Tip of the Mitt Watershed Council

Bass Lake Shoreline Survey 2022

Report written by Anna Watson
3-23-2023

Table of Contents

List of Figures

List of Tables

SUMMARY

Bass Lake is located on the northern side of the Village of Elk Rapids, between Elk Lake and Grand Traverse Bay, in the Grand Traverse Bay watershed. It is a small inland lake, covering 144 acres. In 2022, Tip of the Mitt Watershed Council completed a shoreline survey on Bass Lake to document shoreline conditions and their impact on the water quality of the lake. The shoreline survey included recording the state of the following along the shoreline: algae density, erosion severity, shoreline alterations, greenbelt scores and parcel development. The shoreline survey created a comprehensive data set that can be used as a lake management tool, and help determine next steps to maintain lake health and the water quality of Bass Lake.

INTRODUCTION

Background

During the summer of 2022, a shoreline survey was conducted on Big Bass Lake by the Tip of the Mitt Watershed Council to document shoreline conditions that potentially impact water quality. The entire shoreline was surveyed to document the following: algae as a nutrient pollution indicator, erosion, shoreline alterations, greenbelts, and tributary inlets and outlets. The survey was funded by a Special Assessment District of the Township of Elk Rapids.

The 2022 survey provides a comprehensive data set documenting shoreline conditions on Bass Lake; a valuable data set that can be used as a lake management tool. Combined with follow-up activities, such as questionnaires and on-site visits, problems in shoreline areas that threaten the lake's water quality can be identified and corrected. These solutions are often simple and low cost, such as regular septic system maintenance, proper lawn care practices, and wise land use along the shoreline. Prevention of problem situations can also be achieved through publicity and education associated with the survey. Periodic repetition of shoreline surveys is important for identifying new and chronic problem sites, determining long-term trends of near-shore nutrient inputs and shoreline alterations associated with land-use changes, and for assessing the success of remedial actions.

Shoreline Development Impacts

Lake shorelines are the critical interface between land and water; where human activity has the greatest potential for degrading water quality. Developing shoreline properties for residential, commercial or other uses invariably has impacts on the aquatic ecosystem. During the development process, the natural landscape is altered in a variety of ways; vegetation is removed, the terrain is graded, utilities installed, structures are built, and areas are paved. These changes to the landscape and subsequent human activity in the shoreline area have consequences on the aquatic ecosystem. Nutrients from wastes, contaminants from cars and roads, and soils from eroded areas are among some of the pollutants that end up in and impact the lake following shoreline development.

Nutrient pollution can have adverse impacts on aquatic ecosystems and indirectly poses a danger to human health. Nutrients are necessary to sustain a healthy aquatic ecosystem, but excess will stimulate unnatural plant growth. Increased abundance of aquatic macrophytes (higher or vascular plants) can become a nuisance to recreation in shallow areas (typically less than 20 feet in depth). An increase in algal blooms also has the potential to become a recreational nuisance when algal mats and scum are

formed on the lake's surface. Additionally, algal blooms pose a public health risk as some species produce toxins, including hepatotoxins (toxins that cause liver damage) and neurotoxins (toxins that affect the nervous system).

Excess growth of both macrophytes and algae has the potential to degrade water quality by depleting the ecosystem's dissolved oxygen stores. During nighttime respiration, plants compete with other organisms for a limited oxygen supply. Furthermore, the decomposition of dead algae and plant material has the potential to deplete dissolved oxygen supplies due to the aerobic activity of decomposers, particularly in the deeper waters of stratified lakes.

In general, large, deep lakes are less sensitive to nutrient pollution. Large lakes with greater water volume have a bigger buffer and thus, greater resistance to nutrient pollution. The large lakes tend to have greater dissolved oxygen stores and the greater volume allows for greater dilution of nutrients. By contrast, small lakes, like Bass Lake, generally have smaller stores of dissolved oxygen, a lesser ability to dilute nutrients and therefore, are more susceptible to the indirect impacts of nutrient pollution. Small lakes with extensive shallow areas are at even greater risk as there are more habitats to support excessive aquatic macrophyte growth. Bass Lake is a seepage lake, meaning it does not have an inlet or an outlet. So, it has a higher retention time, and pollutants cannot be flushed through it quickly. Surface waters receive nutrients through a variety of natural and cultural (human) sources. Natural sources of nutrients include stream inflows, groundwater inputs, surface runoff, organic inputs from the riparian (shoreline) area and atmospheric deposition. Springs, streams, and artesian wells are often naturally high in nutrients due to the geologic strata they encounter and wetland seepages may discharge nutrients at certain times of the year. Cultural sources include septic and sewer systems, fertilizer application, and stormwater runoff from roads, driveways, parking lots, roofs, and other impervious surfaces. Poor agricultural practices, soil erosion, and wetland destruction also contribute to nutrient pollution. Furthermore, some cultural sources (e.g., malfunctioning septic systems and animal wastes) pose a potential health risk due to bacterial and viral contamination.

Severe nutrient pollution is detectable through chemical analyses of water samples, physical water measurements, and the utilization of biological indicators (a.k.a., bio-indicators). Chemical analyses of water samples to check for nutrient pollution can be effective, though costlier and more labor intensive than other methods. Typically, samples are analyzed to determine nutrient concentrations (usually forms of phosphorus and nitrogen), but other chemical constituent concentrations can be measured, such as chloride, which are related to human activity and often elevated in areas impacted by

malfunctioning septic or sewer systems. Physical measurements are primarily used to detect malfunctioning septic and sewer systems, which can cause localized increases in water temperature and conductivity (i.e., the water's ability to conduct an electric current). Biologically, nutrient pollution can be detected along the lake shore by noting the presence of *Cladophora* algae.

Cladophora is a branched, filamentous green algal species that occurs naturally in small amounts in northern Michigan lakes. Its occurrence is governed by specific environmental requirements for temperature, substrate, nutrients, and other factors. It is found most commonly in the wave splash zone and shallow shoreline areas of lakes, and can also be found in streams. It grows best on stable substrates such as rocks and logs, though artificial substrates such as concrete or wood seawalls are also suitable. *Cladophora* prefers water temperatures in a range of 50 to 70 degrees Fahrenheit, which means that the optimal time for its growth and thus, detection, in northern Michigan lakes is from late May to early July and from September to October.

The nutrient requirements for *Cladophora* to achieve large, dense growths are typically greater than the nutrient availability in the lakes of Northern Michigan. Therefore, shoreline locations where relatively high concentrations of nutrients, particularly phosphorus, are entering a lake can be identified by noting the presence of *Cladophora*. Although the size of the growth on an individual basis is important in helping to interpret the cause of the growth, growth features of *Cladophora* are greatly influenced by such factors as current patterns, shoreline topography, size and distribution of substrate, and the amount of wave action the shoreline is subject to. Therefore, the description has limited value when making year to year comparisons at a single location or estimating the relative amount of shoreline nutrient inputs. Rather, the presence or absence of any significant growth at a single site over several years is the most valuable 6 comparison. It can reveal the existence of chronic nutrient loading problems, help interpret the cause of the problems, and assess the effectiveness of any remedial actions. Comparisons of the total number of algal growths can reveal trends in nutrient input due to changing land use.

Erosion along the shoreline has the potential to degrade the lake's water quality. Stormwater runoff through eroded areas carries sediments into the lake and impacts the lake ecosystem in a variety of ways. Sediments clog the gills of fish, aquatic insects and other aquatic organisms. Excessive sediments smother fish spawning beds and fill interstitial spaces that provide habitat for a variety of aquatic organisms. While moving through the water column, sediments absorb sunlight energy and increase

water temperatures. In addition, nutrients adhere to sediments that wash in from eroded areas, which can lead to nuisance aquatic plant growth and large algae blooms.

Shoreline greenbelts are essential for maintaining a healthy aquatic ecosystem. A greenbelt consisting of a variety of native woody and herbaceous plant species provides habitat for near-shore aquatic organisms as well as terrestrial animals. Greenbelts function as erosion control devices, stabilizing the shoreline with plant root structures that protect against wave action and ice. The canopy of the greenbelt provides shade to near-shore areas, which is particularly important for lakes with cold-water fisheries. In addition, greenbelts provide a mechanism to reduce overland surface flow and absorb pollutants carried by stormwater from rain events and snowmelt.

Tributaries have great potential for influencing a lake's water quality as they are one of the primary conduits through which water is delivered to a lake from its watershed. Inlet streams may provide exceptionally high-quality waters that benefit the lake ecosystem, but conversely have the potential to deliver polluted waters that degrade the lake's water quality. Outlet streams flush water out of the lake, providing the means to remove contaminants that have accumulated in the lake ecosystem. With regard to shore surveys, noting the location of inlet tributaries is very helpful when evaluating shoreline algae conditions because nutrient concentrations are generally higher in streams than in lakes. The relatively higher nutrient levels delivered from streams often lead to naturally heavier Cladophora and other algae growth along the shoreline.

Responsible, low-impact, lake shoreline property management is paramount for protecting water quality. Maintaining a healthy greenbelt, regular septic tank pumping, treating stormwater with rain gardens, addressing erosion sites, and eliminating fertilizer, herbicide, and pesticide application are among many low-cost best management practices that minimize the impact of shoreline properties on lake water quality. Responsible stewardship on the part of shoreline property owners and living in harmony with the lake is vitally important for sustaining a healthy and thriving lake ecosystem.

