Larks Lake Watershed Planning Project

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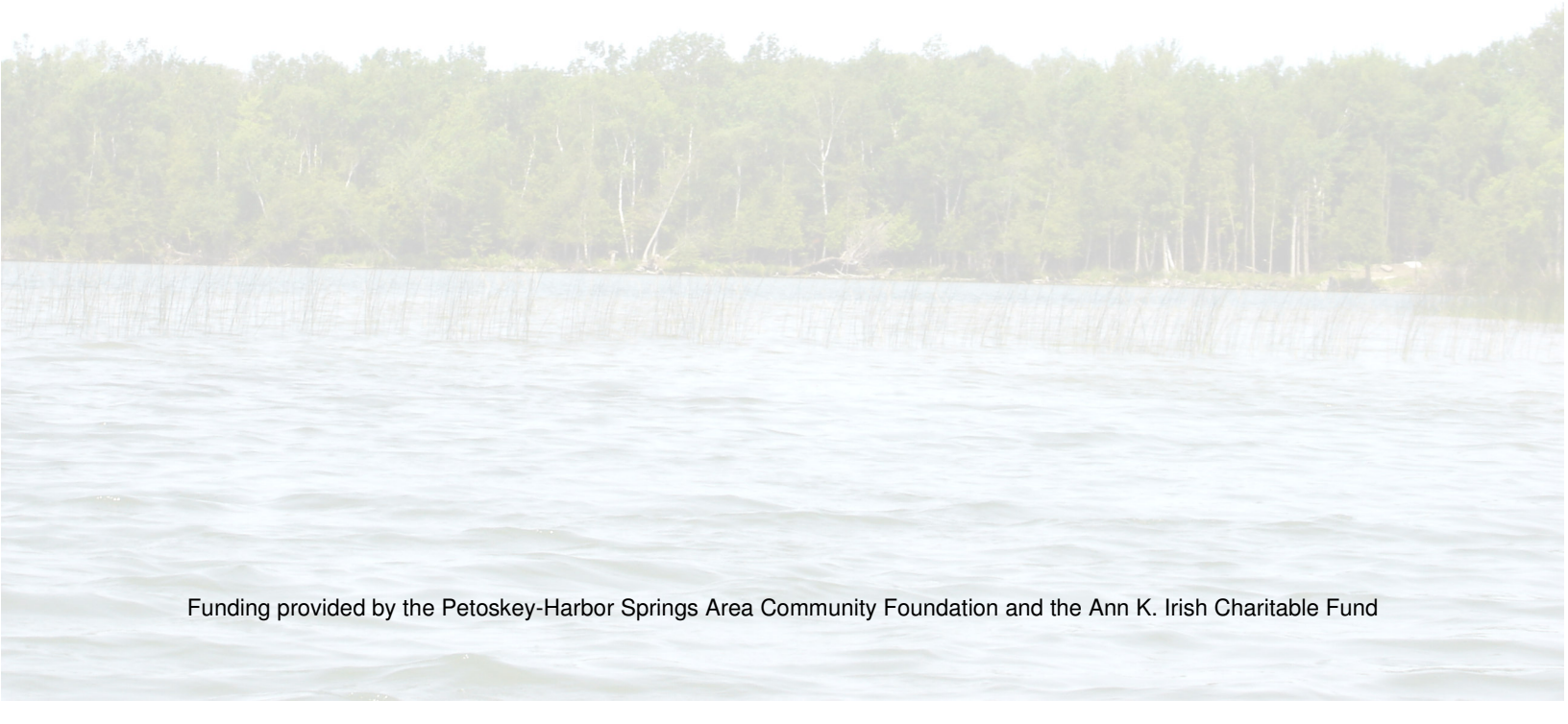

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Chapter One: Getting to Know the Larks Lake Watershed

1. Introduction

a. Geographic Description

Larks Lake is a small, shallow lake located in Center Township in northern Emmet County (Figure 1). Larks Lake is fed by spring outlets. It is the headwaters of Brush Creek; a tributary flowing into the west branch of the Maple River, and also what is known as the Pleasantview Swamp. Larks Lake is considered an important recreation resource for county residents with access provided at the Center Township Park and boat access at the end of Kaz Road. The Larks Lake Watershed land surface area is 4,640 acres. The Larks Lake Watershed is a small subwatershed of the larger Cheboygan River Watershed, which covers 1,461 square miles (935,000 acres) in Cheboygan, Otsego, Emmet, Presque Isle, Montmorency, and Charlevoix Counties. The Larks Lake Watershed land area makes up 0.5% of the Cheboygan River Watershed.

Geology and Soils

The quarternary geology surrounding Larks Lake is glacial outwash sand and gravel and postglacial alluvium; and coarse textured glacial till. Geology in areas adjacent to Larks Lake also include peat and muck (Farrand, 1982). Substrate types within the lake basin include marl, organic silt, coarse and medium sand with pebbles distributed throughout, and fine sand. Organic sediments and silt occur most heavily in the northwest end of the lake, which is adjacent to forested wetland.

Soils are a watershed feature important for many aspects of water resource management, including groundwater recharge, septic system performance, and erosion/sedimentation potential (Fuller, 2006). There are about 400 different "soil series" found in Michigan. Three soil associations (groups of soil series geographically associated in a characteristic repeating pattern) are recognized in the Larks Lake Watershed (Fuller, 2006). Major soil associations include:

- Graycalm-Kalkaska-Montcalm Association: excessively drained sandy to loamy soils formed on glacial outwash plains (NRCS, 2004)
- Lupton-Carbondale-Tawas Association: poorly drained organic muck soils to mucky peat sometimes containing wood fragments at depths below 12 inches (NRCS, 2004)
- Emmet-Montcalm-Kalkaska Association: well drained coarse textured sandy to sandy loam soils of uplands (NRCS, 2004)

Larks Lake Shoreline

Larks Lake has approximately 4 miles of shoreline. About 1.5 miles (37.5%) of lakeshore frontage is in residential development and 2.5 miles (62.5%) are currently undeveloped. About 1.74 miles of undeveloped frontage is characterized by wetland vegetation and soils.

West Branch of the Maple River

The Maple River is a tributary to Burt Lake. The West Branch of the Maple River originates in a large wetland called the Pleasantview Swamp, and is supplemented by the inflow of Brush Creek which drains from Larks Lake.

Pleasantview Swamp

Covering 6,544 acres, this is one of the biggest, uninterrupted expanses of organic soils in northern Lower Michigan. There are areas of forested swamp, shrub swamp, and emergent marshes. Within the Pleasantview Swamp are four "spring ponds" (called The Four Lakes) that form the headwaters of the Maple River. The swamp has more than 30 miles of shoreline on the Maple River, Brush Creek,

Larks Lake, and The Four Lakes. It is home to most of Michigan's large reclusive mammals, including bobcat, black bear, and river otter. Bald eagles and ospreys nest in the swamp. Soils consist of Carbondale and Tawas mucks with Roscommon mucky sand along the margins. Fifty-four percent of the swamp is publicly-owned by the State of Michigan (Fuller, 2006).

Land Uses within the Larks Lake Watershed

Pre-settlement land cover (or vegetation present in about 1800) in the Larks Lake watershed was primarily Beech-Sugar Maple-Hemlock forest in the upland areas and cedar swamp in wetland areas (Fuller, 2006). Present day land cover within the watershed includes forest, grassland, wetland, and minor areas of agricultural and residential land (Table 1, Figure 2). Around Larks Lake, land use is 35% seasonal or permanent residential, 10% recreational (township park) and 55% forested or forest wetland. Approximately 25% of the Larks Lake shoreline is owned by the State of Michigan.

Table 1. Land Cover in the Larks Lake Watershed

Land cover type	Acreage	Percentage
Barren	9.30	0.18
Agriculture	825.06	15.80
Forest	1856.37	35.54
Grassland	1262.17	24.16
Urban/residential	102.71	1.97
Wetland	400.62	7.67
Scrub/Shrub	165.32	3.16
Water	601.82	11.52
TOTAL	5223.38	100

*data from NOAA Coastal Services Center: http://www.csc.noaa.gov/crs/lca/greatlakes.html

Local Governmental Agencies within the Larks Lake Watershed

The Larks Lake Watershed lies within the jurisdiction of the Emmet County government and Center Township. Emmet County administers the zoning for Center Township. The watershed is also within the jurisdiction of a regional government agency- the Northwest Michigan Council of Governments.

b. Water Quality Review

Larks Lake is a shallow marl lake, and is naturally shallower than most typical marl lakes. Marl sediments are a mixture of clay, sand, and calcium carbonate from limestone that tends to be soft in texture, which is deposited on firm substrates and aquatic macrophytes. All the major lakes of the Cheboygan River Watershed have moderately "hard" water, in reference to the levels of dissolved calcium and magnesium carbonates originating from the limestone bedrock geology of the Watershed and conveyed via groundwater to surface waters (Fuller, 2006). Marl lake deposits are rich in calcium carbonate that precipitates during the photosynthetic processes of aquatic plants, such as *Chara* (McDonough, 2002).

