

Big Swan Lake, Todd County

Aquatic Vegetation Management Report

Report by the Invasive Species Program - Division of Ecological and Water Resources

Minnesota Department of Natural Resources



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Project Details

Lake: Big Swan (DOW# 77002300)

Lake Surface Area: 947 acres

Littoral Area: 397 acres

County: Todd County

Survey Type: Point-intercept

Date of Survey (most recent): July 26, 2012

Surveyor[s]:

MN DNR, Invasive Species Program (ISP): Courtney Millaway and Mark Schneider (2012)

MN DNR, Lake Ecology Unit (LEU): Donna Perleberg and Joe Backowski (2004)

RMB Laboratories, Inc. (RMBEL): Emelia Hauck and Laura Geyen (2017), Jake Anderson and Tim Randt (2013)

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Report Details

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Summary

The purpose of this report is to provide an overview of aquatic plant distribution and the management of invasive aquatic plants in Big Swan Lake, Todd County between 2005 and 2019. Historical data on water quality, invasive aquatic plant management permits and point-intercept surveys are all summarized in this report. These summaries will guide future invasive aquatic plant control projects and can evaluate changes in native plant communities.

Lake Description

Big Swan Lake is a 947-acre lake located ten miles southeast of Long Prairie in Todd County, MN. The maximum depth of water in Big Swan Lake is 45 feet, and 42% of the lake is classified as littoral. According to the Minnesota Pollution Control Agency (MPCA), there is evidence of an increasing water clarity trend of 1.1 feet per decade in Big Swan Lake from 1980 to 2018. Big Swan Lake is classified as eutrophic (fairly nutrient rich), based on its Trophic State Index (TSI) of approximately 54. The three parameters that are factored into the trophic state index are total phosphorus (nutrients in the water), chlorophyll-a (measure of the amount of algae growing in the water) and Secchi depths (water transparency). For more information on water quality, go to [Big Swan Lake's water quality data](https://cf.pca.state.mn.us/water/cmp/resultDetail.cfm?siteid=77-0023-00-201&path=wdip) on the MPCA website: (<https://cf.pca.state.mn.us/water/cmp/resultDetail.cfm?siteid=77-0023-00-201&path=wdip>).

Management History

The lake has one invasive plant species, curly-leaf pondweed (*Potamogeton crispus*). Curly-leaf pondweed was confirmed in 2004, although has likely been present in the lake for several years. Invasive aquatic plant management in Big Swan Lake has focused on curly-leaf pondweed, using an endothall herbicide. Only partial-lake treatments have taken place. The most recent treatment was for curly-leaf pondweed in 2019, organized by the Big Swan Lake Improvement District was for 53 acres (Table 1). To date, management has not reduced the areas of curly- leaf pondweed in Big Swan Lake. Pre-treatment survey data (i.e. point-intercept surveys or lake-wide delineations that can be repeatable), collected over time, would be a recommended course of action for analyzing plant abundance and distribution trends into the future.

Table 1-Invasive Plant Management Summary. Characteristics and history of partial lake invasive plant treatments for Big Swan Lake, Todd County (DOW# 77002300), Total acres: 947, Littoral acres: 397, 15% of Littoral acres: 60). CLP is an abbreviation for curly-leaf pondweed. *Note: Total acres permitted does not reflect the actual treatment or known acreage of the taxa in the lake.*

Year	Target Species	Total Acres Treated	Herbicide	Performed by
2005	CLP	25	Endothall	Lake Management
2006	CLP	20	Endothall	Lake Management
2007	CLP	35	Endothall	Lake Management
2008	CLP	55	Endothall	Lake Management
2009	CLP	39	Endothall	Lake Management
2010	CLP	47	Endothall	Lake Management
2012	CLP	38	Endothall	Lake Management
2013	CLP	43	Endothall	Lake Management
2014	CLP	56	Endothall	Lake Management
2015	CLP	56	Endothall	n/a
2016	CLP	51	Endothall	Lake Management
2017	CLP	51	Endothall	Lake Management
2018	CLP	51	Endothall	Lake Management
2019	CLP	53	Endothall	Lake Management




Survey Objectives

Point-intercept surveys were used to assess the distribution of aquatic plants in Big Swan Lake. The primary purpose for this type of survey is to 1) develop baseline knowledge of the current plant community in a lake, and over time, 2) compare year to year plant variation (in plant presence and spatial location) and 3) track invasive aquatic plants. Moreover, this survey will help the DNR and our partners to monitor native plant communities and evaluate possible responses to invasive aquatic plant management via herbicide control. It is important to note that distributions and occurrences of aquatic plants may vary from year to year due to natural variations (water clarity, snow cover, water temperatures, and natural fluctuation in plant species) or human induced alterations, such as, herbicide and shoreline management activities.

