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CHAPTER I

Overview

A. BACKGROUND

What is watershed management?
Watershed management is an ongoing effort aimed at restoring, maintaining, and enhancing water quality by bringing together stakeholders to assess pollutant threats throughout a river's drainage basin and implementing steps to address the source for each problem. Activities on the land, such as residential development, agriculture production, and road maintenance, all have the potential to impact water quality. Of particular concern is the "critical area" - that area within 1000 feet of surface water or wetlands. The critical area is often where the greatest potential for negative water quality impacts occurs due to the proximity of surface water. Proper watershed management seeks to minimize the impact to water resources through the use of such tools as implementation of Best Management Practices (BMP), land protection, community planning, and education.

The Ocqueoc River Watershed Partnership was created to improve and protect the water resources of the river and the lakes and streams that drain into it. As a first step, funding was sought and received in 2002 for the development of a watershed management plan. This plan serves to document nonpoint source pollution occurring within the watershed, and serves as the blueprint for restoring nonpoint problem sites and minimizing future water resource problems. Nonpoint source pollution is caused when rain, snowmelt or wind carries pollutants off the land and into waterbodies. Project sponsors recognize nonpoint source pollution as the single greatest threat to water quality for the Ocqueoc River.

Funding for the watershed plan
Funding for development of the watershed plan was made available by the Michigan Department of Environmental Quality through the federal Clean Water Act Section 319 program, administered by the U.S. Environmental Protection Agency (EPA). Additional funding will need to be secured from more diverse sources for updating the plan to meet the EPA's nine required elements and for implementing many of the recommendations within the plan.

In 2005, Huron Pines Resource Conservation and Development (RC&D) Council received transitional funding through the Section 319 program to: 1) update the Ocqueoc River Watershed Management Plan to meet the criteria of the EPA nine elements, 2) conduct an Information & Education program targeted to riparian landowners, 3) develop training opportunities and resource materials for local officials, and 4) install Best Management Practices (BMP's) at Little Ocqueoc River/North Silver Creek Road crossing.

Ocqueoc River Commission
A critical component of watershed protection is to ensure the longevity of the project, making certain the watershed plan is revisited and funding is sought for necessary improvements. As a result of the Watershed Partnership during the first planning phase of the Ocqueoc River Watershed project, a more formalized river commission was formed and served as the public input forum during the transitional phase. In what may eventually come to be known as the model for river protection, the Presque Isle County Commissioners authorized the formation of an Ocqueoc River Commission January 28, 2004. Beginning in 2002, county representatives, resource professionals, riparian landowners, and other stakeholders have been participating in the plan's development aimed at identifying problems and solutions for the Ocqueoc River.

Five township supervisors and six at-large members were appointed to the commission. The volunteer commission meets regularly to discuss issues impacting the river system, respond to the concerns of residents, prioritize projects, assess funding needs, and implement on-the-ground projects or educational programs. Meeting notices are posted and the public is encouraged to attend and share their input.

Documenting resource threats

Water resource threats were documented in the Ocqueoc River Watershed through two different but equally important processes. Field inventories, conducted by the Presque Isle Conservation District and Huron Pines RC&D, were the first component focusing on assessing the high-potential areas where nonpoint source pollution may be occurring. In addition to an on-the-ground field study, an assessment of watershed nonpoint pollutant risks was completed through the use of aerial photo interpretation, a review of previous research conducted on the watershed, review of county zoning standards, and mapping and analysis of wastewater treatment records. Huron Pines RC&D and the Northeast Michigan Council of Governments (NEMCOG) performed this part of the resource assessment.

In addition to the resource study, concerns were also documented through an intensive public input process. The Watershed Partnership hosted eight public meetings at different times and in different locations throughout the course of the project. Participants included private property owners, community decision makers, resource professionals, nonprofit conservation groups, lake and citizen organizations, and other stakeholders within the Ocqueoc River Watershed.

The public meetings were held to discuss concerns about water quality and to guide the development of the management plan. The group identified various issues and concerns within the watershed. Those in attendance had the opportunity to help set priorities for the watershed project by voting through a nominal group process at several meetings and through a written opinion survey. Specifically, the group's input in this plan was used to generate a list of watershed concerns; rank watershed pollutants, sources, and causes; generate a list of watershed goals; and prioritize specific objectives and tasks. The project partners also wanted to ensure that the public had an opportunity to comment early on in the process, therefore a two-page survey was mailed to all property owners in the Ocqueoc Watershed.

Project goals

Recommendations for protecting water resources in the Ocqueoc River Watershed are included in Chapter V of this plan and highlight specifics tasks needed to implement the objectives, funding needs, and the name of the organization or individual who will provide the leadership to ensure the project is implemented. These strategies are organized under the watershed goals listed below:

- Protect the watershed's fishery population and navigation by reducing the amount of erosion, particularly that caused by human activities, which is negatively impacting the river.

- Safeguard fisheries, aquatic life, public water supply, and body contact recreation by reducing the amount of nutrient loading to surface water.

- Protect the fishery and other aquatic life by restoring a more natural flow regime to the river system.

- Conserve important wildlife habitat areas.

- Enhance and protect the Ocqueoc River Watershed by promoting stewardship, education, and responsible use of the watershed.

Prioritizing restoration projects: benefits and costs of watershed management

Watersheds must be managed as a whole system in order to achieve success in protecting water quality. Projects that address the symptoms at single site are often expensive and fail to address the root cause of a pollution problem.

When selecting Best Management Practices -- whether they are structural, vegetative, managerial or educational -- the proposed solution must include a cost-benefit analysis, a determination whether the proposed solution will actually fix the problem or merely provide a band-aid solution, a thorough understanding of the cause of the problem and the selection of an appropriate solution. Strategies for watershed management can be divided into either pro-active techniques for protecting water quality or methods for restoring problem sites.

For selection of site-specific BMPs, sites in the upper watershed are generally preferred to those in the lower, as the water quality benefits will be greater. Sites along more sensitive waterbodies in the watershed, such as Silver Creek (a coldwater stream that can provide excellent brook trout habitat) and the Little Ocqueoc River, are typically a higher priority for conservation projects by resource managers than a site that has already been degraded, such as the mouth of the river, where the habitat benefits are less. Implementing projects, of course, is always contingent on available funding and other factors, such as property owner willingness and project partnership.

Through utilization of this watershed management plan, efforts to implement water quality protection projects will be better coordinated and more effective and will apply the appropriate skills of the many stakeholders within the Ocqueoc River Watershed.

Map 1 Watershed Map

B. DESCRIPTION OF THE OCQUEOC RIVER WATERSHED

1. Geography

Located in Presque Isle County, the Ocqueoc River Watershed encompasses approximately 94,394 acres. The area is very rural, with tourism, farming, forestry and resource extraction the predominant commercial activities. The county itself has nearly 20% public (state) land, which is an attraction for hunting, fishing, wildlife watching, snowmobiling, skiing, and other outdoor activities. The Ocqueoc River is known for having the largest waterfall in the Lower Peninsula and is a popular tourist and recreation site.

The region is underlain by pre-glacial limestone bedrock. Bedrock is close to the surface and exposed in many areas. Much of the Ocqueoc Watershed exhibits karst geology, characterized by sinkholes, caves, cracked limestone, and swallowholes. Karst areas are very susceptible to pollution since they can serve as a direct conduit for surface runoff to contaminate ground water aquifers. The karst geology of the region is of special concern, as the relationship between ground and surface water is not fully known. Sinkholes can be observed in the region, as well as stream sections that “disappear” underground and re-emerge downstream.

The Ocqueoc River Watershed does not include the major population centers of the county (Rogers City and Onaway), but is experiencing increased development, particularly along the waterfront. There remain significant areas of undeveloped land, giving parts of the Ocqueoc River system a semi-wilderness character.

The main branch of the Ocqueoc River is approximately 30 miles long. Major tributaries include Silver Creek, Little Ocqueoc, and Indian Creek. At least 25 lakes are named within the watershed, many of which are a part of the main branch or drain directly to the river. There are also several small unnamed lakes.

The watershed includes the townships of Bismark, Case, Ocqueoc, Bearinger, and Moltke. (A very small portion of the watershed is located in northern Montmorency County but contains no surface water.) Presque Isle County was legally established in 1875, having previously been a part of Mackinac, then Cheboygan, and then Alpena counties. In the late 1800s, German and Polish immigrants began lumbering the area; French Canadians came to the area in 1870. Early settlers lived on fish, as water routes from the south were cut off. Sturgeon were caught in Hammond Bay and lake trout were caught at the outlet of the Ocqueoc River.

2. Hydrology

Surface water accounts for approximately 1,620 acres within the watershed. At the southernmost extent of the watershed, the headwaters area, numerous small lakes and large wetland complexes can be found. Many of the lakes were flooded artificially by impoundments. As expected, waters in this portion of the watershed support a warmwater fishery. At least 14 of the lakes appear to have a direct surface water connection to the Ocqueoc River.

The main branch of the river, as it leaves the “chain of lakes,” enters the only “urban” area of the watershed, the small town of Millersburg with a

population of 263 according to the 2000 Census. Dams and removal of vegetation in and around this section of river contribute to sedimentation and increase stream temperatures. As the river flows over the Ocqueoc Falls, rock outcroppings can be observed: a rare occurrence in northern Michigan. The swift flow of the stream in this section results in an area much different in character from both the upper and lower parts of the watershed.

The two major tributaries to the Ocqueoc, Little Ocqueoc and Silver Creek, are coldwater streams that enter the main branch between the falls and Ocqueoc Lake. In the future, the quality of these two streams will be closely tied to land use. As the mainstream of the river flows north, water temperature actually decreases due to the gradual declining influence of the lakes and impoundments in the upper watershed and inputs from groundwater fed tributaries. Fish cover (i.e., large woody debris) seems to be abundant throughout the watershed.

