Technical Memo

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To: Pokegama Lake Association
Attn: Al Johnson

From: Tom Langer, Project Biologist, Wenck Associates, Inc.
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Date: 23 June 2016

Subject: June 2016 Vegetation Community Assessment on Pokegama Lake.

Introduction

Wenck Associates, Inc. was contracted by the Pokegama Lake Association to conduct an aquatic vegetation survey to delineate the extent of curly-leaf pondweed (*Potamogeton crispus)* and other vegetation growth in Pokegama Lake in June 2016. Pokegama Lake is a large, deep lake located near the city of Pine City in Pine Country, MN. Pokegama Lake has an approximate surface area of 1,486 acres, 903 littoral acres, 9.34 miles of shoreline and a maximum depth of 25 feet. This technical memorandum summarizes the survey methodology and results of the assessment with further vegetation management considerations.

Survey Methodology

Most vegetation grows in the littoral area (< or = 15 feet depth) of a lake. A well vegetated littoral area promotes and facilitates the health of a lake's ecosystem by providing critical spawning, foraging and nursery habitat for aquatic insects, amphibians, birds and fishes. The littoral area is also an important area for recreational activities and aesthetical services to lakeshore property owners. This assessment considered all depths but focused on areas 10 feet deep or less throughout the lake. Previous vegetation surveys performed by the DNR and local knowledge suggested that depths greater than 10 feet contain little curly-leaf pondweed or other aquatic vegetation species.

Wenck staff (Tom Langer and Jeff Strom) conducted a modified point intercept field survey on June 2nd, 2016. Computer software was used to determine the number and location of sampling points throughout the lake. A 100 x 100 meter grid of survey points was overlaid on the lake for areas less than 10 feet deep. This allowed more intensive assessment of the littoral area of the lake. A 200 x 200 meter grid was created for depths greater than 10 feet, however these points were not assessed since there is little to no vegetation growth in this area of the lake.

A double sided weighted 14 tine rake was thrown from the boat and retrieved across the lake bottom to represent approximately 0.5 square meters of vegetation sampling. We refer to this as a rake toss. For each rake toss, vegetation were identified to the species level, placed in a perforated bucket, weighed and assigned a proportion of the total biomass based on visual approximation (i.e. 80% of total weight was curly-leaf pondweed). All biomass values are reported in wet weights (kg).

Continuous sonar readings were also collected during the survey trip using a Lowarance HDS Sonar/ GPS unit. This data was processed using CiBioBase software (https://www.cibiobase.com/) to map water depth and vegetation biovolume. Biovolume differs from biomass in that it provides context to vegetation water column density. The higher the biovolume the more saturated the water column is with vegetation.

Wenck used the point biomass measurements and percent occurrence information to estimate a total lake biomass for each species (Equation 1). The total lake biomass estimation uses the individual surveyed data point information to extrapolate coverage estimates across the entire basin. This is not meant to serve as an exact biomass calculation, rather, this estimate is useful to 1) make relative comparisons to other observed species, 2) be used to compare to future sampling efforts, and 3) provide general information to assist aquatic vegetation management planning.

Equation 1. Calculation of each species' total lake biomass:

$$Biomass = \%\,species\ occurence * Ave.species\ biomass/m^2\ (kg) * \ Total\ lake\ area \leq 10 feet\ (m^2)$$

Lake bathymetry information from MNDNR sources were used to define and calculate the 10 foot contour interval and area used in Equation 1. Wenck estimated the lake surface area ≤ 10 feet in depth to be approximately 406 acres.

Results

A total of 165 plant survey points were assessed on Pokegama Lake and 14 aquatic vegetation species were observed within the lake (Table 1). Curly-leaf pondweed (*P. crispus),* Eurasian watermilfoil (*M. spicatum)* and Canadian waterweed (*E. canadensis)* were the most abundant species within the lake and were the only species observed at more than 10% of the sample points (Table 1).

Table 1. Summary of species observations and biomass estimates.

