VLAWMO

VADNAIS LAKE AREA WATER MANAGEMENT ORGANIZATION

Charley Lake Review, Ramsey County, MN

2024

Vadnais Lake Area Water Management Organization
800 East County Road E
Vadnais Heights, MN 55127
651-204-6070
www.vlawmo.org

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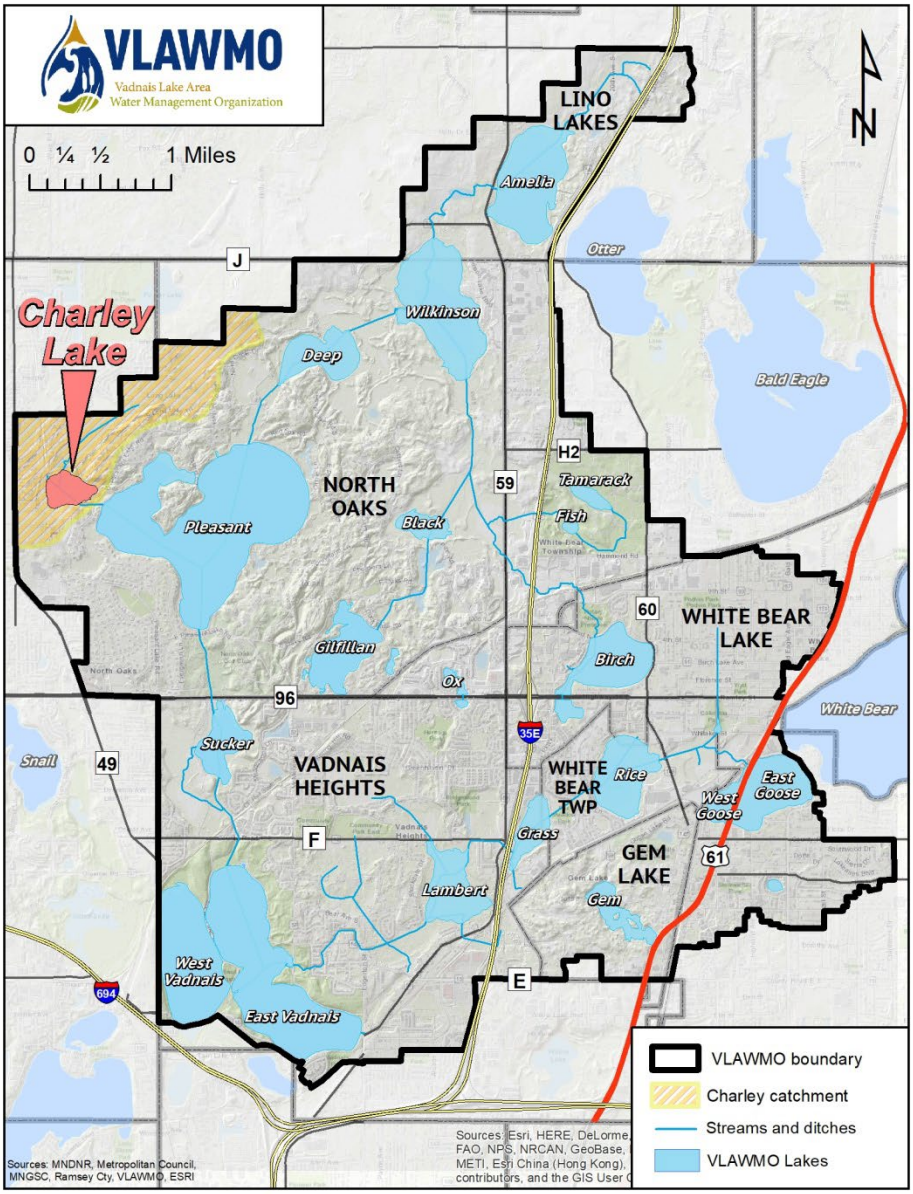
1 INTRODUCTION

1.1 INTRODUCTION

Charley Lake is located in the City of North Oaks, Ramsey County, and within the Vadnais Lake Area Water Management Organization (VLAWMO) watershed area. Charley Lake is 38 acres, with a maximum depth of nearly 18 feet and average depth of 5 feet. It has no public access and is surrounded by private, residential development, mostly on large lots. Charley Lake is at the top of a chain of lakes. Charley Lake is connected via a channel to Pleasant Lake, which links to Sucker Lake, and then to East Vadnais Lake. These lakes are utilized by the St. Paul Regional Water Service (SPRWS) to move water from the Mississippi River to a drinking water treatment facility. On average, 20-25 million gallons of water are pumped into the lake by the SPRWS daily. The amount of water pumped into the system varies according to demand. Due to this constant inflow, the water in Charley Lake changes over approximately every 3 days. An important factor regarding the health of Charley Lake is the water quality of the Mississippi River in addition to the surrounding subwatershed area that drains into the lake.

Figure 1: Map of VLAWMO



2 WATERSHED FEATURES

2.1 HISTORY

AERIAL PHOTO HISTORY

Figure 2: 1940 aerial photo of Charley Lake

In 1940, there are agricultural clearings and lake homes on Turtle Lake. The channel on the NW side of the lake appears to connect to Baldwin Lake. County Rd I and Hodgson Rd are present.

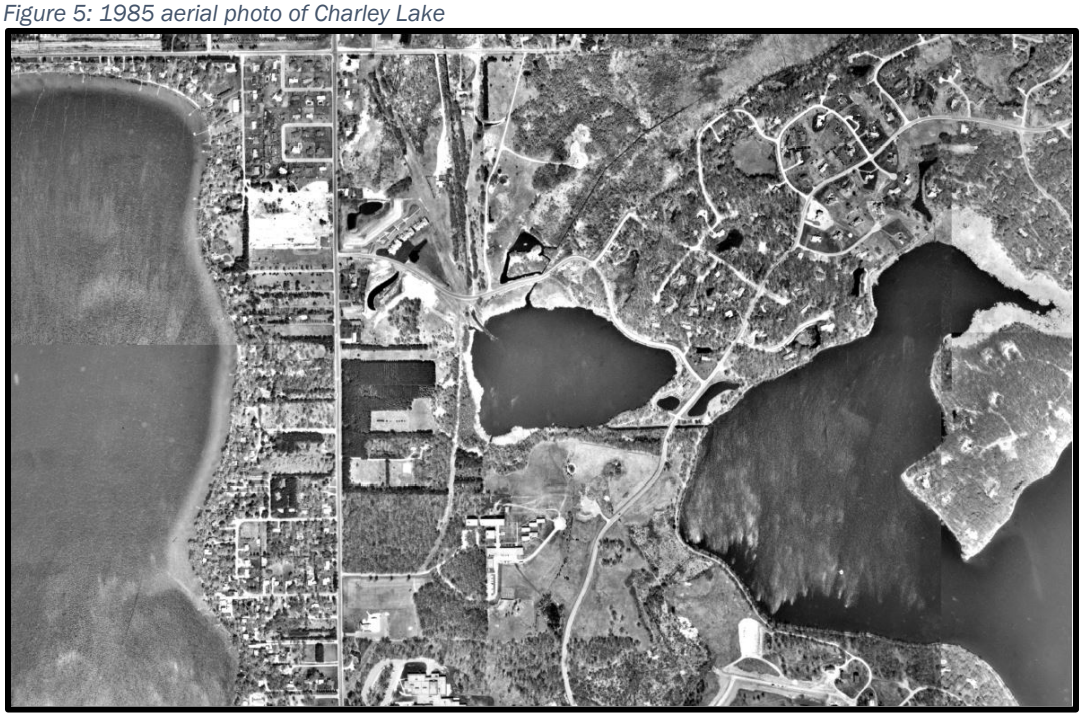
Figure 3: 1953 aerial photo of Charley Lake

In 1953, a road and a few buildings on the north side of the lake have been built.

Figure 4: 1974 aerial photo of Charley Lake

By 1974, the residential development of North Oaks has begun, the convent south of Charley has been built, and the aqueduct pumping water from the Mississippi connects to the North Oaks chain of lakes by entering through Charley.

Figure 5: 1985 aerial photo of Charley Lake



In 1985, early residential development north of Charley is in place, some homes have been added off Hodgson Road, and residential development out of frame to the north has begun.

