# Lake Water Quality Program

## Environmental Planning Initiatives

# St. Charles Lake Aquatic Vegetation Mapping Report 2017 and 2022

www.city.greatersudbury.on.ca

## Overview

The City of Greater Sudbury contains over 330 freshwater lakes, more than any other municipality in Canada. These lakes provide citizens and tourists with a vast array of recreational opportunities and are a drinking water source for many lakeshore residents. Over the last few decades, local lakes have come under threat of several aquatic invasive species, including Eurasian Watermilfoil, an aggressive, dense-growing aquatic plant that can have negative effects on aquatic wildlife and recreational activities. Currently, Eurasian Watermilfoil (EWM) is present in 18 Greater Sudbury lakes.

For the past few years, the City's Lake Water Quality Program has undertaken several education and awareness campaigns on aquatic invasive species and these efforts continue to expand. In 2017, the Lake Water Quality Program repeated the aquatic vegetation mapping efforts originally conducted in 2014 on several local lakes to better understand the spread and impact of Eurasian Watermilfoil. An updated, more rigorous, and robust sampling protocol was developed that resulted in identifying native and invasive aquatic plant species within the survey lakes. The protocol consists of systematic, quantitative, and replicable sampling to track changes in the extent of all aquatic plant species in the sampled lakes over time. This report reviews the 2017 and 2022 aquatic vegetation mapping undertaken on St. Charles Lake and assesses the effectiveness of the protocol.

## Lake Description

St. Charles Lake is in Broder and McKim townships in the Junction Creek Watershed. The lake has a total surface area of 41.3 hectares, a shoreline perimeter of 5.1km and a maximum depth of 6m [1]. The lake's north, east and south shores are developed with residential properties while the western shoreline is currently undeveloped. There are currently 99 developed residential properties, 3 islands with seasonal properties, 1 institution and 1 municipal park on the lake. St. Charles Lake has no public boat launches although canoes and kayaks can access the lake through the municipal park on Brenda Drive. Several of the lake's residents operate their motorized boats and personal watercraft for recreational activities.

The City of Greater Sudbury has conducted spring phosphorus sampling on St. Charles Lake since 2001 to monitor the trophic status of the lake. The average spring total phosphorus value between 2001-2021 (Figure 1) is 11.85 µg/L, which indicates that the lake is moderately productive (mesotrophic).

An urban lakes fisheries study was conducted in 2014 on St. Charles Lake by staff and students of the Cooperative Freshwater Ecology Unit using the Nordic Index Netting protocol. Species found included Brown Bullhead (*Ameiurus nebulosus*), Northern Pike (*Esox Lucius*), Pumpkinseed (*Lepomis gibbosus*), Walleye (*Sander vitreus*) and Yellow Perch (*Perca* flavescens). Iowa Darter was found in previous surveys in 1990 and 2009 but was not found during the 2014 survey [2].

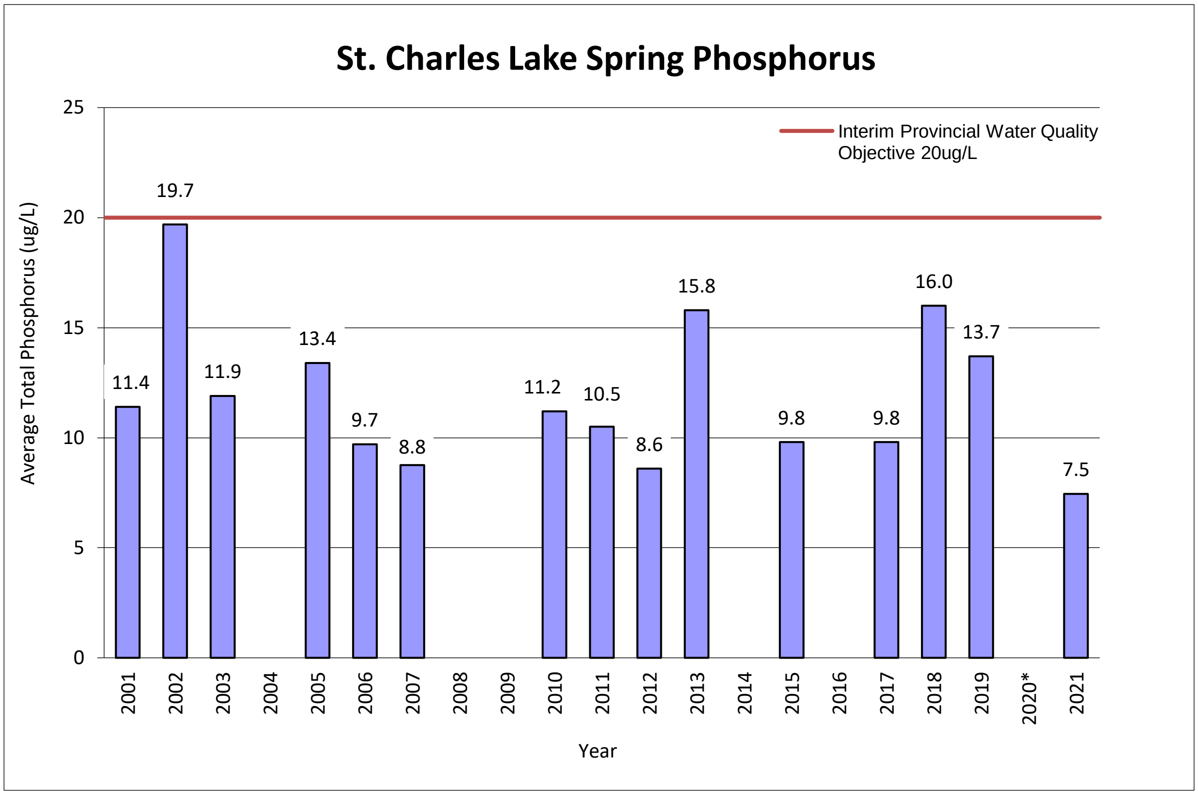



**Figure 1.** St. Charles Lake spring phosphorus results taken by the City of Greater Sudbury

## Methodology

The Lake Water Quality Program's aquatic vegetation sampling protocol was modified from the baseline monitoring protocol developed by the Wisconsin Department of Natural Resources [3]. This protocol employs a point-intercept sampling design that overlays a number of geo-referenced points in a grid pattern over the lake to ensure that year over year results are comparable. The sampling protocol permits the assessment of all aquatic plant species as well as an estimation of species richness, frequency, abundance, and maximum depth of colonization within the lake. The 2017 survey of St. Charles Lake was the first year this survey technique was used and as such only species presence/absence was recorded at each site. In addition to species presence/absence, the 2022 survey recorded dominant species and relative density of total vegetation at each sampling location.

### Point Intercept Map

The protocol outlines the basic information needed to create an evenly distributed grid that is overlaid onto a lake's littoral areas to ensure consistent mapping throughout the water body. The littoral areas of a lake are those where sunlight can penetrate down to the sediment where the most abundant plant growth is found. The sampling protocol developed for these surveys defines the littoral area as occurring in 6 meters, ~20ft, of water depth or less.

The sampling grid resolution was calculated from the following factors: 1) the lake's area in hectares, 2) the percentage of the lake's littoral area, and 3) the shoreline development factor or 'SDF'. The SDF is the ratio of the length of the shoreline to the circumference of a circle equal in area to that of the lake; it is not a measure of housing development on a given lake [4]. A higher SDF signals greater complexity of a given shoreline, which allows for increased development of the aquatic plant communities in the littoral area.

Following the protocol, the number of sampling locations on St. Charles Lake was determined to be 304 points, see Figure 2. The number of sampling points was then used to create an evenly disturbed grid onto the littoral areas of the lake. Each point is geo-referenced using NAD83 UTM coordinates (see Appendix A – Coordinates).

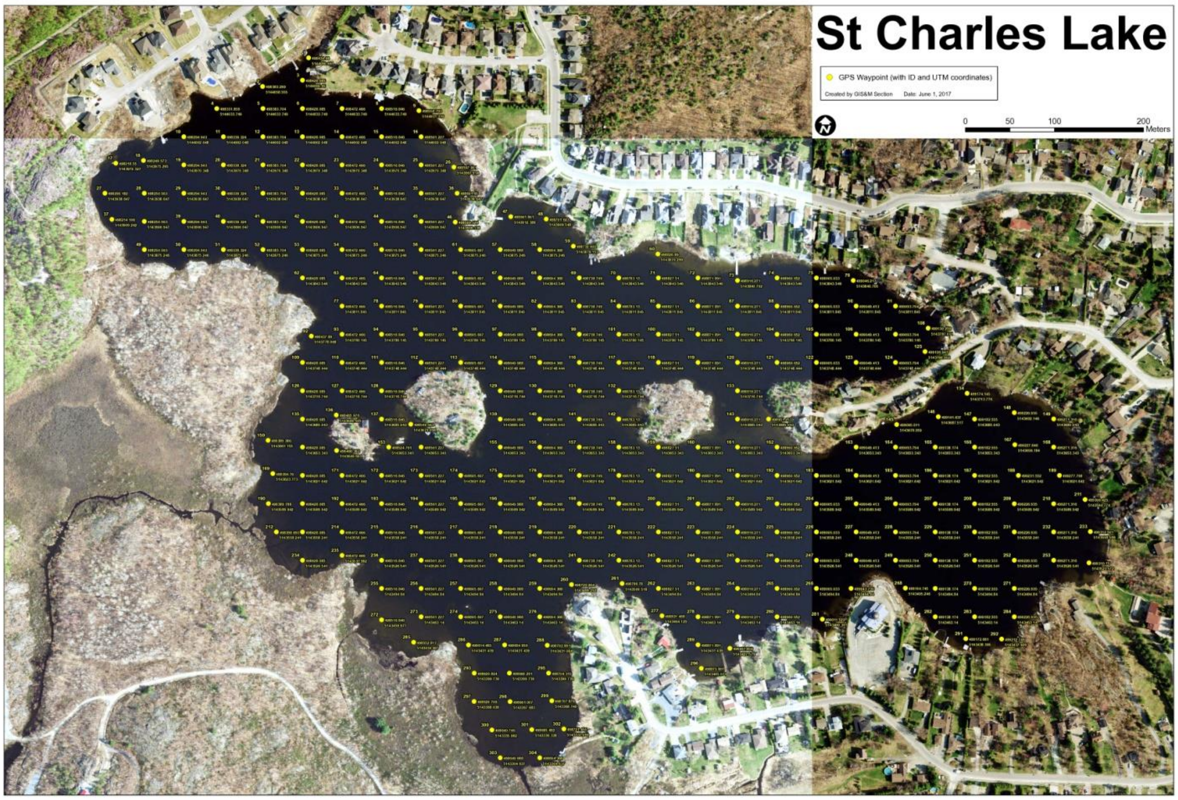



**Figure 2.** Map of geo-referenced sampling points for St. Charles Lake used for 2017 and 2022 aquatic plant surveys.

## Field Survey Techniques & Equipment

Field surveys for the aquatic vegetation mapping require relatively little equipment. Foremost is the rake sampler, which comes in many forms. The City uses the same rake sampler for each lake to ensure consistency. The rake sampler used is a 19-tine thatching rake with the head removed and secured to a 50’ section of rope, see Figure 3. The thatching rake was selected for its double-sided design, low cost and its ability to effectively remove and hold aquatic vegetation while sampling. A Garmin GPSMAP 64S handheld global positioning system, GPS, was used to navigate to each sampling location. The location reported by the GPS is accurate to within 15 meters and will generally have accuracy within 5 to 10 meters under normal conditions [5].

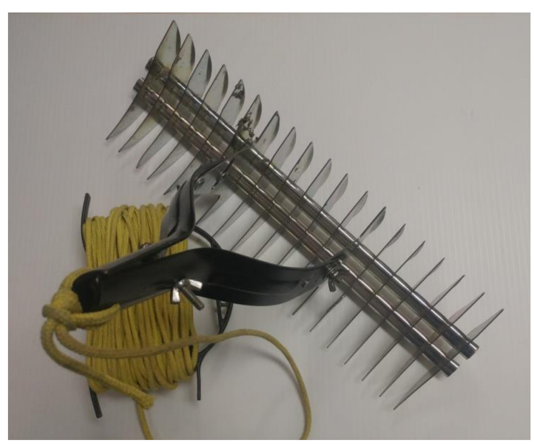


**Figure 3.** Modified thatching rake used for aquatic vegetation sampling.

## Field Surveys

Aquatic vegetation sampling on St. Charles Lake in 2017 took place between July 31 and August 8 and between August 9 and August 12 in 2022. The sampling period ensured that the aquatic vegetation within the lake was near peak growth and comparable year over year. At each sampling point, the rake was tossed into the water within 1-3 meters of the watercraft and dragged across the substrate before being pulled into the watercraft. Rake fullness/vegetation density was recorded in 2022 to determine density of overall plant growth at each site with individual species being recorded and identified. Rake fullness/vegetation density measurements were not made during the 2017 survey. After each rake toss, the watercraft was relocated to compensate for any movement that may have occurred. A total of three (3) rake tosses were completed at each sampling point to ensure an accurate representation of plant community at each site.

The presence/absence data for each species recorded during the surveys was then compiled and overlaid onto geo-referenced satellite imagery using ERSRI ArcGIS software to create a visualization of the extent of each species within the waterbody. A map was also created for density/fullness along with a map for dominant species at each sampling location. An example of these maps can be found in Figure 4 below and the full set of maps from the 2017 and 2022 surveys can be found in Appendix B and C respectively.

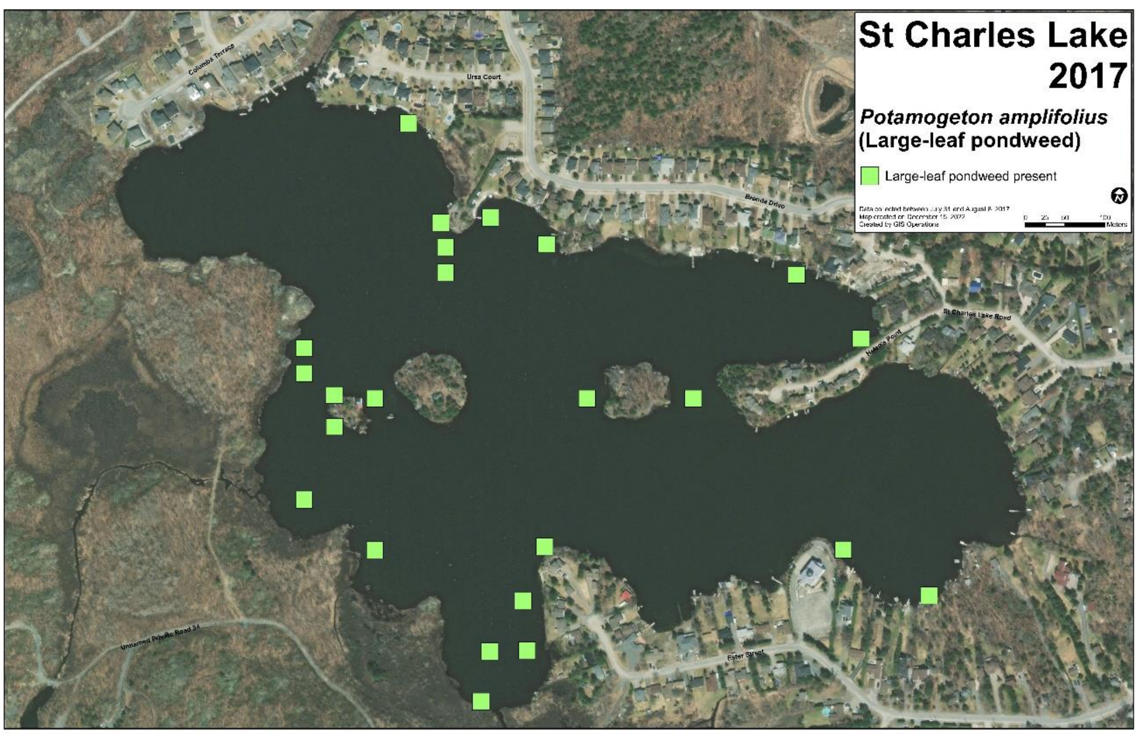



**Figure 4.** Map showing the presence of *Potamogeton amplifolius* in St. Charles Lake, 2017.

# Results

A total of 18 and 16 aquatic plant species were recorded in 2017 and 2022 respectively across the 304 sampling locations on St. Charles Lake. The total number of sampling points in which each aquatic plant species was present is shown in Table 1. The four most frequent species recorded in the lake in both 2017 and 2022 are Eurasian Watermilfoil (*Mryiophyllum spicatum*), *Nitella spp*. (recorded as Muskgrass [*Chara spp.*] in 2017 report), Slender Pondweed (*Potamogeton pusillus*) and Northern Watermilfoil (*Myriophyllum sibiricum*).

Density/fullness of the aquatic vegetation samples was first recorded for St. Charles Lake in 2022. This measure was based on the average amount of vegetation coverage on the three rake tosses done at each site. These results were recorded as sparse, moderate, dense or no vegetation, the guide used for the fullness/density ratings, along with images of field examples can be found in Appendix D. A map of the density/fullness of each site for the 2022 surveys can be found in Figure 5. In total, 26% of sampling sites had sparse vegetation density, 35% had moderate vegetation density and 31% of sites had a dense vegetation rating. The remaining 8% of sites had no aquatic vegetation.

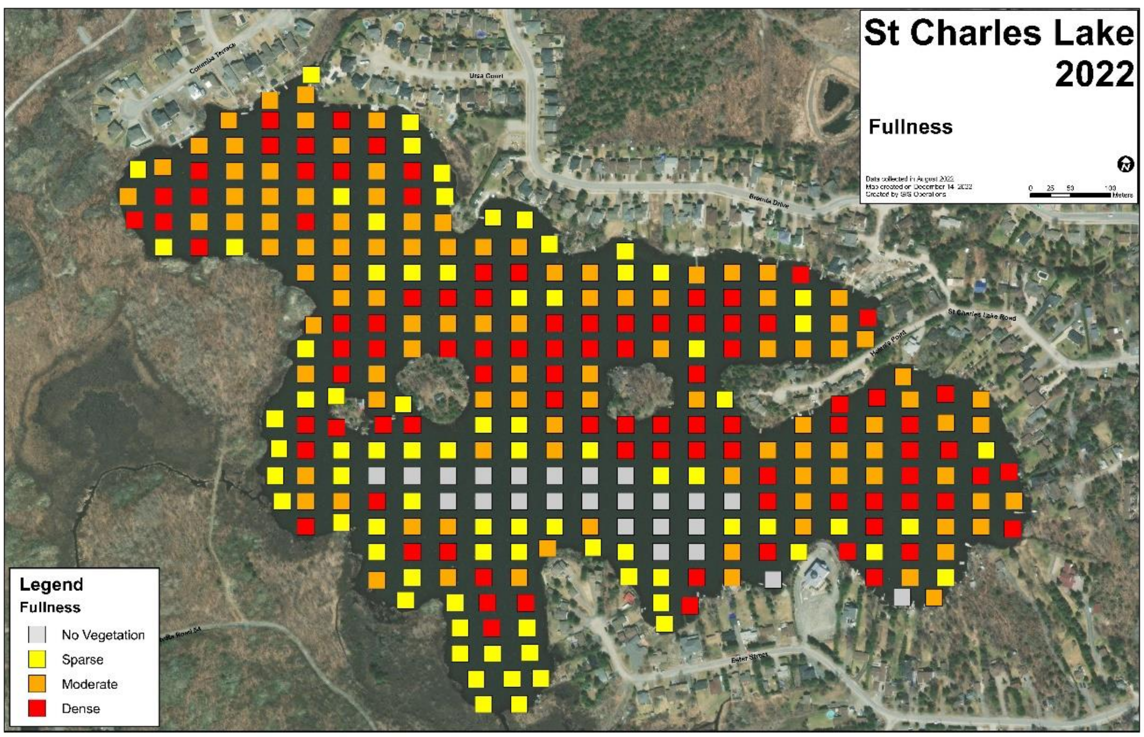



**Figure 5.** Fullness/Density of aquatic vegetation in St. Charles Lake 2022.

The 2022 survey introduced dominant species to the set of parameters measured during the St. Charles Lake surveys which was not recorded in original 2017 survey. Dominant species was estimated at each site based on frequency of occurrence and density of each species averaged over the three rake tosses. *Myriophyllum spicatum* was the dominant species at 105 sampling sites, followed by *Potamogeton pusillus* at 73 sites, *Nitella spp.* at 68 sites and *Myriophyllum tenellum* at 14 sites. A total of 13 species were dominant at one or more sampling locations during the surveys. Six sampling sites had no discernable dominant species. See Table 2.

**Table 1.** 2017 and 2022 St. Charles Lake Survey Results

| Common Name | Scientific Name | # of Sampling Points Present - 2017 | # of Sampling Points Present - 2022 |
|---|---|---|---|
| **Eurasian Watermilfoil** | ***Myriophyllum spicatum*** | **197** | **170** |
| **Nitella** | ***Nitella spp.*** | **161** | **140** |
| **Slender Pondweed** | ***Potamogeton pusillus*** | **154** | **138** |
| **Northern Watermilfoil** | ***Myriophyllum sibiricum*** | **103** | **65** |
| Largeleaf Pondweed | *Potamogeton amplifolius* | 24 | 16 |
| Slender Watermilfoil | *Myriophyllum tenellum* | 23 | 40 |
| Common Pipewort | *Eriocaulon aquaticum* | 20 | 10 |
| Spiny-spore Quillwort | *Isoetes echinospora* | 10 | 3 |
| Yellow Water-lily | *Nuphar lutea* | 8 | 6 |
| White Water-lily | *Nymphaea odorata* | 7 | 5 |
| Richardson's Pondweed | *Potamogeton richardsonii* | 6 | 7 |
| Nodding Waternymph | *Najas flexilis* | 3 | 6 |
| Canadian Waterweed | *Elodea canadensis* | 2 | 10 |
| Wild Celery | *Vallisneria americana* | 2 | 0 |
| Sweet Gale | *Myrica gale* | 1 | 1 |
| Watershield | *Brasenia schreberi* | 1 | 0 |
| Water Smartweed | *Persicaria amphibia* | 1 | 0 |
| Leafy Pondweed | *Potamogeton foliosus* | 1 | 0 |
| Rush | *Juncus spp* | 0 | 1 |
| Variable-leaf Pondweed | *Potamogeton gramineus* | 0 | 2 |

**Table 2.** Number of sites with dominant species during 2022 surveys

| Species Name | # of Sites Where Dominant |
|---|---|
| *Myriophyllum spicatum* | 105 |
| *Potamogeton pusillus* | 73 |
| *Nitella spp.* | 68 |
| *Myriophyllum tenellum* | 14 |
| *Eriocaulon aquaticum* | 2 |
| *Nymphaea odorata* | 2 |
| *Potamogeton amplifolius* | 2 |
| *Potamogeton richardsonii* | 2 |
| *Isoetes echinospora* | 1 |
| *Juncus spp.* | 1 |
| *Myriophyllum sibiricum* | 1 |
| *Najas flexilis* | 1 |
| *Potamogeton gramenius* | 1 |
| No Dominant Species | 6 |

# Discussion

The results from the 2017 and 2022 surveys provide valuable insight into the aquatic plant species composition in St. Charles Lake and can be examined further to determine if the survey methodology can provide a means of monitoring the spread of invasive EWM in St. Charles Lake and other Greater Sudbury area lakes over time.

