memo

Project Name |	2019 Aquatic Plant Management Services	**Date** |	9/25/2019
To / Contact info |	Karen Kill, BCWD Administrator		
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From / Contact info |	Jimmy Marty, Mike Majeski, Joe Pallardy, Pat Conrad, Camilla Correll		
Regarding |	Bass Lakes Aquatic Plant Community		

Bass Lakes Survey Results

A point-intercept aquatic plant survey was completed on August 9th, 2019 on Bass Lake West and on August 19th. 2019 on Bass Lake East. The point-intercept method is considered the standard protocol by MNDNR for sampling macrophytes because it offers a methodology that is quantitative (e.g., frequency of occurrence), repeatable (can be used to track trends in aquatic plant communities over time), and georeferenced (can be used to compare plant communities within different areas of a lake). From this data, a Floristic Quality Index (FQI) was calculated that measures the diversity and health of the aquatic plant community.

The FQI calculation is based on both the quantity of species observed (species richness) as well as the quality of each individual species. Every aquatic plant in Minnesota has been assigned a coefficient of conservatism value (c-value) ranging from 0 to 10. The c-value of all aquatic plants sampled from a lake is used to determine the FQI for a given lake. Species with a c-value of 0 include non-native species such as curly-leaf pondweed (*Potamogeton crispus*) that are indicative of a highly disturbed environment. In comparison, the native species Oakes pondweed (*Potamogeton oakesainus*) has a c-value of 10 because this species is extremely rare and only found in undisturbed, pristine waterbodies.

The average FQI score for Minnesota Lakes in the North Central Hardwood Forest (NCHF) ecoregion is 23.7±8 with a median of 22.5 (Radomski and Perleberg, 2012). A study of 41 Minnesota lakes surveyed across the state, as part of the EPA's National Lakes Assessment Project, yielded a maximum FQI score of 30. In 2016, the MNDNR developed a robust geodatabase of aquatic plant surveys and associated FQI scores from more than 3,600 lakes across the state. FQI scores ranged from 0 to 49 with a median of 25.1±9.

A total of 72 sampling points were surveyed at Bass Lake West and 54 were surveyed at Bass Lake East, each spaced along a grid pattern at 45 meter intervals. Aquatic plants were observed at over 95% of sampling points at both lakes, including at depths of up to 17 feet at Bass Lake West and at depths of up to 10 feet at Bass Lake East. These results indicate a littoral zone (area of aquatic plant growth) encompassing almost the entirety of both lake basins. Secchi depth readings at both lakes were 9.5 feet (2.9 meters), indicating that good water clarity is supporting aquatic plant growth in deeper areas of the lakes.

The most common aquatic plants at Bass Lake West were Canada waterweed (68.1% of sampling points), fern-leaf pondweed (53.6% of sampling points), and coontail (43.5% of sampling points). The most common aquatic plants at Bass Lake East were fern-leaf pondweed (100% of sampling points) and white-water-lily (30.2%of sampling points). Sampling points included an average of 3.1 species per site at Bass Lake West and an average of 2.5 species per site at Bass Lake East.

The FQI score for Bass Lake West was 22.5 and the FQI score for Bass Lake East was 21.9. Both FQI scores are slightly below the median FQI scores for assessed lakes in the MNDNR geodatabase and the NCHF ecoregion average. The slightly lower FQI scores are likely due to relatively low diversity lake-wide and abundance of native plants with relatively low c-values (e.g. coontail and Canada waterweed). However, both lakes were characterized by dominance of fern-leaf pondweed (53.6% of Bass Lake West sampling points and 100% of Bass Lake East sampling points). Fern-leaf pondweed tends to grow in colonies with few other species, but has a high coefficient of conservatism (c-value = 8) and requires good water clarity because it is most common in deeper water.

Additionally, uncommon plant or algae species typical of lakes with good water clarity were present in both lakes. At Bass Lake West, spiny coontail was observed at 11.6% of sampling points; spiny coontail is uncommon in Minnesota, with the maximum c-value of 10. A species of *Nostoc* algae was also observed in abundance at Bass Lake West (36.2% of sampling points). *Nostoc* algae is a blue-green algae that forms globular colonies that appear as small floating balls, sometimes called "freshwater grapes". Abundant *Nostoc* algae is somewhat uncommon and requires good water clarity because colonies typically form on the bottom of the lake and later float to the surface. At Bass Lake East, spiny coontail was present in addition to spiral-fruited pondweed, another uncommon species.

No submerged aquatic invasive plants (e.g. Eurasian watermilfoil or curly-leaf pondweed) were observed during the 2019 surveys. The invasive emergent plant purple loosestrife was observed along the shores of both lakes at low abundances. Purple loosestrife can aggressively invade shorelands and form dense growth that impedes access to open water, reduces plant diversity, and lowers habitat value for native animals. Small populations of purple loosestrife, like those observed at Bass Lake, can be reasonably managed and at the very least should be monitored for aggressive spread.

The results of the surveys for Bass Lake West and Bass Lake East and associated FQI scores are summarized in Table 1 and Table 2. Included in Table 1 and Table 2 is a list of all **native** aquatic species sampled and their associated c-values and frequency of occurrence values. Table 3 and Table 4 include native species and **non-native** species which have assigned c-values of 0. FQI scores from the MNDNR geodatabase exclude non-native species from their FQI calculation; therefore, Table 1 and Table 2 provide the best means of comparison with the MNDNR geodatabase. Table 3 and Table 4 is useful in that non-native species are both an indication of anthropogenic stress and a stressor themselves in terms of their direct impacts to the surrounding plant community. Shoreline species associated with wetland habitats that bordered the lake (*e.g.*, reed canary grass) were also excluded from the FQI calculation.

The distribution and density ranking for each individual species with a frequency of occurrence ≥ 5% is mapped within Appendix A for Bass Lake West and within Appendix B for Bass Lake East. Non-native species were also mapped. For each data point mapped, an abundance ranking of 1 indicates only a few individual plants were observed while a ranking of 4 indicates an abundance of plants.

Table 1. Bass Lake West Point-Intercept Survey Results- Native Species Only.

Common Name	Scientific Name	C-Value	Frequency of Occurrence
Canada waterweed	*Elodea canadensis*	4	68.1%
Common bladderwort	*Utricularia macrorhiza*	5	1.4%
Coontail	*Ceratophyllum demersum*	2	43.5%
Fern-leaf pondweed	*Potamogeton robbinsii*	8	53.6%
Greater duckweed	*Spirodela polyrrhiza*	5	4.3%
Large-leaf pondweed	*Potamogeton amplifolius*	7	14.5%
Northern watermilfoil	*Myriophyllum exalbescens*	7	1.4%
Nostoc algae	*Nostoc* sp.	*	36.2%
Sessile-fruited arrowhead	*Sagittaria rigida*	7	1.4%
Slender naiad	*Najas flexilis*	5	13.0%
Softstem bulrush	*Schoenoplectus tabernaemontani*	4	1.4%
Spiny coontail	*Ceratophyllum echinatum*	10	11.6%
Variable pondweed	*Potamogeton gramineus*	7	2.9%
Water smartweed	*Polygonum amphibium*	4	17.4%
White water lily	*Nymphaea odorata*	6	1.4%
Yellow pond lily	*Nuphar lutea ssp. Variegata*	6	10.1%

Summary Table		
FQI = C*√S	**Average C-Value**	5.8
C= Mean coefficient of conservatism value	**Number of species**	15
S= Number of species in sample	**FQI**	**22.5**

***No C-Value assigned by MPCA (C-values only assigned to vascular plants).**

Table 2. Bass Lake East Point-Intercept Survey Results- Native Species Only.

Common Name	Scientific Name	C-Value	Frequency of Occurrence
Canada waterweed	*Elodea canadensis*	4	15.1%
Fern-leaf pondweed	*Potamogeton robbinsii*	8	100.0%
Large-leaf pondweed	*Potamogeton amplifolius*	7	3.8%
Leafy pondweed	*Potamogeton foliosus*	6	7.5%
Lesser duckweed	*Lemna minor*	5	1.9%
Needle spikerush	*Eleocharis acicularis*	4	9.4%
Soft rush	*Juncus effusus*	4	5.7%
Spiny coontail	*Ceratophyllum echinatum*	10	1.9%
Spiral-fruited pondweed	*Potamogeton spirillus*	8	1.9%
Water celery	*Vallisneria americana*	6	1.9%
Water smartweed	*Polygonum amphibium*	4	11.3%
Watershield	*Brasenia schreberi*	7	15.1%
White water lily	*Nymphaea odorata*	6	30.2%

Summary Table		
FQI = C*√S	**Average C-Value**	6.1
C= Mean coefficient of conservatism value	**Number of species**	13
S= Number of species in sample	**FQI**	**21.9**

Table 3. Bass Lake West Point-Intercept Survey Results- Native and Non-Native Species.

Common Name	Scientific Name	C-Value	Frequency of Occurrence
Canada waterweed	*Elodea canadensis*	4	68.1%
Common bladderwort	*Utricularia macrorhiza*	5	1.4%
Coontail	*Ceratophyllum demersum*	2	43.5%
Fern-leaf pondweed	*Potamogeton robbinsii*	8	53.6%
Greater duckweed	*Spirodela polyrrhiza*	5	4.3%
Large-leaf pondweed	*Potamogeton amplifolius*	7	14.5%
Northern watermilfoil	*Myriophyllum exalbescens*	7	1.4%
Nostoc algae	*Nostoc* sp.	*	36.2%
Purple loosestrife	*Lythrum salicaria*	0	7.2%
Sessile-fruited arrowhead	*Sagittaria rigida*	7	1.4%
Slender naiad	*Najas flexilis*	5	13.0%
Softstem bulrush	*Schoenoplectus tabernaemontani*	4	1.4%
Spiny coontail	*Ceratophyllum echinatum*	10	11.6%
Variable pondweed	*Potamogeton gramineus*	7	2.9%
Water smartweed	*Polygonum amphibium*	4	17.4%
White water lily	*Nymphaea odorata*	6	1.4%
Yellow pond lily	*Nuphar lutea ssp. Variegata*	6	10.1%
Summary Table	**Average C-Value**	5.4	
FQI = C*√S			
C= Mean coefficient of conservatism value	**Number of species**	16	
S= Number of species in sample	**FQI**	**21.8**	

***No C-Value assigned by MPCA (C-values only assigned to vascular plants).**

Table 4. Bass Lake East Point-Intercept Survey Results- Native and Non-Native Species.

