

Munro Lake Shoreline Survey 2014

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Introduction:

The past decades have brought with them an increase in population density across northern Michigan. There are thousands cottages and homes along northern lakes and rivers, with many families moving to spend their summers across the upper edge of the Lower Peninsula. An influx of tourism and summer homes (as well as a continued presence of year round residents) has led to the development of conservation and resource management questions regarding the use of Michigan's beautiful northern landscape. Most inland lakes are now heavily built up, leaving only spaces with state or federally owned land clear of development. As vacationers, beachgoers and locals continue to expect clean and clear inland lakes and waterways, management tools must be put in place in order to maintain the health of Michigan's aquatic ecosystems.

As human development and population density continues to increase around inland lakes, more attention is being paid to the shoreline habitats of lakes and rivers. Riparian zones (areas of terrestrial habitat that impact aquatic ecosystems) serve as critical interfaces between terrestrial and aquatic habitats, particularly in developed regions. Within the riparian zone, the vegetation immediately lining the shoreline is known as the greenbelt, an area that helps create a buffer from terrestrial pollution and erosion by catching and filtering runoff before reaching the waterway. Greenbelts are more effective when they are made up of a diverse variety of herbaceous and woody plants (Blumbergs, et al, 2013); however shoreline biodiversity is often lost during development (creation of beaches, building of permanent docks and structures, planting of tuff grass, etc.).

Degradation and modification of shoreline greenbelt can have lasting impacts on the health of aquatic ecosystems. Erosion can cause excess sediment to build up in the water column, absorbing light and raising water temperatures. Such changes in temperature can disrupt fish spawning and the lifecycles of other animals by filling in natural habitat along the lakebed and shoreline (K. Cronk, 2009). In addition, nutrients can adhere to sediments suspended in the water column, leading to an increase in primary production, algal blooms and eventual die offs (K. Cronk, 2009). Shorelines lacking sufficient greenbelts are at risk of excessive nutrient runoff from surrounding lawns, roadways, septic systems etc. Without a buffer preventing pollutants from running into the waterway, the amount of phosphorous, nitrogen and other limiting nutrients are dumped into the system, often resulting in mass algal blooms and other excessive plant growth.

In the following study, a shoreline survey of Munro Lake was conducted on behalf of The Tip of the Mitt Watershed Council, an organization working to preserve and restore the quality of northern Michigan waterways through community education and outreach. A shallow, inland lake, Munro Lake is located in Cheboygan County, Michigan. Half of the lake's shoreline consists of state forest land operated by the Michigan Department of Natural Resources (MDNR), with the remaining south end of the lake dominated primarily by private development. This survey consists of individual assessment of every property along the shoreline following parameters outlined by the Tip of the Mitt, with the goal of determining greenbelt health ratings for each riparian parcel.

After initial assessment of all criteria outlined in Tip of the Mitt's survey, four indicators of relative greenbelt effectiveness and health were chosen to be discussed in further detail: overall greenbelt score, relative amount of noted shoreline erosion, the presence of *Cladophora* algae and available *Cladophora* habitat. *Cladophora*, a type of filamentous green algae, is often an indicator of excessive nutrient runoff from fertilizer or sewage drainage. Combined with observable erosion along the shoreline, the presence of *Cladophora* gives surveyors a better sense of greenbelt quality per parcel. In the end, the greenbelt score of each property will provide Tip of the Mitt with necessary information regarding whether or not to contact certain property owners in attempt to encourage private shoreline restoration and preservation.

Methods:

A shoreline survey of Munro Lake in Cheboygan County, Michigan was conducted in July, 2014. Each of the 127 parcels of shoreline property were surveyed from a canoe, traveling within 15 feet of the shoreline and recording qualitative data. Parcels were divided and distinguished by use of GPS maps overlaid with property lines from the Tip of the Mitt Watershed Council. The following criteria were surveyed and rated based on guidelines established by The Tip of the Mitt Watershed Council: property description, development, *Cladophora* growth and habitat, composition of substrate, altered shoreline habitat, erosion, greenbelt length, greenbelt depth, and the presence of wetlands and streams (Tip of the Mitt). Finally, a GPS camera was used to photograph each property.

