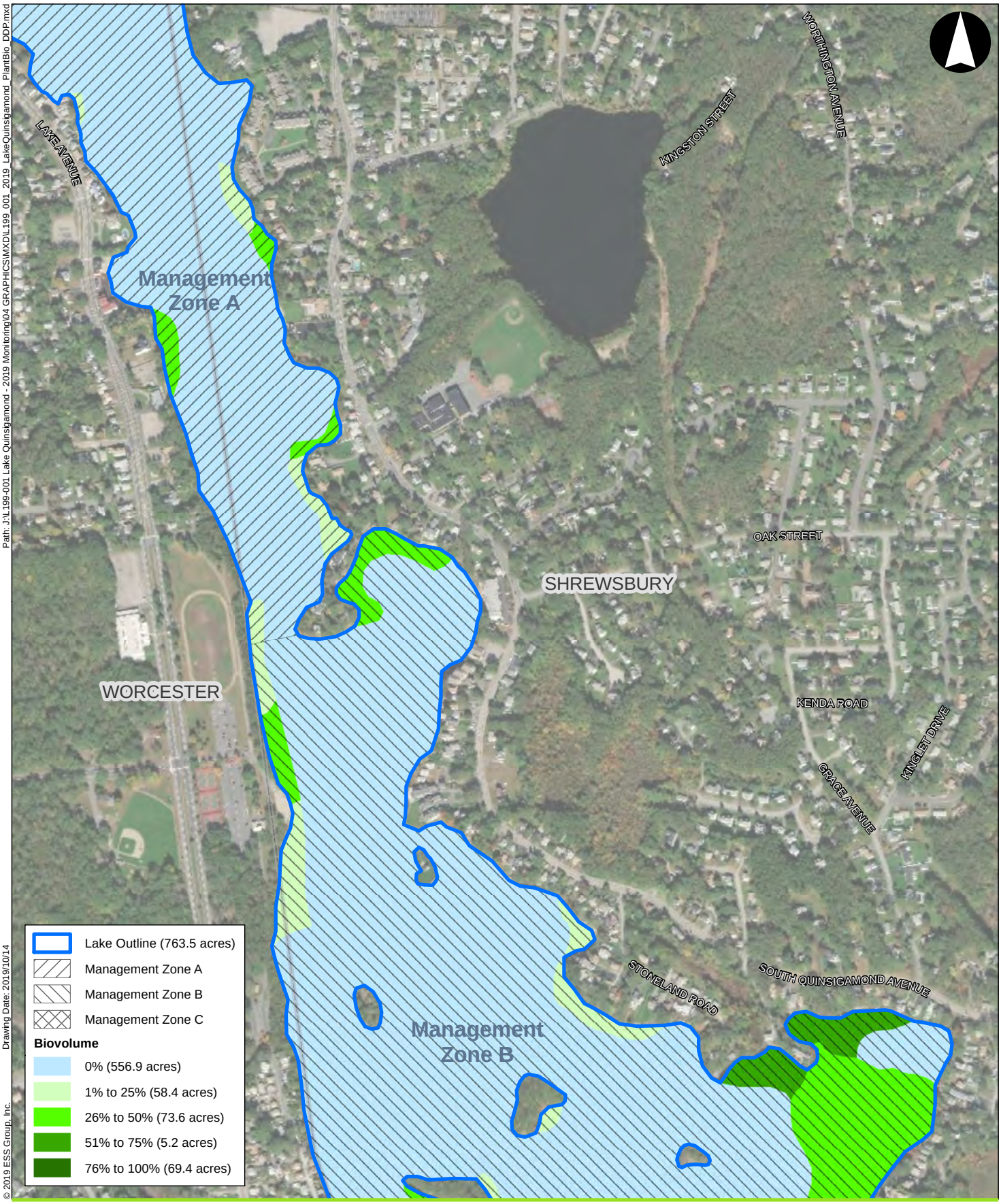

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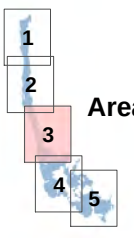

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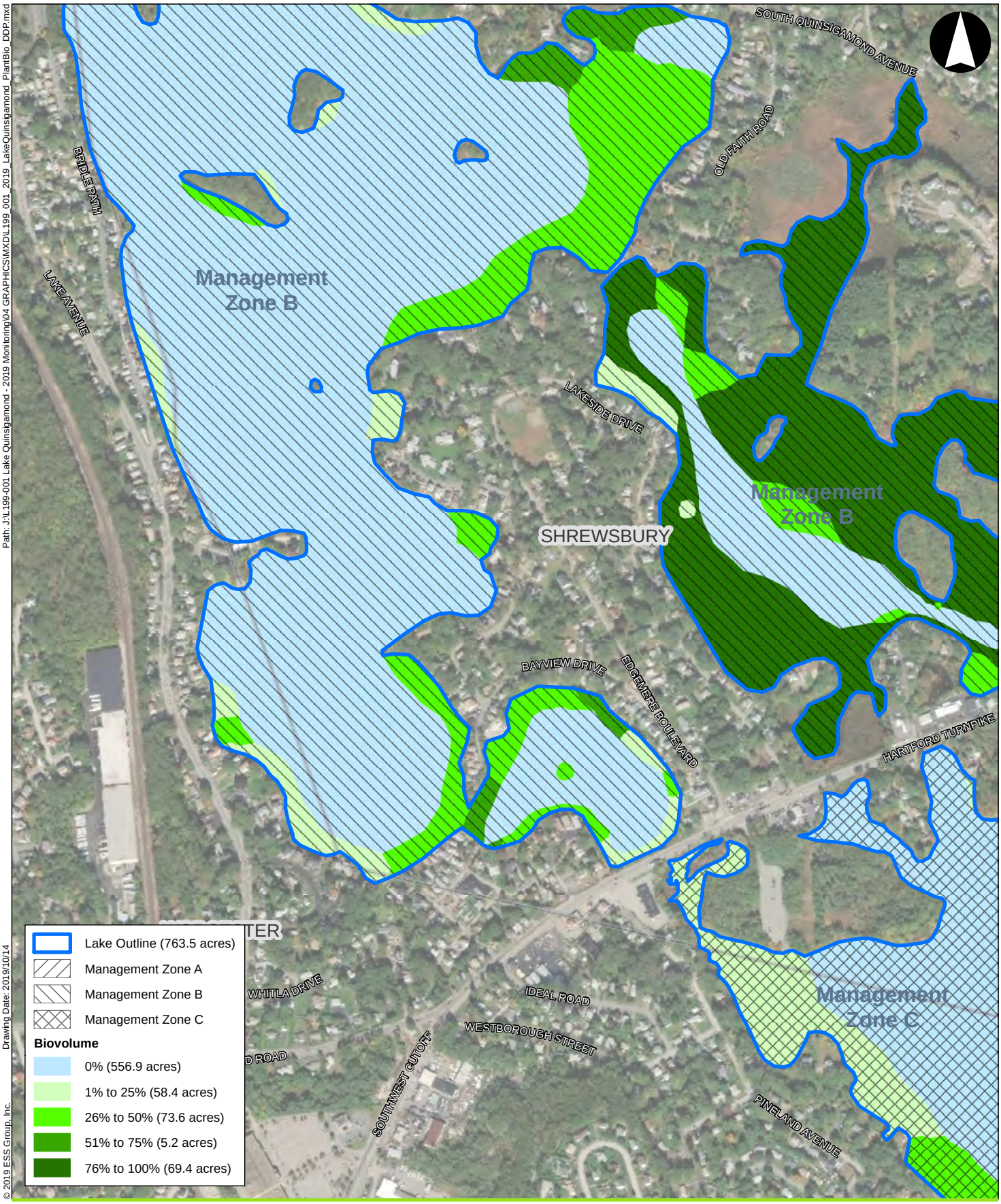

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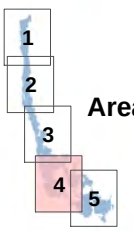

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Plant Biovolume
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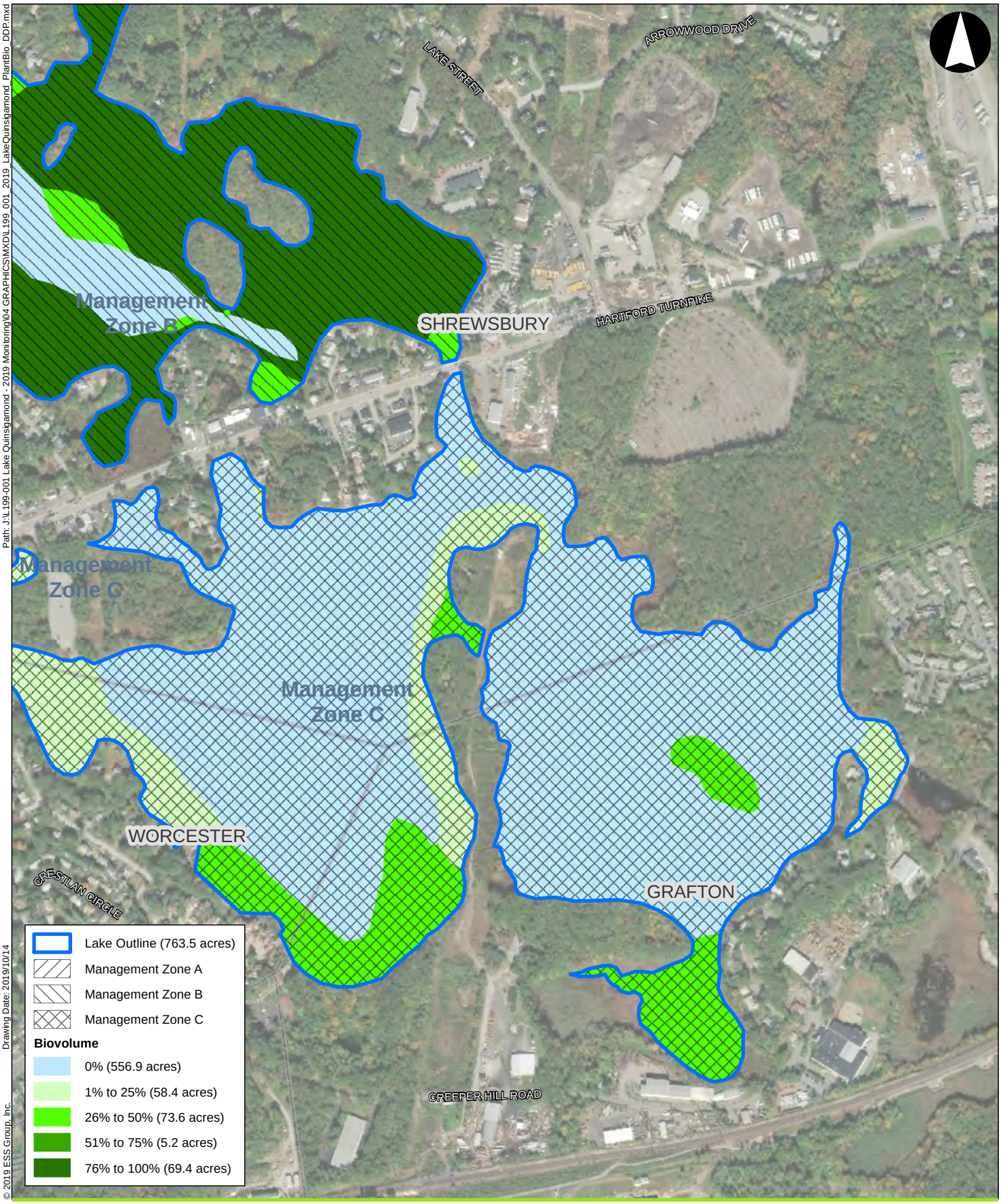

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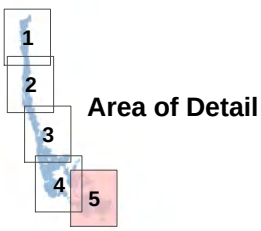

Area of Detail

Plant Biovolume
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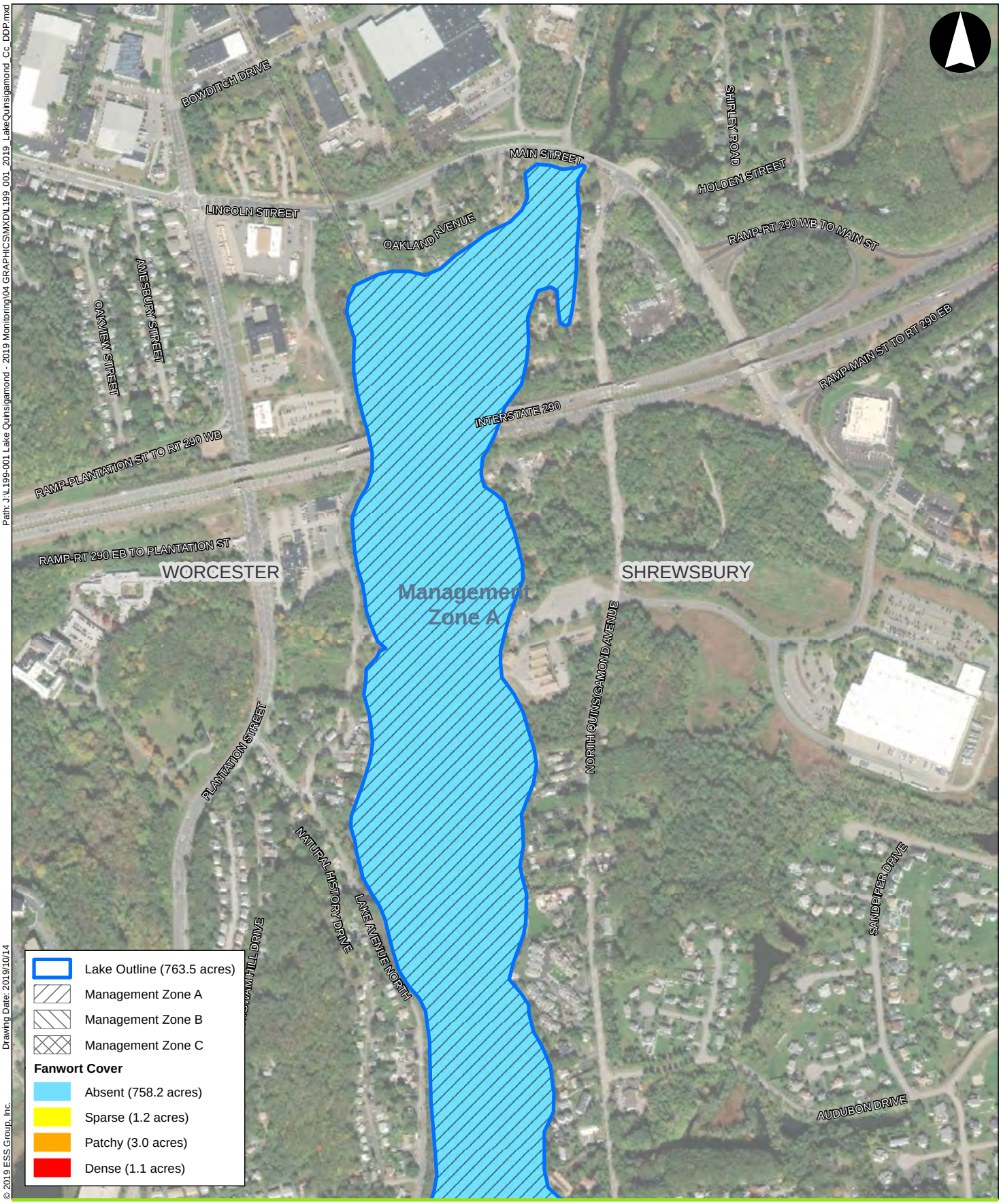