The 2017 and 2022 survey results cannot be compared based on dominant species or density as these measurements were only recorded in the latter year. Results from both years can, however, be compared in terms of presence/absence and frequency in which EWM was growing alone, growing in mixed stands of EWM and native vegetation and sites where only native vegetation was present. In 2022, EWM was most frequently the dominant species (34.5% of sites), occurring alone at only 9.9% of sites. This is a slight increase from 2017 where EWM was found to be growing alone at 7.9% sites. There was an overall decrease in the sites that contained both native and invasive species together, down from 173 sites in 2017 to 140 sites in 2022. This is contrasted by an increase in sites that contained exclusively native species, up from 81 sites in 2017 to 110 sites in 2022, see table 3 below. These results show that, although EWM is present at most of the sampling sites, there was an overall decrease in presence of EWM within the lake down from 197 sites in 2017 to 170 sites in 2022.

**Table 3.** Aquatic plant composition in St. Charles Lake 2017-2022

| | Eurasian Watermilfoil Only | Native Species Only | Mixture of Eurasian Watermilfoil & Native Species | No Vegetation Present |
|---|---|---|---|---|
| **2017 Number of Sampling Sites** | 24 (7.9%) | 81 (26.6%) | 173 (56.9%) | 26 (8.6%) |
| **2022 Number of Sampling Sites** | 30 (9.9%) | 110 (36.2%) | 140 (46.1%) | 24 (7.9%) |

Overall, the frequency of most species decreased between 2017 and 2022, which is reflected in the total number of occurrences of each species found in the lake. In 2017 there were 724 total occurrences of all species which dropped to 620 total occurrences in 2022. While the number of individual occurrences of each species was less in 2022 than in 2017, the proportion of each species found within the lake between survey years remained relatively stable with no major increase in the proportion of the four most common species recorded. For example, the proportion of EWM was 27.2% of all occurrences in 2017 and 27.4% in 2022, see Figure 6.

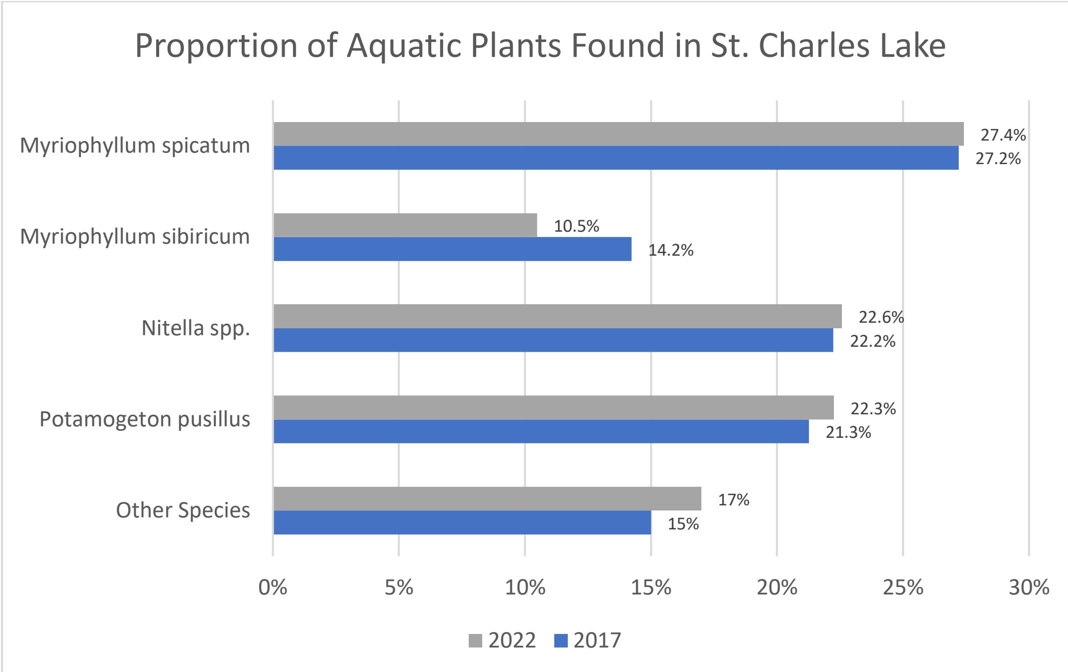



**Figure 6.** Proportion of species found within St. Charles Lake for 2017 and 2022 surveys.

While not true macrophytes, charophyte species, such as those of the genera *Nitella* and *Chara,* are included in this report. These charophytes are a form of green macroalgae and fill the same ecological niche in a lake, generally growing on muddy substrates and providing habitat for micro and macro invertebrates that in turn provide food for fish and other wildlife [6]. These charophytes are similar in that they do not possess roots but instead grow on the lake bottom using root-like rhizomes that anchor them to the bottom substrates. *Nitella spp.* was found throughout St. Charles Lake and was one of the most common species in both 2017 and 2022, frequently found growing at deep to moderate depths. The frequency and density of the *Nitella spp.* found in the lake along with its ecological influences warrant its inclusion in the list of species identified.

In 2022, *Nitella spp.* was the second most abundant species found (140 sampling locations, 46% of all sites), and was the most dominant species at 68 of those sampling sites, the third most common dominant species. These values are down from the 2017 surveys in which *Nitella spp.* occurred at 161 sampling locations, 52.9% of all sampling sites. Although there was a reduction in the total number of sites in which *Nitella spp.* was present, there were more sites where *Nitella spp.* occurred alone, up from 8 sites in 2017 to 34 sites in 2022.

When comparing the surveys conducted on St. Charles Lake to other surveys of lakes in the Greater Sudbury, the frequency of *Nitella*/*Chara* at sampling sites is within the range of expected values for these species (see Table 4). A 2011 survey of Galway Lake in New York found that *Nitella*/*Chara* was present at 83% of 69 sampling locations [7]. The Minnesota Department of Natural Resources has conducted aquatic vegetation surveys on 42 lakes in the state with the frequency of charophytes ranging between 0%-72% of sites on these lakes, with 19 of these lakes having frequencies at or above 25% of sampling sites [8].

**Table 4.** Percent of sampling sites containing charophytes on Sudbury area lakes.

| *Lake Name* | *Survey Year* | *Number of Sampling Sites* | *% of Sites with Charophytes* |
|---|---|---|---|
| St. Charles Lake | 2017/2022 | 304 | 52.9%/46.0% |
| Richard Lake | 2018 | 260 | 28.1% |
| Robinson Lake | 2020 | 214 | 42.0% |
| Minnow Lake | 2019 | 166 | 85.5% |

The total number of aquatic plant species, which is known as 'species richness', remains high with only a slight decrease in overall species richness between 2017 and 2022. Species richness was 18 and 16 in 2017 and 2022, respectively. A study of 99 lakes in Connecticut found that the mean species richness of native plants was 11.3, with a range of 1-27 species, and 1.7 for invasive plant species, with a range of 0-4 invasive species per lake (EWM was the most common invasive plant) [9]. The aquatic vegetation mapping conducted on 42 Minnesota lakes by the Minnesota DNR found the mean lake species richness of native species to be 12.6, with a range of 4-28 species, and 1.2 for invasive plant species, with a range of 0-2 invasive species per lake. On St. Charles Lake, a slight reduction in the average species richness per sampling site was noted between the survey years (2.38 species/site to 2.03 species/site).

Compared to other surveyed lakes in Greater Sudbury by the Lake Water Quality Program, species richness in St. Charles Lake remains high, only surpassed by Whitewater Lake, which is 23 times larger in area (Table 5).

**Table 5.** Species richness of St. Charles Lake compared to other Greater Sudbury area lakes surveyed through the City's Lake Water Quality Program

| *Lake Name* | *Survey Year* | *Species Richness* | *Lake Area (ha)* |
|---|---|---|---|
| *St. Charles Lake* | 2017/2022 | 18/16 | 41.3 |
| Richard Lake | 2018 | 14 | 83.6 |
| Robinson Lake | 2020 | 12 | 33.6 |
| Minnow Lake | 2019 | 8 | 20.9 |
| Whitewater Lake* | 2021 | 21 | 949.1 |

**Survey methodology used on Whitewater Lake differed from other lakes surveyed through the CGS Lake Water Quality Program.*

Other studies of aquatic plant populations within freshwater lakes have used a variety of survey techniques other than presence/absence to determine the abundance of each species within surveyed lakes. Some of these studies measure the abundance of each species in each rake sample. Such measurements could help supplement dominant species information and provide greater detail on species composition within any given lake [9]. Measures of species abundance will be assessed for use in future surveys of Greater Sudbury lakes.

The St. Charles Lake aquatic vegetation surveys provide valuable insight into the dynamics of the aquatic plant community over time. Tracking changes in the size of individual EWM beds would require a more detailed survey approach than the current method. This is mainly due to the relatively wide distance between sampling points (~30-45m), which makes it difficult to track the spread of vegetation between the sampling points. The surveys on St. Charles Lake are tracking the frequency of EWM and its dominance in the aquatic vegetation community. The presence of EWM in St. Charles Lake impacts resident's enjoyment of water-based recreational activities such as boating and swimming. This invasive species has not, however, caused the extirpation of native aquatic plant species within the lake or a decrease in species richness overall which remains high and comparable to other Greater Sudbury lakes. Future surveys will reveal if this lake's diverse native plant community will be sufficient to prevent an expansion of EWM within it.

## References

[1] *St. Charles Lake – Local Lake Description*. (n.d.). City of Greater Sudbury. 2023. https://www.greatersudbury.ca/play/beaches-and-lakes/lakes/local-lake-descriptions/st-charles-lake/

[2] Burrows, G., Bernier, M., Shultz Report, B., Corston, A., Gillespie, M., & Gunn, J. (2014). *St. Charles Lake Urban Lakes Fisheries Study 2014*. Vale Living with Lakes Centre - Laurentian University. https://laurentian.ca/assets/files/Living-With-Lakes/Reports/St_-Charles-Lakes-Urban-Fisheries-Study-2014.pdf

[3] Mikulyuk A, Hauxwell J, Rassmussen P, Knight S, Wagner KI, Nault ME, Ridgely D. (2010). Testing a methodology for assessing plant communities in temperate inland lakes. Lake Reserv Manage 26:54–62.

[4] Hauxwell, J., S. Knight, K. Wagner, A. Mikulyuk, M. Nault, M. Porzky and S. Chase. (2010). Recommended baseline monitoring of aquatic plants in Wisconsin: sampling design, field and laboratory procedures, data entry and analysis, and applications. Wisconsin Department of Natural Resources Bureau of Science Services, PUB-SS-1068 2010. Madison, Wisconsin, USA

[5] *GPS Accuracy*. (n.d). Garmin Ltd. (2019). https://support.garmin.com/en-CA/?faq=aZc8RezeAb9LjCDpJplTY7.

[6] Ditomaso, J. M., Kyser, G. B., et al. (2013). *Weed control in natural areas in the Western United States* (p. 544). University Of California, Weed Research and Information Center.

[7] Eichler, L. (2011). *An Assessment of Aquatic Plant Growth in Galway Lake, Saratoga County, New York*. https://gla.aim.hosting/wp-content/uploads/2021/07/Galway-Lake-Plant-Survey-Report-2011.pdf

[8] *Aquatic Vegetation Reports | Minnesota DNR*. (n.d.). Www.dnr.state.mn.us; Minnesota Department of Natural Resources. Retrieved January 20, 2023, from https://www.dnr.state.mn.us/eco/pubs_aquatics/aquatic_reports.html

[9] Capers, R. S., Selsky, R., Bugbee, G. J., & White, J. C. (2009). Species richness of both native and invasive aquatic plants influenced by environmental conditions and human activity. *Botany*, *87*(3), 306–314. https://doi.org/10.1139/b08-144

# Appendix A

*St. Charles Lake Sampling Locations*

## St. Charles Lake Waypoints 1/3

| ID | UTM NAD83 (Easting) | UTM NAD83 (Northing) |
|---|---|---|
| 1 | 498434.980 | 5144090.661 |
| 2 | 498383.299 | 5144058.555 |
| 3 | 498428.085 | 5144065.450 |
| 4 | 498331.859 | 5144033.749 |
| 5 | 498383.704 | 5144033.749 |
| 6 | 498428.085 | 5144033.749 |
| 7 | 498472.466 | 5144033.749 |
| 8 | 498516.846 | 5144033.749 |
| 9 | 498558.793 | 5144031.316 |
| 10 | 498294.943 | 5144002.048 |
| 11 | 498339.324 | 5144002.048 |
| 12 | 498383.704 | 5144002.048 |
| 13 | 498428.085 | 5144002.048 |
| 14 | 498472.466 | 5144002.048 |
| 15 | 498516.846 | 5144002.048 |
| 16 | 498561.227 | 5144002.048 |
| 17 | 498218.550 | 5143972.327 |
| 18 | 498249.573 | 5143975.295 |
| 19 | 498294.943 | 5143970.348 |
| 20 | 498339.324 | 5143970.348 |
| 21 | 498383.704 | 5143970.348 |
| 22 | 498428.085 | 5143970.348 |
| 23 | 498472.466 | 5143970.348 |
| 24 | 498516.846 | 5143970.348 |
| 25 | 498561.227 | 5143970.348 |
| 26 | 498597.901 | 5143967.914 |
| 27 | 498206.182 | 5143938.647 |
| 28 | 498250.563 | 5143938.647 |
| 29 | 498294.943 | 5143938.647 |
| 30 | 498339.324 | 5143938.647 |
| 31 | 498383.704 | 5143938.647 |
| 32 | 498428.085 | 5143938.647 |
| 33 | 498472.466 | 5143938.647 |
| 34 | 498516.846 | 5143938.647 |
| 35 | 498561.227 | 5143938.647 |
| 36 | 498601.650 | 5143938.647 |
| 37 | 498214.106 | 5143909.242 |
| 38 | 498250.563 | 5143906.947 |
| 39 | 498294.943 | 5143906.947 |
| 40 | 498339.324 | 5143906.947 |

| ID | UTM NAD83 (Easting) | UTM NAD83 (Northing) |
|---|---|---|
| 41 | 498383.704 | 5143906.947 |
| 42 | 498428.085 | 5143906.947 |
| 43 | 498472.466 | 5143906.947 |
| 44 | 498516.846 | 5143906.947 |
| 45 | 498561.227 | 5143906.947 |
| 46 | 498599.524 | 5143906.136 |
| 47 | 498661.861 | 5143912.389 |
| 48 | 498701.623 | 5143909.548 |
| 49 | 498250.563 | 5143875.246 |
| 50 | 498294.943 | 5143875.246 |
| 51 | 498339.324 | 5143875.246 |
| 52 | 498383.704 | 5143875.246 |
| 53 | 498428.085 | 5143875.246 |
| 54 | 498472.466 | 5143875.246 |
| 55 | 498516.846 | 5143875.246 |
| 56 | 498561.227 | 5143875.246 |
| 57 | 498649.988 | 5143875.246 |
| 58 | 498694.368 | 5143875.246 |
| 59 | 498732.002 | 5143879.153 |
| 60 | 498826.890 | 5143870.299 |
| 61 | 498605.607 | 5143875.246 |
| 62 | 498428.085 | 5143843.546 |
| 63 | 498472.466 | 5143843.546 |
| 64 | 498516.846 | 5143843.546 |
| 65 | 498561.227 | 5143843.546 |
| 66 | 498605.607 | 5143843.546 |
| 67 | 498649.988 | 5143843.546 |
| 68 | 498694.368 | 5143843.546 |
| 69 | 498738.749 | 5143843.546 |
| 70 | 498783.130 | 5143843.546 |
| 71 | 498827.510 | 5143843.546 |
| 72 | 498871.891 | 5143843.546 |
| 73 | 498916.271 | 5143840.702 |
| 74 | 498960.652 | 5143843.546 |
| 75 | 499005.033 | 5143843.546 |
| 76 | 499046.217 | 5143840.705 |
| 77 | 498472.466 | 5143811.845 |
| 78 | 498516.846 | 5143811.845 |
| 79 | 498561.227 | 5143811.845 |
| 80 | 498605.607 | 5143811.845 |

| ID | UTM NAD83 (Easting) | UTM NAD83 (Northing) |
|---|---|---|
| 81 | 498649.988 | 5143811.845 |
| 82 | 498694.368 | 5143811.845 |
| 83 | 498738.749 | 5143811.845 |
| 84 | 498783.130 | 5143811.845 |
| 85 | 498827.510 | 5143811.845 |
| 86 | 498871.891 | 5143811.845 |
| 87 | 498916.271 | 5143811.845 |
| 88 | 498960.652 | 5143811.845 |
| 89 | 499005.033 | 5143811.845 |
| 90 | 499049.413 | 5143811.845 |
| 91 | 499093.794 | 5143811.845 |
| 92 | 498437.890 | 5143778.068 |
| 93 | 498472.466 | 5143780.145 |
| 94 | 498516.846 | 5143780.145 |
| 95 | 498561.227 | 5143780.145 |
| 96 | 498605.607 | 5143780.145 |
| 97 | 498649.988 | 5143780.145 |
| 98 | 498694.368 | 5143780.145 |
| 99 | 498738.749 | 5143780.145 |
| 100 | 498827.510 | 5143780.145 |
| 101 | 498783.130 | 5143780.145 |
| 102 | 498871.891 | 5143780.145 |
| 103 | 498916.271 | 5143780.145 |
| 104 | 498960.652 | 5143780.145 |
| 105 | 499005.033 | 5143780.145 |
| 106 | 499049.413 | 5143780.145 |
| 107 | 499093.794 | 5143780.145 |
| 108 | 499130.259 | 5143787.071 |
| 109 | 498428.085 | 5143748.444 |
| 110 | 498472.466 | 5143748.444 |
| 111 | 498516.846 | 5143748.444 |
| 112 | 498561.227 | 5143748.444 |
| 113 | 498605.607 | 5143748.444 |
| 114 | 498649.988 | 5143748.444 |
| 115 | 498694.368 | 5143748.444 |
| 116 | 498738.749 | 5143748.444 |
| 117 | 498783.130 | 5143748.444 |
| 118 | 498827.510 | 5143748.444 |
| 119 | 498871.891 | 5143748.444 |
| 120 | 498916.271 | 5143748.444 |

St. Charles Lake Waypoints 2/3

| ID | UTM NAD83 (Easting) | UTM NAD83 (Northing) |
|---|---|---|
| 121 | 498960.652 | 5143748.444 |
| 122 | 499005.033 | 5143748.444 |
| 123 | 499049.413 | 5143748.444 |
| 124 | 499093.794 | 5143748.444 |
| 125 | 499126.947 | 5143760.652 |
| 126 | 498428.085 | 5143716.744 |
| 127 | 498472.466 | 5143716.744 |
| 128 | 498516.846 | 5143716.744 |
| 129 | 498649.988 | 5143716.744 |
| 130 | 498694.368 | 5143716.744 |
| 131 | 498738.749 | 5143716.744 |
| 132 | 498783.130 | 5143716.744 |
| 133 | 498916.271 | 5143716.744 |
| 134 | 499174.145 | 5143713.776 |
| 135 | 498428.085 | 5143685.043 |
| 136 | 498465.976 | 5143689.505 |
| 137 | 498516.846 | 5143685.043 |
| 138 | 498549.563 | 5143679.098 |
| 139 | 498649.988 | 5143685.043 |
| 140 | 498694.368 | 5143685.043 |
| 141 | 498738.749 | 5143685.043 |
| 142 | 498783.130 | 5143685.043 |
| 143 | 498916.271 | 5143685.043 |
| 144 | 498951.253 | 5143685.043 |
| 145 | 499095.011 | 5143678.959 |
| 146 | 499141.637 | 5143687.517 |
| 147 | 499182.555 | 5143685.043 |
| 148 | 499226.935 | 5143692.146 |
| 149 | 499271.316 | 5143685.043 |
| 150 | 498389.386 | 5143661.155 |
| 151 | 498428.085 | 5143653.343 |
| 152 | 498466.382 | 5143649.693 |
| 153 | 498524.761 | 5143653.343 |
| 154 | 498561.227 | 5143653.343 |
| 155 | 498649.988 | 5143653.343 |
| 156 | 498694.368 | 5143653.343 |
| 157 | 498738.749 | 5143653.343 |
| 158 | 498783.130 | 5143653.343 |
| 159 | 498827.510 | 5143653.343 |
| 160 | 498871.891 | 5143653.343 |

| ID | UTM NAD83 (Easting) | UTM NAD83 (Northing) |
|---|---|---|
| 161 | 498916.271 | 5143653.343 |
| 162 | 498960.652 | 5143653.343 |
| 163 | 499049.413 | 5143653.343 |
| 164 | 499093.794 | 5143653.343 |
| 165 | 499138.174 | 5143653.343 |
| 166 | 499182.555 | 5143653.343 |
| 167 | 499227.646 | 5143656.184 |
| 168 | 499271.316 | 5143653.343 |
| 169 | 498394.760 | 5143623.773 |
| 170 | 498428.085 | 5143621.642 |
| 171 | 498472.466 | 5143621.642 |
| 172 | 498516.846 | 5143621.642 |
| 173 | 498561.227 | 5143621.642 |
| 174 | 498605.607 | 5143621.642 |
| 175 | 498649.988 | 5143621.642 |
| 176 | 498694.368 | 5143621.642 |
| 177 | 498738.749 | 5143621.642 |
| 178 | 498783.130 | 5143621.642 |
| 179 | 498827.510 | 5143621.642 |
| 180 | 498871.891 | 5143621.642 |
| 181 | 498916.271 | 5143621.642 |
| 182 | 498960.652 | 5143621.642 |
| 183 | 499005.033 | 5143621.642 |
| 184 | 499049.413 | 5143621.642 |
| 185 | 499093.794 | 5143621.642 |
| 186 | 499138.174 | 5143621.642 |
| 187 | 499182.555 | 5143621.642 |
| 188 | 499231.552 | 5143621.642 |
| 189 | 499277.708 | 5143621.642 |
| 190 | 498389.788 | 5143589.942 |
| 191 | 498428.085 | 5143589.942 |
| 192 | 498472.466 | 5143589.942 |
| 193 | 498516.846 | 5143589.942 |
| 194 | 498561.227 | 5143589.942 |
| 195 | 498605.607 | 5143589.942 |
| 196 | 498649.988 | 5143589.942 |
| 197 | 498694.368 | 5143589.942 |
| 198 | 498738.749 | 5143589.942 |
| 199 | 498783.130 | 5143589.942 |
| 200 | 498827.510 | 5143589.942 |

| ID | UTM NAD83 (Easting) | UTM NAD83 (Northing) |
|---|---|---|
| 201 | 498871.891 | 5143589.942 |
| 202 | 498916.271 | 5143589.942 |
| 203 | 498960.652 | 5143589.942 |
| 204 | 499005.033 | 5143589.942 |
| 205 | 499049.413 | 5143589.942 |
| 206 | 499093.794 | 5143589.942 |
| 207 | 499138.174 | 5143589.942 |
| 208 | 499182.555 | 5143589.942 |
| 209 | 499226.935 | 5143589.942 |
| 210 | 499271.316 | 5143589.942 |
| 211 | 499306.425 | 5143594.774 |
| 212 | 498398.693 | 5143558.241 |
| 213 | 498428.085 | 5143558.241 |
| 214 | 498472.466 | 5143558.241 |
| 215 | 498516.846 | 5143558.241 |
| 216 | 498561.227 | 5143558.241 |
| 217 | 498605.607 | 5143558.241 |
| 218 | 498649.988 | 5143558.241 |
| 219 | 498694.368 | 5143558.241 |
| 220 | 498738.749 | 5143558.241 |
| 221 | 498783.130 | 5143558.241 |
| 222 | 498827.510 | 5143558.241 |
| 223 | 498871.891 | 5143558.241 |
| 224 | 498916.271 | 5143558.241 |
| 225 | 498960.652 | 5143558.241 |
| 226 | 499005.033 | 5143558.241 |
| 227 | 499049.413 | 5143558.241 |
| 228 | 499093.794 | 5143558.241 |
| 229 | 499138.174 | 5143558.241 |
| 230 | 499182.555 | 5143558.241 |
| 231 | 499226.935 | 5143558.241 |
| 232 | 499271.316 | 5143558.241 |
| 233 | 499312.501 | 5143558.596 |
| 234 | 498428.085 | 5143526.541 |
| 235 | 498472.466 | 5143531.982 |
| 236 | 498516.846 | 5143526.541 |
| 237 | 498561.227 | 5143526.541 |
| 238 | 498605.607 | 5143526.541 |
| 239 | 498649.988 | 5143526.541 |
| 240 | 498694.368 | 5143526.541 |