Common Name	Scientific Name	C-Value	Frequency of Occurrence
Canada waterweed	*Elodea canadensis*	4	15.1%
Fern-leaf pondweed	*Potamogeton robbinsii*	8	100.0%
Large-leaf pondweed	*Potamogeton amplifolius*	7	3.8%
Leafy pondweed	*Potamogeton foliosus*	6	7.5%
Lesser duckweed	*Lemna minor*	5	1.9%
Needle spikerush	*Eleocharis acicularis*	4	9.4%
Purple loosestrife	*Lythrum salicaria*	0	1.9%
Soft rush	*Juncus effusus*	4	5.7%
Spiny coontail	*Ceratophyllum echinatum*	10	1.9%
Spiral-fruited pondweed	*Potamogeton spirillus*	8	1.9%
Water celery	*Vallisneria americana*	6	1.9%
Water smartweed	*Polygonum amphibium*	4	11.3%
Watershield	*Brasenia schreberi*	7	15.1%
White water lily	*Nymphaea odorata*	6	30.2%
Summary Table FQI = C*√S C= Mean coefficient of conservatism value S= Number of species in sample	**Average C-Value** **Number of species** **FQI**	5.6 14 **21.1**	

Appendix A

Bass Lake West 2019 Aquatic Plant Species Distribution

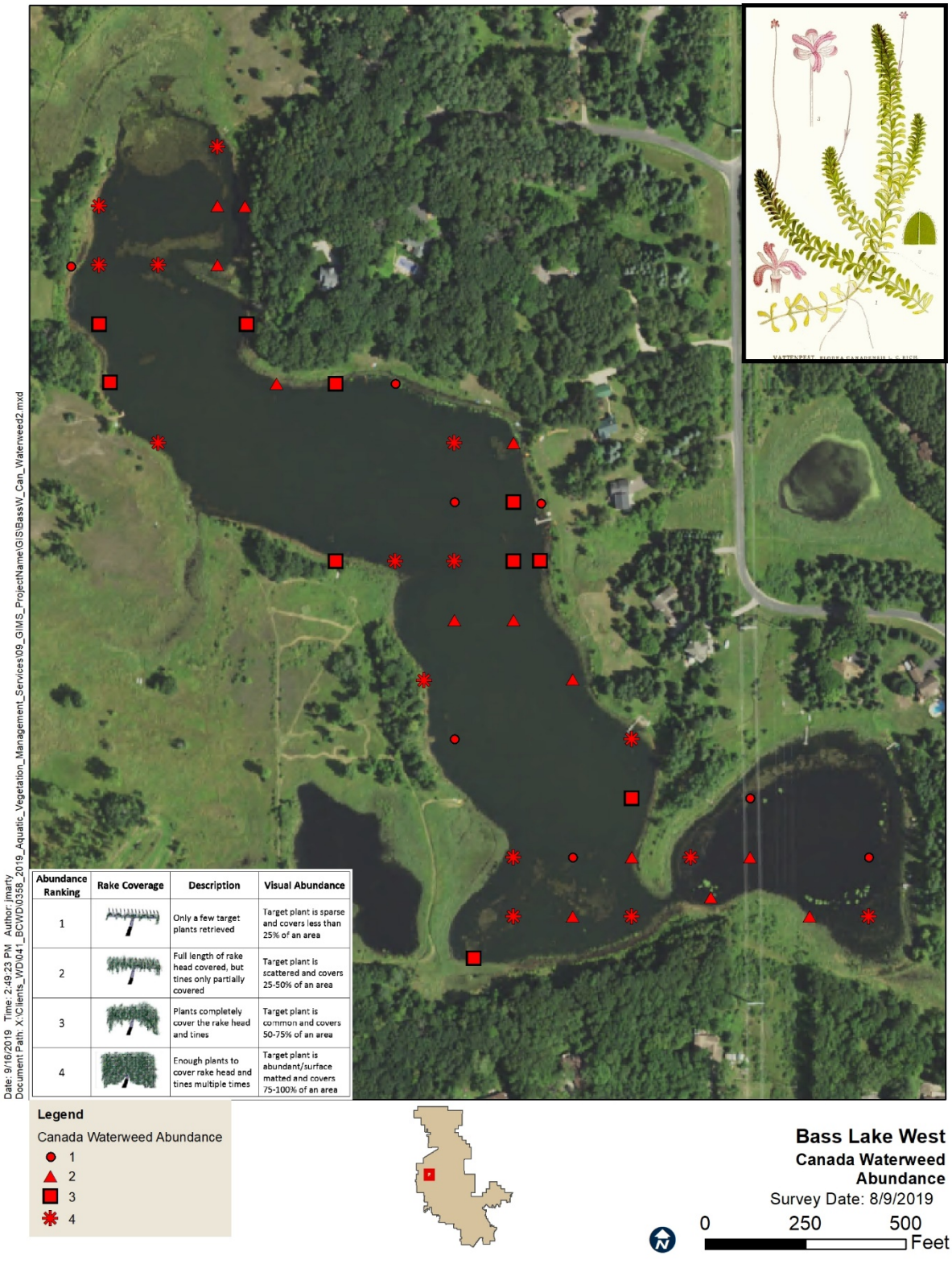

Figure 1. Bass Lake West Canada waterweed distribution and abundance – August 2019.

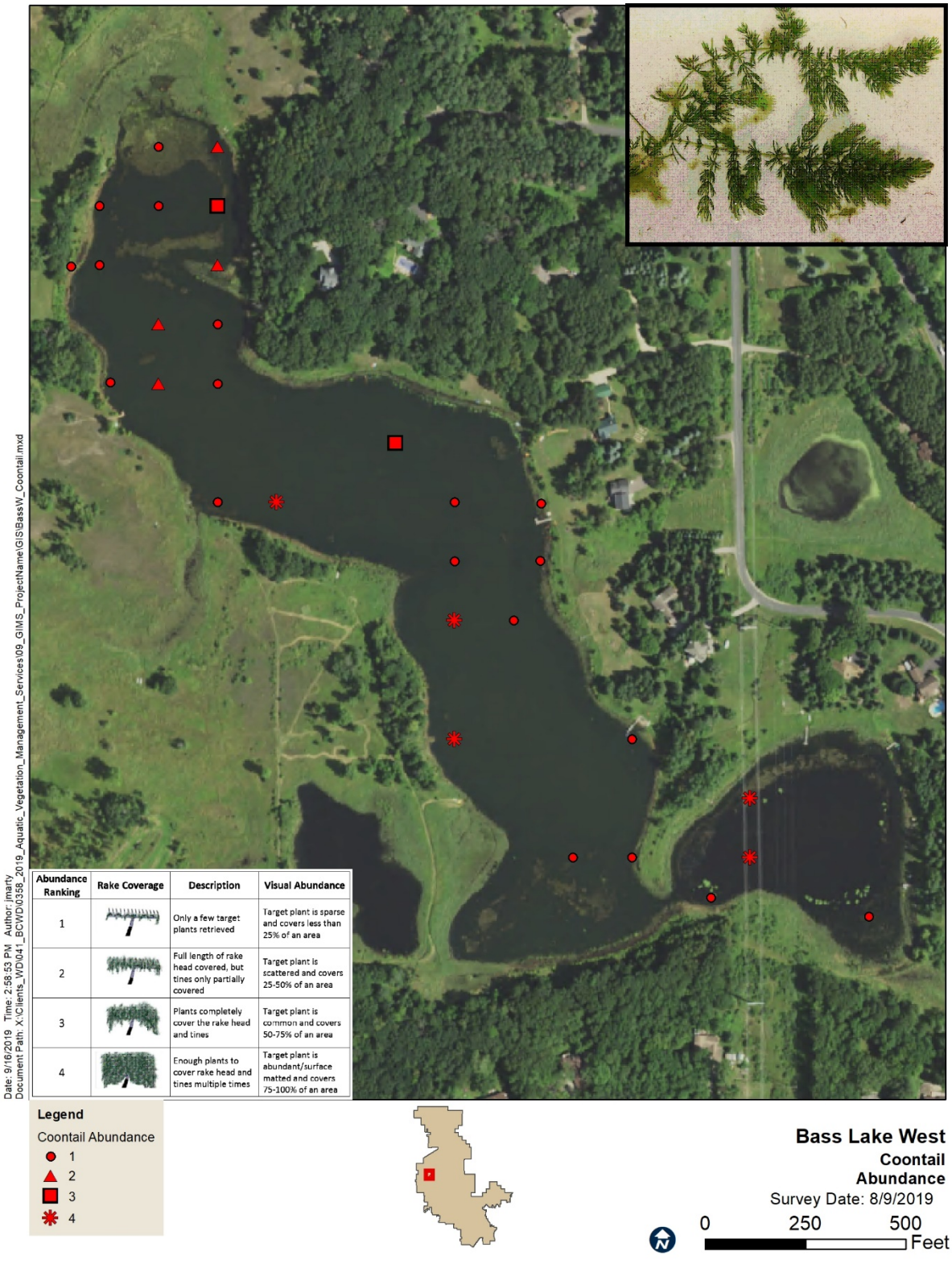

Figure 2 Bass Lake West coontail distribution and abundance – August 2019.

