Torch Lake Shoreline Survey 2017

By Tip of the Mitt Watershed Council

<u>Report written by:</u>

Dave D. Edwards

Monitoring and Research Director

Data collected by Watershed Protection Team 2017

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SUMMARY

During the summer of 2017, Tip of the Mitt Watershed Council conducted a shoreline survey of Torch Lake. The survey was a part of a comprehensive shoreline survey for the entire Elk River Chain of Lakes. Surveys were designed to document conditions that can impact water quality, including the three biggest threats to inland lakes: nutrient pollution, habitat loss, and shoreline erosion. The shoreline assessment was conducted on a parcel-by-parcel basis around the entirety of Torch Lake. Survey results indicate that large portions of Torch Lake shoreline contains natural and native vegetation growth. However, human activity around Torch Lake shoreline might be impacting the lake ecosystem and water quality. Improving areas with poor greenbelts will help the character and quality of Torch Lake by reducing nutrient pollution and sediments from erosion entering the Lake.

INTRODUCTION

Background

During the summer of 2017, a shoreline survey was conducted on Torch Lake by the Tip of the Mitt Watershed Council to document shoreline conditions that impact water quality. Torch Lake was one of 15 lakes surveyed during 2016 and 2017 as a part of a broader effort to document shoreline conditions within the entire Elk River Chain of Lakes. The entire shoreline was surveyed to document the following: algal (*Cladophora*) growth as a nutrient pollution indicator, erosion, and greenbelts.

This survey offers important follow-up and current baseline data for comparison in future years. The following 2017 survey results provide a comprehensive dataset documenting shoreline conditions on Torch Lake that can be used as a lake management tool.

Shoreline Development Impacts

Lake shorelines are an important interface linking the landscape to water within a watershed. A shoreline is the area in which a transfer of water and nutrients occurs from land to water. This transitional zone does not necessarily have an exact line between the landscape and water as lake shorelines vary based on shape, size, and vegetation. Accordingly, human activities along shorelines will have varying potential for degrading water quality of Torch Lake. Development of shoreline properties for residential, commercial, or other use have an impact on Torch Lake in a variety of ways and in various degrees. For example, as more shoreline vegetation is removed, the potential for nutrients and pollutants to run off the landscape and enter Torch Lake increases. Additionally, as the Torch Lake Watershed terrain is altered, sediments and nutrients from eroded areas can often end up in Torch Lake.

While nutrients are necessary to sustain a healthy aquatic ecosystem, excess nutrients will stimulate nuisance growth of both macrophytes (aquatic plants that grow in or near water and are either emergent, submergent, or floating) and algae. Additionally, algal blooms pose a public health risk as some species (i.e. Cyanobacteria - blue green algae) produce toxins, including hepatotoxins (toxins that cause liver damage) and neurotoxins (toxins that affect the nervous system). Excess plant and algal growth can degrade water quality by depleting the ecosystem's dissolved oxygen. As algal growth increases and individuals begin to die, the aerobic activity of decomposers deplete dissolved oxygen, particularly in the deeper waters of stratified lakes. In general, small lakes are more prone to nutrient pollution than large lakes. With the increased volume, large lakes tend to have greater stores of dissolved oxygen and increased dilution of nutrients. By contrast, small lakes generally have a lesser ability to dilute nutrients and extensive shallow areas that can support aquatic plant growth. Excess nutrients enter surface waters through a variety of natural and cultural (human) sources.

Natural sources of nutrients include stream inflows, groundwater inputs, surface runoff, organic inputs from riparian (shoreline) areas, and atmospheric deposition. Springs and seeps, streams, and artesian wells are often naturally high in nutrients due to the geologic strata they encounter. Nearby wetland seepages may also discharge nutrients at certain times of the year. Cultural (human) sources include septic systems, fertilizers, and stormwater runoff from roads, driveways, parking lots, roofs, and other impervious surfaces. Poor agricultural and forestry practices, which oftentimes result in soil erosion, and wetland destruction also contribute to nutrient pollution. Moreover, some cultural sources (e.g., malfunctioning septic systems) 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.

Although chemical analyses of water samples to check for nutrient pollution can be effective, they are oftentimes more labor intensive and cost prohibitive than other methods. Typically, water samples are analyzed to determine nutrient concentrations (usually the forms of phosphorus and nitrogen), but other chemical constituents, such as chloride, can be measured. Physical measurements, such as water temperature and conductivity (the ability for water to conduct an electrical current), are primarily used to detect excess nutrients entering a water body. Biologically, nutrient pollution can be detected along the lake shore by noting and observing the presence of *Cladophora* algae, a biological indicator. Observed increases of *Cladophora* presence can be an indicator of elevated nutrients along the shoreline.

Cladophora is a branched, filamentous green algal species that occurs naturally in relatively small amounts in Northern Michigan lakes. *Cladophora* occurrence is governed by specific environmental requirements for temperature, substrate, sunlight, and nutrients. This algal bio-indicator is found most commonly in the wave splash zone and shallow shoreline areas of lakes and grows best on stable substrates such as rocks and logs. Artificial substrates such as concrete or wooden seawalls are also suitable growth areas. *Cladophora* prefers water temperatures in a range of 50 to 70 degrees Fahrenheit, which means that the optimal time for growth and detection in Northern Michigan lakes is usually from middle of May to early July, and again in early to middle of September. The nutrient availability in Northern Michigan lakes is typically less than what is needed for *Cladophora* to achieve large, dense growth. 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 growth of *Cladophora* can be influenced by factors such as water current patterns, shoreline topography, substrate composition, and wave action, the presence or absence of any significant growth can be a powerful lake-wide screening tool. The existence of chronic nutrient availability along the shoreline can be revealed and chronic observance of dense *Cladophora* presence can assess the effectiveness of any remedial actions. Comparing the total number of algal growth areas along the shoreline over time can reveal trends in nutrient inputs to a lake. One factor contributing to nutrient input is bank erosion.

Erosion along the shoreline can degrade the lake's water quality. Stormwater runoff carries sediments into the lake that can reduce organism respiration by clogging the gills of fish, insects, and other aquatic organisms. Excessive sediments can smother fish spawning beds and fill interstitial spaces along the lake bottom that provide habitat for a variety of aquatic organisms. Suspended sediments absorb sunlight energy and increase water temperatures. In addition, nutrients (particularly phosphorus) adhere to sediments that wash in from eroded areas, which can lead to nuisance aquatic plant growth and algal blooms. To help prevent erosion and runoff of sediments and nutrients, healthy shoreline greenbelts are essential.

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 other shoreline-dependent wildlife. Natural greenbelts can help deter geese as these shoreline guests tend to prefer well-manicured lawns with easy access to the water. Greenbelts also help stabilize shorelines against wave and ice action with their extensive network of deep, fibrous roots. Overhanging vegetation provides shade to nearshore areas, which is particularly important for many fisheries and insects that the fish consume. Lastly, and perhaps most importantly, greenbelts provide a mechanism to filter pollutants carried by stormwater from rain events and snowmelt. Vegetation will utilize nutrients (nitrogen and phosphorus) for growth and filter them out of runoff before entering a lake. Another pollutant and nutrient delivery mechanism to a lake is a tributary.

The primary function of a tributary is to drain the landscape (lake watershed). Therefore, tributaries have a very high potential for influencing a lake's water quality as they are one of the primary conduits through which water is delivered to a lake within a watershed. Inlet streams may provide exceptionally high-quality waters that benefit the lake ecosystem. Conversely, they have the potential to deliver polluted waters that degrade the lake's water quality. Outlet streams flush water out of the lake, providing a way to remove contaminants in the lake ecosystem. While conducting shore surveys, noting inlet tributary locations is very helpful when evaluating shoreline algal 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 algal growth in nearby shoreline areas.

Background of Study Area

Located in the northwestern area of the Lower Peninsula, Torch Lake is in Antrim County. Torch

Lake has a surface area of 18,473 acres and a shoreline length of 41 miles. The primary inflow is the Clam River from the East. Other inflows include Spencer, Wilkinson, and Eastport Creeks. The primary outflow is from the south through the Torch River and eventually flowing into Lake Skegemog. According to digitized bathymetry maps acquired from the Michigan Geographic Data Library, the deepest area of Torch Lake is located near the center, reaching 285 feet in depth (Figure 1).

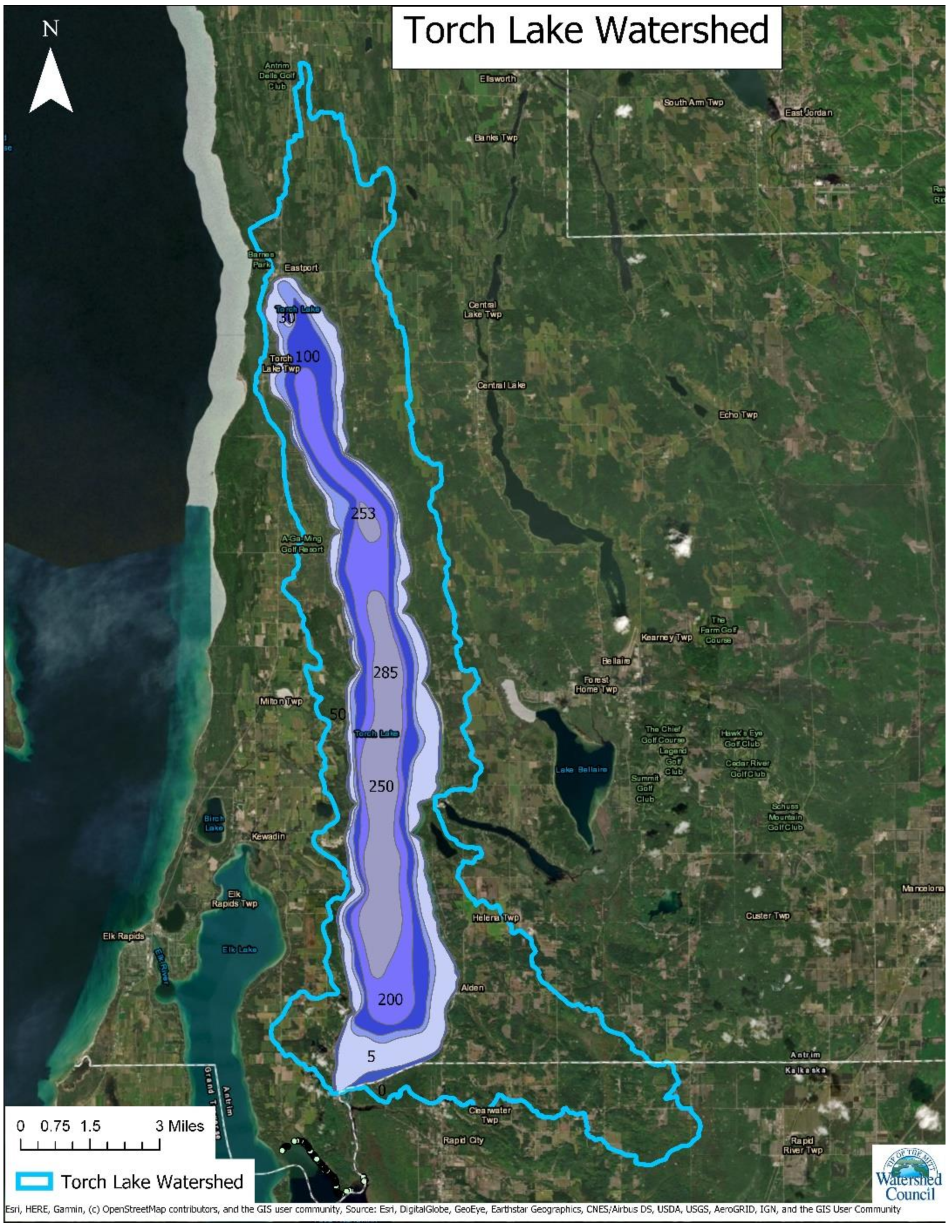


Figure 1 Torch Lake Watershed and Bathymetry

Land cover statistics generated for the surface watershed using data from the NOAA Coastal Great Lakes Land Cover Project reveal much of Torch Lake's surrounding watershed land cover is forest (29.04%), agriculture (10.07), and grassland/herbaceous area (6.67%) (Table 1). Over one-third of the Torch Lake area is open water, signifying a relatively large watershed to lake surface area ratio.