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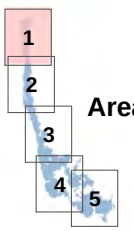

Area of Detail

Fanwort Cover
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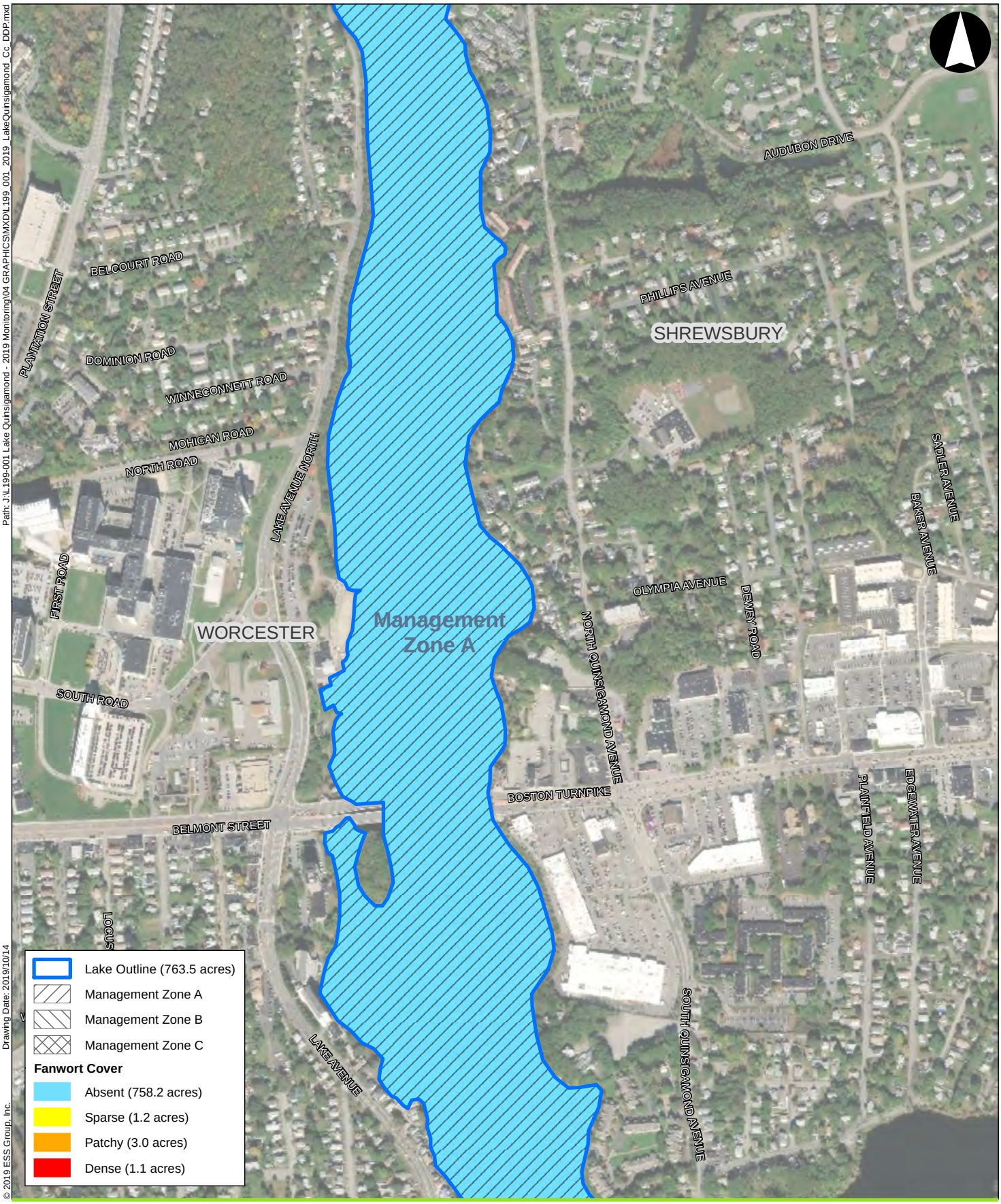
Figure 3



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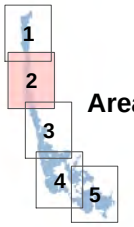
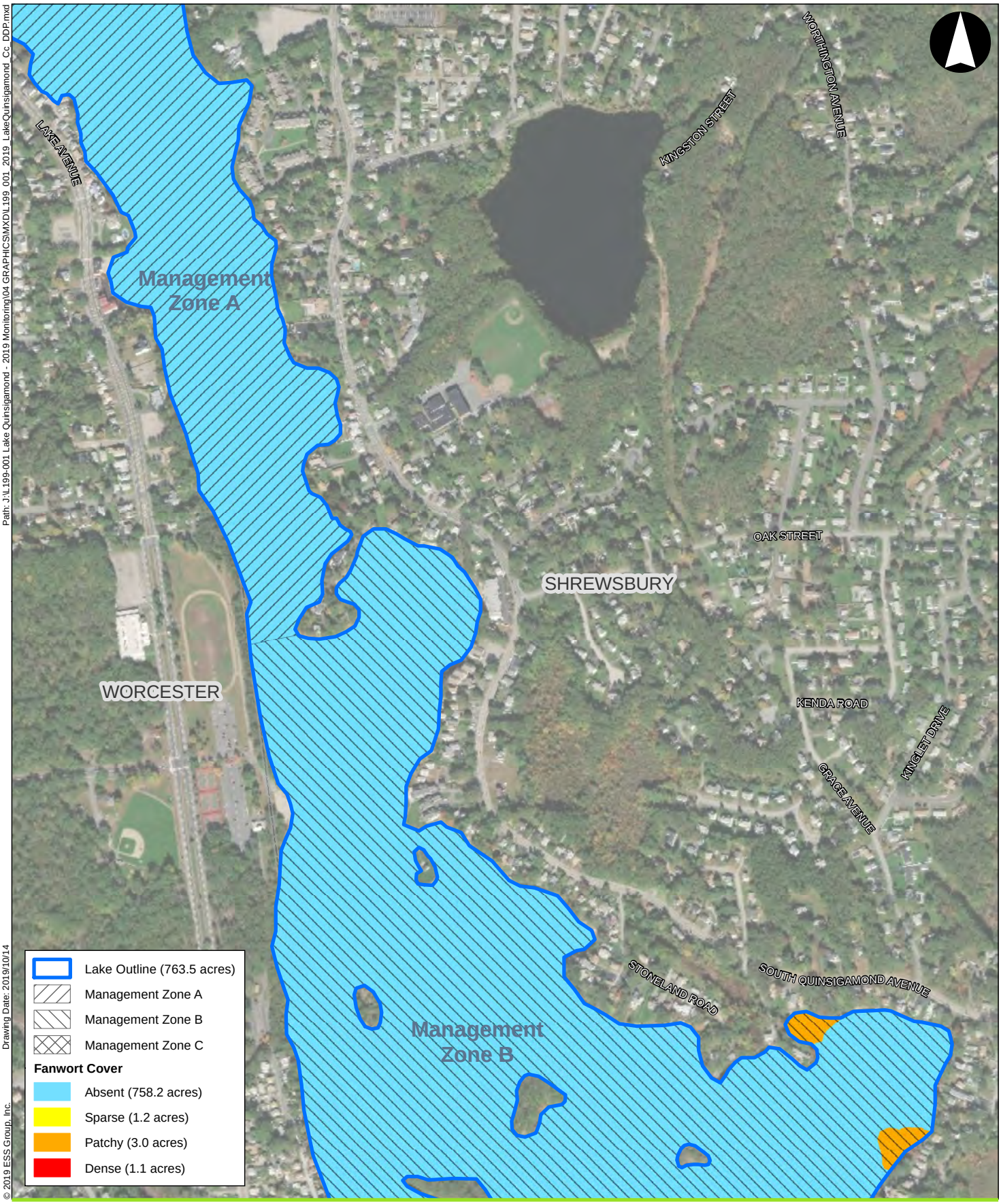


Area of Detail

Fanwort Cover
October 8th & 9th, 2019

Figure 3



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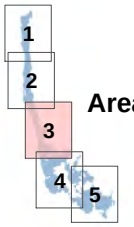
0 350 700 Feet

Lake Quinsigamond Monitoring

Shrewsbury, Worcester & Grafton, Massachusetts

1 inch = 700 feet

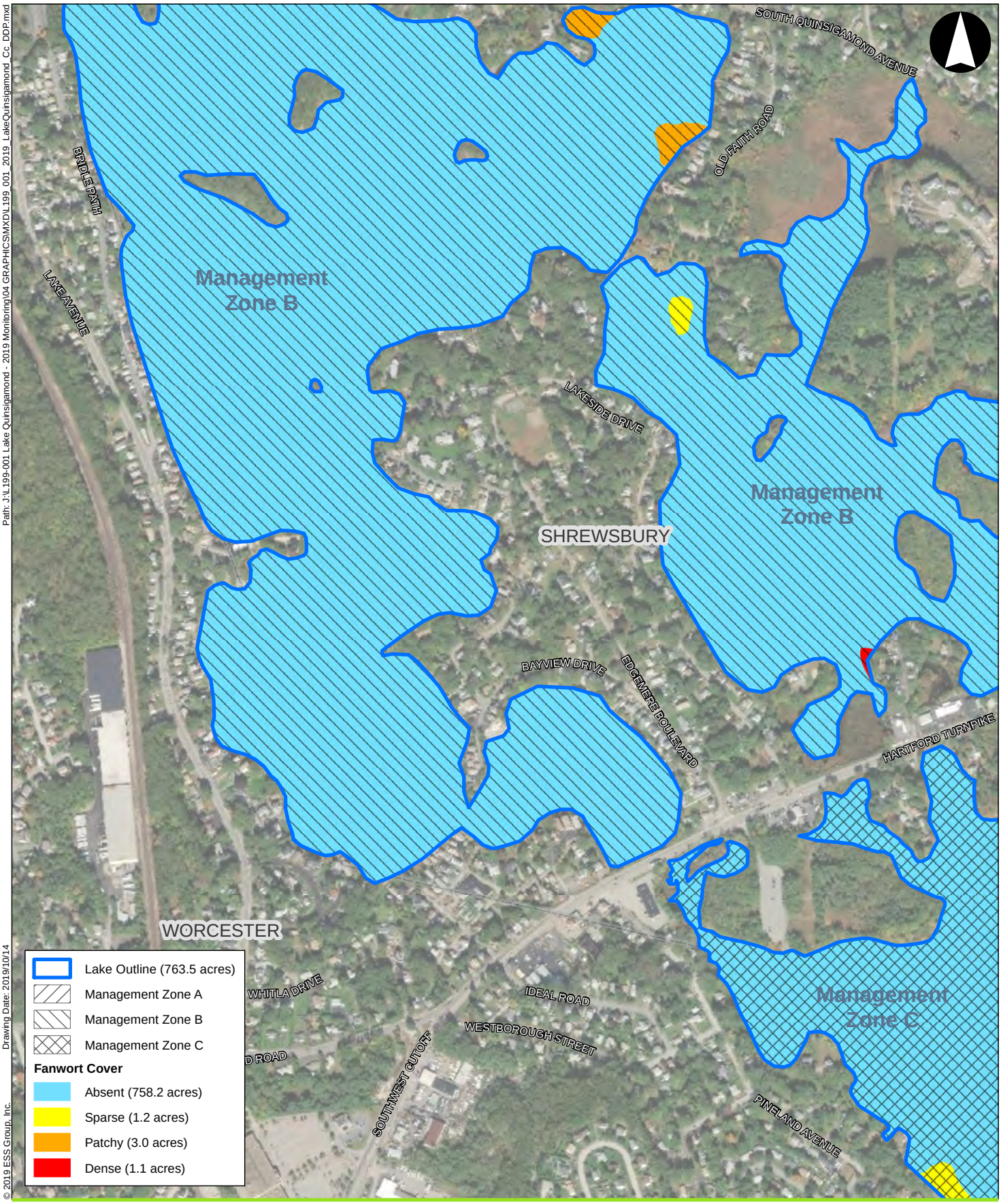
Source: 1) ESRI, World Imagery, 2018
2) ESS, Field Survey, October 2019



Area of Detail

Fanwort Cover
October 8th & 9th, 2019

Figure 3



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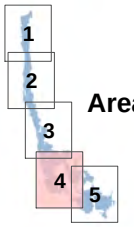
0 350 700 Feet