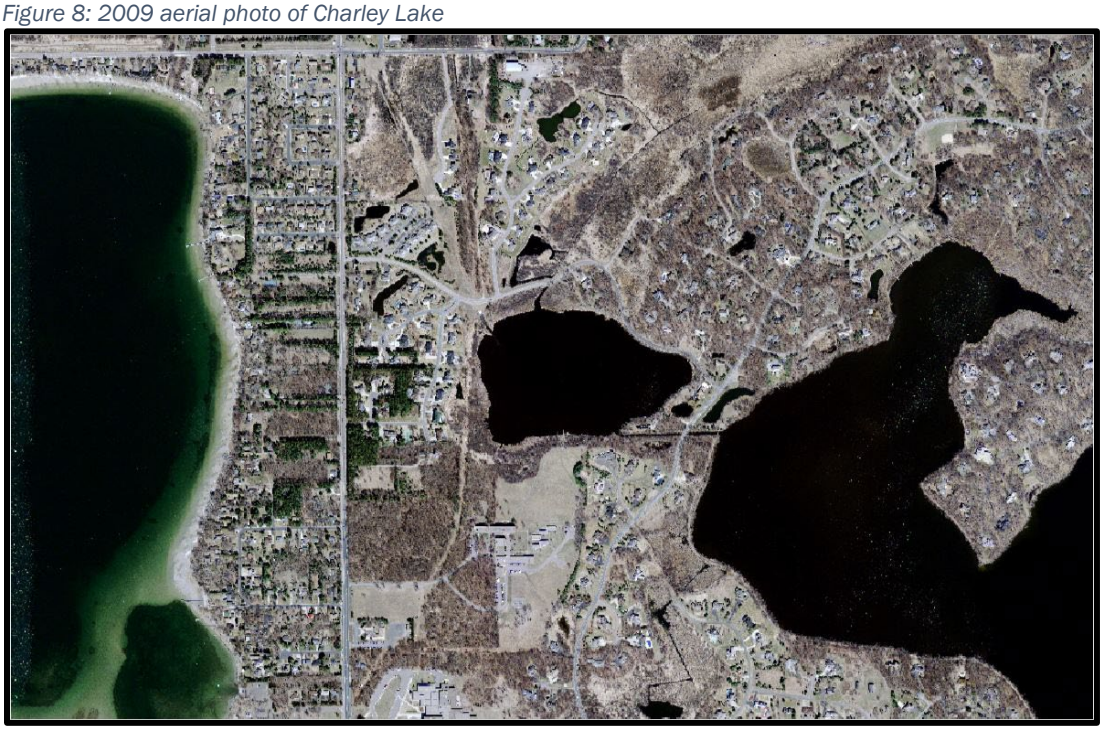
Figure 6: 1991 aerial photo of Charley Lake

In 1991, the first-phase development within the Charley subwatershed catchment has been completed.

Figure 7: 2003 aerial photo of Charley Lake

In 2003, more development has been added to the north and west of Charley, and development is underway to the south of Charley Channel.

Figure 8: 2009 aerial photo of Charley Lake



In 2009, there is little has change since the 2003 aerial.

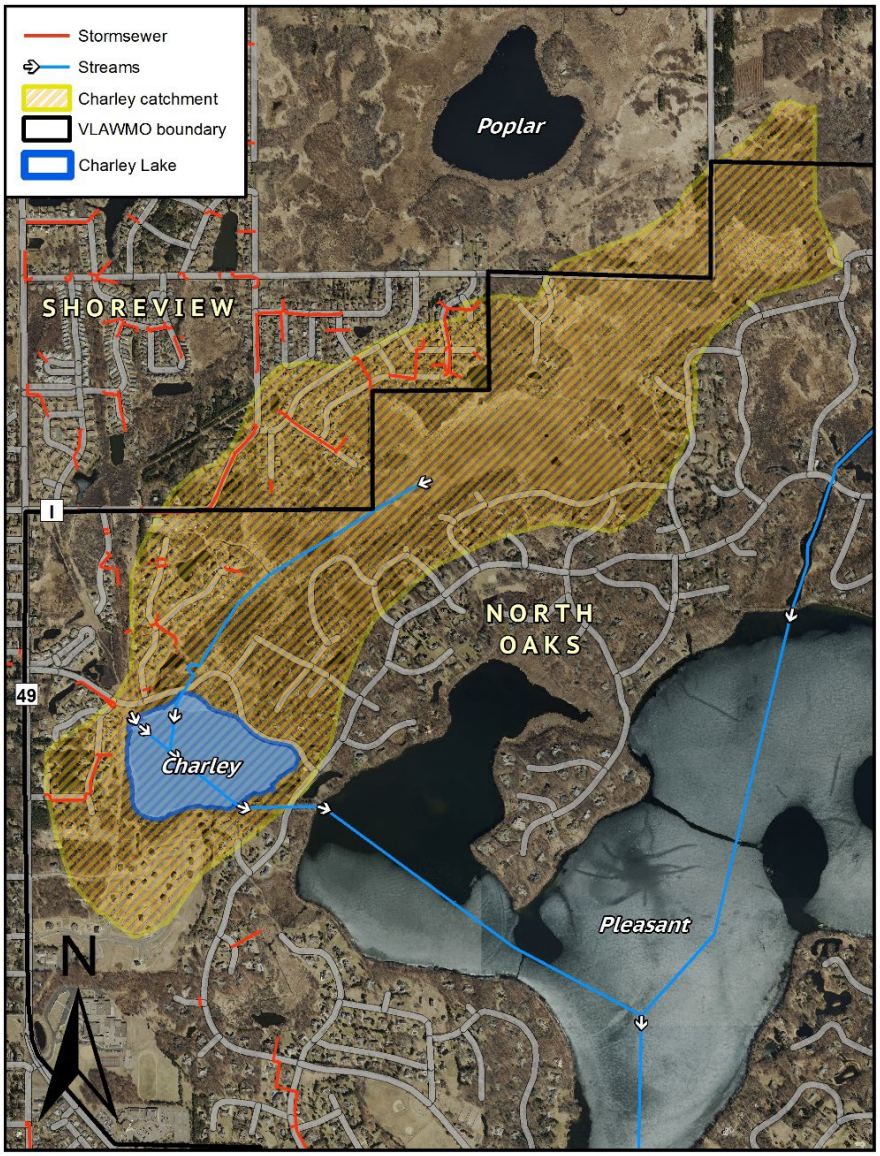
Figure 9: 2015 aerial photo of Charley Lake

In 2015, the convent south of Charley has been demolished, a new residential development has begun, and development has contributed to sediment and nutrient inputs into the lake.

2.2 CHARLEY LAKE DRAINAGE AREA

Charley Lake receives water runoff mainly from the northeast, which is largely residential area and open space. Just over 638 acres of land lies within the Charley's drainage area, which is about 15 times larger than the lake itself. Charley's main water input is fed from 2, 60-inch culverts that run from the Mississippi River in Fridley and enter into the lake on the northwest shoreline. Water also collects in the lake from its catchment area. On the north side, Long Marsh Stream enters the lake. It contributes drainage from 2 neighborhoods and wetlands further upstream. The lake outlets to the southeast into Charley Channel, where the water flows into Pleasant Lake. The water level in the lake varies depending on pumping from the Mississippi River by the St. Paul Regional Water Service (SPRWS). SPRWS maintains water the level within a 2-foot fluctuation.