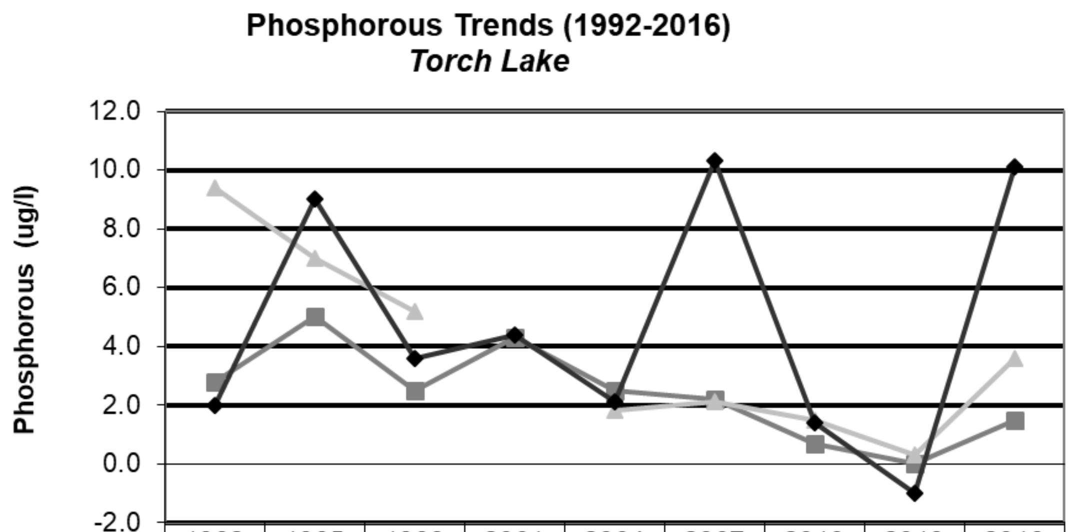
Table 1 Torch Lake Surface Watershed Land Cover 2016

Land Cover Type	2016 (% of watershed)
Agriculture	10.07
Bare Land	<1
Developed	2.32
Forest	29.04
Grassland/Herbaceous	6.67
Open Water	38.97
Pasture/Hay	2.72
Scrub/Shrub	2.65
Wetland	6.60

Water Quality Data

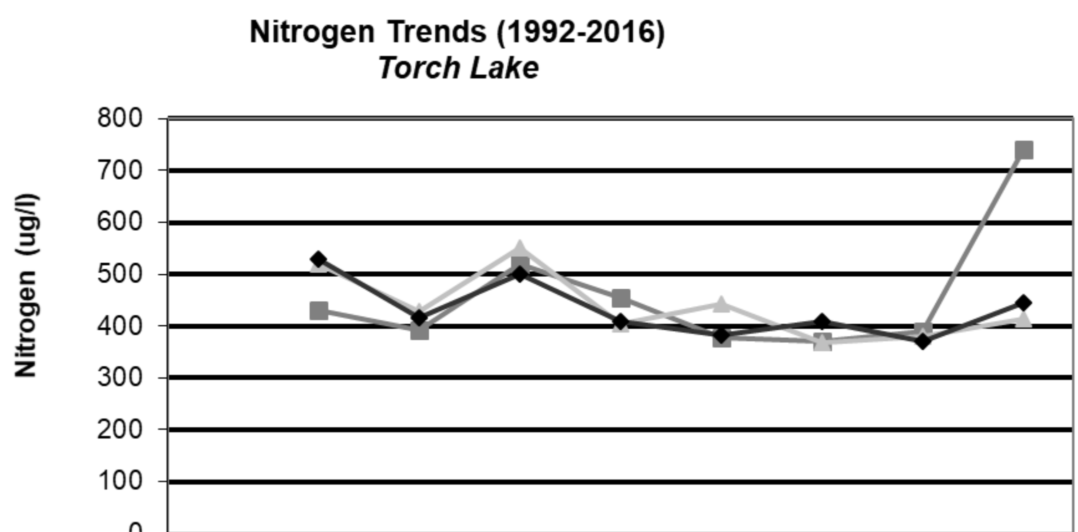
Volunteers have actively engaged with water quality monitoring coordinated by The Watershed Council and the Cooperative Lakes Monitoring Program (MiCorps). In addition, Watershed Council staff monitor Torch Lake water quality as a part of their Comprehensive Water Quality Monitoring Program (CWQM). Watershed Council staff began monitoring Torch Lake in 1992, and this has occurred every three years since.

From the CWQM program, data indicate Torch Lake water quality is relatively high. Total phosphorous measurements show concentrations have steadily fallen since 1992, with appearance of spikes near the bottom of the water column in 1995, 2007, and 2016 (Figure 2). Nitrogen has decreased slightly, ranging between 350 and 500 µg/L (Figure 3). Chloride has nearly tripled since 1992, increasing from 4 mg/l to upwards of 12 mg/L in 2016 (Figure 4).



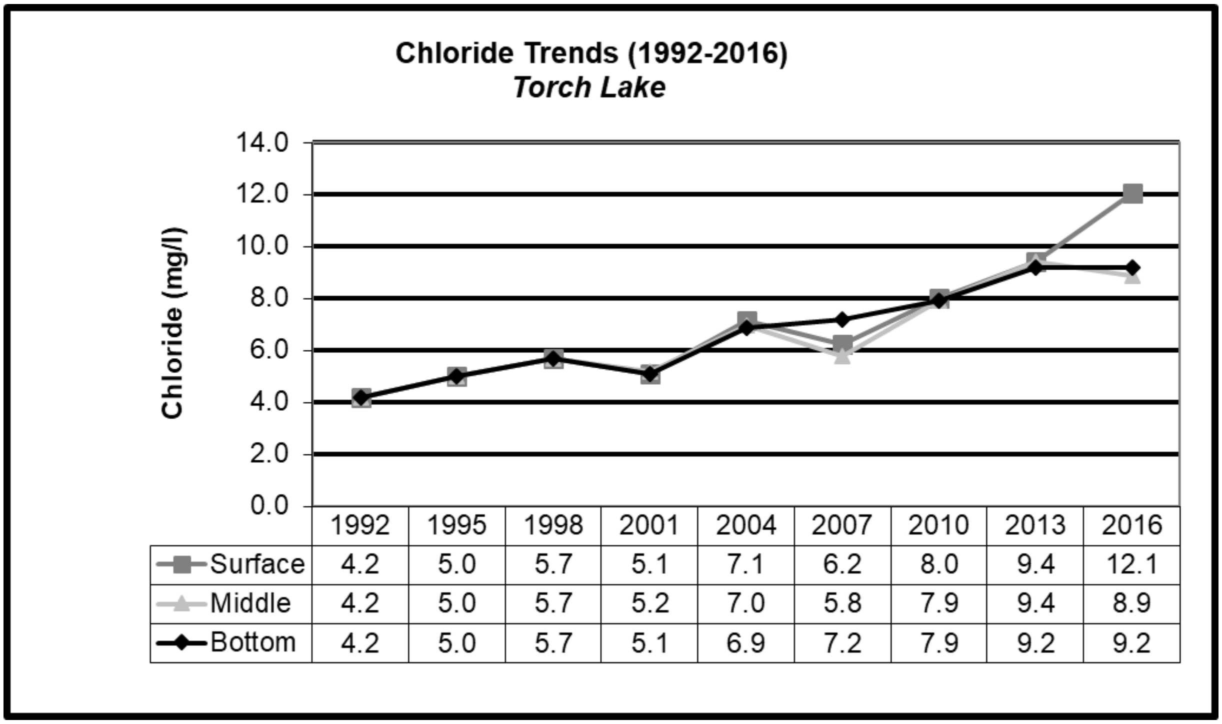
	1992	1995	1998	2001	2004	2007	2010	2013	2016
Surface	2.8	5.0	2.5	4.3	2.5	2.2	0.7	0.0	1.5
Middle	9.4	7.0	5.2		1.8	2.1	1.5	0.3	3.6
Bottom	2.0	9.0	3.6	4.4	2.1	10.3	1.4	-1.0	10.1

Figure 2 Torch Lake Total Phosphorus Trends from 2008 through 2017 as part of the Comprehensive Water Quality Monitoring Program at Tip of the Mitt Watershed Council.



	1992	1995	1998	2001	2004	2007	2010	2013	2016
Surface		430	392	520	455	377	371	389	741
Middle		520	428	550	403	443	369	379	415
Bottom		530	416	500	410	382	408	370	445

Figure 3 Torch Lake Nitrogen Trends from 1995 through 2016 as part of the Comprehensive Water Quality Monitoring Program at Tip of the Mitt Watershed Council.



	1992	1995	1998	2001	2004	2007	2010	2013	2016
Surface	4.2	5.0	5.7	5.1	7.1	6.2	8.0	9.4	12.1
Middle	4.2	5.0	5.7	5.2	7.0	5.8	7.9	9.4	8.9
Bottom	4.2	5.0	5.7	5.1	6.9	7.2	7.9	9.2	9.2

Figure 4 Torch Lake Chloride Trends from through 2016 as part of the Comprehensive Water Quality Monitoring Program at Tip of the Mitt Watershed Council.

Since 1975, local volunteers have ventured out to Torch Lake to record Secchi disk depth, water temperature, and collect water samples for total phosphorus and *chlorophyll-a* measurements. From 1975 through 2018, Torch Lake appears to have become slightly clearer, with Secchi disk readings increasing from around 16ft in 1975 to a little over 35ft (Figure 5).