Survey Methods

In 2012, MN DNR surveyors used a point-intercept survey method developed by John Madsen in “Aquatic Plant Control Technical Note MI-02, 1999”. Sampling points were placed 110 meters apart using a Geographic Information System (Figure 1). The most recent survey was comprised of 119 points. Plant samples were collected by throwing and dragging a double-sided rake along the lake bottom at each point. All plant taxa (submerged, floating-leaf, emergent and free floating) were recorded to species or genera during the survey following Crow and Hellquist (2000). Plant samples were assessed on the boat to determine species presence-absence and abundance. The abundance rake ratings are as follows: 1: sparse, 2: common/ frequent/ occasional, and 3: abundant/matted (Table 2). Frequencies of occurrence percentages (i.e., how often a plant species was sampled in the lake) were calculated based on the littoral zone. Maximum depths were calculated at the 95th percentile for all vegetated sampling points.

Table 2. Quantitative rake abundance ranking (0-3) used to estimate plant abundance for each species based on rake coverage and/or visual observation (MN DNR). A zero (0) ranking indicates no target plants were retrieved or observed in a sample.

Abundance Ranking	Rake Coverage	Description
1		Sparse; plants covering <25% of the rake head
2		Common; plants covering 25%-75% of the rake head
3		Abundant; plants covering >75% of the rake head

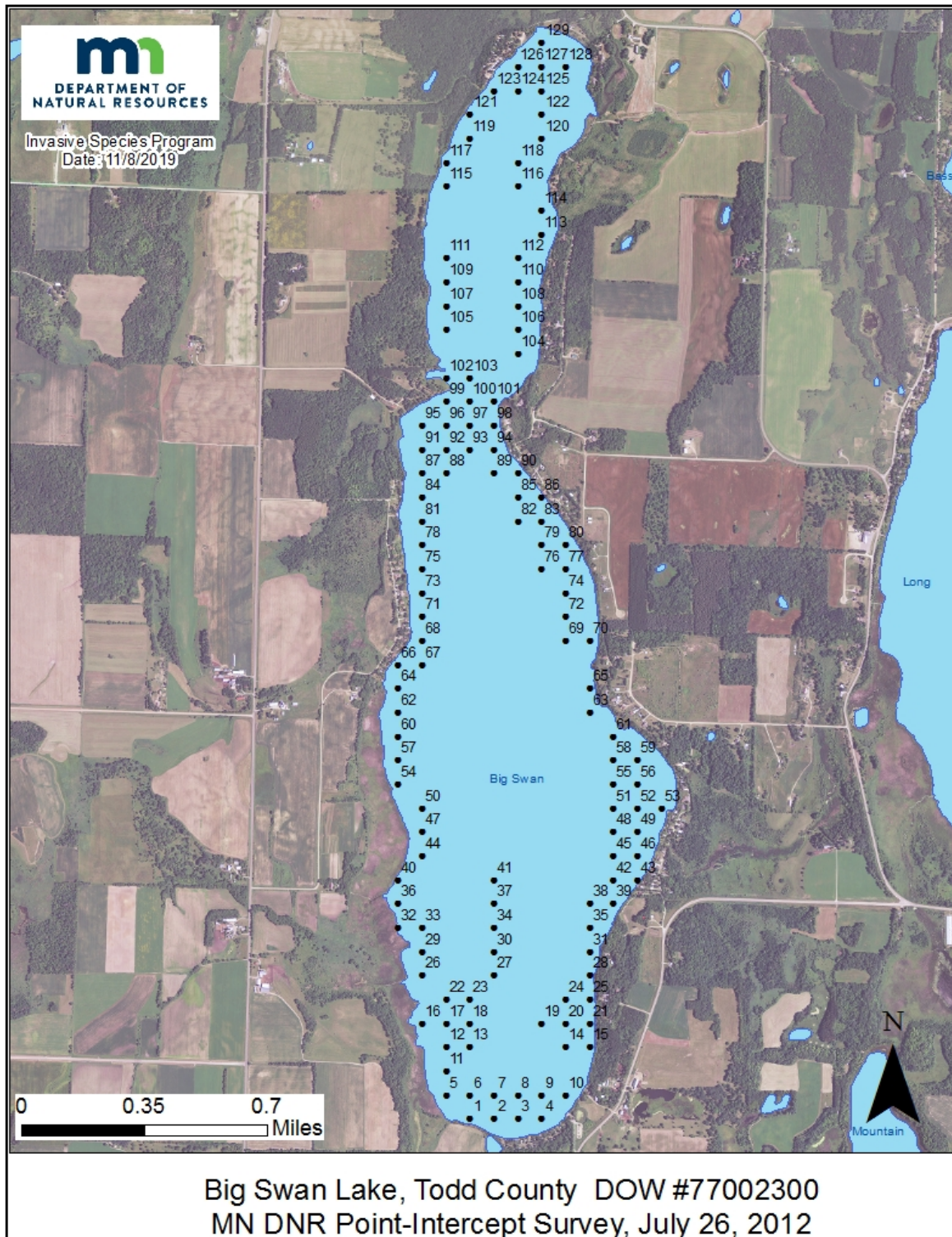


Figure 1 – Point-intercept Survey Grid. Point-intercept survey grid for Big Swan Lake, Todd County (DOW# 77002300). The points were 110 meters apart, totaling 119 points in 2012.