Study Area

Bass Lake is located in the northern tip of the Lower Peninsula of Michigan; in Elk and Sauble Townships in northwestern Lake County. Bass Lake falls within the Grand Traverse Bay watershed, which is mainly forest (41%) and agriculture (16%) (River Restoration in Northern Michigan). More specifically, Bass Lake resides in the Grand Traverse Bay Coastal Watershed. Bass Lake is an irregularly shaped, 290-acre

natural lake, with four distinct lobes. Most of the lake is less than 15 feet deep. The deepest point is approximately 45 feet deep, in the northern basin of the lake. (FIGURE 1) Big Bass Lake has approximately 7.1 miles of shoreline, including four islands. Bass Lake is a mesotrophic lake, meaning it has an intermediate level of productivity. The substrate in the lake is mostly organic, with sand and a few patches of marl in the shoreline areas. Bass Lake is a seepage lake, meaning it does not have an inlet or an outlet, and has a higher retention time than other lakes. The primary source of water is precipitation or runoff.

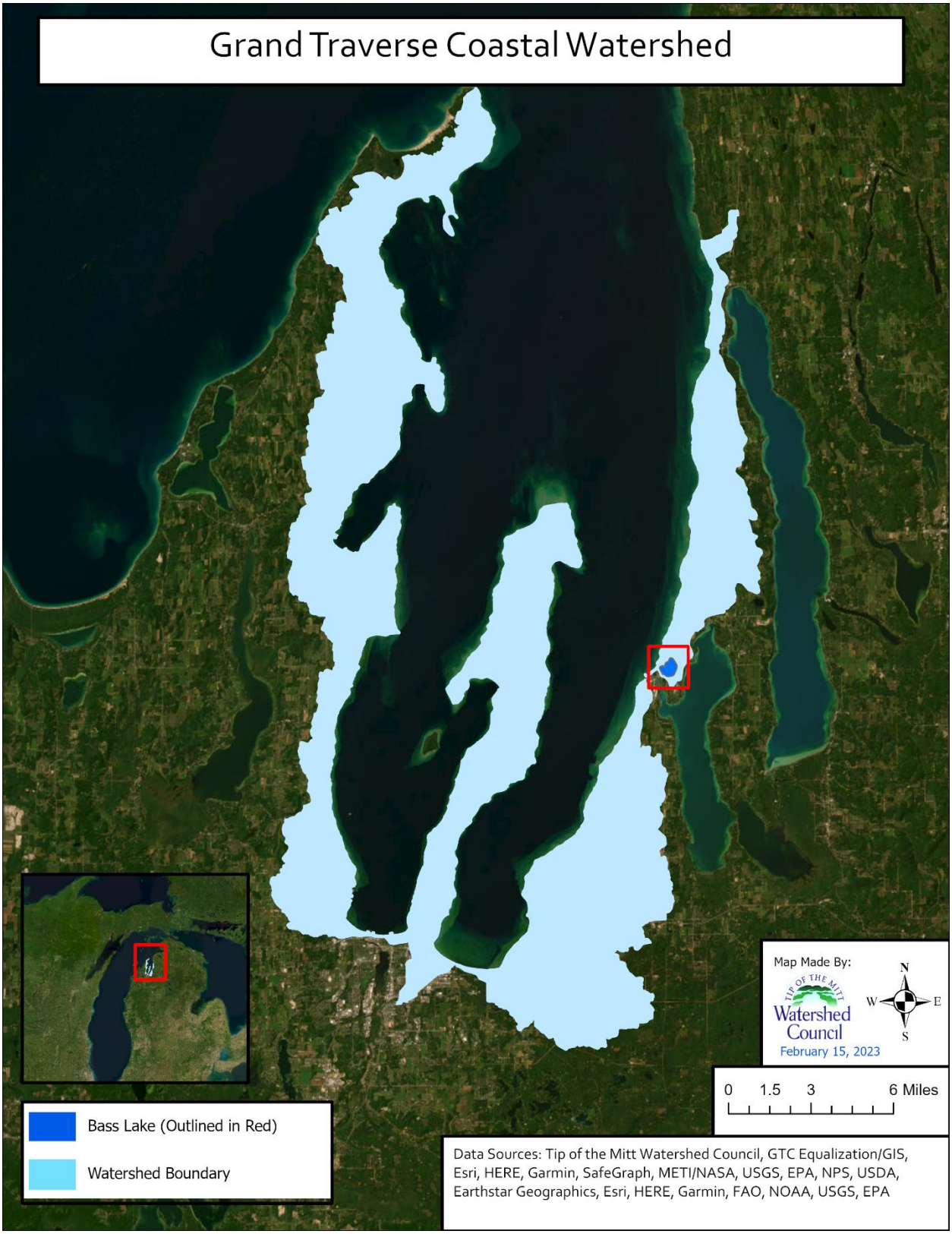

Figure 1.Grand Traverse Bay watershed map with Bass Lake.

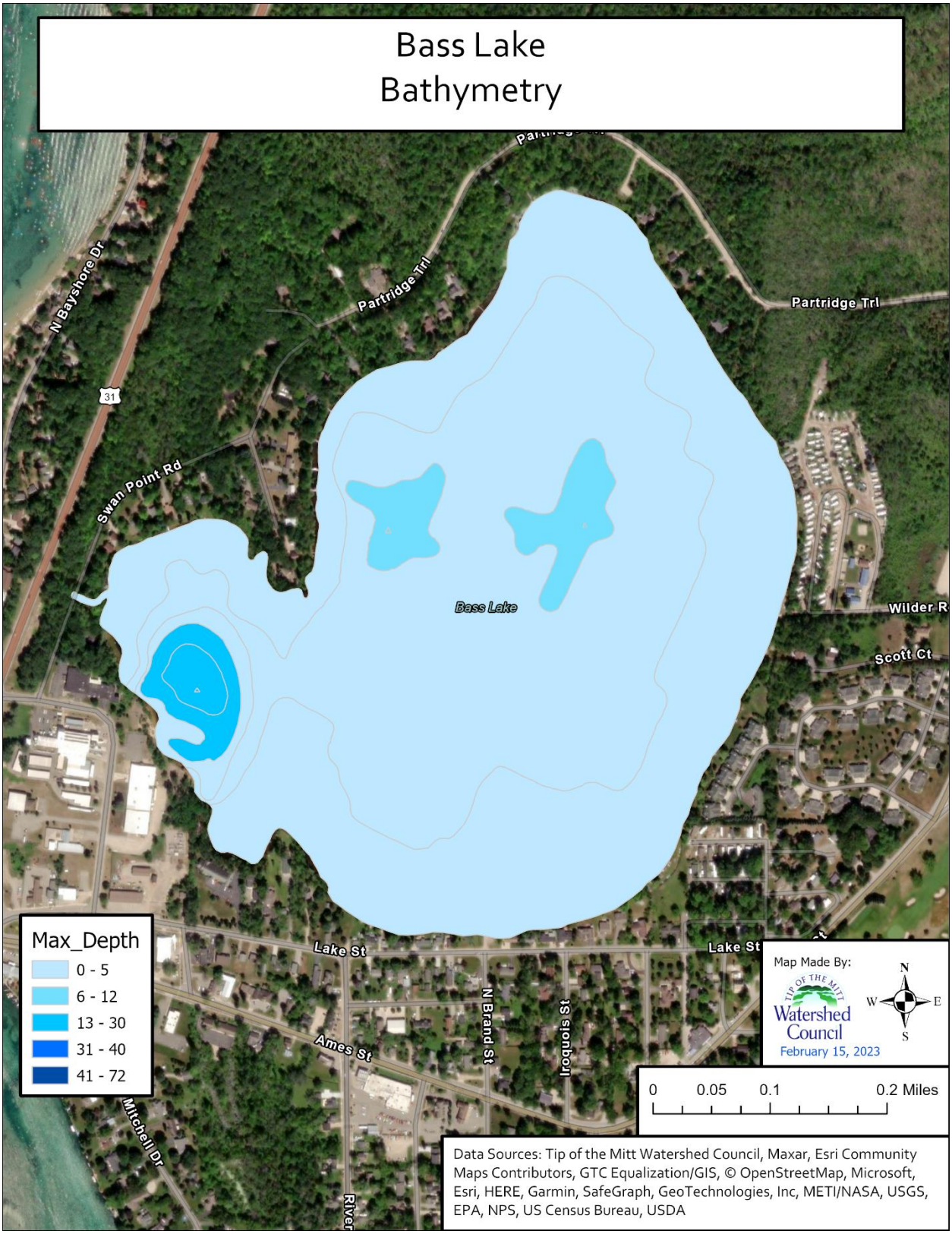

Figure 2. Map of depths in Bass Lake.

The shoreline of Bass Lake is highly developed, due to its proximity to the city of Elk Rapids, with many homes surrounding the lake and only a few areas of undeveloped shoreline. The lake is highly impacted by removal of shoreline vegetation (greenbelt loss), hardened shorelines (seawalls, riprap), and urban stormwater runoff.