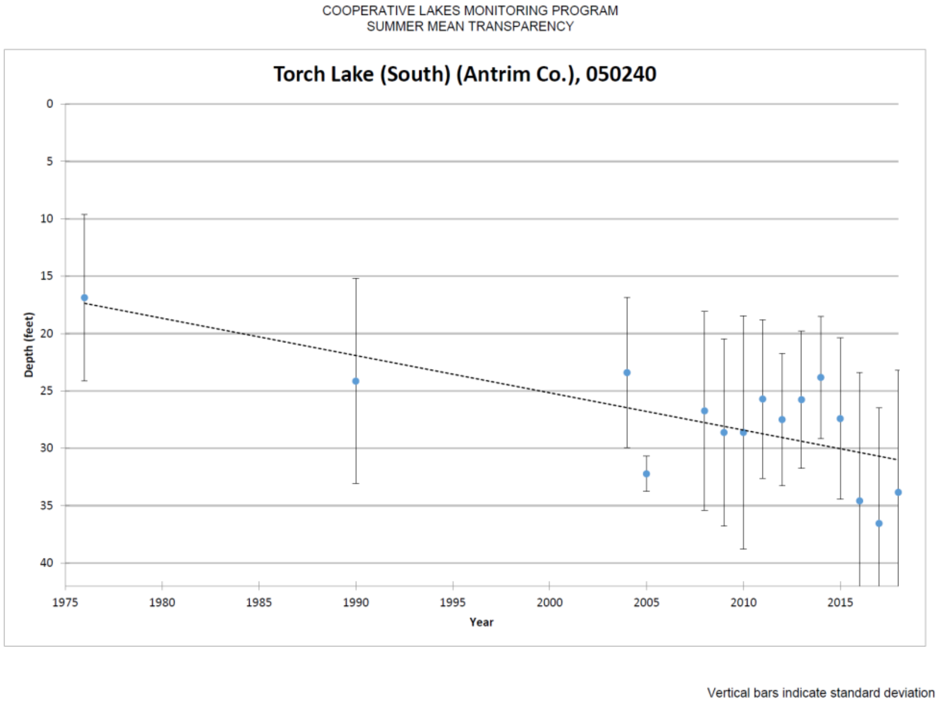


Figure 5 Torch Lake Secchi Disk depth, adapted from Cooperative Lakes Monitoring Program (CLMP), 2018 lake report.

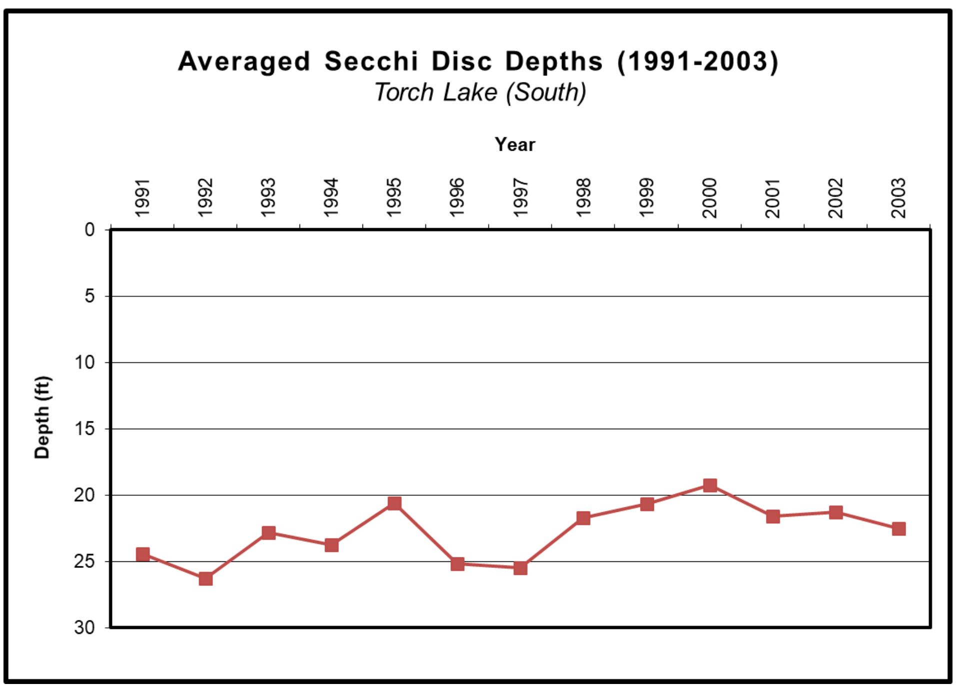


Figure 6 Average Secchi Disk from volunteer data Tip of the Mitt Watershed Council.

At the end of each sampling year, a trophic status index (TSI) is calculated (Figure 7). This value is a measure of biological productivity in a lake at the time of Secchi disk and *chlorophyll-a* sampling. A TSI value ranges from 0 to 100, where a score below 38 describes a lake devoid of nutrients, low biological productivity, and very clear water. A TSI score of 39 – 49 indicates a mesotrophic lake system. Mesotrophic simply means the lake has a moderate amount of nutrients. When nutrients become a problem and productivity becomes too high, a lake is considered "eutrophic" (TSI value above 50). Torch Lake has been in the oligotrophic category, with a TSI value ranging between 33 and 35.

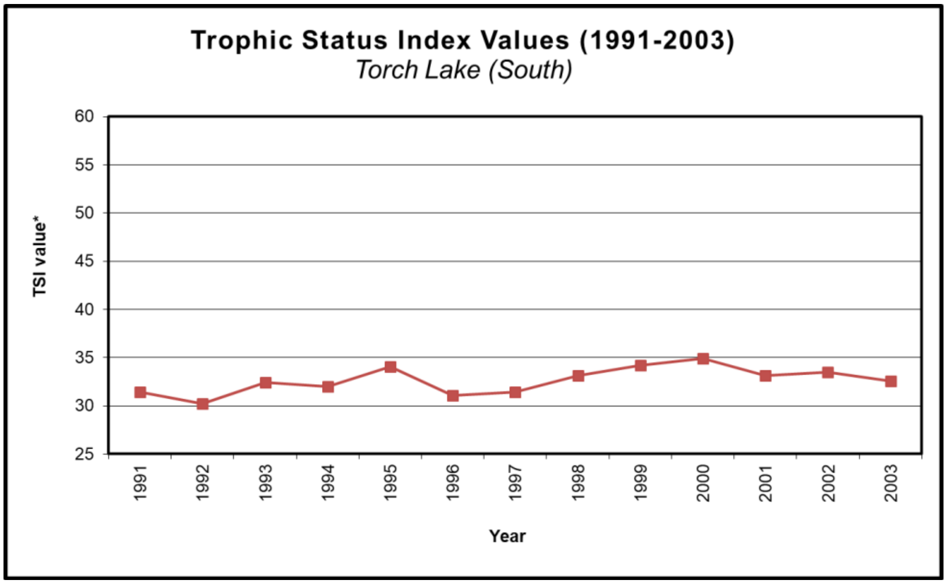


Figure 7 TSI value calculated from volunteer data at Tip of the Mitt Watershed Council

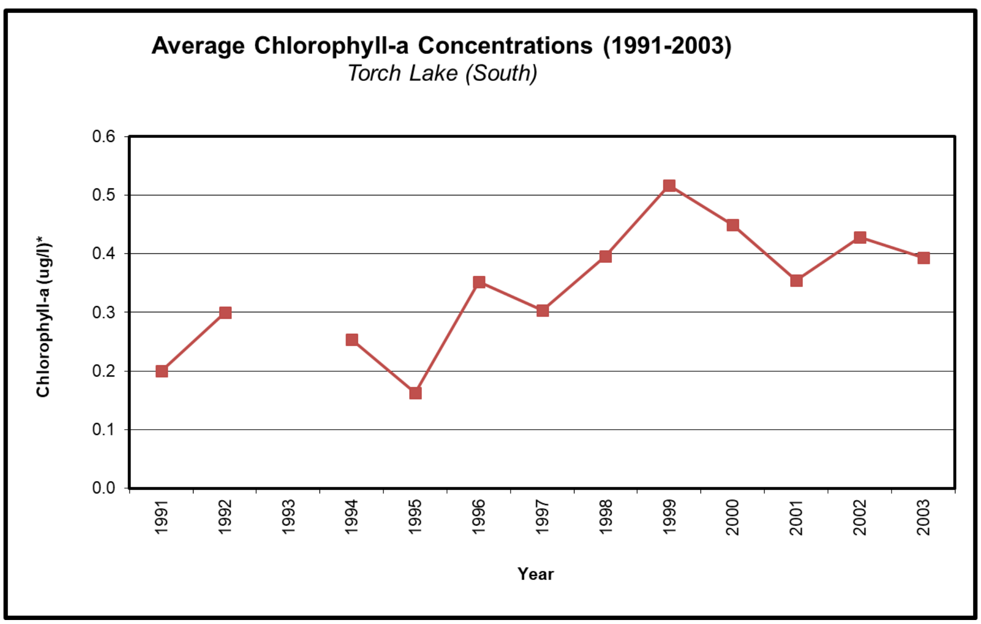
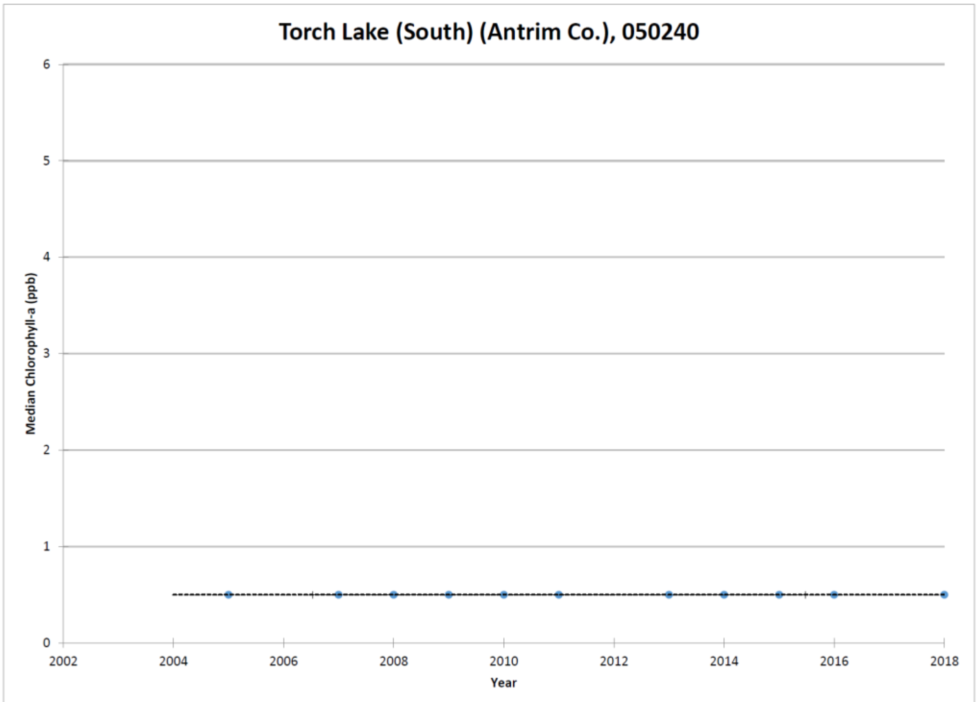


Figure 8 Average Chlorophyll-a concentrations collected by Torch Lake Volunteers, Tip of the Mitt Watershed Council

COOPERATIVE LAKES MONITORING PROGRAM
SUMMER MEDIAN CHLOROPHYLL-A



Vertical bars indicate standard deviation

Figure 9 Average Chlorophyll-a in Torch Lake, adapted from Cooperative Lakes Monitoring Program (CLMP), 2018 lake report.

SHORELINE SURVEY METHODS

Torch Lake was surveyed by kayak during June and July of 2017 to document shoreline conditions. Shoreline conditions were surveyed by traveling as close to the shoreline as possible (usually within 20 feet) and noting *Cladophora* growth, substrate type, erosion conditions, greenbelt length, greenbelt depth, and tributaries. All information was recorded on field data sheets and subsequently compiled into a database.

Parameters

Shoreline property features were documented by photographing and noting physical features on a data sheet. Developed parcels were noted on field data sheets and included as a separate column in the database. Properties described as developed indicate the presence of buildings or other permanent structures, including roadways, boat launching sites, and recreational properties (i.e., 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. The length and area of developed versus undeveloped shoreline was not calculated. After noting development status, *Cladophora* was identified in the area.