Parcels were considered developed (Y=yes, N=no, P=partial) if permanent structures were present. Examples of permanent structures include buildings, paved roads, parking lots, boat launches, and pavilions. Undeveloped parcels include cleared land (ex. lawns), seasonal structures (such as campers or RV's), and unpaved roadways. Parcels were considered partially developed when a large percentage of the parcel was made up of natural, undeveloped habitat with one or more permanent structures present.

Cladophora density was estimated based on the amount of algae observed as each parcel. After density was assessed, the length of the affected shoreline was estimated and recorded as level x length (e.g. MX25 ft.) Table 1 details the parameters used to determine relative levels.

Category	Density
Very Light (VL)	A green shimmer
Light (L)	Up to 25% coverage (small bits of filamentous growth)
Light to Moderate (LM)	25-49% coverage
Moderate (M)	50-59% coverage
Moderate to Heavy (MH)	60-64% coverage (substrate mostly covered)
Heavy (H)	75-99% coverage (substrate entirely covered)
Very Heavy (VH)	100% coverage (long filamentous growth: shaggy)

Table 1-Levels of Cladophora Density

*Parameters provided by the Tip of the Mitt Watershed Council

Substrate composition in each property was identified according to the following categories:

- M = Muck, a dark, soft or marl bottom
- S = Sand
- G = Gravel (0.1" to 2.5" diameter)
- R = Rocks (2.5" to 10" diameter)
- B = Boulders (greater than 10" diameter)
- W = Woody debris (logs, sticks, etc.)

Of these categories, gravel, rocks, boulders and woody debris are the only substrates on which *Cladophora* can persist. *Cladophora* habitat was then determined (yes or no) based on the presence of such substrates.

Observed anthropogenic alterations were identified based on the following categories:

- SB = steel bulkhead (i.e. seawall)
- CB = concrete bulkhead
- WB = wood bulkhead
- BH = permanent boathouse
- G = groin (extending into water to break waves)
- BB = boulder bulkhead
- RR = rock rip-rap
- BS = beach sand
- DP = discharge pipe

Relative shoreline erosion was categorized as light (L), moderate (M), or heavy (H) based on the observation and severity of erosional indicators: areas of bare soil on steep banks, undercut banks,

leaning or downed trees, excessive sediment deposits, etc. After categorization, the length of the eroding shoreline was estimated and recorded as level x length (e.g. "MX25 ft." which indicates "moderate erosion for 25 feet").

Greenbelt length and depth ratings were assigned based on parameters defined in Tables 2 and 3. Measurements of greenbelt length and depth were subjective and based on observations of vegetation. Overall greenbelt scores were assigned to each parcel by adding greenbelt length scores to greenbelt depth scores. Scores were ranked as follows: 0 = Very Poor, 1-2 = Poor, 3-4 = Good, 5-6 = Good, 7 = Excellent.

Greenbelt Length Rating	Greenbelt Length Description
0	No vegetation present along shoreline
1	<10% of shoreline has vegetation present
2	10-25% of shoreline has vegetation present
3	25-75% of shoreline has vegetation present
4	>75% of shoreline has vegetation present

Table 2--Ratings for Greenbelt Length
 *Standards provided by Tip of the Mitt Watershed Council

Greenbelt Depth Rating	Greenbelt Depth Description
0	No vegetation present deeper in property
1	<10 ft vegetation present deeper in property
2	10-40 ft vegetation present deeper in property
3	>40 ft vegetation present deeper in property

Table 3--Ratings for Greenbelt Depth
 *Standards provided by Tip of the Mitt Watershed Council

After completion of the survey, all field data collected was transferred to a spreadsheet in Microsoft Excel. The GPS photographs taken at each property were cross checked with property descriptions and then labeled in the following fashion: MunroLake_ShorelineSurvey2014_Property#_Photo#. (For example, the second photo taken of parcel 35 would be labeled as: MunroLake_ShorelineSurvey2014_0035_02.) Maps of erosion, *Cladophora* presence / habitat and overall greenbelt scores were created using ArcMap 10.0. These particular criteria were chosen to map as they are key indicators of shoreline health and development, and results varied across 127 Munro Lake property parcels.

Results:

Property along the shoreline of Munro Lake consisted of 127 parcels. Total parcel lengths varied from 1800 ft (or about 1/3 of a mile) to less than 20 ft. 90 of 127 (70.87%) parcels were privately owned and either fully or partially developed. The remaining 37 plots were classified as undeveloped as they are managed by Michigan’s Department of Natural Resources.