The river does experience fluctuating water flows, which can be observed by noticing numerous sand deposits adjacent to the river, deposited during high-flow events.

Downstream from Ocqueoc Lake, the river is relatively straight with little streambank erosion. However, at about the halfway point between the lake and the river mouth, streambanks become very high. Sandy banks and very sharp bends in the river contribute to very heavy erosion problems in this area. Stabilization of this area would be extremely difficult, as the river will continue to naturally meander and erode the high sandy banks.

3. Soils Associations

Approximately 52% of the land within the watershed is dominated by upland forest, with 18% agriculture, 24% lowland forest/wetland, 4% surface water, and 2% residential development. Bedrock is close to the surface and rock outcrops are common. Variations in elevation are not extreme, ranging from 580 feet at Lake Huron to a high of 930 feet in the upper part of the watershed.

According to the *Soil Survey of Presque Isle County* (published by the USDA – Natural Resources Conservation Service, 1993) the major soil associations within the Ocqueoc River Watershed are (listed generally from the headwaters to the river's mouth):

Au Gres-Roscommon Association: Nearly level and very gently sloping, somewhat poorly drained and poorly drained, sandy soils on outwash plains, lake plains, and till plains. The slope of the major soils in this association ranges from 0 to 3 percent. Most of the soils in this association are used as woodland, as they are poorly suited for cropland and pasture. Droughtiness and the hazard of soil blowing are major management concerns if these soils are used as cropland or pasture. Wetness is an additional management concern in areas that are not adequately drained. The soils in this association are poorly suited or unsuited to building site development and septic tank absorption fields. Excess water and a poor filtering capacity are the major management concerns.

Cathro-Lupton-Tawas Association: Nearly level, very poorly drained, mucky soils on lake plains, outwash plains, till plains, and moraines. The slope of the major soils in this association ranges from 0 to 2 percent. These soils are in depressions, drainageways, bogs, and swamps. The soils in this association are unsuited to cropland and pasture and to building site development and septic tank absorption fields.

Croswell-Pinconning-Hettinger Association: Nearly level and gently undulating, moderately well drained and poorly drained, sandy and loamy soils on lake plains, outwash plains, beach ridges, and terraces. The slope of the major soils in this association ranges from 0 to 3 percent. Most

areas of this association are used as woodland; some is used for cropland or pasture. Excess water, seedling mortality, and soil blowing are major management concerns. The soils in this association are poorly suited or unsuited to building site development and septic tank absorption fields. Excess water and restricted permeability are the major management concerns.

Emmet-Onaway-Omena Association: Nearly level to hilly, well drained and moderately well drained, loamy soils on drumlins and ground moraines. The slope of the major soils in this association ranges from 0 to 25 percent. These soils are generally used for cropland or pasture, with some used as woodland. Depending on the slope, the soils in this association are well suited, moderately well suited, poorly suited or unsuited to building site development and septic tank absorption fields.

Rubicon-Cheboygan-Graycalm Association: Nearly level to steep, excessively drained to well drained, sandy soils on moraines, drumlins, outwash plains, and till plains. Much of the acreage in the Ocqueoc River Watershed is under this association. The slope of the major soils in this association ranges from 0 to 35 percent. The slope is the key to determining whether these soils are suitable for cropland, woodland, and building site development. The Rubicon and Graycalm soil of this association are a management concern because of their poor filtering capacity.

Moltke-Grace-Glawe Association: Nearly level to undulating, well drained to poorly drained, loamy soils on lake plains, outwash plains, and deltas. The slope of the major soils in this association ranges from 0 to 6 percent. Depending on drainage, the soils in this association are moderately, poorly, or unsuited for site development. Excess water and restricted permeability are the major management concerns. Water erosion is a hazard in the undulating areas of the Grace soils.

East Lake-Deer Park Association: Nearly level to very steep, somewhat excessively drained and excessively drained, sandy soils in outwash plains, eskers, beach ridges, and sand dunes. The slope of the major soils in this association ranges from 0 to 45 percent. Most areas in this association are woodland, with some used for building site development. Depending on the slope, this association is well suited, poorly suited, or unsuited to building site development and septic tank absorption fields. The soils are poorly suited or unsuited for cropland and pasture.

Map 2: General Soils Map

4. Land Use/Land Cover

Developing an accurate representation of existing land use conditions within the Ocqueoc River Watershed critical area is a crucial step of the land use planning process. The type and intensity of land use may contribute to nonpoint source pollution if adequate prevention measures are not incorporated during the development phase. It is also important to maintain various water protection standards after development has occurred.

a. Methods

The Northeast Michigan Council of Government's Geographic Information System (GIS) was used to produce the land cover maps in this report. The digital land use polygons were placed over the 1998 digital aerial photo images. These were then modified to reflect the land use at the time that the aerial photos were taken. The categories of land use were updated using the Michigan Resource Inventory System (MIRIS) classifications. Those classifications were then merged into 11 categories for map display purposes: Residential, Commercial, Industrial, Institution/Recreational, Agricultural, Nonforest, Upland Forest, Lowland Forest, Wetlands, and Surface Water. The following table lists categories of land use within the critical area (35,384 of the 94,394 acres) of the Ocqueoc River Watershed. Map 3 displays the current land use.

b. Results

Table 1 depicts each land use classification within the critical area in number of acres and percentage of the critical area.

Table 1: Land Use Classifications in the Critical Area of the Watershed

Land Use	Number of Acres	Percentage
Residential	663	1.87%
Commercial	38	0.11%
Industrial	192	0.54%
Institution/Recreational	51	0.14%
Agricultural	3,555	10.5%
Nonforest	1,374	3.88%
Upland Forest	18,229	51.52%
Lowland Forest	7,003	19.79%
Wetlands	2,659	7.52%
Surface Water	1,620	4.58%
Total for Critical Area	**35,384**	**100%**

The following definitions describe the various land use classifications:

Map 3-Land Use

Residential: Residential land includes residential dwelling structures such as single family or duplexes, multi-family low-rise residential, multi-family medium & high rise residential, and mobile home parks. The total residential land use in the critical area is 663 acres (1.87%). The largest concentration of people in the watershed is the Village of Millersburg (pop. 263), although much of the new development is along the waterfront. From 1980 to 2000, the population of Bismark Township increased from 278 to 408; Case increased from 830 to 942; Ocqueoc increased from 578 to 634; Bearinger increased from 235 to 329; and Moltke increased from 326 to 352.

Commercial: The commercial land category includes classifications related to the sale of products and services such as central business districts, shopping centers/malls, strip commercial, and neighborhood compact groups of stores that are surrounded by noncommercial uses. This category includes parking areas related to the commercial businesses. The total commercial land in the Ocqueoc River Watershed critical area is 38 acres (0.11%).

Industrial: Industrial land includes manufacturing and industrial parks, light industries that fabricate or package products, oil & gas drilling and production facilities, quarry operations, lumber mills, chemical plants, brick-making plants, large power facilities, waste product disposal areas, areas of stockpiled raw materials, and transportation facilities that normally handle heavy materials. The total industrial land in the Ocqueoc River Watershed critical area is 192 acres (0.54%).

Institution/Recreational: Institution/recreational land includes a variety of classifications such as education, government, religious, health, correctional, and military facilities, all indoor and outdoor recreational facilities, and all cemeteries. The buildings, parking areas, and immediate grounds are included in this category, however all surface water, forest, barren land, and wetlands associated with these facilities are entered into their own respective categories. The total institution/recreational land use in the critical area is 51 acres (0.14%).

Agricultural: The agricultural land use category generally includes land that is used for the production of food and fiber, as well as land used for non-food livestock such as horses. These classes are cropland, orchards (including vineyards and ornamental horticulture), confined feeding operations for livestock of any kind, permanent pasture lands, farmsteads, greenhouse operations, and horse training areas. The total agricultural land in the Ocqueoc River Watershed critical area is 3,555 acres (10.5%). Farming has declined through the years (in 1959, about 31% of Presque Isle County was in agriculture production, compared to 20% in 1993). The major crops are potatoes, dry beans, corn, small grains, and hay. Livestock account for about 32% of the total agricultural land.

Nonforest: Nonforest land includes “open land” and rangeland classifications such as barren land, herbaceous open land, and shrubland. Herbaceous open land is usually subjected to continuous disturbance such as mowing, grazing, or burning, and typically it can have a variety of grasses, sedges, and clovers. Shrubland is land in transition from being open to becoming forested. It contains native shrubs and woody plants like blackberry, dogwood, willow, sumac, and tag alder. The nonforest land in the Ocqueoc River Watershed critical area is 1,374 acres (3.88%) of the total land area.

Upland Forest: Forest land areas are generally at least 10% covered by trees of any size. The upland forest category includes upland hardwoods like maple & beech, other upland species like aspen & birch, species of pine like red, white or jack pine, and other upland conifers like white spruce, blue spruce, eastern hemlock, and balsam fir. Upland forest in the Ocqueoc

River Watershed critical area comprises the majority of land use with a total of 18,229 acres (51.52%) of the land area.

Lowland Forest: Lowland forest areas are dominated by tree species that grow in very wet soils. Lowland hardwoods include ash, elm, soft maple, cottonwood and others. Lowland conifers include cedar, tamarack, black and white spruce, and balsam fir. The lowland forest in the Ocqueoc River Watershed critical area covers 7,003 acres (19.79%) of the total land area.