Many species of filamentous green algae are commonly found growing in the nearshore regions of lakes. Positive identification at the species level usually requires the aid of a microscope. However, *Cladophora* genus usually has a unique appearance and texture that is quite distinct to a trained surveyor. 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. 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 2 Categorization system for Cladophora density

Density Category	Field Notation	Substrate Coverage (%)
Very Light	(VL)	0 *
Light	(L)	1- 20
Light to Moderate	(LM)	21-40
Moderate	(M)	41-60
Moderate to Heavy	(MH)	61-80
Heavy	(H)	81-99
Very Heavy	(VH)	90-100 *

**Very Light is noted when a green shimmer is noticed on hard substrate, but no filamentous growth present. Very Heavy overlaps with heavy and is distinguished by high percentage of substrate coverage and long filamentous growth.*

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 along a shoreline parcel in terms of distance was not documented. Erosion conditions were similarly noted along each shoreline.

Erosion was noted based on shoreline areas that exhibited: areas of bare soil, leaning or downed trees, exposed tree roots, undercut banks, slumping hunks of sod, excessive deposits of sediments, or muddy water. Similar to *Cladophora*, shoreline erosion was recorded on field data sheets with extent and relative severity estimates (light, moderate, or heavy/severe). For example "Mx20" indicated 20 feet of shoreline with moderate erosion. Additional information about the nature of the erosion, such as potential causes, were also noted.

Minor: exposed soils, gullies up to 1" deep.
Moderate: exposed soils, gullies > 1" & < 6", banks undercut by <6", minor slumping.
Severe: exposed soils, gullies > 6", banks undercut by > 6", severe slumping, tree fall

Greenbelts were rated based on the relative length of shoreline with a greenbelt and the average depth of the greenbelt from the shoreline into the property. Ratings ranged from zero to four and were based on the following.

Length	0: None, 1: 1-10%, 2: 10-25%, 3: 25-75%, 4:>75%
Depth	0: None, 1: <10 ft, 2: 10-40 ft, 3: >40 ft

Greenbelt ratings for length and depth were summed to produce an overall greenbelt score.

Data Processing

Upon completion of surveying the entire Torch Lake shoreline, all field data were transferred to a Microsoft Excel® workbook. Digital photographs and GPS data were uploaded to a computer and processed for use. Linking field and equalization data allows shoreline conditions documented during the survey to be referenced by parcel identification number or parcel owner name. Field data were linked to Antrim County parcel data in a Geographic Information

System (GIS) with the aid of GPS and photographs.

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 department and a Torch Lake shoreline layer. The new map layer consists of a narrow band following the shoreline, split into polygons that contain field and equalization data. This data layer was overlaid with other GIS data from the State of Michigan to produce the maps contained in this report.

RESULTS

Following are results of the 2017 survey documenting shoreline conditions at 61 parcels on Torch Lake. Approximately 88% (1504) of shoreline properties on Torch Lake were considered developed.

Cladophora

Noticeable growths of *Cladophora* or other filamentous green algae were found along the shoreline at 666 parcels (39.1% of total parcels surveyed; Table 3). At properties where *Cladophora* growth was observed, 347 parcels consisted of light or very light growth. A majority of the patches exhibiting heavy *Cladophora* growth were located along the southeastern shore of Torch Lake (Figure 10).

Table 3 Cladophora density results

***Cladophora* Density**	**Parcels**	**Percent of total parcels (%)**
Very light	147	8.62
Light	200	11.73
Light to Moderate	73	4.28
Moderate	149	8.74
Moderate to Heavy	0	0
Heavy	85	4.98
Very Heavy	12	<1
Total	666	39.1