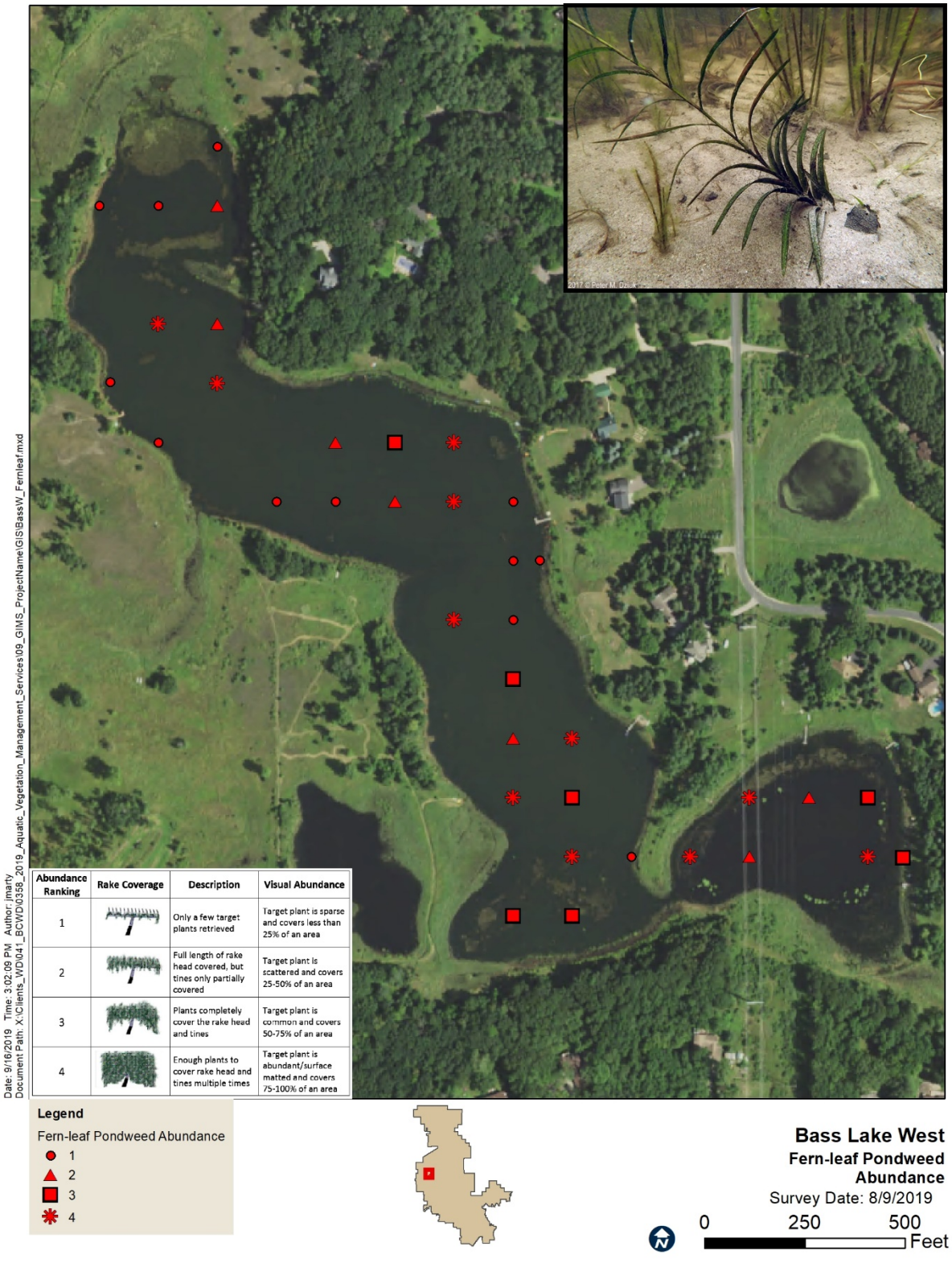

Figure 3. Bass Lake West fern-leaf pondweed distribution and abundance – August 2019.

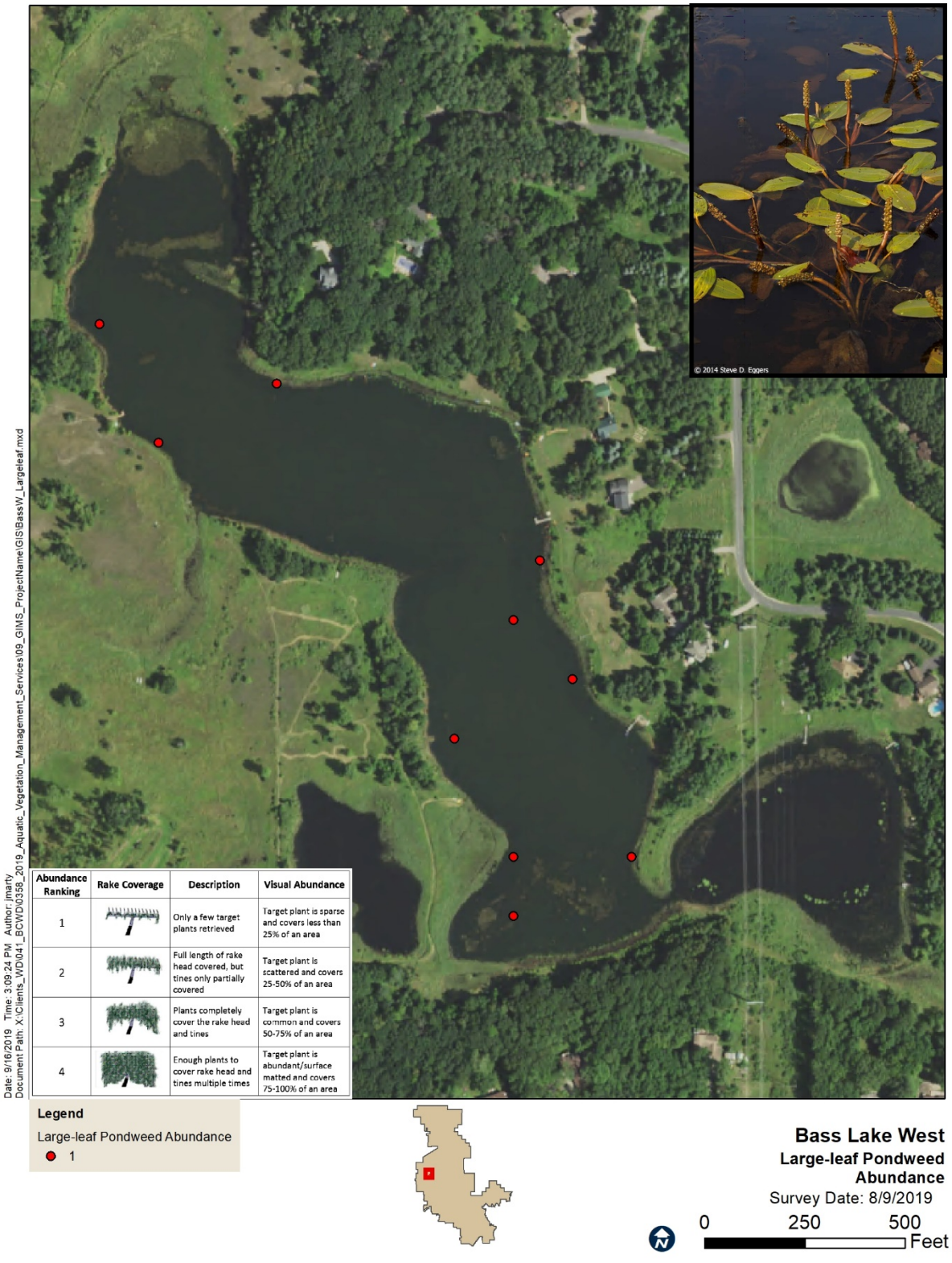

Figure 4. Bass Lake West large-leaf pondweed distribution and abundance – August 2019.

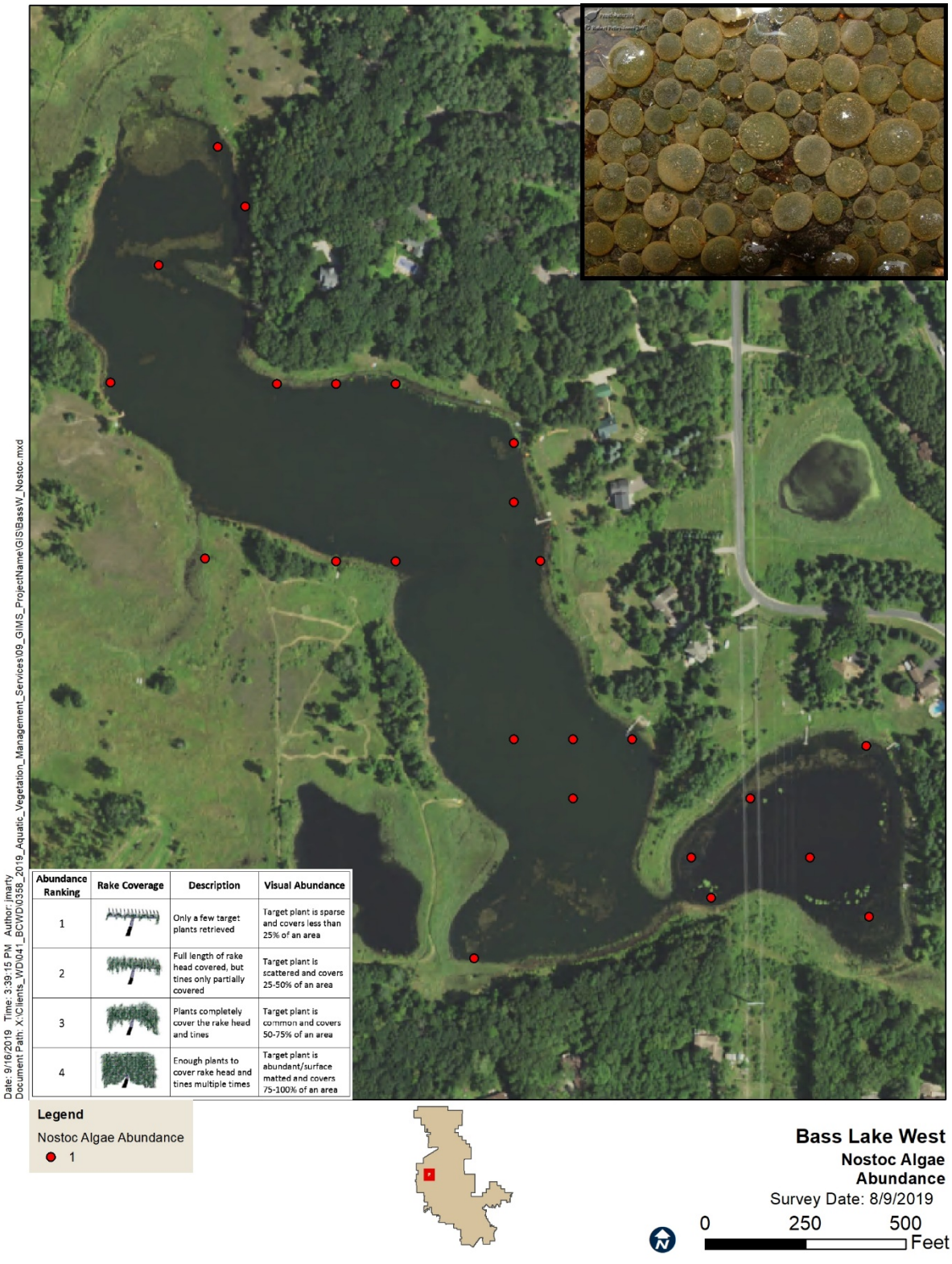

Figure 5. Bass Lake West *Nostoc* sp. distribution and abundance – August 2019.