Wetlands: Wetlands are those areas where the water table is at or near the land surface for a significant part of most years. Examples of wetlands are marshes, mudflats, wooded swamps, shallow areas along rivers, lakes or ponds. Wetlands areas include both non-vegetated mud flats and areas of hydrophytic vegetation. Wetlands in the Ocqueoc River Watershed critical area cover 2,659 acres (7.52%) of the land.

Surface Water: The surface water category includes areas such as lakes, reservoirs, ponds, rivers and streams. Surface water in the Ocqueoc River Watershed critical area covers 1,620 acres (4.58%) of the total land area.

5. Presque Isle County Future Land Use Planning

An important issue to be considered in watershed planning is future development and growth, particularly in riparian areas where increased development can also increase nonpoint source pollution to water bodies. Presque Isle County has prepared a comprehensive plan, which addresses future development needs. A future land use plan takes into consideration existing natural resources and the natural capacity of land to withstand increased growth and development.

The following is an excerpt from the *Presque Isle County Comprehensive Plan*, 2004 discussing future waterfront design considerations:

> *Any new development along or near lakes and streams will require a greater standard of review to maintain or improve the quality of the County's resources. Water features serve as important recreational, economic and natural assets within the County, which are and will continue to be popular locations for residential growth. Future development proposals should address issues including erosion control, minimum building elevations, setbacks from high water mark of Great Lakes and inland lakes and streams, stormwater runoff, septic field setbacks from water, shoreline buffering and lower density development. These considerations are intended to grant private development access to the features with the expectation that higher standards will be necessary.*

With careful planning to protect streams, rivers, lakes, wetlands and ground water, future development can be implemented which balance the natural environment of a watershed with desired community growth.

The future land use map (map 4) serves as a guide for potential future growth within the watershed and should not be confused with the County's zoning map, which is law.

Map 4: Future Land Use Map

6. Fisheries and Biological Surveys Conducted in the Ocqueoc River Watershed

The Michigan Department of Natural Resources (DNR) Fisheries Division has surveyed many of the lakes in the Ocqueoc River watershed and the river itself. Survey methods for lakes normally include the use of large mesh fyke nets, large mesh trap nets, and/or 125' inland gill nets. Streams are normally surveyed using standard stream shocking electrofishing gear.

a. DNR Fisheries Surveys

Northern pike in the Ocqueoc River watershed are very slow-growing. This slow growth has resulted in a regulation of 'no minimum size limit' for northern pike in the lakes within this watershed. The regulation took effect in 1973 and remains in effect today.

The DNR will be conducting stream temperature studies at various locations within the Ocqueoc River Watershed in 2006. Results of a temperature study can help prioritize installation of Best Management Practices. For example, an inadequate road stream crossing or impoundment can increase stream temperature creating an inhospitable environment for certain trout species.

Lake May
Lake May was last surveyed in June 2003. Ten species of fish were captured including black crappie, bluegill, largemouth bass, northern pike, pumpkinseed, and yellow perch. Bluegill was the most abundant species, with a good length-frequency distribution to 8 inches. The low numbers of 9 inch and larger fish indicate that anglers are likely cropping off the larger fish. While numbers of largemouth bass are not high, they are well distributed across many size classes. Pumpkinseed and yellow perch also have a good distribution of sizes, although numbers are somewhat low. There is also a good distribution of northern pike, with a good percentage of fish 25 inches or larger. Overall, the fish community is balanced.

Lake Emma
Lake Emma was last surveyed in May 2003. Panfish populations appear to be doing well in this lake, with a good size distribution of both bluegill and pumpkinseed up to 8 inches. The low numbers of 9 inch fish and larger indicate that the larger fish are getting cropped off by anglers. Numbers of predatory species (largemouth bass and northern pike) are good, with a good prey base of small bluegill.

Lake Nettie
Lake Nettie was last surveyed in June 1995. The survey found excellent panfish populations, especially bluegill and black crappie. Pike were also abundant, with small pike dominating the catch. Largemouth bass were present in good numbers with a good size distribution.

Upper and Lower Barnhart Lakes
Upper and Lower Barnhart Lakes were last surveyed in 2001. Bluegill were abundant in the lakes with good sizes and a wide range of ages represented. Additional panfish, such as black crappie, were less abundant but could be found up to 14-inches in length. Both largemouth and smallmouth bass can be found in the Barnhart Lakes with largemouth bass much more common. Northern pike were abundant, but, like other lakes in the watershed, had poor growth.

Ocqueoc Lake
Ocqueoc Lake was last surveyed in May 1998, and appeared to have a balanced fish population. The northern pike, walleye, and black crappie deserve special note as having a

decent size distribution of fish. Ocqueoc Lake is stocked with spring fingerling walleye every two to three years.

Ocqueoc River
MDNR Fisheries Division surveyed a 1000-foot reach of the Ocqueoc River in August 1995. This survey was conducted to assess the annual brown trout plants. Marginal survival of trout plants was observed. A few anglers reported acceptable fishing, but pressure was suspected to be light. The size structure was indicative of poor growth or cropping of fish by anglers. The brown trout stocking was discontinued after the 1995 survey, and was replaced by annual steelhead plants. The river currently receives spawning runs of stocked steelhead and some chinook salmon.

b. DEQ Biological Surveys

MDEQ staff conducted biological surveys in July 1995 of the Ocqueoc River at Domke Road, Ocqueoc River at Walker Road, Ocqueoc River at Forest Camp Road, Little Ocqueoc River at Silver Creek Road, Silver Creek at Silver Creek Road, and an unnamed creek at Pomranke Road.

MDEQ staff reported that overall stream habitat was “good” to “excellent” in all stations surveyed except Silver Creek and the main branch of the Ocqueoc at Domke Road. Impaired conditions at these sites were caused by sediment inputs from road/stream crossings. In addition, for the Domke Road site, past and current livestock access (to an unnamed tributary upstream) is contributing to the problem.

MDEQ also reported that the macroinvertebrate community was “good” at all six of their survey stations, with the exception of the Ocqueoc River site at Walker Road. The macroinvertebrate community was considered moderately impaired at this location; the site was likely influenced by the open canopy and low stream gradient. The staff noted that further assessment is needed to determine whether upstream impoundments or activities in Millersburg are also contributing to the problem.

The study was repeated in August 2000 at Ocqueoc River at Domke Road and Ocqueoc River at Forest Camp Road. Upstream habitat rated “good” and “excellent” at the sites respectively, while the macroinvertebrate community ranked “acceptable” and “excellent” indicating that both sites met the DEQ designated use of “other indigenous aquatic life”. All water quality parameters were within expected ranges for the Northern Lakes and Forests Ecoregion and met Michigan Water Quality Standards.

The DEQ Biological Studies are scheduled on a five-year rotation per watershed or Ecoregion area. Study parameters were collected in the summer of 2005 for various locations within the Ocqueoc River Watershed; however data were not available for inclusion in this report.

Complete copies of the MDEQ staff reports are included as Appendix A to this document.

7. Historic Watershed Resource Studies, Projects, and Issues

The Ocqueoc could aptly be called Michigan’s “undiscovered” river, as development within the watershed is very low, river protection efforts have been sparse, and monitoring studies to document changes in the river’s health have been almost non-existent.

Water Quality Monitoring

At this time, there is no ongoing water quality monitoring program for the Ocqueoc Watershed. While a watershed-wide diagnostic study can be expensive, it is important for setting a baseline of information. The Michigan Department of Natural Resources does conduct fish studies periodically on a few of the lakes within the watershed; this inventory typically includes a temperature profile of the waterbody and visual observations about vegetation. The Michigan Department of Environmental Quality last conducted monitoring at several sites in 2005 and will likely return to these in the near future. Setting up a volunteer monitoring program with property owners or school groups would help address this need.

Ocqueoc River Project

This project was intended to reduce erosion at the most severe sites in the watershed. The implementation phases of this project occurred in 1983 through 1988. A total of 80 sites were treated with Best Management Practices funded by the RC&D program and installed by the Conservation District.

- 62 sites were seeded
- 3 log structures sites (1211 lineal feet)
- 16 major log jams removed
- 1 cattle crossing
- 2 cattle ramps
- 1 rock chute
- 120 feet stairways
- 200 feet rustic fencing
- 5,099 feet of barbed wire fencing on three farms for livestock exclusion
- 46 sites were treated with rock riprap; this amounted to a total of 2.6 stream miles and 10,320 tons of rock
- 6 high banks were planted with beach grass

The total cost of this project was $320,409.

Sea Lamprey Control Project

On July 16 – 25 (2002) the U.S Fish and Wildlife Service applied Lampricide to the Ocqueoc and the tributaries of Silver Creek and the Little Ocqueoc. The project was started in 1968, and has been repeated every 3 to 5 years. A new sea lamprey trap was installed in 1999 at the Ocqueoc Lake Road Bridge, replacing the US-23 site. At this time the trap is working so well that Lampricide treatment should be discontinued for any rivers or streams south of the Ocqueoc Lake Road Site.

Land Protection

HeadWaters Land Conservancy has developed a new initiative to work with property owners to protect “Big Lands” in northeast Michigan. Such an initiative, along with protection of smaller parcels along the waterfront, could help to maintain the water quality and wild character of the Ocqueoc Watershed and help ensure that future development has a minimal impact on water resources.