Survey Observations

The most recent aquatic vegetation point-intercept survey conducted by MN DNR for Big Swan Lake (DOW #77002300) occurred on July 26, 2012. Plants were rooted to a maximum depth (95%) of 8.8 feet, with depths ranging from 1.0 to 15.2 feet. However, it was very rare to find any rooted plants deeper than 9 feet. In the littoral zone (water depth from 0 to 15 feet, where aquatic plants are likely to be found), 65% of the points had submersed native vegetation (Table 3) with a mean submersed native taxa per point of 1.3. Big Swan Lake has up to 11 submersed native taxa (Table 4) and one non-native submerged taxa (curly-leaf pondweed) comprising of 2% of the littoral area. The percent frequency of curly-leaf pondweed will vary depending on the timing of the survey. The most recent survey in 2017 by RMB Labs, indicated 42% of the sampling points had curly-leaf pondweed during a late June survey. Figure 2 displays the frequency and distribution of curly-leaf pondweed among surveys.

Table 3- Point-intercept Metrics. Summary of point-intercept metrics for Big Swan Lake, Todd County (DOW# 77002300). Shaded values were calculated from littoral depth range (0-15 feet).

Metric	JUNE 2004	JULY 2012
Surveyor	MN DNR (LEU)	MN DNR (ISP)
Total # Points Sampled	217	119
Depth Range of Rooted Veg (ft.)	n/a	1.0-15.2
Max Depth of Growth (95%) in ft.	n/a	8.8
# of Vegetated Points in Max Depth Range	180	84
# Points in Littoral (0-15 feet)	171	97
% Points with Submersed Native Taxa	68	65
% Points with Submersed Non- native Taxa	80	2
Mean Submersed Native Taxa per Point	1.4	1.3
# Submersed Native Taxa	16	11

Based on the 2012 point-intercept survey, the native plant community within the littoral area in Lake was primarily dominated by muskgrass (*Chara* sp., Figure 3) following by star duckweed (*Lemna trisulca*), and flat-stemmed pondweed (*Potamogeton zosteriformis*; Figure 4). These aquatic plants are central to a healthy fish population, offering shelter and providing food and habitat to wildlife. The most dominant emergent aquatic plant in Big Swan Lake is bulrushes (Figure 5). Emergent plants are especially good at preventing shoreline erosion, habitat and provides food sources for waterfowl. Plants also absorb nutrients and reduce algae, thereby

improving water quality. Figure 6 displays the species richness distribution in Big Swan Lake. The invasive aquatic plant surveyed in the lake was curly-leaf pondweed.

Comparison to previous years

Aquatic plant surveys on Big Swan Lake also occurred in 2004, 2013, and 2017. The only aquatic plant survey completed by the MN DNR AIS program and the focus of this report, occurred in 2012. RMB Environmental Laboratories conducted the most recent point-intercept surveys in 2013 and 2017, while the DNR Lake Ecology Unit conducted the earliest survey in 2004. Among the survey years, the dominant native plant species (muskgrass) had remained relatively consistent. Curly- leaf pondweed has fluctuated but is also prevalent in Big Swan Lake. When comparing survey years, it is important to note when the survey was conducted. For example, curly- leaf pondweed peak abundance is June, although for most native aquatic plants, mid to late summer is the best time to evaluate native aquatic plant communities.

Table 4- Plant Frequency of Occurrence. Percent frequency of occurrence for observed plant species sampling depths varied among years. The survey depths (feet) vary by year and are as followed: (2004: 0-25 feet; 2012: 0-26 feet; 2013: 0 -20 feet; 2017: 0-20 feet) in Big Swan Lake, Todd County (DOW# 77002300).