The water quality of Bass Lake was monitored consistently from 1992 to 2014, by staff and volunteers, through the Watershed Council's Volunteer Lake Monitoring program. Volunteer Lake Monitoring follows Cooperative Lakes Monitoring Program protocols (adapted slightly for Watershed Council volunteers) and includes weekly Secchi disk readings and bi-weekly chlorophyll-a samples May through August each year (Tip of the Mitt Watershed Council, 2021). Secchi disk readings and chlorophyll-a samples can be used to assign a Trophic State Index (TSI) value, which characterizes the lake's productivity. Based on data recorded from 2001 until 2014, Bass Lake falls within the mesotrophic category, which indicates intermediate productivity levels. The green on the chart below (Figure 3) indicates the mesotrophic category. Following years of not monitoring Bass Lake, in 2022, volunteers found that TSI values in Bass Lake remained consistent with historical data and Bass Lake remains in the mesotrophic category.

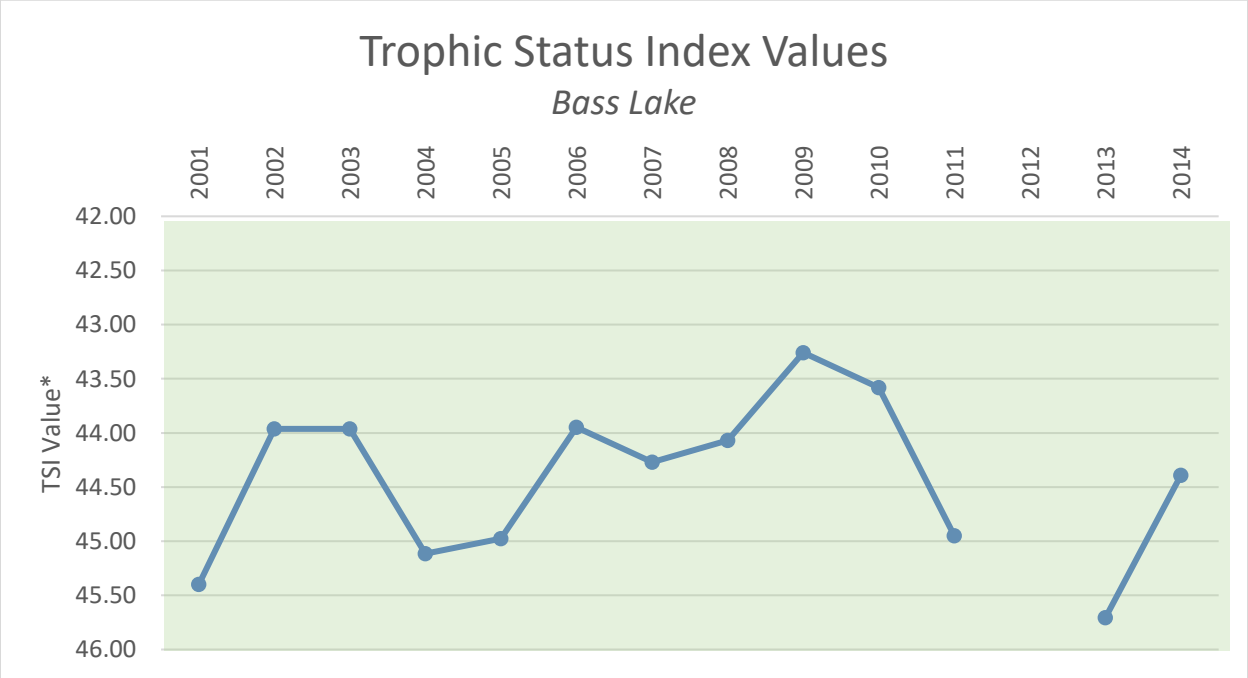

Figure 3. Historic Trophic Status Index Values for Bass Lake.

Bass Lake has been monitored every three years since 1992 at the deepest point by Watershed Council staff as part of our CWQM program. Monitoring is conducted in the spring within two weeks after ice-out. Water samples are collected at the top, middle, and bottom of Bass Lake and analyzed for total nitrogen, nitrate-nitrogen, total phosphorus, and chloride. A multi-parameter probe is used to measure temperature, depth, dissolved oxygen, conductivity, and pH. Monitoring found that total nitrogen levels have decreased in recent years. Total phosphorus levels have been fairly consistent (between 5 and 10 ug/l) since 2004, following the highest levels in 2001. However, phosphorus levels in the middle depth of the lake seem to be rising again recently. According to U.S. Environmental Protection Agency recommendations for lakes in ecoregion 50, natural conditions in lakes have less than 9.69 micrograms per liter (µg/l) of total phosphorus and 400 µg/l of total nitrogen. Phosphorus levels have remained close to this recommended level, but nitrogen levels have historically always been higher than the recommended level in Bass Lake (Figures 4 and 5). Chloride levels in Bass Lake have decreased overall since hitting a peak level in 2010 (Figure 6).

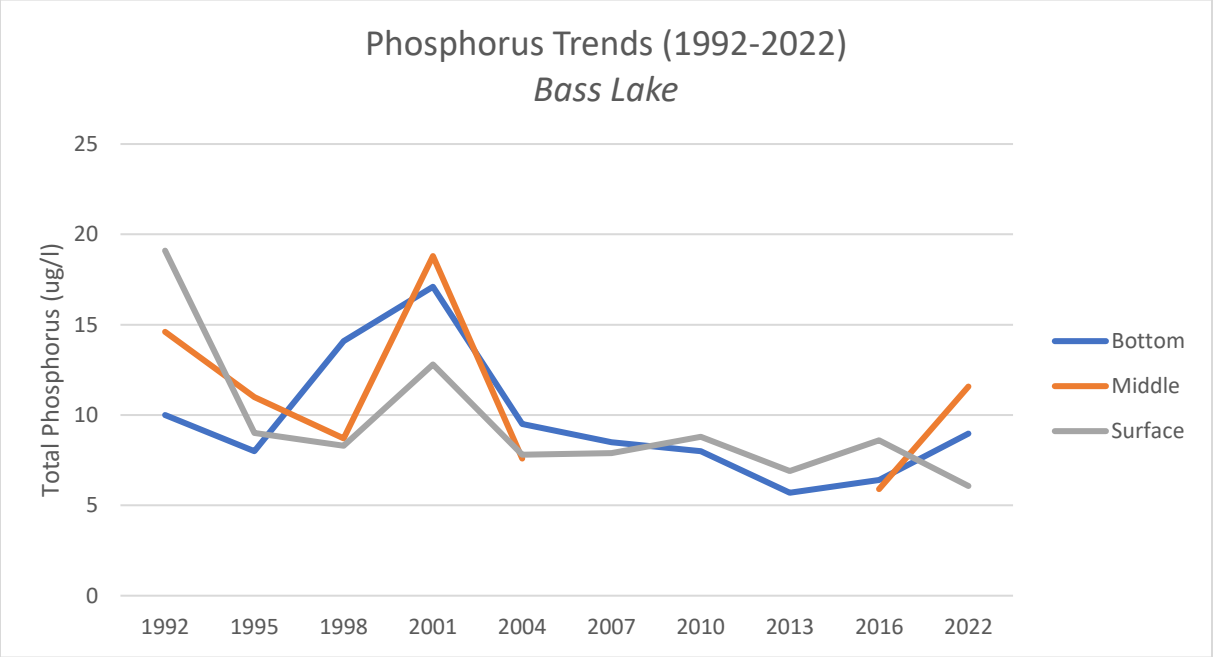

Figure 4. Historical total phosphorus trends for Bass Lake (1992-2022).

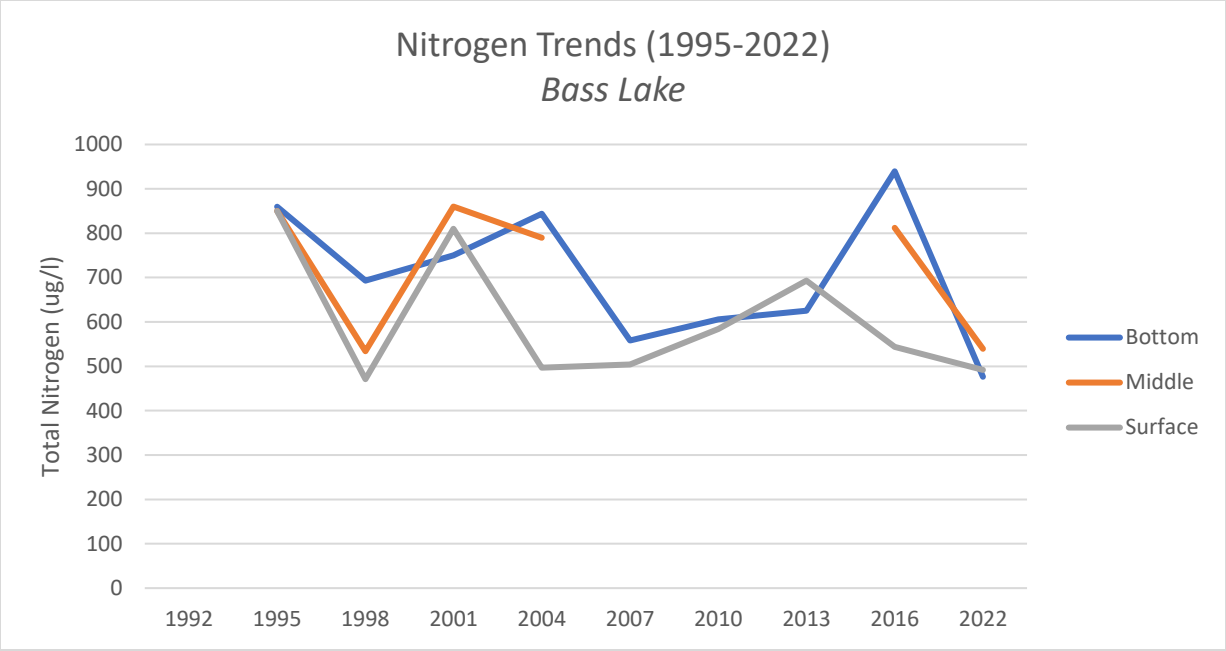

Figure 5. Historical total nitrogen trends for Bass Lake (1995-2022).