Enforcement of the Clean Water Act

Land development actions by property owners in the watershed, including dam construction, pond, diversion of stream flow, pond creation, and disposal of dredged soils, have occurred in the last twenty years without prior procurement of a permit for these activities. Often, such actions have a significant, though unintended, negative impact to the river, its inhabitants, and downstream property owners. Several of these, such as the diversion of Silver Creek for pond creation, have been followed up with enforcement action by the State of Michigan. (Dams and pond creation on a stream such as Silver Creek will increase water temperature, resulting in a degraded coldwater

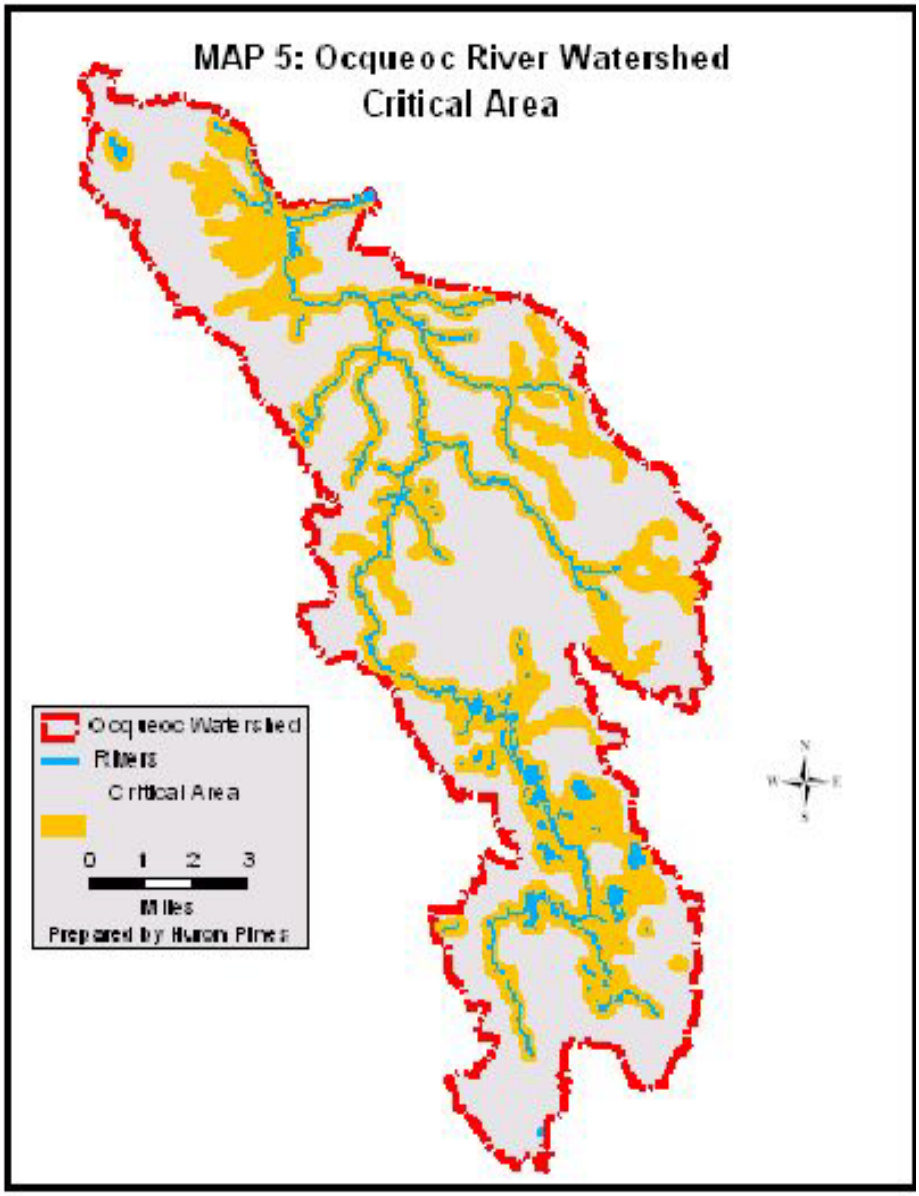
fishery, restriction of fish passage, and accelerate downstream erosion.) Increased education programs, targeted directly to landowners, are needed to minimize such problems in the future. Once damaged, restoration rarely returns the site to a natural state and can be very expensive to property owners who try to do so.

CHAPTER II

Water Resource Threats and Impairments

A. CRITICAL AREA

For this watershed project, the “critical area” is defined as that portion of the watershed that is most likely to impact water quality. Thus, the area of land that serves as an aquatic buffer around surface water resources is the critical area. An ideal calculation of this area would be made based on soil type, slope of the land, amount of impervious surface, and type of vegetative cover present. However, it is common for watershed management efforts to use proximity to surface water as the determining factor in order to provide an easily defined boundary of the critical area. Like many other watershed projects, the land area within 1,000 feet of surface water was used as the guideline for this project. While land use throughout the watershed is important in determining water quality, the nonpoint source inventory focused on this 1,000 foot critical zone as a priority area for study. Map 5 shows the critical area of the Ocqueoc River Watershed (shown in orange).



B. WATER QUALITY STANDARDS – MEETING THE DESIGNATED USES

All of Michigan's surface waters are designated to meet minimum Water Quality Standards in order to protect the public's health and welfare, to enhance and maintain the quality of water, and to protect the state's natural resources. Pursuant to the Water Resources Commission Act (P.A. 451 of 1994, Part 31, R323.1100 of Part 4), all surface waters of the State of Michigan shall be protected for all of the following uses:

1) Agricultural: Water supply for cropland irrigation and livestock watering
2) Industrial: Water utilized in industrial processes
3) Public water supply: Safe public drinking water source
4) Navigation: Supports navigation of inland waters
5) Warm or cold water fishery: Supports reproduction of warm- or cold-water fish
6) Indigenous aquatic life and wildlife: Supports reproduction of other indigenous animals, plants and insects
7) Partial and/or total body contact recreation: Water quality standards are maintained for boating, skiing, swimming, canoeing and wading

If a waterbody or portion of a waterbody is not meeting these standards, it is considered by the state to be at "non-attainment" status. MDEQ annually publishes a non-attainment list. Currently, the Ocqueoc is not on the non-attainment list. However, there are threats to the designated uses that are listed in Table 2.

Table 2: Threatened & Impaired Designated Uses

Designated Use	Threatened or Impaired
Public water supply	Threatened
Navigation	Threatened
Warm or cold-water fishery	Threatened
Indigenous aquatic life and wildlife	Threatened
Partial and/or total body contact recreation	Threatened

C. DESIRED USES AND ADDITIONAL STEERING COMMITTEE CONCERNS

At the July 30, 2002 meeting of the Ocqueoc River Watershed Partnership, participants identified the following aquatic resource issues, threats and/or concerns to help guide future project efforts:

- Erosion on riverbanks and the resultant sedimentation, particularly on the lower stretch of river
- Impoundments on the river – impact on the temperature/fishery
- Impoundments on the river – condition/ownership
- Removal of water for agricultural use
- Residential development
- Loss of vegetative buffer zones along the waterfront
- Septic systems (malfunctioning/poorly maintained)
- Removal of instream aquatic habitat (e.g., woody material)
- Fertilizers/pesticides
- Unique groundwater characteristics of the watershed (karst)
- Long-term climate trends

- Road/stream crossings
- Off-road vehicles
- Invasive exotic species (such as Eurasian watermilfoil in the chain of lakes)
- Lamprey and lamprey control measures
- Compatibility of recreational uses
- Impact of agriculture (e.g., runoff)
- Fishing – erosion and trespass concerns
- Enforcement of fishing regulations
- Riparian laws
- Lack of zoning regulations
- Hydrology – "flashiness" of the river
- Wetland loss
- Endangered species
- Oil & gas wells
- "Big Cut" chemical site

This list provided a starting point for Watershed Partnership discussion and helped with planning resource inventories. At subsequent meetings, additional concerns included:

- Excessive sedimentation and weed growth in channel on the south end of Ocqueoc Lake
- Poor maintenance of culverts – often blocked
- Streambank erosion on the lower section of the river as a result of trespass by anglers

In addition to the designated uses and their general watershed concerns listed above, the Watershed Partnership also expressed a strong desire to conserve important areas for both aquatic and wildlife habitat and incorporate pro-active watershed educational outreach programs. These desired uses are reflected within the watershed plan as key strategies to implement. Specifically, at the group's September 23, 2002 meeting, the following desired uses were proposed:

Table 3: Desired Uses
➢ Balance recreation with property owner rights and river ecology. ➢ Maintain instream woody material in such a way as to benefit fishery, but allow canoe passage in navigable waters. ➢ Investigate possibility of establishing a canoe trail. ➢ Protect and maintain loon habitat within the watershed. ➢ Identify potential areas for voluntary conservation easements with property owners. ➢ Improve management of already established access (fishing/boating) sites.

D. KNOWN AND SUSPECTED POLLUTANTS

Nutrients, sediment, pesticides, and exotic species were identified as the main pollutants of concern that threaten the designated and desired uses of the Ocqueoc Watershed. Table 4 shows the Designated Use and the Known and Suspected Pollutants threatening that particular use. In most cases a single designated use is being threatened by several different pollutants.

Table 4: Known and Suspected Pollutants which Threaten the Designated Uses	
Designated Use	**Pollutants**
Warm Water Fishery	Nutrients (K) Sediment (K) Pesticides (S) Invasive exotic species (K) Pathogenic bacteria and viruses (S)
Cold Water Fishery	Elevated Water Temperature (K) Nutrients (K) Sediment (K) Pesticides (S) Invasive exotic species (K) Pathogenic bacteria and viruses (S)
Other indigenous aquatic life/ wildlife	Nutrients (K) Sediment (K) Pesticides (S) Invasive exotic species (K) Pathogenic bacteria and viruses (S) Heavy metals, i.e. mercury, PCBs, metals (S) Solid waste (S)
Partial and total body contact recreation	Nutrients (K) Pesticides (S) Invasive exotic species (S) Pathogenic bacteria and viruses (S) Solid waste (S)
Public water supply	Nutrients (K) Pesticides (S) Household hazardous waste (S) Fuels, oils, greases (S) Pathogenic bacteria and viruses (S)
Navigation	Sediment (K) Nutrients (K) Invasive exotic species (K) Organic material (K) Fluctuating water flow (K)

In order to address each of these pollutants, it is important to identify the source of the problem and the underlying cause for each. Over 900 surveys were sent to watershed residents and the Watershed Partnership asking them to rank the sources and causes of the pollutants. A copy of the survey and results are included in Appendix B. Sediment, nutrients, and pathogens were the top three pollutants of concern in the watershed. Following discussion of the survey results, the committee used the nominal group process to prioritize the pollutants, sources, and causes. Table 5 lists these pollutants, sources, and causes as prioritized by the committee.