Figure 10: Charley Lake Drainage Area

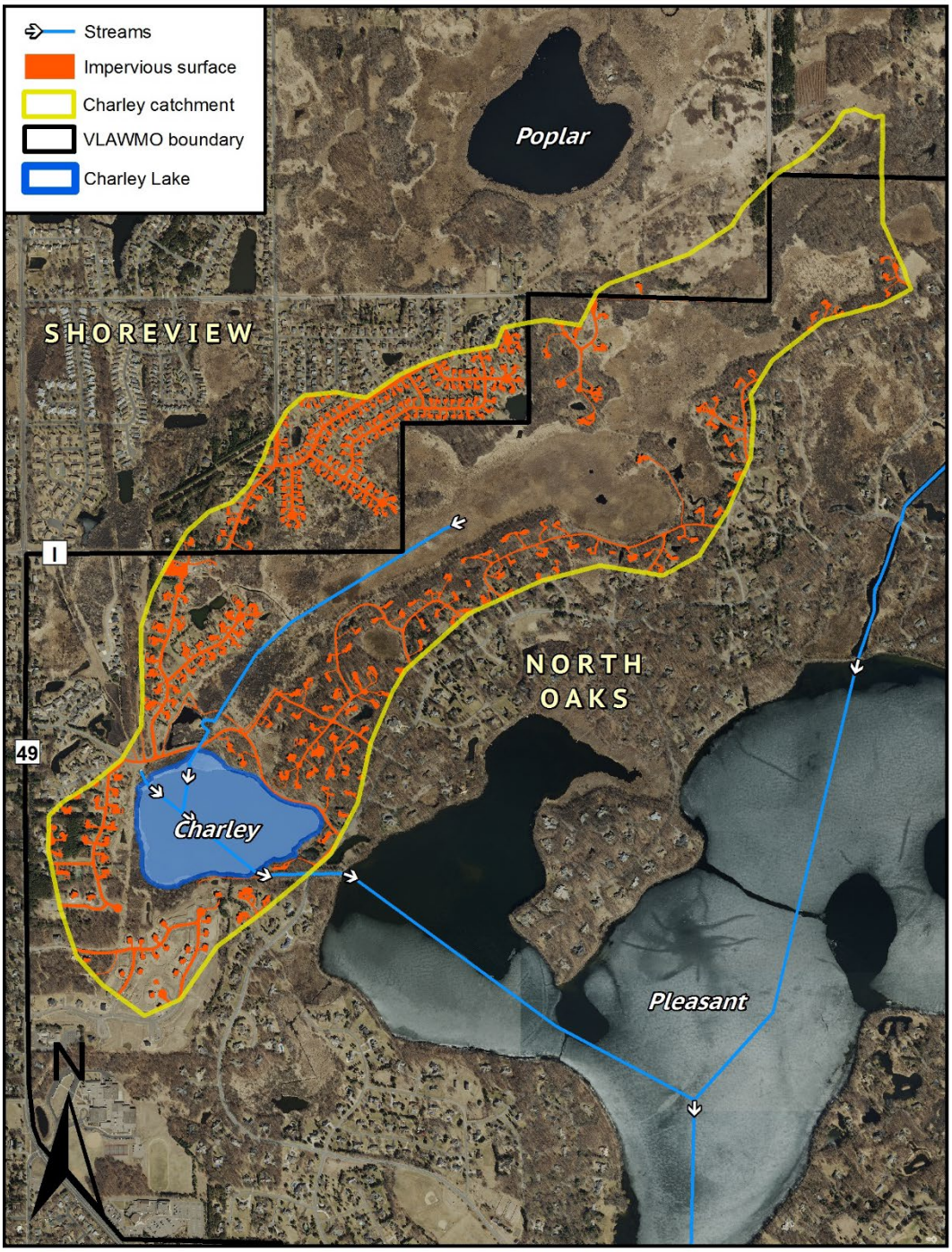


The lake is surrounded by low-density development. There are minimal impervious surfaces, and yards provide sufficient shoreline buffers. However, the 2015 Ramsey Conservation District's Urban Stormwater Retrofit Analysis of the subwatershed determined that improvement can be made to pretreatment and reduction of stormwater inputs into the lake. In addition, stormwater runoff from a new residential area to the south of Charley Lake resulted in a treatment pond overflow that caused nutrient loading and algae blooms in the lake in 2015 and 2016.

The amount of impervious surface is a contributing factor for runoff into a lake, because impervious surfaces do not allow water to infiltrate into the ground. An increasing amount of impervious area present in a subwatershed means more untreated water runoff flowing into the lake. This could lead to water quality problems in the future. Impervious surfaces in the Charley Lake subwatershed are primarily homes and roads (see Figure 11). To date, there is minimal impervious area. However, increasing development in the subwatershed means there is increasing potential for harmful runoff into the lake. VLAWMO will continue

monitoring nutrient levels so that any adverse changes can be detected early and addressed. In 2015, the Ramsey Conservation District conducted a retrofit analysis for the larger Pleasant–Charley–Deep Subwatershed. Optimal areas for additional stormwater capture were identified within the Charley catchment. As future actions are pursued in the subwatershed, the retrofit report provides direction and suggests specific strategies for future implementation.

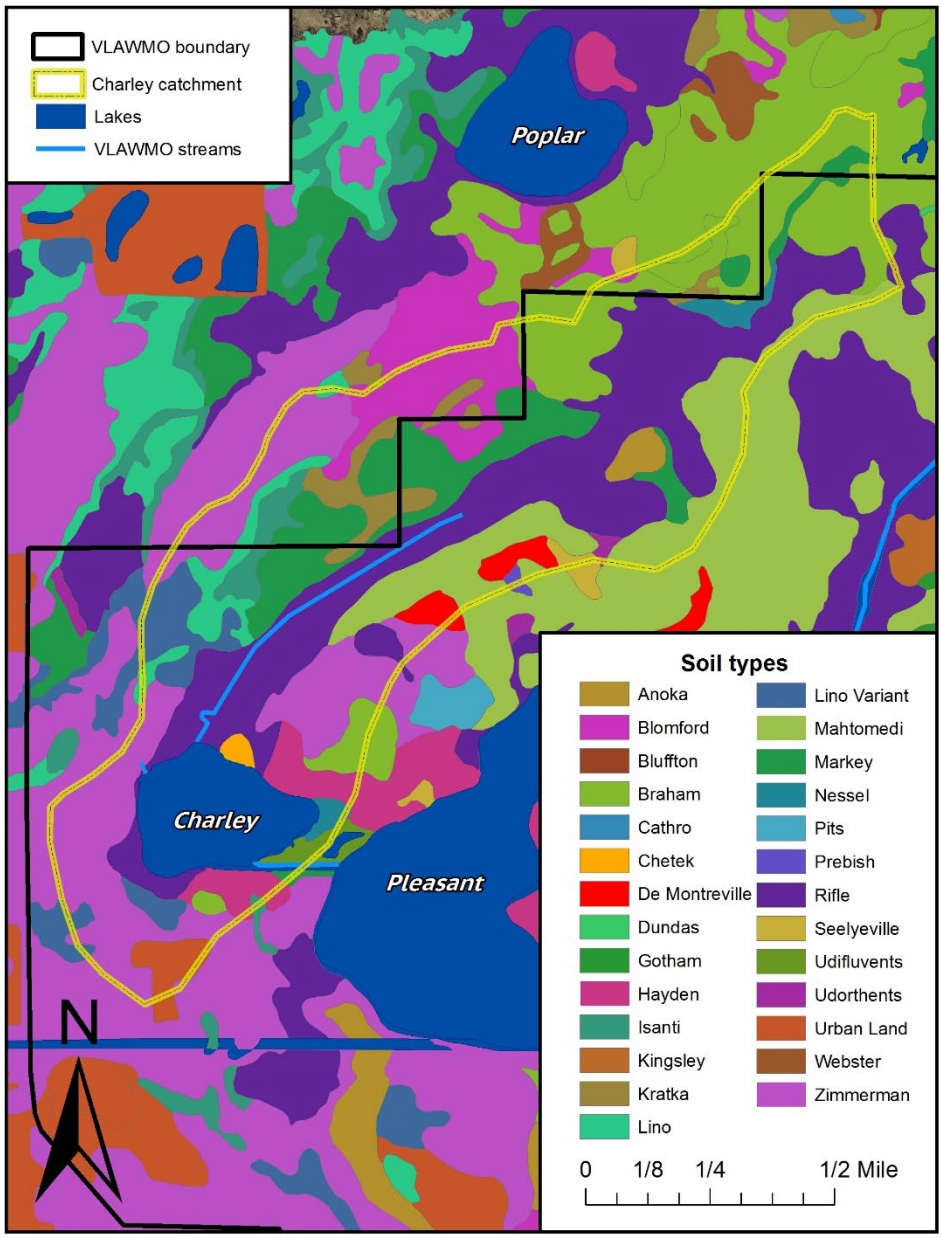
Figure 11: Impervious Surfaces within Charley Lake Area



2.3 CHARLEY LAKE SOILS

Overall, soils are sandy and drain well in the Charley Lake drainage area. Soils in the Long Marsh area are thicker and poorly drained, which is a common characteristic of wetlands and bogs.