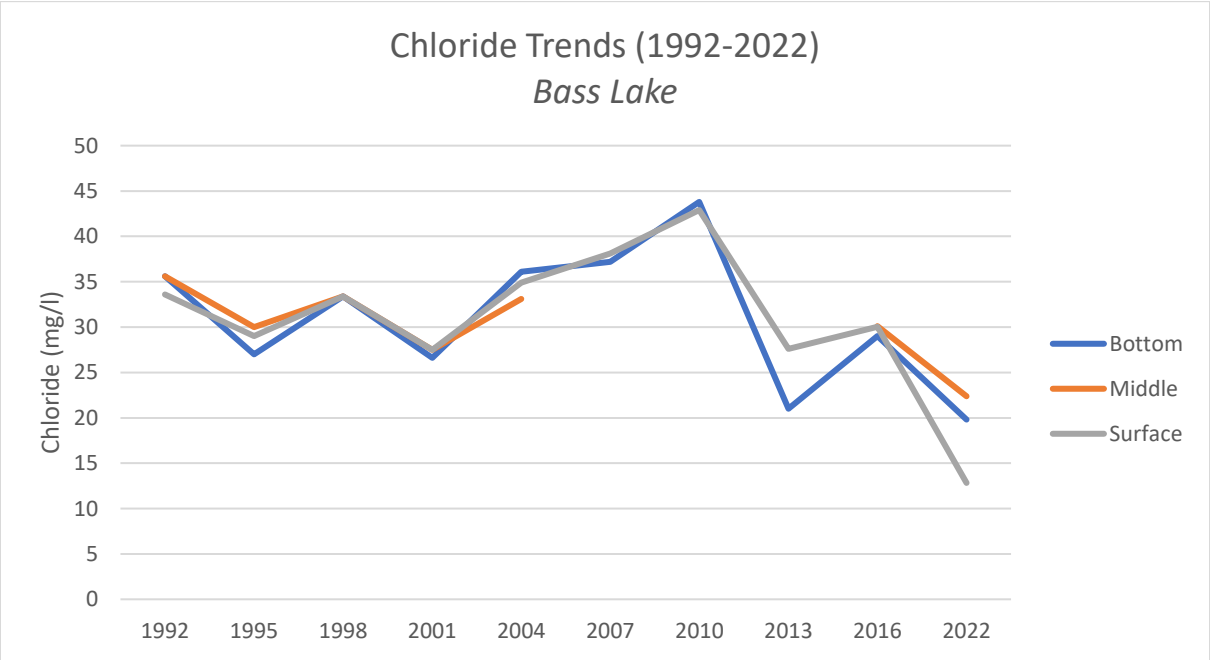

Figure 6. Historical chloride trends for Bass Lake (1992-2022).

Prior to 2022, a shoreline survey had never been conducted on Bass Lake. The 2022 survey provides a comprehensive data set documenting shoreline conditions on Bass Lake; a valuable data set that can be used as a lake management tool. Combined with follow-up activities, including on-site visits, problems in shoreline areas that threaten the lake's water quality can be identified and solved. These solutions are often simple and low cost, such as regular septic system maintenance, proper lawn care practices, and wise land use along the shoreline. Prevention of problem situations can also be achieved through the publicity and education associated with the survey. Periodic repetition of shoreline surveys is important for identifying new and chronic problem sites, determining long-term trends of near-shore nutrient inputs and shoreline alterations associated with land-use changes, and for assessing the success of remedial actions.

METHODS

In August of 2022, the entire Bass Lake shoreline was surveyed to comprehensively document shoreline conditions. Shoreline conditions were surveyed by traveling in kayak as close to the shoreline as possible (usually within 20 feet) and noting *Cladophora* growth, substrate type, erosion, greenbelt health, shoreline alterations, and tributaries. Information for each property was recorded on iPads using FieldMaps, which immediately linked it with property owner data from county equalization records.

Field Survey Parameters

A feature class with shoreline property outlines and ownership information were collected from Antrim County Equalization records, and imported into the software program ArcGIS Pro. The parcels from each county were merged into a single feature layer. Only shoreline parcels were selected using a 100-meter buffer around a shapefile of Bass Lake. Fields for each survey parameter were set up in an attribute table with owner, property identification numbers, and address information. Domains were described in each field according to options available under each parameter. The feature layer was uploaded to ArcGIS online and options were set for editing offline in the app ArcGIS FieldMaps. The lake was downloaded on the FieldMaps app in an iPad for data collection.

Shoreline property features were documented by photographing and noting physical features in the FieldMaps app on iPads. Physical features include building descriptions, public access sites, and county road endings. Building descriptions were recorded in an abbreviated style such as, "*Red 2 sty, brn rf, wht trm, fldstn chim, lg pine."* This means that the property has a red two-story house with a brown roof, white trim, fieldstone chimney, and a large pine tree in the yard.

Development

Parcels were noted in FieldMaps as developed, non-developed, or partially developed, in a separate column in the database. Properties described as developed indicate the presence of buildings or other significant permanent structures, including roadways, boat launching sites, and recreational properties (such as parks with pavilions and parking lots). Properties with only mowed or cleared areas, seasonal structures (such as docks or travel trailers), or unpaved pathways were not considered developed. Additionally, large parcels that had structures in an area far from the water's edge were not considered developed. Partially developed parcels included those with a non-livable structure or addition to the land, including a shed, driveway, gazebo, etc. The length and area of developed versus undeveloped

shoreline was not calculated.

Cladophora

Many species of filamentous green algae are commonly found growing in the nearshore regions of lakes. Positive identification of these species usually requires the aid of a microscope. However, *Cladophora* usually has an appearance and texture that is quite distinct to a trained surveyor, and these were the sole criteria upon which identification was based. Other species of filamentous green algae can respond to an external nutrient source in much the same way as *Cladophora*, though their value as an indicator species is not thought to be as reliable. When other species occurred in especially noticeable, large, dense growths, they were recorded on the data sheets and described the same as those of *Cladophora*.

When *Cladophora* was observed, it was described in terms of the length of shoreline with growth, the relative growth density, and any observed shoreline features potentially contributing to the growth. For example, "MHx30 – seeps" denotes a moderate to heavy growth that covered 30 feet of the shoreline and with groundwater seeps in the area that may have been contributing to the growth. Both shoreline length and growth density are subjective estimates. Growth density is determined by estimating the percentage of substrate covered with *Cladophora* using the following categorization system:

Table 1. Categorization system for Cladophora density.

Density Category	**Field Notation**	**Substrate Coverage**
Very Light	(VL)	A green shimmer
Light	(L)	Up to 25% coverage
Light to Moderate	(LM)	25-49% coverage
Moderate	(M)	50-59% coverage
Moderate to Heavy	(MH)	60-74% coverage
Heavy	(H)	75-99% coverage
Very Heavy	(VH)	90-100% coverage

Among other things, the distribution and size of each *Cladophora* growth is dependent on the amount of suitable substrate present. The extent of suitable substrate should therefore be considered when interpreting the occurrence of individual growths, and assessing the overall distribution of *Cladophora* along a particular stretch of shoreline. Substrate types were noted during the survey, using the following abbreviations: M = soft muck or marl, S = sand, G = gravel (0.1" to 2.5" diameter), R = rock (2.5" to 10" diameter), B = boulder (>10" diameter), W = woody debris (logs, sticks), and MTL = steel bulkhead, barrels, etc. Suitable habitat for *Cladophora* growth, which is based on the substrate types present and includes the categories: G, R, B, W and MTL. Either Yes (Y), Partial (P), or No (N), was noted to record if habitat for *Cladophora* was present throughout most of the shoreline.

Greenbelts

Greenbelts, i.e. shoreline vegetation, were rated based on the length of shoreline with a greenbelt and the average depth of the greenbelt from the water's edge landward into the property. Ratings for length ranged from zero to four while depth ranged from zero to three and were based on the following:

Table 2. Greenbelt scoring chart.

Score	Length (%)	Depth (feet)
0	Absent	Absent
1	<10%	<10
2	10-25%	10-40
3	25-75%	>40
4	>75%	NA

Greenbelt ratings for length and depth were summed to produce an overall greenbelt score. Greenbelt scores ranged from 0 to 7, representing the greenbelt status or health. Scores of 0 were considered very poor, 1-2: poor, 3-4: moderate, 5-6: good, and 7: excellent.