Table 5: Pollutants, Sources, and Causes		
Pollutant	**Source**	**Cause**
Sediment	1) Road/stream crossings	1a) Poorly designed crossings 1b) Poor maintenance practices
	2) Streambank erosion	2a) Lack of vegetation on the banks 2b) Foot traffic 2c) Bends in river 2d) Fluctuating water levels
	3) Access sites/road ends	3a) Poorly maintained 3b) More use than site can handle
	4) Construction	4a) Poor setback requirement for development along waterfront (30ft) 4b) Excessive clearing of vegetation 4c) Runoff from erosion sites 4d) Poor location of residential development
	5) Shoreline erosion	5a) Removal of vegetation 5b) Fluctuating water levels
Nutrients	1) Septic systems	1a) Systems put in place before adequate regulations 1b) Undersized systems 1c) Poorly maintained systems
	2) Fertilizer use	2a) Poor application/overuse by homeowners along waterfront
	3) Livestock	3a) Unrestricted access to water, leads to waste in water & (often) streambank erosion
	4) Stormwater runoff	4a) Lack of filter strips
Pathogens	1) Septic systems	1a) Systems put in place before regulations 1b) Undersized systems 1c) Poorly maintained systems
	2) Livestock	2a) Unrestricted access to water, leads to waste in water & streambank erosion
Elevated water temperature	1) Impoundments	1a) Humans 1b) Beavers
	2) Runoff	2a) Impervious surfaces located too close to surface water 2b) Runoff from impervious surfaces discharged directly to surface water
	3) Loss of vegetative cover along the riparian corridor	3a) Removal of vegetation by landowners

Table 5: Pollutant Sources and Causes (cont.)		
Pollutant	**Source**	**Cause**
Fluctuating water flow	1) Runoff	1a) Increased development accelerating runoff, creating a "flashier" river
	2) Impoundments	2a) Humans 2b) Beavers
Invasive exotic species	1) Recreational watercraft	1a) Lack of awareness
	2) Migration from Lake Huron	2a) Natural migration of species
Pesticides	1) Homeowners	1a) Improper application and disposal 1b) Lack of disposal facilities
	2) Agriculture practices	2a) Improper application and disposal
	3) Control methods for exotic species	3a) Lack of integrated pest management plan for invasive species
Oils & Greases	1) Stormwater runoff	1a) Impervious cover—poorly sited parking areas, roads, etc. 1b) Stormwater BMPs rarely utilized
Trash	1) Recreational users	1a) Lack of facilities 1b) Apathy

CHAPTER III

Watershed Resource Assessment

Chapter III summarizes resource studies conducted to analyze the risk to surface water in the Ocqueoc Watershed. These studies can be broken down into two general categories: (A) field studies documenting nonpoint source pollution and (B) other resource studies.

Field inventories for this project included a site assessment of all road/stream crossings in the watershed, documentation of streambank erosion for all navigable stretches of river and at all access points, and an inventory of all agricultural operations within 1,000 feet of surface water. Huron Pines RC&D re-inventoried the road/stream crossing sites in 2005, while the Presque Isle Conservation District (PICD) conducted the agriculture and streambank erosion inventory. In addition, the PICD and Huron Pines performed a shoreline development inventory for all lakes with a direct surface water connection to the Ocqueoc River.

Huron Pines RC&D, with the assistance of District Health Department #4, documented and analyzed risk assessment of on-site wastewater treatment practices. The Northeast Michigan Council of Governments updated the land use information. A review of land use planning and zoning practices in the watershed was completed by Huron Pines RC&D, and a biological survey conducted by MDEQ.

A. NONPOINT SOURCE POLLUTION INVENTORIES

Nonpoint source pollution is the primary pollution threat facing the water resources of the Ocqueoc River Watershed. Nonpoint source pollution is any pollutant carried off the land by water or wind and deposited into surface water. It is so pervasive that it is difficult to control on a watershed scale. The purpose of this watershed management plan is to combat nonpoint source pollution by inventorying pollutant sources, prioritizing the areas of concern and developing management recommendations. Project partners will implement these recommendations in order to restore and protect the water resources and wildlife habitat of the Ocqueoc River Watershed.

The most common nonpoint source pollutant in nearly every rural river system is sediment. Sediment degrades habitat for fish and aquatic insects and contributes to the widening of the stream channel and the associated increase in stream temperature. Sources of sediment typically include road/stream crossings, streambank erosion, runoff from impervious surfaces and construction practices, shoreline erosion, and runoff from agricultural operations.

Excessive quantities of nutrients, particularly phosphorus, are often the major pollutant in lake ecosystems. The addition of artificially high amounts of nutrients contributes to high levels of algae and aquatic plant growth. As these plants eventually die off, they can consume dissolved oxygen and thus degrade fish habitat. Nutrient inputs are often tied closely to residential development, and can come from such sources as septic systems and fertilizer use. Oftentimes the protective shoreline vegetation is removed as a result of development. Loss of the natural shoreline can contribute to erosion, accelerate nutrient runoff, eliminate wildlife habitat, and reduce the effectiveness of nutrient uptake by root systems.

Other common watershed pollutants include such things as thermal pollution, pathogens, oils and greases, fluctuating water levels, salts, metals, animal waste, and organic matter.

Resource inventories for this project were designed to explore the possible sources and causes of pollution in this watershed. The focus was on the critical area, a 1000-foot aquatic buffer zone that

represents the most likely area for nonpoint source pollutants to runoff the land and into water. Resource inventories conducted included road/stream crossings, streambank erosion, agriculture, and shoreline development. Additionally, local land use policies were analyzed and research was done on the status of wastewater treatment practices in the watershed. A biological survey conducted by MDEQ is also included.

1. Road/Stream Crossing Inventory

Sediment has been identified as one of the primary pollutants to water quality. Road/stream crossings are often a conduit for this pollution when excessive soil from roads and/or eroding banks flows into a stream. Sedimentation is an area of concern in flowing water systems as it directly affects the diverse fauna within such a system. The purpose of this inventory was to identify and document all road/stream crossing sites in the Ocqueoc River Watershed. A total of 70 sites were located and documented during this inventory.

a. Methods

Onsite field evaluations were performed to inventory each potential crossing. A Road/Stream Crossing Field Data Form was completed at each site. A series of photographs were taken of each site to document existing conditions at each crossing. Each site was visited to assess potential problems that may contribute nonpoint source pollution and impact water quality. Data collected at the crossings included detailed information about the location, road characteristics (width, shoulder, drainage, approaches, surface), culvert condition, and erosion and runoff problems. Stream characteristics such as width, depth, current and substrate were also recorded.

At each crossing, soil erosion was evaluated in terms of existing and potential conditions. In addition, various physical measurements were made and each site was documented with an inlet and an outlet photograph. This information was compiled into a database for evaluation.

In order to help prioritize road/stream crossings for improvement, a severity ranking was given to each site. The severity ranking was determined by using the scoring worksheet noted in Appendix C. However, a pretreatment site assessment will need to be conducted prior to Best Management Practice (BMP) installation.

b. Results

Of the 70 road/stream crossing sites that were identified within the Ocqueoc River Watershed, 1 site was ranked severe, 53 sites were ranked moderate and 16 sites were ranked minor. The problematic condition of sites inventoried is based predominately on road design; road maintenance; the type, size and placement of the watercourse crossing; and the embankment vegetation and its slope. See Appendix C for more detailed site information.

c. Recommendations

Sites serving as delivery mechanisms of nonpoint source pollution, specifically those road/stream crossings classified as severe or moderate should have a system of BMPs put in place. While the inventory recommends some potential treatments, on-site investigation, engineering designs, and funding are all needed to implement the BMPs. Typical BMPs may include such things as replacing an undersized culvert with a larger, bottomless version or a bridge; lengthening the culvert in order to decrease the slope of the road embankment and reduce erosion; hardening the road surface to reduce sand runoff; or, incorporating detention or diversions to minimize the amount of pollutants directed to surface water.

2. Streambank Erosion Inventory

Severely to moderately eroding streambanks are sources of unwanted soil deposition to river systems. The erosive action of flowing water can cause untold cubic yards of soil to fall into a stream where it becomes suspended and clouds water clarity, disturbs aquatic life, hinders navigation and may contribute excessive nutrients when detached from soil particles. Additionally, severe streambank erosion jeopardizes land integrity and may result in the loss of residential property.