Greenbelt scores tended to be higher in undeveloped parcels and lower in developed parcels. A majority of the high greenbelt scores were found on large, undeveloped parcels where the natural habitat was maintained. Parcels with lower greenbelt scores tended to be located along the eastern shore of Lake Munro (see Figure 1).

Greenbelt Score/Rating	Number of Parcels	Percent of Parcels
0 = Very Poor (absent)	2	1.57%
1-2 = Poor	41	32.28%
3-4 = Moderate	34	26.77%
5-6 = Good	18	14.17%
7 = Excellent	32	25.20%
TOTAL	127	100%

Table 4--Greenbelt score statistics

The majority of parcels with heavy amounts of erosion occurred along the northern shore of Munro Lake (see Figure 2). However, the most parcels had erosion ratings light, medium, or none (44.09%, 21.26% and 21.26%; see Table 6).

Alteration Type	Number of Parcels	Percent of Parcels
Concrete bulkhead	4	3.15 %
Wood bulkhead	3	2.36 %
Groin (extending into water to break waves)	4	3.15 %
Boulder bulkhead	24	18.90 %
Rock riprap	49	38.58 %
Beach sand	14	11.02 %
Drain pipe	5	3.94 %
Other*	5	3.94 %

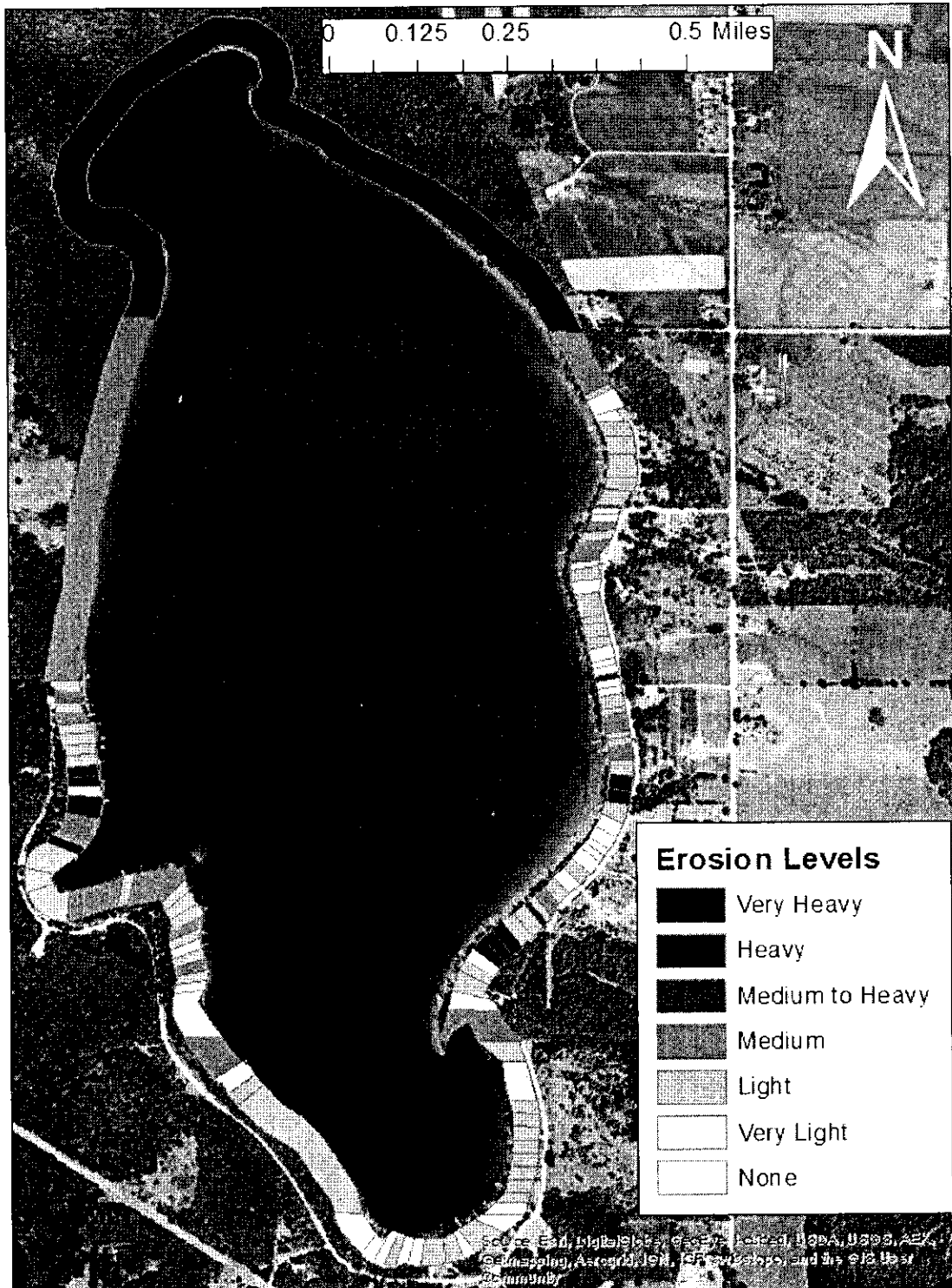
Table 5--Shoreline alteration statistics