Taxonomic Name	Common Name	JUNE 2004 (MN DNR LEU)	JULY 2012 (MN DNR ISP)	MAY 2013 (RMBEL)	JUNE 2017 (RMBEL)
SUBMERSED NON-NATIVE					
<i>Potamogeton crispus</i>	curly-leaf pondweed	64	2	30	42
SUBMERSED NATIVE					
<i>Bidens beckii</i>	water marigold	<1	0	0	0
<i>Ceratophyllum demersum</i>	coontail	23	18	10	30
<i>Chara</i> sp.	muskgrass (genus)	23	31	23	54
<i>Drepanocladus</i> sp.	water moss species	2	0	0	2
<i>Elodea canadensis</i>	Canada waterweed	0	1	1	5
<i>Heteranthera dubia</i>	water stargrass	P	0	0	<1
<i>Hippuris vulgaris</i>	maretail	P	0	0	0
<i>Myriophyllum sibiricum</i>	northern watermilfoil	6	3	2	6
<i>Nitella</i> sp.	native stonewort species	0	0	0	1
<i>Potamogeton amplifolius</i>	large-leaf pondweed	1	1	0	0
<i>Potamogeton epihydrus</i>	ribbon-leaf pondweed	P	0	0	0
<i>Potamogeton friesii</i>	Fries' pondweed	0	0	0	7
<i>Potamogeton illinoensis</i>	Illinois pondweed	1	0	3	1
<i>Potamogeton praelongus</i>	white-stem pondweed	5	4	<1	5
<i>Potamogeton richardsonii</i>	clasping-leaf pondweed	5	8	0	13
<i>Potamogeton</i> spp.	narrow-leaf pondweed	19	7	0	5
<i>Potamogeton zosteriformis</i>	flat-stemmed pondweed	13	21	7	19
<i>Ranunculus</i> sp.	white water buttercup	6	0	<1	5
<i>Stuckenia pectinata</i>	sago pondweed	3	8	0	2
<i>Utricularia</i> sp.	bladderwort species	3	2	1	13
<i>Vallisneria americana</i>	wild celery	<1	0	0	2
<i>Zosterella dubia</i>	water stargrass	2	0	0	0
EMERGENT					
<i>Equisetum fluviatile</i>	horsetail	P	0	0	1

Taxonomic Name	Common Name	JUNE 2004 (MN DNR LEU)	JULY 2012 (MN DNR ISP)	MAY 2013 (RMBEL)	JUNE 2017 (RMBEL)
<i>Phragmites australis</i>	cane	<1	0	0	0
<i>Sagittaria sp.</i>	arrowhead species	P	0	0	0
<i>Schoenoplectus sp.</i>	bulrush species	20	19	0	34
<i>Typha sp.</i>	cattail species	1	11	4	2
<i>Zizania palustris</i>	wild rice	3	4	0	3
FLOATING LEAF					
<i>Nuphar variegata</i>	yellow waterlily	7	15	0	21
<i>Nymphaea odorata</i>	white waterlily	3	8	0	32
<i>Potamogeton natans</i>	floating-leaf pondweed	P	0	0	<1
FREE-FLOATING					
<i>Lemna triscula</i>	star duckweed	33	26	40	0