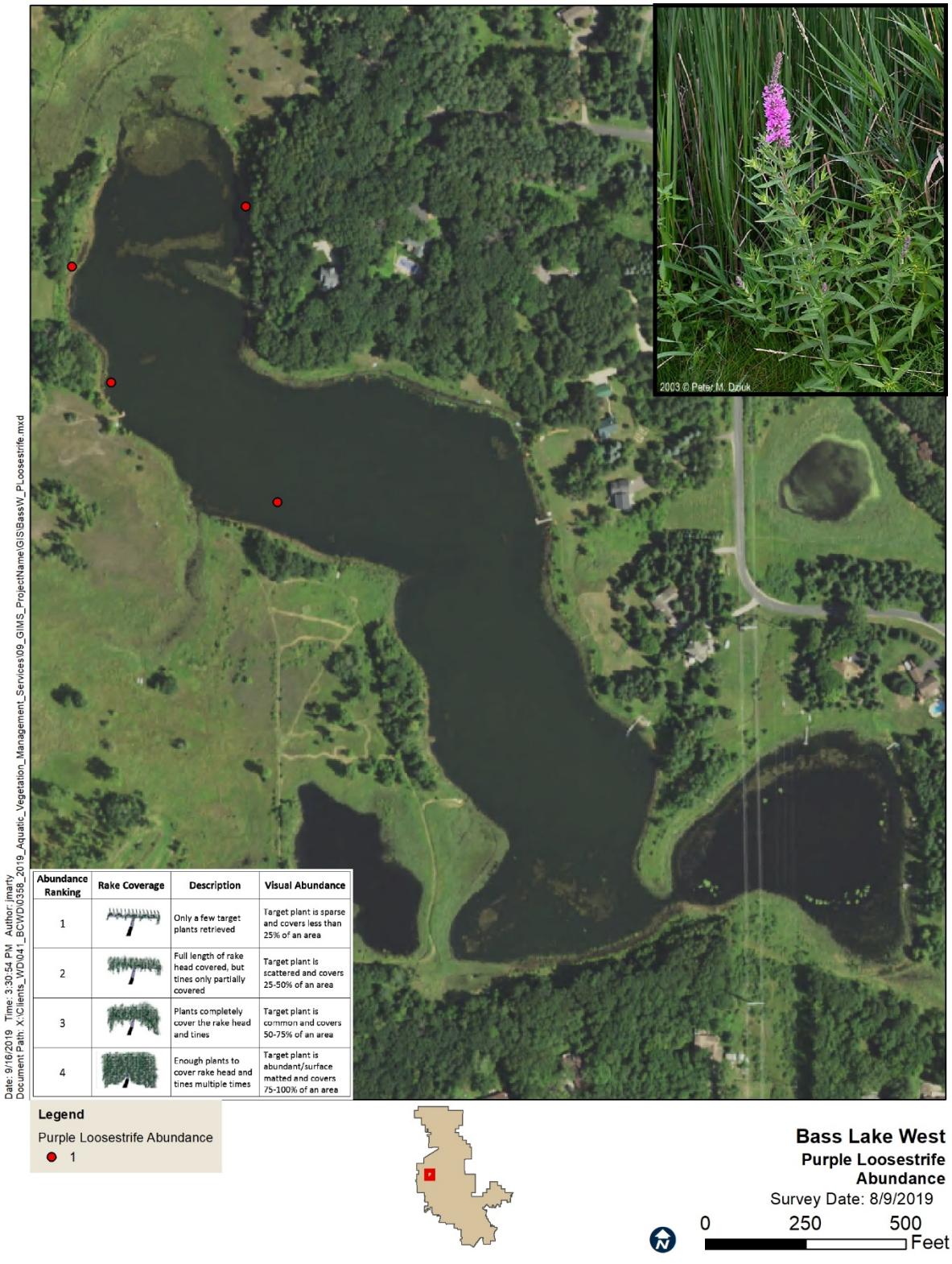

Figure 6. Bass Lake West purple loosestrife distribution and abundance – August 2019.

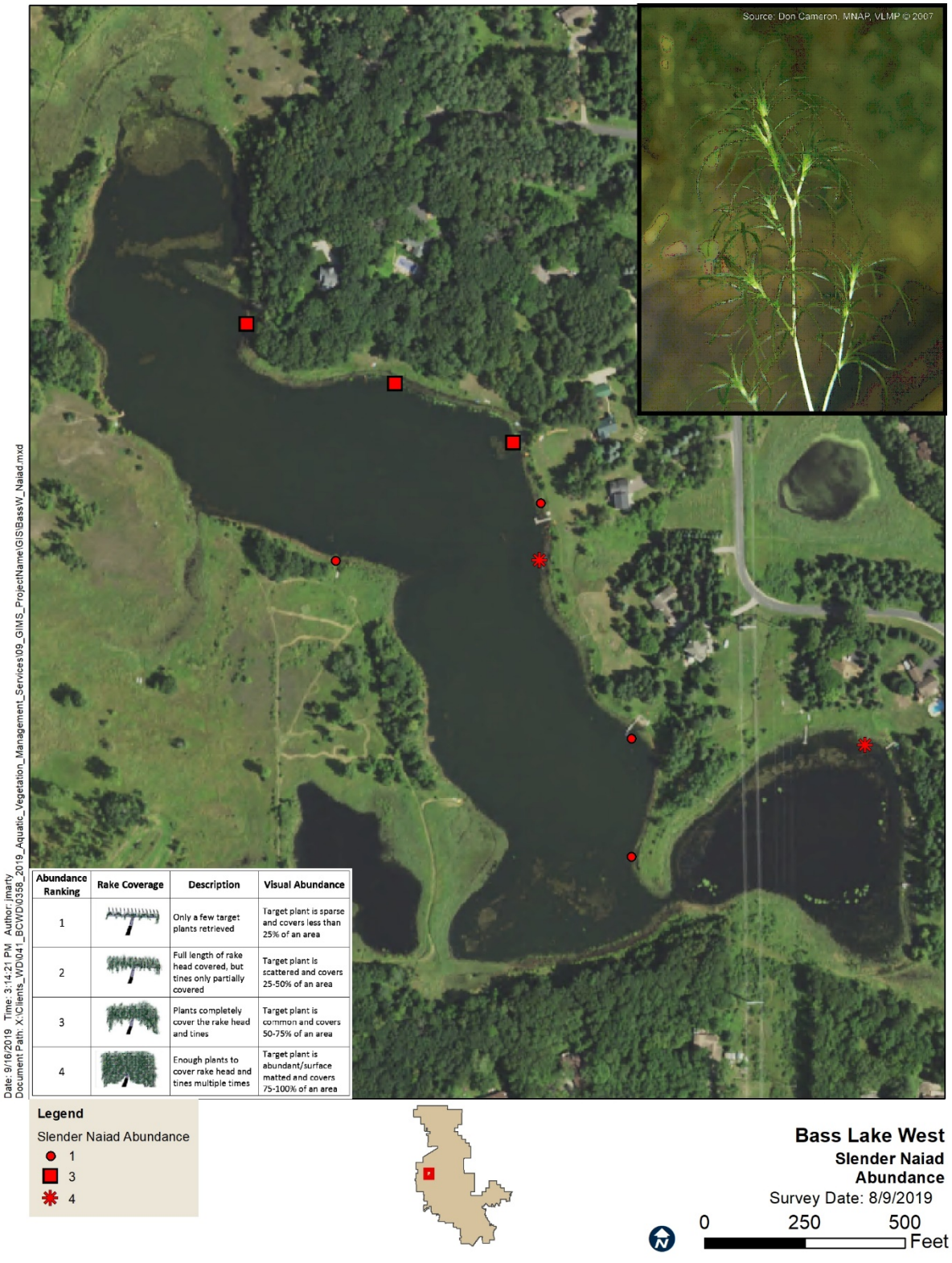

Figure 7. Bass Lake West slender naiad distribution and abundance – August 2019.

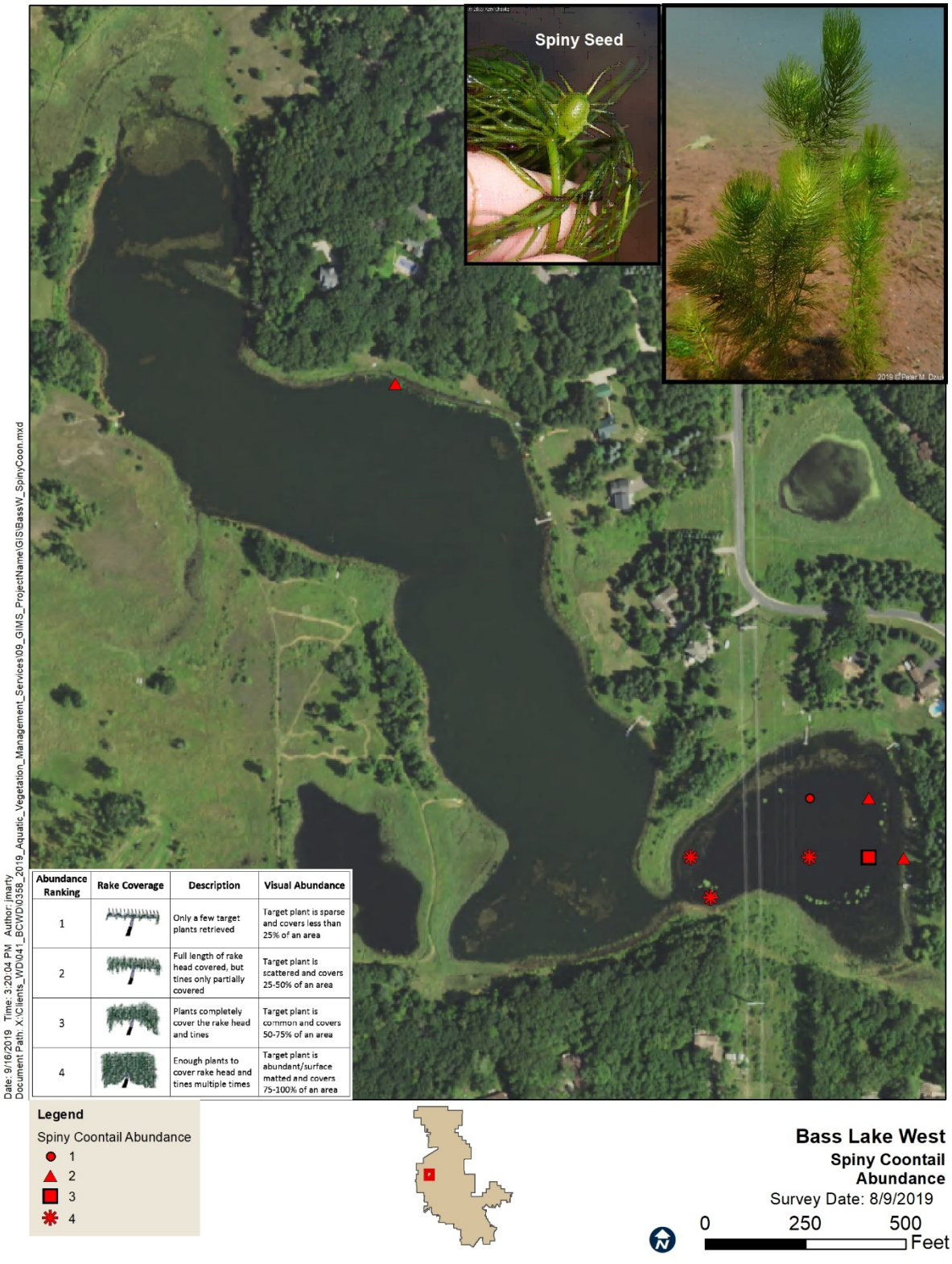

Figure 8. Bass Lake West spiny coontail distribution and abundance – August 2019.