Shoreline Alterations

Shoreline alterations were surveyed and noted with the following abbreviated descriptions. Bulkheads refer to an erect manmade structure parallel to shoreline, which hardens the shoreline. Rip-rap can be described as a range of individual rocks that harden the shoreline.

SB = steel bulkhead (i.e., seawall)	BB = big boulder rip-rap/bulkhead
CB = concrete bulkhead	RR = rock rip-rap
G = groin (rock, concrete in water)	BR = mixed boulder and rock rip-rap
WB = wood bulkhead	BS = beach sand
BH = permanent boathouse	DP = discharge pipe

Additional information regarding shoreline property features or shoreline conditions recorded on field data sheets was included in the database in a "comments" column.

Erosion

Erosion was noted based on shoreline areas that exhibited areas of bare soil, leaning or downed trees, exposed tree roots, scalloped shoreline shape, rapid rate of recession, vegetation removal for beach sand, slumping hunks of sod, undercut bans and gullies from runoff. Similar to *Cladophora*, shoreline erosion was recorded on field data sheets with estimates of its extent and relative severity (light (L), moderate (M), or heavy (H)). For example, "Mx20' at E. End" indicated 20 feet of shoreline with moderate erosion on the east end. Additional information about the nature of the erosion, such as obvious causes, were also noted.

Data Processing

Data was collected using the app ArcGIS FieldMaps on offline maps. Offline maps were synced daily to a web map on ArcGIS online. Data was downloaded weekly from the ArcGIS shapefile.

One discrepancy in the data that was altered during data processing. Null values recorded in the field were changed to zero in the data, in order to enter an analyze data in ArcGIS.

In order to display survey results without pinpointing specific parcels, a new map layer was developed using the parcel map data layer acquired from the county equalization departments and a Bass Lake

shoreline layer. The new map layer consists of a 200-meter band following the shoreline, split into polygons that contain field and equalization data. Parcels were generalized and squared off so the public data layer does not match actual parcel size and shape.

Final products include a comprehensive database with attached photos, GIS data layers of shoreline parcels that include both county equalization and shore survey data, and a story map displaying results. The database contains all data collected in the field and identification numbers in the database correspond to those in the GIS data layer and on hard-copy maps.

RESULTS

Development

This survey documented shoreline conditions at 72 parcels on Bass Lake. Approximately 82% of shoreline properties on Bass Lake were considered to be developed or partially developed, with the vast majority of these being developed (Figure 7). This percentage of developed parcels is higher in comparison to other shoreline surveys conducted in 2022.

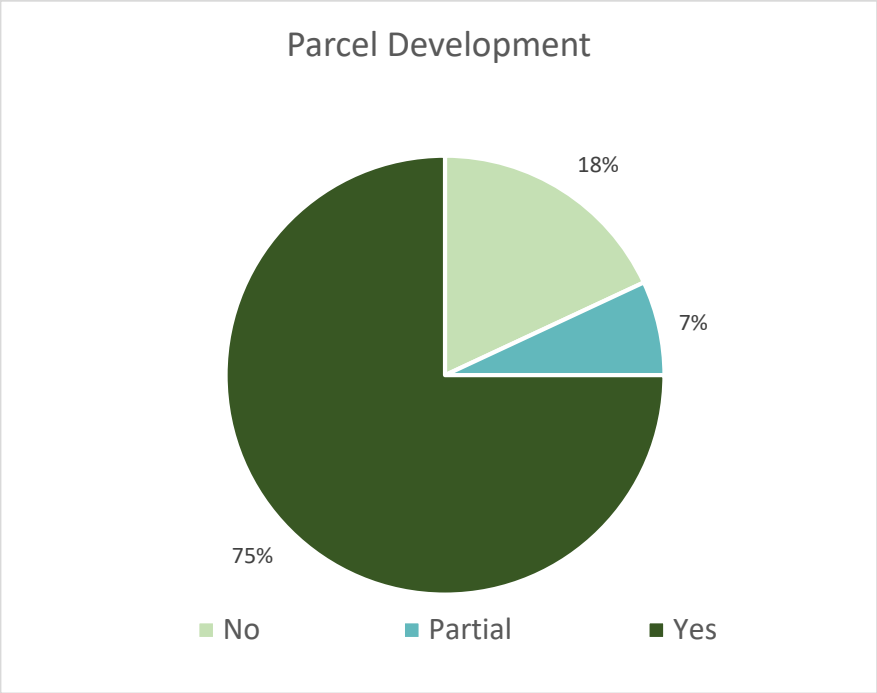

Figure 7. Parcel development percentages.

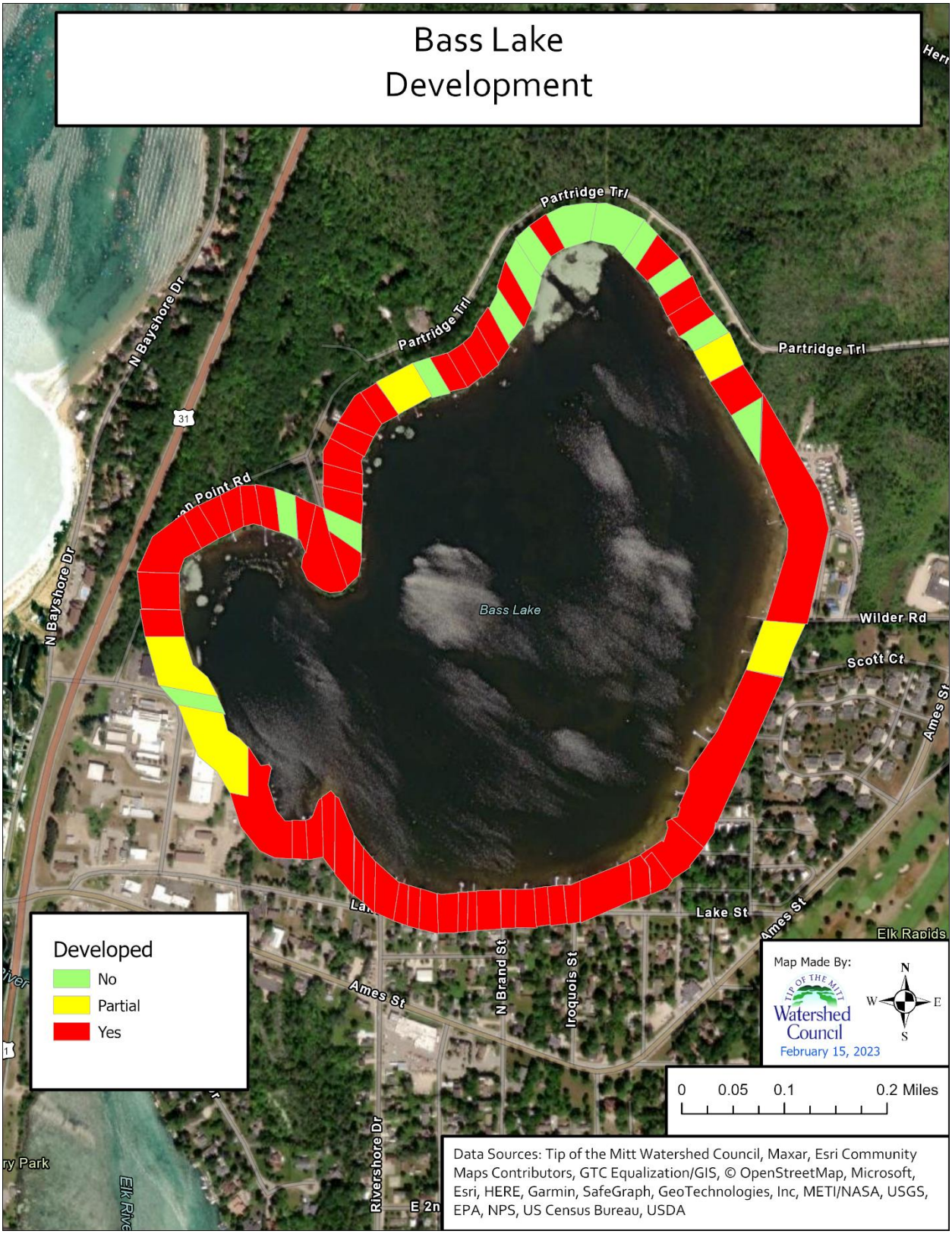

Figure 8. Map of developed parcels.

Cladophora

Cladophora growth was not found along any of the parcels on Bass Lake in the 2022 survey (Figure 9).