Common Name:	Scientific Name:	Total Observations	% Sample Occurrence	Observed Biomass (kg)	Ave. Biomass/ Observation	Lake Estimated Biomass (kg)
curly-leaf pondweed	*Potamogeton crispus*	108	65.5	12.204	0.113	243,054
waterweed (Canadaian)	*Elodea canadensis*	80	48.5	3.507	0.044	69,837
water milfoil (Eurasian)	*Myriophyllum spicatum*	62	37.6	4.032	0.065	80,299
flat-stemmed pondweed	*Potamogeton zosteriformis*	10	6.1	0.087	0.009	1,733
water celery	*Vallisneria americana*	10	6.1	0.125	0.013	2,493
muskgrass	*Chara sp.*	8	4.8	0.073	0.009	1,450
coontail	*Ceratophyllum demersum*	3	1.8	0.299	0.100	5,945
water milfoil (northern)	*Myriophyllum sibiricum*	3	1.8	0.037	0.012	727
greater duckweed	*Spirodela polyrhiza*	2	1.2	0.015	0.007	293
duckweed (lesser)	*Lemna minor*	1	0.6	0.004	0.004	84
duckweed (star)	*Lemna trisulca*	1	0.6	0.001	0.001	16
white waterlily (common)	*Nymphaea odorata*	1	0.6	0.003	0.003	52
yellow waterlily (common)	*Nuphar variegata*	1	0.6	0.016	0.016	319
claspingleaf Pondweed	*Potamogeton richardsonii*	1	0.6	0.005	0.005	100

*Observed biomass is the total observed biomass
*Lake estimated biomass was calculated using Equation 1 (above text).

The presence of curly-leaf pondweed and Eurasian watermilfoil were wide spread across the surveyed area at variable densities (Figures 1 and 2) and across a range of depths (~1 to 13 feet); (Figures 5 through 9).

Canadian waterweed, a native species to Minnesota lakes, was relatively widespread across the basin (Figure 10) and occurred at a relatively high frequency of occurrence (48.5%). All other native species were found to occur at less than 7% of the survey points.

Conclusions

Curly-leaf pondweed

Curly-leaf pondweed is dormant through late summer and begins growing in the fall. The plant grows under the ice and reaches its maximum growth in May and June, when most native plant growth is still hindered by cool water temperatures. Since it has little competition from native species early in the year, curly-leaf pondweed can form dense stands that incorporate nutrients from the lake sediments. When the plants begin to die back (senesces) in early summer the nutrients stored in the stems and leaves of the plants are released back into the lake. The timing of the large pulse of nutrients to the lake (typically mid-summer) can cause excess algal blooms or impact water quality negatively in other ways.

Curly-leaf pondweed spreads across the lake by forming turions at the end of each stem tip in early summer which break off and fall to the lake bottom. The turions are distributed across the lake by currents and wave action and germinate into new plants in the early fall. Developing turions were observed across much of Pokegama Lake suggesting that the population of curly-leaf pondweed is still developing but nearing summer senescence.

Eurasian watermilfoil

Eurasian watermilfoil is typically large and rapidly growing species that can quickly outcompete native species for light which can lead to large monoculture stands. Eurasian watermilfoil can spread through plant fragments which are easily distributed across the lake by currents, wave action and boaters. Besides being recreational and aesthetically displeasing, dense monoculture stands of AIS are not a favorable biological community for many aquatic biota. Dense AIS stands provide a single type of habitat coverage that may benefit only a few if any species. This imbalance of habitat can result in an imbalance in the food web and reduced health in invertebrate and fish communities.

Native Submerged Vegetation

The prominence of Canada waterweed across the basin and in areas where AIS occurred is pleasing. While the presence and abundance of Canada waterweed later in the growing season is unknown, this species could provide important habitat for fishes and invertebrates after the senescence of curly-leaf pondweed. The low occurrence of other native species is concerning as the integrity and health of the lake and the aquatic food web are compromised. Local knowledge suggests that water clarity decreases as the curly-leaf pondweed dies and the growing season continues. These conditions do not favor the propagation and growth of native vegetation.

Native species often co-exist with each other and provide a robust and versatile community and habitat for aquatic biota. In the presence of AIS native species are often threatened and reduced to low frequency of abundance, compromising the integrity of the vegetation community. Native vegetation establishment is often an afterthought and typically not the primary motive for lake users, however a native dominated vegetation community should be considered a primary goal of AIS control and management objectives. The presence of native species in Pokegama Lake provides insight in to what species could be targeted to restore and protect the lake's vegetation community.