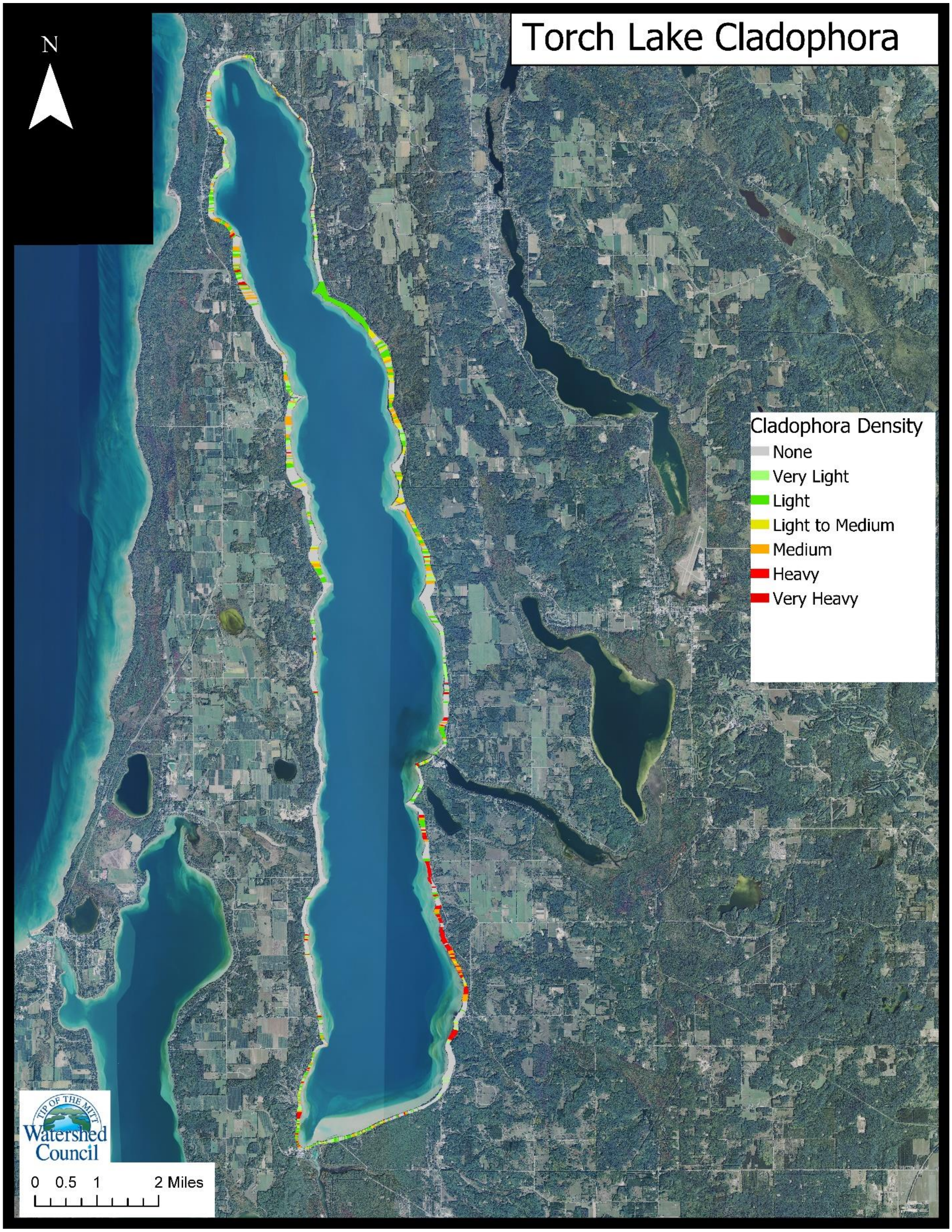


Figure 10 Cladophora presence around Torch Lake Shoreline

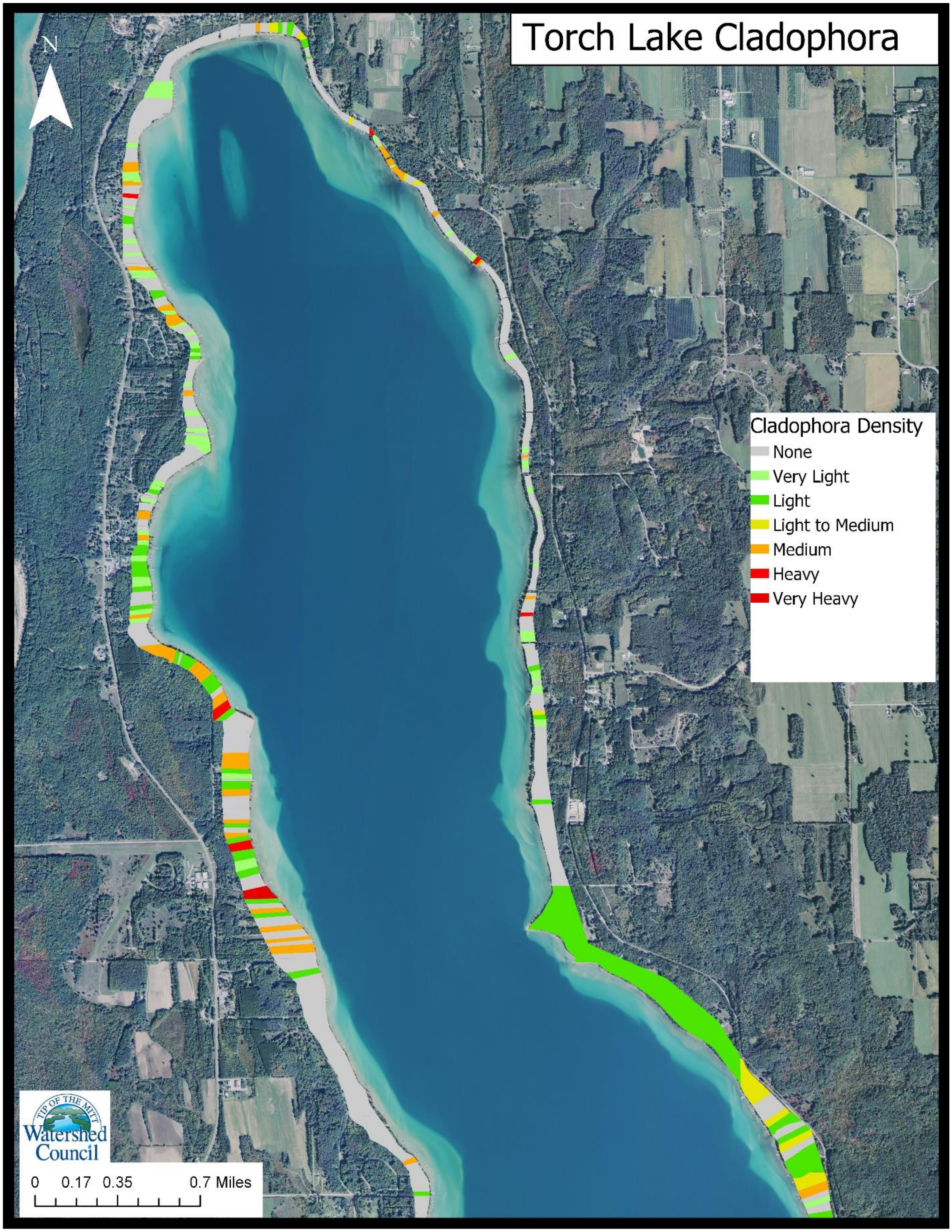


Figure 11 Cladophora presence North Torch Lake shoreline

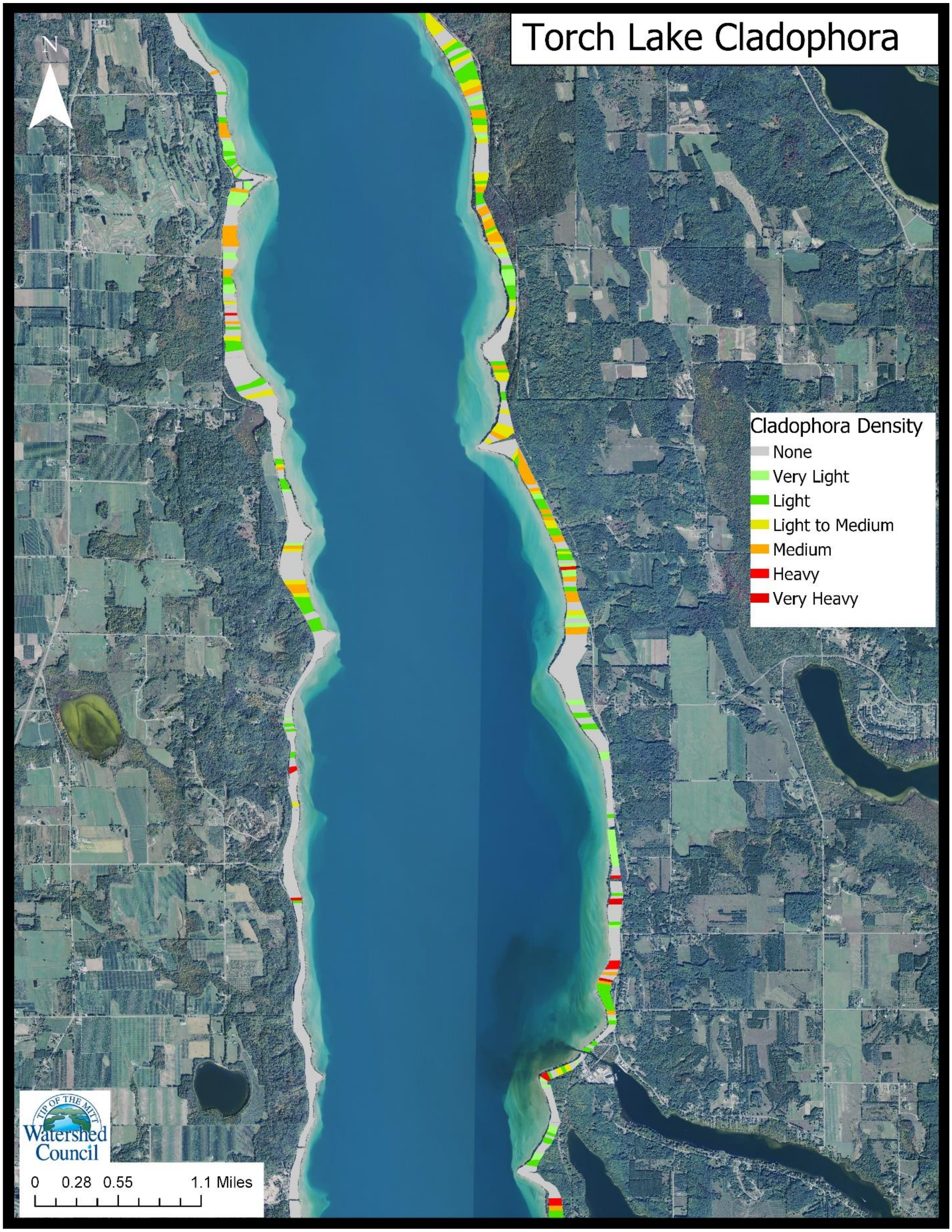


Figure 12 Cladophora presence central Torch Lake shoreline

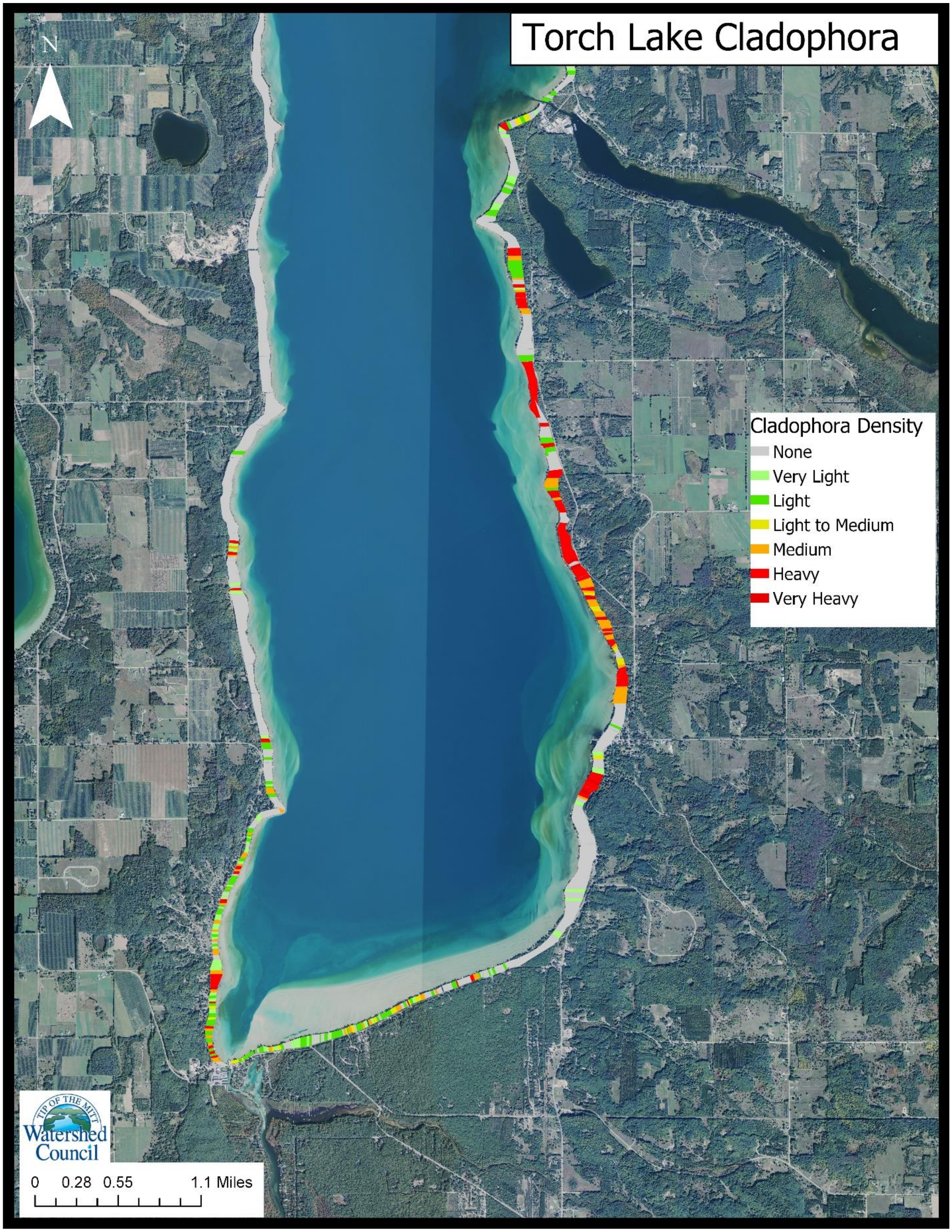


Figure 13 Cladophora presence southern Torch Lake shoreline

Greenbelt Scores

Greenbelt scores ranged from 0 (little to no greenbelt) to 7 (exemplary greenbelt) (Table 4). Torch Lake greenbelts were generally observed to be in moderate to good condition. Of 1,705 parcels surveyed, 1,155(67.7%) received a greenbelt rating in the moderate, good, or excellent categories.

Table 4 Greenbelt rating results

Greenbelt Rating		Number of Parcels	Percent (%)
0	Very Poor (absent)	337	19.8
1-2	Poor	213	12.5
3-4	Moderate	371	21.6
5-6	Good	612	35.9
7	Excellent	172	10.1

Clusters of properties along the northwestern and southern shoreline areas were ranked in the very poor (absent) to poor categories (Figure 14). Large parcels along the central eastern and western shorelines showed excellent, healthy greenbelts. Many of these areas were also largely undeveloped parcels of land.