*Other includes groin, boat ramp, concrete ramp, tarps and pumps. Properties may contain multiple alterations.

Erosion Level	Number of Parcels	Percent of Parcels
Very Heavy	3	2.36 %
Heavy	6	4.72 %
Medium to Heavy	1	0.80 %
Medium	27	21.26 %
Medium to Light	0	0 %
Light	56	44.09 %
Very Light	7	5.51 %
None	27	21.26 %
Total	127	100 %

Table 6--Erosion statistics

Munro Lake Erosion Levels



Projection: Lambert Conformal Conic Source: Tip of the Mitt Watershed Council
Shelly Gleason, Kate Laramie, Darbi O'Brien, Catrina Smith

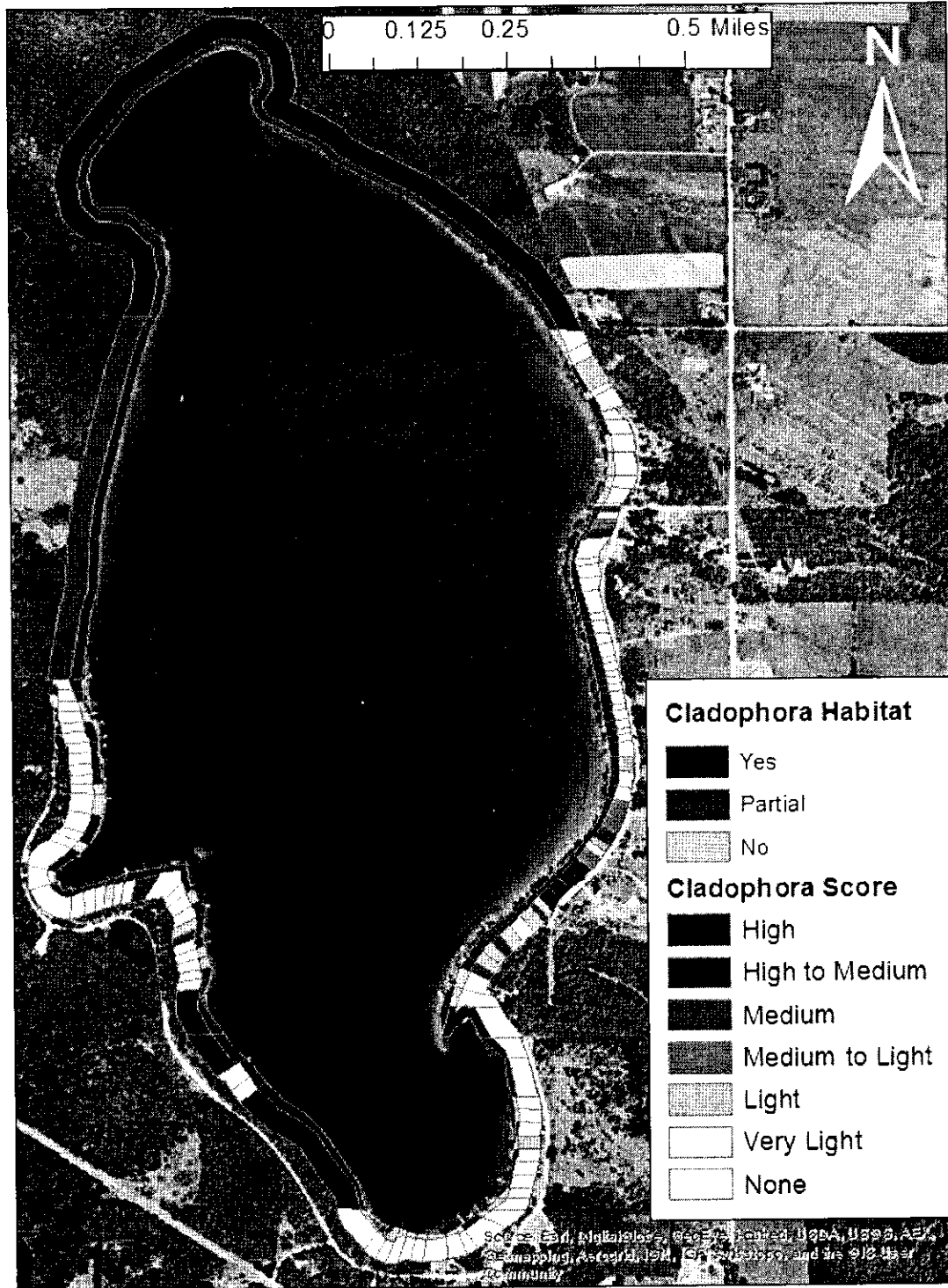
Figure 2--Erosion rating per parcel

Parcels with hard or rough substrates, such as rocks, boulders or woody debris, provide habitats for *Cladophora* to grow. Of the 127 parcels, 79 were noted as habitats suitable for *Cladophora* growth (62.20%), however *Cladophora* was only found to be present at 48 of 127 parcels (37.80%). Of these, the majority of *Cladophora* density levels were rated as either very light or light (33.33% and 22.92%, respectively; see Table 7).

Cladophora Density	Parcels	Percent
Very Light	16	33.33 %
Light	11	22.92 %
Light to Moderate	4	8.33 %
Moderate	9	18.75 %
Moderate to Heavy	2	4.17 %
Heavy	6	12.50 %
TOTAL	48	100.00 %

Table 7--Cladophora density statistics from properties where Cladophora was present.

Munro Lake Cladophora Score



Projection: Lambert Conformal Conic Source: Tip of the Mitt Watershed Council
 Shelly Gleason, Kate Laramie, Darbi O'Brien, Catrina Smith

Figure 3—Cladophora rating and habitat.

*Parcels labeled as “yes” for Cladophora habitat are areas in which there is potential for Cladophora growth.

Discussion:

Of all the parcels surveyed along the shoreline of Munro Lake, more than half of the total properties were given an overall greenbelt rating of moderate, good, or excellent (see Table 4). There is a considerable amount of undeveloped (often state owned) land on Munro Lake (see Figure 1), therefore this high range of ratings for a good portion of the properties assessed is understandable. Commonly, undeveloped land is naturally forested and rarely maintained with little or no alterations made to the shoreline. Such natural habitat provides a greenbelt rich in various types of vegetation, leading to an aquatic environment effectively protected from terrestrial runoff.