Lake Quinsigamond Monitoring

Shrewsbury, Worcester & Grafton, Massachusetts

1 inch = 700 feet

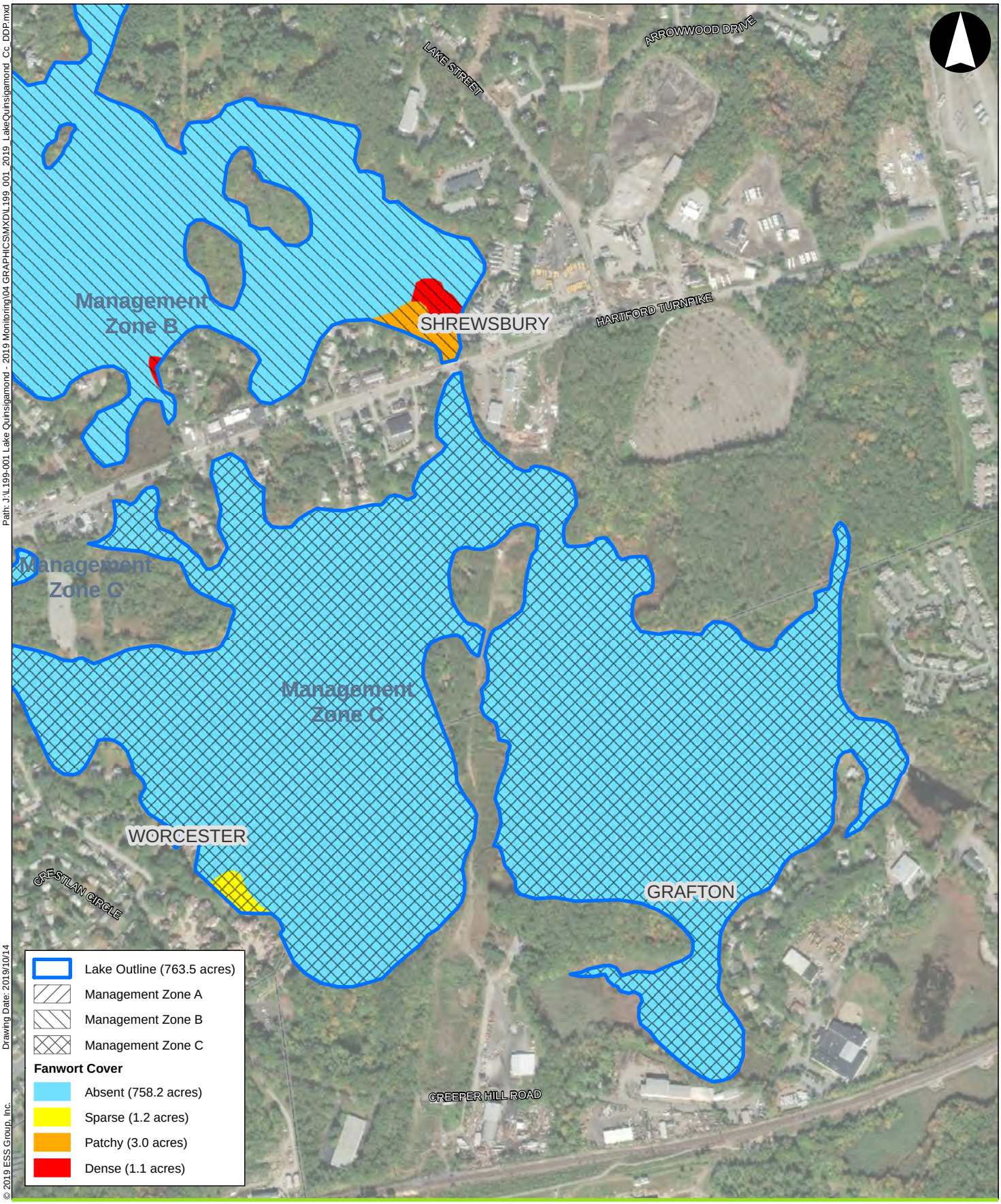
Source: 1) ESRI, World Imagery, 2018
2) ESS, Field Survey, October 2019



Area of Detail

Fanwort Cover
October 8th & 9th, 2019

Figure 3



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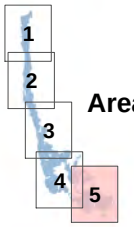
Lake Quinsigamond Monitoring

Shrewsbury, Worcester & Grafton, Massachusetts

1 inch = 700 feet

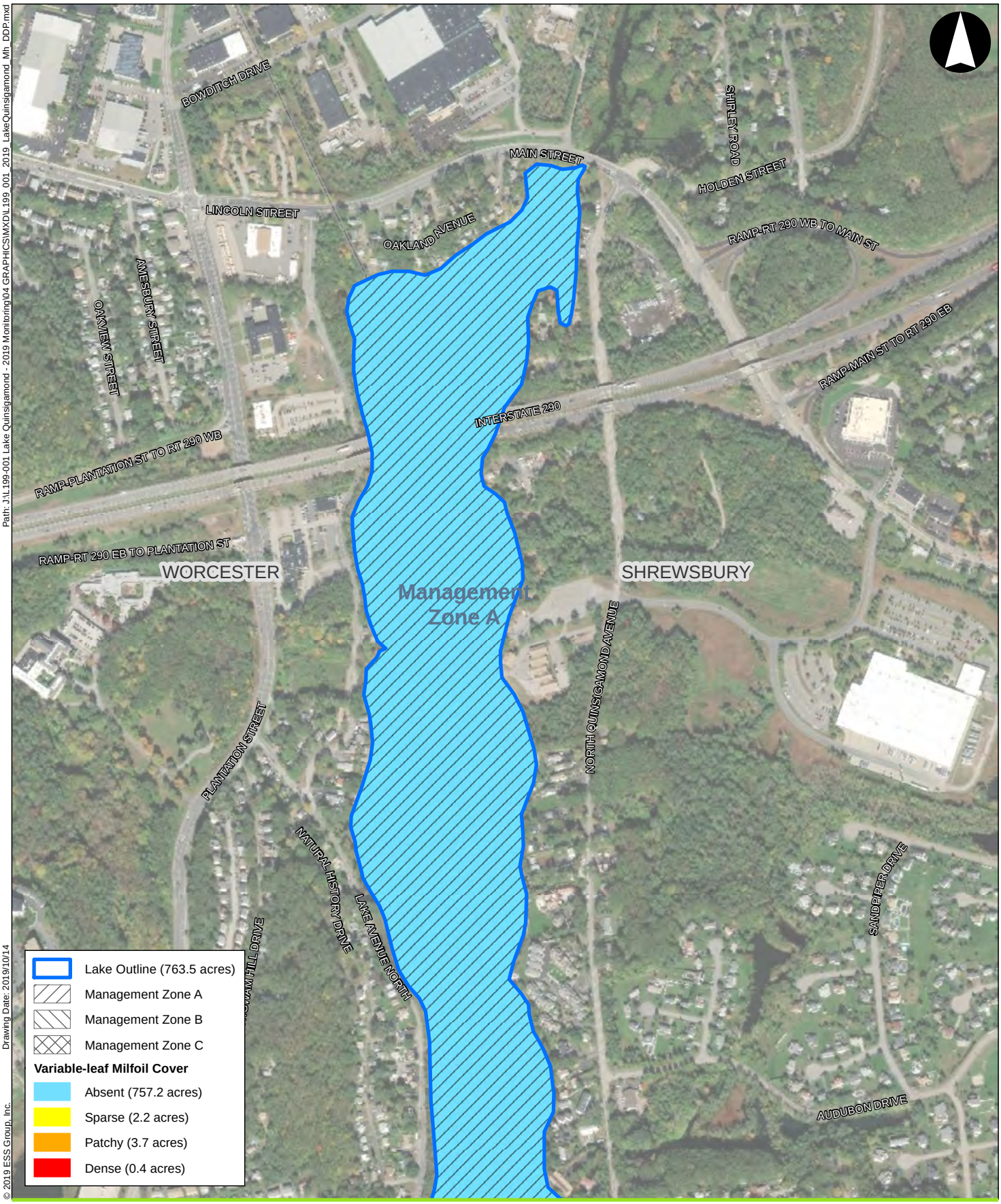
Source: 1) ESRI, World Imagery, 2018
2) ESS, Field Survey, October 2019



Area of Detail

Fanwort Cover
October 8th & 9th, 2019

Figure 3



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0 350 700 Feet

Lake Quinsigamond Monitoring

Shrewsbury, Worcester & Grafton, Massachusetts

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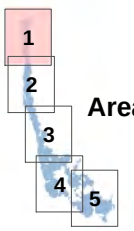
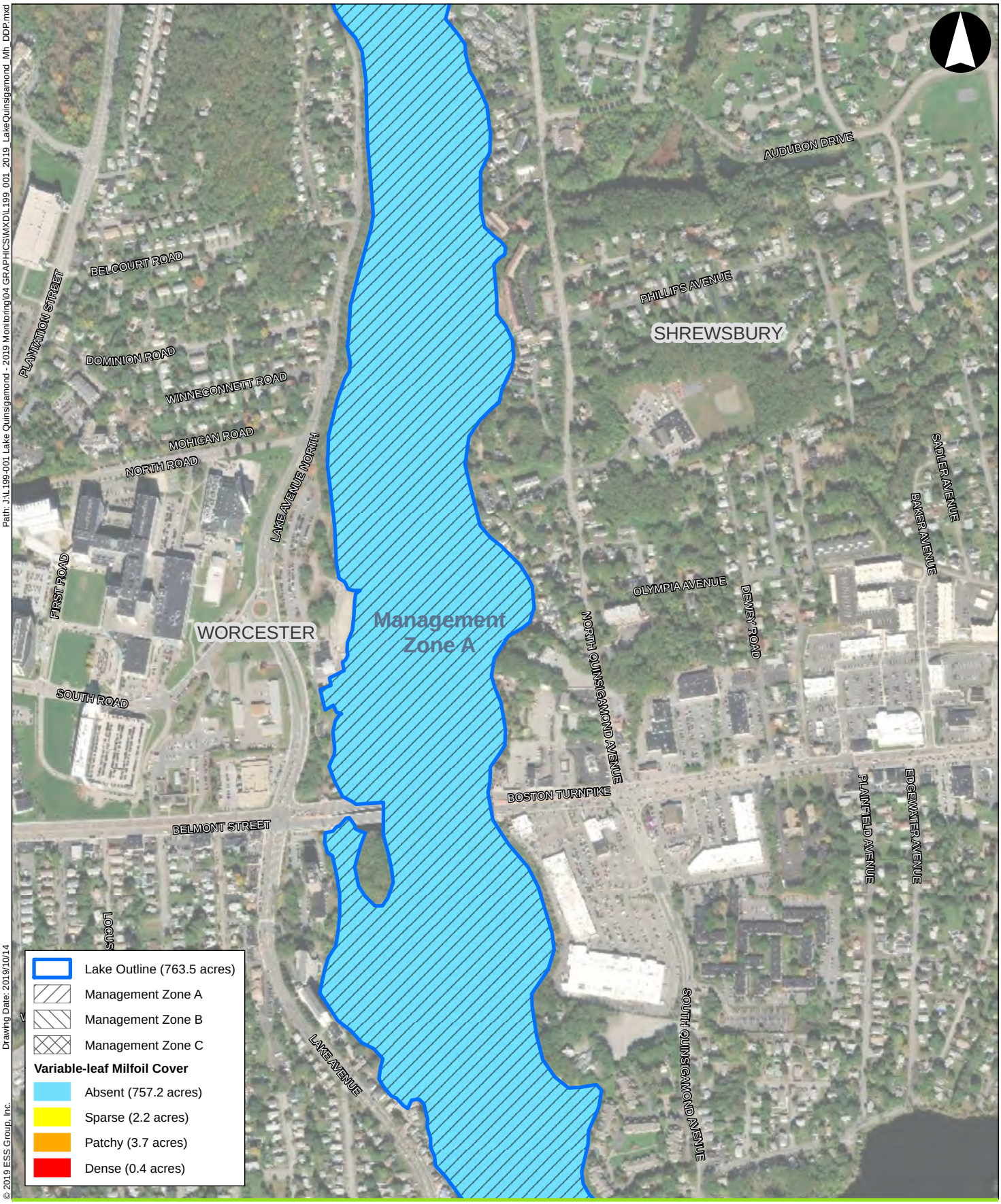


Area of Detail

Variable-leaf Milfoil Cover
October 8th & 9th, 2019

Figure 4



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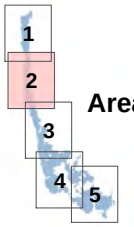
0 350 700 Feet

Lake Quinsigamond Monitoring

Shrewsbury, Worcester & Grafton, Massachusetts

1 inch = 700 feet

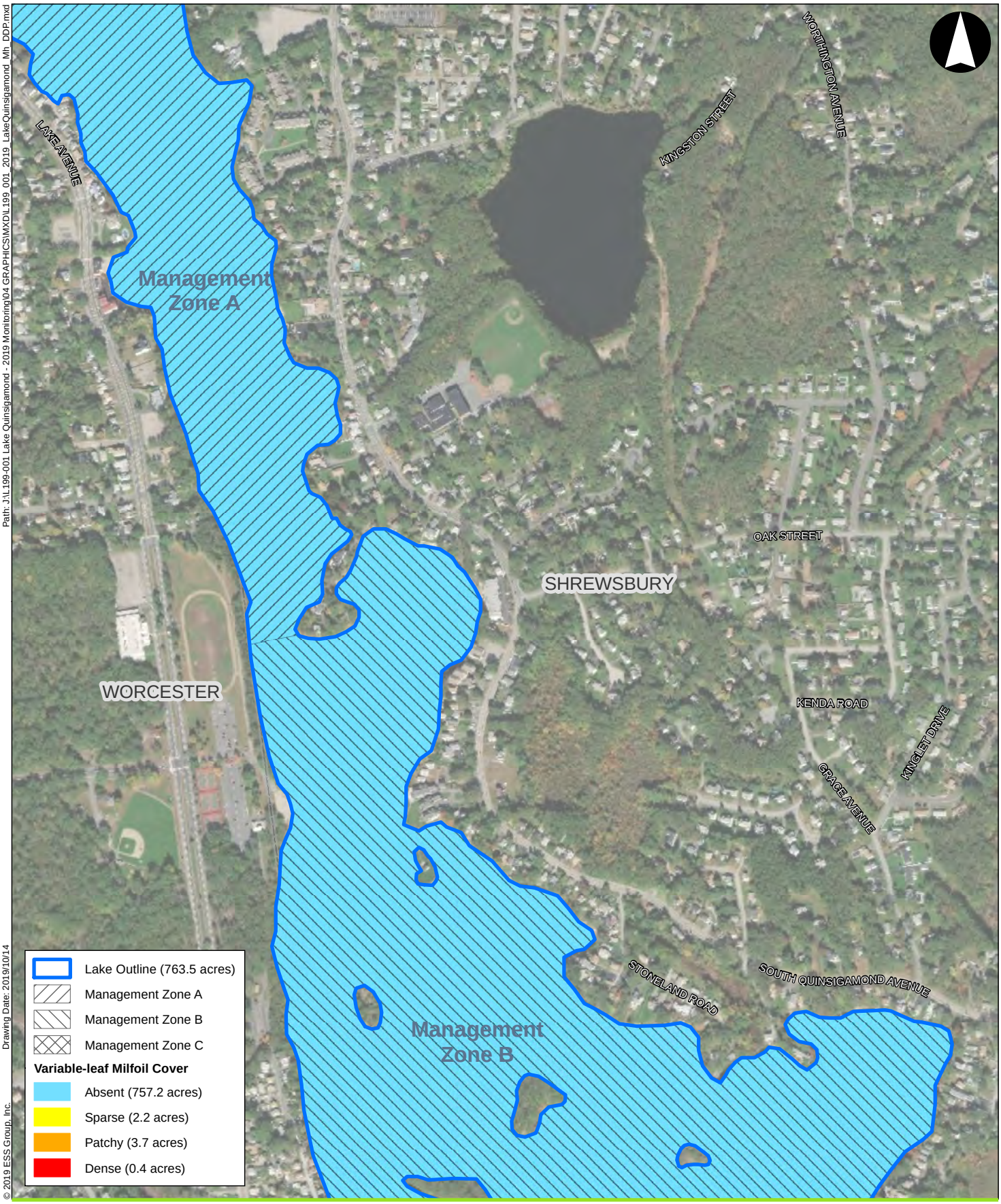
Source: 1) ESRI, World Imagery, 2018
2) ESS, Field Survey, October 2019