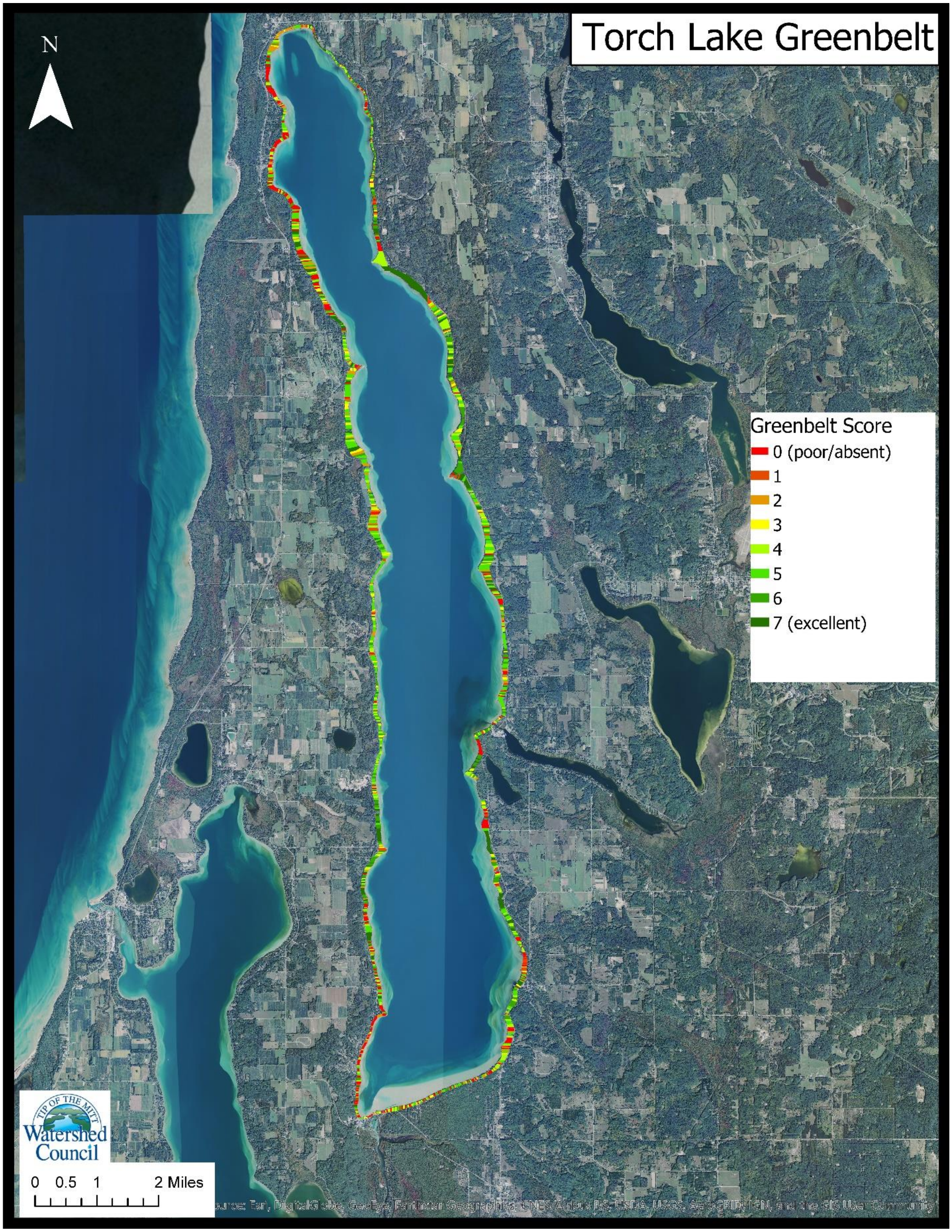


Figure 14 Greenbelt scores around Torch Lake shoreline

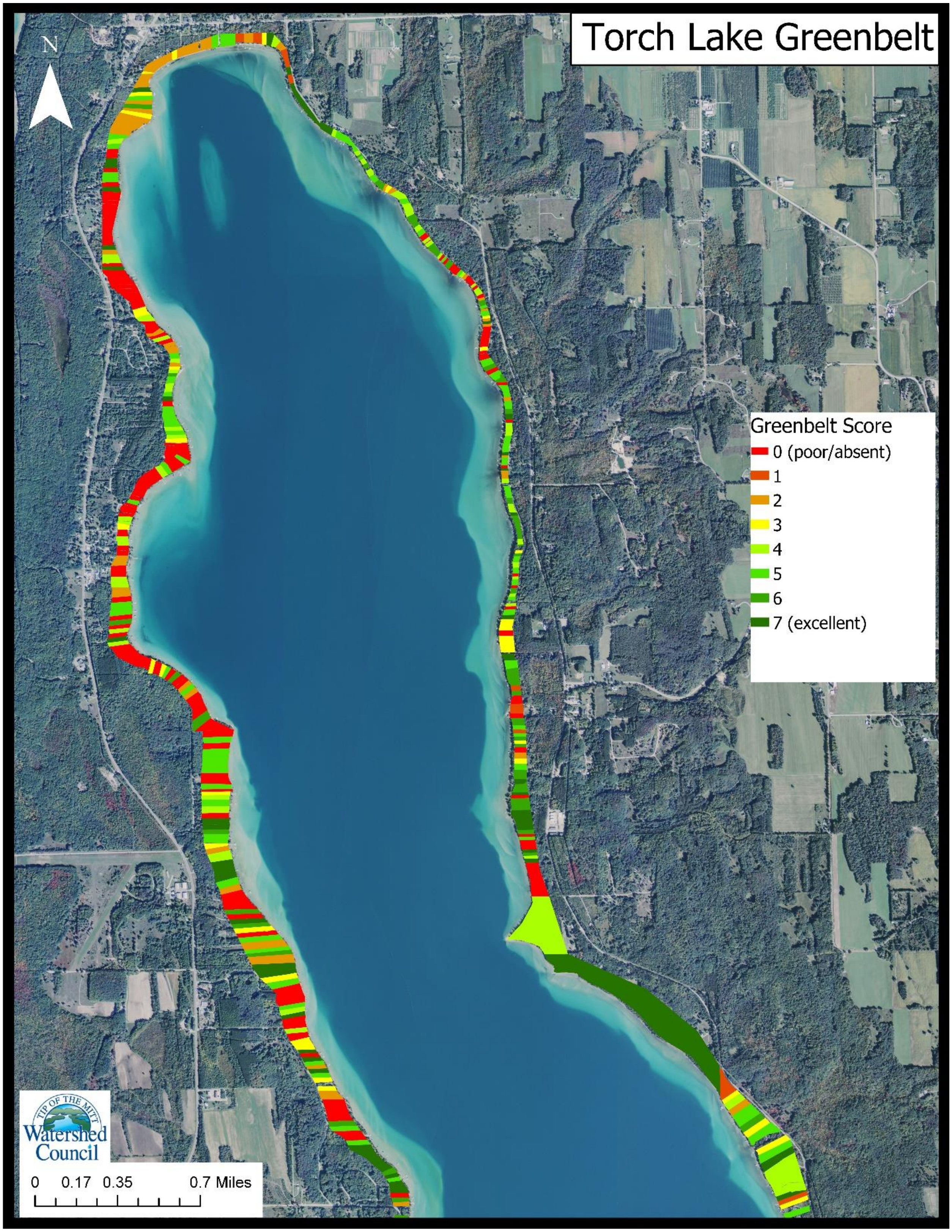


Figure 15 Greenbelt scores north Torch Lake shoreline

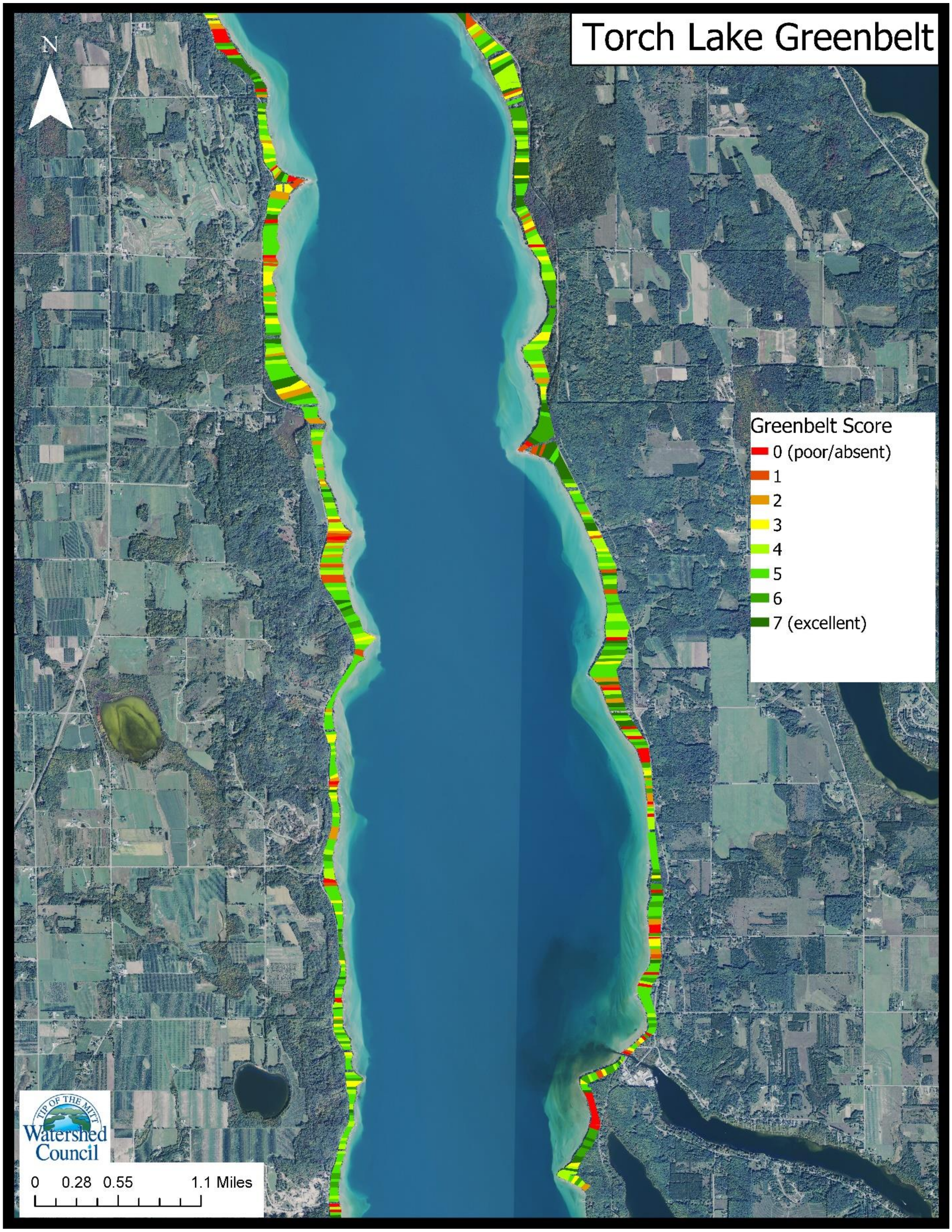


Figure 16 Greenbelt scores central Torch Lake shoreline

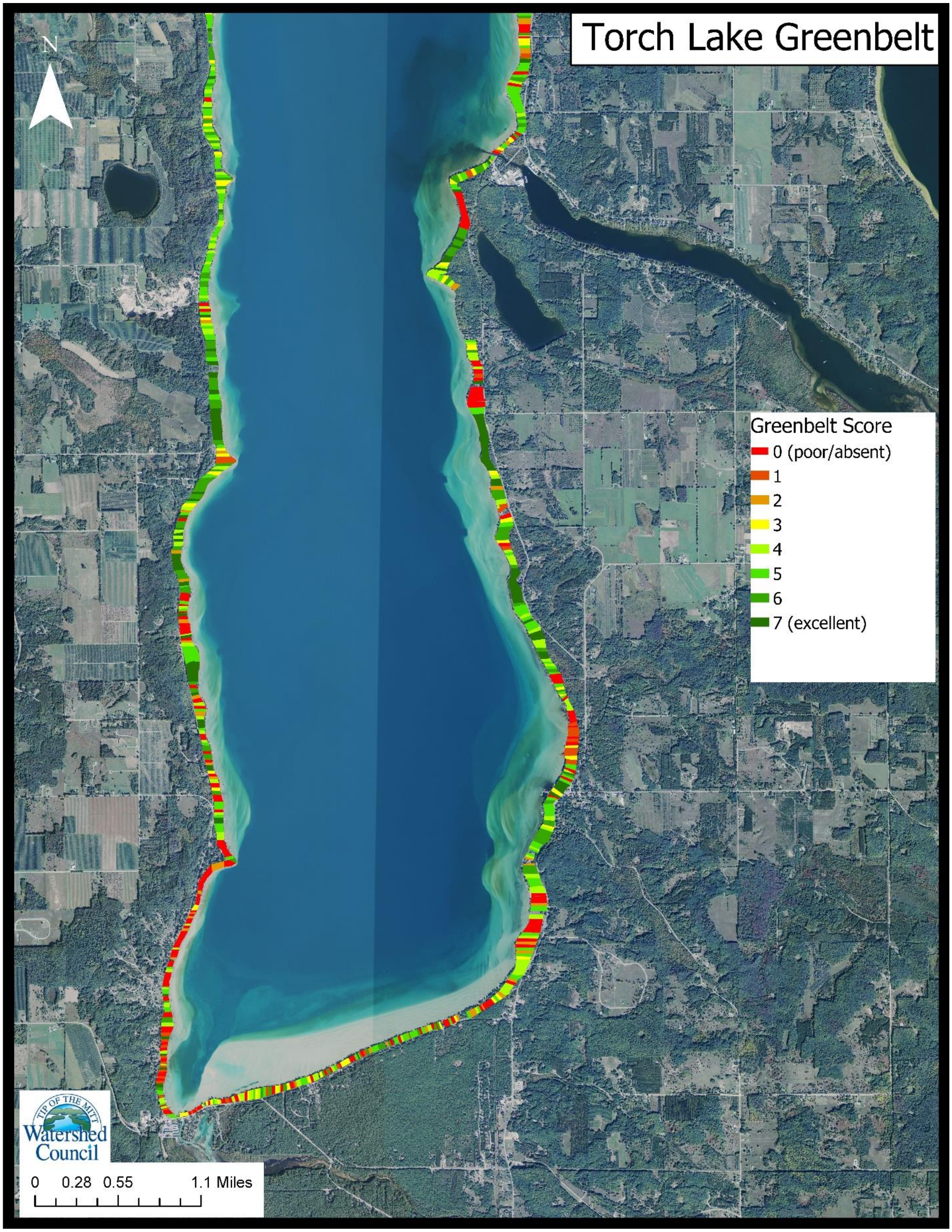


Figure 17 Greenbelt Scores southern Torch Lake shoreline

Erosion

Erosion was noted at 443 parcels (25.98%) on the Torch Lake shoreline (Table 5). Much of the erosion (24.57%) was classified as minor in terms of severity, while less than 2% of the total properties around Torch Lake were considered severe (Figure 13).