Sediment in the northwest cove of the lake is organic muck, and muck deposits are deep in this area. Observational depths vary from about six inches to over five feet in depth, as measured with a paddle at various locations. This section of the lake is adjacent to forested wetlands with peat soils. Locally produced organic matter in peat soils will accumulate and bury underlying mineral substrates (Keddy, 2002). Also in the northwest cove there is an area with wood fragments below two to three feet of muck soils. This may be due to the presence of the Carbondale soil series, in which wood fragments are a common component below 12 inches of depth (NRCS, 2004).

Figure 1: Larks Lake Watershed Map

Figure 2: Larks Lake Watershed Land Cover Map

Morphometric features of Larks Lake and its watershed are shown in Table 2. Larks Lake has a low shoreline development factor. This limits the amount of shoreline influence on water quality. Larks Lake has a watershed to lake size ratio of 7.9:1, which is considered a small ratio. Lakes that have a large watershed relative to lake size are generally more susceptible to nutrient enrichment from nonpoint source than lakes with proportionally smaller watersheds. Fortunately, much of the watershed is currently in land uses that characteristically don't export excessive levels of nutrients.

Table 2. Morphometric Features of Larks Lake and its Watershed	
Lake Surface Area	239 hectares (591 acres)
Watershed Area	2,117 hectares (4,640 acres)
Maximum Depth	2.4 meters (7.87 feet)
Mean depth	0.8 meters (2.62 feet)
Maximum length	1.94 km (1.21 miles)
Maximum width	1.89 km (1.17 miles)
Volume	1,866,543 cubic meters
Shoreline Development Factor	1.13
Shoreline length of Lake	6.44 km (4.0 miles)
Watershed Area: Lake Size	7.9:1

Results from the Comprehensive Water Quality Monitoring Program conducted by Tip of the Mitt Watershed Council on Larks Lake are summarized in Table 3. Seven water quality parameters were measured as a means to characterize the lake and detect any problem conditions in water quality trends for Larks Lake. Based upon these results, the water quality of Larks Lake is good. Each measured parameter falls within the range for high water quality, with the exception of phosphorus. Phosphorus is normally found at concentrations of less than 10 micrograms per liter (µg/L) in high quality surface waters (Wetzel, 2001).

Table 3. Larks Lake Comprehensive Water Quality Monitoring Results				
	1995	***1998***	***2001***	***2004***
Clarity (feet)	8	8	8.3	8.3
pH	7.7	8.1	8.1	8.4
Chloride (mg/L)	-	2.7	1.4	2.9
Total Nitrogen (mg/L)	-	0.48	0.58	0.95
Nitrate Nitrogen (mg/L)	-	0.12	0.01	0.09
Total Phosphorus (µg/L)	8.0	11.9	9.4	9.4
Conductivity (µhmo/cm^2)	231	222	201	201

Larks Lake is considered a shallow eutrophic to mesoeutrophic lake (Fuller, 2006). A lake with a mesoeutrophic classification is considered capable of producing and supporting moderate levels of living organisms, which includes plants and animals. This lake class is characterized by moderate

concentrations of nutrients, chlorophyll *a*, algae and/or macrophyte growth, and visibility between three and six meters (Harper, 1992).

Larks Lake has unstained water and does not undergo summer stratification. However, Larks Lake is known to develop winterkill conditions during severe, snowy winters. Larks Lake does not currently reach anoxic conditions in the summer. Dissolved oxygen concentrations June-August 2001-2005 averaged 8.3 mg/L (Davis, 2005), which is highly suitable for the survival of aquatic organisms such as fish and aquatic invertebrates.

2. Designated Uses and Water Quality Summary

The Waters Resources Commission Act (P.A. 451 of 1994, Part 31, Chapter 1) requires all waters of the State of Michigan to be of the quality to meet seven designated uses: 1) agriculture; 2) navigation; 3) industrial water supply; 4) public water supply; 5) warm water fishery; 6) habitat for indigenous aquatic life and wildlife; and 7) partial or total body contact recreation. An eighth designated use—cold water fishery—is applicable for many rivers and lakes in Michigan.

A variety of activities and changing land uses in the watershed threaten some of the designated uses (Table 4).

Table 4. Larks Lake Watershed Threatened Uses
• Navigation (N) • Habitat for indigenous aquatic life and wildlife (H) • Warm water fishery (W) • Recreation (total and partial body contact) (R)

a. Watershed Concerns

In 2006 a series of meetings were held with local watershed residents, local government officials, conservation groups, environmental organizations, the Little Traverse Bay Bands of Odawa, and other stakeholders within the Larks Lake Watershed to discuss concerns about water quality. The group identified many different issues and committed to working together in a partnership to develop a watershed management plan. The group identified the priority issues of concern (Table 5).

Table 5. Priority Concerns and Threats to Designated Uses	N	H	W	R
Impacts to fisheries from sedimentation and habitat destruction		x	x	
Boats/ wave runners		x	x	x
Impacts from sedimentation in north end of Larks Lake	x	x	x	x
Lakeshore and streambank erosion	x	x	x	
Lawn care/ fertilization and pesticide use		x	x	x
Destruction of greenbelts and shoreline vegetation		x	x	
Aquatic nuisance species (e.g. purple loosestrife)		x		
Water withdrawal	x	x	x	x
Loss of habitat for threatened or endangered species (loons, eagles)		x		
Overharvesting fish		x	x	

Table 5. Priority Concerns and Threats to Designated Uses	N	H	W	R
Pollution from septic systems		x	x	x
Loss of aquatic habitat		x	x	
Shoreline algae		x		x
Impacts from stormwater runoff from roads	x	x	x	x
Elimination of fish stocking		x	x	

b. Known and Suspected Pollutants in the Larks Lake Watershed

Navigation, habitat for aquatic life and wildlife, the warm water fishery, and recreation (partial and total body contact) are the primary uses that are threatened by pollution in the Larks Lake watershed. The key pollutants of concern are sediment, nutrients, aquatic nuisance species, toxics, pesticides/ herbicides, and bacteria. The table below provides a list of the known and suspected pollutants (Table 6).

Table 6. Known and Suspected Pollutants	
Threatened Use	**Pollutants**
Navigation	Sediment (k)
Aquatic life/ wildlife	Sediment (k) Nutrients (s) Aquatic nuisance species (k) Toxics (s) Pesticides/ herbicides (s)
Warm water fishery	Sediment (s) Toxics (k)
Partial and total body contact recreation	Sediment (k) Nutrients (s) Pesticides/ herbicides (s) Bacteria (s)

k = known s = suspected

c. Sources of Pollutants in the Larks Lake Watershed

There are numerous sources of pollutants to the water resources in the Larks Lake watershed. Land use ranges from residential to forested wetland along stretches of the Larks Lake shoreline. Diverse land use results in a diverse amount of activities and many potential sources of nonpoint source pollution. The main sources contributing nonpoint source pollution for each primary pollutant of concern in the Larks Lake watershed are listed below (Table 7).

Table 7. Sources of Pollutants in the Larks Lake Watershed	
Pollutants	**Sources**
Sediment	Lakeshore and streambank erosion (k) Road/stream crossings (k) Access sites (boat launches, road ends) (s) Stormwater runoff (k) Construction (s)

Table 7. Sources of Pollutants in the Larks Lake Watershed	
	Forestry activities (s)
Nutrients	Lawn care on shoreline properties (k) Septic systems (s) Stormwater runoff (k) Road/stream crossings (s) Lakeshore and streambank erosion (s) Construction (s)
Pesticides/herbicides	Lawn care on shoreline properties (s) Stormwater runoff (s) Agricultural fields (s)
Bacteria	Septic systems (s) Stormwater runoff (k)
Toxics	Air deposition (k) Stormwater runoff (k) Household hazardous wastes (s)
Aquatic nuisance species	Wildlife (s) Boat trailers (s)

k = known s = suspected

d. Causes for Each Pollutant Source in the Larks Lake Watershed

Understanding the potential causes of pollution is essential for developing goals and action strategies. Below is a list of causes for each pollutant source (Table 8).