<u>Biomass estimation</u>

The majority of curly-leaf pondweed rake toss observations consisted of sparse to moderate levels of vegetation biomass (Figure 1) as there seemed to be only a few sample points that exhibited very high biomass numbers (Figure 2). There were areas on the lake that were not sampled but were visually observed to contain dense growth of curly-leaf pondweed. Not all of these areas were sampled with the plant rake due to the modified point intercept method, however, the CiBioBase heat maps presented in Figure 6-9 are able to approximate vegetation biovolume between individual sample points. With the high occurrence of curly-leaf pondweed in the lake, the 'high heat' areas on these maps likely comprise a high biomass of curly-leaf pondweed.

The Pokegama Lake Association currently implements a weed harvesting program which targets dense areas of curly-leaf pondweed and Eurasian watermilfoil growth. Thus, the biomass and biovolume results presented in this report may have changed in the weeks leading up to this survey depending on the timing and location of the harvesting operations.

We mention these limiting factors as these influence the lake biomass estimates we calculated.

<u>Species Identification</u>

There was one species collected at the northern end of the lake near the inlet of Pokegama Creek that was difficult to identify (Figure 4). This species was sent to the MNDNR for identification and to determine whether it was yellow floating heart (*Nymphoides peltata)* which is a rare invasive species. The MNDNR identified the sample as a native yellow water lily (*Nuphar sp.*). Due to the lack of prominent identifiable characteristics, Wenck and the MNDNR suggest that the area that this species was found be revisited later in the summer to confirm identification.

Figure 1. Represents a plant rake toss in an area of sparse curly-leaf pondweed with a mass of 0.08 kg (wet weight).

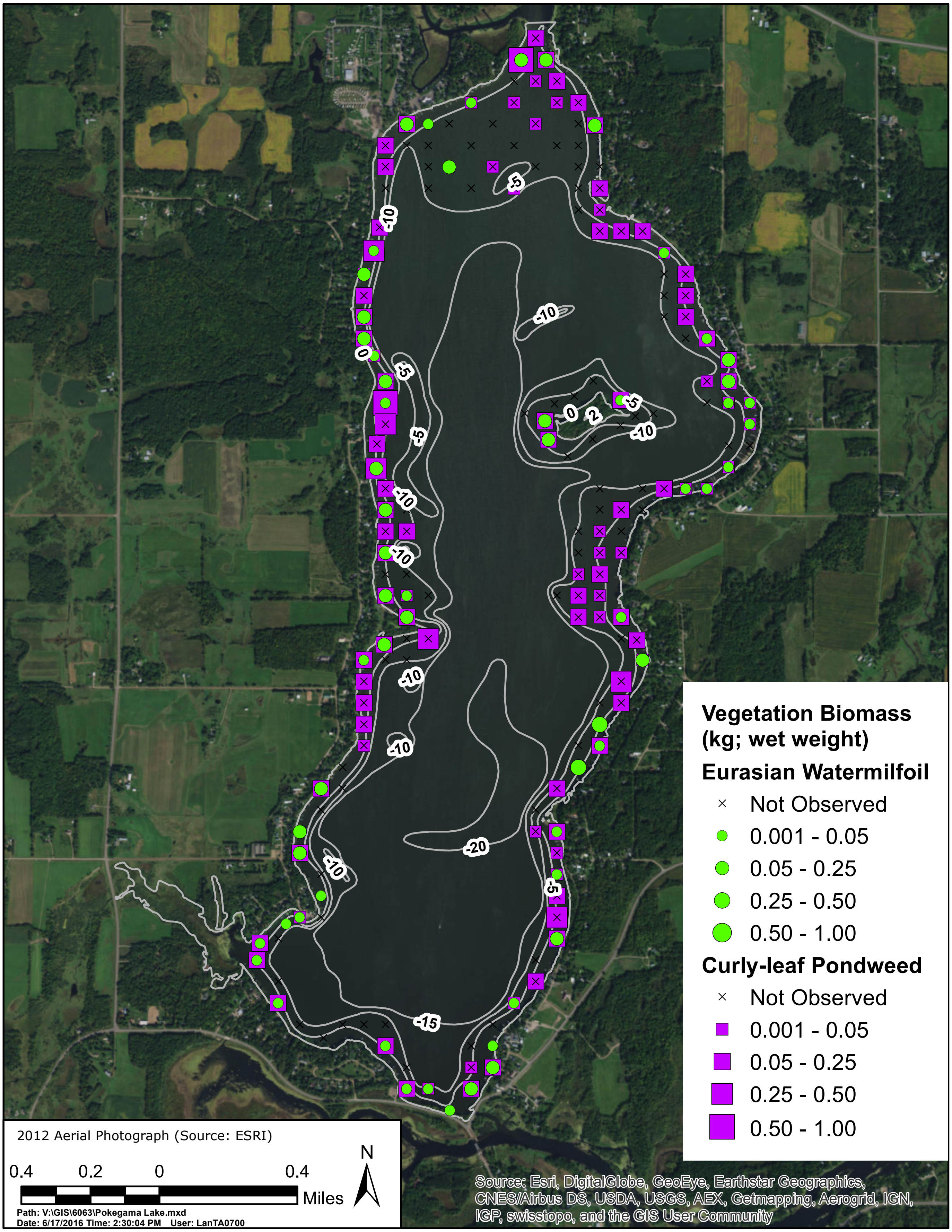
Figure 2. Represents a plant rake toss in an area of dense curly-leaf pondweed with a mass of 0.73 kg (wet weight).