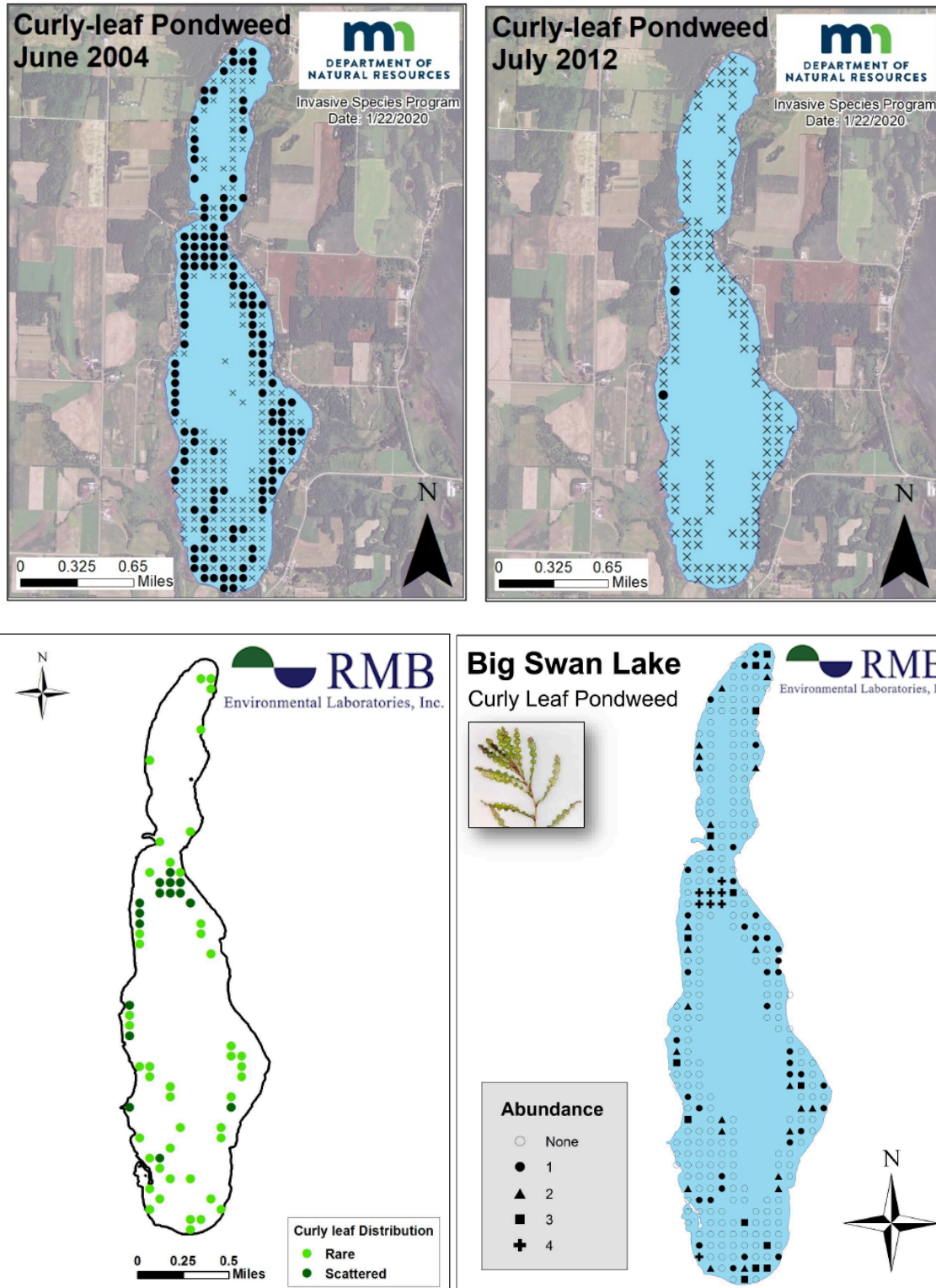


Figure 2 – Curly-leaf pondweed Distribution. Distribution from the 2004, 2012, 2013, and 2017 point-intercept surveys for curly-leaf pondweed in Big Swan Lake, Todd County (DOW# 77002300). For the 2004 and 2012 maps, an “X” indicates that no curly-leaf pondweed was present and a black circle indicates that curly-leaf pondweed was present.