Table 8. Sources and Causes of Pollutants in the Larks Lake Watershed	
Source	**Cause**
Lakeshore and streambank erosion (k)	Shoreline development and removal of shoreline vegetation (k); boater and canoeist access (s); boat waves (s); changes in runoff due to shoreline development (s)
Road/stream crossings (s)	Undersized culverts (k); improperly placed culverts (k); lack of runoff diversions (k); inadequate fill on road surface (k); lack of vegetation (k)
Access sites (boat launches, road ends) (s)	Lack of erosion control (s); lack of runoff diversions (s)
Construction (s)	Lack of adequate erosion control measures (k)
Forestry activities (s)	Past dumping of wood fragments into lake (s); lack of adequate erosion control measures (s)
Lawn care on shoreline properties (k)	Overapplication of phosphorus fertilizers and pesticides (s)
Septic systems (s)	Outdated or improperly maintained systems (s)
Air deposition (k)	Burning of waste (k); industrial air discharge (k)
Wildlife (s)	Carrying and spreading purple loosestrife seeds (s)
Stormwater runoff (k)	Sediments and/or road salts in runoff from roads/driveways (s); Oils, grease, fuels, etc. on roads/driveways (s); improper disposal of pet waste (s); wildlife waste (s)
Boat trailers (s)	Transporting and spreading aquatic invasive species (s)
Household hazardous waste (s)	Improper use and/or disposal of household hazardous wastes (s)

e. Watershed Goals

The overarching goal of the Larks Lake Watershed Planning Project is to protect and enhance the water quality of Larks Lake and its tributaries by reducing current and future polluted runoff. A variety of local stakeholders participated in the planning process, some of which included Tip of the Mitt Watershed Council, Larks Lake Association, various lake residents, Little Traverse Bay Bands of Odawa Indians- Natural Resources and Environmental Services departments, Conservation Resource Alliance, and Emmet County Conservation District. In addition to these groups the Michigan Department of Natural Resources Fisheries Division played an advisory role as well. The goals of the project are to address each designated use as stated in the Water Resources Commission Act (Table 9).

Table 9. Larks Lake Watershed Goals to Address Designated Uses

Designated Use	Status	Watershed Goal
Agriculture	Supported	Maintain nonpoint source pollution to ensure that the status of this use does not decline.
Industrial water supply	Supported	Manage nonpoint source pollution to ensure that the status of this use does not decline.
Public water supply at intake point	Supported	Manage nonpoint source pollution to ensure that the status of this use does not decline.
Navigation	Threatened	Improve and maintain navigation in Larks Lake by reducing sediment inputs.
Warm water fishery	Threatened	Improve warm water fishery by reducing inputs of sediments; protecting and restoring wetlands; controlling aquatic nuisance species; improving fish habitat; reduce inputs of toxic substances.
Other indigenous aquatic life and wildlife	Threatened	Improve and maintain habitat for other indigenous aquatic life and wildlife by reducing inputs of sediments, nutrients, and pesticides; protecting and restoring wetlands; controlling aquatic nuisance species; prevent vegetation removal from the shoreline; restore vegetation along shoreline to provide shade and wildlife cover; reduce inputs of toxic substances.
Recreation (partial and total body contact)	Threatened	Address possible failing septic systems; encourage clean-up of pet wastes; research funding and implement control of swimmers itch through monitoring.

f. Water Quality Summary

The Larks Lake Watershed has four designated uses that are threatened: 1) navigation; 2) warm water fishery; 3) habitat for indigenous aquatic life and wildlife; and 4) recreation (partial and total body contact).

Navigation

Larks Lake is characteristically a marl lake, resulting in heavy marl deposits on the lake bottom. Water level and geochemistry of marl lakes are subject and sensitive to local environmental changes; for example, increased deposition of marl generally occurs in warmer water temperatures when rates of photosynthesis are highest (McDonough, 2002). Marl deposits coupled with biogenic accumulation of

organic sediments, particularly in the northwest corner of the lake, naturally contribute to areas of soft substrate and deep muck.

However, navigation is threatened in Larks Lake from the increasing sediment. Large amounts of flocculent sediments that have accumulated in the northwest end of the lake appear to be moving to other parts of the lake by waves and currents. Additional suspected sources of sediment include altered wetlands, lakeshore erosion, imported beach sand, access sites at road ends, and construction activities.

Lakeshore erosion is typically the result of the removal of shoreline vegetation. Access sites at road ends for boating and canoe access are another source of erosion in Larks Lake. Construction in the shoreline area can also contribute sediment, particularly if inadequate erosion controls are used. Not maintaining buffer strips during forestry activities is also suspected of contributing to erosion and sedimentation.

Warm water fishery

Larks Lake is used as a recreational warm water fishery. Angler reports in recent years have indicated a decline in populations of sport fish. A variety of fish species (bluegill, yellow perch, smallmouth bass, largemouth bass, and northern pike) were stocked by the MDNR in the early 1930's until 1959. The Michigan Department of Natural Resources Fisheries Division states that the fish community at present is typical for a shallow lake with limited nutrient availability as a result of lake morphology (i.e. low vegetation levels and marl substrate) (MDNR, 2005). An additional study has cited the inability of Larks Lake to support a healthy game fish population due to the lack of lake productivity (Anderson and Ridley, 1993).

While Larks Lake has a limited ability to support a larger fishery, the warm water fishery is potentially threatened by an increase in sediment and inadequate habitat. There may also have been an increase in angling pressure in recent years, though evidence of hooking sores on a number of largemouth bass collected in a recent survey indicates that many fish are caught and released (MDNR, 2005). Throughout the watershed, the warm water fishery is impaired due to the occurrence of mercury, which has resulted in fish consumption advisories. The primary source of mercury is atmospheric fallout.

Habitat Protection for Aquatic Life/ Wildlife

Habitat for indigenous aquatic life and wildlife is threatened throughout the watershed by sediment, and aquatic nuisance species. It is suspected to be threatened by nutrients and toxics. Toxic chemicals, such as mercury from atmospheric fallout, can harm aquatic life by weakening immune systems, making organisms more susceptible to disease, and harming reproduction. In long-lived organisms, such as freshwater mussels, toxins can accumulate in the tissues for many years. Freshwater mussels were once considered a food source for Native Americans, but due to various toxins, they are generally no longer edible (MNFI, 2005).

An abundance of native freshwater mussels were observed on Larks Lake. High-density mollusk populations are common in marl lakes (McDonough, 2002). Freshwater mussels are one of the most endangered groups of animals in North America, and Michigan supports globally significant populations for several freshwater mussel species that are federally listed as endangered or candidates for federal listing (MNFI, 2005).

Sources of sediment pollution are the same as mentioned above for threats to navigation. Suspected sources of nutrient pollution include lakeshore erosion, vegetation removal from the shoreline, lawn

care on residential properties, and potentially failing or outdated septic systems. Pesticides and herbicides may be contributed from lawns.

A pair of bald eagles nest near Larks Lake on Brush Creek. LTBB-Odawa Natural Resources staff have observed eagles nesting there for the last several years, but have not confirmed if they have successfully fledged any young. Common loons are also seen on Larks Lake. However, they have not been reported to have nested on Larks Lake. Improved nesting habitat for these birds may help them fledge young more successfully.

Purple loosestrife has been observed on the shoreline of Larks Lake. Purple loosestrife is a highly invasive wetland perennial plant that is considered a threat to native wetland flora and fauna. Once it becomes established, purple loosestrife oftentimes becomes the dominant vegetation by out-competing native plants. As a result, native plant communities are degraded, and so too are the wildlife species that depend on them.

Recreation (Partial and Total Body Contact)
Nutrient pollution can stimulate nuisance levels of aquatic plant and algae growth, which disrupt recreational activities and make swimming and boating undesirable. Additionally, high bacteria counts can make it unsafe for swimming. Although these scenarios currently do not exist for Larks Lake and its tributaries, preventative measures are essential to maintain the diversity and quality of recreational opportunities in this watershed.

Sources and causes of nutrients have been described previously. Suspected sources of bacteria include possibly failing, outdated, or improperly maintained septic systems. Stormwater discharge can collect and deposit pet and wildlife waste into Larks Lake, and be a cause of bacteria pollution.