Figure 3. Dense growth of curly-leaf pondweed.

Figure 4. Yellow water lily species in an early growth form. Identification was confirmed by MNDNR.

Recommended Actions:

- Urgent: Re-visit north inlet area of lake later in the summer. Verification that area is not becoming infested with invasive yellow floating heart.
- Perform a late summer vegetation point intercept survey. This information will allow for further assessment of native vegetation growth in the lake and the ability to compare biomass estimates to June assessment.
- Consider developing aquatic vegetation management plan to identify further aquatic invasive species treatment options and establishment of native vegetation. Current harvesting of dense stands of curly-leaf pondweed improve aesthetics and reduce the biomass of curly-leaf pondweed but appear to be limited in long term management of the invasive species.
- Consider assessing and developing ecosystem level management plan by evaluating the health of the fish community, vegetation community and shoreline habitat. Conducting MNDNR supported lake assessments such as fisheries IBI, vegetation FQI, Score the Shoreline and RFQA will provide a baseline evaluation of the entire lake ecosystem and the following information:
    - The current ecological health of the lake
    - Provide a platform to track changes in ecosystem health
    - Ability to compare Pokegama Lake to similar size lakes and minimally impacted lakes in the region
    - Aide in the development of ecological restoration and protection strategies for the lake



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2016 June SAV Survey		Figure 5