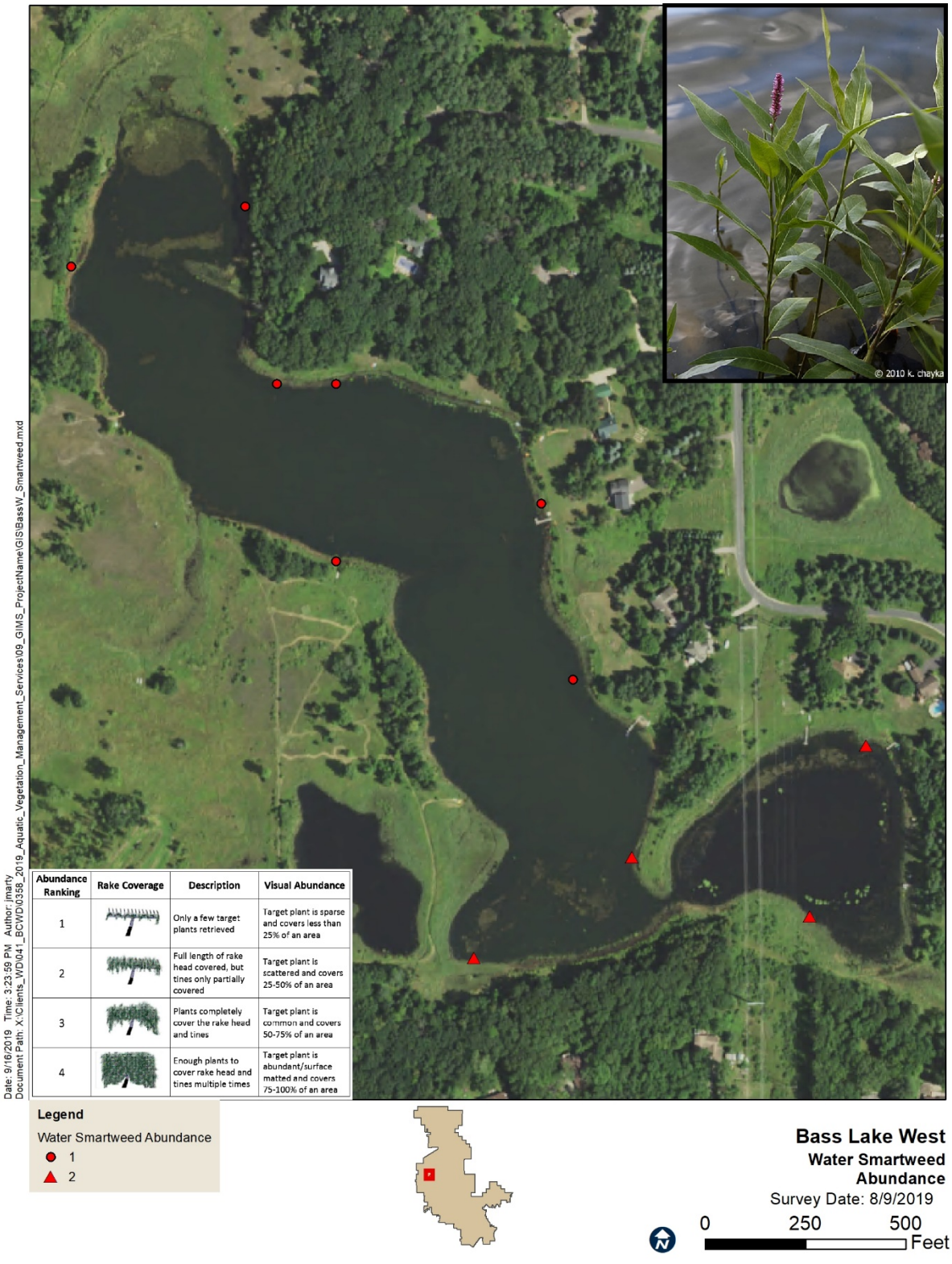

Figure 9. Bass Lake West water smartweed distribution and abundance – August 2019.

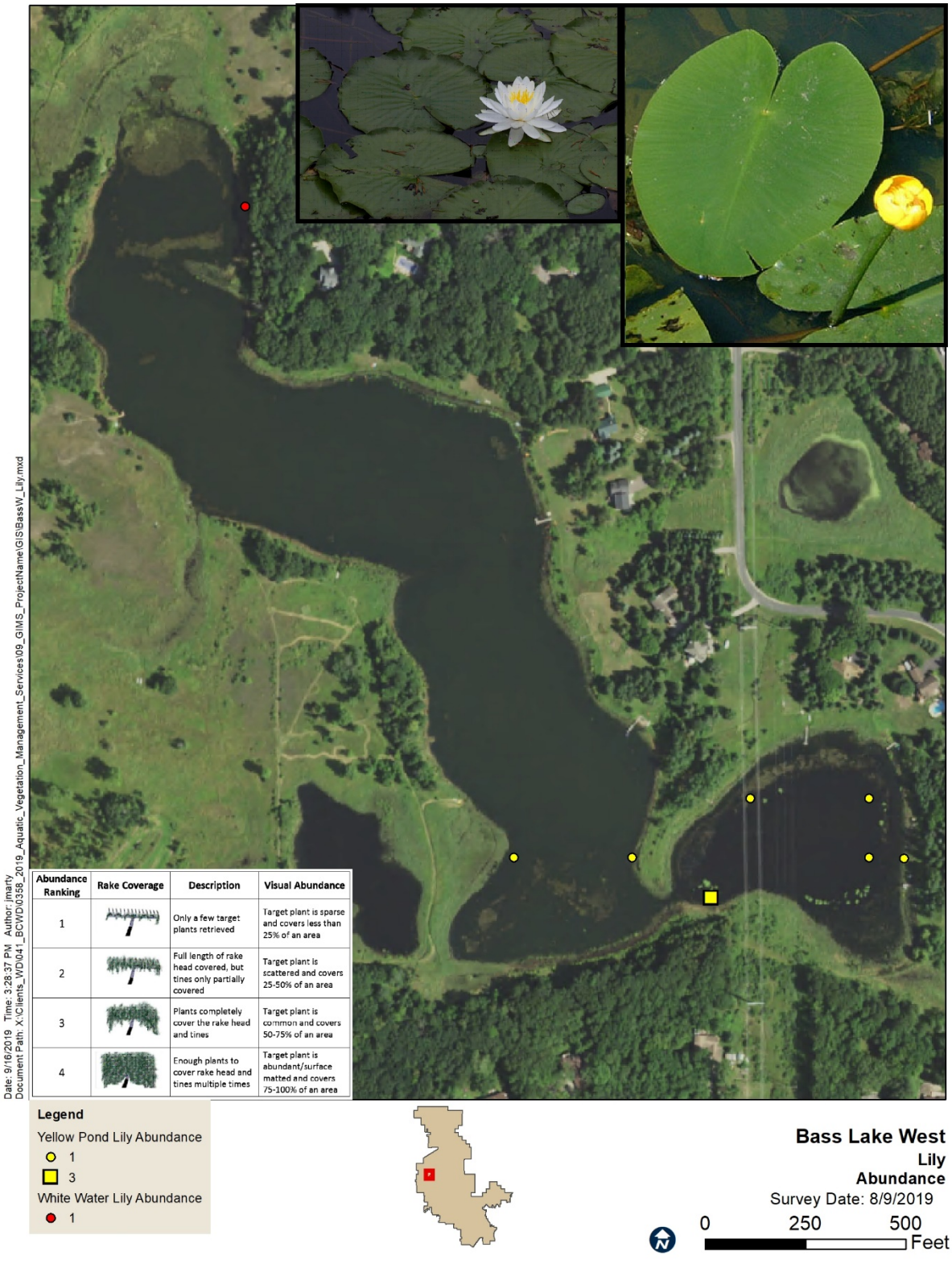

Figure 10. Bass Lake West yellow pond lily and white water lily distribution and abundance – August 2019.

Appendix B

Bass Lake East 2019 Aquatic Plant Species Distribution

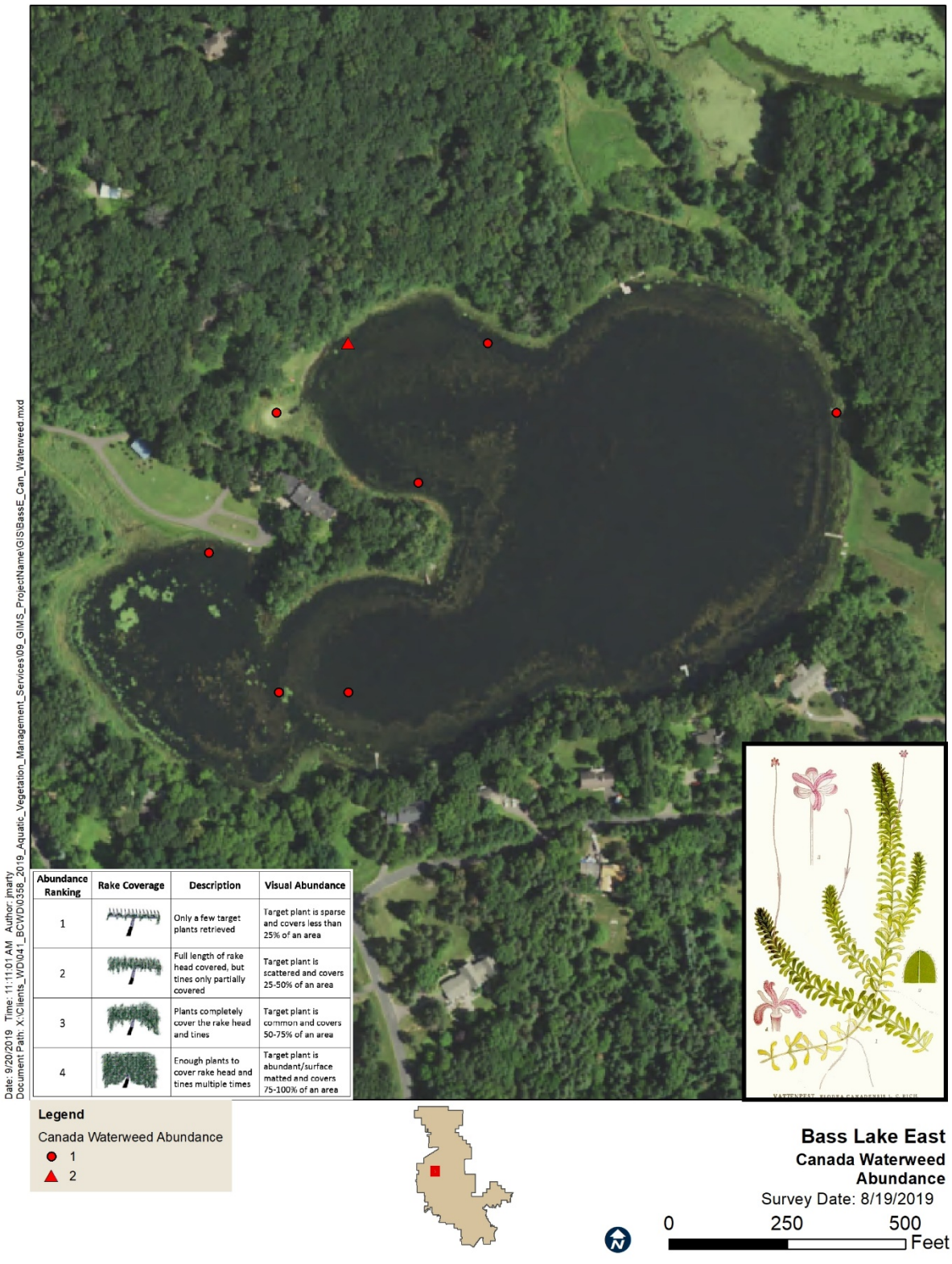

Figure 11. Bass Lake East Canada waterweed distribution and abundance – August 2019.