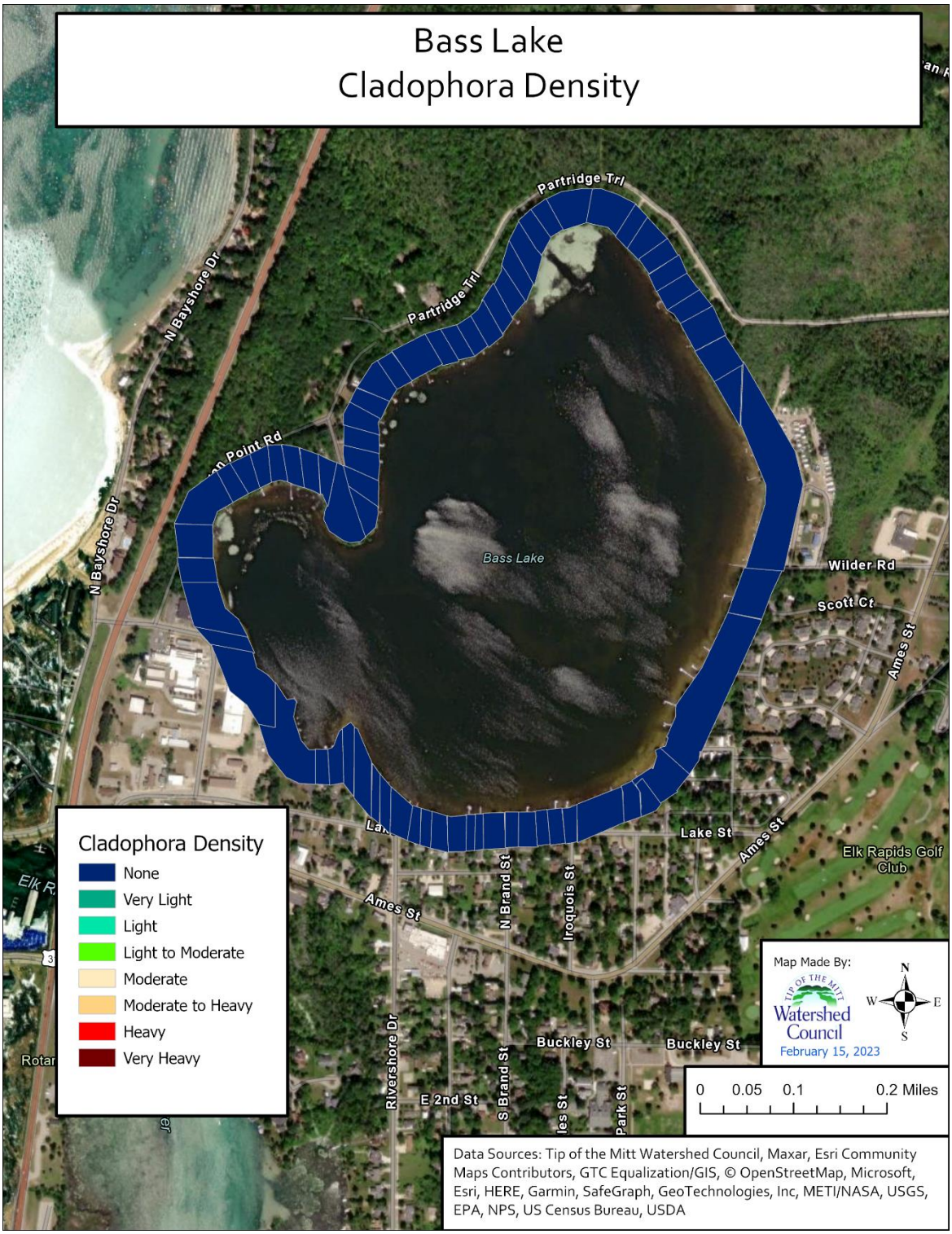

Figure 9. Map of Cladophora density on Bass Lake 2022.

Greenbelts

Greenbelt scores ranged from 0 (Very Poor) to 7 (Excellent). The highest percentage (29.2%) of Bass Lake parcels had a very poor greenbelt score, meaning that the greenbelt was absent. Half (50%) of the Bass lake parcels fell into the two best categories, labeled good and excellent, while 45.9% of parcels were scored very poor and poor (Table 3). The parcel greenbelt scores chart (Figure 10) is a great visual for understanding the large number of parcels where greenbelts were absent. Figure 11 shows where greenbelt scores were located on the map. Red indicates the lower greenbelt scores (0-1) while green indicates the higher greenbelt scores (5-7).

Table 3. Greenbelt scores on Bass Lake 2022.

Greenbelt Score	Frequency	Percent
Very Poor (Absent)	21	29.2
Poor (1-2)	12	16.7
Moderate (3-4)	3	4.2
Good (5-6)	19	26.4
Excellent (7)	17	23.6
Total	72	100

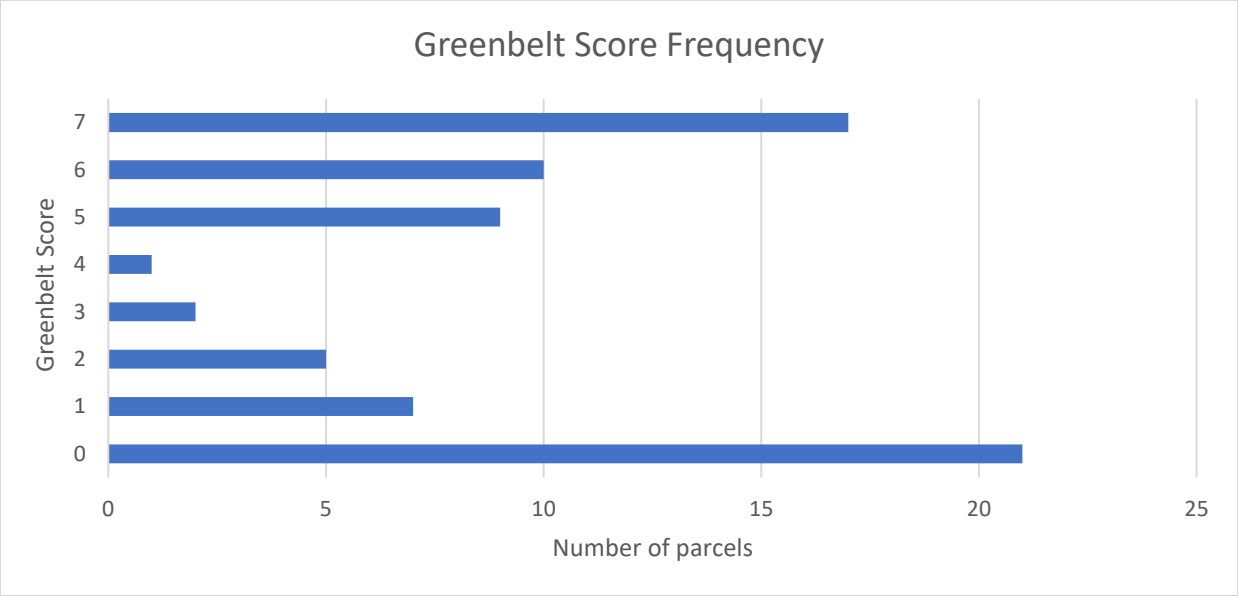

Figure 10. Greenbelt score frequency chart Bass Lake 2022.