In order to gain an overall indication of the severity, quantity and location of streambank erosion sites within the Ocqueoc River Watershed, a field inventory was conducted by the Presque Isle Conservation District between October 2002 and August 2003.

a. Methods

Using US Geological Survey topographic maps and aerial photographs an initial evaluation was performed to determine which tributaries could be inventoried using personal watercraft, those requiring automobile travel to portions of the streambank corridor, or those reachable by wading in the stream. Each site location was cataloged with Global Positioning System (GPS) technology to record its position along the stream. Data were collected to document site accessibility, condition of the bank, percent of vegetative cover, apparent cause of the erosion, bank slope, length and height, river conditions, soil types and recommended treatments. A photographic record was also made of each site. Sites were then scored using a standard streambank erosion severity index. Both the data sheet and scoring sheet can be found in Appendix D.

b. Results

There were a total of 24 streambank erosion sites identified. All of the sites documented were located on the Ocqueoc River. Of these sites 12 were ranked minor, 11 were ranked moderate, and 1 was ranked severe. Eleven of the erosions sites were caused by “natural” activities such as bends in the river, log jams, and bank seepage. The other 13 erosion sites were caused by human activities. These activities include excessive foot traffic to the river and livestock access at one site.

c. Recommendations

Sites contributing nonpoint source pollution, specifically those road/stream crossings and streambanks classified as severe or moderate, should have a system of BMPs put in place. While the inventory recommends some potential treatments, on-site investigation, engineering designs, and funding are all needed to implement the BMPs. Follow-up and cooperation with landowners is also necessary. Typical BMPs may include such things as revegetating barren streambanks, stabilizing the toe of the streambank, or using steps and/or fencing to manage access at the site.

3. Agricultural Inventory

Agricultural practices on the land near riparian corridors may negatively influence water quality. The over-application of fertilizers or manure to the water’s edge can introduce an excessive amount of nutrients such as nitrogen and phosphorus into the river system. Livestock that have unrestricted access to streams destroy banks and substrate, causing erosion along the streambank and sediment deposits in the water. Furthermore, animal waste from livestock in stream or feedlots located close to waterways can add nutrients and pathogens to the river system.

In order to assess the agricultural influences within the critical area of the watershed, an inventory was conducted in the summer of 2003. During that time, all of the active farms located in the critical area were inventoried. There were a total of 21. Of those, only 2 were noted as being an apparent pollutant source for surface water.

a. Methods

Information regarding active agricultural production within the critical area was gathered from the Presque Isle Conservation District and the Natural Resources Conservation Service. Aerial photographs and field observations were used to determine inventory sites.

Site information such as type of operation (i.e. livestock, crops, and orchard), estimated acreage, general topography and estimated riparian frontage were collected. Other information regarding soil type and stream conditions, as well as foreseeable risks to surface water, groundwater or wetlands were noted.

During the survey apparent pollutant sources within 1000 feet of surface water were documented. The types of pollutant sources that were identified may include: unrestricted livestock access to water, crop production adjacent to water, feedlot runoff, manure storage runoff, manure application within 150 feet of a waterway, poor fertilizer storage, or other sources such as pesticides or milking parlor runoff.

Recommended treatments typically include such BMPs as livestock exclusion fencing, livestock crossing or access points, alternate watering sources, riparian buffer strips, fertilizer and pesticide storage, erosion control structures, animal waste facilities and feedlot diversions.

b. Results

Two sites were found to have some apparent nonpoint source pollutant. One site shows unrestricted livestock access to the river with no apparent buffer zone or exclusion fencing. The other site suggests a similar problem with no obvious buffer zone and possible livestock access to the stream.

c. Recommendations

It is recommended that these livestock operations install exclusion fencing and an alternative watering source or cattle access/crossings. Along with the fence installation it is suggested that a riparian buffer strip be planted within the fence zone. Additional data and a copy of the inventory form may be found in Appendix E.

4. Shoreline Development Inventory

The Shoreline Inventory for the Ocqueoc River Watershed Project was a nonpoint source pollution risk assessment for the lakes in the 100,000-acre drainage area which are directly connected to the river system.

One of the most serious threats to water quality is accelerated eutrophication (aging) of the lake. This occurs when excessive amounts of nutrients, particularly phosphorus, are added to the lake. These are typically from sources such as septic systems, fertilizer use, and shoreline erosion.

One simple method for identifying potential sources of nutrients to the lake is to perform a shoreline inventory. Such an inventory can be used to characterize the lake and potential opportunities for water resource protection by identifying potential hotspots for nutrient loading. The

shoreline survey is used to document serious erosion sites, the presence and condition of shoreline greenbelts, and the intensity of algae growth along the waterfront.

While the shoreline inventory does not replace the need for more detailed water quality studies, it is a good starting point and a useful tool for watershed management. However, data generated by this inventory must be carefully interpreted and is intended only to help characterize the current condition of the lake, help predict future impacts to the lake from shoreline practices, and serve as an educational tool. During the implementation phase of watershed restoration efforts, a confidential follow-up of the shoreline results with property owners can be an opportunity to provide practical recommendations which are often simple to implement and very beneficial to the lake.

a. Methods

The shoreline survey assesses erosion, vegetation along the shoreline, and other indicators of possible nonpoint pollution, including excessive algae and weed growth, poor setbacks, or stormwater discharge pipes.

In addition to aerial photo interpretation, the survey was conducted by canoe or other small watercraft. Presque Isle Conservation District utilized this method to complete the shoreline inventory.

Typically, Cladophora (a genus of algae) would be observed attached to rocks, logs and other solid surfaces along shorelines with high nutrient input. Within a given lake, prominent growths of Cladophora can often be observed in areas where excessive nutrient inputs occur, particularly in nutrient-poor lakes. Generally, for lakes in the Ocqueoc Watershed, Cladophora is not a reliable indicator of nutrient pollution. This is due to the fact that nearly all of the shoreline has poor “cladophora habitat” (i.e., rocks along the shoreline) and the lakes are not oligotrophic. For this reason, Cladophora was not used as an indicator in this survey.

Categories of information collected included:

► Shoreline property parcels: These are numbered sequentially, starting with the boat launch/township park on the north end of the lake and running counterclockwise around the lake. Parcels include both undeveloped and developed areas. In a few instances there was a relatively long stretch of undeveloped shoreline which was considered one parcel based on the apparent ownership and development status of the parcel.

► Shoreline erosion: While erosion is a natural process, it can be accelerated by human activities and lead to both property loss and environmental problems. This survey noted only obvious erosion, such as bare soil on steep slopes, gullies, undercut banks, and slumping. The extent of the erosion was classified as slight, moderate, or severe. Very few sites in this watershed exhibit signs of erosion.

► Shoreline greenbelts: Greenbelts were scored on a scale of 0 to 3, with 3 being an undeveloped shoreline. A .5 signifies removal of all vegetation except for turfgrass, a 1 represents some vegetation, but not enough to qualify as a greenbelt zone, and a 2 or above is considered “good.” Good greenbelts will have significant areas of natural vegetation that remain, particularly adjacent to the shoreline. Homes with good to excellent greenbelts can often be difficult to observe from the water. This may be the most subjective of the inventory categories; however, maintaining natural vegetation is perhaps the most significant action a lakefront property can take to preserve high water quality. Greenbelts minimize overland runoff, hold shoreline soils in place and buffer the shoreline from erosion, remove nutrients

from the soil, minimize the need for intensive lawn maintenance, and provide important riparian habitat for wildlife.

► Other field notes: This section was for comments by the technician regarding any special resource concerns. Field notes made by the shoreline technician also indicated sites where tributaries were noticeable, setbacks were poor (less than 40 feet), or stormwater outfalls were present.

Parcel data was not available from the County Equalization Department at the time of this study. However, through the use of aerial photographs, the county plat book, and on-the- lake observations, it was possible to accurately plot the information with the Geographic Information System (GIS).

b. Results

Table 6: Shoreline Development

Lake Name (those connected directly to the river and greater than 5 acres in size)	**Acres**	**Number of shoreline miles**	**Percent of shoreline that remains undeveloped (approximate)**	**Number of Developed parcels**	**Percent of developed properties with good to excellent greenbelts**	**% of shoreline properties with poor greenbelt or none at all**	**# of parcels with moderate to heavy shoreline erosion**
Horseshoe (Floodwater)	154	5.5	100	0	N/A	N/A	N/A
Unnamed	17.5	0.8	100	0	N/A	N/A	N/A
Emma	200	5.6	70	21	57%	14%	0
Ann	25	0.83	100	0	N/A	N/A	N/A
Wilson	18	0.99	60	11	72%	0	0
Nettie	278	5.4	30	95	57%	5%	6%
Bullhead	33	0.86	100	0	N/A	N/A	N/A
Mud	35	0.95	85	5	60%	10%	0
McIntosh	12	0.65	100	0	N/A	N/A	N/A
U. Barnhart	51	1.5	30	33	55%	6%	0
L. Barnhart	67	1.3	30	19	58%	11%	0
Ocqueoc	128	3.5	60	27	66%	15%	0
Orchard	33	2.4	60	12	50%	30%	0
Mud	27	0.68	100	0	N/A	N/A	N/A

c. Shoreline Recommendations

Results from the complete set of data collected indicate that overall management of shoreline vegetation by property owners can be considered “good” in this watershed. In many instances, an aquatic buffer zone of vegetation has been maintained. Unfortunately, there is typically a decline in the use of aquatic buffers for lakes with more development. This is true in the Ocqueoc Watershed, where higher density of waterfront development correlates to poor greenbelts. Many of the shoreline miles in the Ocqueoc Watershed are privately owned but not yet developed – protecting water quality in the future depends on maintaining these buffer zones. Much of the residential development, both old cottages and new homes, is located very close to the ordinary high water mark, making it very difficult for property owners to maintain natural vegetation along the shore.

One of the greatest threats to maintaining an aquatic buffer occurs when new construction begins. Sites are cleared of vegetation, oftentimes right to the waterfront. Compounding this problem is the setback distance for new development in this watershed, currently only 30 feet as described in the Presque Isle County Zoning Ordinance. Under present guidelines, it is unlikely that increased development and water resource protection will be compatible.