Area of Detail

Variable-leaf Milfoil Cover
October 8th & 9th, 2019

Figure 4



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Lake Quinsigamond Monitoring

Shrewsbury, Worcester & Grafton, Massachusetts

1 inch = 700 feet

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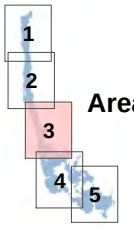
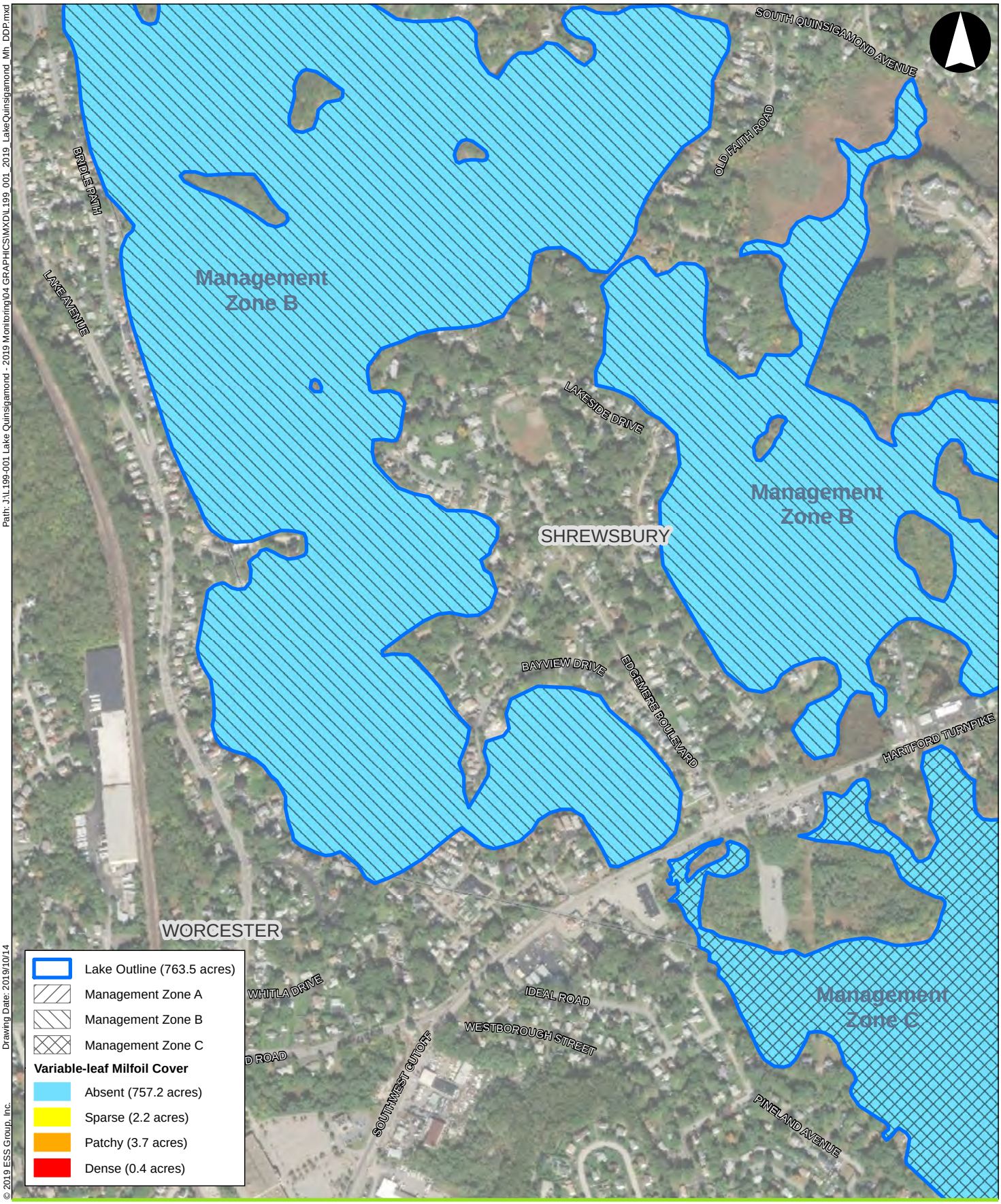
2) ESS, Field Survey, October 2019



Area of Detail

Variable-leaf Milfoil Cover
October 8th & 9th, 2019

Figure 4



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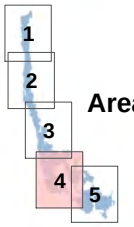
0 350 700 Feet

Lake Quinsigamond Monitoring

Shrewsbury, Worcester & Grafton, Massachusetts

1 inch = 700 feet

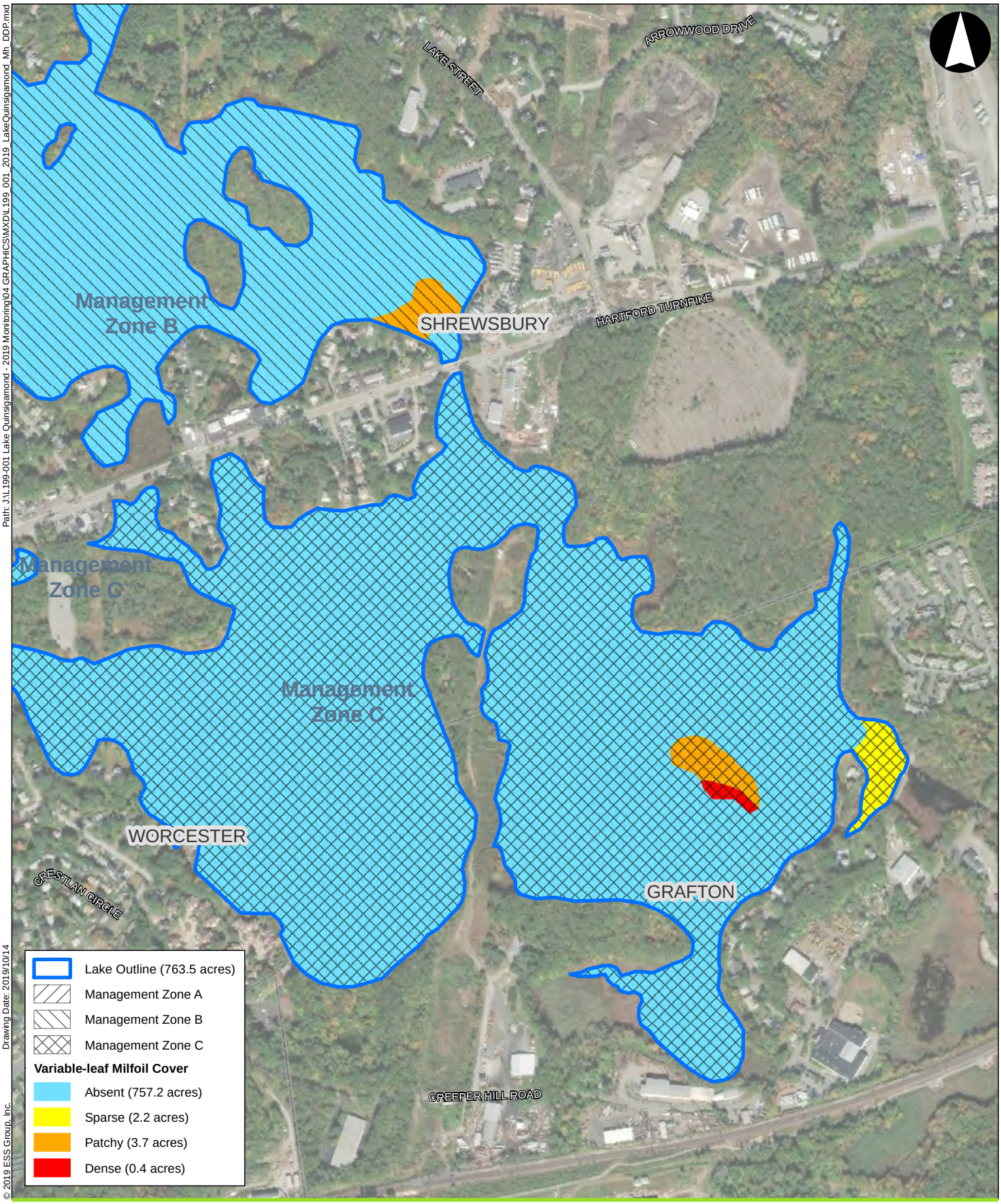
Source: 1) ESRI, World Imagery, 2018
2) ESS, Field Survey, October 2019



Area of Detail

Variable-leaf Milfoil Cover
October 8th & 9th, 2019

Figure 4



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Lake Quinsigamond Monitoring

Shrewsbury, Worcester & Grafton, Massachusetts

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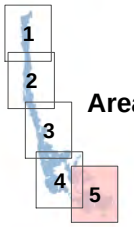
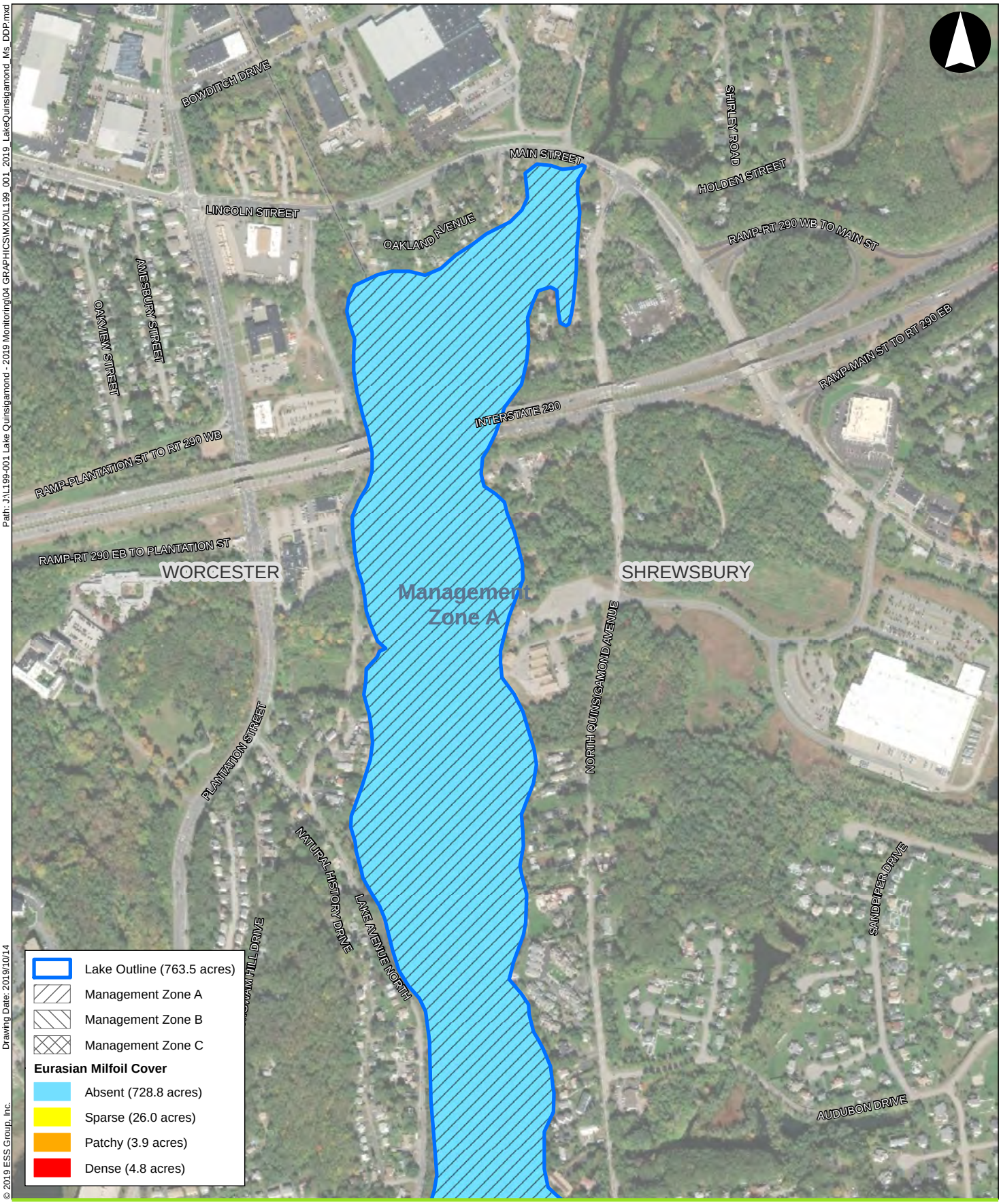


Area of Detail

Variable-leaf Milfoil Cover
October 8th & 9th, 2019

Figure 4



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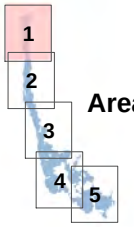
Lake Quinsigamond Monitoring