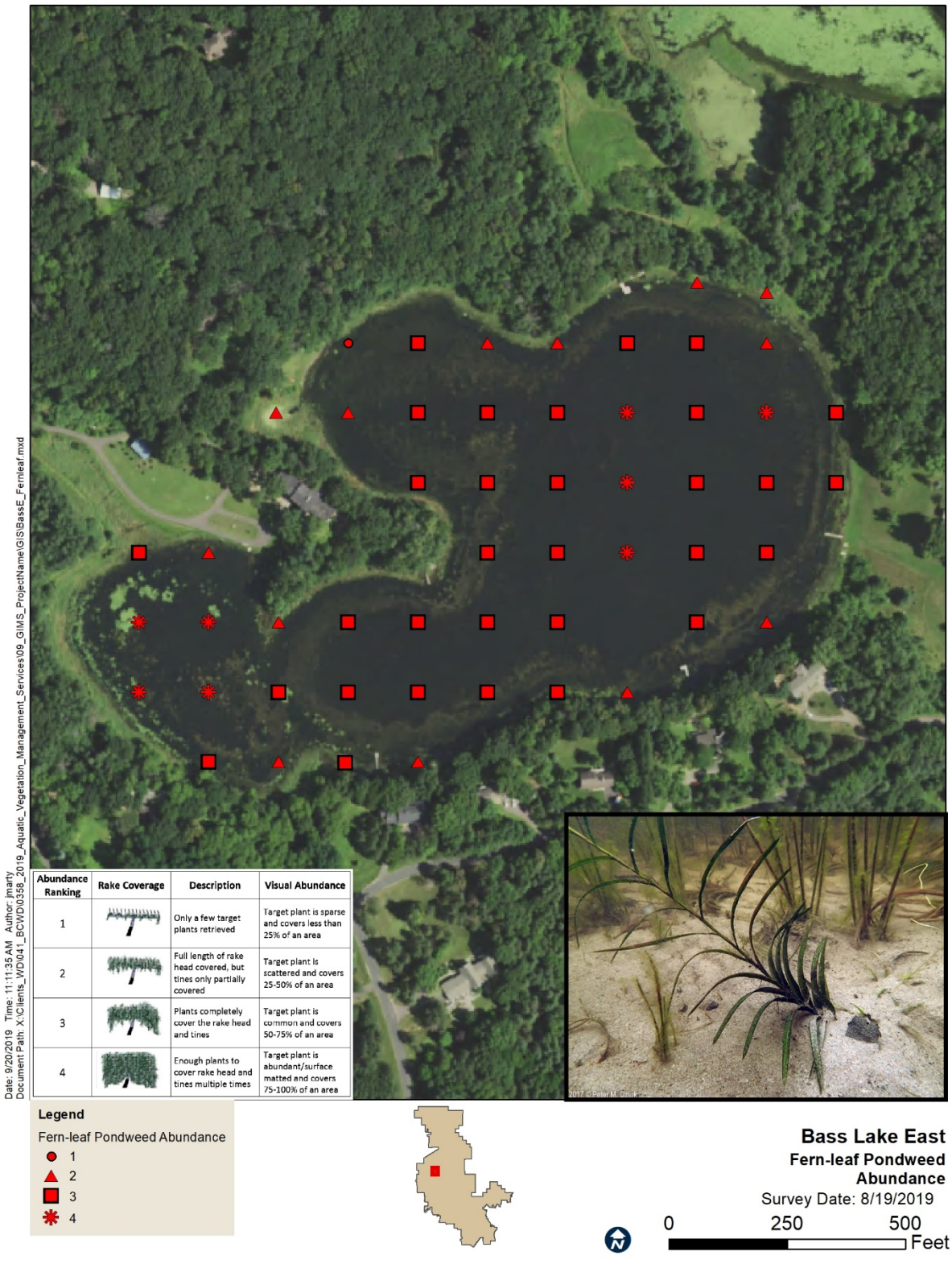

Figure 12. Bass Lake East fern-leaf pondweed distribution and abundance – August 2019.

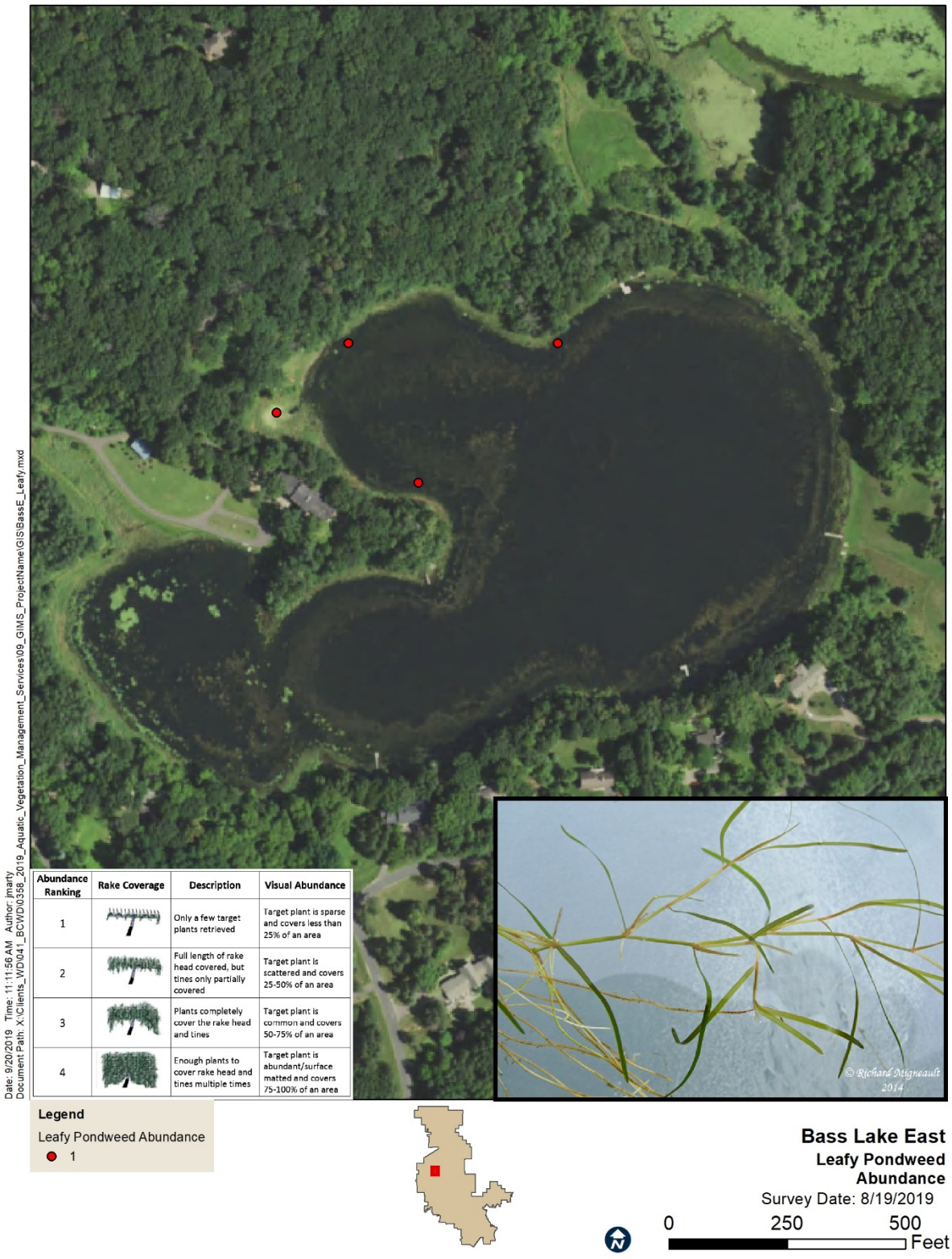

Figure 13. Bass Lake East leafy pondweed distribution and abundance – August 2019.