Interestingly, however, it was found that *Cladophora* levels were often higher at or near undeveloped parcels (see Figure 3). *Cladophora* is often an indicator of terrestrial nutrient runoff into an aquatic system; therefore it is surprising to see higher densities around areas that have well established greenbelts. It should be noted, however, that *Cladophora* is a form of algae that is only able to grow on hard substrate (see Figure 3). Higher greenbelt ratings indicate the presence of diverse vegetation such as shrubs and trees, and as the shoreline of undeveloped land is usually left with little or no anthropogenic maintenance, considerable woody debris is often found along the shore and in the water. With the availability of down trees and branches providing suitable *Cladophora* habitat, it is reasonable to see higher levels of *Cladophora* in the same areas with noted moderate to excellent greenbelt ratings.

In addition, while the presence of a well-established greenbelt aids in prevention of nutrient runoff into waterways, it is important to consider the natural levels of nutrients such as phosphorous and carbon that are coming into the lake from the surrounding terrestrial environment. Undeveloped areas where shoreline vegetation meets the water are providing a certain amount of nutrients to the freshwater system. In order to determine the relative amount of natural nutrients coming into the system from the surrounding riparian zone, however, further chemical analysis of Munro Lake would need to be completed. That said, it is important to recognize that overall, the presence of observed *Cladophora* along the shoreline of Munro Lake was relatively low (see Table 7). *Cladophora* was only found on 48 of the 127 parcels, with the majority of *Cladophora* densities for such parcels ranked as either very light (16 parcels) or light (11 parcels).