Swimmer's itch has been known to be an issue on Larks Lake during the swimming season and warm weather, which is likely due to the shallow depth of the lake. Swimmer's itch, or cercarial dermatitis, is a skin rash caused by parasitic flatworms in a larval stage (MDEQ, 2005). The larvae, known as cercaria, emerge from a specific snail species to search for a suitable host (such as waterfowl, birds, or rodents). However, cercariae sometimes mistakenly burrow into an unsuspecting swimmer's skin. Since human flesh does not provide the proper environment for cercaria to mature, the larva dies, causing an allergic reaction in many people. Swimmers can take precautions to reduce the chance of contracting swimmer's itch by discouraging waterfowl in swimming areas, towel drying completely, and avoiding prolonged or repeated swimming in shallow areas. Studies have also shown that swimmers on the northern and western shores of lakes are significantly less likely to contract swimmer's itch due to the wind patterns of Northern Michigan (MDEQ, 2005).

3. Defining the Priority Area

The "priority area" is that portion of the watershed which is most sensitive to environmental impacts, and which has the greatest likelihood to affect water quality and aquatic habitat.

The priority area for Larks Lake includes the following areas (Figure 3):

1. Areas within 1000 feet of the following features:
    a. Larks Lake
    b. Brush Creek outlet and other intermittent drainages
    c. Contiguous wetlands (a contiguous wetland is defined as a wetland within 500 feet of streams or lakes within the watershed)

d. Areas which drain to surface waters via drainage ditches

2. Areas of steep slopes contiguous with any priority perimeter described above. Regarding water resources, the definition of a steep slope seems to range widely in the literature (from 8 to 25%). For this priority area determination, a 10% slope (or 1:10 ratio, or 6 degrees) or greater is recommended.

Chapter Two: Nonpoint Source Pollution Inventories

The inventories conducted to document nonpoint source pollution included field data collecting inventories to identify current sources and causes of pollution as well as potential sources. Below are the summaries of the inventories conducted and their results.

1. Larks Lake Shoreline Inventory

A shoreline survey to identify locations of nutrient pollution (using Cladophora as an indicator), shoreline erosion, bottom sediment type, and shoreline development characteristics was performed by Tip of the Mitt Watershed Council (Watershed Council) during the summer of 2006 (Figure 4).

Cladophora survey

Cladophora is a branched, filamentous, green algae that occurs naturally in small amounts in Northern Michigan lakes. Its occurrence is governed by specific environmental requirements for temperature, substrate, and nutrients. 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. Artificial substrates such as concrete or wood seawalls are also suitable. The preferred water temperature is 50 to 70 degrees Fahrenheit. This means that late May to early July, and September and October are the best times for its growth in Northern Michigan lakes.

The nutrient requirements for Cladophora to achieve large, dense growths are greater than the nutrient availability in lakes with good water quality, such as Larks Lake. Therefore, the presence of Cladophora can indicate locations where relatively high concentrations of nutrients, particularly phosphorus, are entering a lake. Sources of these nutrients can be due to natural conditions, including springs, streams, and artesian wells that are naturally high in nutrients due to the geologic strata they encounter; as well as wetland seepages which may discharge nutrients at certain times of the year. However, the majority of Cladophora growths can be traced to cultural sources such as lawn fertilization, septic systems, poor agricultural practices, soil erosion, and wetland destruction. These nutrients can contribute to an overall decline in lake water quality. Additionally, failing septic systems can pose a potential health risk due to bacterial and viral contamination.

A database containing numerous information fields (tax identification number, description of the property or development as viewed from the water, and names and addresses of property owners) was developed by the Watershed Council. The database and maps were intended to facilitate repeat shoreline surveys. When used in conjunction with the parcel maps, the location of Cladophora growths are revealed.

Figure 3: Larks Lake Watershed Priority Areas Map

Figure 4: Larks Lake 2006 Shore Survey

The shoreline was visually surveyed by traveling in a small boat (mostly by kayak) as close to the shoreline as possible (usually 5 to 20 feet). The locations of significant Cladophora growths, sites of erosion concern, bottom substrate, and property description were recorded.

When Cladophora growth was observed, it was described by estimating the length (feet) of shoreline it covered and the density or amount of available substrate that was utilized. The density description was divided into three categories, Light (L) 0-25%, Medium (M) 25-75%, or Heavy (H) 75-100%. When an algal growth occurred between two houses and could not be affirmatively associated with either one, the growth was indicated as occurring at both locations on the shoreline database.

The bottom substrate (or sediment) survey was conducted in that area of the lake where the bottom was visible. Where a wide, shallow nearshore area was present, the focus of the data collection was generally within about 50 feet of shore. Sediments were assessed visually, by probing with a paddle to judge texture, or by closer examination in a few cases.

Approximately 57 property parcels were identified along the Larks Lake shoreline. The number is approximate because property boundaries were not always evident. Of the 57 parcels, nine were recorded as having substrate that Cladophora requires. Cladophora growths were associated with four property parcels (Table 10).

Table 10: Larks Lake Cladophora Survey Summary

	2006
Shoreline Property Parcels	**57**
Parcels with suitable habitat	**9**
Cladophora Growths	**4**
Heavy growths	**0**
Medium growths	**1**
Light growths	**3**

Shoreline erosion

Erosion, the wearing away of the land surface by physical forces, is a natural, although slow, process along shorelines. However, erosion can be accelerated (often by human activities) and result in environmental problems and property damage. Oftentimes, erosion control projects are not based on current best management practices, and they can be ineffective or even result in more water quality impacts or habitat loss. This survey noted areas of visible, accelerated erosion, including gullies or rills on the land surface, undercut, slumping, or receding banks or shorelines, or bare soil on slopes or steep banks. In addition, ill-conceived or ineffective erosion control projects were noted, as was the widespread (and often illegal and environmentally damaging) practice of beach sanding.

No parcels were identified as having lakeshore erosion problems. However, many parcels had sand beaches rather than shoreline vegetation greenbelts. This could have impacts on the water quality of Larks Lake. In locations where sand does not naturally occur, sand rarely stays in place and requires a lot of plant control through hand pulling and herbicide use (Henderson et al.,1999) Once a sand beach has been created, wave action and surface runoff may erode the sand, or if the lake bottom is soft, then the sand will sink through the muck, requiring additional loads of sand to be deposited on the beach.

When the sand washes into the water, it may also cover aquatic plant beds and degrade fish and wildlife habitat (Henderson et al., 1999).

2. Larks Lake Greenbelt Survey

The current condition of greenbelts, or shoreline vegetation, was assessed and documented during the shoreline survey performed during the summer of 2006 (Figure 4). A greenbelt provides a natural strip of vegetation between the shoreline and lawn or structures to help prevent erosion and remove pollution from runoff.

Greenbelt status was documented for 83 property parcels (Table 11). The number of parcels is approximate because survey observations were made from watercraft and exact property boundaries were not always evident. 54 property parcels are developed lots and 29 are considered undeveloped.

Table 11: Larks Lake Greenbelt Survey Summary

	Total count (2006)	% of Total
Shoreline Property Parcels	83	100
Greenbelt length (>75% length of shoreline)	53	64
Greenbelt width (>40 ft wide)	39	47
Turf (>75% of shore mowed to edge)	15	18

Of the 83 parcels surveyed, 53 parcels (64%) had a greenbelt that extended 75% or greater of the length of the shoreline (Table 11). This includes the 29 undeveloped parcels. When considering developed parcels only, then this changes to 30% (25 parcels). 20% (17 parcels) had a greenbelt 25-75% the length of the shoreline. 4% (3 parcels) had a greenbelt 10-25% the length of the shoreline, and 5% (4 parcels) had a greenbelt less than 10% of the shoreline. Six of the 83 parcels (7%) were documented as having no shoreline greenbelt. All parcels documented as having no shoreline greenbelt were developed property parcels.

Greenbelt depth (or width) was also documented, with 64% having greenbelts that are 40 feet wide or more. 40 feet is the desired greenbelt width for best surface runoff buffering. 19% (16 parcels) had greenbelt widths of 10-40 feet, and 27% (22 parcels) had greenbelts less than 10 feet wide. Additionally, 18% of property parcels surveyed had turf mowed to the water's edge on greater than 75% of their shoreline.

While over half of the shoreline property parcels on Larks Lake do have a greenbelt along most of the shoreline, it is important that information and education continue regarding the importance of greenbelts. Maintaining, enhancing, or restoring shoreline greenbelts is a critical way to protect lake water quality by filtering sediments or other pollutants before they reach the lake via surface runoff.

3. Zoning Assessment

Zoning is the principal means of land use control in the watershed. Land use around Larks Lake is under the Emmet County Zoning Ordinance. Historically, zoning was devised to avoid conflicting land uses in urban areas with only minimal concern given to water quality and environmental concerns.