Shrewsbury, Worcester & Grafton, Massachusetts

1 inch = 700 feet

Source: 1) ESRI, World Imagery, 2018
2) ESS, Field Survey, October 2019

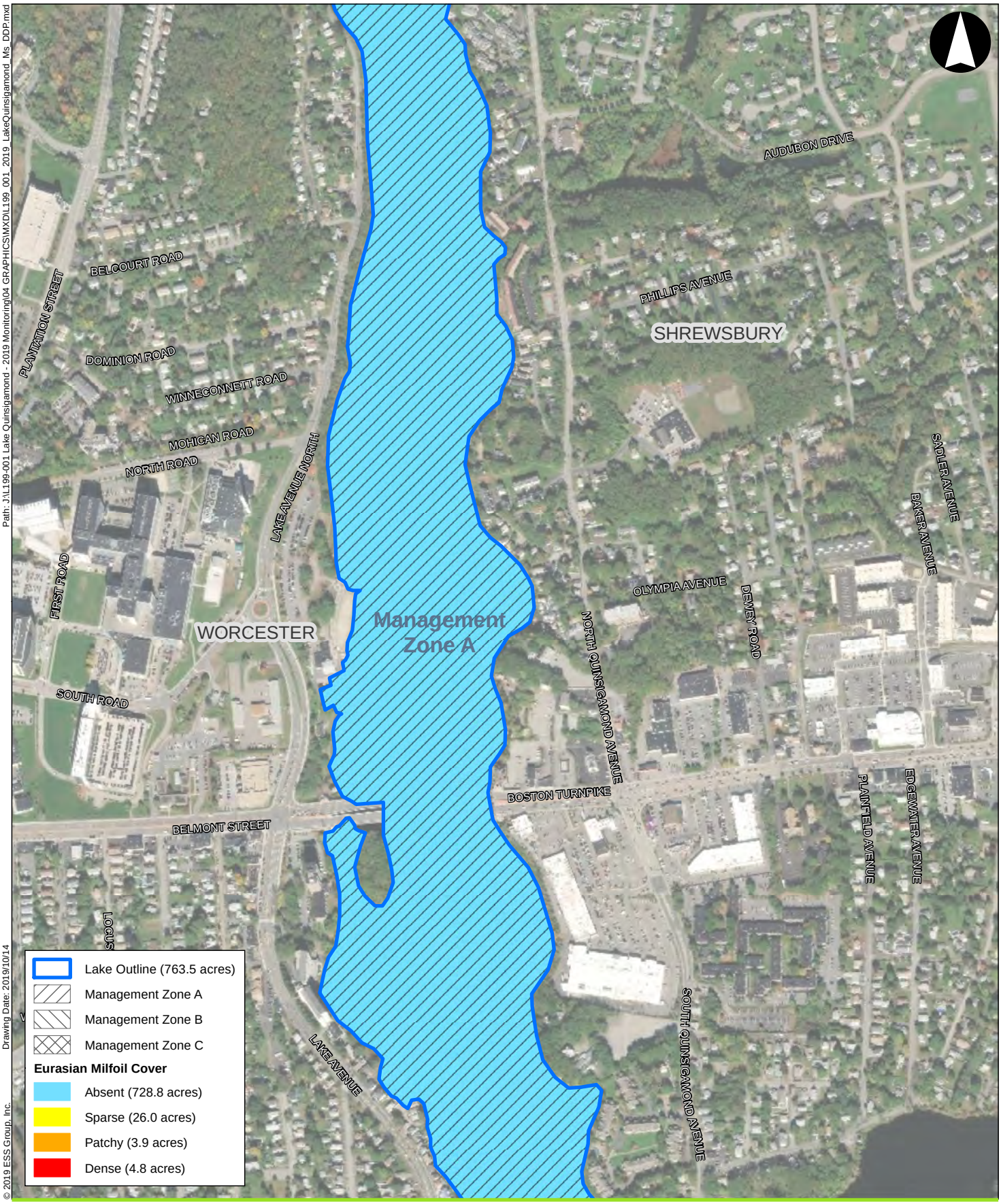
0 350 700 Feet



Area of Detail

Eurasian Milfoil Cover
October 8th & 9th, 2019

Figure 5



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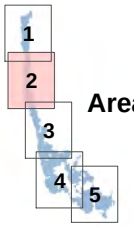
0 350 700 Feet

Lake Quinsigamond Monitoring

Shrewsbury, Worcester & Grafton, Massachusetts

1 inch = 700 feet

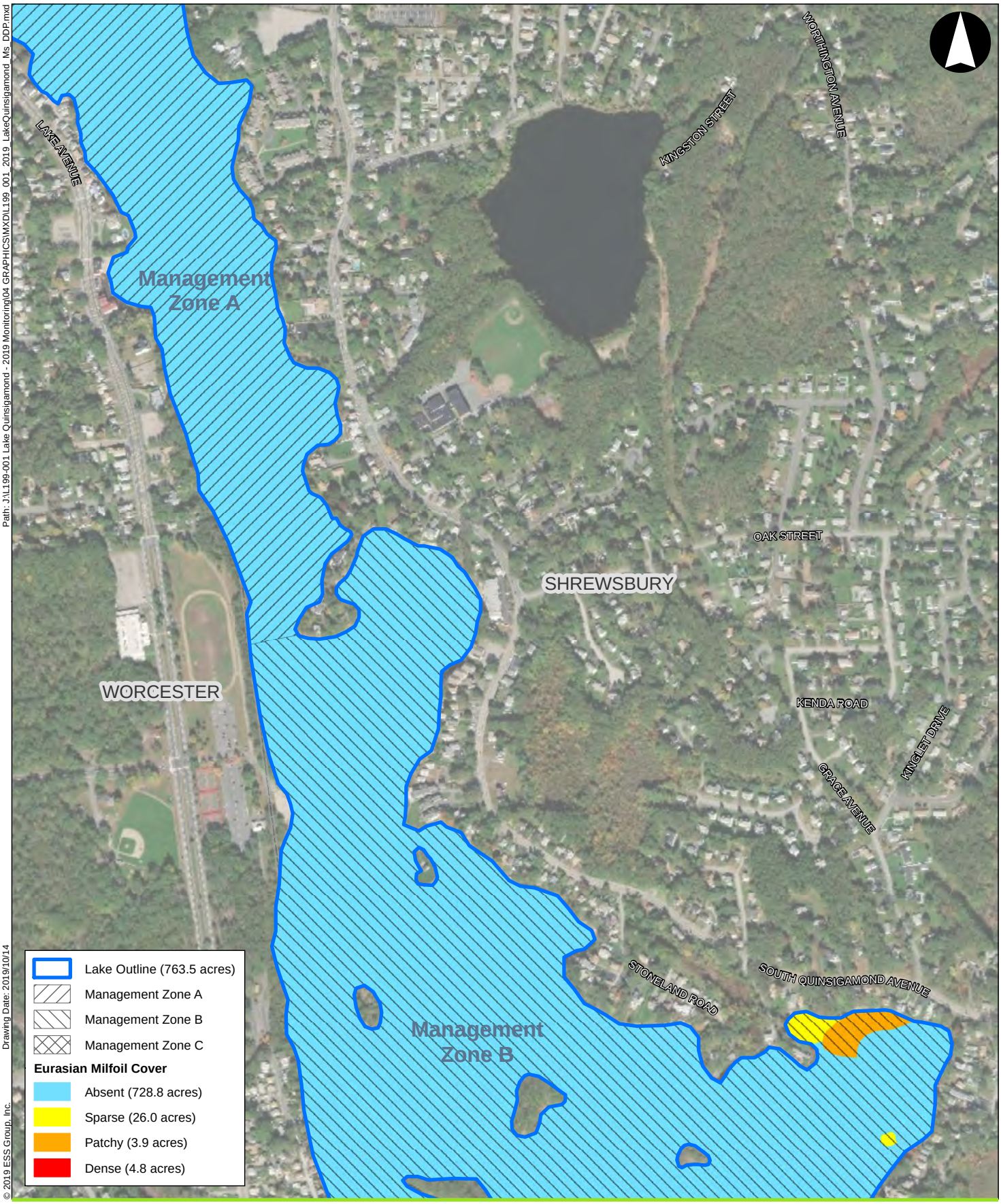
Source: 1) ESRI, World Imagery, 2018
2) ESS, Field Survey, October 2019



Area of Detail

Eurasian Milfoil Cover
October 8th & 9th, 2019

Figure 5



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0 350 700 Feet

Lake Quinsigamond Monitoring

Shrewsbury, Worcester & Grafton, Massachusetts

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Source: 1) ESRI, World Imagery, 2018
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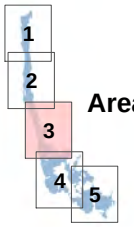
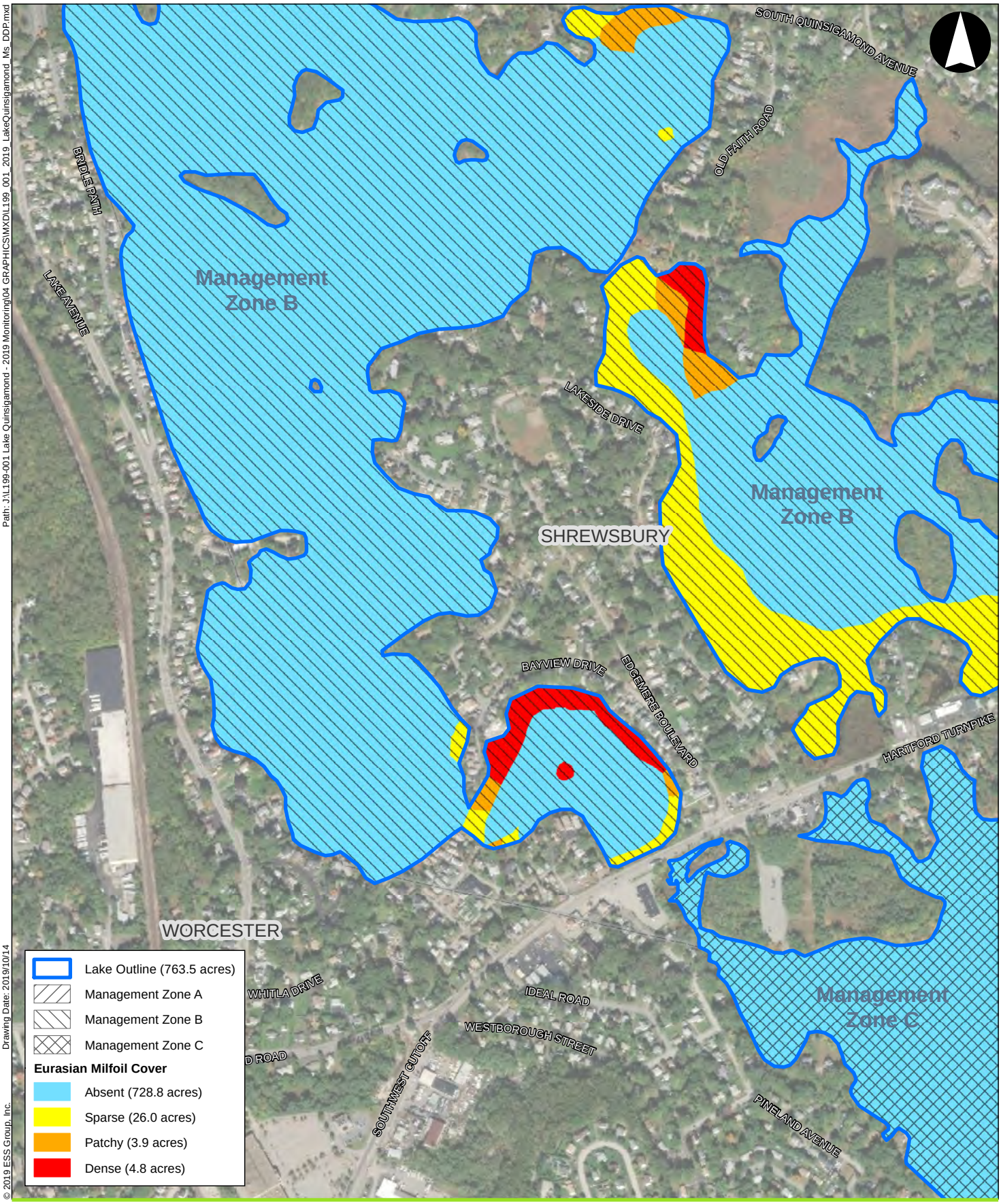


Area of Detail

Eurasian Milfoil Cover
October 8th & 9th, 2019

Figure 5



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Lake Quinsigamond Monitoring

Shrewsbury, Worcester & Grafton, Massachusetts

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Source: 1) ESRI, World Imagery, 2018
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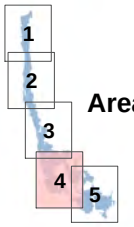
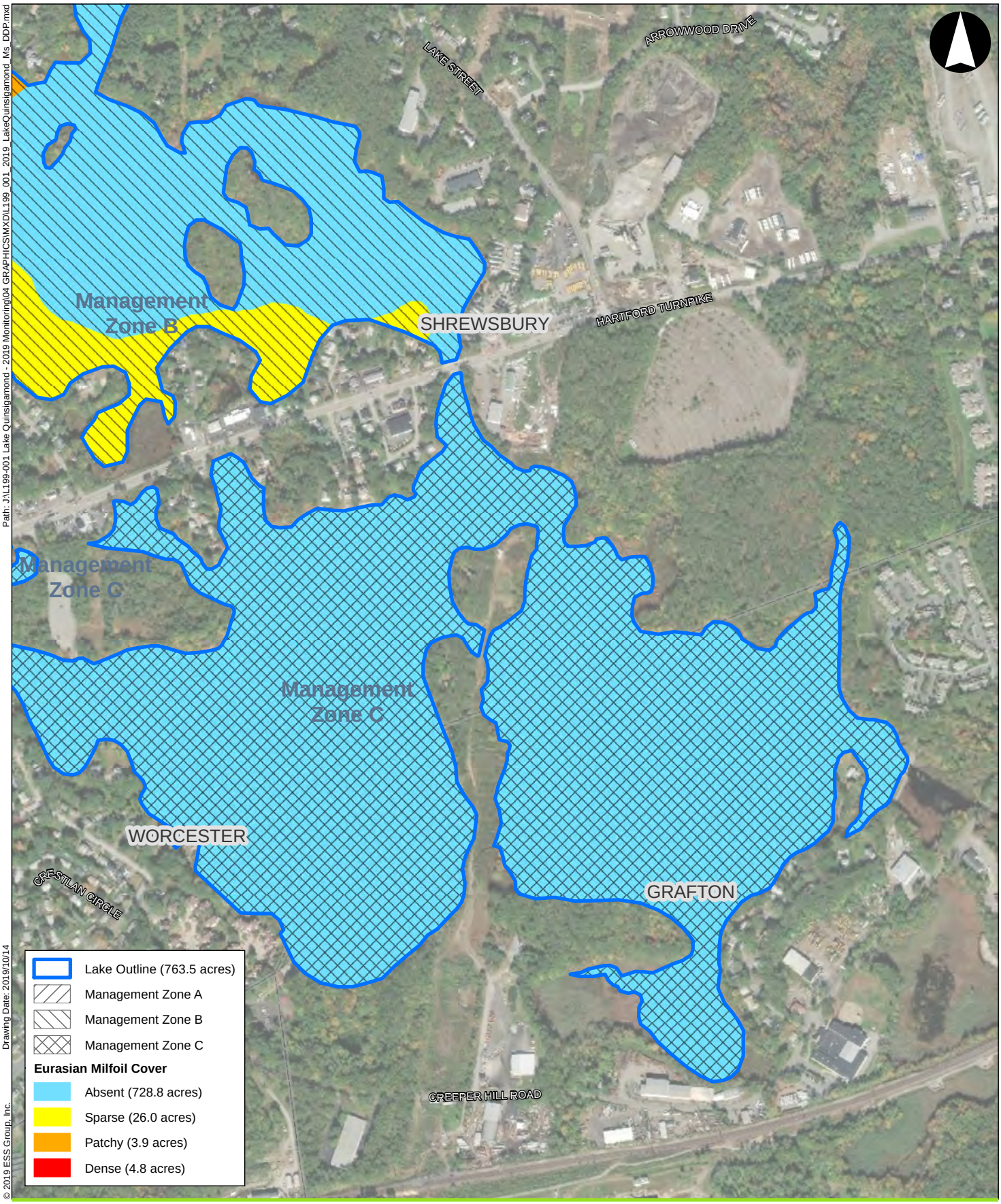