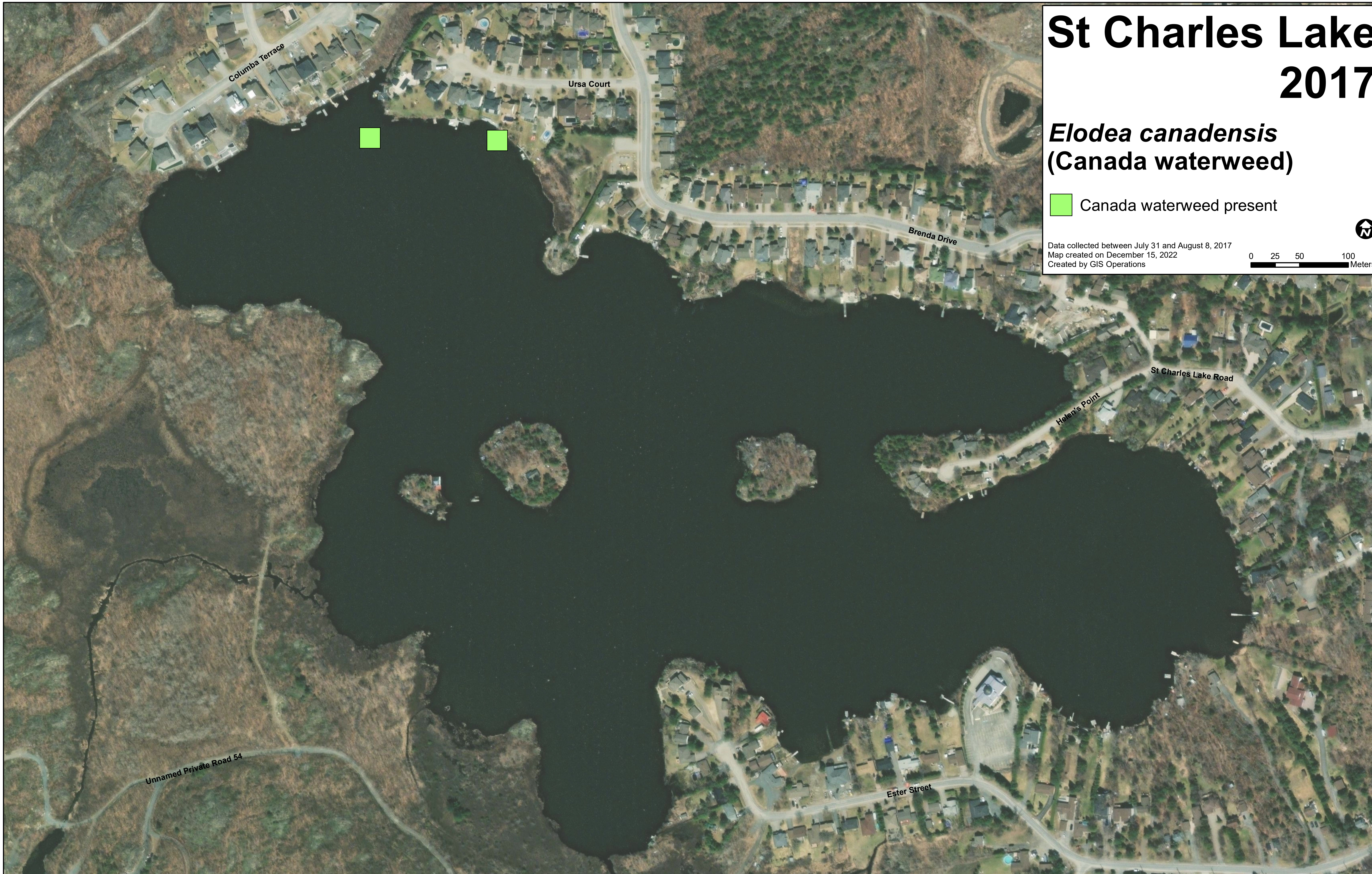
**St. Charles Lake Waypoints 3/3**

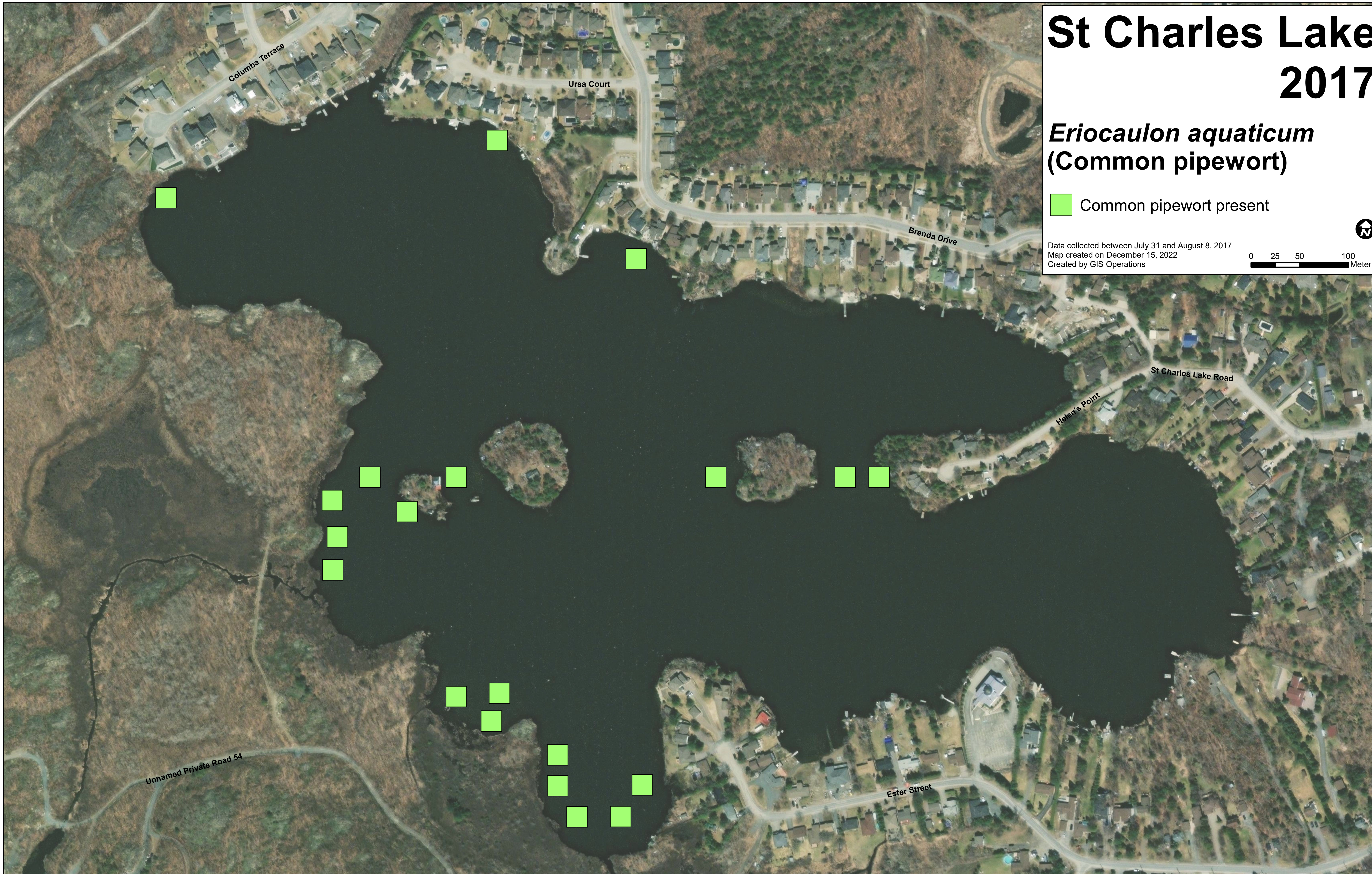
| ID | UTM NAD83 (Easting) | UTM NAD83 (Northing) |
|---|---|---|
| 241 | 498738.749 | 5143526.541 |
| 242 | 498783.130 | 5143526.541 |
| 243 | 498827.510 | 5143526.541 |
| 244 | 498871.891 | 5143526.541 |
| 245 | 498916.271 | 5143526.541 |
| 246 | 498960.652 | 5143526.541 |
| 247 | 499005.033 | 5143526.541 |
| 248 | 499049.413 | 5143526.541 |
| 249 | 499093.794 | 5143526.541 |
| 250 | 499138.174 | 5143526.541 |
| 251 | 499182.555 | 5143526.541 |
| 252 | 499226.935 | 5143526.541 |
| 253 | 499271.316 | 5143526.541 |
| 254 | 499310.750 | 5143523.572 |
| 255 | 498516.846 | 5143494.840 |
| 256 | 498561.227 | 5143494.840 |
| 257 | 498605.607 | 5143494.840 |
| 258 | 498649.988 | 5143494.840 |
| 259 | 498694.368 | 5143494.840 |
| 260 | 498729.964 | 5143499.252 |
| 261 | 498786.780 | 5143500.518 |
| 262 | 498827.510 | 5143494.840 |
| 263 | 498871.891 | 5143494.840 |
| 264 | 498916.271 | 5143494.840 |
| 265 | 498960.652 | 5143494.840 |
| 266 | 499005.033 | 5143494.840 |
| 267 | 499043.735 | 5143494.840 |
| 268 | 499104.745 | 5143495.246 |
| 269 | 499138.174 | 5143494.840 |
| 270 | 499182.555 | 5143494.840 |
| 271 | 499226.935 | 5143494.840 |
| 272 | 498516.846 | 5143459.677 |
| 273 | 498561.227 | 5143463.140 |
| 274 | 498605.607 | 5143463.140 |
| 275 | 498649.988 | 5143463.140 |
| 276 | 498694.368 | 5143463.140 |
| 277 | 498831.468 | 5143464.129 |
| 278 | 498871.891 | 5143463.140 |
| 279 | 498916.271 | 5143463.140 |
| 280 | 498960.652 | 5143463.140 |
| 281 | 499011.522 | 5143460.301 |
| 282 | 499138.174 | 5143463.140 |
| 283 | 499182.555 | 5143463.140 |
| 284 | 499226.935 | 5143463.140 |
| 285 | 498552.817 | 5143434.407 |
| 286 | 498614.485 | 5143431.439 |
| 287 | 498654.959 | 5143431.439 |
| 288 | 498702.891 | 5143431.084 |
| 289 | 498871.891 | 5143431.439 |
| 290 | 498907.859 | 5143427.579 |
| 291 | 499172.661 | 5143438.365 |
| 292 | 499212.749 | 5143437.929 |
| 293 | 498620.824 | 5143399.739 |
| 294 | 498660.291 | 5143399.739 |
| 295 | 498704.315 | 5143399.739 |
| 296 | 498875.801 | 5143405.071 |
| 297 | 498620.709 | 5143368.038 |
| 298 | 498661.007 | 5143367.683 |
| 299 | 498707.876 | 5143368.749 |
| 300 | 498640.746 | 5143335.982 |
| 301 | 498685.482 | 5143336.338 |
| 302 | 498721.455 | 5143337.099 |
| 303 | 498649.988 | 5143304.637 |
| 304 | 498694.368 | 5143304.637 |

# Appendix B

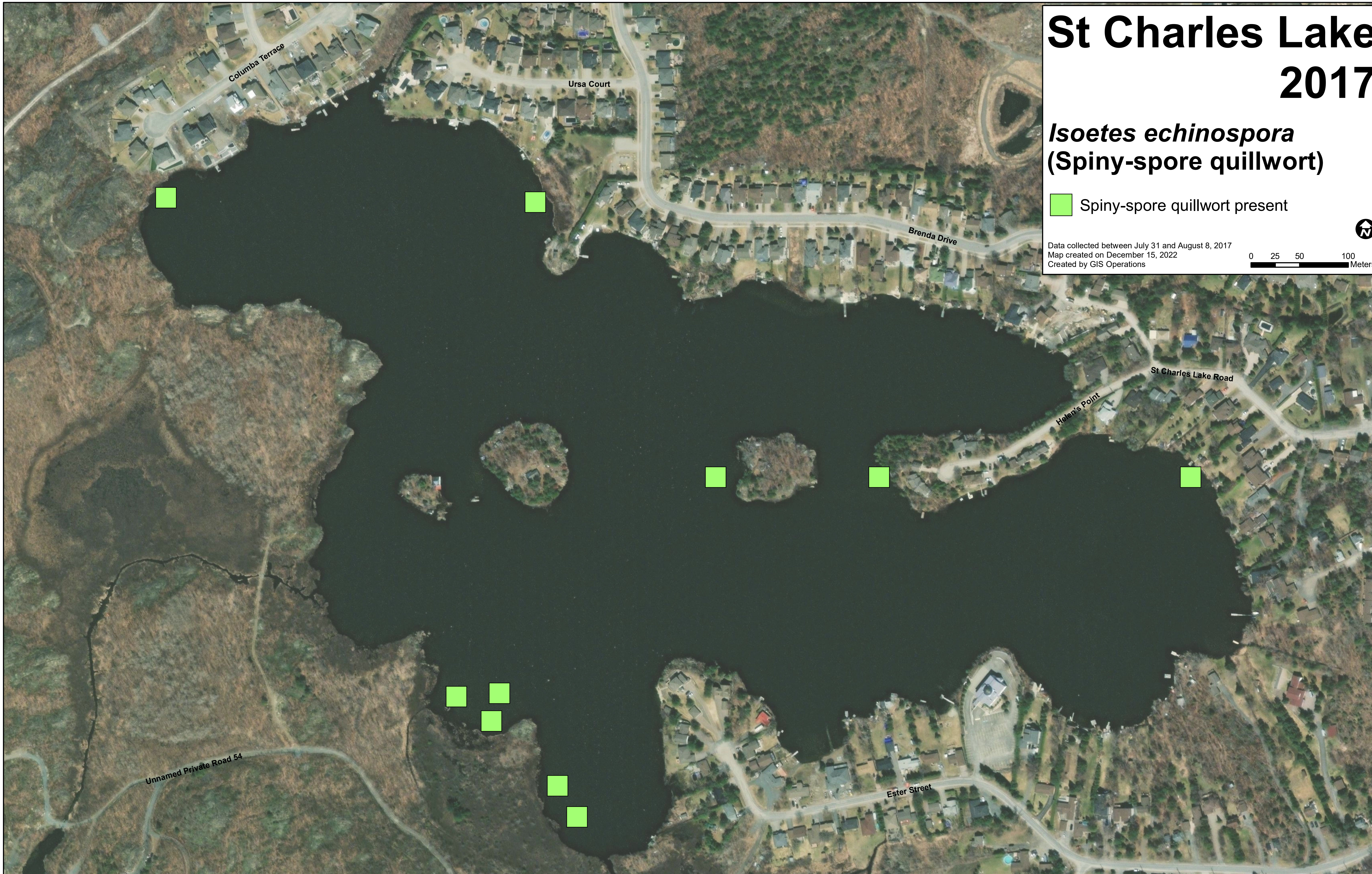
## *2017 St. Charles Lake Vegetation Mapping Results*


St Charles Lake
2017
Brasenia schreberi
(Water-shield)
Water-shield present
Data collected between July 31 and August 8, 2017
Map created on December 15, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Ester Street
Unnamed Private Road 54


St Charles Lake
2017
Elodea canadensis
(Canada waterweed)
Canada waterweed present
Data collected between July 31 and August 8, 2017
Map created on December 15, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Ester Street
Unnamed Private Road 54

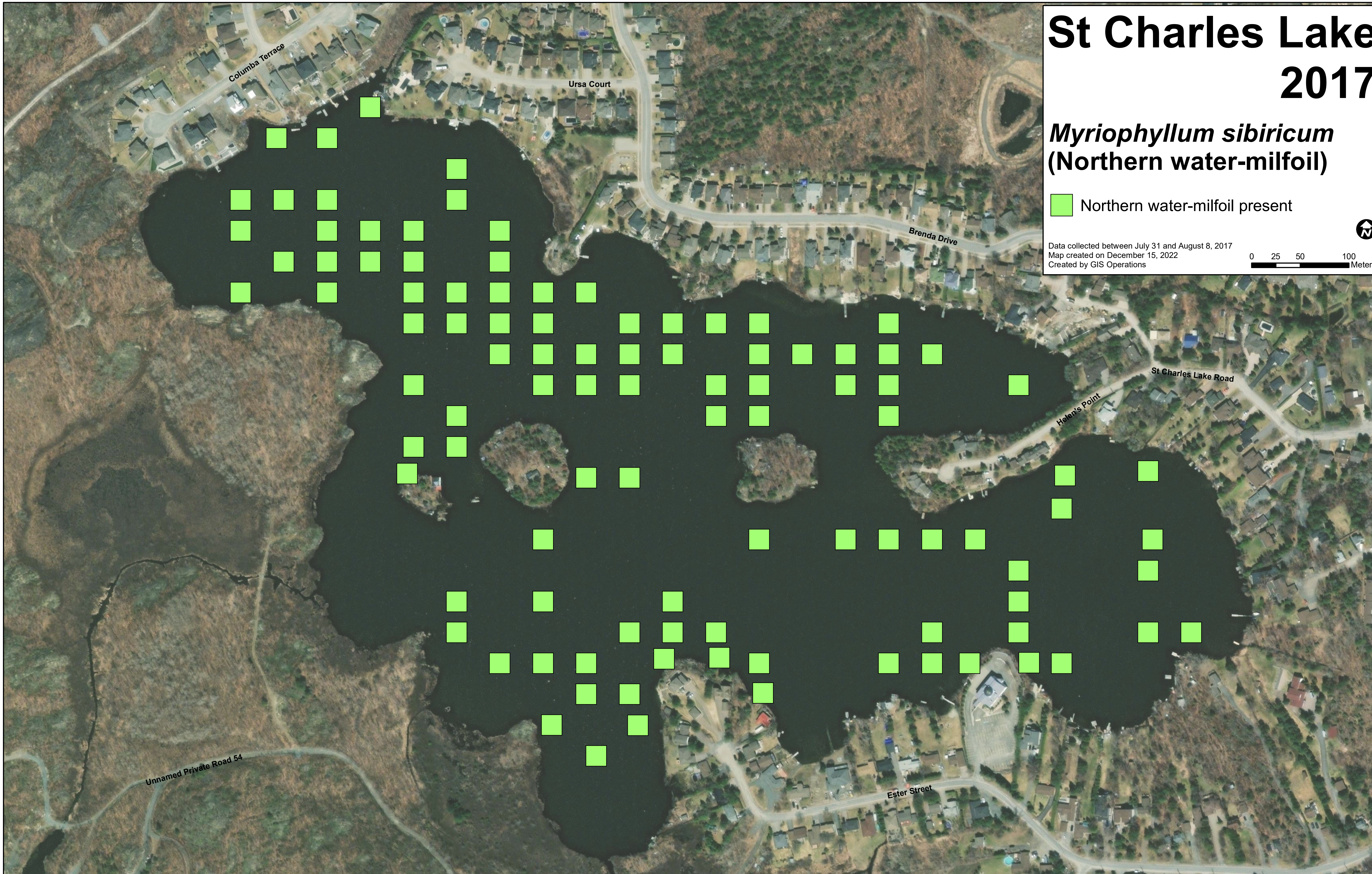


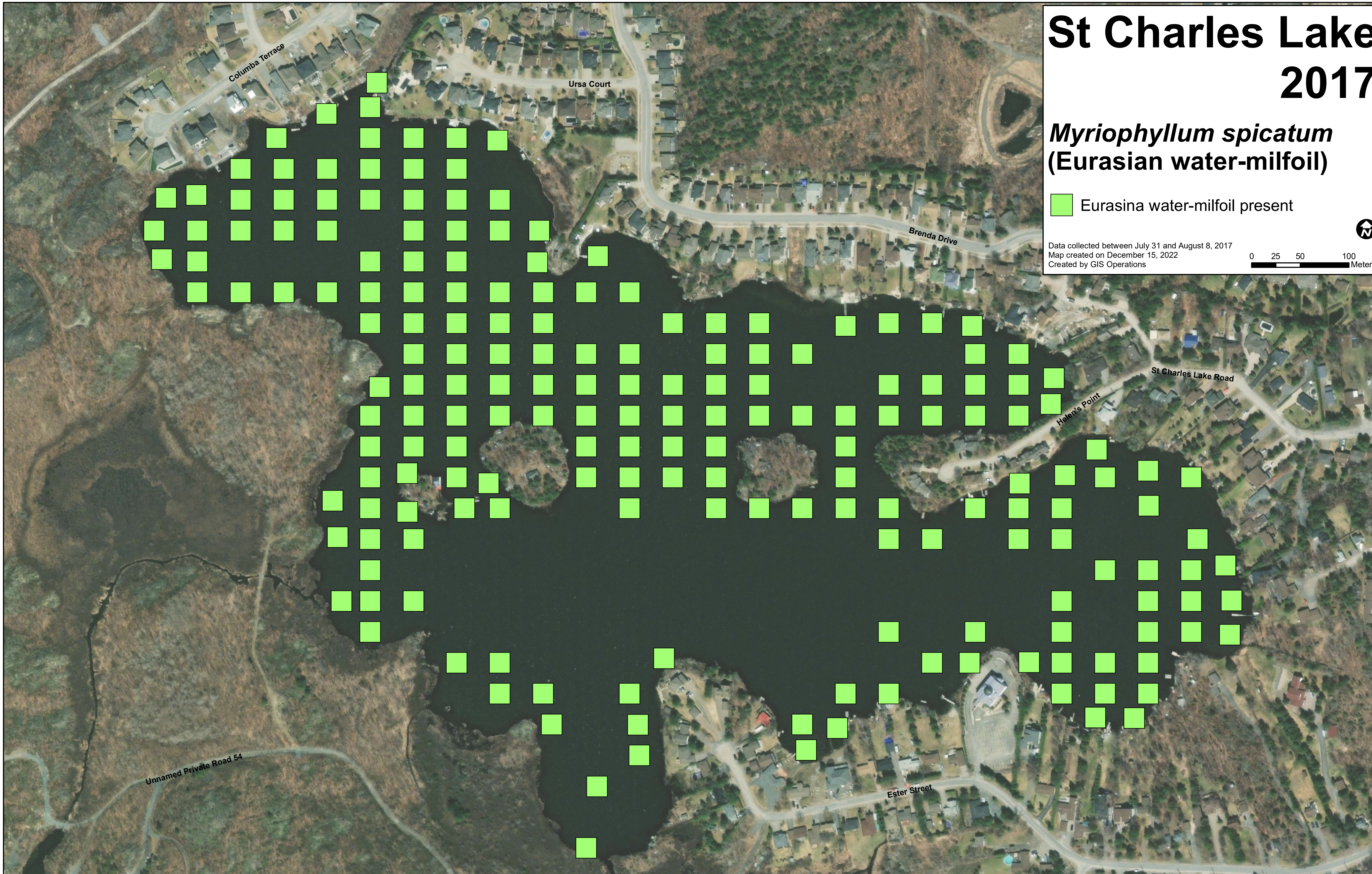
St Charles Lake 2017
Eriocaulon aquaticum (Common pipewort)
Common pipewort present
Data collected between July 31 and August 8, 2017
Map created on December 15, 2022
Created by GIS Operations
0 25 50 100 Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Ester Street
Unnamed Private Road 54