Additionally a lack of local land use controls allowed lakeshore development to occur which may effect water quality. This includes dense shoreline development on small lots, funnel development, and inadequate setbacks. All of these have potential to increase nonpoint source pollution to the lake.

A local planning and zoning review was performed for the Larks Lake watershed by looking at the Emmet County Zoning Ordinance. The zoning ordinance was reviewed for provisions affecting water quality. The Emmet County Master Plan is currently being updated by the county and is expected to be completed in late 2007. A summary of the water quality provisions are described in Table 12.

Table 12. Zoning Provisions Affecting Water Quality in the Larks Lake Watershed

	Emmet County
Water Quality Goals	Proper use of natural resources, agriculture, wildlife, and floodplains. Avoid excessive structural encroachment of natural waters and waterways. Promote high water quality, undisturbed natural area to trap nutrients, and sediments from entering natural waters, prevent erosion.
Special Districts	Scenic Resource District SR1 & SR2 High Risk Erosion and Environmental Areas
Shoreline Protection Strips	40 feet width strip maintained with natural trees and shrubs in Scenic Resource Districts. 100 feet in High Risk Erosion Areas 35 feet in other districts
Shoreline Setbacks	All structures 60 feet from waterfront. Decks and patios are allowed within 25 feet from waterfront.
Shoreline Density	Minimum lots width ranges from 100-200 feet.
Accessory Uses (docks, boats, access)	No special standards.
Site Plan Review	Required for uses other than single family, two family, or multi-family dwellings.
Vegetation Screening	Required for non-residential uses when adjacent to residential uses and other special uses. Spacing, plant materials, and maintenance standards are detailed.
Other	Steep Slopes Ordinance amendment. Stormwater Ordinance, maximum lot coverage of 30-35% for some districts. Soil Erosion and Sedimentations Control Part 91.

Chapter Three: Priority Pollutants and Best Management Practices

1. Priority Pollutant Sources and Causes

Based on the preceding inventories and analyses the following pollutants were determined to be of priority (Table 13).

Table 13. Larks Lake Priority Pollutants	
Pollutants	**Priority Ranking**
Sediment	1
Nutrients	2
Bacteria	3
Aquatic nuisance species	4
Pesticides/Herbicides	5
Toxics	5

Table 14 outlines how each of the priority pollutants impacts designated water uses.

Table 14. Pollutant Priorities for Each Designated Use		
Designated Use	**Pollutant**	**Priority Ranking**
Navigation	Sediment	1
Warm water fishery	Sediment Toxics	1 2
Habitat	Sediment Nutrients Aquatic nuisance species Toxics Pesticides/Herbicides	1 2 2 3 3
Recreation	Bacteria Nutrients Pesticides/Herbicides Sediment	1 2 3 4

After prioritizing pollutants, the pollution sources and causes were prioritized. In large part the rank of both the source and the cause corresponded.

Table 15. Larks Lake Priority Sources and Causes			
Pollutant Source	**Rank**	**Cause**	**Rank**
Stormwater runoff (k)	1	Sediments and/or road salts in runoff from roads/driveways (s); oils, grease, fuels, etc. on roads/driveways (s); improper disposal of pet waste (s); wildlife waste (s)	1
Access sites (road ends) (s)	3	Lack of erosion control (s); lack of runoff diversions (s)	3
Septic systems (s)	4	Outdated or improperly maintained systems (s)	4
Lawn care on shoreline properties (k)	3	Overapplication of phosphorus fertilizers and pesticides (s)	3
Lakeshore erosion (k)	2	Shoreline development and removal of shoreline vegetation (k); boater and canoeist access (s); boat waves (s); changes in runoff due to shoreline development (s)	2
Construction (s)	5	Lack of adequate erosion control measures (k)	5
Forestry activities	6	Inadequate buffer strips near water (s)	6
Wildlife	9	Carrying and spreading purple loosestrife seeds (s)	9

Table 15. Larks Lake Priority Sources and Causes			
Air deposition	8	Burning of waste (k); industrial air discharge (k)	8
Road/stream crossings	6	Undersized culverts (k); improperly placed culverts (k); lack of runoff diversions (k); inadequate fill on road surface (k); lack of vegetation (k)	6
Boat trailers	5	Transporting and spreading aquatic nuisance species (s)	5
Household hazardous waste	7	Improper care and/or disposal of household hazardous wastes (s)	7

2. Proposed Best Management Practices

To address the sources and causes of priority pollutants in the Larks Lake Watershed, a series of best management practices (BMPs) may be implemented. BMPs are techniques, measures, or structural controls designed to minimize or eliminate runoff and pollutants from entering surface and ground waters.

Types of BMPs

Non-structural BMPs are preventative actions that involve management and source controls. This includes policies and ordinances that provide requirements and standards to direct growth of identified areas, protection of sensitive areas such as wetlands and riparian areas, and maintaining and/or increasing open space (including a dedicated funding source for open space acquisition). Other examples are providing buffers along sensitive water bodies, minimizing impervious surfaces, and minimizing disturbance of soils and vegetation. Additional non-structural BMPs can be education programs for homeowners, students, businesses, developers, and local officials about project designs and everyday actions that minimize water quality impacts.

Structural BMPs are physical systems that are constructed to reduce the impact of development and stormwater runoff on water quality. They can include storage practices such as wet ponds and extended-detention outlet structures; filtration practices such as grassed swales, sand filters, and filter strips; and infiltration practices such as infiltration basins and infiltration trenches.

Since priority pollutants and their sources and causes have been identified in the Larks Lake Watershed, we can determine which BMPs can be used to address these water quality issues. Structural and non-structural BMPs will be used in combination in the Watershed to obtain the maximum reduction or elimination of a pollutant or pollutants.

BMP Effectiveness

The actual effectiveness or efficiency of a BMP is determined by the size of the BMP implemented (e.g., feet of vegetated buffer or acres of stormwater detention ponds), and how much pollution was initially coming from the source. Table 16 (Huron River Watershed Council, 2003) lists estimates of pollutant removal efficiencies for stormwater BMPs that may be used in the Watershed.

Table 16: Pollutant Removal Efficiencies of Stormwater BMPs						
	Pollutant Removal Efficiencies					
Management Practice	**Total Phosphorus**	**Total Nitrogen**	**TSS**	**Metals**	**Bacteria**	**Oil & Grease**
Riparian buffers *Forested: 20-40 m width* *Grass: 4-9 m width*	Forested: 23-42%; Grass: 39-78%	Forested: 85%; Grass: 17-99%	Grass: 63-89%			
Vegetated roofs	70-100% runoff reduction, 40-50% of snow/rainfall. 60% temperature reduction. Structural addition of plants over a traditional roof system.					
Vegetated filter strips *7.5 m length* *45 m width*	40-80%	20-80%	40-90%			
Bioretention	65-98%	49%	81%	51-71%	90%	
Wet extended detention pond	48-90%	31-90%	50-99%	29-73%	38-100%	66%
Constructed wetland	39-83%	56%	69%	(-80)-63%	76%	
Infiltration trench	50-100%	42-100%	50-100%			
Infiltration basin	60-100%	50-100%	50-100%	85-90%	90%	
Grassed swales	15-77%	15-45%	65-95%	14-71%	(-50)-(-25)%	
Soil stabilization on construction sites			80-90%			
Sediment basins or traps at construction sites			65%			
Porous pavement	65%	80-85%	82-95%	98-99%		

Information regarding pollutant removal efficiency, designs of BMPs, and costs are constantly evolving and improving. The information contained in the table above is subject to change, and research to use the most current information will continue throughout the implementation phase.

Location of BMPs in the Watershed

The location of structural BMPs depends on the site and site conditions. Table 17 lists general guidelines for the placement of structural BMPs that have been adapted from the rapid assessment protocol of the Center for Watershed Protection (Huron River Watershed Council, 2003).

Table 17: General Guidelines for Locating Structural BMPs			
Amount of development	Undeveloped	Developing	Developed
Philosophy	Preserve	Protect	Retrofit
Amount of impervious surface	<10%	11-26%	>26%

Table 17: General Guidelines for Locating Structural BMPs			
Water quality	Good	Fair	Fair-Poor
Stream biodiversity	Good-Excellent	Fair-Good	Poor
Channel stability	Stable	Unstable	Highly unstable
Stream protection objectives	Preserve biodiversity and channel stability	Maintain key elements of stream quality	Minimize pollutant loads delivered to downstream waters
Water quality objectives	Sediment and temperature	Nutrients and metals	Bacteria
BMP selection and design criteria	Maintain pre-development hydrology		Maximize pollutant removal and quantity control
	Minimize stream warming and sediment	Maximize pollutant removal, remove nutrients	Remove nutrients, metals, and toxics
	Emphasize filtering systems		

Chapter Four: Goals and Objectives

Goal 1: Warm water fishery. Reduce inputs of sediment, nutrients, and toxics which threaten to harm habitat conditions for the warm water fishery in Larks Lake. Protect the warm water fishery by preventing the spread of aquatic nuisance species.