Table 5 Shoreline erosion severity results

Erosion Category	Number of Properties	Percent of Properties (%)
Light	348	20.4
Medium	71	4.2
Heavy	24	1.4
Total	**443**	**26**

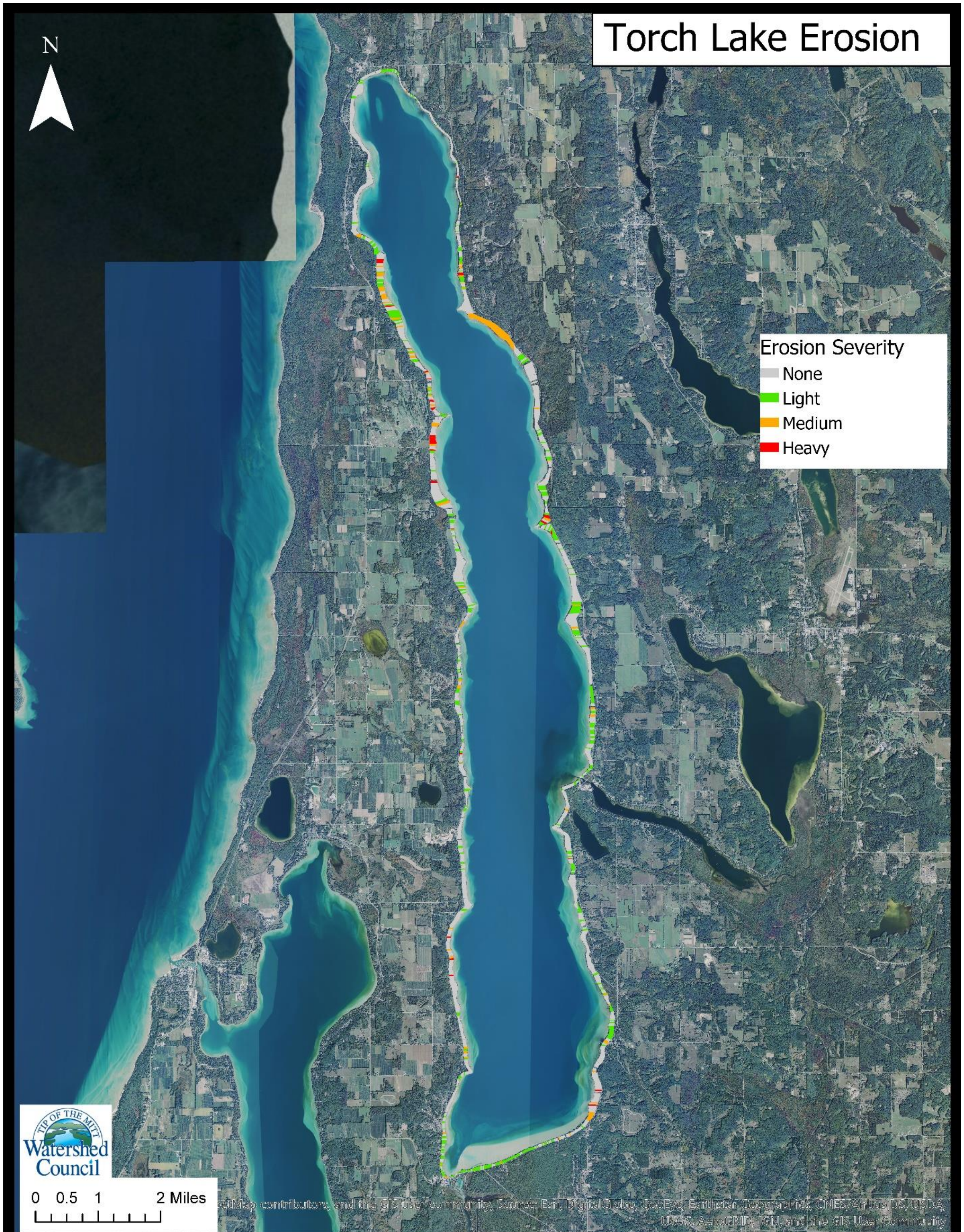


Figure 18 Erosion severity around Torch Lake shoreline

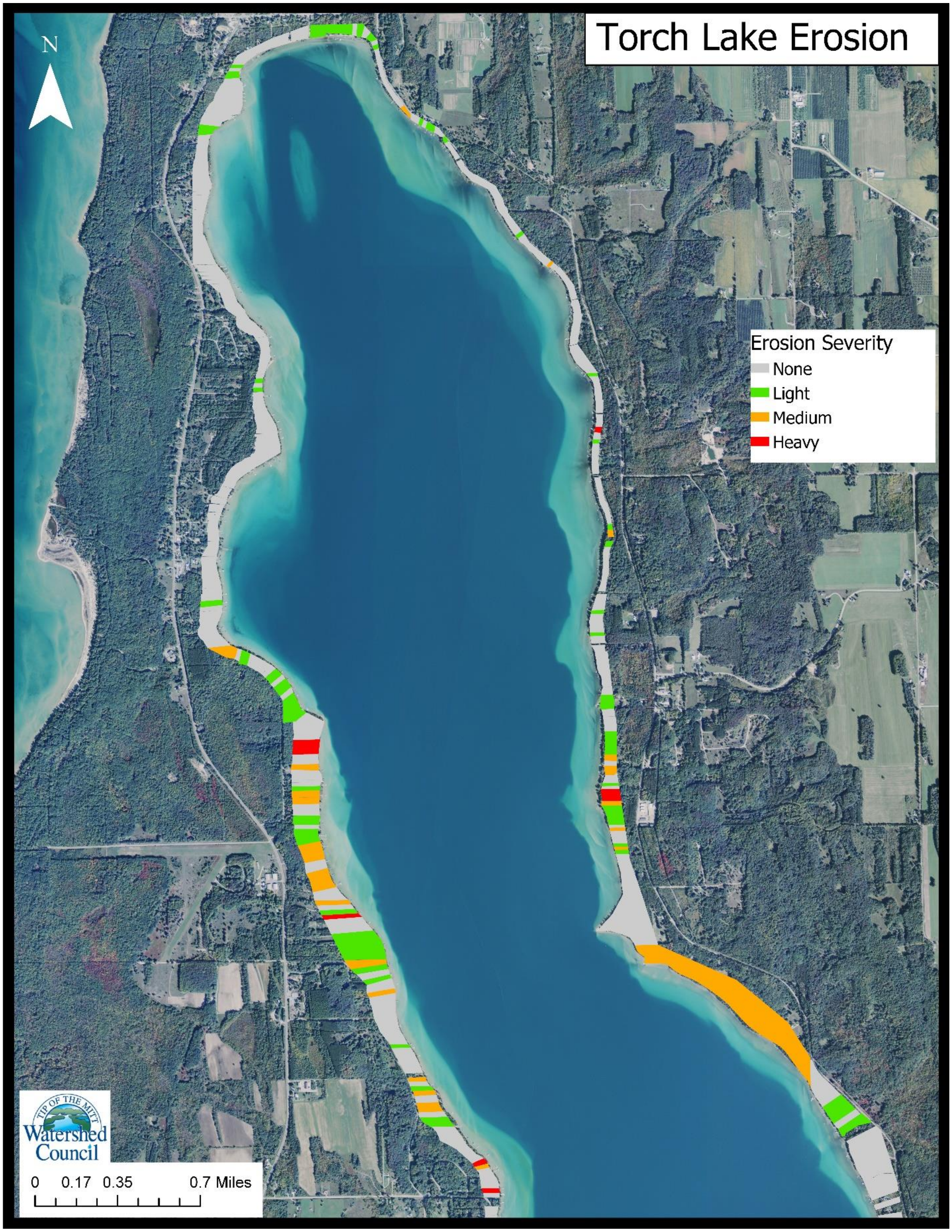


Figure 19 Erosion around north shoreline of Torch Lake

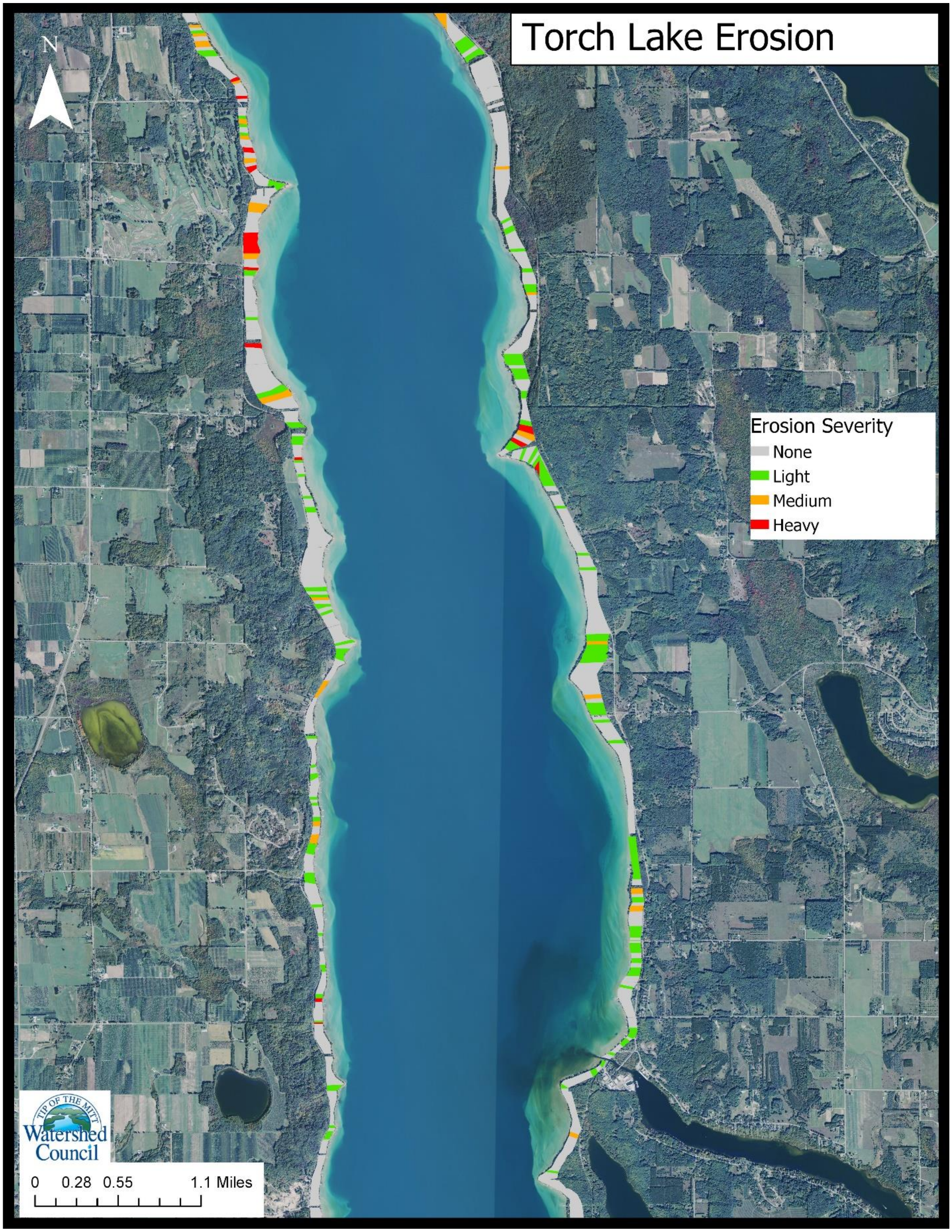


Figure 20 Erosion around central shoreline Torch Lake

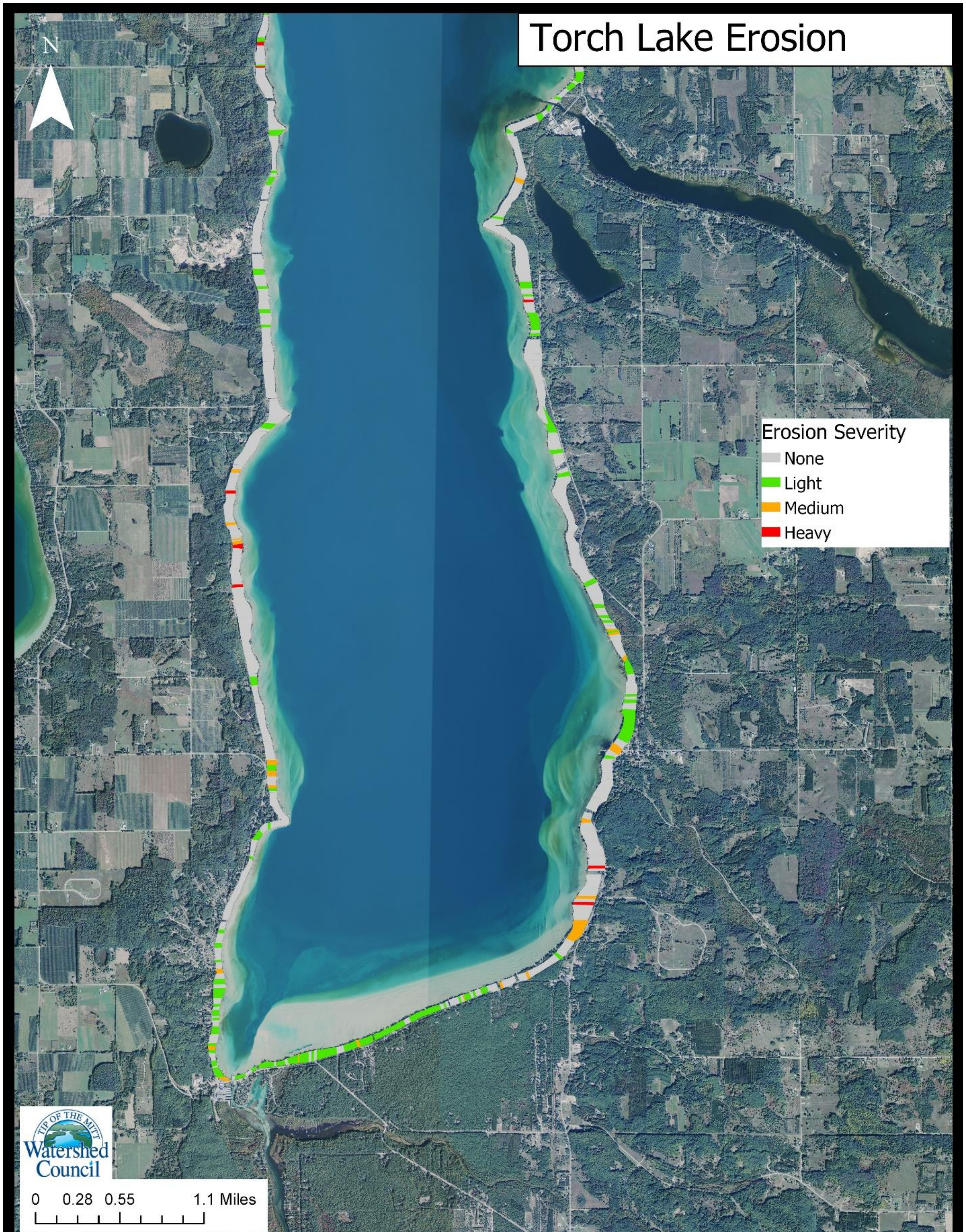


Figure 21 Erosion around southern shoreline, Torch Lake

DISCUSSION

In general, development of shoreline parcels can negatively impact a lake's water quality due to a multitude of factors. Among the most serious impacts to water quality include:

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.
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 eliminating impacts. Numerous best management practices have been developed that help minimize negative impacts to water quality and can be utilized during or after the development of shoreline parcels. A buffer of diverse, native plants can be planted/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.

A quick comparison with prior shoreline survey shows changes in these measurements over time. The total number of properties with poor greenbelts has decreased while erosion along the shoreline is similar to 2008. This is good news for the future of Torch Lake. Outreach regarding septic system maintenance, phasing out of old systems, and properly siting new systems may help play a role in preventing other potential issues, such as nutrient pollution related to septic systems. Where human-caused nutrient pollution is occurring, the source has to be identified in order to address the problem. Although impeded by factors such as wind, wave action, currents, and groundwater paths, efforts by trained personnel to identify specific nutrient input sources on individual properties are often successful.

Table 6 Critical shoreline survey parameter comparisons: 2008 to 2016.

Survey Parameter	**2008 Survey Results**		**2017 Survey Results**	
	Properties	%	Properties	%
Cladophora Algae Presence	ND	ND	666	39.1
Poor Greenbelts (score 0-2)	771	44	550	32.2
Erosion	455	26	443	26

Results from the 2017 shoreline survey indicate that some of the aforementioned issues may pose a threat to the water quality and overall health of Torch Lake. The lack of native vegetation at water's edge with potential septic leakage for some parcels might be the greatest threat to Torch Lake. Removal of shoreline vegetation and *Cladophora* presence are highlights as the main concerns. Erosion was less of a concern around the lake. Fortunately, wetland and forested areas surrounding Torch Lake are remain largely intact. The easiest, and perhaps most beneficial way to improve Torch Lake shoreline to defend water quality would be to have native vegetation at water's edge.

A lack of vegetation on the lake's shoreline, which provides habitat and acts as a food source, can impact the abundance and diversity of aquatic organisms, ranging from minute crustaceans to top tier predator fish. Furthermore, the absence of vegetation can lead to increased shoreline erosion and less filtration of nutrients and pollutants. Properties with healthy, intact greenbelts provide a model for improvement for other shoreline properties (Table 7).

Many properties with patches of lawn at water's edge experience a minor undercutting caused by waves and ice shove. Properties with artificial beach sand usually experience some loss of sand into the Lake, evidenced by small erosional rills leading into the Lake. Although not catastrophic, these types of minor erosion collectively do have the ability to degrade the water and habitat quality of Torch Lake. To prevent changes to the lake ecosystem, changes should be made in shoreline property management. Mismanagement of shoreline properties can degrade the lake's water quality, diminish fisheries, and even create an environment that poses threats to human health.

Table 7 Shore survey statistics from Northern Michigan lakes

Lake Name	Survey Date	*Cladophora**	Heavy Algae*	Erosion*	Poor Greenbelts*	Alterations*
Beals Lake	2016	0%	0%	0%	17%	0%
Ben-Way Lake	2016	3%	0%	84%	47%	40%
Burt Lake	2009	47%	29%	4%	36%	46%
Bellaire Lake	2017	35%	1%	27%	30%	55%
Charlevoix, Lake	2012	22%	19%	14%	34%	79%