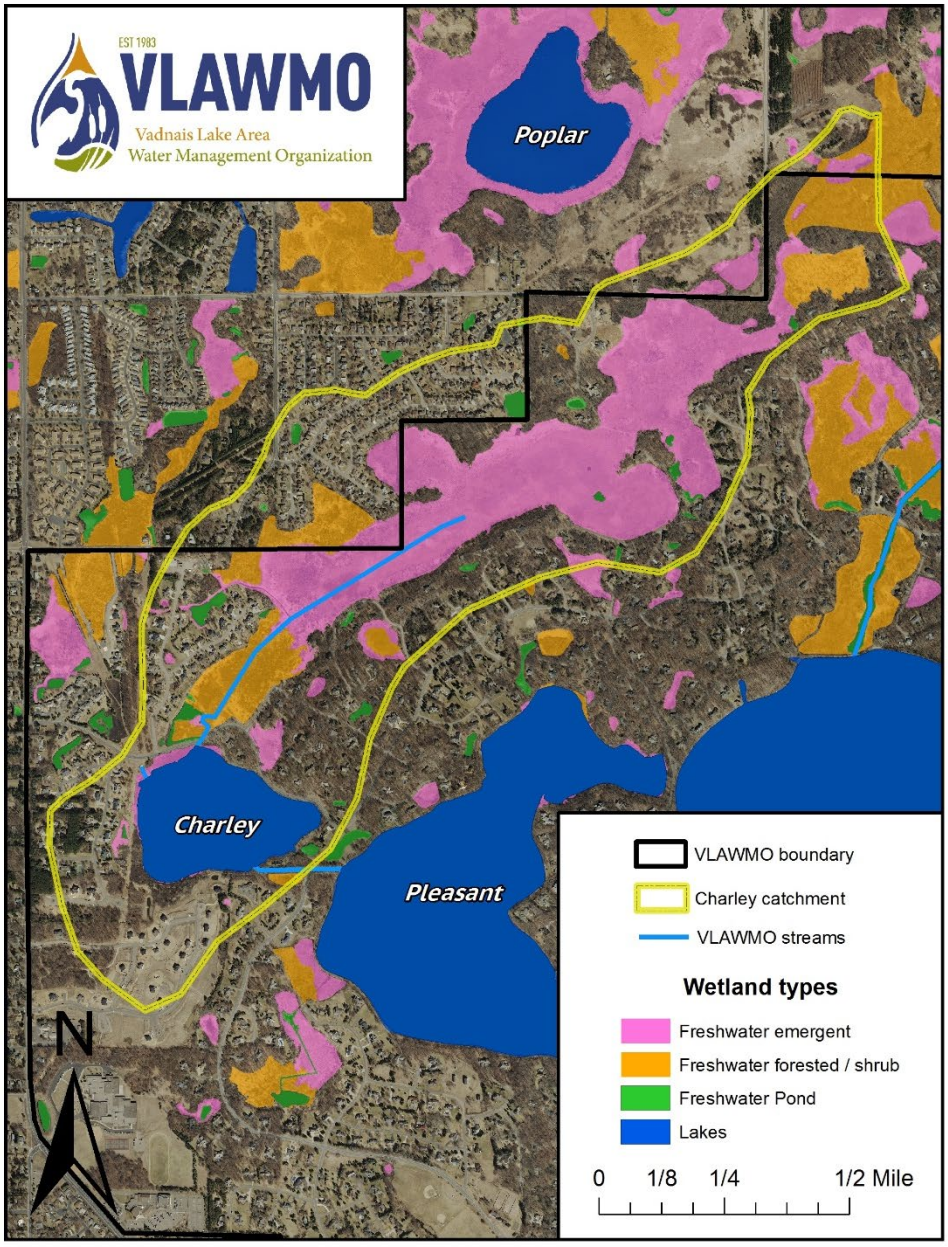
Figure 12: Charley Lake Area Soils



2.4 CHARLEY LAKE WETLANDS

There is a large wetland complex to the north of Charley Lake called Long Marsh. This wetland feeds into Charley Lake and could be an area to monitor for possible nutrient inputs.

Figure 13: Charley Lake Area Wetlands

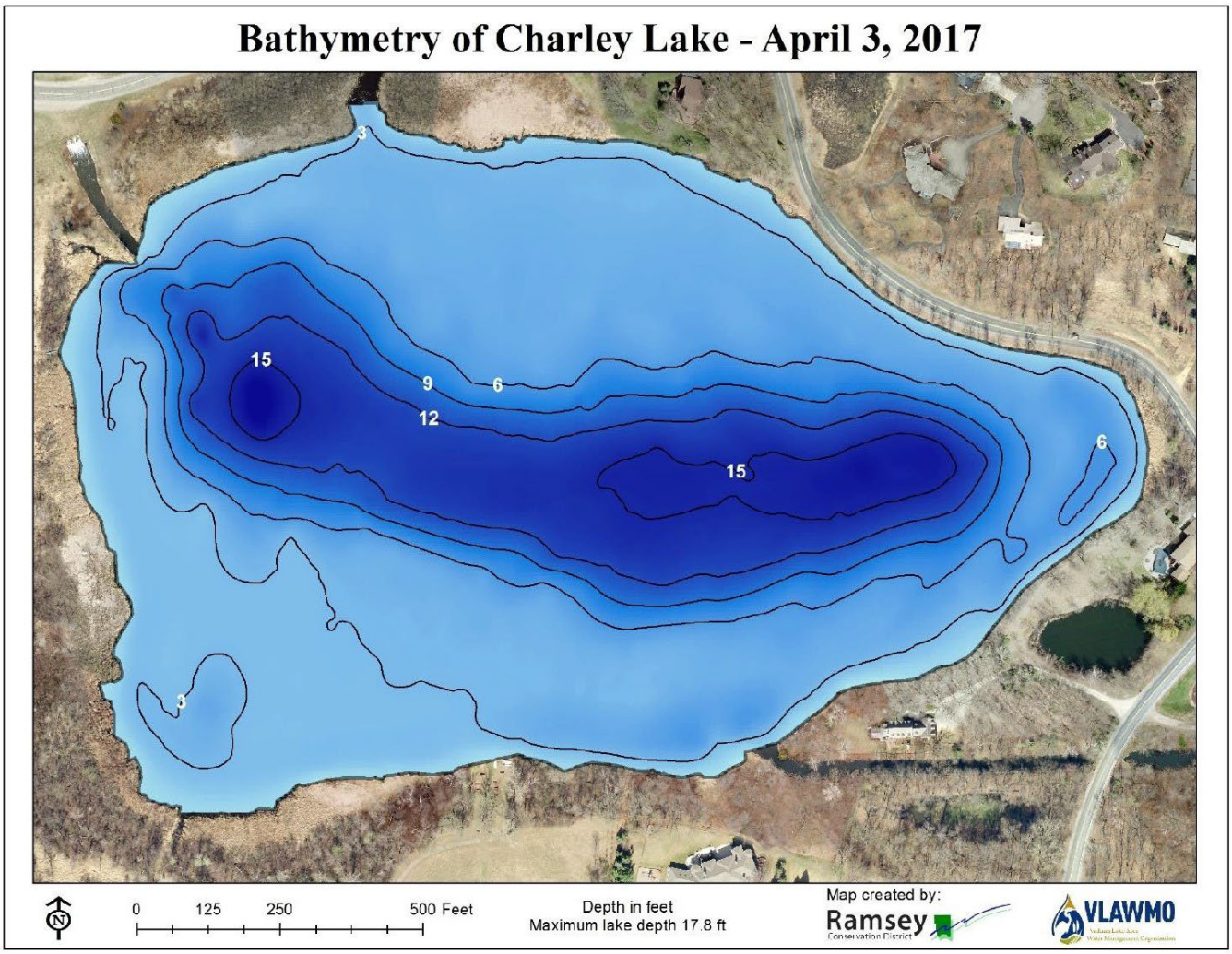


3 LAKE FEATURES

3.1 CHARLEY LAKE DEPTH

A bathymetry survey was completed in 2017 to develop a map of the lake bottom. Charley Lake has a maximum depth of nearly 18 feet. It has a typical lake bottom shape with shallower areas along the outer portions of the lake and deeper sections toward the middle.