Area of Detail

Eurasian Milfoil Cover
October 8th & 9th, 2019

Figure 5



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Lake Quinsigamond Monitoring

Shrewsbury, Worcester & Grafton, Massachusetts

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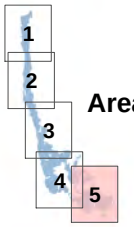
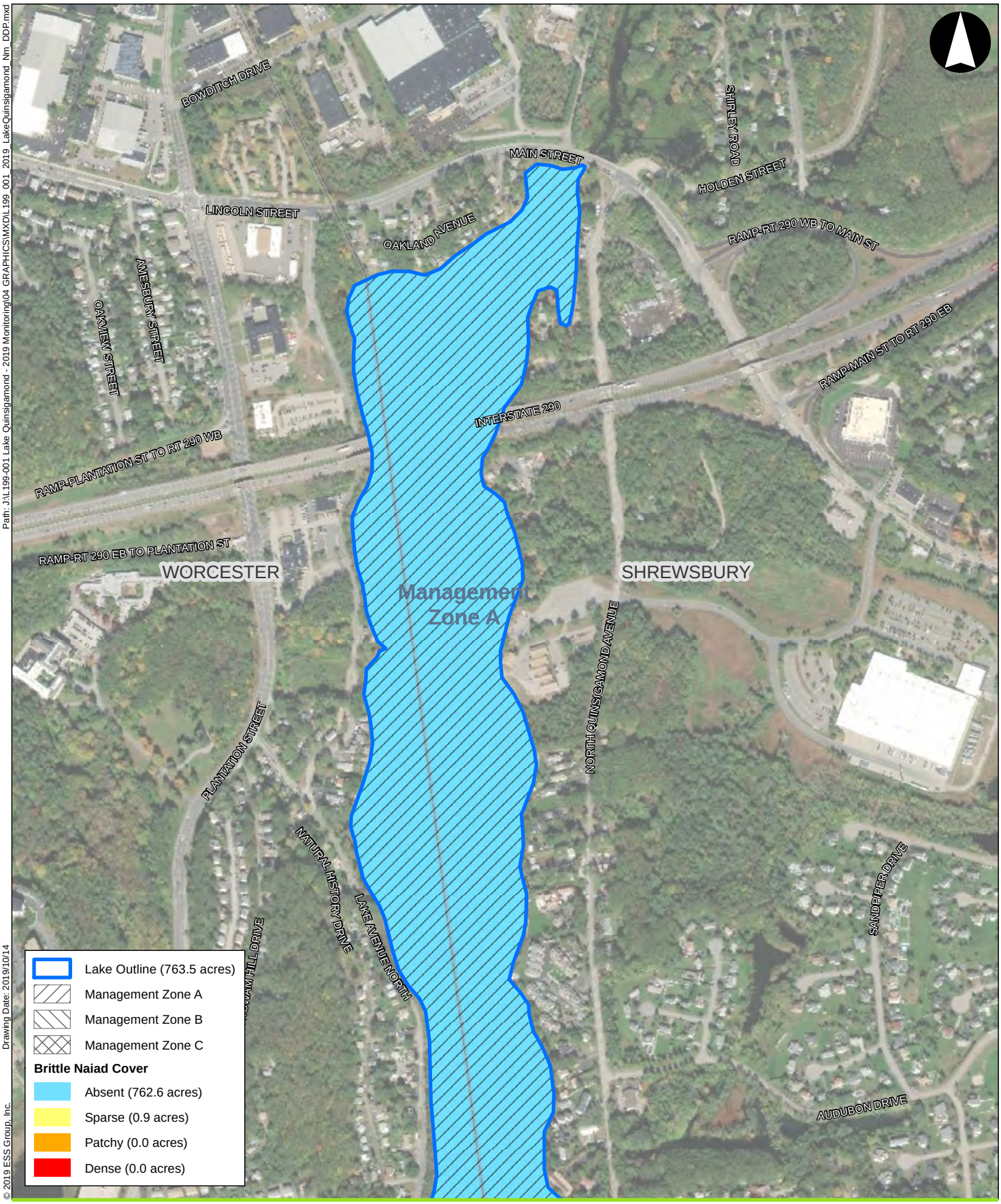


Area of Detail

Eurasian Milfoil Cover
October 8th & 9th, 2019

Figure 5



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0 350 700 Feet

Lake Quinsigamond Monitoring

Shrewsbury, Worcester & Grafton, Massachusetts

1 inch = 700 feet

Source: 1) ESRI, World Imagery, 2018
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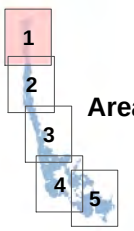
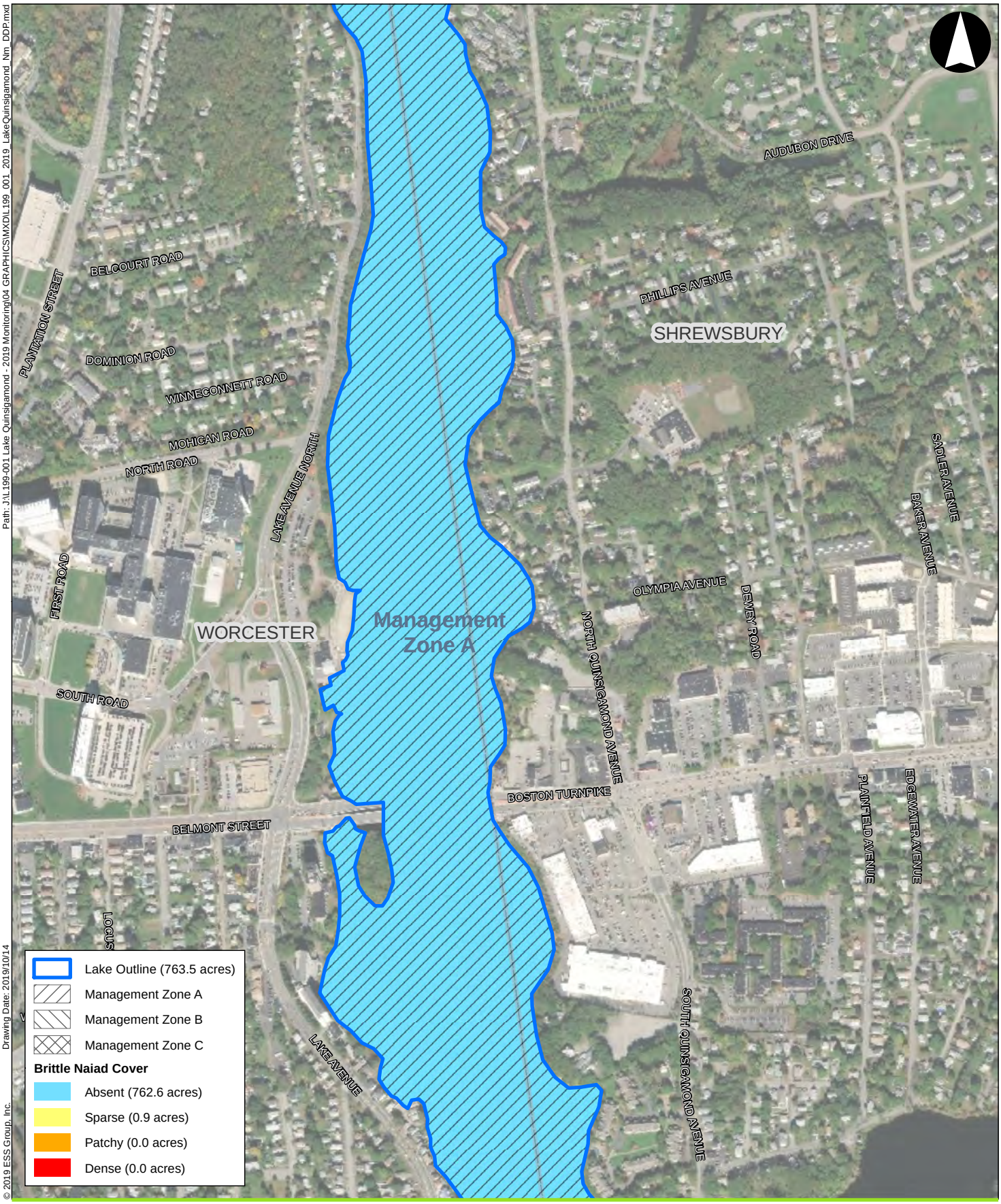


Area of Detail

Brittle Naiad Cover
October 8th & 9th, 2019

Figure 6



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0 350 700 Feet

Lake Quinsigamond Monitoring

Shrewsbury, Worcester & Grafton, Massachusetts

1 inch = 700 feet

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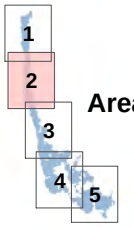
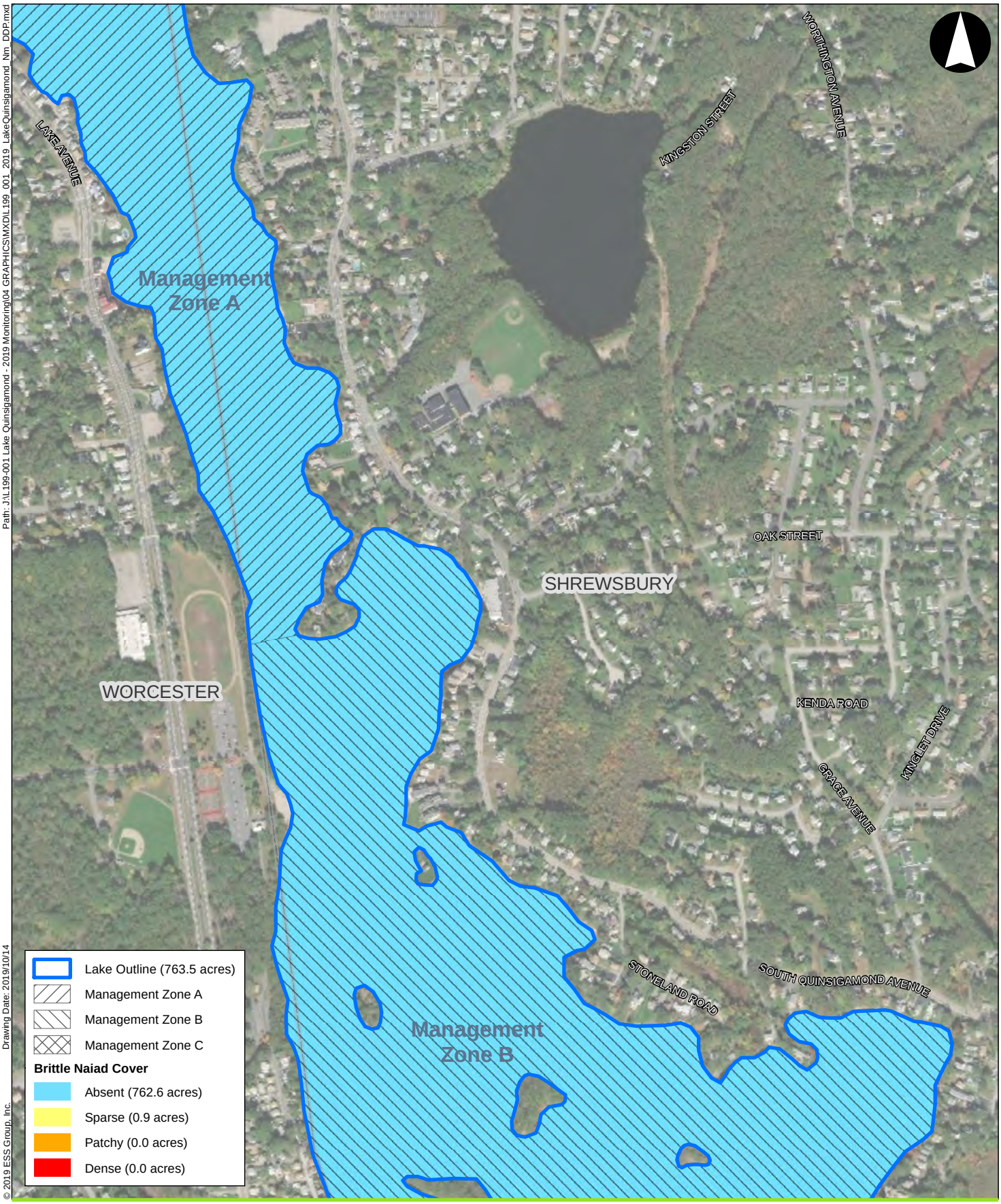


Area of Detail

Brittle Naiad Cover
October 8th & 9th, 2019

Figure 6



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Lake Quinsigamond Monitoring