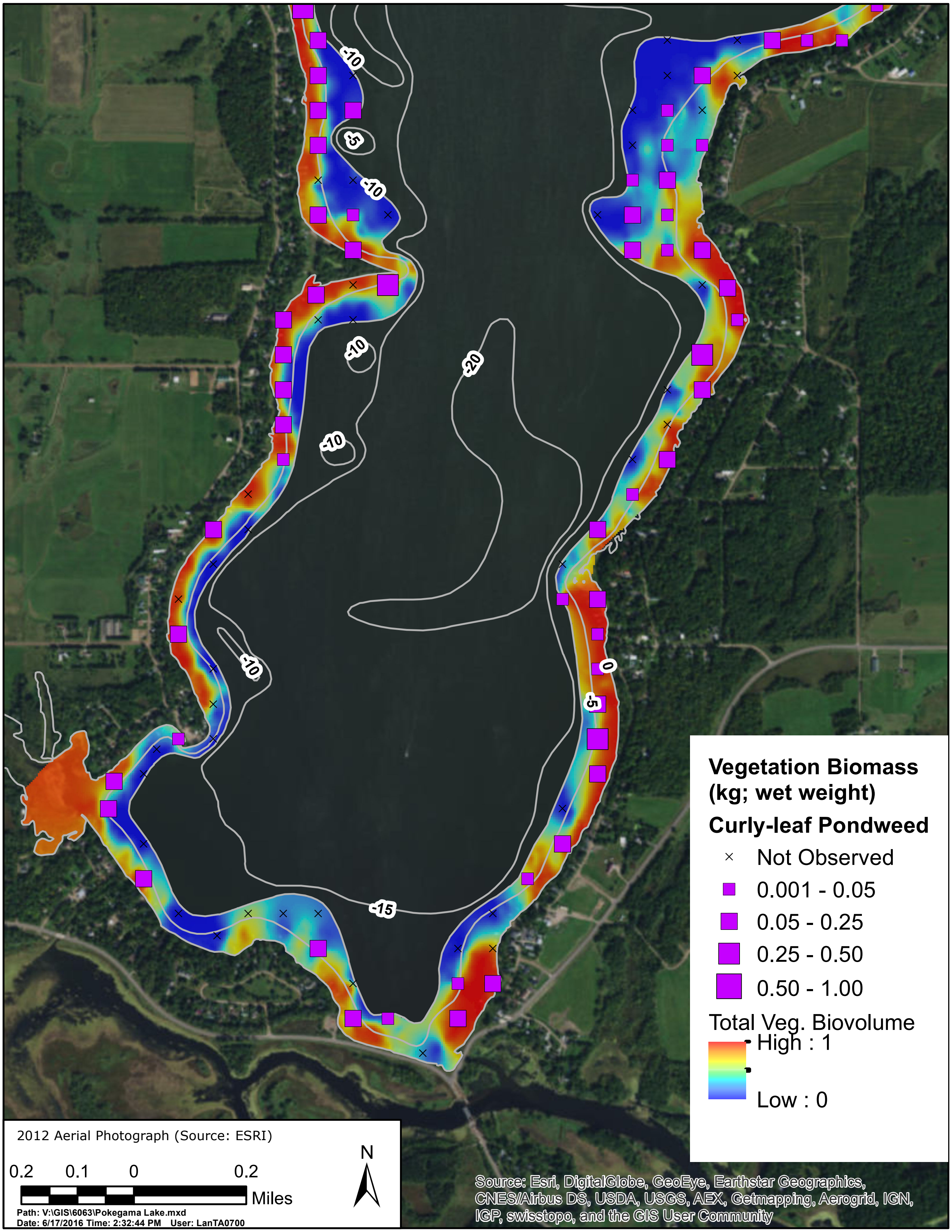

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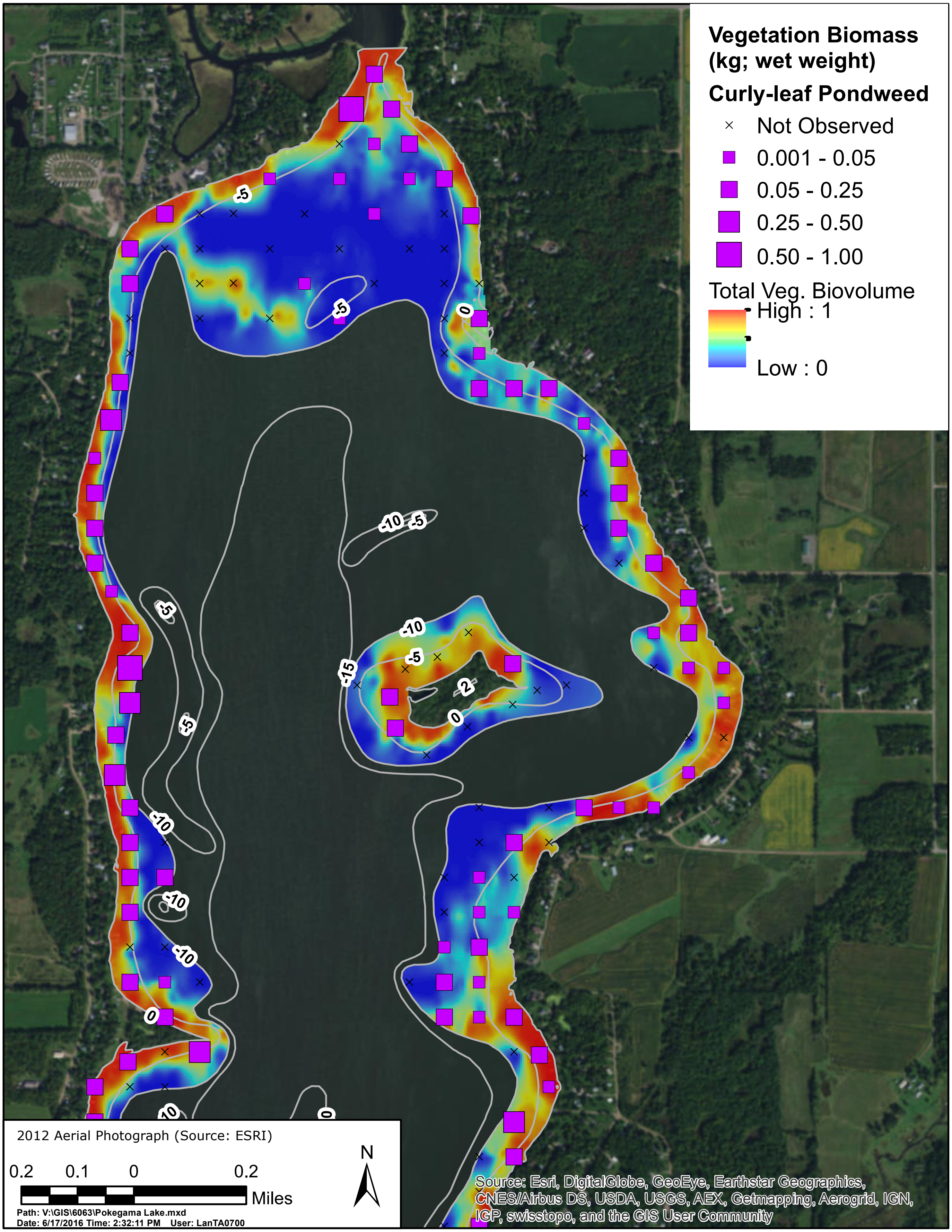
Figure 6