Goal 2: Aquatic life and wildlife. Protect the aquatic habitats within the Larks Lake watershed by reducing the contribution of sediment, nutrients, and toxics. Protect lakeshore and wetland habitats by preventing the spread of aquatic nuisance species.

Goal 3: Navigation. Maintain navigation in Larks Lake by reducing any sediment inputs.

Goal 4: Recreation (partial and total body contact). Maintain recreational opportunities in Larks Lake by reducing sediment, nutrient, and bacteria contributions, and preventing swimmer's itch.

Table 18 lists the main objectives to accomplish the above four primary goals.

Table 18: Goals and Objectives of the Larks Lake Watershed Plan	
Goals	**Objectives**
Warm water fishery Aquatic life and wildlife Navigation Recreation	**Reduce the amount of sediment by:** Reducing the pollutant load from stormwater Correcting most severe lakeshore erosion sites Correcting erosion sites at road ends Prevent lakeshore erosion Providing adequate erosion control measures for construction activities Protecting and restoring contiguous wetlands

Table 18: Goals and Objectives of the Larks Lake Watershed Plan	
Warm water fishery Aquatic life and wildlife Recreation	**Reduce the amount of nutrients by:** Reducing fertilizer use on residential lawns Educating about good shoreline property management and septic system maintenance Identifying and correcting failing septic systems Reducing pollutant load from stormwater Encourage clean-up of pet wastes
Warm water fishery Aquatic life and wildlife	**Protect and restore wetlands and fish habitat by:** Developing local ordinances to protect wetlands Contacting landowners of sensitive lands and educating about land stewardship and protection options Ensuring that state and federal wetland laws are properly administered and enforced Encourage landowners and citizens concerned with wetland protection to comment on wetland permits submitted to Michigan Department of Environmental Quality and/or U.S. Army Corps of Engineers Educating landowners, developers, and citizens on the importance of wetland protection Enhance existing fish habitat Educating anglers on the protection of fish habitat
Warm water fishery Aquatic life and wildlife	**Control aquatic nuisance species by:** Inventorying for aquatic nuisance species Educating boaters and shoreline property owners on how to identify and prevent the spreading of aquatic nuisance species Manage aquatic nuisance species using approved techniques
Warm water fishery Aquatic life and wildlife	**Reduce the amount of toxics (oils, grease, heavy metals, salts, etc.) by:** Reducing pollutant load from stormwater Restoring erosion and diverting runoff at road ends Encouraging proper disposal of hazardous waste
Aquatic life and wildlife	**Reduce input of pesticides and herbicides by:** Reducing amount of pesticides and herbicides used on residential lawns
Recreation	**Reduce the amount of bacteria by:** Reducing pollutant load from stormwater Improving maintenance and inspection of septic systems Encourage clean-up of pet wastes Monitoring presence and outbreaks of E.coli bacteria outbreaks
Recreation	**Reduce problems with swimmer's itch by:** Educating landowners and swimmers about how to reduce chances of contracting swimmer's itch Monitoring presence and outbreaks of swimmer's itch

Chapter Five: Recommended Actions to Protect the Larks Lake Watershed

The Larks Lake Watershed Planning Project developed an integrative approach to reduce existing sources of sediment and nutrient pollution and prevent future contributions. Integrating the use of (1) systems of best management practices (BMPs); (2) partnerships, community consensus building, and work with local and Tribal governments, and (3) information and education components.

Action Steps:
Reduce sediment, nutrient, and toxic pollution to Larks Lake by implementing systems of best management practices on identified priority problem sites and by conducting a program of information and education for targeted audiences. Watershed plan timeline is based on a timeframe of ten years from 2007 to 2017.

SHORELINE RECOMMENDATIONS

1. Develop guidelines for redevelopment of lakeshore properties to protect/improve shoreline from nonpoint source pollution.
Responsible Organization: Tip of the Mitt Watershed Council
Timeline: 2007-2012
Estimated Cost: $2,000

2. Educate shoreline residents on the importance of nearshore habitat, impacts from beach sanding, and maintaining shoreline vegetation.
Responsible Organization: Tip of the Mitt Watershed Council
Timeline: 2007-2017
Estimated Cost: $10,000

3. Create and distribute educational packages to realtors, contractors, landscapers, nurseries, and others whose clients are shoreline property owners. Develop/sponsor education program for lake realtors on special regulations and management for lake properties.
Responsible Organization: Tip of the Mitt Watershed Council
Timeline: 2008-2010
Estimated Cost: $5,000

4. Improve fisheries habitat by enhancing aquatic vegetation, placing brush bundles, recycled line Fish-Habs, and promoting leaving shoreline vegetation and woody debris.
Responsible Organization: LTBB Odawa, MNDR Fisheries, Conservation Resource Alliance
Timeline: 2007-2017
Estimated Cost: $25,000

5. Monitor for the presence of invasives (i.e. purple loosestrife) and work to control species that impair aquatic habitat. Educate to prevent the introduction of new invasives.
Responsible Organization: Tip of the Mitt Watershed Council, Larks Lake Association
Timeline: 2007-2011
Estimated Cost: $10,000

6. Inventory and identify failing septics and educate shoreline residents on proper septic maintenance.
Responsible Organization: Tip of the Mitt Watershed Council, Northwest Michigan Community Health Agency
Timeline: 2007-2009
Estimated Cost: $5,000

7. Conduct inventory to assess nonpoint source pollution problems at boat access locations (road ends).
Responsible Organization: Tip of the Mitt Watershed Council
Timeline: 2007

Estimated Cost: $2,000

8. Repeat shoreline pollution inventory and associated follow-up actions at least every five years. Maintain an up-to-date database.
Responsible Organization: Tip of the Mitt Watershed Council
Timeline: 2011 and 2016
Estimated Cost: $10,000

9. Install demonstration greenbelts on shoreline properties on Larks Lake.
Responsible Organization: Tip of the Mitt Watershed Council
Timeline: 2007-2017
Estimated Cost: $30,000

10. Restore shoreline wetlands that have been altered.
Responsible Organization: Tip of the Mitt Watershed Council, Natural Resources Conservation Service, US Fish & Wildlife Service
Timeline: 2007-2017
Estimated Cost: $50,000

11. Install nesting platforms to encourage nesting of desired bird species (i.e. loons, bald eagles).
Responsible Organization: LTBB Odawa
Timeline: 2007-2012
Estimated Cost: $10,000

STORMWATER RECOMMENDATIONS

1. Educate residents and local officials about nonpoint source pollution and how to reduce stormwater runoff to surface waters.
Responsible Organization: Tip of the Mitt Watershed Council, Emmet County Drain Commissioner, LTBB Odawa
Timeline: 2007-2017
Estimated Cost: $25,000

2. Provide programs and resources to Emmet County contractors about soil erosion and stormwater management techniques.
Responsible Organization: Tip of the Mitt Watershed Council, Emmet County Soil & Erosion Control, Emmet County Ordinance Enforcement
Timeline: 2007-2017
Estimated Cost: $30,000

3. Develop model stormwater ordinance language for the watershed. Assess the effectiveness, identify the shortcomings, and work to improve Emmet County stormwater ordinance.
Responsible Organization: Tip of the Mitt Watershed Council, Emmet County Planning, Emmet County Soil & Erosion Control
Timeline: 2007-2017
Estimated Cost: $20,000

4. Work cooperatively with local units of government to develop stormwater management plans. Implement priorities identified in stormwater management plan.