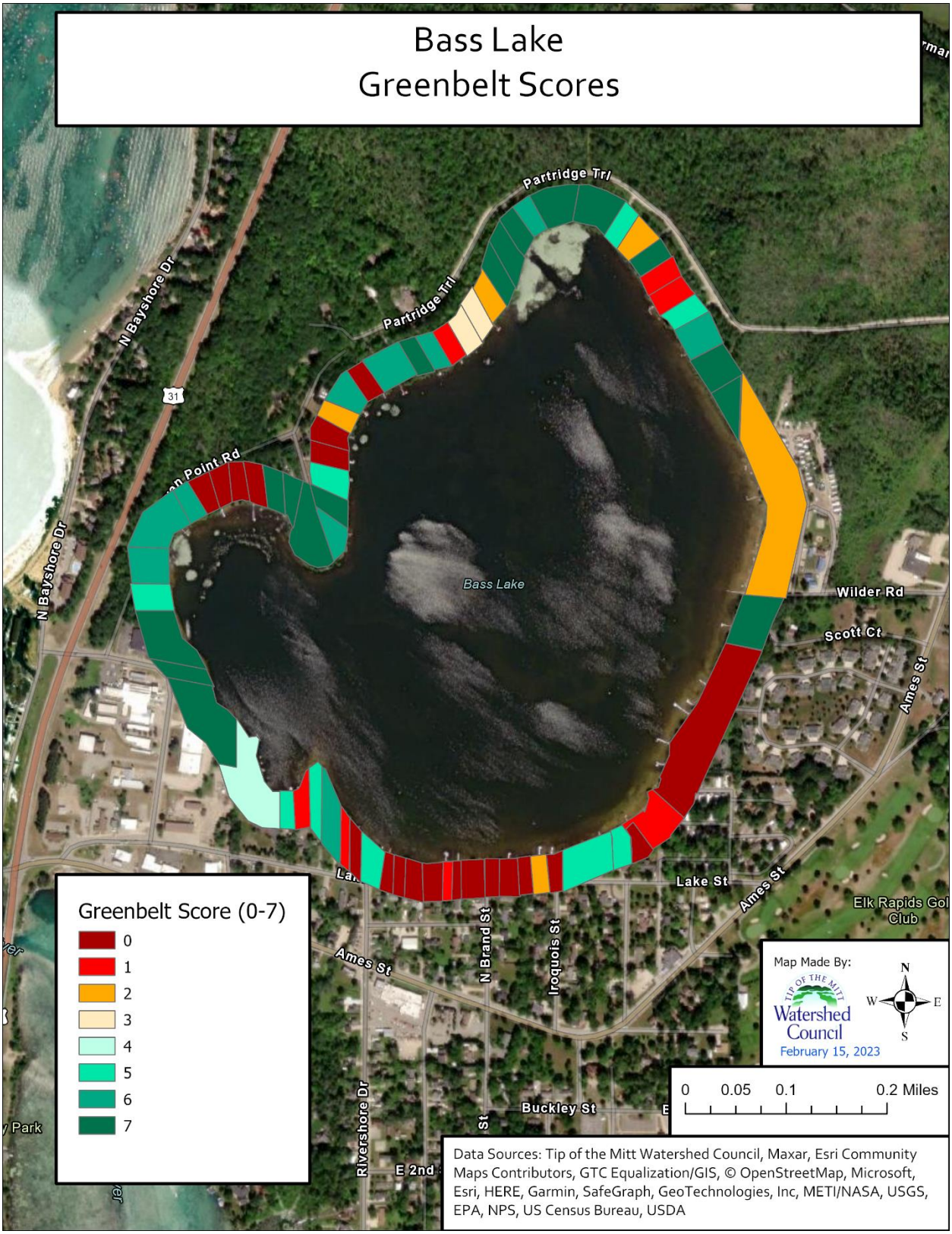

Figure 11. Map of greenbelt scores Bass Lake 2022

Shoreline Alterations

The majority (56.3%) of Bass Lake parcels did not have any alterations to the shoreline. A total of 27 parcels (43.7%) had at least one alteration to the shoreline. The most shoreline alterations found on one parcel was 2 alterations, which was present at 7 properties (Table 4). Alterations to the shoreline on each parcel were recorded and categorized into the groupings shown below in Table 5. The most common alteration seen (16.3%), was mixed boulder and rock rip-rap (Table 5 & Figure 12).

Note that the percentages for the following two tables depend on the total frequency numbers, which are different than the number of parcels involved in the survey, due to the fact that these results are looking at the total number of shoreline alterations.

Table 4. Number of alterations per parcel on Bass Lake 2022.

Number of alterations	Frequency	Percent
0	45	56.3
1	28	35.0
2	7	8.8
Total	80	100.0

Table 5. Shoreline alteration types on Bass Lake 2022.

Alteration Type	Frequency	Percent
beach sand (from fill or grooming)	4	5.0
big boulder rip-rap/bulkhead	3	3.8
concrete bulkhead	3	3.8
discharge pipe	5	6.3
mixed boulder and rock rip-rap	13	16.3
rock rip-rap	7	8.8
none	45	56.3
Total	80	100.0

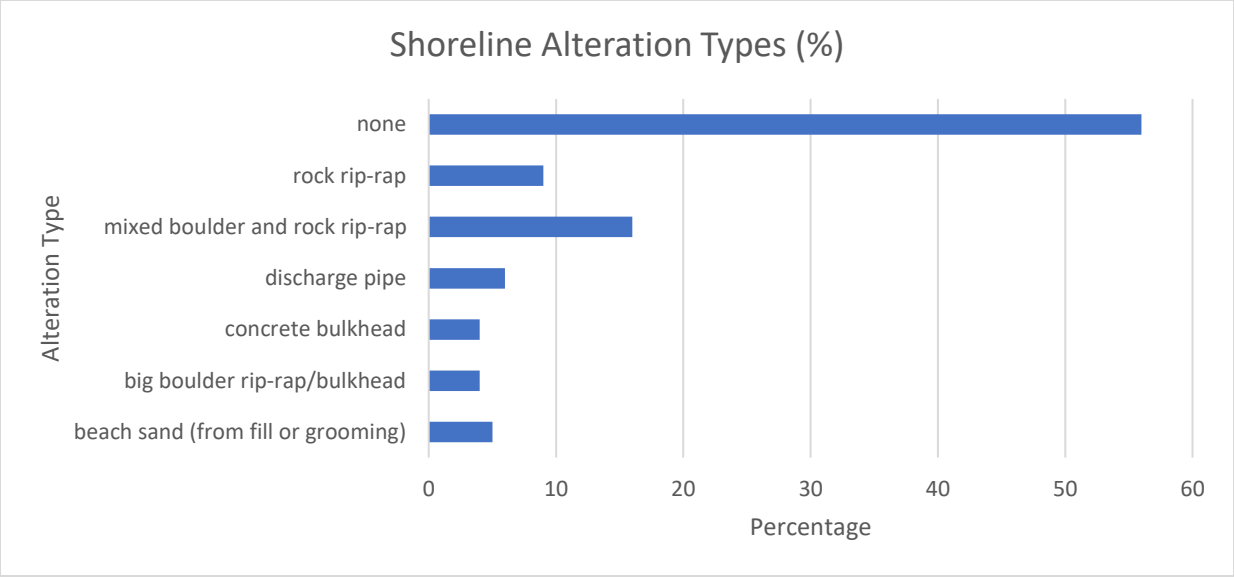

Figure 12. Frequency of shoreline alteration types.

Erosion

Erosion was noted at 6 parcels on Bass Lake in 2022. Only erosion that was observed to be caused by human activity was recorded. The majority (91.7%) of shoreline properties did not show signs of erosion, and no sign of heavy erosion was recorded on the shoreline (Table 6). Locations for erosion were scattered along the Bass Lake shoreline, but one concentrated location for light erosion was on the shoreline of the residential area near the Elk Rapids Golf Course (Figure 13).

Table 6. Erosion severity on Bass Lake 2022.

Erosion Severity	**Frequency**	**Percent**
None	66	91.7
Light	4	5.5
Medium	2	2.8
Heavy	0	0
Total	72	100.0

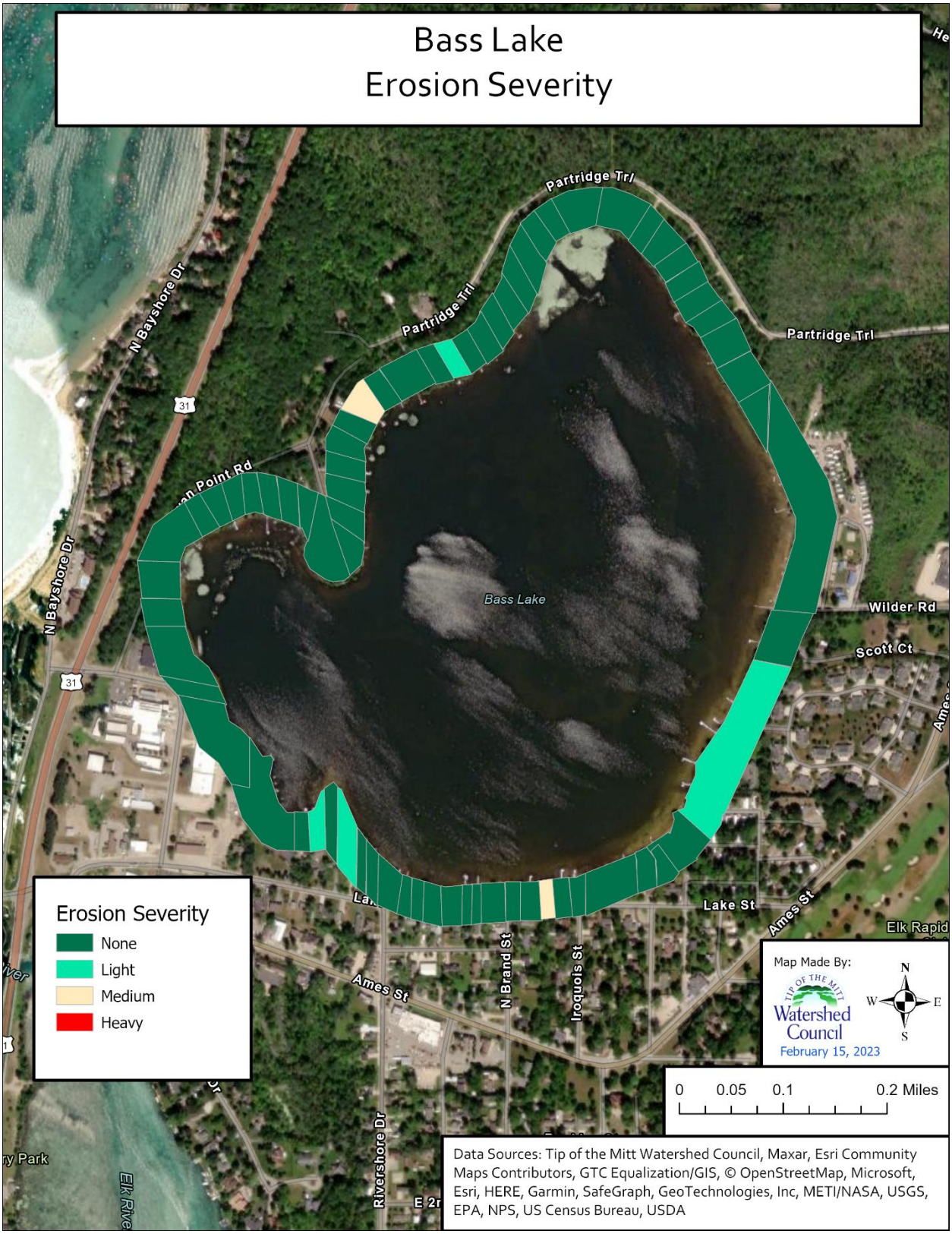

Figure 13. Map of erosion locations on Bass Lake 2022.