The highest levels of erosion were often noted along the shorelines of undeveloped parcels as well. Shoreline erosion is one process that will dump large amounts of woody debris into a water way, further establishing a habitat for *Cladophora* on undeveloped parcels of land. The lowest erosional ratings coincided with certain types of alterations made to the shoreline—namely the presence of rock riprap or boulder bulkheads (38.58% and 18.90%; see Table 5). Similar to *Cladophora* ratings, of the 127 parcels surveyed, the majority were rated as having only medium, light, or no erosion along the shoreline.

Recommendations:

It is recommended that Tip of the Mitt contact the owners of properties that received a score of two or less in overall greenbelt rating. The majority of these low ratings occur along the eastern shoreline of Munro Lake, an area in which there is a high density of homes. In order to boost greenbelt ratings, property owners could plant shoreline vegetation, trees and shrubs, in effect building a buffer between the edge of the lake and any maintained lawn/turf grass. Efforts to improve greenbelts along the entire shore of the lake may be bolstered by encouraging property owners (particularly those with little land and structures in close proximity to others) to work with their neighbors in order to establish a more continuous natural shoreline.

Cladophora ratings could be improved along undeveloped or partially developed properties by removing/cleaning up woody debris. That said, the presence of *Cladophora* is simply an indicator of higher nutrient input; if nutrient runoff is not believed to be an issue in the area, the presence of *Cladophora* itself is not necessarily negative. The presence of heavy *Cladophora* is more notable along the shoreline of parcels with low greenbelt ratings, as there is the greater possibility of anthropogenic nutrient runoff. It is recommended, therefore, that parcel owners only be contacted regarding *Cladophora* levels if it appears that excessive nutrient runoff could be resulting from the practices they employ on their property (grass fertilization, broken septic system, etc.). This is particularly true if the property has already been given a low greenbelt rating and there is no terrestrial buffer between lawn and shore.

As excessive sediment deposition can have a drastic effect on aquatic systems, erosional prevention is an important part of maintaining lake health. While developed properties often lack well-established greenbelts, many have built structures that significantly decrease shoreline erosion (such as riprap walls). It is recommended that homeowners be encouraged to construct some sort of barrier to protect against erosion, particularly along shorelines where turf grass/lawn is simply meeting the edge of the lake.

This said, protecting shorelines from erosion by building man-made structures (sea walls, riprap, etc.) may be controversial along stretches of natural shoreline. In the case of Munro Lake along which there are large stretches of natural, state owned land, there are many areas where trees and woody debris are eroding into the lake. It is recommended that further study be done of sediment deposition and suspension in Munro Lake if there is concern over the shoreline erosion that is occurring along stretches of land that are not developed.

Based on the data obtained from the 2014 shoreline survey of Munro Lake, the conclusion of this report is that outreach is needed to work with certain property owners to boost greenbelt rating and prevent shoreline erosion. It appears, however, that the majority of parcels surrounding Munro Lake are maintaining moderate to good overall greenbelt ratings, and that shoreline erosion is mainly occurring along the shorelines of natural (often state owned) parcels. *Cladophora* densities

did not appear to be at levels that would cause serious concern over nutrient runoff or pollution. However, there are certain parcels along the shore in which further assessment may be needed in order to determine whether densities are acceptable based on the standards and parameters maintained by Tip of the Mitt.

References:

Blumbergs, Chelsea, Jack Controne, Erin Eberhard, Sarah Halperin, Julia Kehoe, and Caroline Wilkinson. "Search Deep Blue." *Assessment of the Greenbelt at Michigan Department of Natural Resources Boat Launches in Cheboygan and Emmet County, Michigan*. N.p., n.d. Web. 11 Aug. 2014. <<http://deepblue.lib.umich.edu/handle/2027.42/101143>>.

Cronk, Kevin L. "Burt Lake Shoreline Survey 2009." (2009): Tip of the Mitt Watershed Council. Web. 7 Aug. 2014. <<http://www.watershedcouncil.org/water%20resources/inland%20lakes/burt%20lake/files/2009%20Burt%20Lake%20Shoreline%20Survey.pdf>>.