Responsible Organization: Tip of the Mitt Watershed Council, Center Township, Emmet County Drain Commissioner, LTBB Odawa
Timeline: 2007-2017
Estimated Cost: $500,000

5. Conduct impervious surface and gravel roads study in watershed.
Responsible Organization: Tip of the Mitt Watershed Council
Timeline: 2007-2010
Estimated Cost: $10,000

6. Install a demonstration best management practice at a residential site.
Responsible Organization: Tip of the Mitt Watershed Council
Timeline: 2007-2010
Estimated Cost: $2,000

RECREATION RECOMMENDATIONS

1. Educate boaters and personal watercraft (PWC) users about ecologically sound boating practices.
Responsible Organization: Tip of the Mitt Watershed Council
Timeline: 2007-2017
Estimated Cost: $5,000

2. Regularly test beach for *E. coli* bacteria counts, swimmer's itch, etc.
Responsible Organization: Northwest Michigan Community Health Agency, Larks Lake Association
Timeline: 2007-2017
Estimated Cost: $10,000

3. Perform boat counts and dock inventory to assess changes in recreational use of lake.
Responsible Organization: Larks Lake Association, Tip of the Mitt Watershed Council
Timeline: 2007-2017
Estimated Cost: $5,000

4. Improve condition of boat access sites (road ends) and implement erosion control measures at these sites.
Responsible Organization: Tip of the Mitt Watershed Council, Conservation Resource Alliance, Emmet County Road Commission
Timeline: 2007-2012
Estimated Cost: $60,000

5. Educate residents on bacteria inputs (i.e. pet waste, waterfowl). Install a pet waste bag station at the township park.
Responsible Organization: Northwest Michigan Community Health Agency, Tip of the Mitt Watershed Council, Larks Lake Association, LTBB Odawa
Timeline: 2007-2010
Estimated Cost: $5,000

ROAD/STREAM CROSSINGS:

1. Inventory road/stream crossings. Restore priority sites.
Responsible Organizations: Conservation Resource Alliance, Emmet County Road Commission
Timeline: 2007-2012
Estimated Cost: $100,000

2. Develop database method to keep track of repairs/records of culverts and problems.
Responsible Organizations: Conservation Resource Alliance, Emmet County Road Commission
Timeline: 2007-2008
Estimated Cost: $2,000

3. Work with road commission to use best management practices (BMPs) on all road maintenance/work.
Responsible Organizations: Conservation Resource Alliance, Emmet County Road Commission
Timeline: 2007-2017
Estimated Cost: $2,000

ZONING ASSESSMENT RECOMMENDATIONS

1. Provide training program to townships and planning commissions to promote conservation planning to protect water resources.
Responsible Organization: Tip of the Mitt Watershed Council, Emmet County Planning, Center Township, MSU Extension
Timeline: 2008-2012
Estimated Cost: $20,000

2. Develop a yearly summary of variances of sanitary code/zoning to determine if there are water quality impacts.
Responsible Organization: Northwest Michigan Community Health Agency, Tip of the Mitt Watershed Council
Timeline: 2007-2017
Estimated Cost: $5,000

3. Reprint and distribute brochure that lists information on permits needed and whom to contact when conducting construction or earth-changing activities that could impact water quality.
Responsible Organization: Tip of the Mitt Watershed Council, Emmet County Planning
Timeline: 2007-2009
Estimated Cost: $5,000

4. Educate watershed residents about land use issues and foster citizen involvement in local land use decision making (i.e. comment on wetland permits).
Responsible Organization: Tip of the Mitt Watershed Council, LTBB Odawa
Timeline: 2007-2017
Estimated Cost: $10,000

LAND PROTECTION

1. Distribute information to landowners about land stewardship and land protection. Develop personal contacts with landowners.
Responsible Organization: Little Traverse Conservancy
Timeline: 2008
Estimated Cost: $1,000

2. Protect and conserve wetlands throughout the watershed.
Responsible Organization: Tip of the Mitt Watershed Council, Little Traverse Conservancy
Timeline: 2007-2017
Estimated Cost: $100,000

GENERAL INFORMATION AND EDUCATION

1. Produce a summary of the watershed plan and distribute to watershed residents.
Responsible Organization: Tip of the Mitt Watershed Council
Timeline: 2007
Estimated Cost: $1,000

2. Continue to promote the Aquatic Invasive Species Patrol in the watershed and encourage data reporting to the Watershed Council. Initiate Volunteer Purple Corps to manage and control purple loosestrife.
Responsible Organization: Tip of the Mitt Watershed Council
Timeline: 2007-2017
Estimated Cost: $10,000

3. Educate boaters and residents on the impacts from invasives using informational display boards at launch sites and Township park.
Responsible Organization: Larks Lake Association, Tip of the Mitt Watershed Council
Timeline: 2007-2017
Estimated Cost: $5,000

4. Give presentations to promote the project's goals and activities.
Responsible Organization: Tip of the Mitt Watershed Council
Timeline: 2007
Estimated Cost: $2,000

5. Work with Larks Lake Association to build capacity and membership.
Responsible Organization: Tip of the Mitt Watershed Council
Timeline: 2007-2012
Estimated Cost: $5,000

6. Educate on proper disposal of household hazardous waste. Encourage participation in county disposal days.
Responsible Organization: Emmet Conservation District, LTBB Odawa
Timeline: 2007-2017

Estimated Cost: $5,000

MONITORING RECOMMENDATIONS

1. Involve lake residents in monitoring beach for bacteria and swimmer's itch.
Responsible Organization: Northwest Michigan Community Health Agency
Timeline: 2007-2017
Estimated Cost: $10,000

2. Perform inventory and map bottom substrates to determine areas of accumulated organic muck.
Responsible Organization: Tip of the Mitt Watershed Council, LTBB Odawa
Timeline: 2007-2010
Estimated Cost: $15,000

3. Work with volunteers to gather data through the Volunteer Lake Monitoring program.
Responsible Organization: Tip of the Mitt Watershed Council, Larks Lake Association
Timeline: 2007-2017
Estimated Cost: $10,000

4. Monitor the physical, chemical, and biological characteristics of Larks Lake.
Responsible Organization: Tip of the Mitt Watershed Council, LTBB Odawa
Timeline: 2007-2017
Estimated Cost: $10,000

5. Test ground water wells for bacteria, pesticides, or other toxics. Work with AmeriCorps and Lake-A-Syst programs.
Responsible Organization: Emmet Conservation District
Timeline: 2007-2017
Estimated Cost: $10,000

6. Inventory dumping sites on state lands and throughout the watershed.
Responsible Organization: Emmet Conservation District
Timeline: 2007-2010
Estimated Cost: $6,000

7. Research historical agricultural and forestry practices in the watershed.
Responsible Organization: Emmet Conservation District
Timeline: 2007
Estimated Cost: $5,000

EVALUATION

1. Document the before and after status of all physical improvements with photographs.
Responsible Organization: Tip of the Mitt Watershed Council
Timeline: 2007-2017
Estimated Cost: $5,000

2. Develop evaluation methods for the variety of information and education programs.
Responsible Organization: Tip of the Mitt Watershed Council

Timeline: 2007-2009
Estimated Cost: $5,000

3. Conduct annual evaluation and overall evaluation of implementation activities.
Responsible Organization: Tip of the Mitt Watershed Council
Timeline: 2007-2017
Estimated Cost: $10,000

Chapter Six: Information and Education Strategy

The long-term protection of Larks Lake's water quality will depend on the values and actions of future generations. Educating Larks Lake Watershed residents about how their actions impact water quality is a priority. Increasing awareness and ultimately changing behaviors is the long-term antidote for water quality protection. Target audiences for education programs are identified in Table 19.

Table 19. Information and Education Strategy Target Audiences

Sources	Target Audiences	Specific Target Audience	Priority
Stormwater runoff	Homeowners Local government officials Teachers/educators	Homeowners and residents, riparian property owners, and local government officials (county, township); business owners; teachers, educators, and students	1
Lakeshore erosion	Homeowners	Riparian property owners	2
Lawn care	Homeowners	Riparian property owners, and all watershed residents in the priority area	3
Access sites (road ends)	Road commissions Local government officials	Road commission managers, crew workers; local government officials (county, township)	3
Septic systems	Homeowners	Riparian property owners	4
Boat trailers	Recreationists	Registered boat owners	5
Road/stream crossings	Road commissions	Road commission managers, crew workers	6
Forestry activities	Forestry consultants, landowners	Forestry business consultants, landowners, MDNR	6
Household hazardous waste	All watershed residents	Homeowners, renters	7

Water resources issues are often complex to communicate through mass media such as radio, newspapers, or television. In order for this information strategy to be effective, the following guidelines for content were recommended:

- Highlight the successes of this and similar projects
- Match the message to the target audience
- Try to distill information into costs and benefits
- Utilize interesting ways to tell the story such as looking at the changes over time or tapping into positive visions for the future
- Use quality graphics and compelling images

The Information and Education Strategy was developed using our existing understanding of the target audiences. Consideration of the targeted audience's perspectives was used to create the message and identify delivery mechanisms. Additional review of the message will be done prior to the implementation of any education programs.