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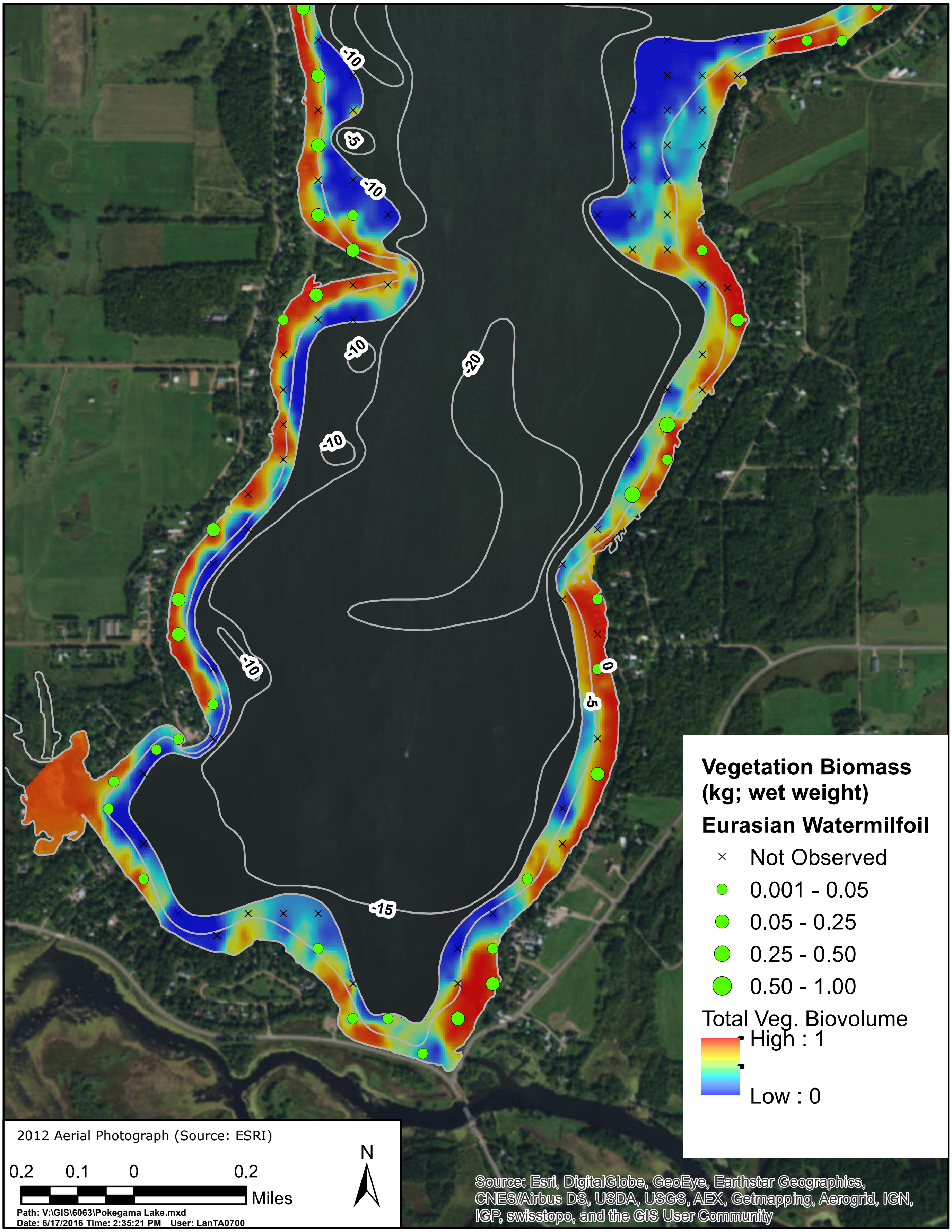
2016 June SAV Survey	Responsive partner. Exceptional outcomes.	Figure 7