Figure 14: Charley Lake Depth Map

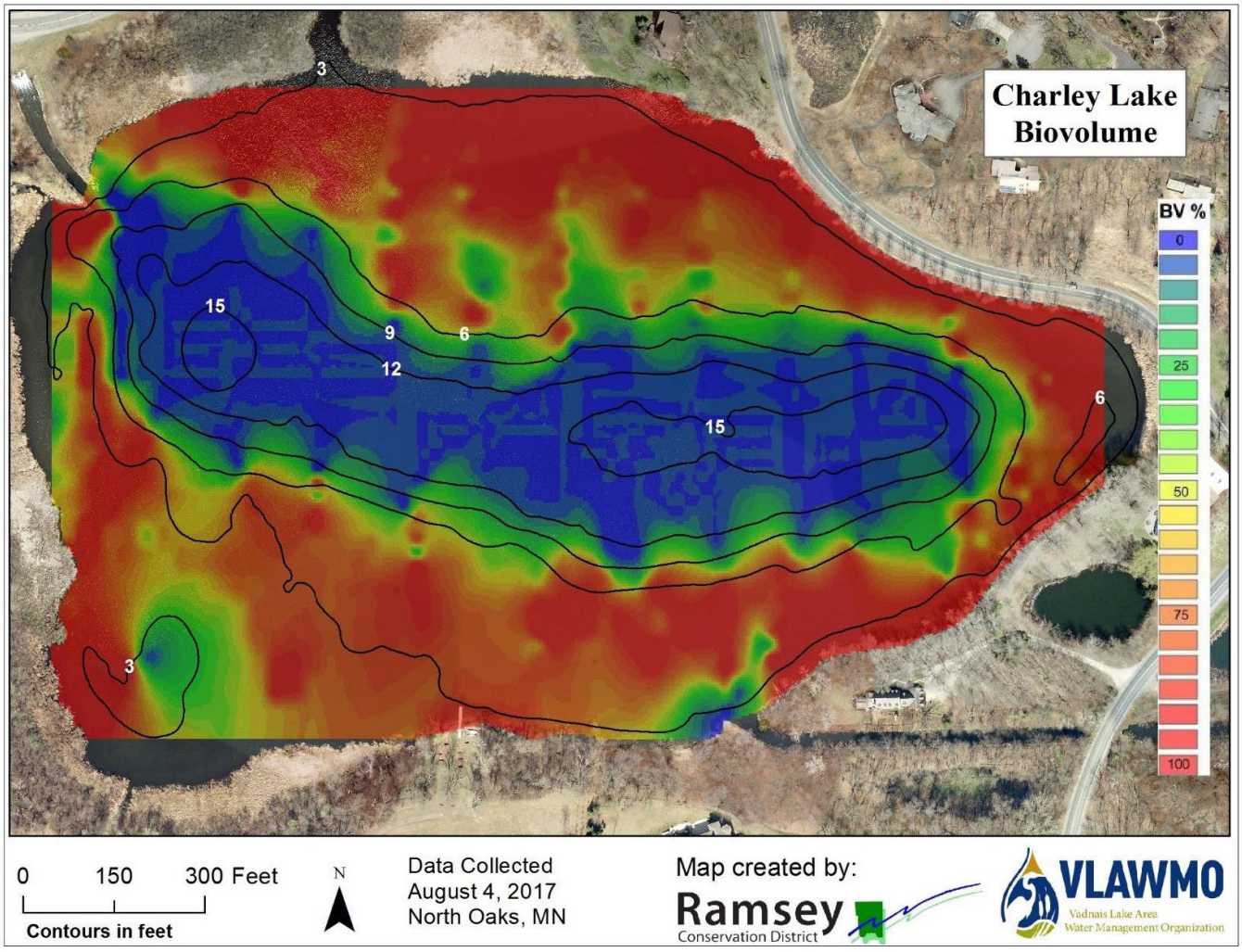


3.2 CHARLEY LAKE BIOVOLUME AND AQUATIC VEGETATION

Biovolume

The Ramsey Conservation District conducted a biovolume and aquatic vegetation survey in 2017. Biovolume is the density of plant life in the lake. Blue signifies 0% plant life, and red signifies 100% plant life. At depths greater than 4-6 feet, there is commonly no plant life in Minnesota lakes. Plant growth is limited because the sun does not penetrate the water column below those depths enough to allow photosynthesis to occur. Charley Lake has abundant plant life in areas that are 0-6 feet deep and very little is found past that depth (Figure 15).

Figure 15: Charley Lake Biovolume



Aquatic Vegetation

Ramsey Conservation District conducted an assessment of the types and abundance of aquatic plants in 2017. Vegetation was documented at 14 of the 23 survey points. Ten plant species were documented; 5 species were dominant:

Figure 16: Charley Lake Aquatic Plant Survey Points

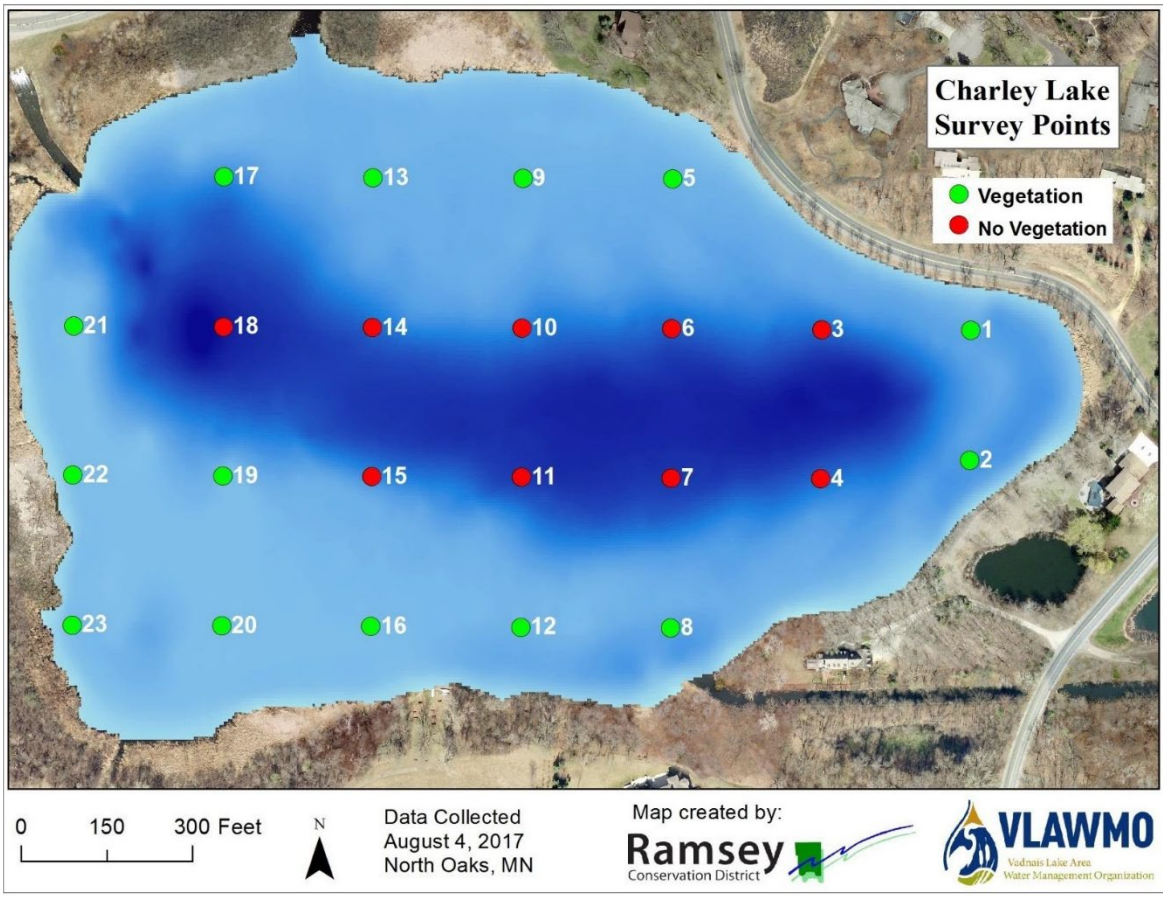


Table 1: Most Prevalent Aquatic Vegetation in Charley Lake

Common Name	Scientific Name	Percent Occurrence	Native to MN?
Coontail	*Ceratphyllum demersum*	93%	Yes
Canada Waterweed	*Elodea canadensis*	86%	Yes
*Curly Leaf Pondweed	*Potamogeton crispus*	57%	No
Filamentous Algae	*Spirogyra/Cladophora sp*	43%	Yes
Northern Watermilfoil	*Myriophyllum sibiricum*	43%	Yes

*Curly Leaf Pondweed (CLP) is an aquatic invasive species (AIS) and of concern in Charley Lake. CLP can be a source of nutrient loading and may need to be addressed. This survey provides a reference condition for possible future vegetation management.