Shrewsbury, Worcester & Grafton, Massachusetts

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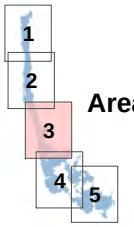
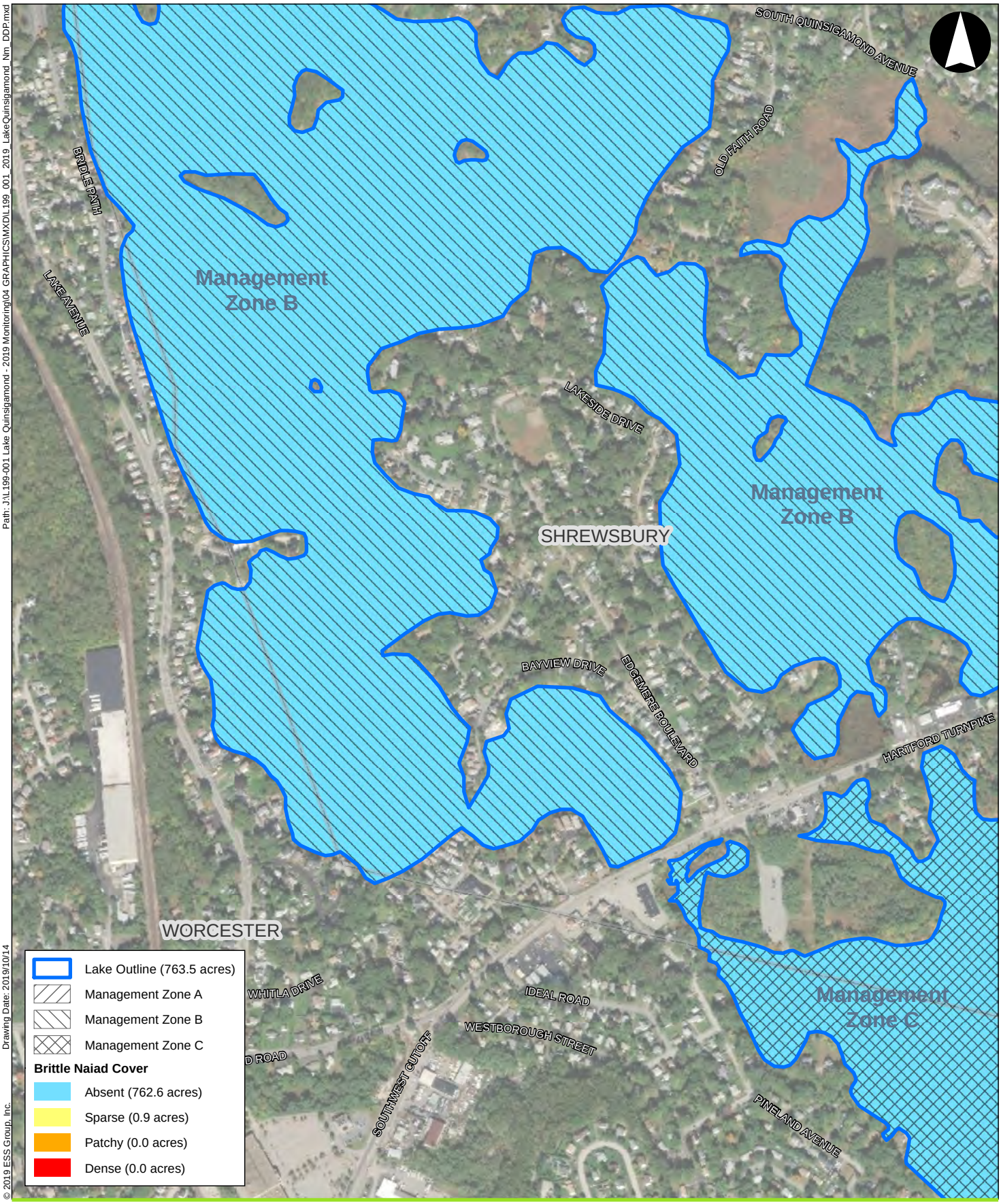


Area of Detail

Brittle Naiad Cover
October 8th & 9th, 2019

Figure 6



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Lake Quinsigamond Monitoring

Shrewsbury, Worcester & Grafton, Massachusetts

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Source: 1) ESRI, World Imagery, 2018
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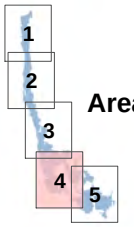
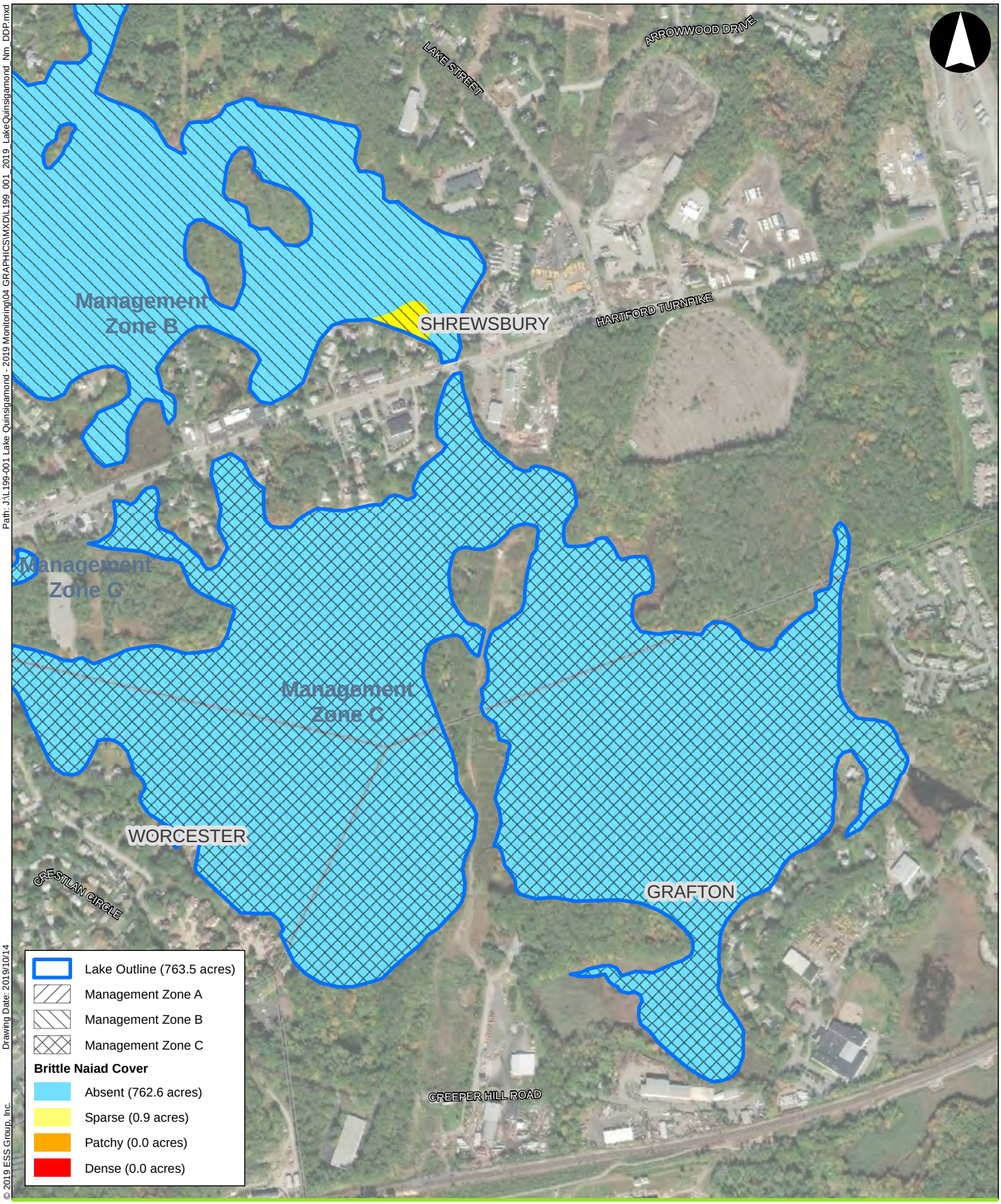


Area of Detail

Brittle Naiad Cover
October 8th & 9th, 2019

Figure 6



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Shrewsbury, Worcester & Grafton, Massachusetts

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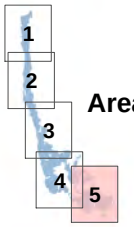
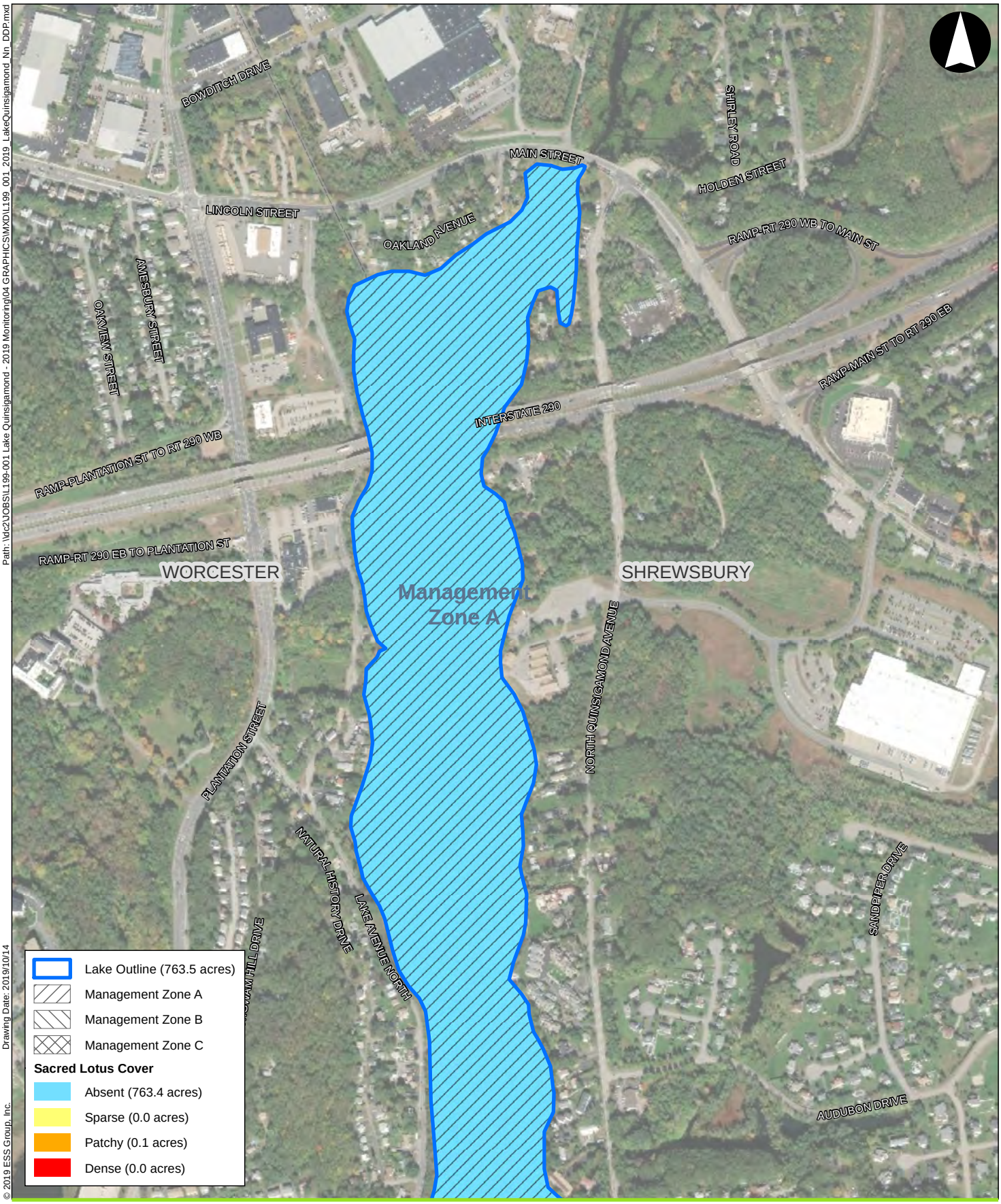


Area of Detail

Brittle Naiad Cover
October 8th & 9th, 2019

Figure 6



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Shrewsbury, Worcester & Grafton, Massachusetts

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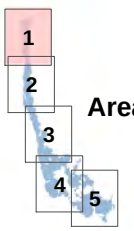
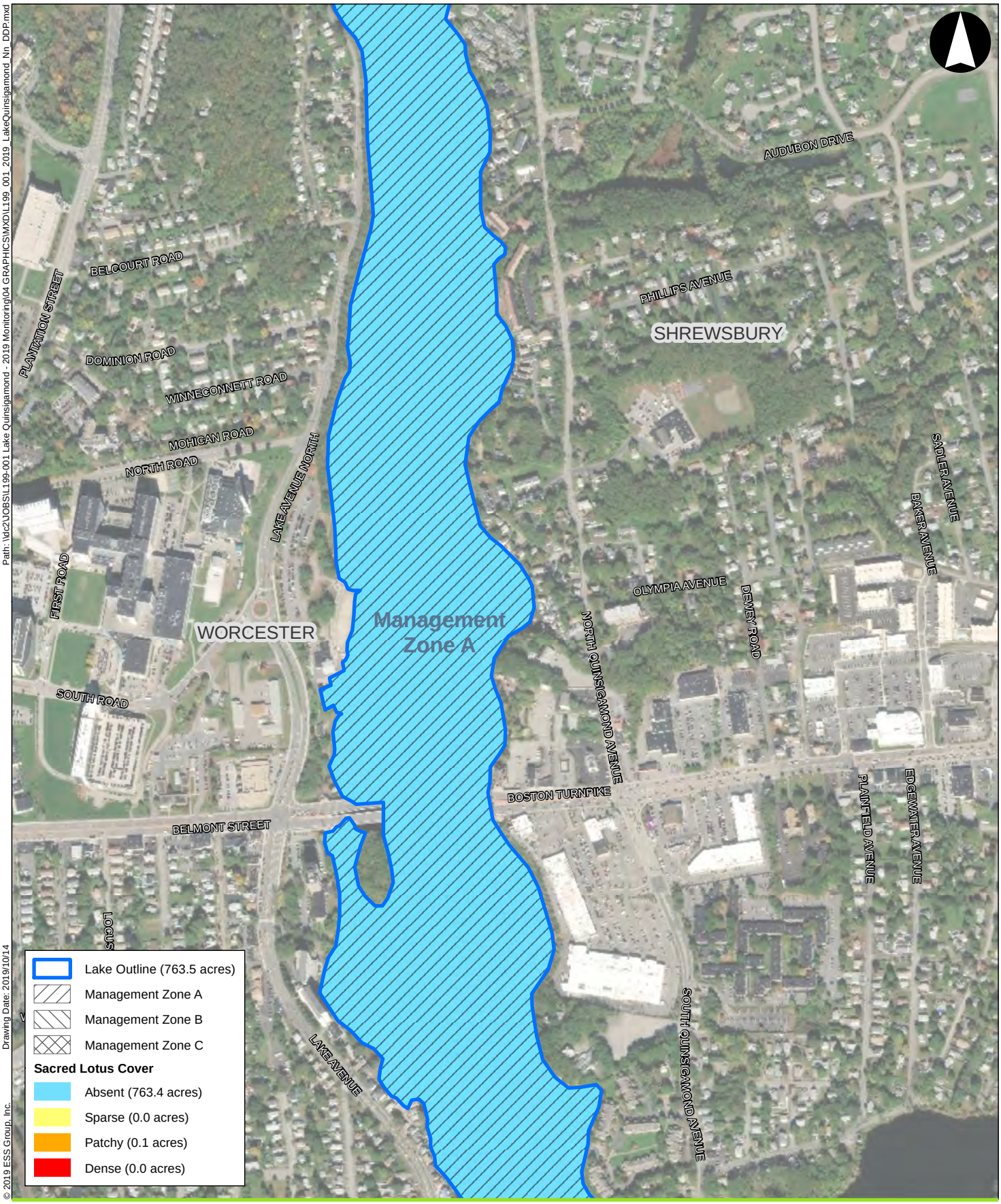