DISCUSSION

Development of shoreline parcels negatively impacts a lake's water quality due to a multitude of factors. Among the most serious impacts are: 1) loss of vegetation that would otherwise absorb and filter pollutants in stormwater runoff as well as stabilize shoreline areas and prevent erosion, 2) increased impervious surface area such as roofs, driveways and roads, which leads to greater inputs of stormwater runoff and associated pollutants, and 3) waste and byproducts of human activity such as septic leachate, fertilizers and decomposing yard waste that potentially reach and contaminate the lake water. Clearly, there are many problems associated with development, but there are also many solutions for reducing or even entirely eliminating impacts.

Numerous best management practices have been developed that help minimize negative impacts to water quality and can be utilized during, or retroactively after, the development of shoreline parcels. A buffer of diverse, native plants can be maintained along the shoreline to filter pollutants and reduce erosion. Impacts from stormwater generated from roofs, roads, and driveways can be reduced using rain barrels, rain gardens, grassy swales, and many other techniques. Leachate reaching the lake from septic systems can be minimized by pumping the septic tank regularly, having all components of the septic system inspected regularly, and replacing the septic system when necessary. Mulch can be composted far from the shoreline and fertilizers applied sparingly, if at all.

Comparison to Long Lake Shoreline Survey (2021)

Prior to 2022, no shoreline survey was conducted on Bass Lake, so there is no means for comparison to historical shoreline data on the lake. However, 2022 shoreline survey data on Bass lake, in comparable to shoreline survey data on Long Lake. Long Lake is another small inland lake in northern Michigan. It covers 392 acres in Cheboygan County. A shoreline survey was conducted on Long Lake in 2021.

In 2021, *Cladophora* algae growth, ranging from very light to moderate, was documented at 24% of shoreline properties on Long Lake. In 2022, algae growth was not recorded as present at a single shoreline property of Bass Lake (Figure 14). This is significant, as algae growth has become prevalent in lakes across northern Michigan. No algae growth on Bass Lake speaks to the health of the small inland lake.

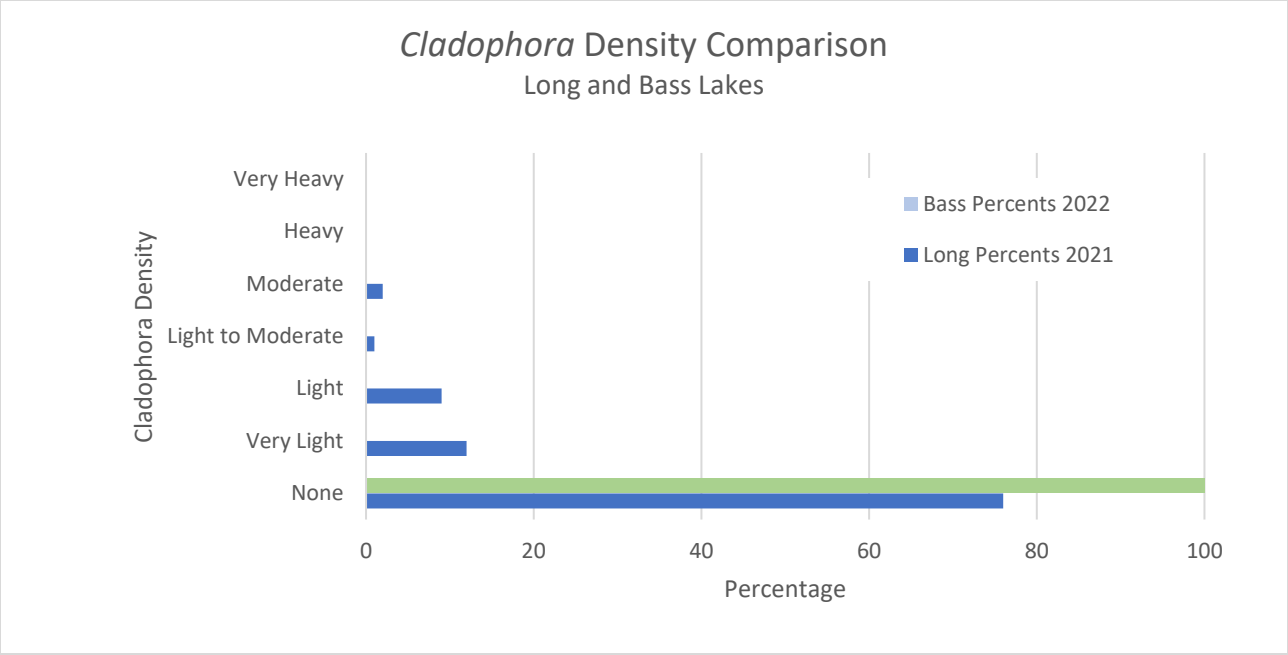

Figure 14. Cladophora density comparison; Long and Bass Lakes.

Greenbelt scores of Long Lake in 2021, and Bass Lake in 2022 were very similar. Highest percentages for both lakes were recorded in the Very Poor, but also Excellent and Good categories. Bass Lake had slightly worse scores in 2022, than Long Lake in 2021, with 2% more parcels having very poor (absent) greenbelts, and 3% less properties having excellent greenbelts. However, Bass did have 5% more parcels with good greenbelt ratings, so greenbelt scores were overall very similar between the lakes (Figure 15).

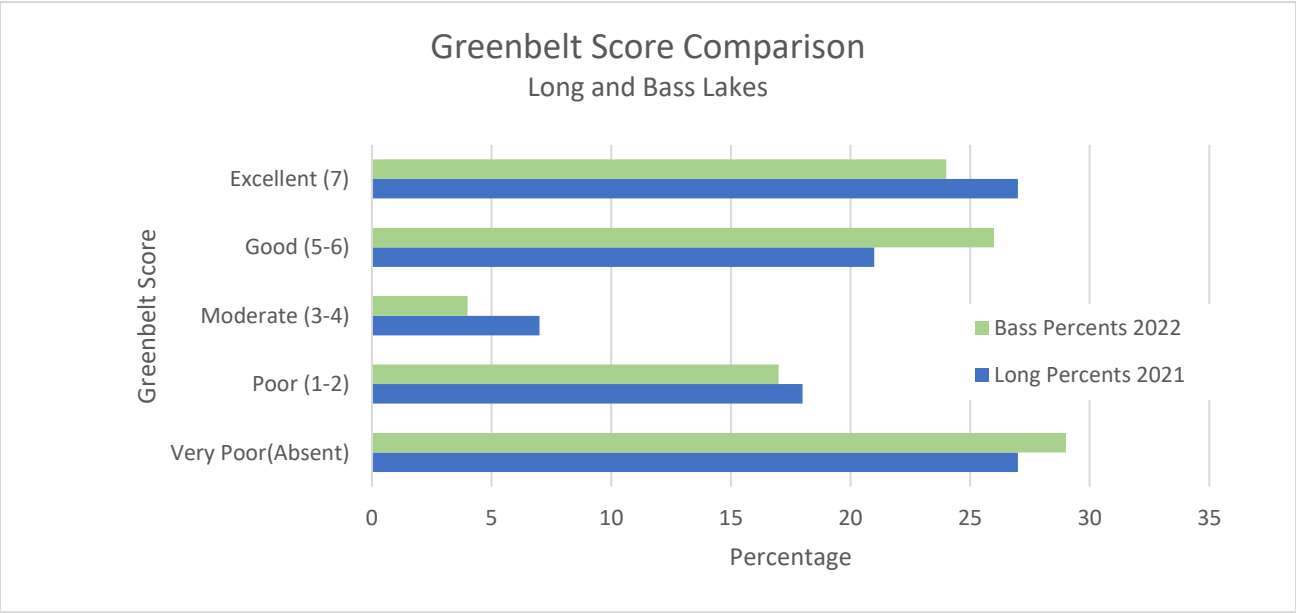

Figure 15. Greenbelt score comparison; Long and Bass Lakes.

RECOMMENDATIONS

The full value of a shoreline survey is only achieved when the information is used to educate riparian property owners about preserving water quality, and to help them rectify any problem situations. The following are recommended follow-up actions:

1. Keep the specific results of the survey confidential (e.g., do not publish a list of sites where *Cladophora* algae were found) as some property owners may be sensitive to publicizing information regarding their property.
2. Share/present findings to Bass Lake Association.
3. Send a *general* summary of the survey results to all shoreline residents.
4. Make results available online through an ESRI StoryMap or WebApp.
5. Encourage land owners to sign up and take a self-assessment for MI Shoreland Stewards.
6. Promote and encourage landscape contractors and designers to attend bioengineering workshops held by the Watershed Council.
7. Repeat some version of the survey periodically (ideally every 5-10 years).
8. Continue to support the Tip of the Mitt Watershed Council Volunteer Lake and Stream Monitoring programs by providing volunteer support. The information collected by volunteers is extremely valuable for evaluating water quality and determining trends.

REFERENCES:

"Bass Lake." *Tip of the Mitt Watershed Council.* https://www.watershedcouncil.org/bass-lake.html Accessed January 28, 2023.

"Grand Traverse Bay Watershed." *River Restoration in Northern Michigan.* February 9, 2021. http://www.northernmichiganstreams.org/gtbayws.asp Accessed February 3, 2023.