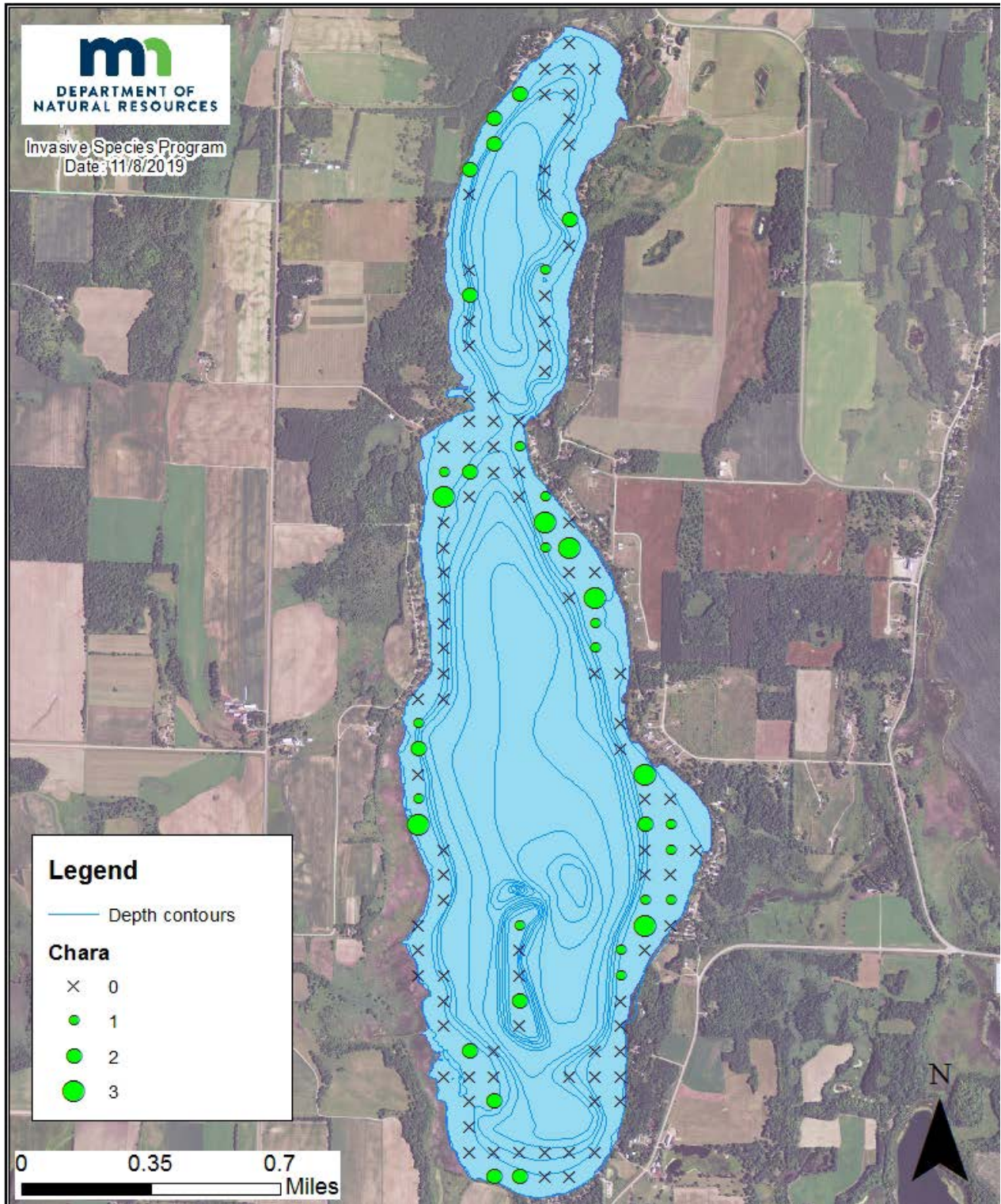


Figure 3 – Muskgrass Distribution. Distribution from the 2012 point-intercept survey for muskgrass in Big Swan Lake, Todd County (DOW# 77002300).