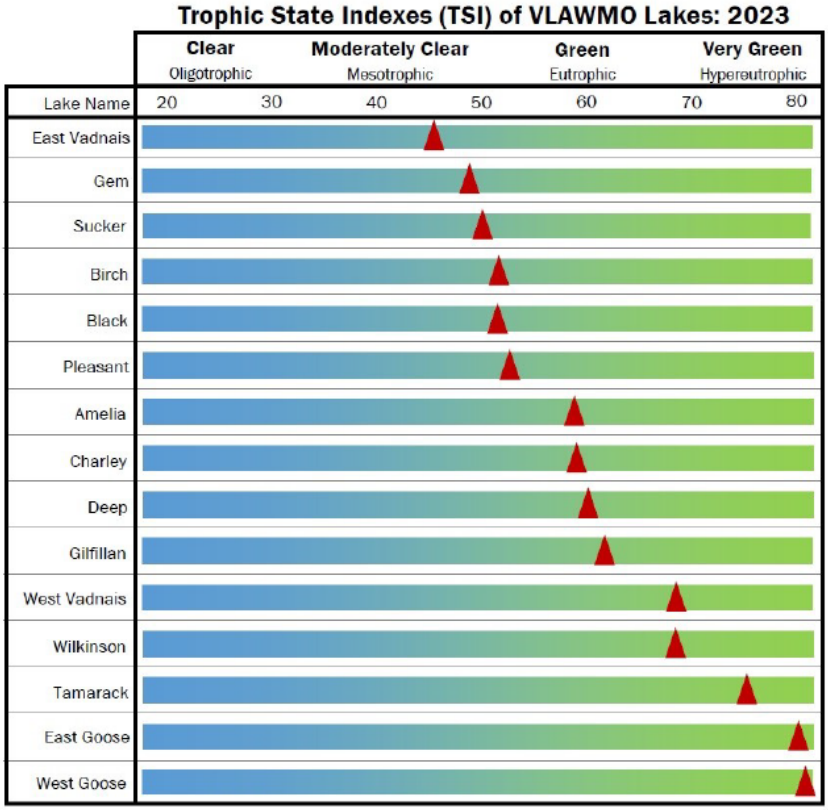
3.3 SHORELINE VEGETATION

Ramsey Conservation District assessed shoreline vegetation in 2017. Abundant native plant diversity and some common invasive plants were documented. An active management plan is not warranted at this time. However, VLAWMO recommends that the City of North Oaks and the Homeowners' Association consider a developing a weed maintenance shoreline plan to keep invasive species from taking over.

3.4 WATER QUALITY SUMMARY

Charley Lake is shallow and falls in the green/eutrophic classification on the Trophic State Index (TSI) (shown below using the Carlson scale, MPCA). Charley Lake had recent scores of 57 (2022) and 59 (2023).

Figure 17: TSI scores for VLAWMO lakes



VLAWMO has collected water quality (WQ) data on Charley Lake since 1995. Regular, long-term uniform sampling was implemented in 2009 (Table 1). VLAWMO staff collects WQ data and water samples biweekly, May-September, for water clarity (secchi disk), nutrients (TP, Chl-a, SRP, nitrogens), and chemistry (temperature, conductivity, dissolved oxygen, and potential hydrogen [pH]). Total Phosphorus (TP) and Chlorophyll A (Chl-a) analyses are conducted by a contracted lab.

- TP is the primary cause of excessive plant and algae growth in lake systems. Phosphorus originates from a variety of sources, many of which are human related. Major sources include human and animal waste, soil erosion, detergents, septic systems, and stormwater runoff. Internal loading can also be present in a lake. Internal loading can result from P becoming re-suspended into the water

column from the sediment. High amounts of P in sediments may occur as a result of historical land uses including, but not limited to, waste disposal into the lake.

- Chl-a is a green pigment in algae. Measuring Chl-a concentration gives an indication of algae abundance.

- The MN Pollution Control Agency (MPCA) has impairment standards for the levels of TP and Chl-a. For shallow lakes in Minnesota, the standard level for TP is <60µg/L and <20µg/L for Chl-a.

Table 2: Charley Lake Monitoring Data 2009-2023

Charley Lake Historical Average TP/Chl-a/SDT/Chl				
Year	TP (µg/L)	Chl-a (µg/L)	Secchi (m)	Chloride (mg/L)
2009	39	18	1	N/A
2010	90	18.9	1	16
2011	87	9.3	1.1	20
2012	74	13	1	22
2013	57	11	1	30
2014	59	10	1.1	25
2015	57	14	1.1	20
2016	78	10	1.2	15
2017	54	10	1.2	19
2018	78	14	1.5	35
2019	60	7	1.6	17
2020	52	7	1.3	10
2021	52	19	1.4	20
2022	51	8	1	26
2023	48	11	0.8	38

Table 2: Charley Lake Chemistry. The numbers in red indicate parameters that exceed State Standards. The Trophic State Index (TSI) for Charley Lake indicates the basin's nutrient levels combined with clarity levels qualify it as eutrophic. Curly Leaf Pondweed, present in Charley, can exacerbate negative effects by contributing additional TP to the system. However, because Charley Lake is mostly a flow-through system that is constantly being flushed with water from the Mississippi River, it likely keeps the lake cleaner and clearer than if it had a lower water exchange rate.

Figure 18: Historical Water Quality Averages in Charley Lake 2009-2023

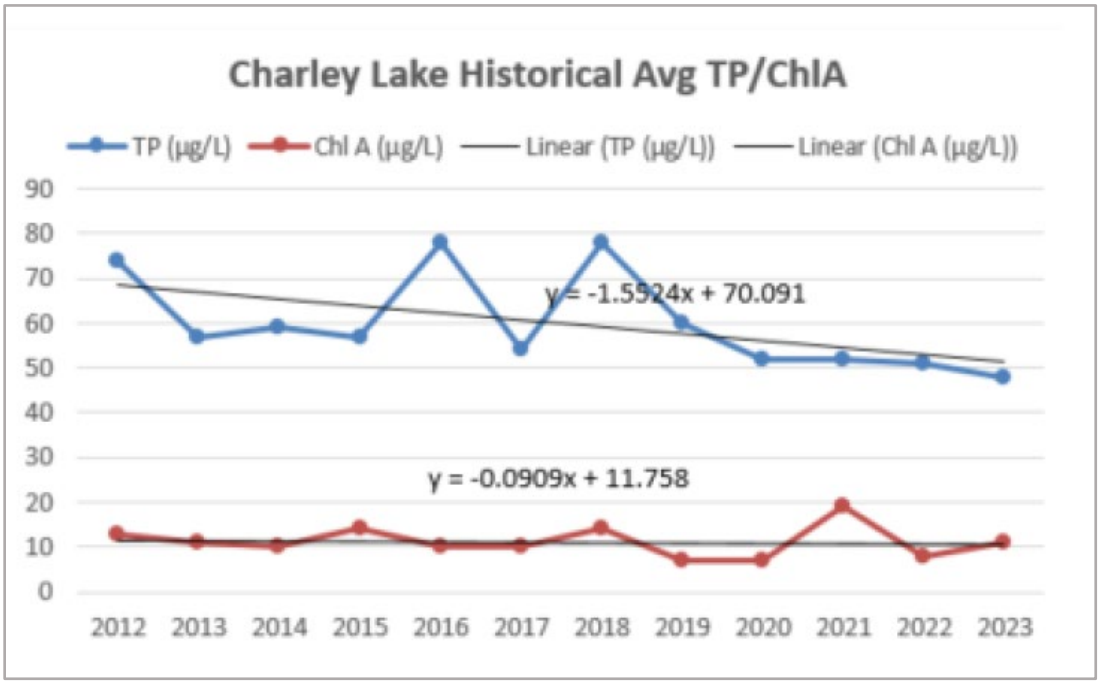


Figure 18: The graph shows results of TP/Chl-a with a linear trend through time. There is evidence of results of the Mississippi River water flushing the system. Although TP sometimes exceeds the State Standard (60µg/L), it does not remain consistently above the target. Chl-a hovers around the value of 20µg/L because TP is likely not being retained in the lake at levels that are high enough to cause increased, dramatic algae growth.

4 MANAGEMENT ACTIONS

4.1 COMPLETED BEST MANAGEMENT PRACTICES (BMPS) IN THE SUBWATERSHED

VLAWMO has 6 Landscape Level 1 Cost Share recipients in the Charley catchment area that include: 1 rainbarrel, 1 shoreline restoration, 1 raingarden, and 3 native planting restorations.

4.2 RESULTS OF STAKEHOLDER SURVEY

Surveys were mailed to 54 residents who live along the Charley Lakeshore or very close (e.g., across the street) on November 6, 2018. The original survey is included in the Appendix. Twenty-two surveys (41%) were returned to VLAWMO and analyzed. These responses help us better understand concerns and priorities of residents. They also serve as a baseline from which we will continue to engage with stakeholders and adaptively manage water and habitat quality in Charley Lake.