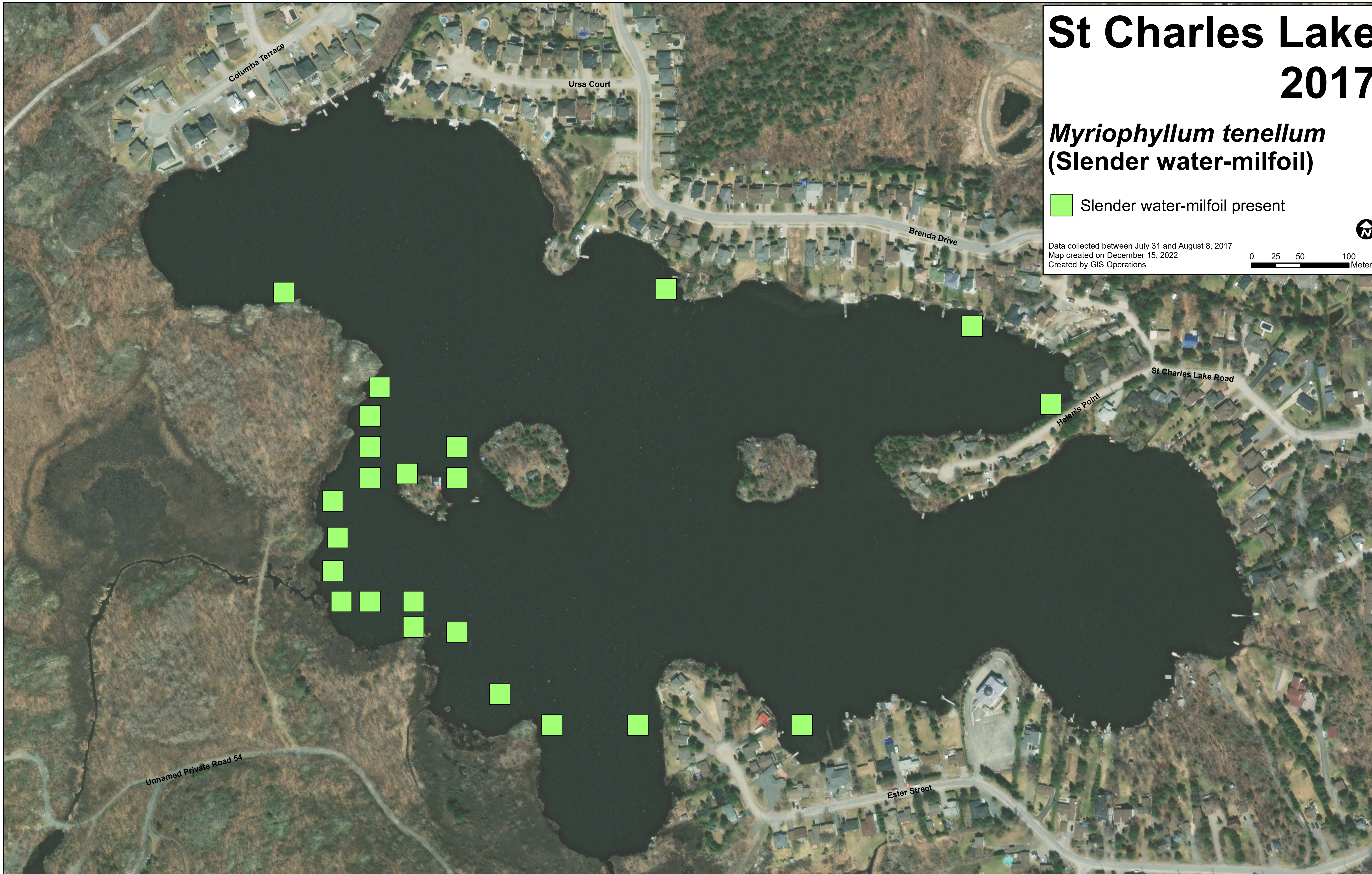


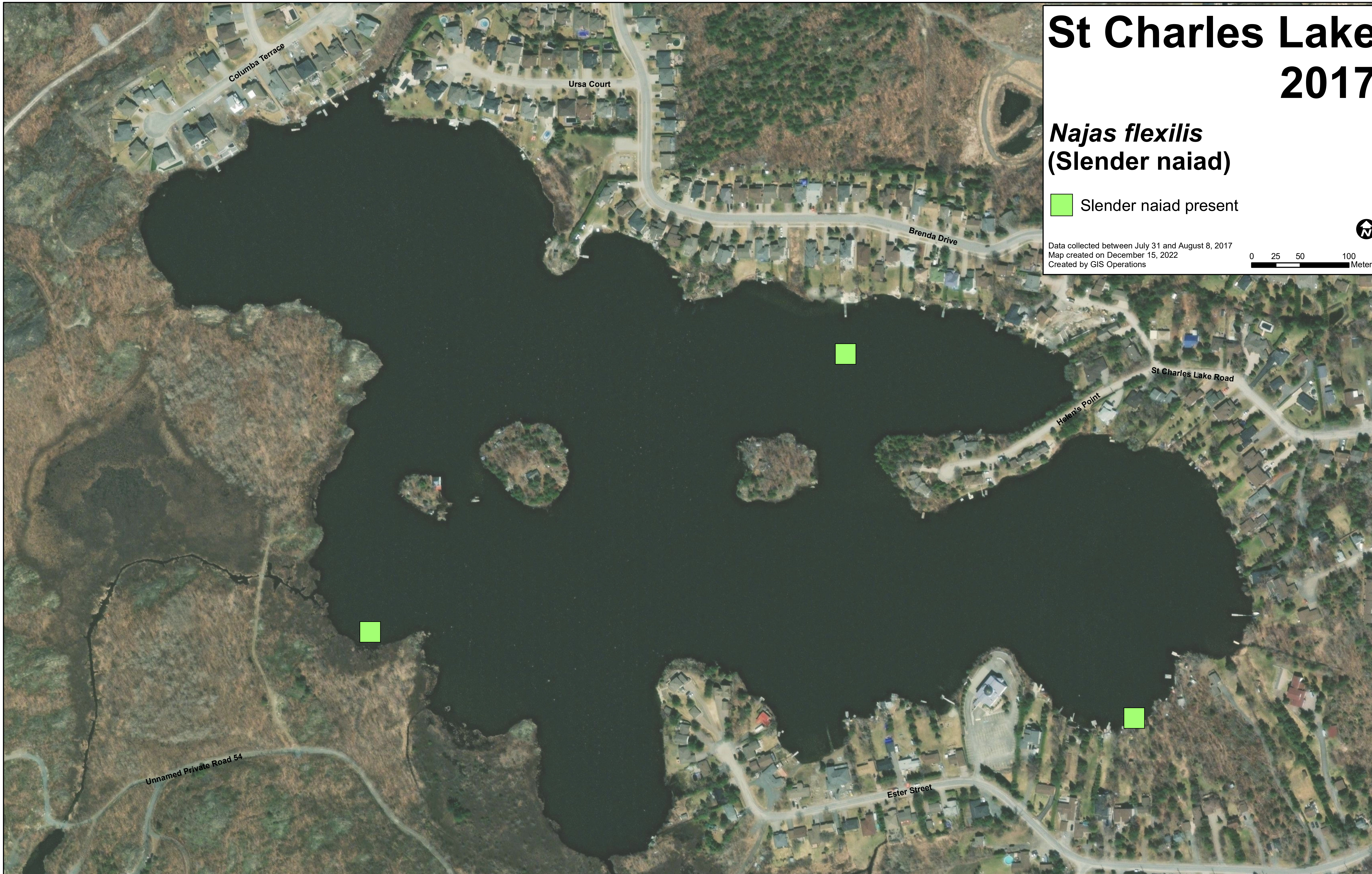
St Charles Lake
2017
*Isoetes echinospora*
(Spiny-spore quillwort)
Spiny-spore quillwort present
Data collected between July 31 and August 8, 2017
Map created on December 15, 2022
Created by GIS Operations
0 25 50 100 Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Unnamed Private Road 54
Ester Street

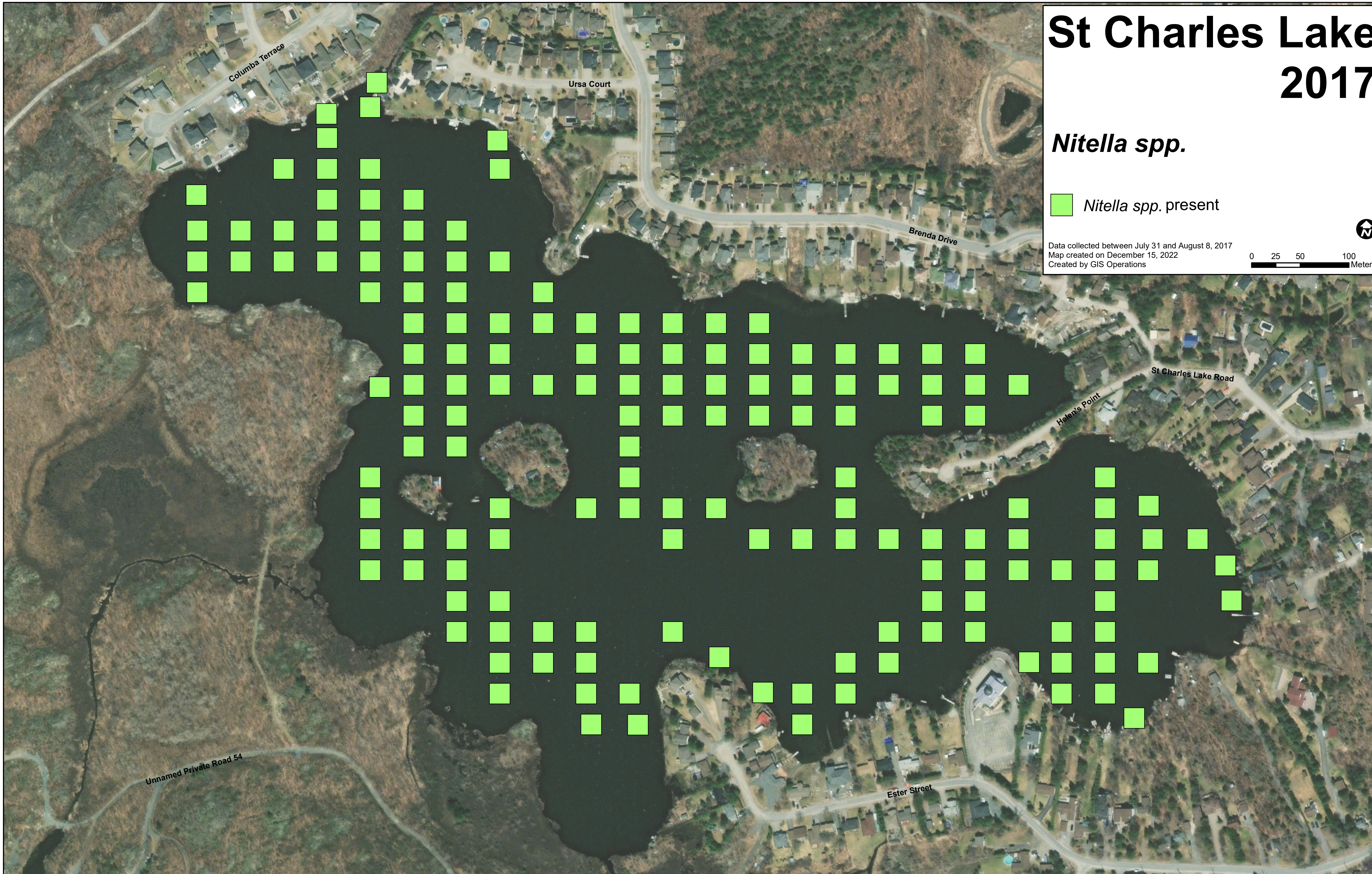

St Charles Lake
2017
Myrica gale
(Sweetgale)
Sweetgale present
Data collected between July 31 and August 8, 2017
Map created on December 15, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Ester Street
Unnamed Private Road 54

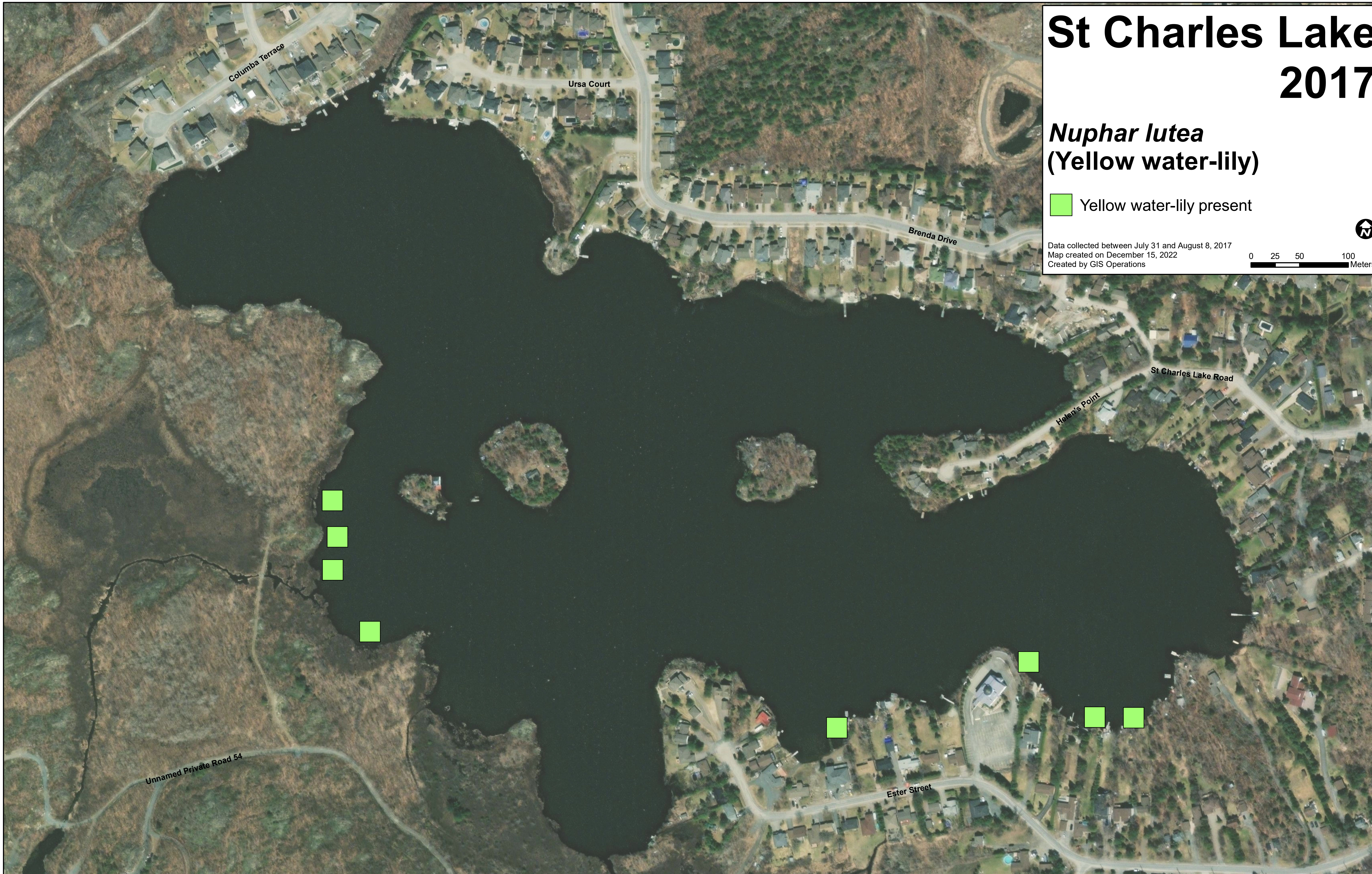

St Charles Lake
2017
Myriophyllum sibiricum
(Northern water-milfoil)
Northern water-milfoil present
N
Data collected between July 31 and August 8, 2017
Map created on December 15, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Ester Street
Unnamed Private Road 54

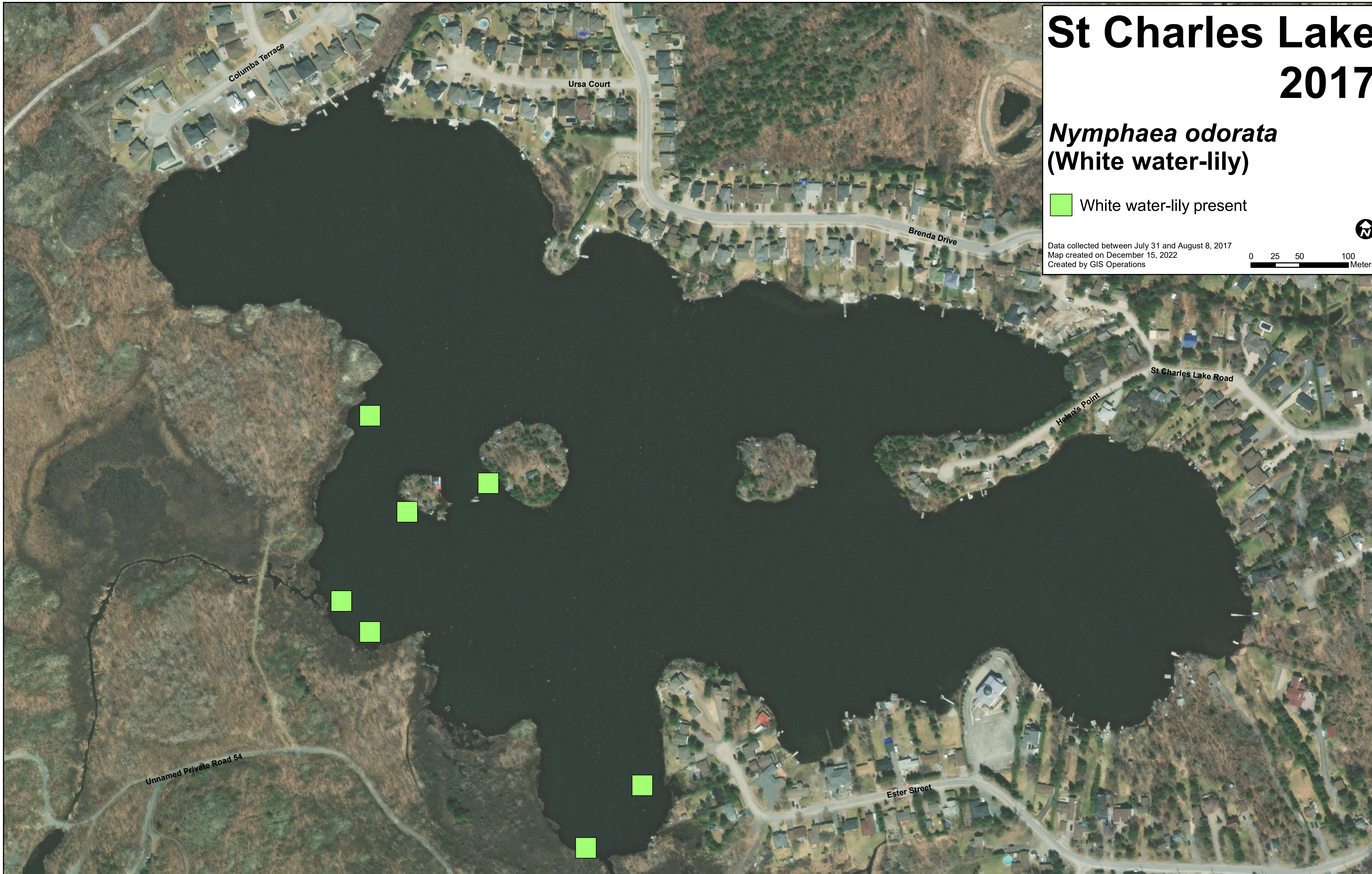

St Charles Lake
2017
Myriophyllum spicatum
(Eurasian water-milfoil)
Eurasina water-milfoil present
Data collected between July 31 and August 8, 2017
Map created on December 15, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Unnamed Private Road 54
Ester Street

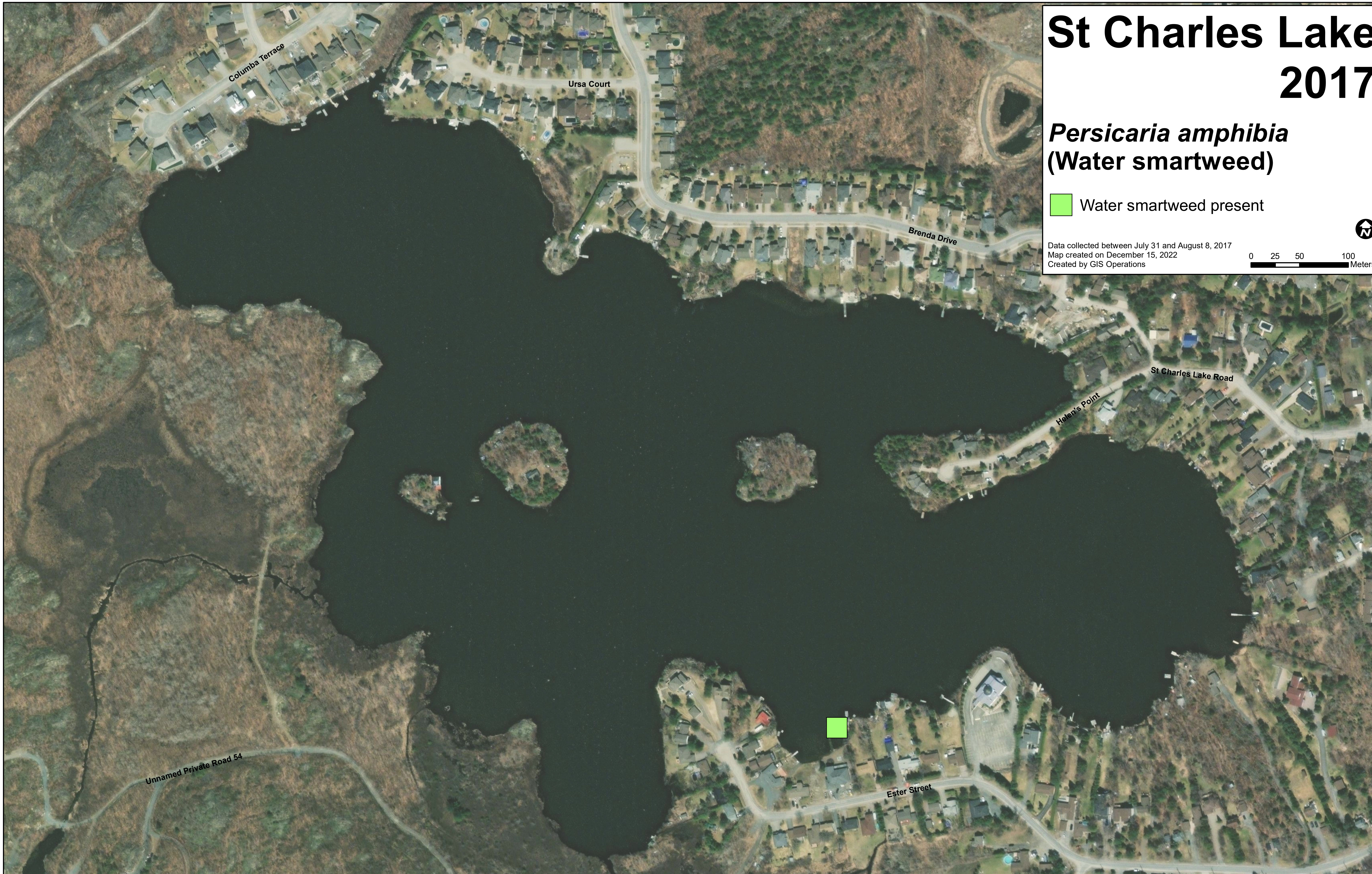

St Charles Lake
2017
Myriophyllum tenellum
(Slender water-milfoil)
Slender water-milfoil present
Data collected between July 31 and August 8, 2017
Map created on December 15, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Ester Street
Unnamed Private Road 54