Information must also be distributed to new landowners, as they are often unfamiliar with living along the waterfront and the steps they can take to protect water quality. Reaching new homeowners is difficult, and requires the pro-active involvement and cooperation of contractors, real estate agents, landscapers, and the County Building Department. The Watershed Partnership should develop a packet of materials on lake-friendly lawn care, aquatic buffers, erosion control, and septic system care for distribution to both new and current homeowners.

B. OTHER RESOURCE STUDIES

1. Wastewater Treatment

Within the Ocqueoc River Watershed, wastewater treatment for residents is managed through on-site treatment. Typically called septic systems, on-site treatment can be a functional and relatively inexpensive method of wastewater treatment. However, there are several factors of concern when conducting a surface water quality risk assessment.

Foremost among these are the distance of the septic system to ground water (i.e., is their enough area for filtration before contaminants reach the water table). Other considerations include the separation distance to surface water, location of wells, soil type (i.e., both rapidly draining and nearly impervious are major concerns), size of the system versus its use, maintenance of the system, and age of the system. As land development increases, so will the amount of septic systems. This is a concern considering much of the increasing development will occur along the waterfront, based on land development practices throughout Michigan. All septic systems contribute nutrients to a watershed; it is essential that this contribution be minimized to the greatest extent possible.

Practices such as inspections of septic systems, replacement of sub-standard systems, maintaining aquatic buffers, not allowing development on sub-standard size lots, maintaining wetlands, and incorporating advanced treatment systems where necessary are all important strategies for minimizing pollution from septic systems.

(A map of soil limitations is on the following page, along with the general septic system locations and risk factor based on age of the system.)

Map 6-On-Site Wastewater

On-site wastewater treatment in Michigan is managed through multi-county District Health Departments. For the Ocqueoc, District Health Department #4 oversees the program. For this project, District Health Department #4 provided locations of water wells within the watershed. The Health Department provided application records to install individual sewage disposal systems; this information was then utilized to map the locations of specific on-site systems.

A total of 518 septic systems were located within the watershed, 278 of the total sites have known site permits. The critical area of concern, which is the land within 1,000 feet of surface water, contains approximately 315 of those systems. Of the 315 sites within the critical area, 160 have known septic system permits.

The permitting records identified the year the septic systems were installed or replaced; this information was used by Huron Pines RC&D as an indicator of risk for determining areas of possible surface or ground water contamination. Based on current standards for wastewater treatment (specifically, the isolation distance required of the system from surface and ground water), many of those systems installed prior to 1973 are likely substandard.

Of the 518 systems in the watershed, 251 were installed or replaced after 1973. If properly maintained, these systems should provide adequate wastewater treatment based on current regulatory standards.

Additionally, 27 systems were identified as being installed or replaced prior to 1973 and concluded to likely be substandard. Of greater concern is that the locations of 240 systems were unable to be linked to a permit based on many factors with the record keeping process at the Health Department. Since the method of record keeping has been greatly improved in the last two decades, it can be assumed that nearly all of these 240 systems were installed prior to 1973. *Thus, systems classified as "unknown" are also likely to be "sub-standard."*

Within the critical area of the watershed, 155 of the 315 systems are currently labeled as "unknown." In addition to age of systems, a risk classification can be conducted on the basis of soil types in the watershed. A soil study for Presque Isle County was published in 1993 by the US Department of Agriculture – Natural Resources Conservation Service. Many of the soil associations in this watershed were listed as either excessively well-drained (poor filtering capacity) or had restricted permeability. Of the 90,009 acres of soil classified by NRCS within this watershed, 85,165 (95%) were identified as a severe risk for septic systems.

2. Land Use Policies

Water is one of the main features that attract people to Presque Isle County. All activities on the land have the potential to impact the quality of water. Watershed management is a process of identifying sources of pollution and potential sources of pollution and working with the community to implement solutions in order to restore or protect water quality. In order to be effective, watershed management requires the use of many different tools, such as educational outreach programs, land stewardship, on-the-ground implementation of Best Management Practices, research & monitoring, and incorporating conservation design standards into development. Local land use planning and zoning is another important management tool for watershed protection. In addition to the direct benefits for aquatic resources, planning and zoning are tools used for ensuring the conservation of wildlife habitat, protection of property values and maintaining community character.

A sound planning and zoning program requires that local government officials, property owners, and developers not only buy-in to the concept, but are willing to dedicate the trained personnel and

funding to make the program work. Effective planning and zoning thus takes commitment and resources.

“Good” land use planning involves education, training, and effective regulations. Oftentimes people are unaware of how land use ultimately impacts water quality. In communities where there are little or no efforts to educate the community, train planning officials, or implement effective regulations; the quality of water resources are reduced year by year. Zoning regulations that have no real “teeth” and/or regulations that are not enforced offer no value to a community that is trying to protect water quality, property values, and their community character.

Public input, along with an inventory of community resources, is used to generate a master plan. Within that plan, there are standards that are reasonable yet adequate for protecting what the community feels is important, as well as protecting private property. Generally, it is not felt that individual property owners would benefit from planning and zoning; however, they have the most to gain. (For example, a greenbelt ordinance would prevent excessive clearing of vegetation along a streambank that would in turn lead to severe erosion at a particular site, a negative impact for the landowner and others downstream.) In the case of Presque Isle, a county master plan was adopted in 1980. Since that time, there have been many changes in the county. Fortunately, the County Planning Commission is updating the plan and expects to have a new document in 2004 that can help guide the changes that PI County will inevitably experience.

Following adoption of a master plan, the local unit of government creates a zoning ordinance. For Presque Isle County, the zoning ordinance was adopted in 1987, although numerous amendments have been made since that time. A zoning ordinance must be based on the goals developed by the community and set forth in the master plan. Even after local government units have up-to-date, credible documents in place, there is still work that needs to be done. The governing body must keep their policies up-to-date and make decisions regarding infrastructure and zoning in accordance with their plan. Staff must be adequate to enforce the ordinance and work with the landowners to help achieve their goals while protecting the resources. Typically, these positions are understaffed and the zoning official is required to take on many other duties.

Oftentimes, volunteers on local zoning boards are pressured to make a decision on a site-specific issue without considering the whole system. Zoning standards and decisions must be made with the comprehensive master plan in mind. It can be extremely difficult to step back from a particular issue and consider the big picture, but that is exactly what well-trained planning commission officials must do. In addition, zoning regulations need to be enforced and followed up. Without enforcement, the majority that makes the effort to follow land use regulations are, in effect penalized; as they have gone to greater effort and expense than those not following regulations. If proper ordinances and enforcement are not in place, essential land use planning will eventually break down for local units of government. Either most citizens will give up on following the rules or the court system will not hold up the regulations.

In the State of Michigan, planning and zoning are implemented at the township, municipal, or county level. The enabling legislation for land use planning can be found within four State acts:

Public Act 285 of 1931 -- Municipal Planning Act
Public Act 168 of 1959 -- Township Planning Act
Public Act 282 of 1945 -- County Planning Act
Public Act 281 of 1945 -- Regional Planning Act

The state also has three legislative zoning acts that enable local units of government to control land uses through regulation of activities on the land:

Public Act 184 of 1943 -- the Township Rural Zoning Act
Public Act 183 of 1943 -- the County Zoning Act
Public Act 207 of 1921 -- the City and Village Zoning Act

In addition to planning and zoning, there are State regulations that are intended to help conserve natural resources. Relevant state laws for water resource protection include (this is only a brief summary, please see the respective law or contact MDEQ for more information):

Act 451, Part 91, Soil Erosion Control and Sedimentation Act
(for earth changes within 500 feet of the shoreline)

Act 451, Part 303, Wetland Protection
(covers the dredging, draining, or filling of regulated wetlands; however, non-contiguous wetlands in rural counties are generally not regulated wetlands)

Act 451, Part 301, Inland Lakes & Streams Act
(covers most work done below the ordinary high water mark)

Public Act 368 (1978), Aquatic Nuisance Control

This following review of local land use regulations is not intended to evaluate the history of planning and zoning within the watershed, nor is it intended to be the sole basis for determining the effectiveness of policies regarding water resource management. However, it may provide insight into how effective local units of government are at protecting aquatic resources and help to identify some of the glaring weaknesses within current zoning ordinances.

For some of the issues related to watershed management, agencies beyond the local unit of government have a regulatory role. In the case of soil erosion and sedimentation, the Michigan Department of Environmental Quality (MDEQ) has jurisdiction, but they have an agreement with counties to enforce the program at the local level (thus every county has a soil erosion officer). For wetlands, MDEQ also has jurisdiction. Questions regarding wetlands and the permitting process should be sent to MDEQ's Land & Water Management Division (their field office for Presque Isle County is in Gaylord). Regulations for septic systems are handled through the District Health Department. In all three of the areas listed above, a local community may adopt their own policies that are equal to or more stringent than the standards already in place. Such a decision may lead to more work for the local unit of government and a greater expenditure of fiscal resources; it may also create an opportunity to better achieve the goals described in their master plan.

Analysis of Local Planning and Zoning Efforts in the Watershed

Townships located in a county with zoning have the option of having the county manage the entire planning and zoning program or administering their own. (In rare cases, neither a county nor township may have a zoning ordinance; these areas are considered "unzoned.") Within Presque Isle County, all of the townships in the watershed (Case, Bearinger, Bismark, Moltke, and Ocqueoc) are under county zoning. There is also one incorporated community, the Village of Millersburg, which is not under jurisdiction of the County and which has not adopted their own zoning ordinance. (A very small portion of the watershed is located in Montmorency County. This land area is not included within this report, due to its size and the fact that most of the area is under state ownership.)