The information and education activities will use a variety of approaches including installing demonstration sites, building partnerships, sponsoring seminars, attending public events with displays, creating new informational materials, and distributing educational materials (Table 20). We believe this diversified approach will be the most effective in reaching our identified target audiences.

Table 20. Information and Education Strategy

Pollutant	*Source*	*Target Audience*	*Messages*	*Delivery Mechanism*	*Potential Evaluation*
Sediment	Stormwater runoff	Riparian property owners	I can make a difference to protect water quality.	Media campaign for residents and education programs for students.	Conduct follow-up survey to see if any tips were implemented
		Local government officials	Good land use decisions protect property values, quality of life, and water quality.	Develop ongoing education program for local planning officials that covers basics of water quality and tools that can help protect water quality.	Evaluation forms
	Lakeshore erosion	Riparian property owners, landscaping companies	Protect lake water quality for future generations and your investment.	Use model biotechnical erosion control site to demonstrate restoration, as well as newsletters and brochures.	Photographs and questionnaire to homeowners with erosion
	Access sites	Road commissions	Help protect water quality and save money.	Meet with road commissions to discuss standard designs that reduce pollution and are cost effective.	Photographs and interviews
	Road/stream crossings	Road commissions	Help protect water quality and save money.	Meet with road commissions to discuss standard designs that reduce pollution and are cost effective.	Photographs and interviews
	Construction	Contractors, realtors, local government officials, homeowners	Protect water quality and property values.	Prepare stormwater systems design package, give presentation at contractors' workshop, work with local governments to standardize setback distances, and use print media to educate riparians about the importance of setbacks.	Focus groups Interviews
	Forestry activities	Forestry consultants, businesses, private landowners, MDNR	Good forestry practices means good hunting and fishing.	Develop a brief handout and information packet that can be mailed to forest businesses and give a presentation at a forestry workshop.	Interviews
Nutrients	Stormwater runoff	Homeowners	Healthy environment can clean water equals a great place to live.	Advertisements in newspapers, possible insert into tax bill.	Interviews
	Lawn care	Landscaping and lawn care	Protect water quality and protect your	Sponsor seminars for landscaping companies	Interviews

Table 20. Information and Education Strategy					
		companies, homeowners, riparian property owners	investment.	to learn more about water quality friendly maintenance. Sponsor workshops and use print media to reach riparians.	
	Septic systems	Riparian property owners	Protect water quality and keep the water safe for swimming.	Meet one-on-one with property owners who may have potential septic system problems. Provide assistance to address problems. Conduct follow-up activities for shoreline survey.	Interviews
Pesticides/ Herbicides	Lawn care	Homeowners, riparian property owners	Save money, protect lake	Sponsor seminars for landscaping	Focus group and survey
Bacteria	Stormwater runoff	Pet owners	Keep the water safe for swimming and protect water quality.	Implement media campaign about proper disposal of pet waste.	Survey
Toxics	Stormwater runoff	Homeowners	We all live in the watershed—what we do on our property impacts the lake.	Media campaign with local newspapers, radio, and TV. Mail residents information on reducing nonpoint source pollution.	Survey
	Household hazardous waste	Residents (property owners and renters)	Protect your drinking water.	Promote household hazardous waste collections to residents in the watershed.	Survey
Aquatic nuisance species	Boat trailers	Registered boat owners	Don't transport aliens!	Signs at boat launch sites, wash stations, articles in boating magazines, hand-out that accompanies boat registration fee.	Survey

Evaluation Strategy

To ensure that the recommended actions are meeting the goals of the watershed plan, an evaluation will be required to determine the progress and effectiveness of the proposed activities. The evaluation step is an important part of any watershed planning effort in that it provides feedback on the success of an activity or the project's goals. It also provides communities with important information about how to conduct future efforts, or how to change the approach to a specific problem to be more successful next time. If activities are successful, this will gain more support for future activities amongst decision makers.

Evaluating the success of the Larks Lake Watershed Planning Project will be evaluated on two levels—one level will assess specific activities or projects and the other level will evaluate the project overall.

Evaluation methods generally fall under two categories: qualitative and quantitative methods. Both types of evaluation techniques will be used based on BMP or activity.

<u>Qualitative Methods</u>

Qualitative information includes words, phrases, stories, pictures that describe reactions or results of activities. Qualitative information can be subjective, but it can be a very effective way to evaluate certain components of a watershed management project. For example, it could measure whether or not people have learned new facts, changed their attitudes, or changed their behaviors about their own or others impact on water quality. Because protecting the quality of the resources is a focus of this project, information and education components are very important. A variety of techniques will be used. A written evaluation form will be used for workshops, seminars, or other events where people are gathered for a specific event. For riparian homeowners, interviews will be conducted after a certain number of the actions have been implemented to see what tools were most effective (personal visits, news articles, booklets, presentations).

Evaluating the effectiveness of programs directed towards improving land use management will require a different approach. Focus groups would be the most effective in learning how helpful the ordinances, programs, materials, maps, and other tools were for changing policy and protecting water resources. Interviews may also be used to assess the progress as the land use tasks are being implemented. A comparison study documenting the types of ordinance changes and standards adopted that have benefits to water quality could also be conducted.

The project will also utilize the *Seeking Signs of Success* (Beyer et al. 2001) publication to assist with evaluation tasks throughout the project for all components, physical improvements, information and education tasks, and land use/local government activities. This publication provides a structure to evaluate watershed management projects to measure success, document outcomes, and identify shortcomings and constraints. This method is very focused on identifying specific goals, defining success, gathering information, analyzing and then determining if success as previously defined was accomplished.

The Advisory Committee will be asked to assist with an annual evaluation of any implementation activities. Every three to five years the Committee will be asked to look over the entire list and reassess the recommendations.

Quantitative Methods

Quantitative methods show how certain water quality parameters have changed over time, and are often the result of a physical change within the Watershed. A set of criteria were developed to attempt to determine if the proposed pollutant reductions in the watershed are being achieved and that water quality standards are being maintained or improved. Since the water quality of Larks Lake is good, the goal is to maintain this good quality. The plan identified many threats to water quality and reducing these threats will be critical to maintain the good water quality and ecological health of Larks Lake. The water quality criteria include:

1. Maintain or reduce sediment loads in surface runoff draining into Larks Lake.
2. Maintain high dissolved oxygen levels (above 7 mg/l) in Larks Lake.
3. Maintain pH levels within range of 6.5 to 9.0 in Larks Lake.
4. Maintain or reduce *E. coli* levels in Larks Lake. *E. coli* levels should not exceed Michigan and US EPA water quality standards for single day (>300 *E. coli* per 100 ml of water) or 30-day geometric mean measurement (>130 *E. coli* per 100 ml of water in 5 samples over 30 days).
5. Maintain or reduce number of outbreaks of swimmer's itch in Larks Lake.

We will also document changes with photographs to evaluate the effectiveness and improvements for any components of the project that modify physical features (road/stream crossings, lakeshore erosion, stormwater management improvements, recreational access sites, etc.).

Chapter Seven: Conclusion

What will the water quality of Larks Lake be in ten years? Without the benefit of a crystal ball, we can only guess. Our goal is to protect and improve the water quality and ecosystem integrity of Larks Lake in a way that ensures all designated uses are restored and protected. The Larks Lake Watershed Planning Project will provide a framework to accomplish the following goals (related to the designated uses for public surface waters):

1. Manage nonpoint source pollution to ensure the status of the following designated uses remains supported—agriculture, industrial water supply, and public water supply at the intake point.

2. Improve and maintain navigation in Larks Lake by reducing excess sediment inputs.

3. Improve and maintain the warm water fishery by reducing inputs of sediments, toxic substances and nutrients; controlling aquatic nuisance species and protecting and restoring wetlands.

4. Improve and maintain habitat for other indigenous aquatic life and wildlife by reducing inputs of toxic substances, sediments, and nutrients; protecting and restoring wetlands; controlling aquatic nuisance species; and restoring vegetation along the lakeshore to provide shade and wildlife cover.

5. Assure that recreation (partial and total body contact) is safe by improving quality of water discharged as stormwater surface runoff; discouraging waterfowl in swimming areas; addressing possible failing septic systems; and researching and implementing control of swimmer's itch.

Larks Lake is an important resource that has been important to many people for many generations of families and visitors. We hope that the *Larks Lake Watershed Planning Project* provides the map to ensure that the waters of Larks Lake will be enhanced, restored, and protected for generations to come.

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