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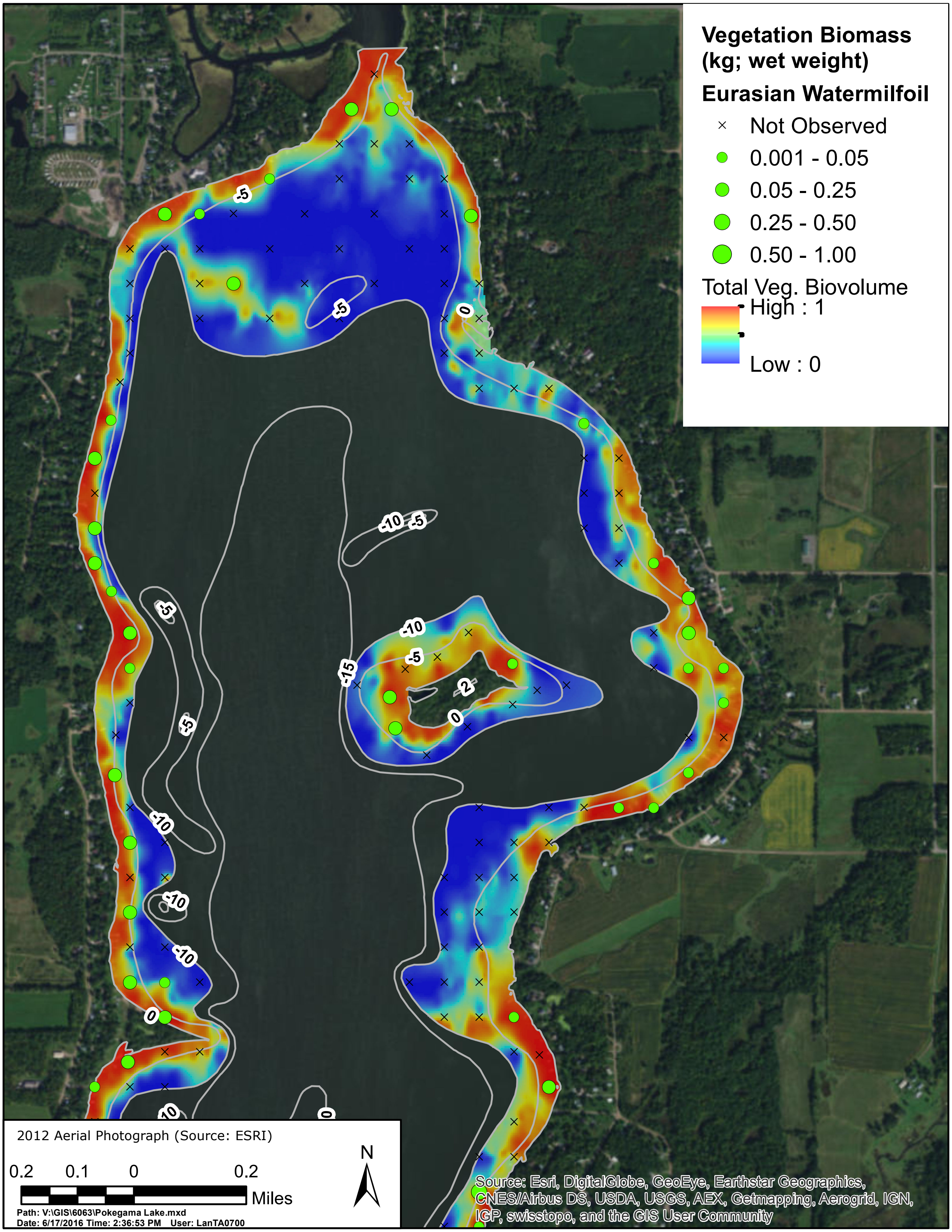