Clam Lake	2017	48%	5%	30%	51%	55%
Crooked Lake	2012	29%	26%	14%	51%	65%
Douglas Lake	2015	27%	6%	17%	53%	60%
Elk Lake	2017	84%	2%	52%	30%	87%
Ellsworth Lake	2016	40%	14%	38%	24%	23%
Hanley Lake	2016	11%	0%	33%	19%	23%
Huffman Lake	2015	14%	0%	7%	57%	70%
Huron, Duncan Bay	2013	41%	2%	19%	45%	63%
Huron, Grass Bay	2013	0%	0%	4%	0%	8%
Intermediate Lake	2016	19%	9%	53%	63%	77%
Lance Lake	2014	19%	0%	12%	35%	31%
Larks Lake	2006	4%	0%	ND	12%	29%
Mullett Lake	2016	44%	6%	36%	59%	76%
Pickerel Lake	2012	27%	33%	15%	52%	64%
Round Lake	2014	21%	0%	27%	44%	44%
Scotts Lake	2016	0%	0%	2%	18%	7%
Silver Lake	2014	3%	0%	70%	53%	65%
Skegemog Lake	2017	52%	5%	40%	46%	76%
St. Clair Lake	2016	4%	0%	13%	34%	21%
Six Mile Lake	2016	10%	24%	13%	41%	37%
Thayer Lake	2017	11%	1%	32%	16%	22%
Thumb Lake	2007	4%	0%	ND	ND	39%
Torch Lake	2017	39%	5%	26%	20%	ND
Walloon Lake	2016	62%	2%	17%	39%	80%
Wildwood Lake	2014	5%	0%	22%	45%	50%
Wilson	2016	27%	5%	29%	11%	14%
AVERAGE	NA	24%	6%	26%	36%	47%

**Percentages are in relation to number of parcels on the lake shore, except for "heavy algae", which is the percent of only parcels that had Cladophora growth. Erosion is the percentage of parcels with moderate to severe erosion and poor greenbelts include those in the poor or very poor categories. ND=no data.*

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. Send a <u>general</u> summary of the survey results to all shoreline residents.
3. Organize and sponsor an informational session to present findings of the survey to shoreline residents and provide ideas and options for improving shoreline management practices that would help protect and improve the Lake's water quality.
4. Inform owners of properties with heavy *Cladophora* growths of specific results for their property, ask them to fill out a questionnaire in an attempt to interpret causes of the growth, and offer individualized recommendations for water quality protection.
5. Inform owners of properties with poor greenbelt scores and those with severely eroded shorelines of specific results for their property. Supply these property owners with information (e.g., brochures) regarding the benefits of greenbelts and/or the problems associated with erosion. Encourage property owners to improve greenbelts using a mix of native plants and to correct erosion problems. Property owners can contact the Watershed Council for more information on how to improve greenbelts and/or correct erosion problems.
6. Utilize the Internet and other organizations' websites to share survey information. A general summary report and this detailed report can be posted on websites because they do not contain any property-specific information. Property-specific information can be shared by randomizing and encrypting the shoreline survey database and providing property owners with a code number that refers specifically to survey results from their property. The Watershed Council is available to assist with this approach.
7. 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.

These data are also provided to State agencies (EGLE, EPA). Lake residents are encouraged to continue supplying volunteer help and volunteers should attend training sessions held by the Watershed Council to ensure that a complete set of quality data is being collected each year.

8. Repeat some version of the survey periodically (ideally every 5 - 10 years), coupled with the follow-up activities described previously, in order to promote water quality awareness and good management practices on an ongoing basis. During each subsequent survey, more details about shoreline features are added to the database, which can be utilized for other water resource management applications.
9. The Michigan Natural Shoreline Partnership has developed a new educational tool called the Michigan Shoreland Stewards Program, which is a voluntary web-based survey designed to educate shoreline property owners on the importance of lake-friendly management practices. The survey asks questions related to management practices in each of the four sections of a shoreland property: upland, buffer, shoreline and lake. Responses to the questions are rated to determine the shoreland steward recognition level. A gold, silver, bronze or starter level rating can be achieved. Encourage Torch Lake residents to visit www.mishorelandstewards.org to take the survey.

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