Stakeholders were asked how important a list of 12 possible lake issues were to them (Q1). The top 3 concerns identified were, in order of importance: algae growth, invasive plants, and other aquatic invasive species. Specific concerns mentioned in the comments section include a need for more AIS education and prevention, and concerns about common carp in the lake. The graph below shows the full set of possible lake issues and importance assigned by stakeholders.

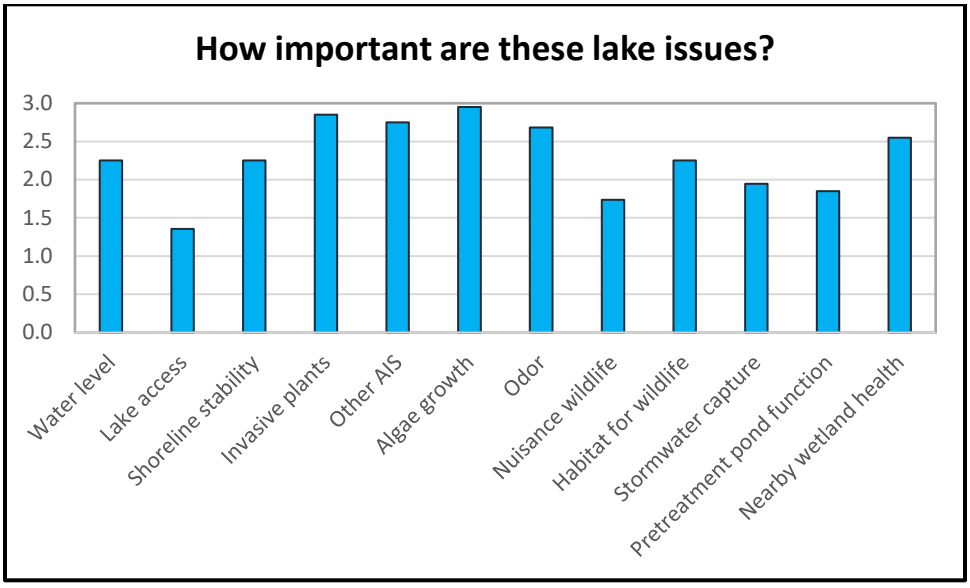


Figure 19: Survey Q1: How important are the following possible lake issues to you? (0 = Not Important, 1 = Fairly Important, 2 = Important, and 3 = Very Important).

Stakeholders were asked which activities they enjoy at Charley Lake and the quality of those activities at the lake (Q2-3). Activity choices included: aesthetics, wildlife viewing/birding, non-motorized boating, using trails, and outdoor grilling. Respondents were asked to choose all activities that apply. They identified trail use and wildlife viewing/birding as top activities and felt that resources are in good shape for those activities (2.5 and 2.6 out of 3 points possible). Non-motorized boating ranked the lowest in current quality (1.8). Comments reflected that people would like higher quality water to be able to canoe and kayak.

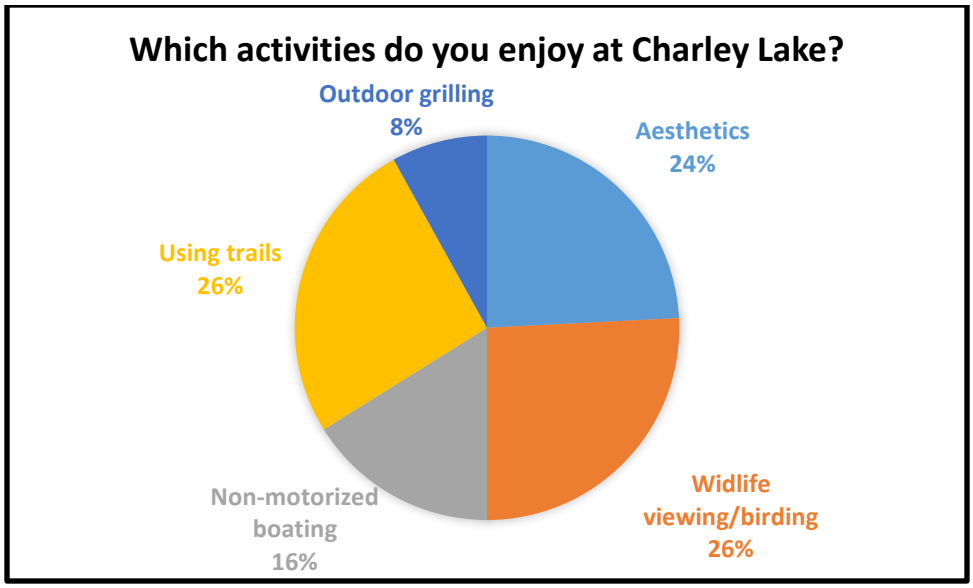


Figure 20: Survey Q2-3: Q2) Which activities do you enjoy at Charley Lake? (Check all that apply), and Q3) How do you feel about the current quality of Charley Lake for activities you enjoy? (1 = Poor, 2 = Average, and 3 = Excellent).

The theme of invasive-species concerns was consistent throughout the survey. When asked which water-related priorities stakeholders feel are most important, they rated water pollution and invasive species as top concerns (Q4).

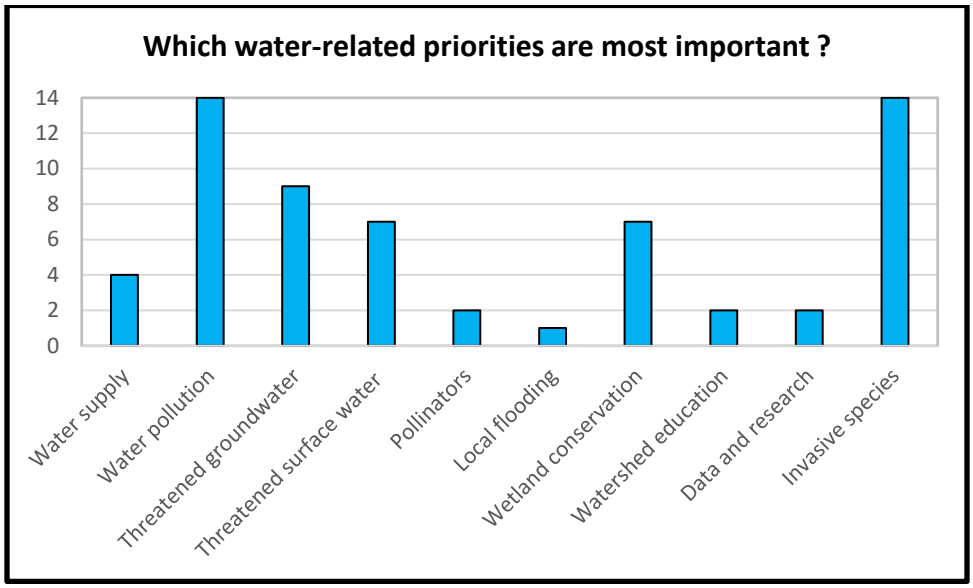


Figure 21: Survey Q4: Which water-related priorities are most important to you? (Check up to 3.)

4 MANAGEMENT ACTIONS

Stakeholders identified wildlife habitat, scenery, and future generations as top reasons why water quality is important to them (Q5). Respondents were invited to choose as many of the 6 choices as they felt applied. Many respondents chose all options; most respondents chose multiple options.

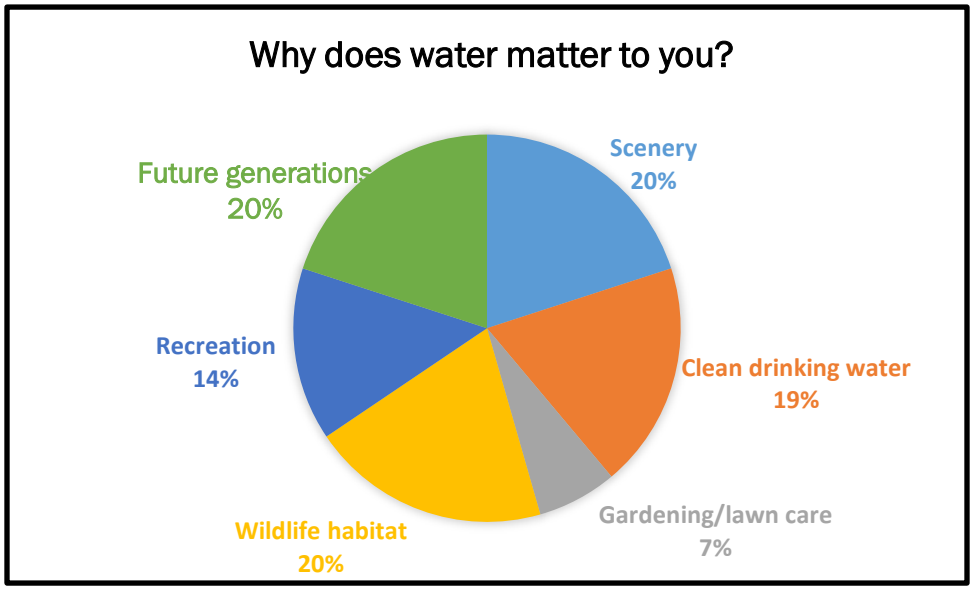


Figure 22: Survey Q5: Why does water matter to you? (Check all that apply).