Area of Detail

Sacred Lotus Cover
October 8th & 9th, 2019

Figure 7



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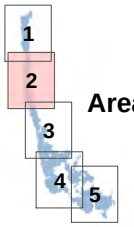
0 350 700 Feet

Lake Quinsigamond Monitoring

Shrewsbury, Worcester & Grafton, Massachusetts

1 inch = 700 feet

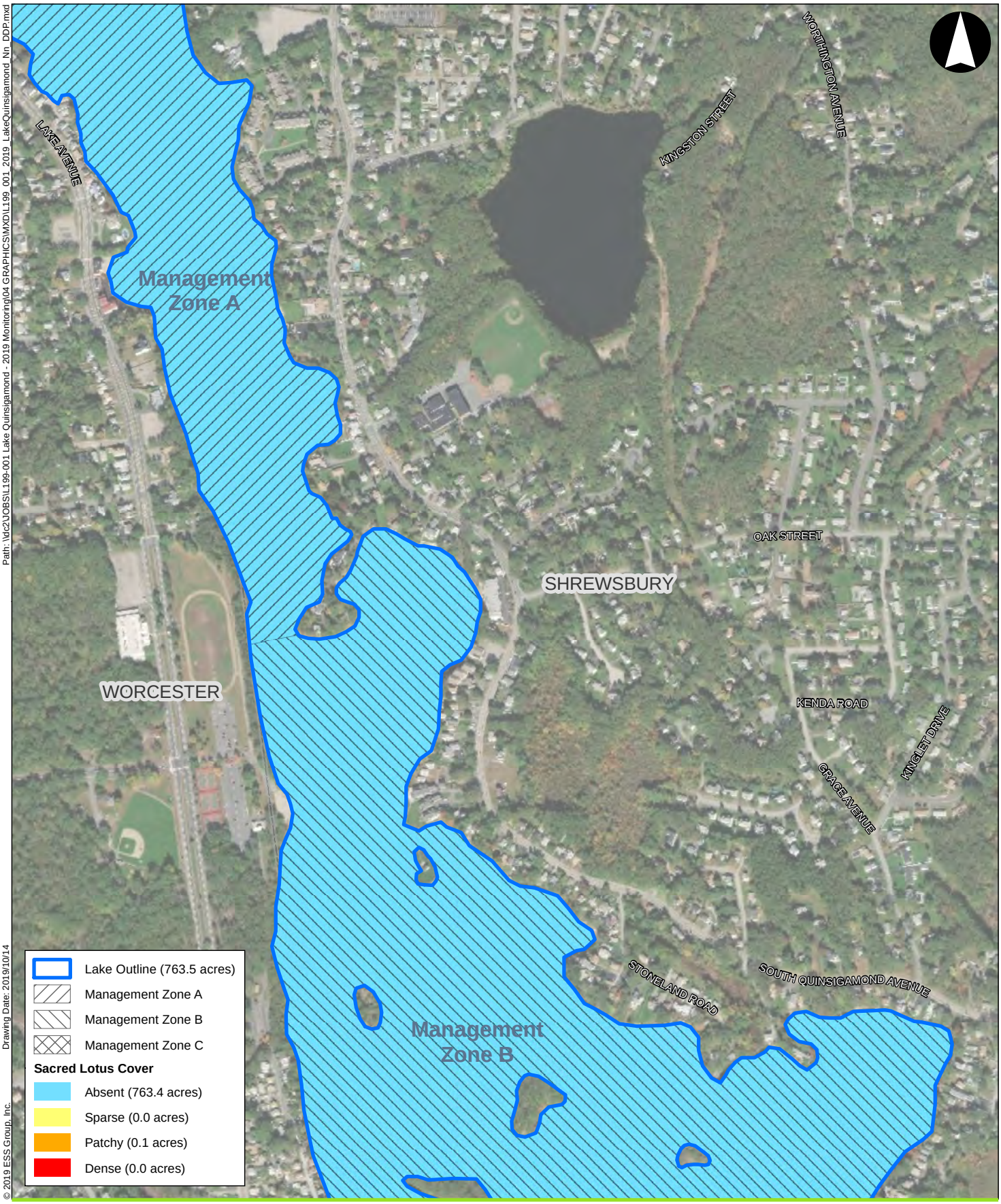
Source: 1) ESRI, World Imagery, 2018
2) ESS, Field Survey, October 2019



Area of Detail

Sacred Lotus Cover
October 8th & 9th, 2019

Figure 7



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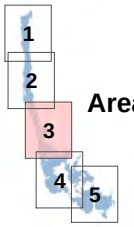
0 350 700 Feet

Lake Quinsigamond Monitoring

Shrewsbury, Worcester & Grafton, Massachusetts

1 inch = 700 feet

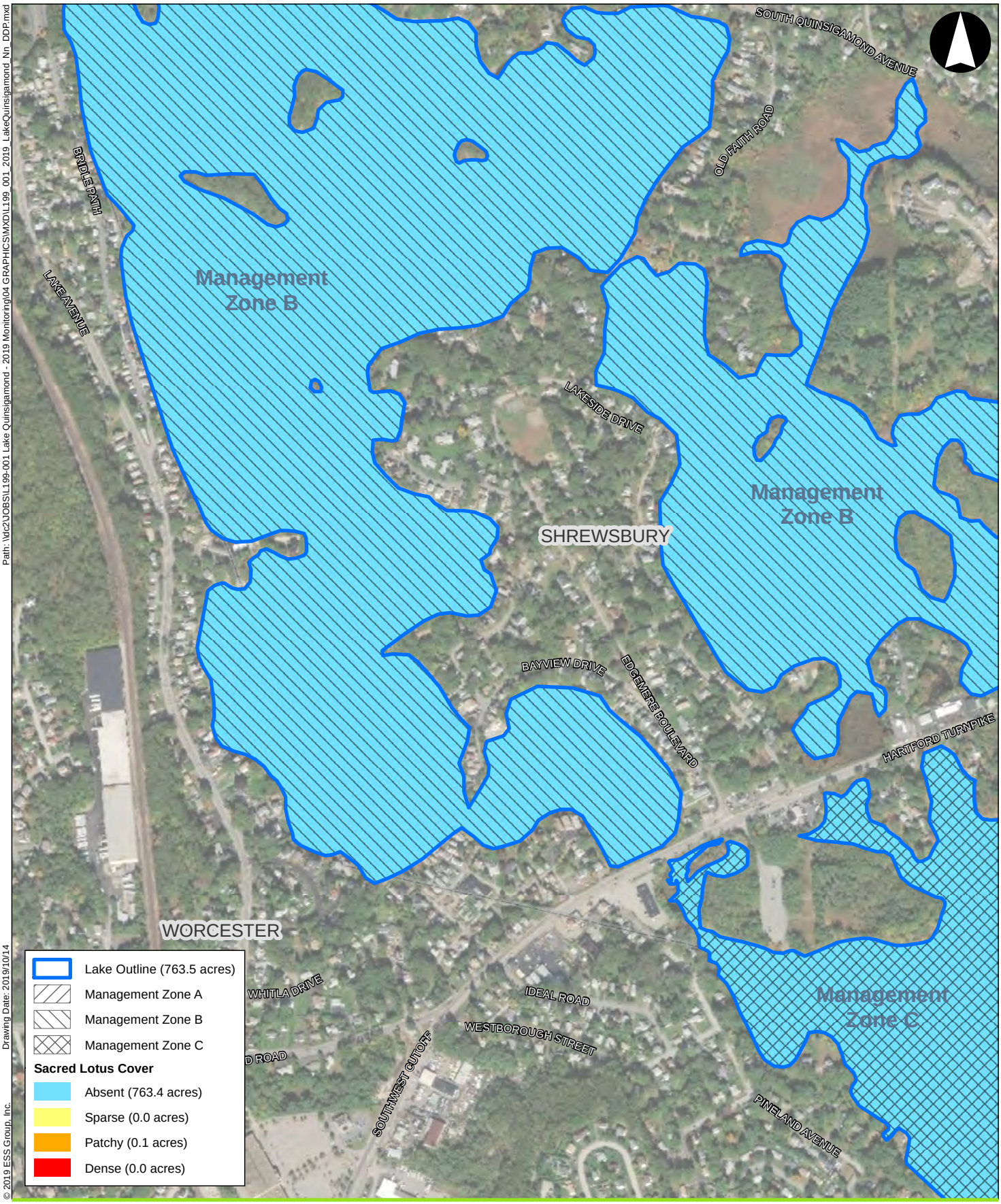
Source: 1) ESRI, World Imagery, 2018
2) ESS, Field Survey, October 2019



Area of Detail

Sacred Lotus Cover
October 8th & 9th, 2019

Figure 7



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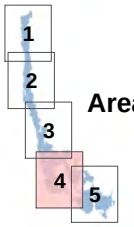
0 350 700 Feet

Lake Quinsigamond Monitoring

Shrewsbury, Worcester & Grafton, Massachusetts

1 inch = 700 feet

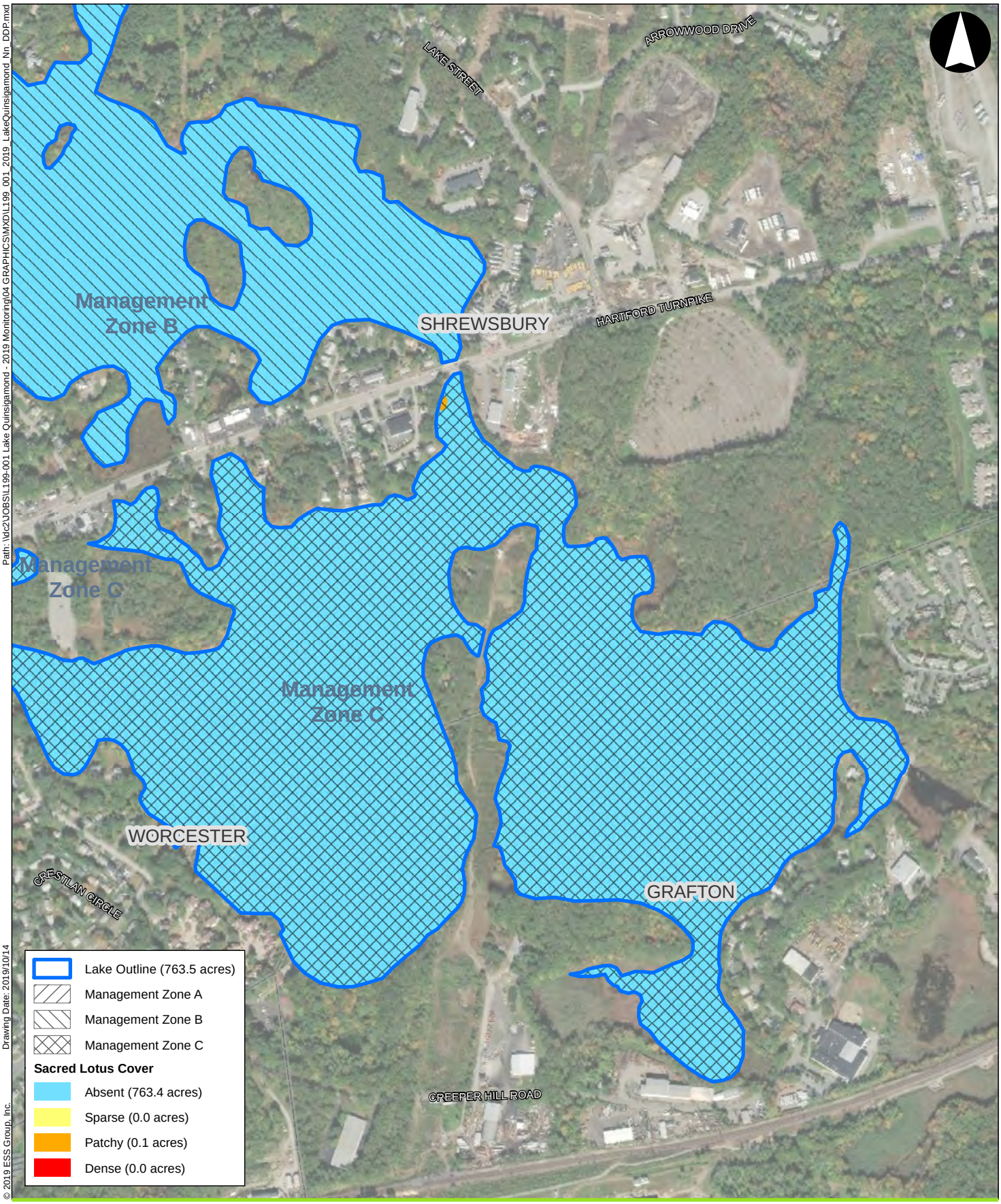
Source: 1) ESRI, World Imagery, 2018
2) ESS, Field Survey, October 2019



Area of Detail

Sacred Lotus Cover
October 8th & 9th, 2019

Figure 7



ess group
environmental consulting & engineering services

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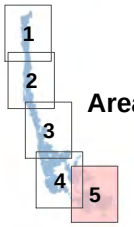

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