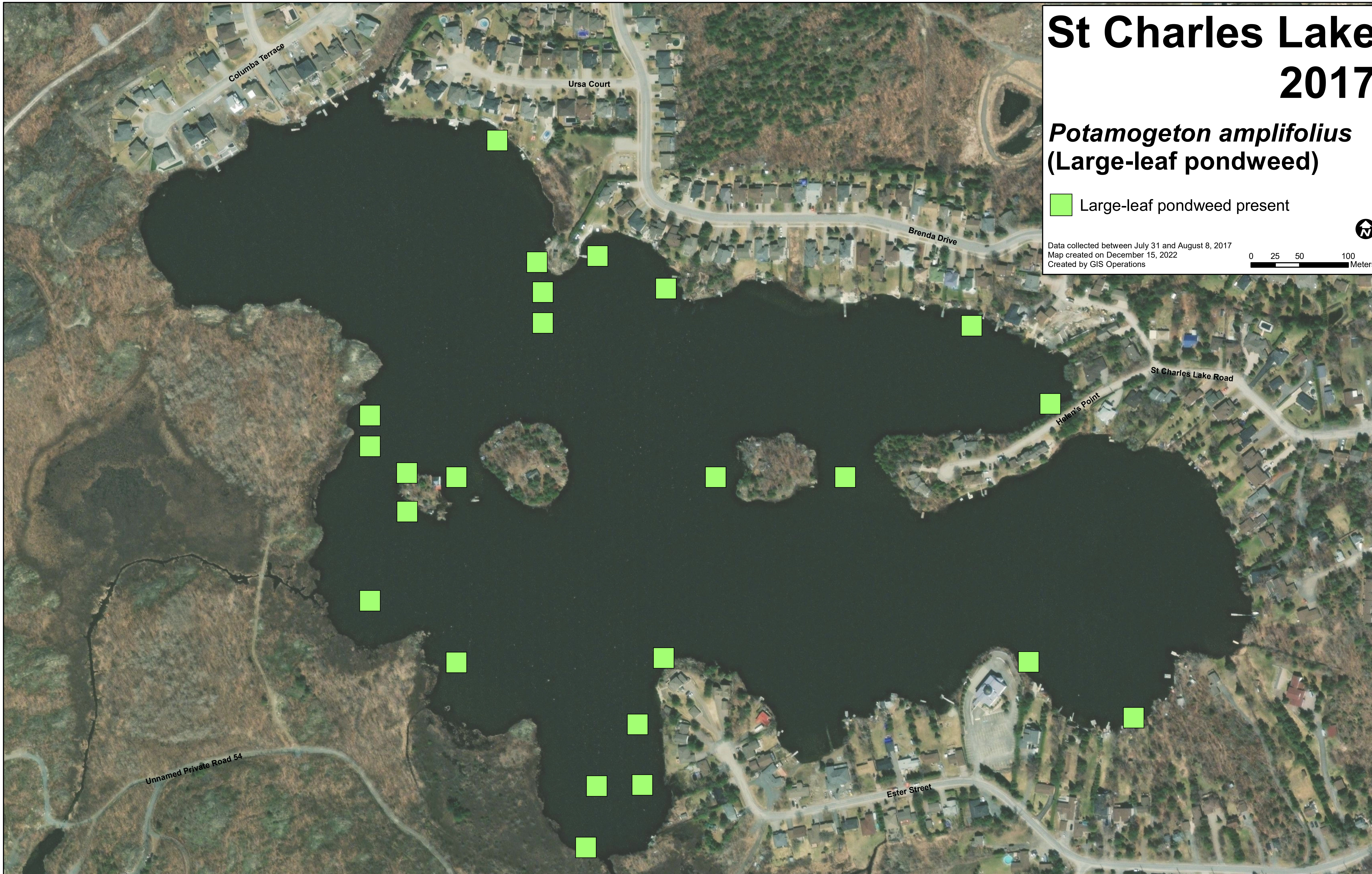

St Charles Lake 2017
Najas flexilis
(Slender naiad)
Slender naiad present
Data collected between July 31 and August 8, 2017
Map created on December 15, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Ester Street
Unnamed Private Road 54

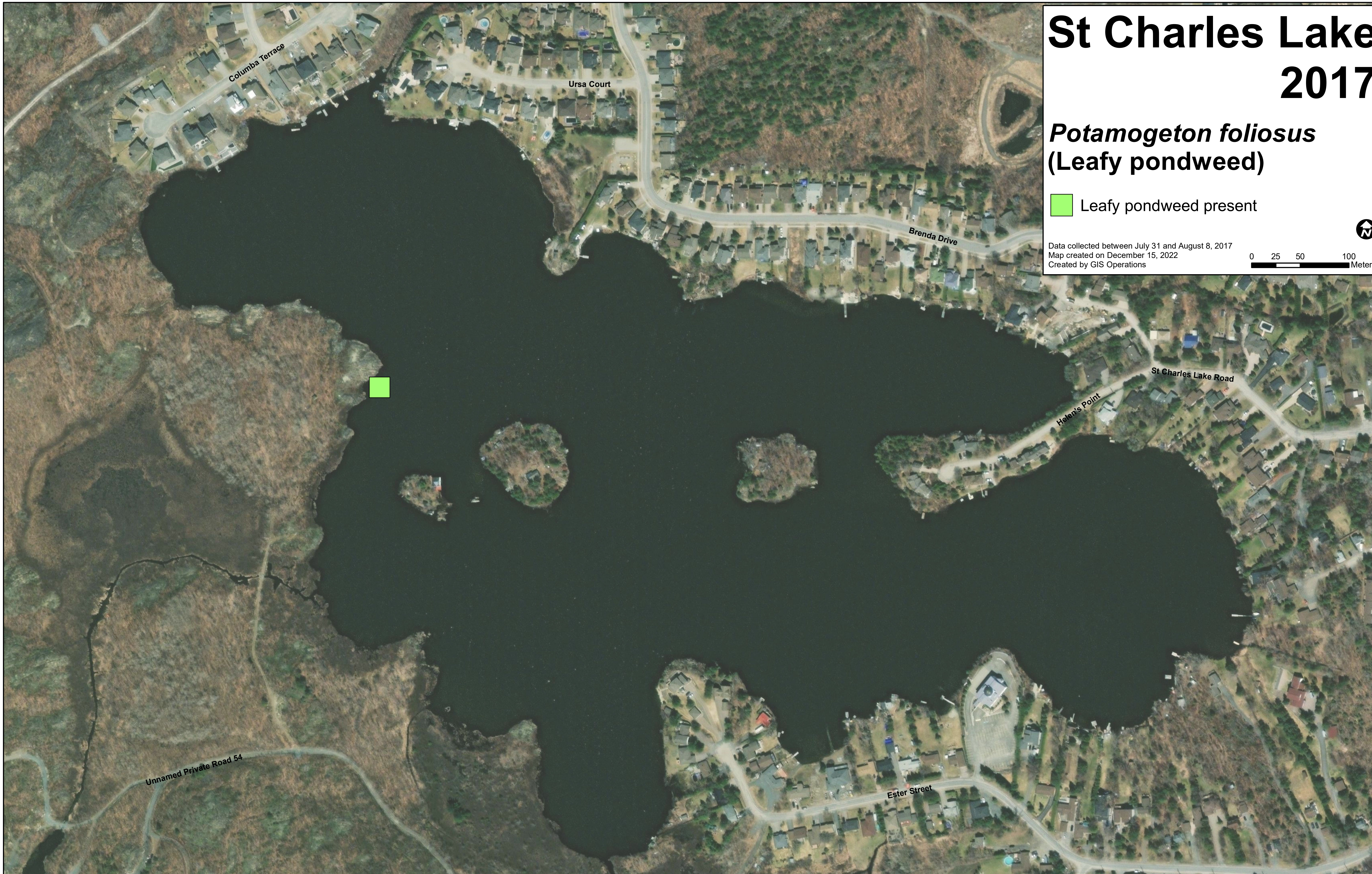

St Charles Lake
2017
Nitella spp.
Nitella spp. present
Data collected between July 31 and August 8, 2017
Map created on December 15, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Ester Street
Unnamed Private Road 54

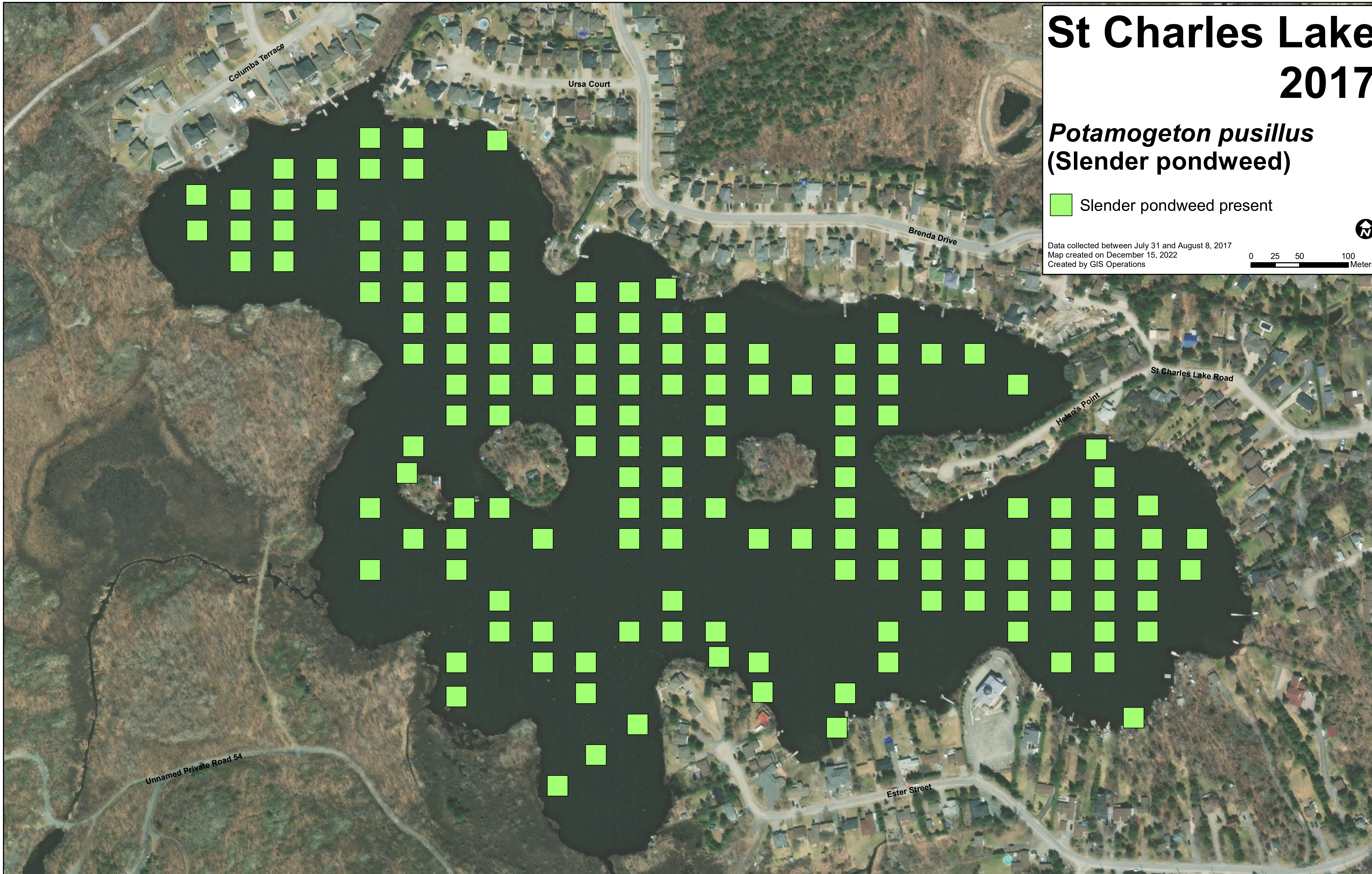

St Charles Lake
2017
Nuphar lutea
(Yellow water-lily)
Yellow water-lily present
Data collected between July 31 and August 8, 2017
Map created on December 15, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Ester Street
Unnamed Private Road 54


St Charles Lake
2017
*Nymphaea odorata*
(White water-lily)
White water-lily present
Data collected between July 31 and August 8, 2017
Map created on December 15, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Unnamed Private Road 54
Ester Street

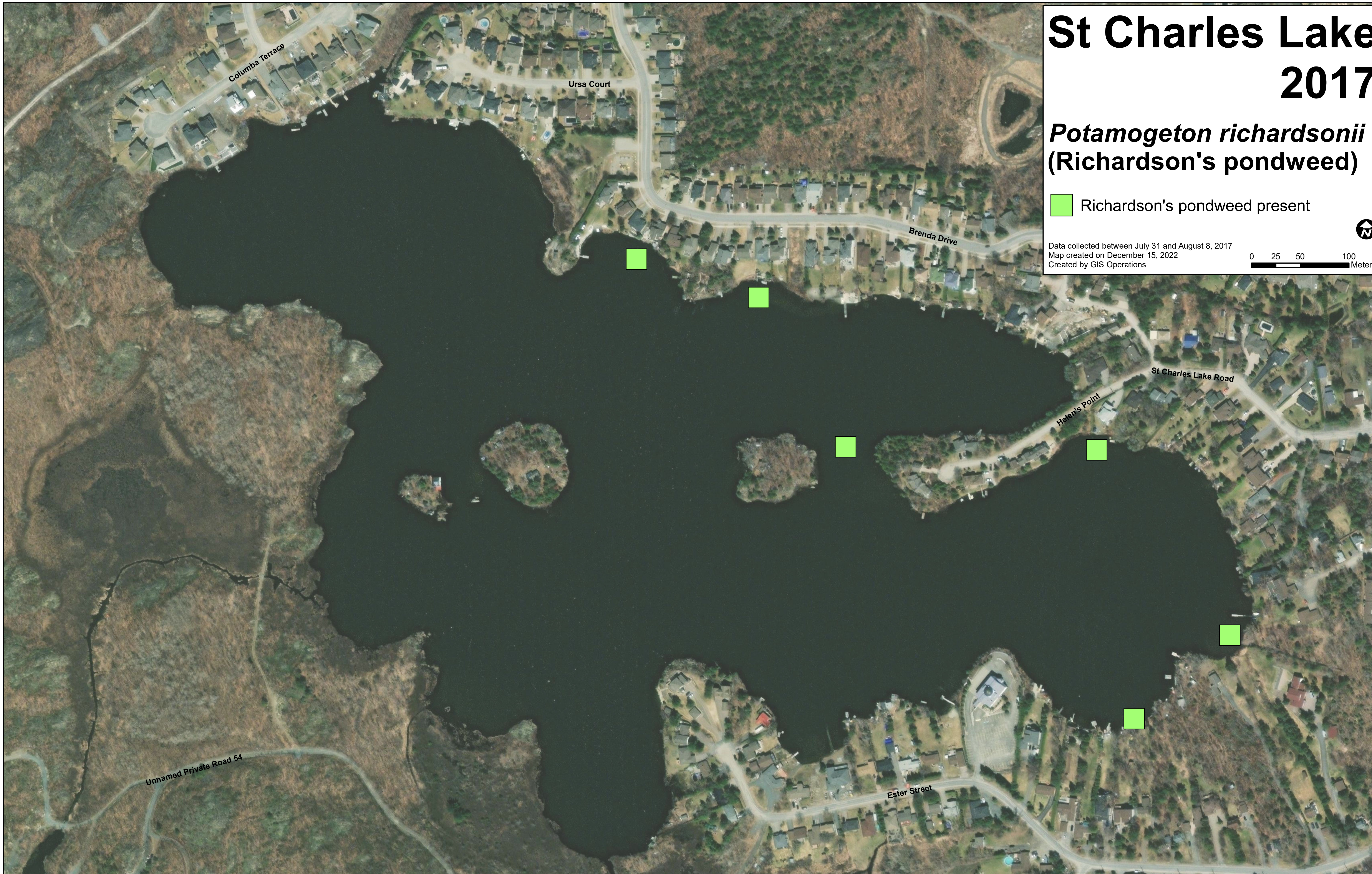

St Charles Lake
2017
Persicaria amphibia
(Water smartweed)
Water smartweed present
Data collected between July 31 and August 8, 2017
Map created on December 15, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Unnamed Private Road 54
Ester Street

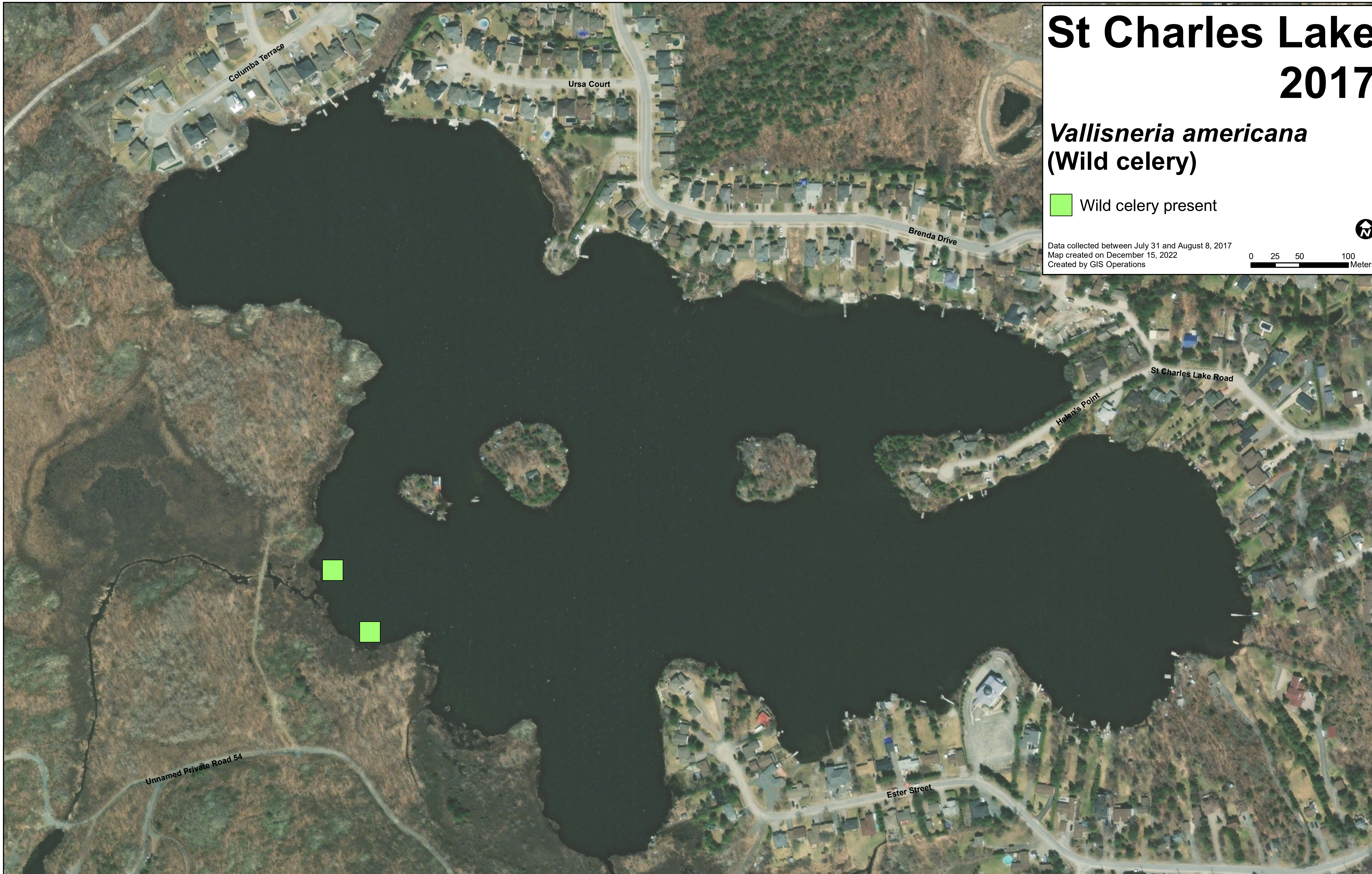

St Charles Lake 2017
Potamogeton amplifolius
(Large-leaf pondweed)
Large-leaf pondweed present
Data collected between July 31 and August 8, 2017
Map created on December 15, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Unnamed Private Road 54
Ester Street


St Charles Lake
2017
Potamogeton foliosus
(Leafy pondweed)
Leafy pondweed present
Data collected between July 31 and August 8, 2017
Map created on December 15, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Unnamed Private Road 54
Ester Street



St Charles Lake 2017
Potamogeton pusillus (Slender pondweed)
Slender pondweed present
Data collected between July 31 and August 8, 2017
Map created on December 15, 2022
Created by GIS Operations
0 25 50 100 Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Ester Street
Unnamed Private Road 54

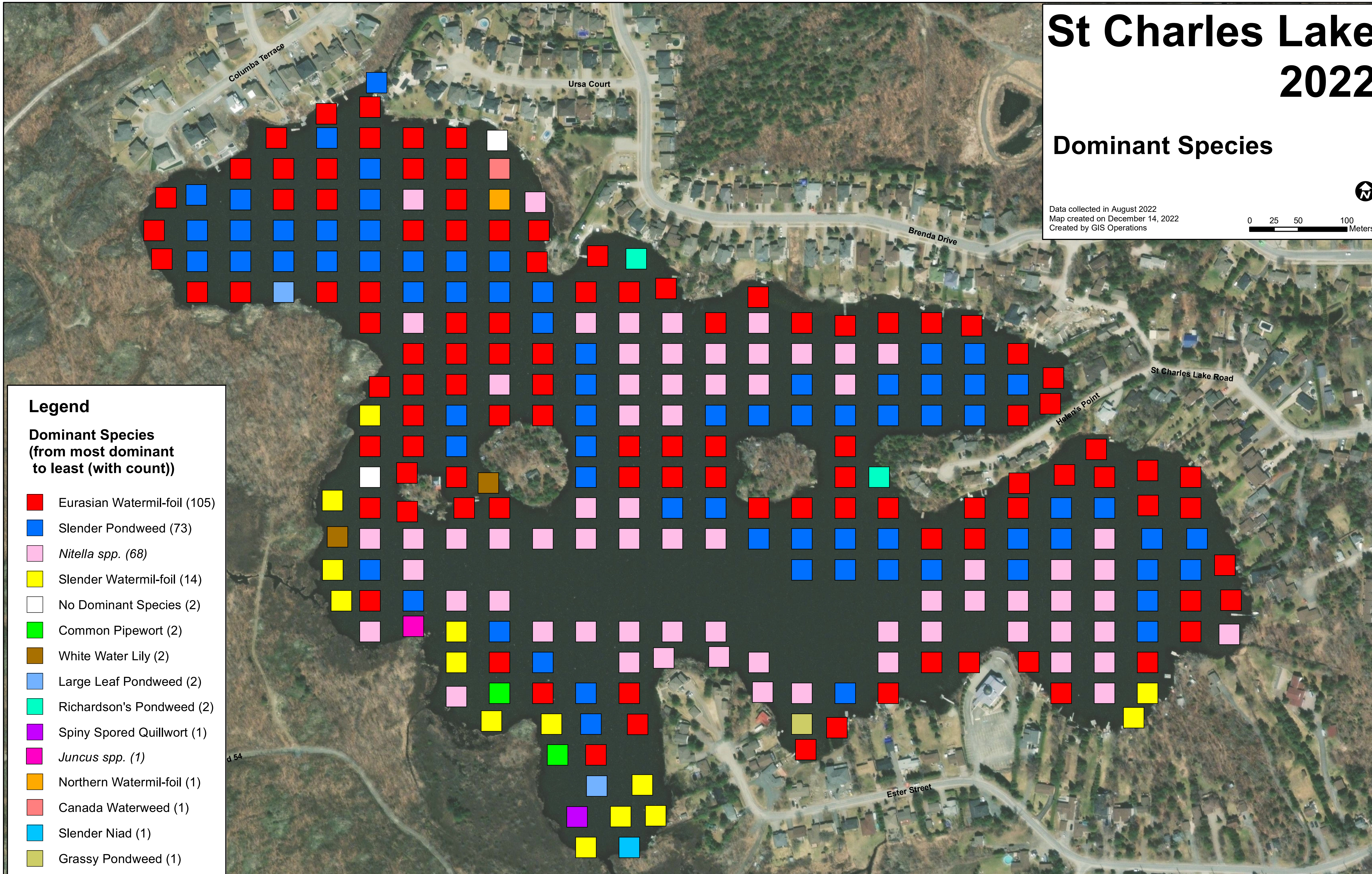

St Charles Lake 2017
Potamogeton richardsonii (Richardson's pondweed)
Richardson's pondweed present
Data collected between July 31 and August 8, 2017
Map created on December 15, 2022
Created by GIS Operations
0 25 50 100 Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Ester Street
Unnamed Private Road 54