Stakeholders identified how familiar and involved they currently are with local water issues (Q 6a-c). The majority of respondents felt they were familiar with local water issues at an average level (N = 11), that primary perceived barriers to involvement are time constraints and that they aren't sure where to look, and that their current level of involvement is at a medium level and that they do their part within their normal routine (N = 10). The survey itself served as a form of communication and information. At the end of the survey, we provided website links and volunteer information. Surveys were returned with the bottom portion removed, and we received one request to become a new volunteer as a note in a returned survey.
No new ideas were identified when stakeholders were asked about their highest priority for management (Q7). Responses included topics from Q1 and centered around improving water and habitat quality; and controlling weeds, carp, and algae. There was also recognition that any efforts need to take into account the constant addition of water from the Mississippi River into Charley Lake.

Additional concerns, comments, and questions by stakeholders include potential for pollution from lawn applications, unintentional destruction of habitat, adding and/or improving walking trails, possible increased involvement with SPRWS, and an appreciation about the survey and communicating ideas for improvement (Q8).

These topics, themes, and priorities will be part of an upcoming stakeholder meeting in 2019 and help to identify strategies and guide water-quality improvement in the watershed. One strategy that has been identified is a joint lake association for Charley, Deep, and Pleasant Lakes, which are all located in North Oaks, part of the SPRWS chain of lakes for drinking water delivery, and the focus of current SLMPs by VLAWMO.

4.3 RETROFIT RECOMMENDATIONS

In 2015, the Ramsey Conservation District completed a Retrofit Report for the Pleasant-Charley-Deep subwatershed, assessing possible areas and locations for implementing BMPs for improving water quality.

The Report described and catchment and recommended locations for possible retrofits. The elongated Charley Lake catchment has a more newly developed western half, near Hodgson Rd, and an eastern half that is mostly undeveloped or natural preserve, with some single-family homes in forested areas bordering the Pleasant Lake catchment.

This catchment is unique in that it is the direct recipient for pumped Mississippi River water, at the northwest corner of the lake. At the southern tip of the catchment, Chippewa Middle School and Peace United Methodist Church comprise the institutional land use. Both have runoff that largely drains west to Hodgson Rd's stormwater infrastructure, though one retrofit was identified for a section of school property that drains inward toward Charley Lake.

Just south of Charley Lake, there is a housing development called Charley Lake Preserve. The full-turf lawns and ditches of this neighborhood are a departure from North Oaks' more traditional, wooded residential areas, and the increased runoff from those lawns and ditches-particularly the acres that drain to Charley Lake – create opportunities for BMPs to reduce runoff and treat water before entering the lake, particularly with the high amounts of lawn clippings and fertilizers of the runoff and the minimal treatment the water receives before entering the lake.

To the west and north of Charley Lake, there is a range of single and multi-family homes with a mix of turf lawns and trees. The runoff from these homes enters stormwater ponds by way of stormwater infrastructure. Water from the stormwater ponds enters Charley Lake after passing through canals, providing some level of treatment. Nevertheless, water entering Charley Lake from the stormwater pond outlet provides phosphorus and other nutrients to Charley Lake, prompting algal blooms. A great concentration of suggested retrofits is found in this area of the catchment, where stormwater can be intercepted before it reaches the stormwater conveyance infrastructure.

The Mississippi River canal entering Charley Lake, while stabilized, should be monitored regularly for needed maintenance due to the high flow passing through this confined area. In areas of undercutting and erosion, additional riprap can be added to the channel with native plantings and perennials to help stabilize the banks.

The soils within the area where retrofit opportunities were identified consists of loamy fine sand with the exception of Chippewa Middle School, where the soil is loam.

Figure 23: Retrofit Locations Part 1

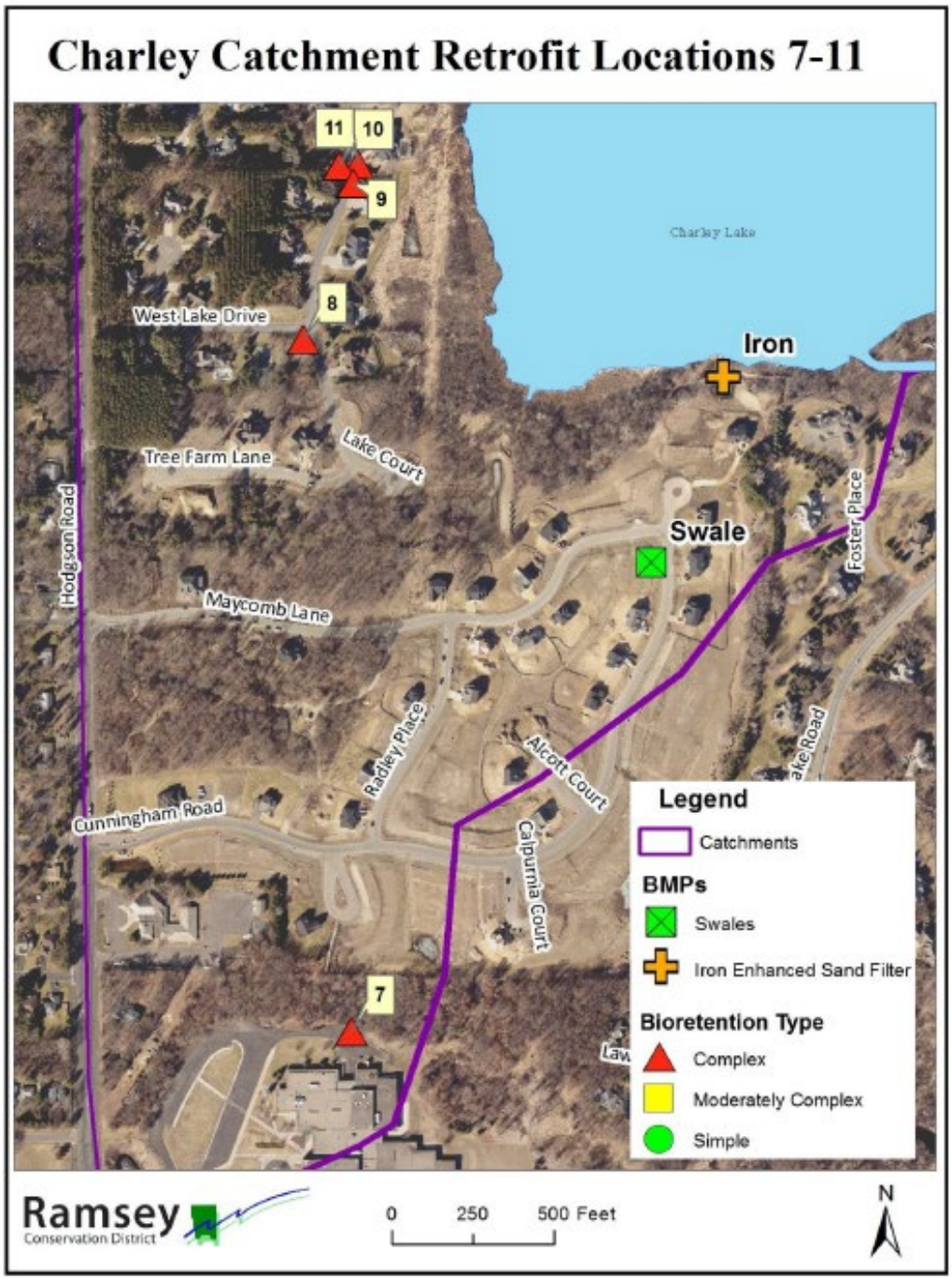


Figure 24: Retrofit Locations Part 2