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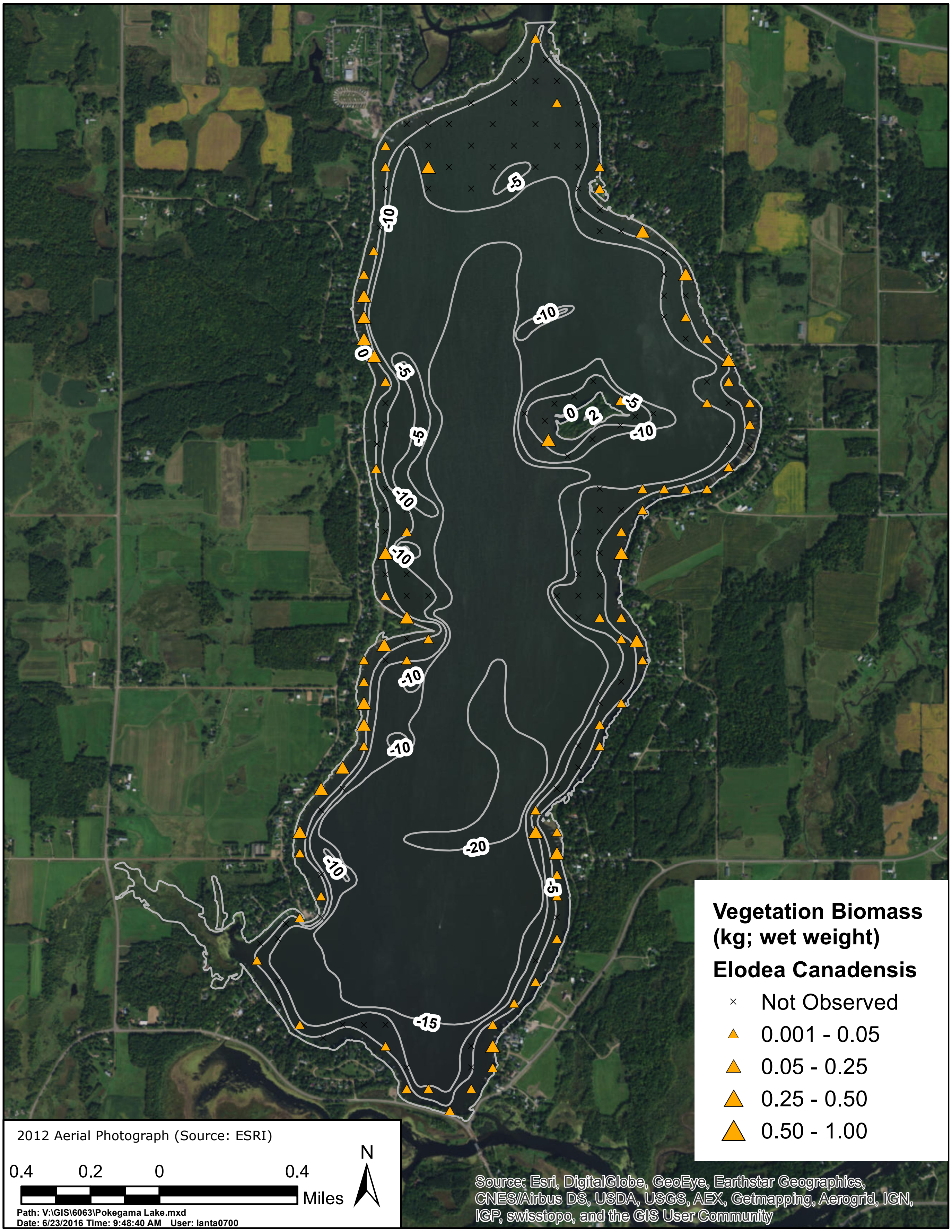

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