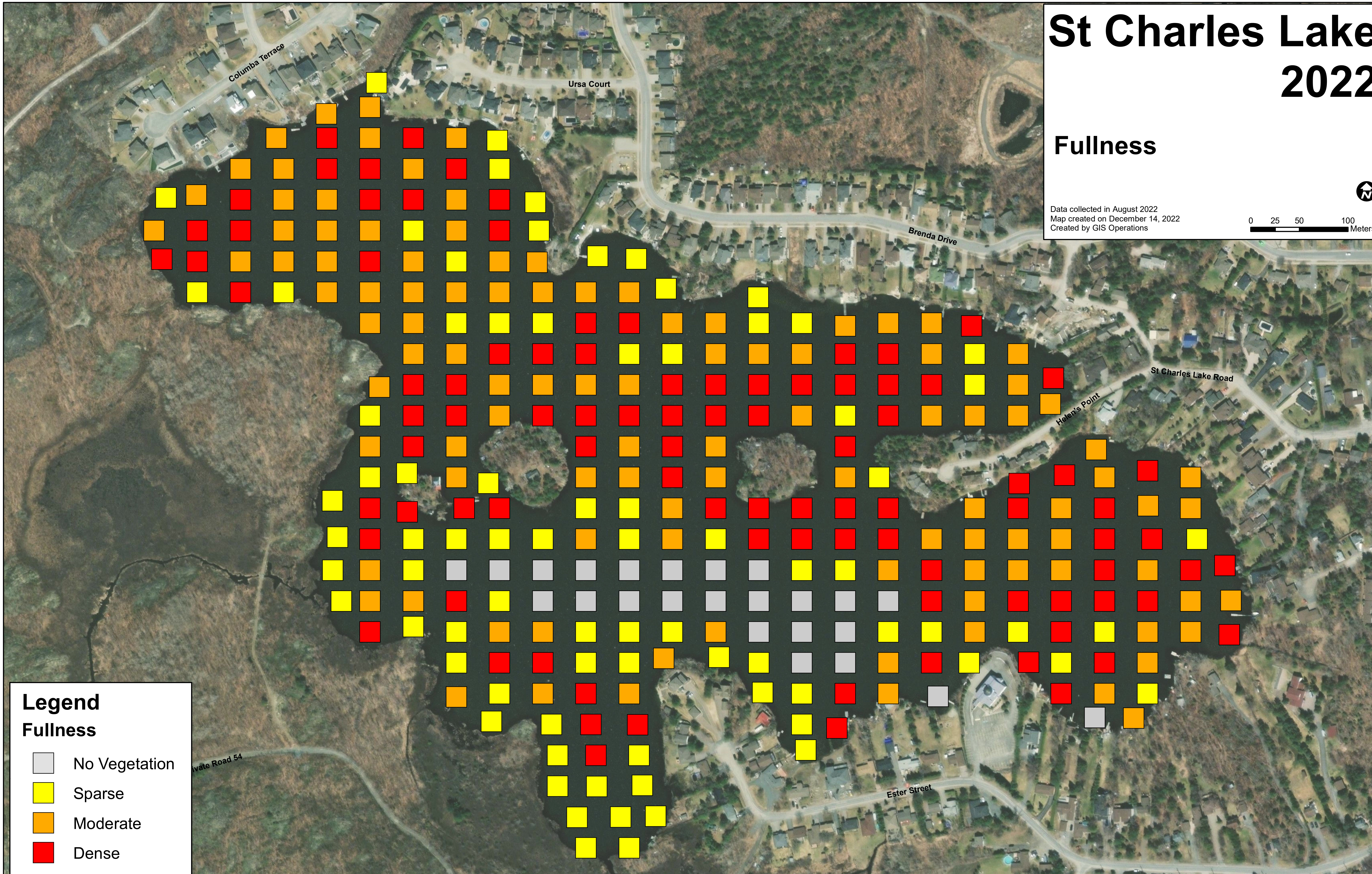
St Charles Lake
2017
Vallisneria americana
(Wild celery)
Wild celery present
Data collected between July 31 and August 8, 2017
Map created on December 15, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Unnamed Private Road 54
Ester Street

# Appendix C

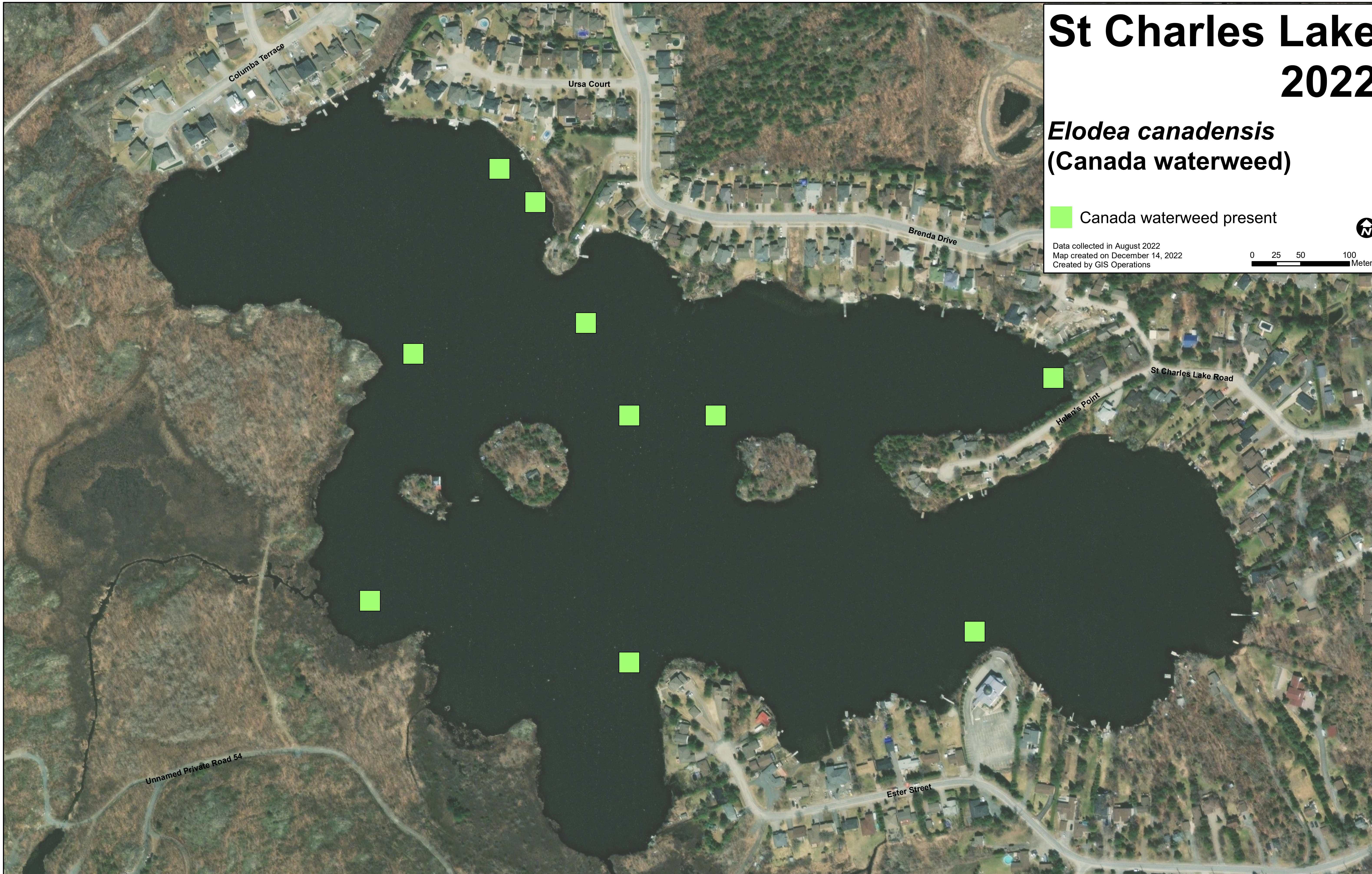
## *2022 St. Charles Lake Vegetation Mapping Results*

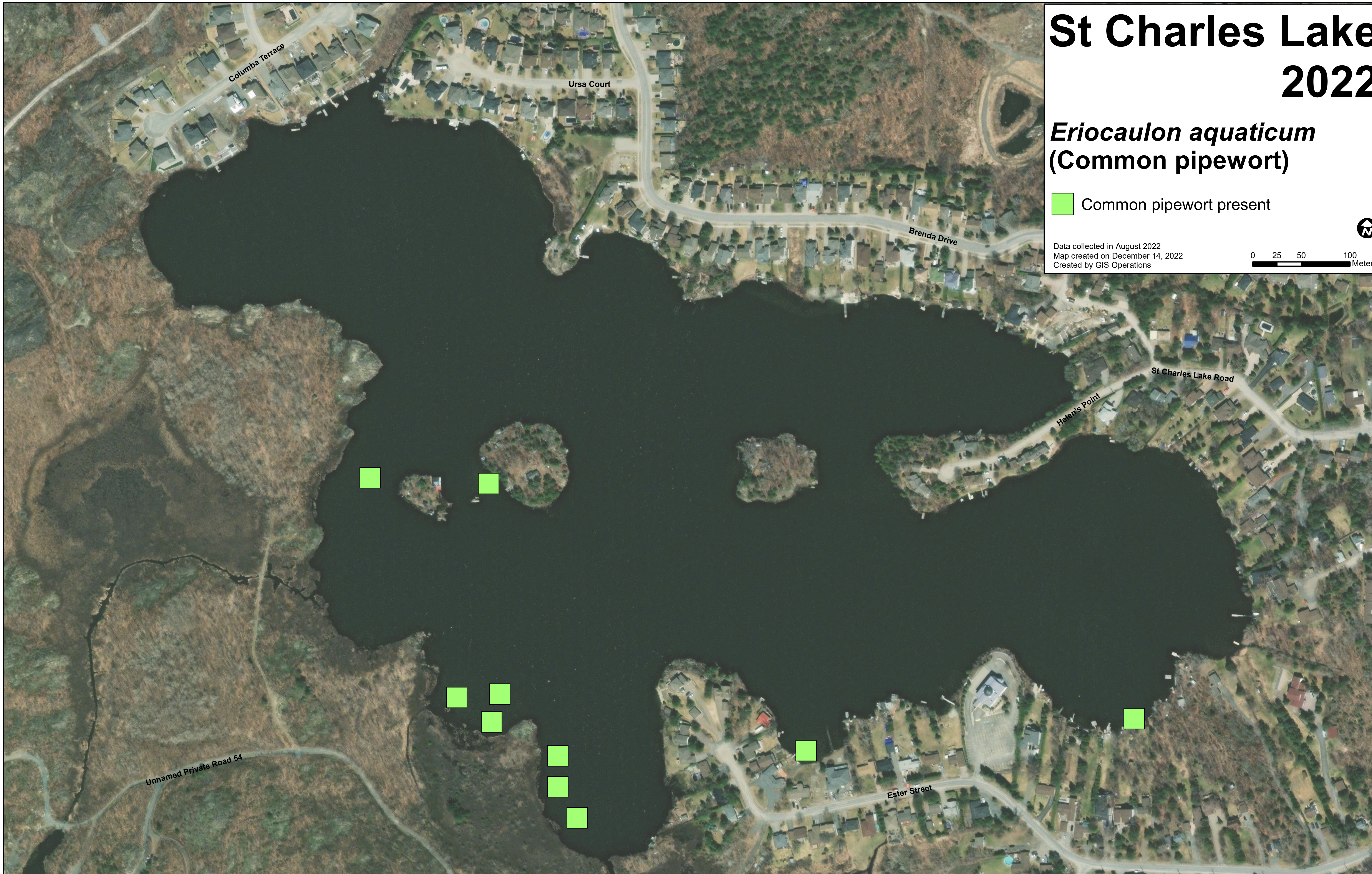


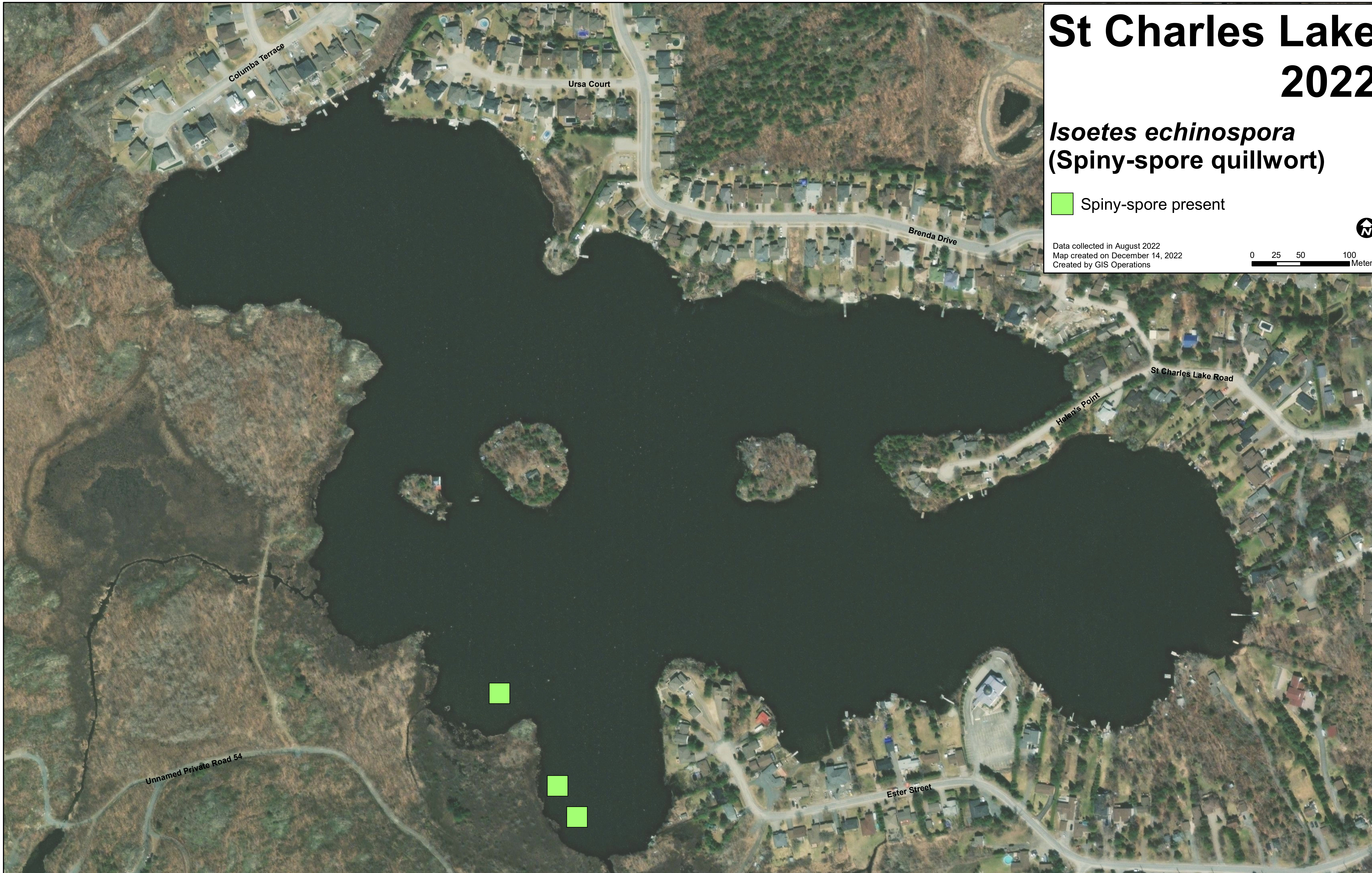
St Charles Lake
2022
Dominant Species
Data collected in August 2022
Map created on December 14, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Ester Street
Legend
Dominant Species
(from most dominant
to least (with count))
Eurasian Watermil-foil (105)
Slender Pondweed (73)
Nitella spp. (68)
Slender Watermil-foil (14)
No Dominant Species (2)
Common Pipewort (2)
White Water Lily (2)
Large Leaf Pondweed (2)
Richardson's Pondweed (2)
Spiny Spored Quillwort (1)
Juncus spp. (1)
Northern Watermil-foil (1)
Canada Waterweed (1)
Slender Niad (1)
Grassy Pondweed (1)

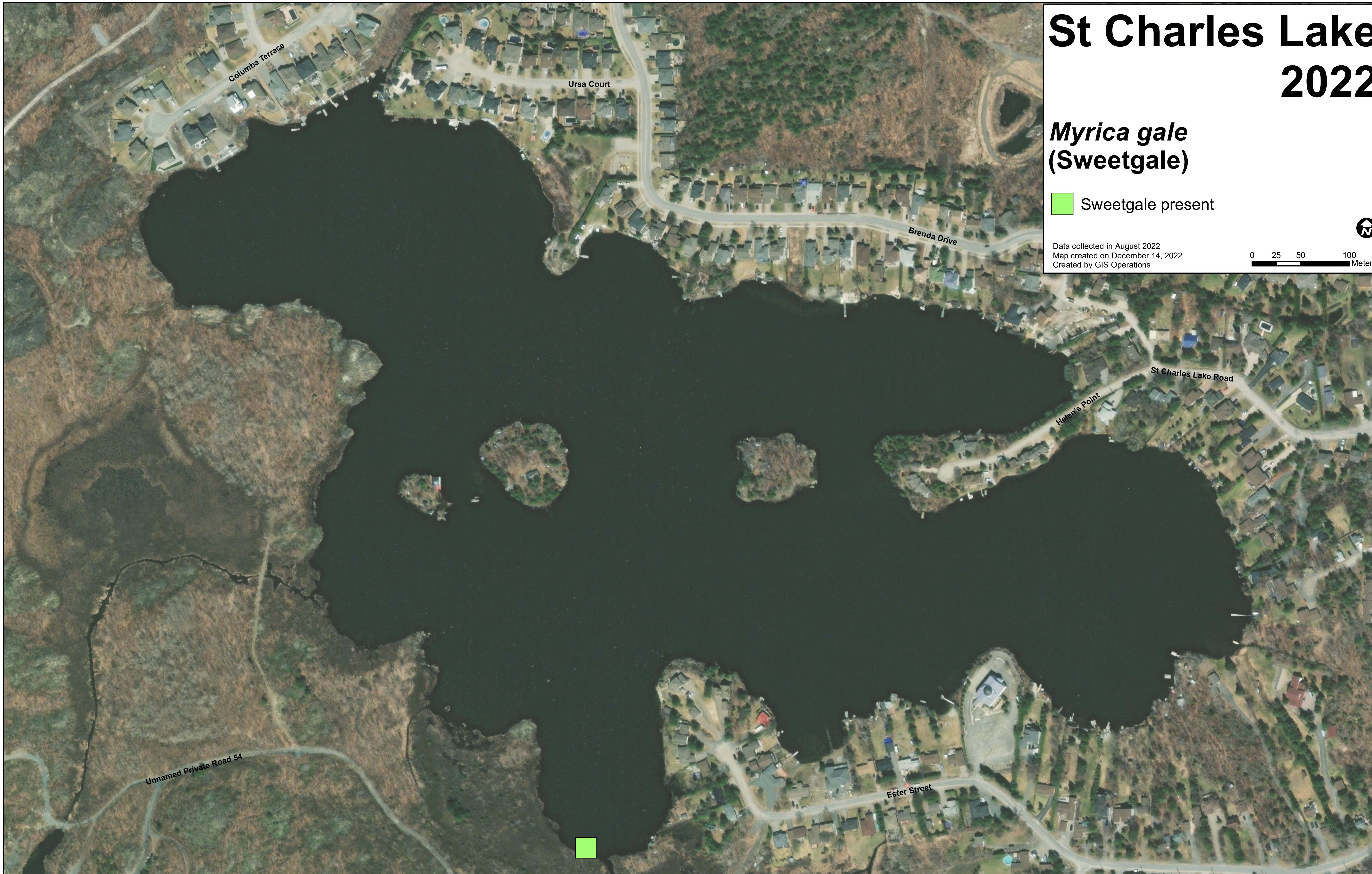


St Charles Lake
2022
Fullness
Data collected in August 2022
Map created on December 14, 2022
Created by GIS Operations
0 25 50 100 Meters
Legend
Fullness
No Vegetation
Sparse
Moderate
Dense
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Ester Street
ivate Road 54

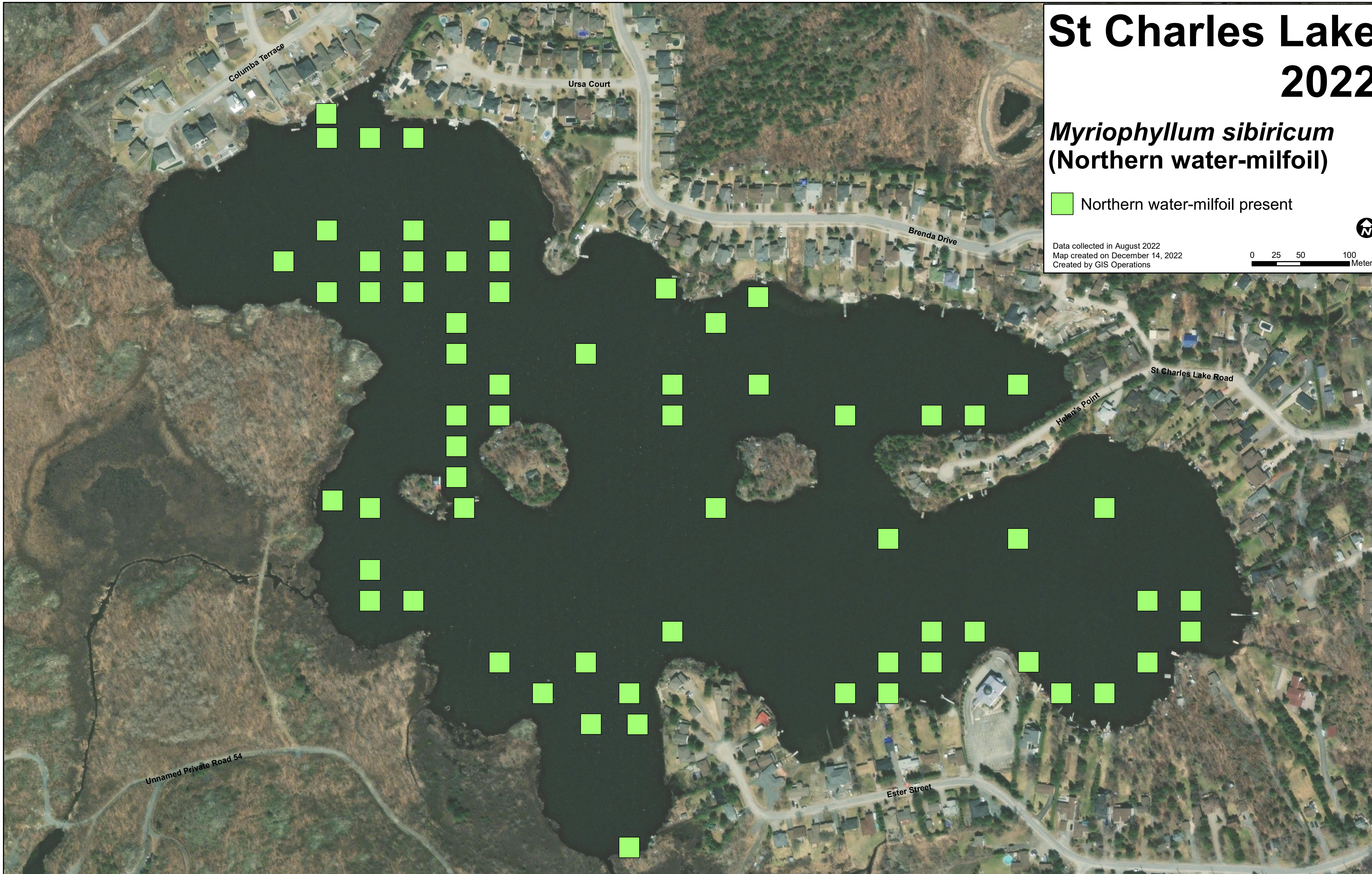

St Charles Lake
2022
Elodea canadensis
(Canada waterweed)
Canada waterweed present
Data collected in August 2022
Map created on December 14, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Ester Street
Unnamed Private Road 54