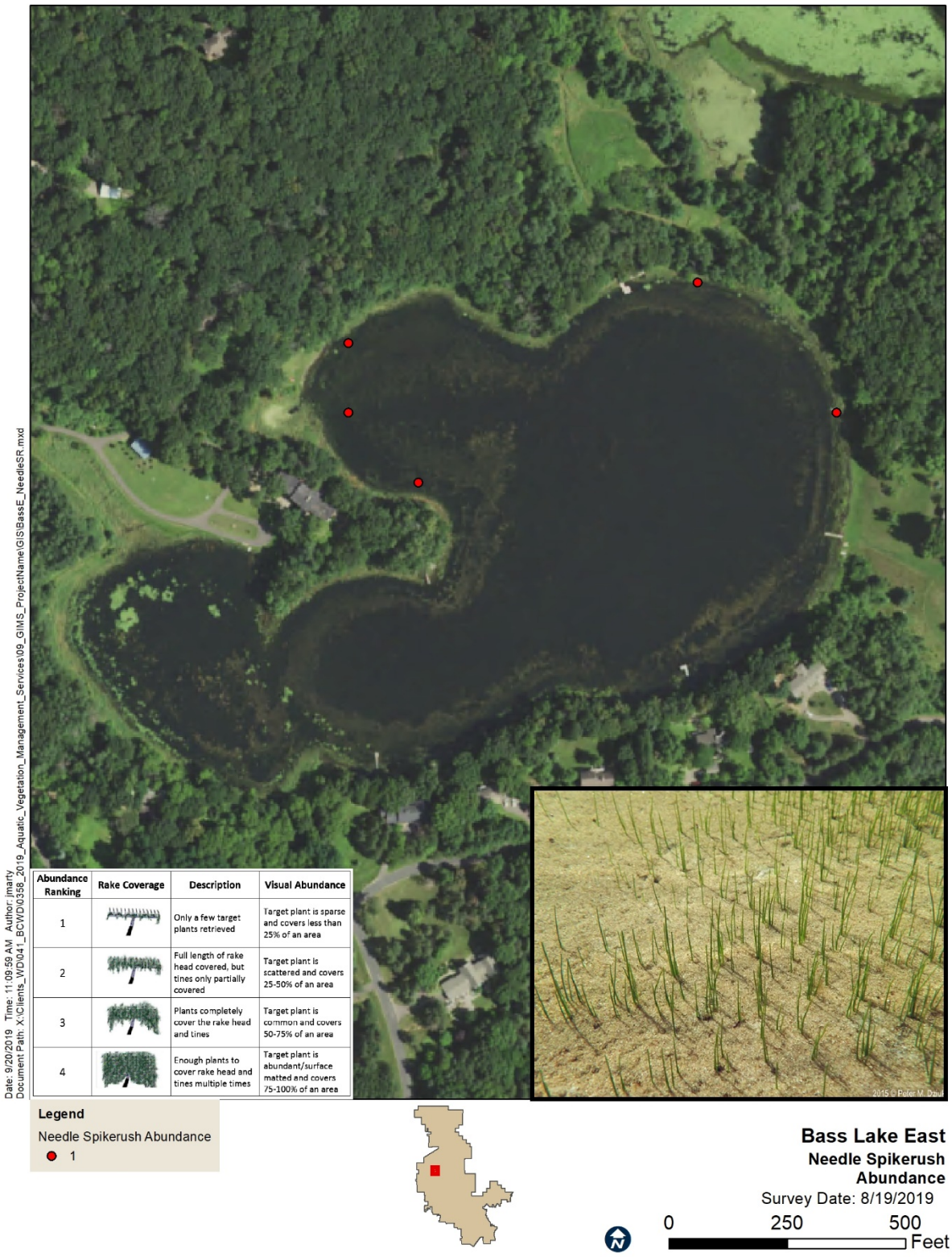

Figure 14. Bass Lake East needle spikerush pondweed distribution and abundance – August 2019.

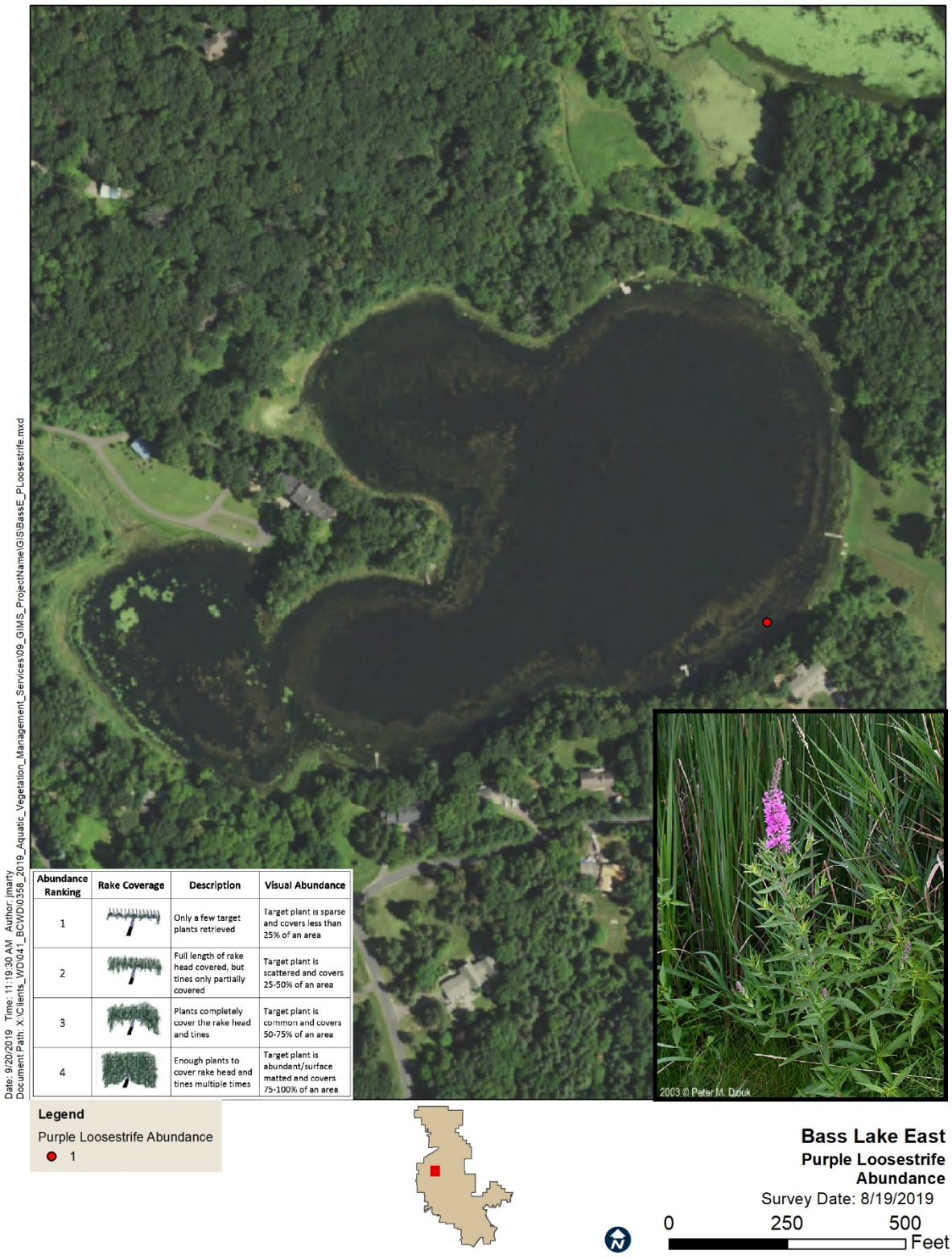

Figure 15. Bass Lake East purple loosestrife distribution and abundance – August 2019.

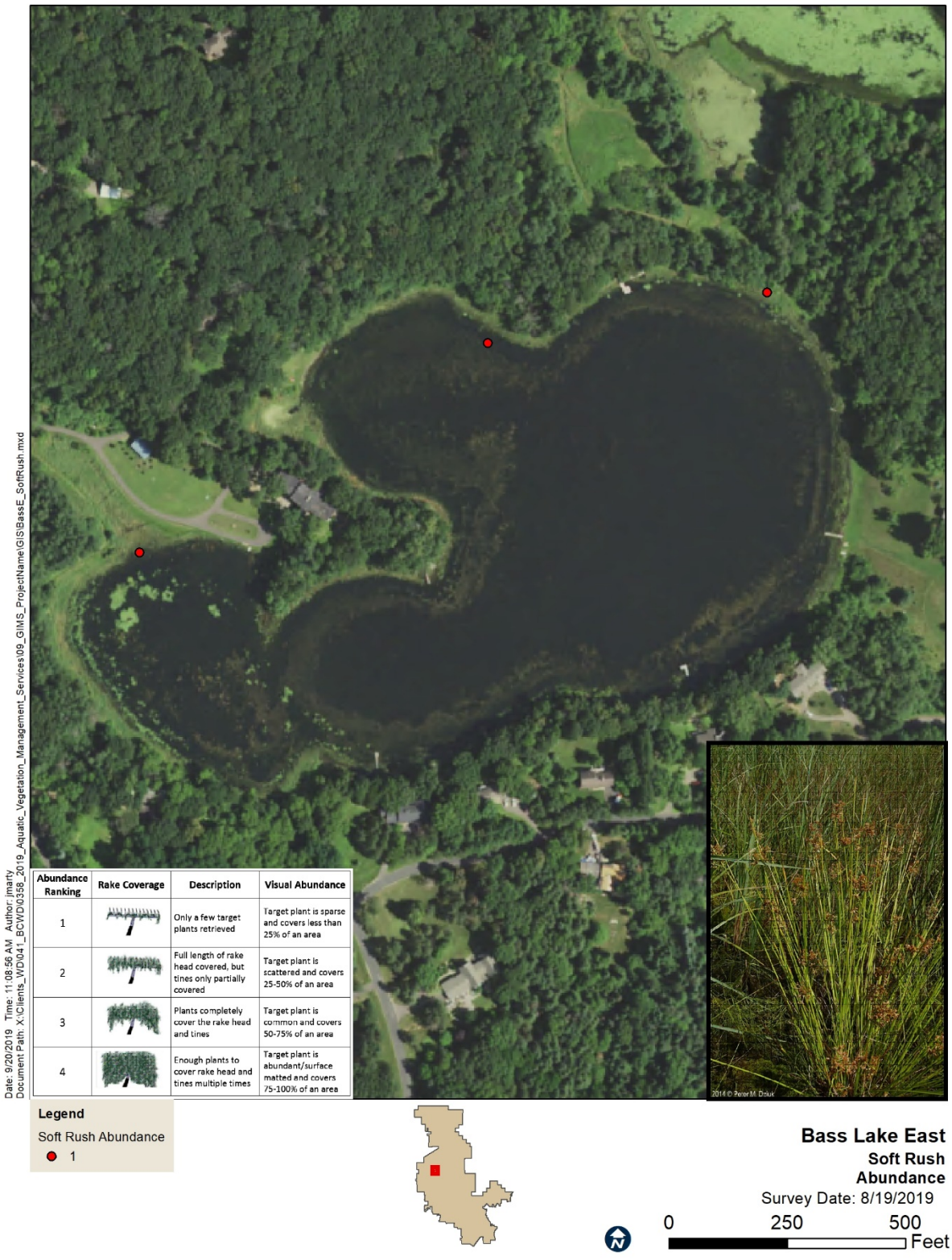

Figure 16. Bass Lake East soft rush distribution and abundance – August 2019.