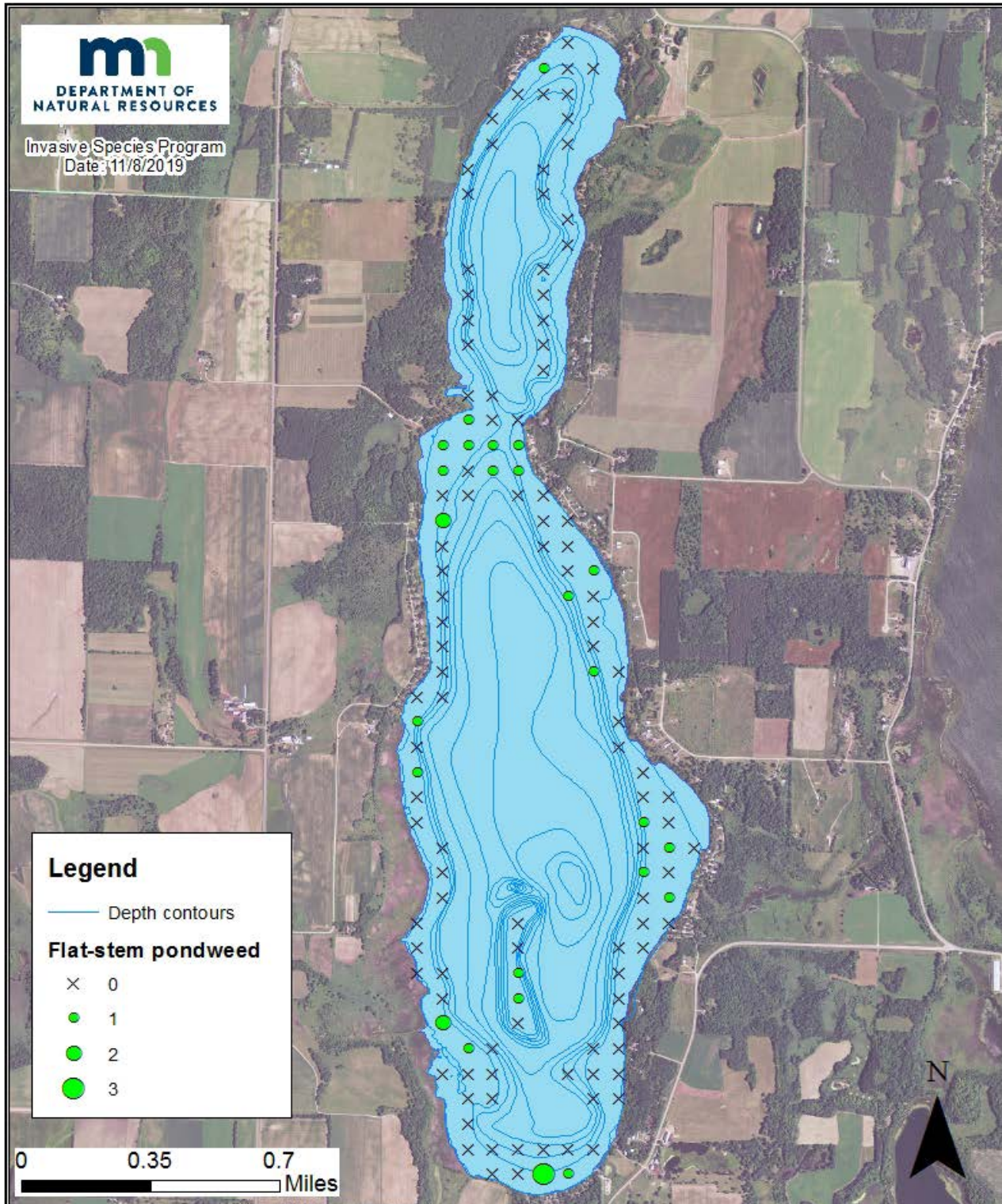


Figure 4 – Flat-stemmed pondweed Distribution. Distribution from the 2012 point-intercept survey for flat-stemmed pondweed in Big Swan Lake, Todd County (DOW# 77002300).

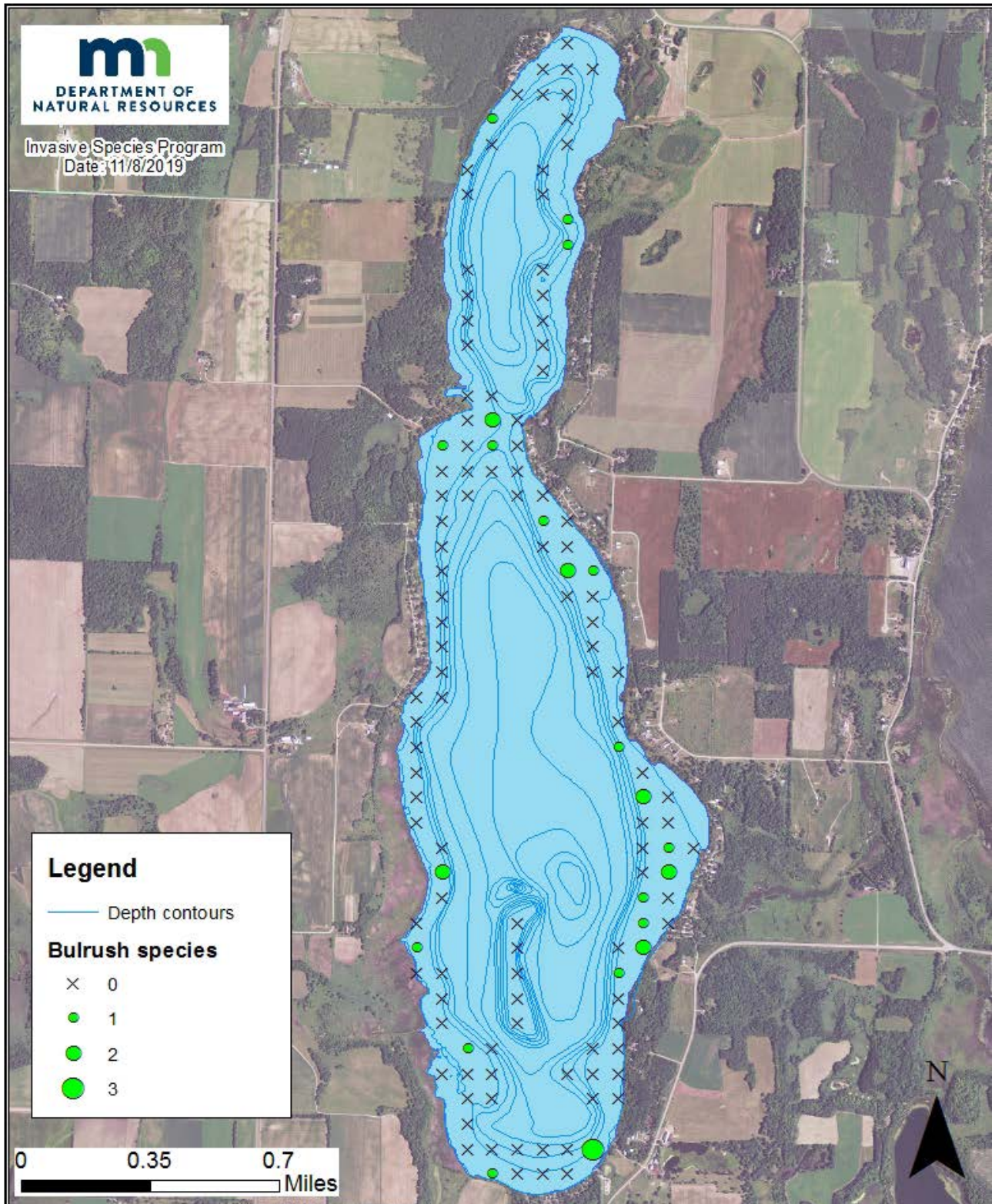


Figure 5 – Bulrush Distribution. Distribution from the 2012 point-intercept survey for bulrush species in Big Swan Lake, Todd County (DOW# 77002300).