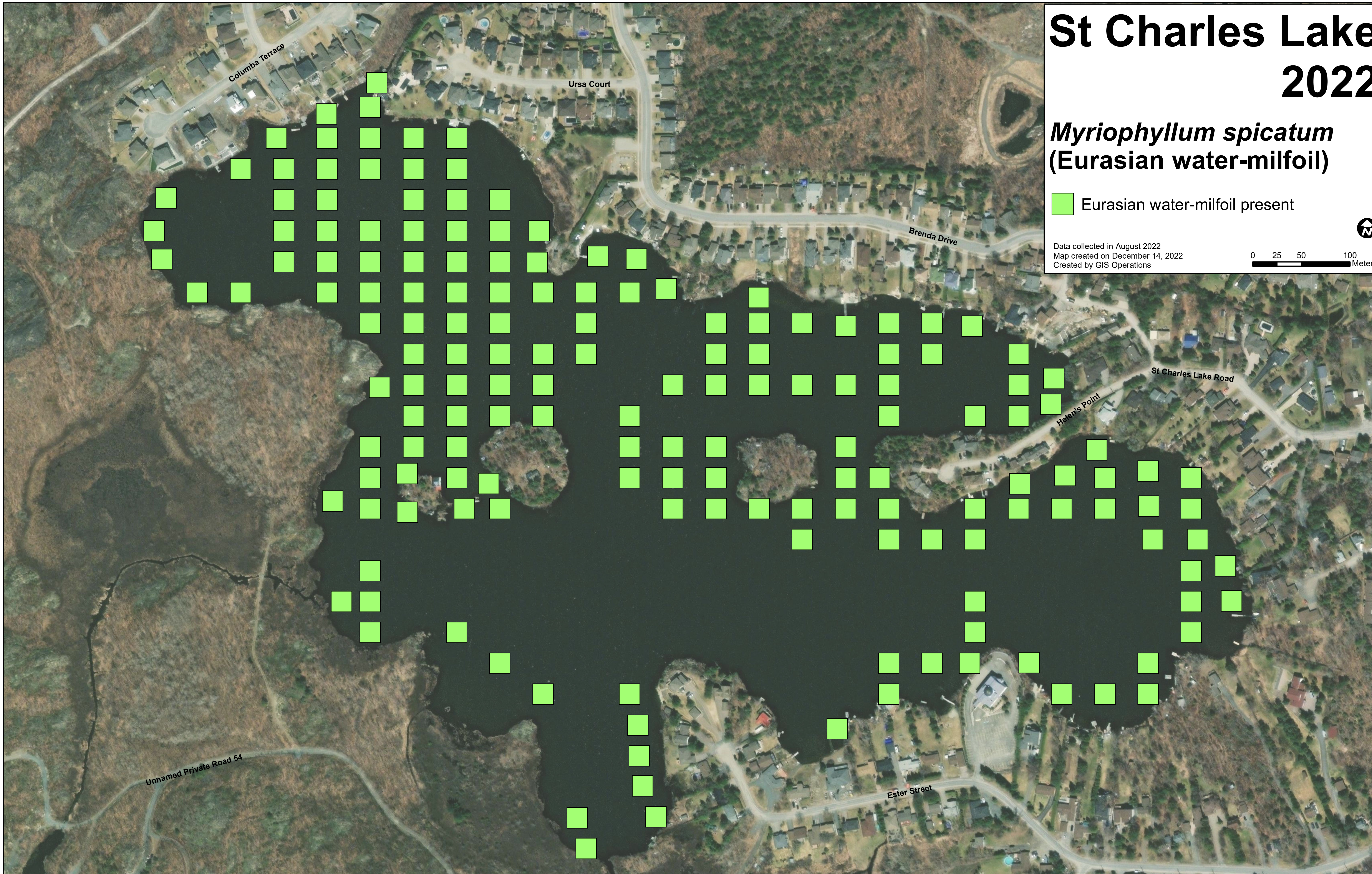

St Charles Lake
2022
Eriocaulon aquaticum
(Common pipewort)
Common pipewort present
Data collected in August 2022
Map created on December 14, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Unnamed Private Road 54
Ester Street

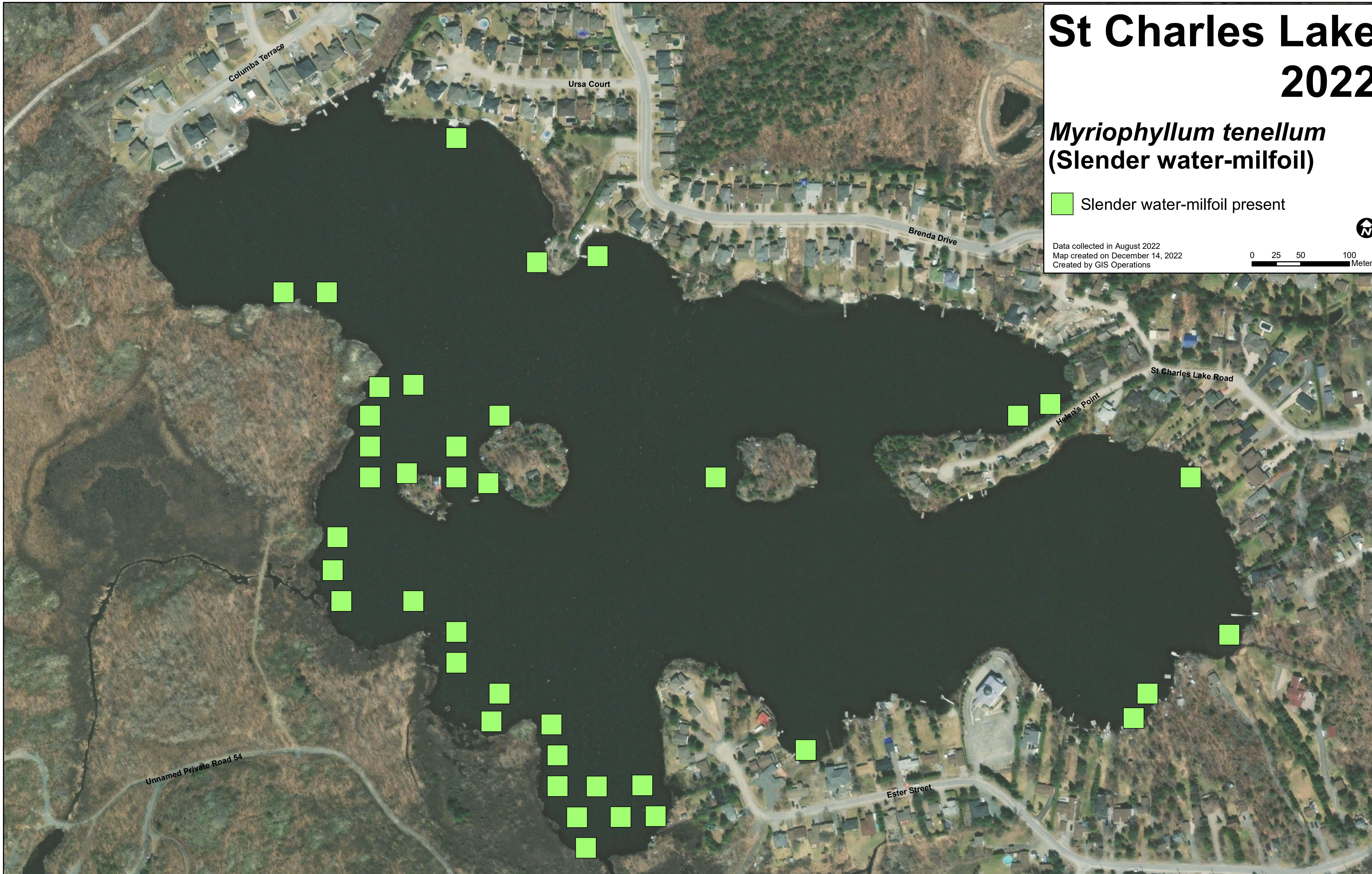

St Charles Lake
2022
Isoetes echinospora
(Spiny-spore quillwort)
Spiny-spore present
Data collected in August 2022
Map created on December 14, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Unnamed Private Road 54
Ester Street

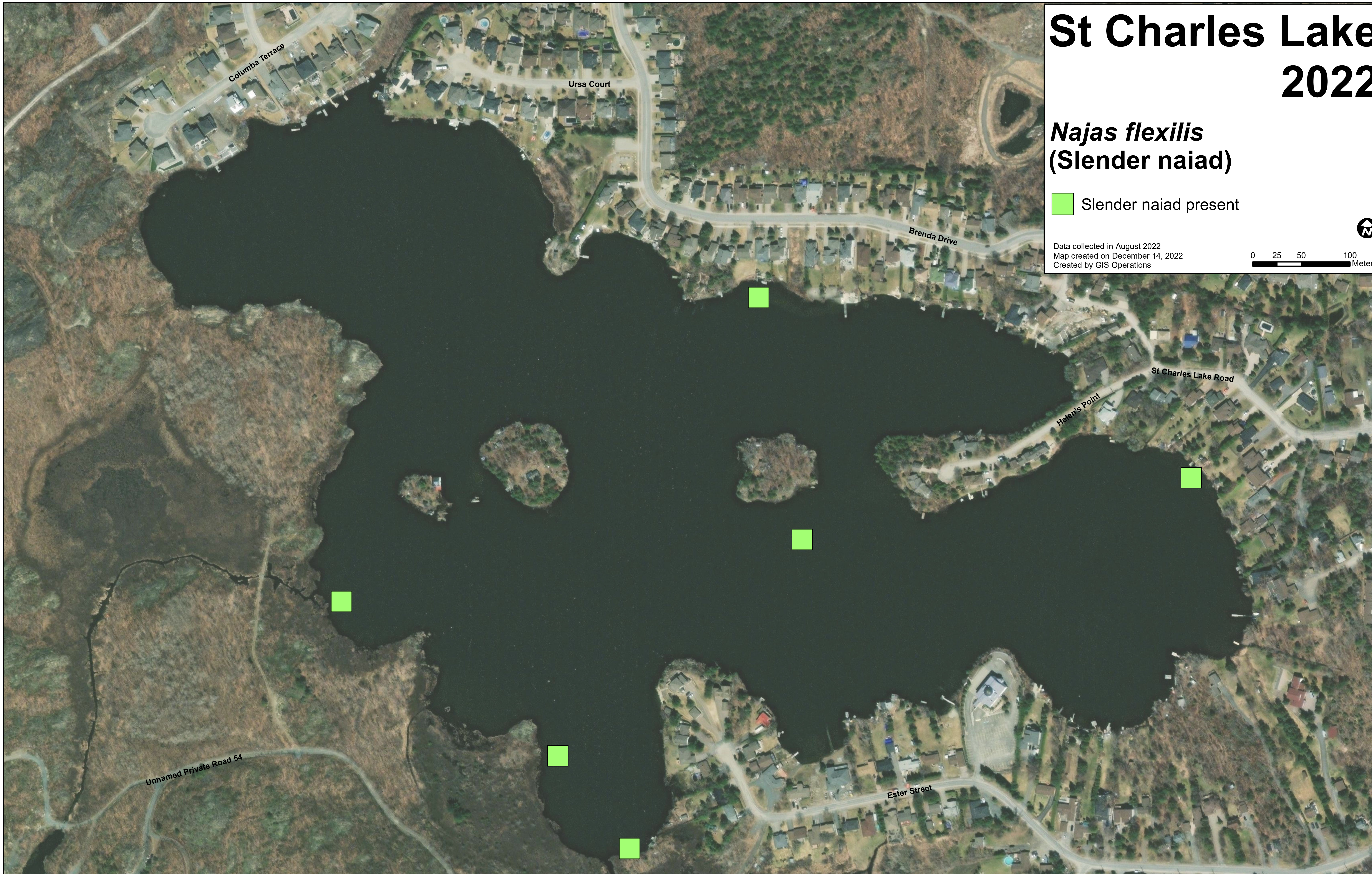


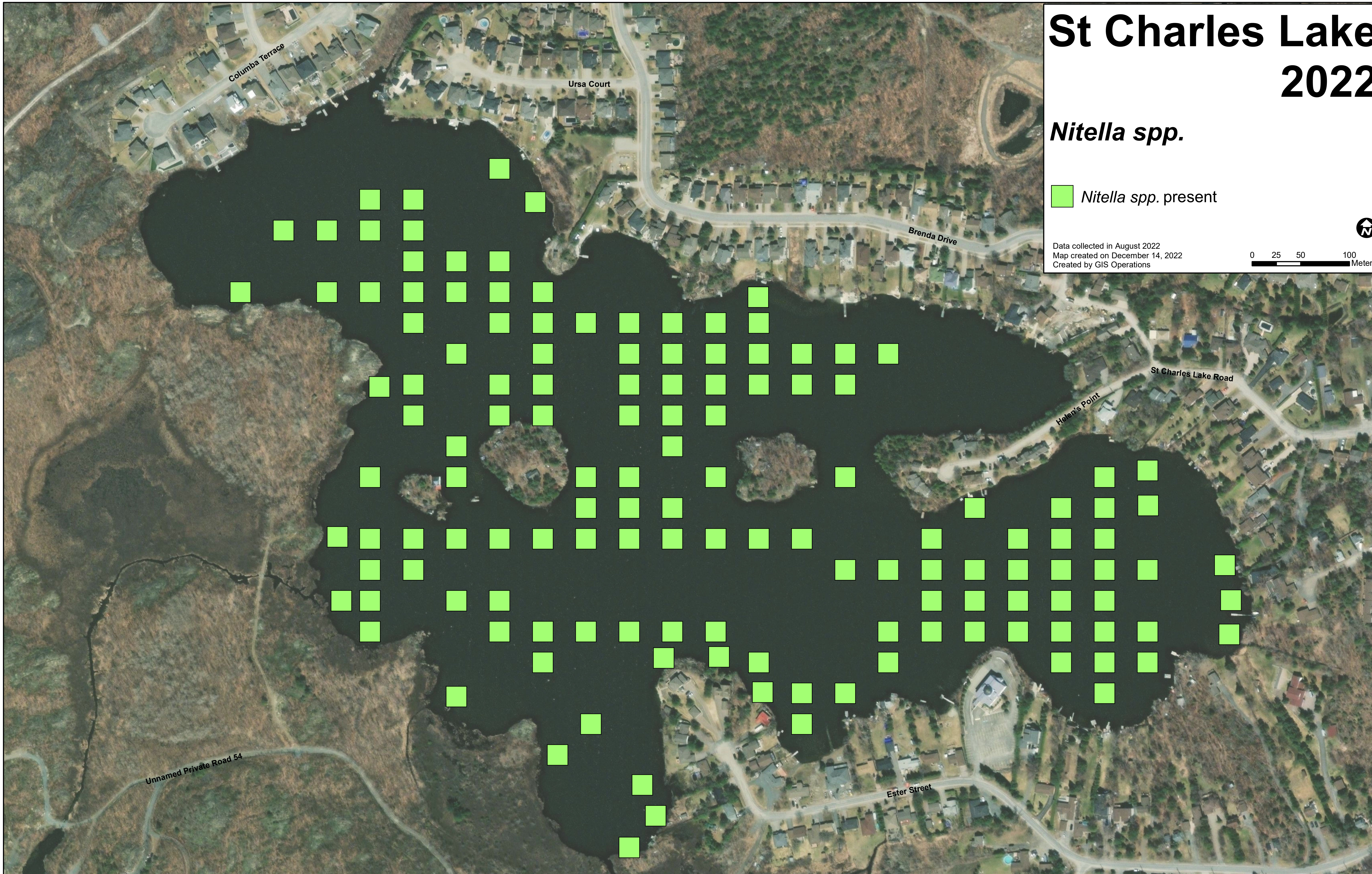
St Charles Lake
2022
*Myrica gale*
(Sweetgale)
Sweetgale present
Data collected in August 2022
Map created on December 14, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Ester Street
Unnamed Private Road 54

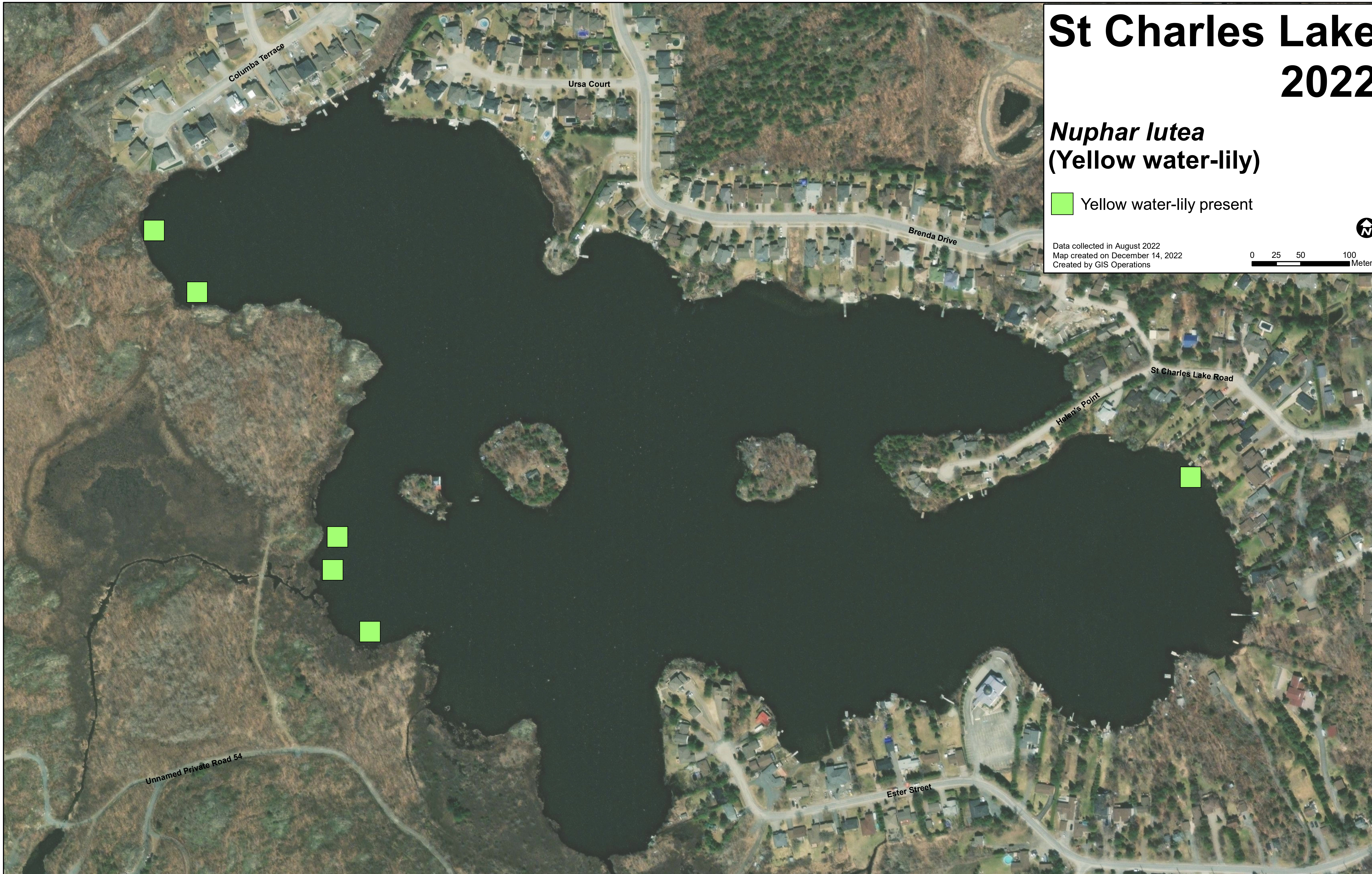

St Charles Lake
2022
Myriophyllum sibiricum
(Northern water-milfoil)
Northern water-milfoil present
Data collected in August 2022
Map created on December 14, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Ester Street
Unnamed Private Road 54

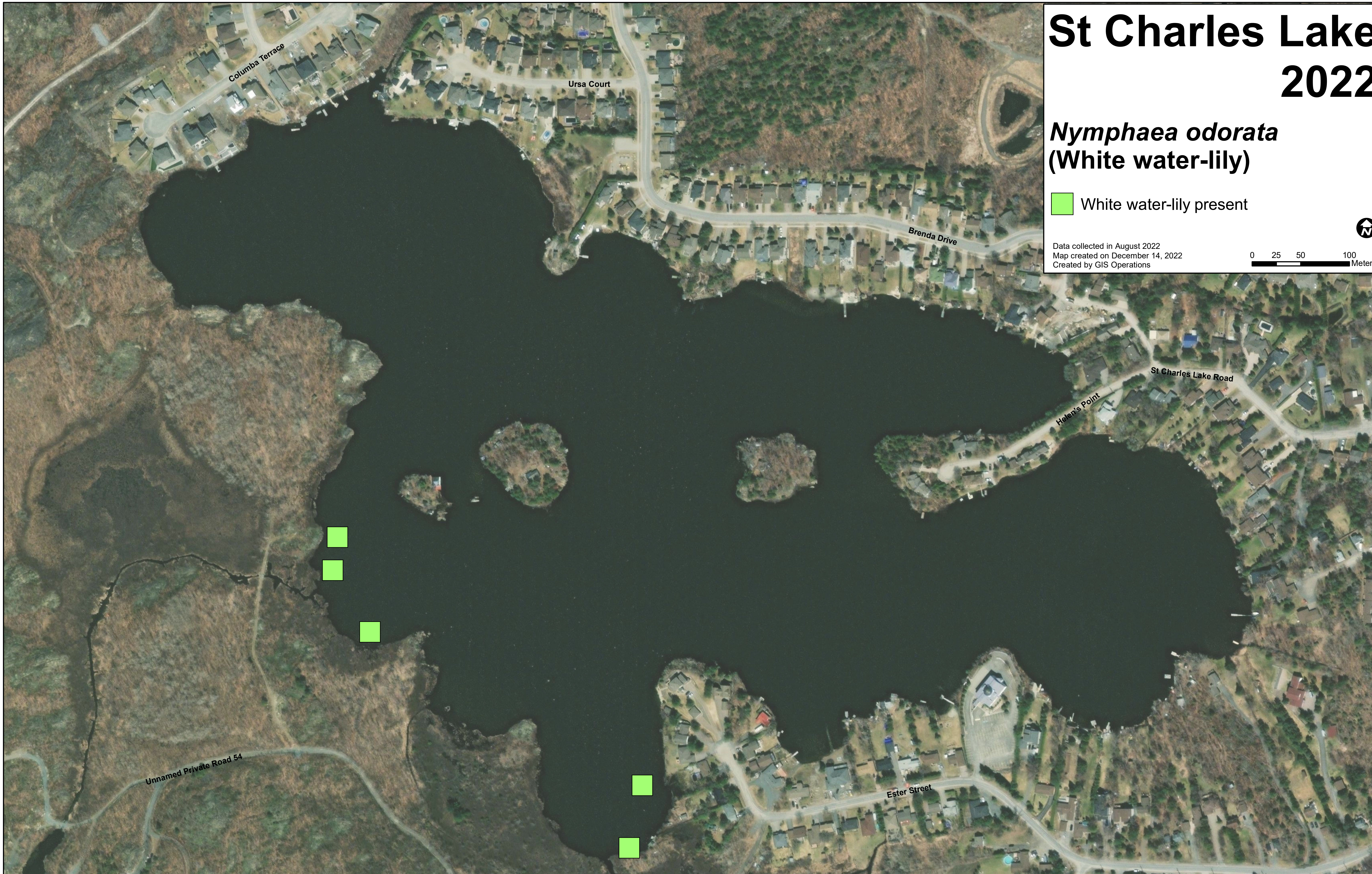

St Charles Lake
2022
Myriophyllum spicatum
(Eurasian water-milfoil)
Eurasian water-milfoil present
Data collected in August 2022
Map created on December 14, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Unnamed Private Road 54
Ester Street