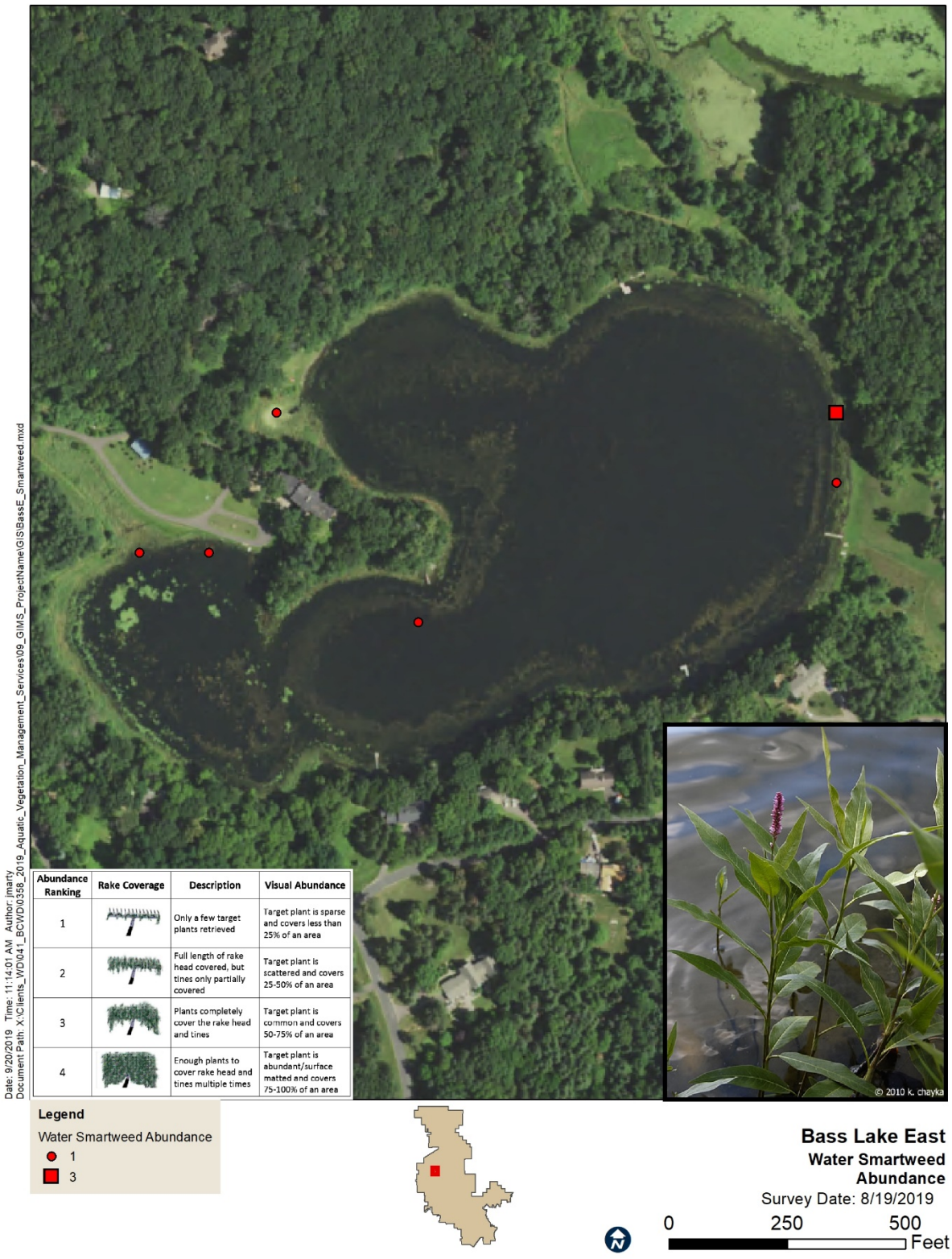

Figure 17. Bass Lake East water smartweed distribution and abundance – August 2019.

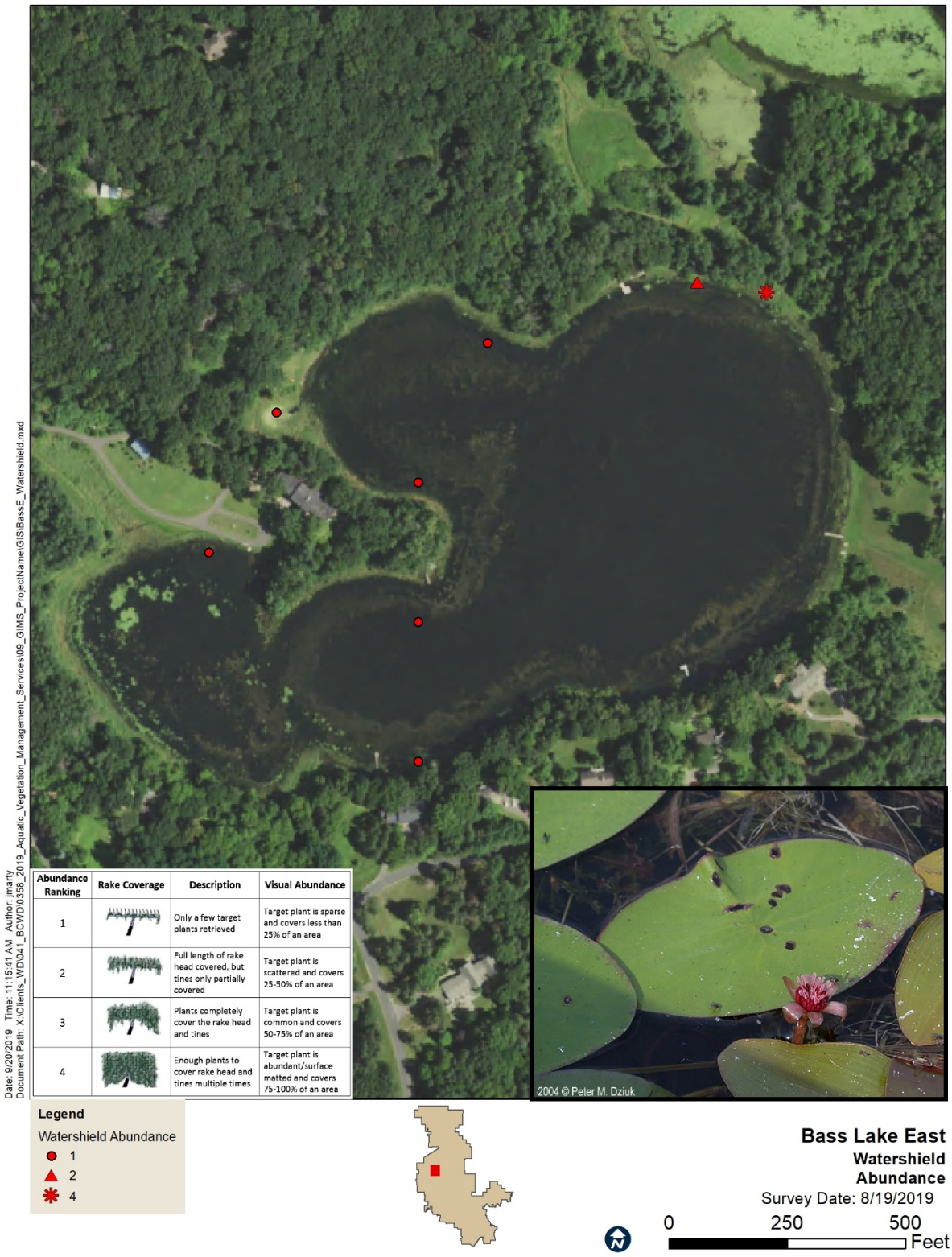

Figure 18. Bass Lake East watershield distribution and abundance – August 2019.

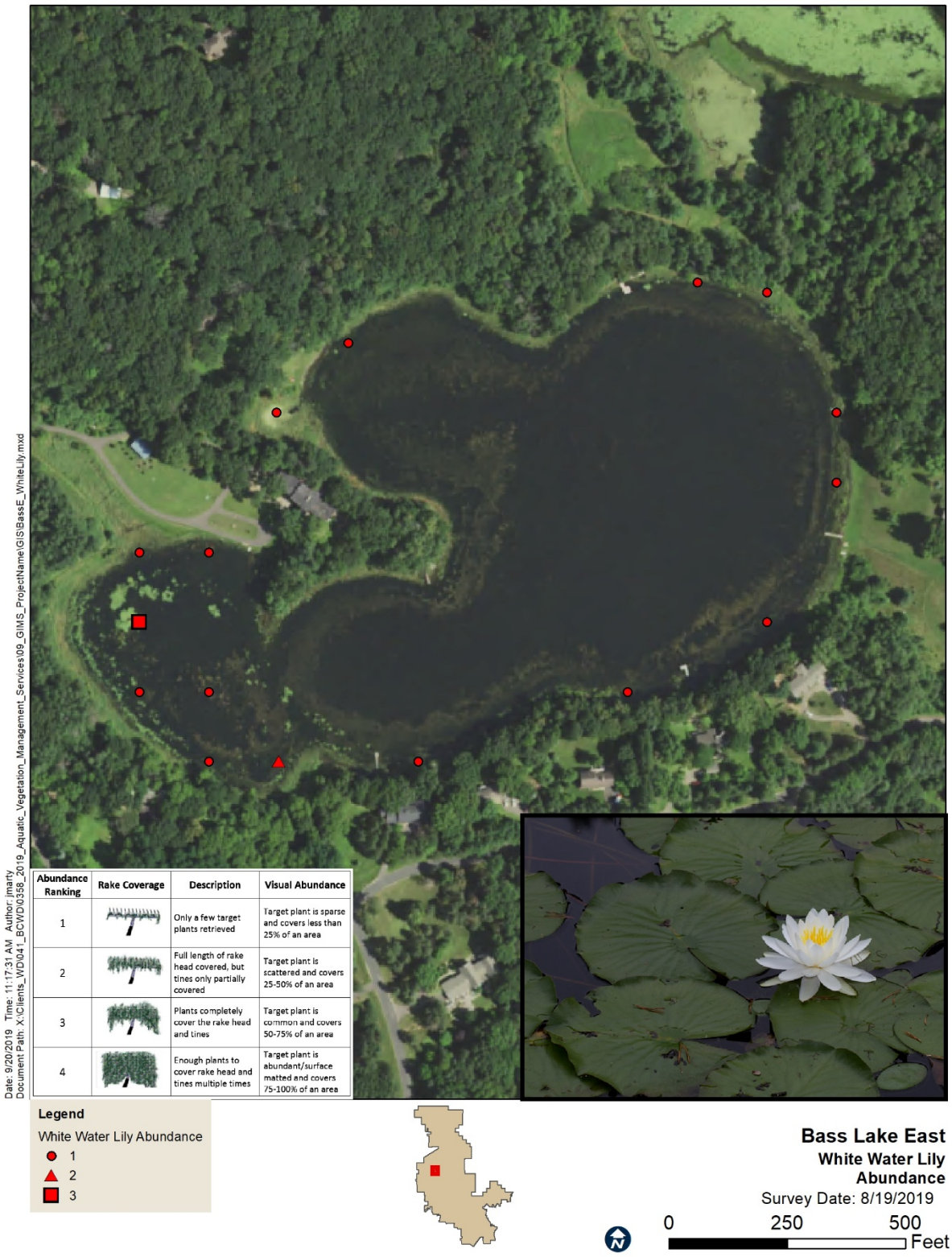

Figure 19. Bass Lake East white water lily distribution and abundance – August 2019.