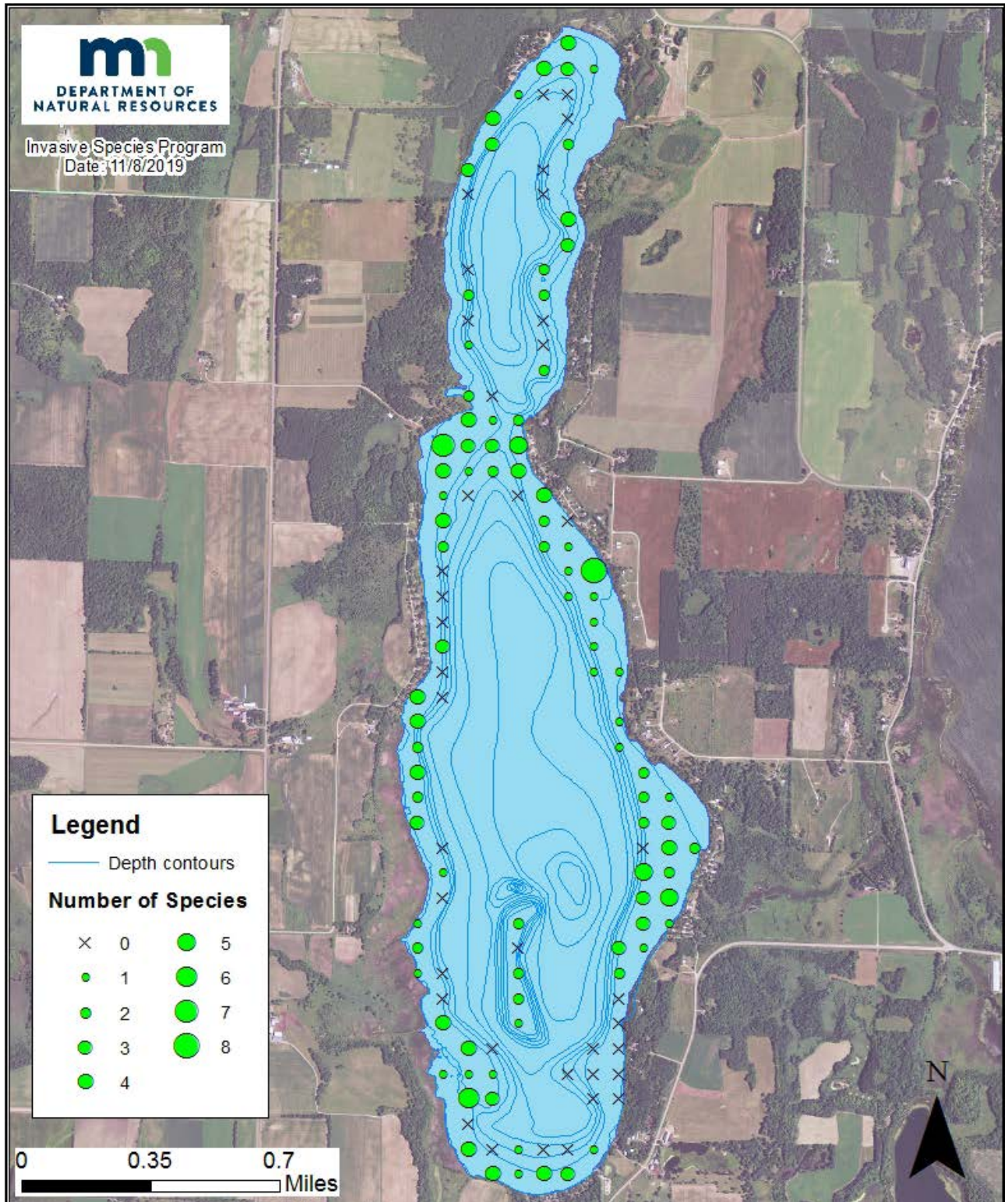


Figure 6 – Species Richness Distribution. Species abundance from the 2012 point-intercept survey in Big Swan Lake, Todd County (DOW# 77002300).

Literature Cited

Anderson, J and T. Randt. 2013. Big Swan Lake (77-0023-00) Aquatic Vegetation Survey June 3, 2013. RMB Environmental Laboratories, 22796 County Highway 6, Detroit Lakes, MN 56501. 13 pp.

Crow, G.E. and C.B. Hellquist. (2000). *Aquatic and wetland plants of Northeastern North America*. (Vols. 1 & 2). Madison, WI: The University of Wisconsin Press.

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