St Charles Lake
2022
Myriophyllum tenellum
(Slender water-milfoil)
Slender water-milfoil present
Data collected in August 2022
Map created on December 14, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Ester Street
Unnamed Private Road 54

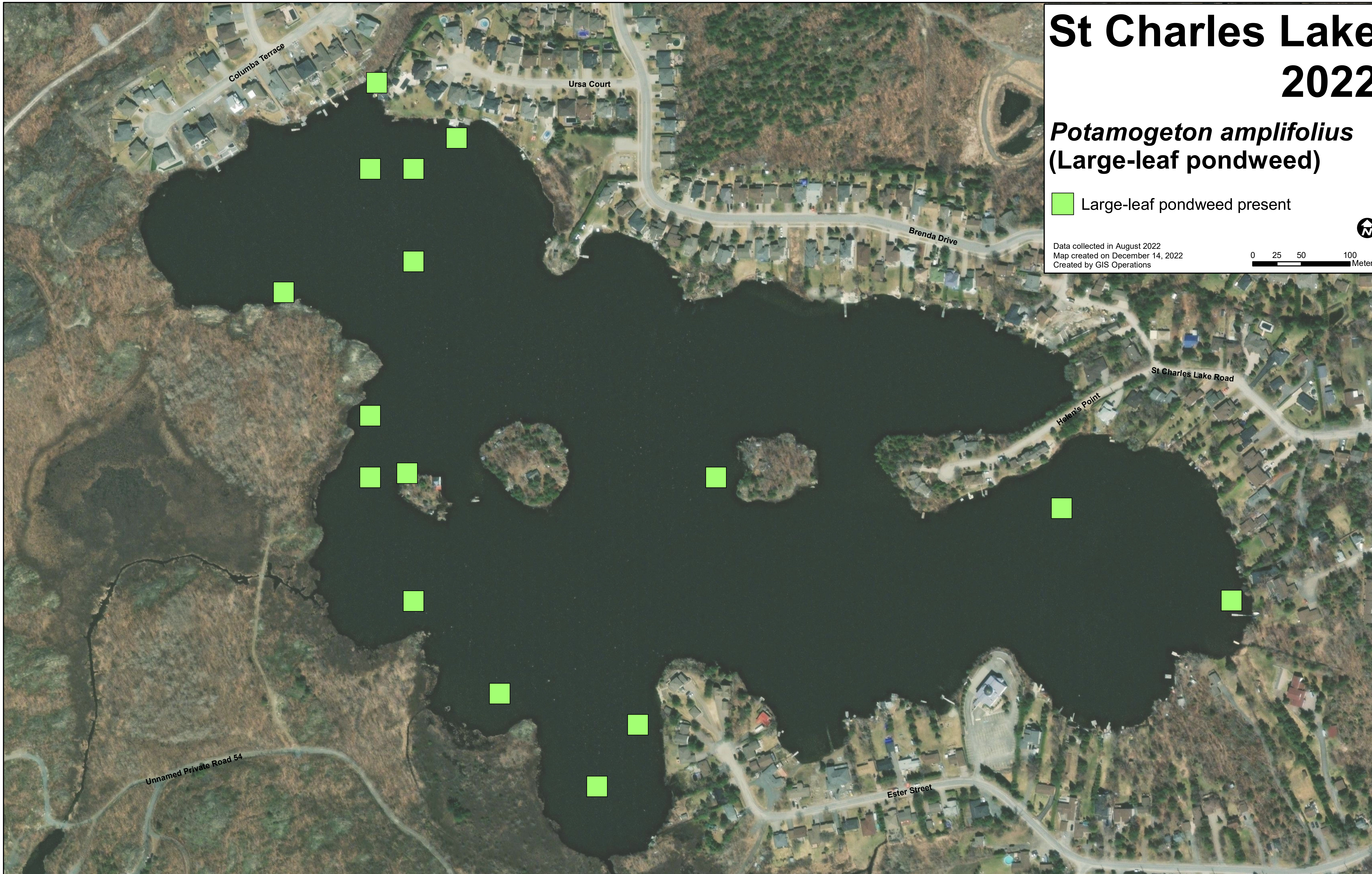

St Charles Lake 2022
Najas flexilis
(Slender naiad)
Slender naiad present
Data collected in August 2022
Map created on December 14, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Unnamed Private Road 54
Ester Street

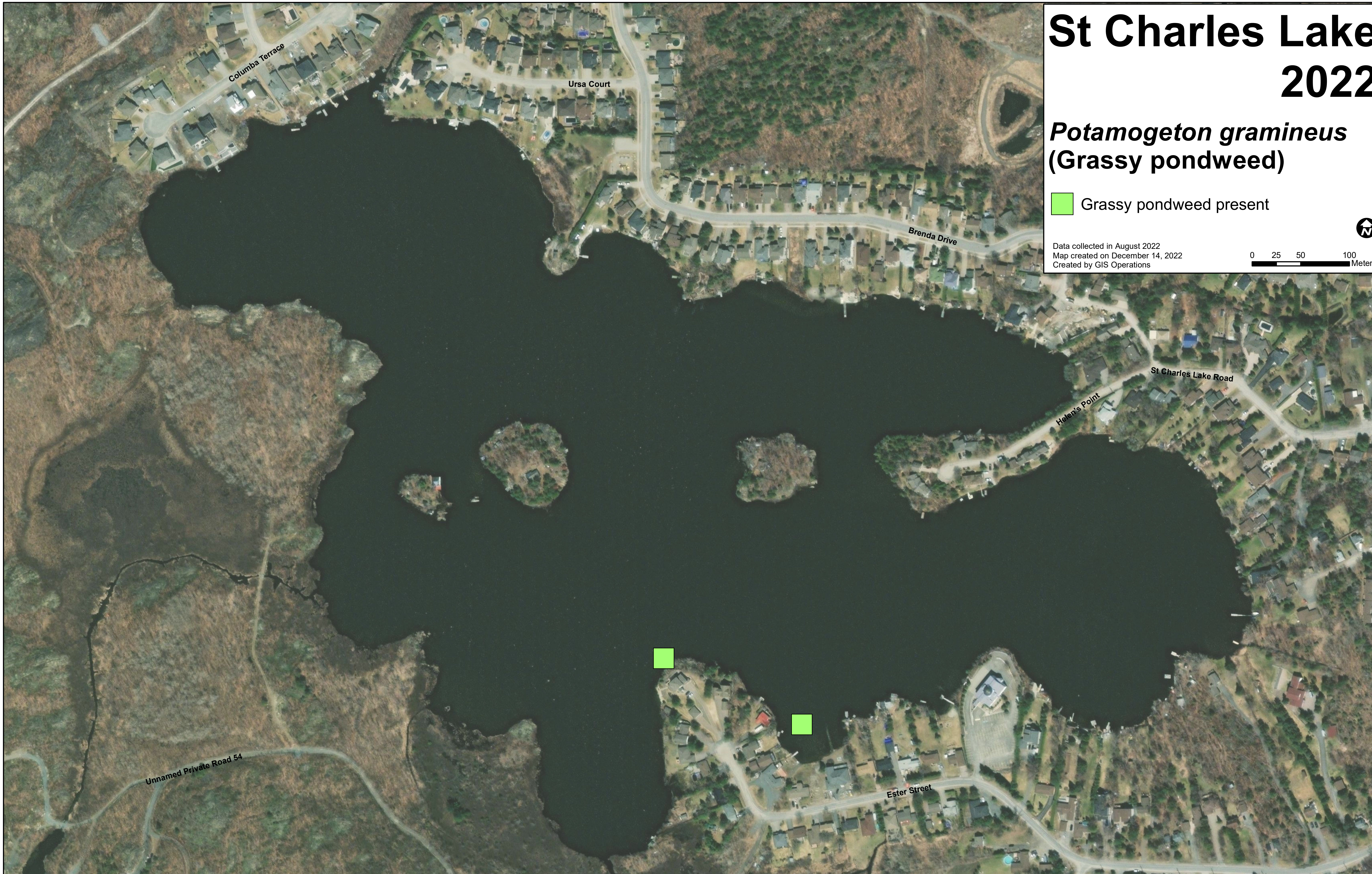

St Charles Lake
2022
Nitella spp.
Nitella spp. present
Data collected in August 2022
Map created on December 14, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Ester Street
Unnamed Private Road 54


St Charles Lake 2022
Nuphar lutea
(Yellow water-lily)
Yellow water-lily present
Data collected in August 2022
Map created on December 14, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Ester Street
Unnamed Private Road 54

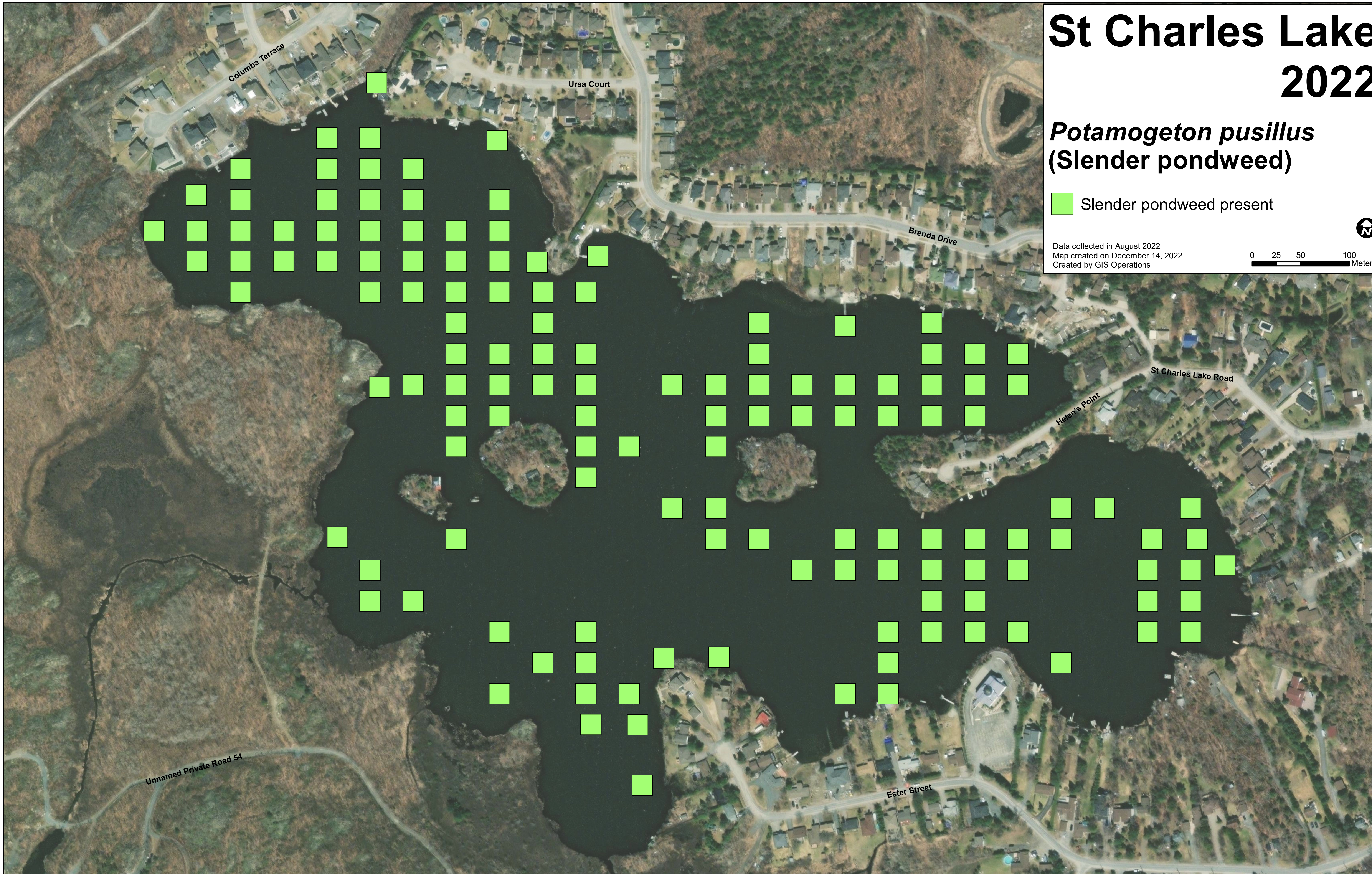


St Charles Lake
2022
Nymphaea odorata
(White water-lily)
White water-lily present
Data collected in August 2022
Map created on December 14, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Ester Street
Unnamed Private Road 54

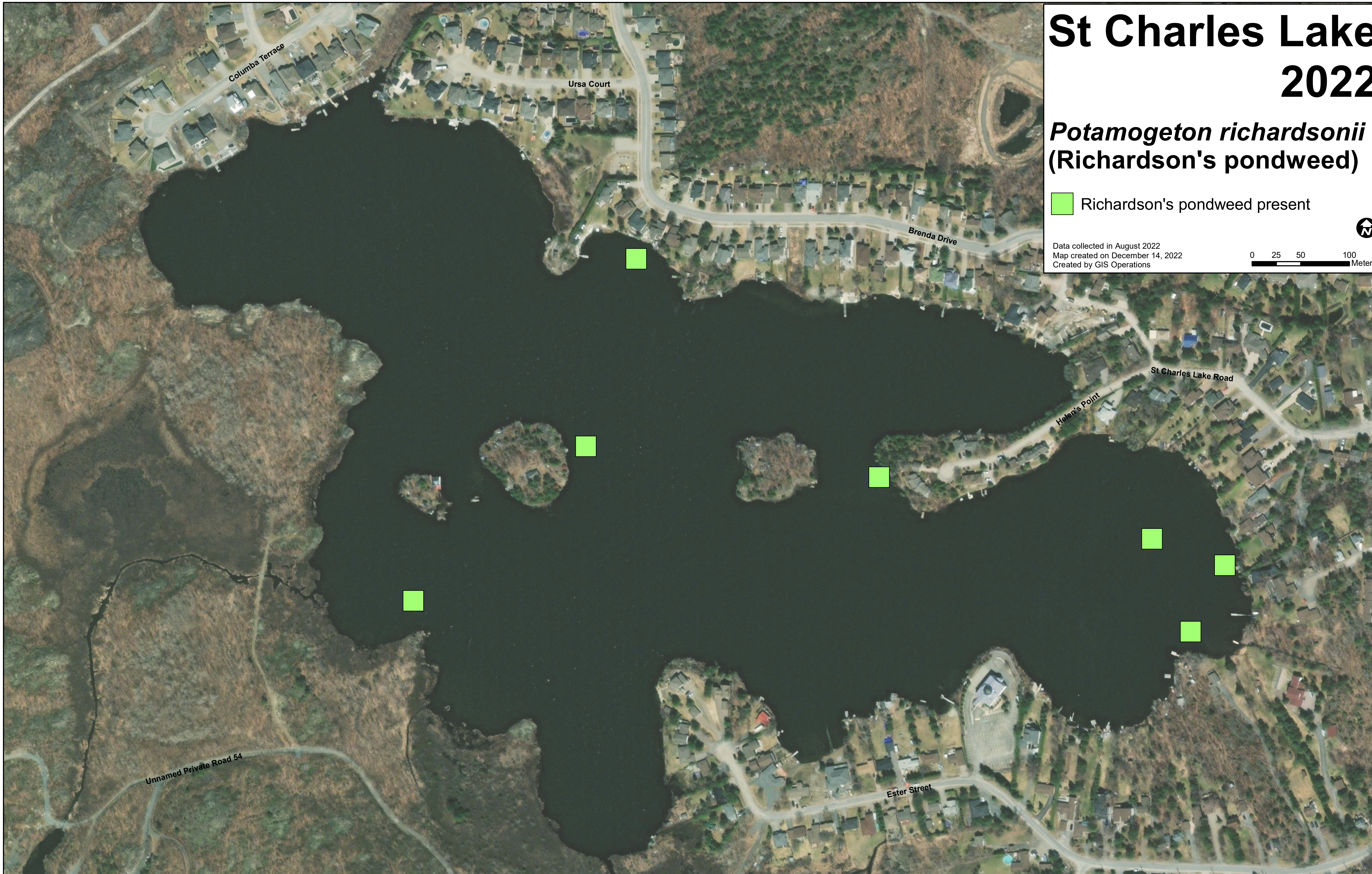

St Charles Lake
2022
Potamogeton amplifolius
(Large-leaf pondweed)
Large-leaf pondweed present
Data collected in August 2022
Map created on December 14, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Ester Street
Unnamed Private Road 54

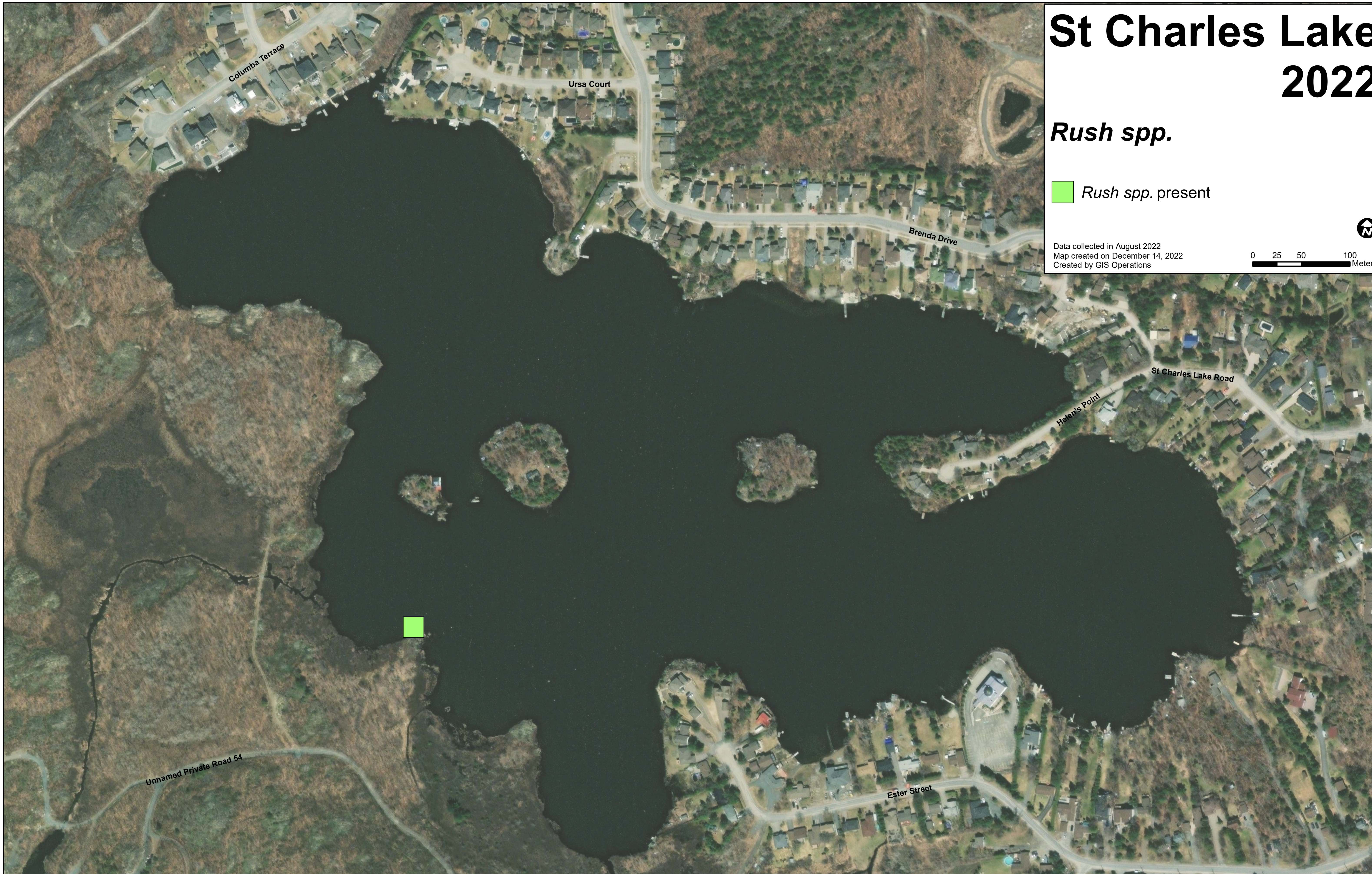


St Charles Lake 2022
Potamogeton gramineus (Grassy pondweed)
Grassy pondweed present
Data collected in August 2022
Map created on December 14, 2022
Created by GIS Operations
0 25 50 100 Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Ester Street
Unnamed Private Road 54



St Charles Lake 2022
Potamogeton pusillus
(Slender pondweed)
Slender pondweed present
Data collected in August 2022
Map created on December 14, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Unnamed Private Road 54
Ester Street


St Charles Lake
2022
Potamogeton richardsonii
(Richardson's pondweed)
Richardson's pondweed present
Data collected in August 2022
Map created on December 14, 2022
Created by GIS Operations
0 25 50 100
Meters
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Ester Street
Unnamed Private Road 54


St Charles Lake
2022
Rush spp.
Rush spp. present
Data collected in August 2022
Map created on December 14, 2022
Created by GIS Operations
0 25 50 100
Meters
N
Columba Terrace
Ursa Court
Brenda Drive
St Charles Lake Road
Helen's Point
Unnamed Private Road 54
Ester Street

# Appendix D

## *Aquatic Vegetation Mapping Density/Fullness Guide*

**Table 6.** Illustration of rake fullness/density rating used for the survey. Adapted from Hauxwell et al, 2010 [4]

| Density/Fullness | Coverage Example | Description |
|---|---|---|
| Sparse |  | Few plants present. There are not enough plants to entirely cover the length of the rake head in a single layer |
| Moderate |  | There are enough plants to cover the length of the rake head in a single layer, but not enough to fully cover the tines. |
| Dense |  | The rake is completely covered, and the tines are mostly not visible. |

**Sparse*** **Moderate*** **Dense***

***images taken by CGS staff during 2022 St. Charles Lake aquatic vegetation mapping survey