While most of the land within the Ocqueoc River Watershed is zoned for low density residential, agriculture, or forest/recreational, the county has a special standard that applies to development along the waterfront, regardless of what zone the land is in.

To determine the effectiveness of regulatory coverage for aquatic resources within the Ocqueoc River Watershed, the county zoning ordinance was reviewed to evaluate what "environmental provisions" were in place. The ordinance was specifically reviewed for the following:

- *Vegetative Buffer Zones (Greenbelts)*: With regard to minimizing the impact of residential development along the waterfront, ensuring that vegetation is left along the shoreline is generally the most important action that can be taken. Loss of these natural buffers along the waterfront often leads to near shore habitat destruction, increased overland runoff, increased stream temperatures, and increased erosion due to weakened shoreline soils. Greenbelt ordinances can be difficult to enforce, many local officials and residents are unaware of what an effective greenbelt consists of, historic patterns of development have already degraded many areas (and these may be "grandfathered" in), zoning language is often poorly worded for proper enforcement, and citizens are often unaware that there is an ordinance in place. With that said, maintaining a greenbelt is essential for protecting water resources – even a 25 foot greenbelt can be effective. A mowed lawn to the water's edge is not a greenbelt.

- *Setbacks of structures* along the waterfront are important for reducing the amount of impervious surface near the water, helping to ensure that a greenbelt can be maintained, and reducing the potential for serious resource problems. A structure that is setback only 30 or 40 feet is more likely to be associated with negative impacts to water resources than a structure 75 or 100 feet away from the water's edge. Unfortunately, many local units of government that do have an effective setback for homes will make many exceptions for large decks and boathouses. Such exemptions defeat the intent of the setback, as impervious surface cover will still be present near the water's edge. Furthermore, while many local units of government may have a greenbelt requirement of 50 or 75 feet width, they allow the structure setback to be less than the greenbelt restriction. Such a scenario significantly reduces the effectiveness of the greenbelt requirement. In addition, during the construction period, a structure being built less than 50 feet from the water will have a construction site that abuts the water. This leads to the unavoidable problem of the destruction of the greenbelt during construction. Maintaining the natural greenbelt in the first place is much easier than restoring a greenbelt. Setback requirements should be regarded as a key element for water resource protection.

- *Minimum Lot Width for waterfront parcels* is important for waterbodies because it ultimately determines the number of homes that will be built on the water. Developed shorelines with less than a 100-foot minimum lot width often experience water resource problems. Studies done on lakes in northern Michigan link higher density of development along the shoreline with increased pollutant loading. Generally, smaller lot widths around the shoreline increases the number of homes, septic systems, user conflicts, fertilizer use, degraded shorelines, and impervious surfaces all of which can contribute to declining water quality.

- *Open space preservation* is used for communities to protect their rural character, as well as maintain prime recreational, farm or forestland. Unfortunately most zoning ordinances, even if implemented correctly, are not written in such a way to accomplish those goals. Many local units of government that have open space guidelines that typically state, "At least 40% of the total gross project shall be left as open space." Some only require 25%, which is not a way to accomplish their community goals.

  An improvement to the open space section of their ordinances would require the developer to increase the amount of open space to 50 or 60% and make sure that some of the set aside acreage is from the developable portion of the site. Steep slopes, surface water, wetlands, etc., should be excluded from this calculation; otherwise only the most

undesirable building areas will be set aside as open space. Ordinance language should be something such as, "A minimum of 60% of the parent parcel's gross acreage shall be set aside as permanently protected open space. This area shall include at least half of the parcel's buildable land area."

There are incentive programs that local communities can adopt to encourage open space preservation, such as allowing higher development densities on the remaining land in a development, a conservation easement program, or through setting up a Purchase of Development Rights (PDR) program. (At the time of this report, PI County is not active in such a program. Property owners in the county can contact HeadWaters Land Conservancy for help with establishing voluntary programs for land protection that may also provide economic incentives for landowners.)

- *Septic Systems* are under the jurisdiction of the District Health Department. Typically, only severe problems are addressed, departments are understaffed, and there are poor records of septic systems. Some counties have begun to initiate their own programs for inspections, maintenance, or replacement requirements. Generally, such a program is being run as a “Point of Sale” program, whereby inspections of septic systems are required at the time of property transfer. Other successful programs have required inspections every several years. Under either program, septic system upgrades are required for those that are not working properly.

- *Wetland Protection* is handled through the state Department of Environmental Quality. For rural northern Michigan, the law does not cover isolated wetlands. Some communities have addressed this oversight by adopting their own wetland regulatory program, which is authorized through the state wetland act.

- *Stormwater Management* is recognized as critical for keeping oils, greases, organic debris, and trash from running directly into a waterbody. While stormwater control measures are often taken during construction, the post-construction runoff of stormwater is a problem that is often overlooked. Proper management would require that stormwater is handled on-site for new developments, rather than get the stormwater off their site as quickly as possible (this has been the historic engineering practice). Many communities that have not had a stormwater ordinance are now spending a great deal of funds to correct problems that could have been prevented in the first place.

- *Lot Coverage/Impervious Cover* is, on a watershed-wide level, an important indicator for overall watershed health. Impervious surfaces accelerate runoff to surface waters oftentimes transporting pollution, and do not allow for percolation through the soil which can act as a filtering agent. (Studies have been conducted that show water quality declines once 10% of the land area in a watershed is covered by impervious surfaces and that serious problems occur once more than 25% of the land area is covered.) Communities that recognize this fact sometimes attempt to address this problem on a parcel by parcel level by placing a maximum on the amount of land that can be covered by impervious surface. While well intended, these standards typically state that the buildings can only occupy a certain percentage of land, but fail to address roads, driveways, decks, patios, and walkways, which are all impervious surfaces.

Table 7 is a summary of specific environmental provisions found in the current Presque Isle County Zoning Regulations.

Table 7: Environmental Provisions
Summary of Presque Isle County Zoning Regulations

Section of ordinance	Current standard	Recommended change for watershed
Setback requirement for structures along the waterfront	30 feet	75 feet
Vegetative Buffer Zones (greenbelts)	Not addressed through county zoning	35-foot buffer zone of natural vegetation along the waterfront
Minimum Lot Width for Riparian Parcels	75 feet for all waterfront parcels *at the point of development*	200 feet; drop the 'at the point of development' and ensure that the width requirement is applied to the waterfront, in order to decrease density
Open Space	Protection of open space is in the Planned Unit Development (PUD) section of the ordinance, which requires 40% of the total gross area of the parcel to remain undeveloped.	Increase the amount of open space to 50% and also make sure that some of the set aside acreage is from the developable portion of the site. Steep slopes, surface water, wetlands, etc., should be excluded from this calculation; otherwise only the most undesirable building areas will be set aside as open space. Ordinance language should be something such as, "A minimum of 60% of the parent parcel's gross acreage shall be set aside as permanently protected open space. This area shall include at least half of the parcel's buildable land area."
Septic Systems	Not addressed through county zoning	The health department appears to do an effective job for new systems. Adoption of a periodic inspection program would have a benefit for water quality, particularly regarding old systems located close to surface water.
Wetland Protection	Not addressed through county zoning	If standards for greenbelts and stormwater are put in place in PI County, wetland protection could be accomplished through the continued natural use of wetlands as groundwater recharge and stormwater filtering areas. Enforcement of the State act and voluntary land protection efforts by property owners is encouraged.
Stormwater Management	Not addressed through county zoning	On-site control of stormwater should be required for all new development.
Maximum % of Lot Coverage (Impervious Cover)	Not addressed through county zoning	Not necessary at this time due to low density development; incorporating the standards listed above should be adequate.

CHAPTER IV

Nonpoint Source Pollutant Loading and Reductions

Pollutant loading estimates were calculated to provide a baseline understanding of nonpoint pollution entering the Ocqueoc watershed. Although it is difficult to measure polluted runoff, several models were applied to the watershed to provide the most accurate description. Each model or calculation used and any assumptions made are described under the specific sources of nonpoint pollution.

It is important to note that the following pollution calculations and load reductions are based on models and not on chemical analysis conducted in the watershed. Although each model or calculation used is based on sample testing and applied to the Ocqueoc River Watershed, they are estimates only.

In addition, all load estimates and load reductions are for the critical area of the watershed. The critical area is defined as that portion of the watershed which is most likely to impact water quality. The land area within 1000 feet of surface water and adjacent wetlands serves as the critical area. While land use throughout the watershed is important in determining water quality, nonpoint source pollution control is focused within critical area.

A. TOTAL WATERSHED RUNOFF AND POLLUTANT LOADING BASED ON LAND USE TYPES

An overall watershed runoff analysis was completed using the Long-Term Hydrologic Impact Assessment (L-THIA) model (www.ecn.purdue.edu/runoff). The model was designed by Purdue University with cooperation from the U.S. EPA. Based on average annual runoff, soil conditions, land use type, and impervious cover, the L-THIA model estimates runoff volume and depths, and expected nonpoint source pollution loadings to water bodies. The model was also used to determine the pollutant loading if maximum development occurred according to existing zoning regulations.

To determine runoff and pollutant loading for current conditions the land use figures (circa 1995) within the critical area (1,000 feet from surface water) were used. To estimate potential future loads existing zoning ordinances within the critical area were utilized, providing estimates for maximum development based on current zoning conditions. The following tables depict estimated runoff amounts and pollutant loading for nitrogen, phosphorus and sediment for current conditions and future building conditions.

Table 8: Average Annual Runoff Results (acre-ft*)

Land Use	Current conditions (based on existing land use)		Future runoff (maximum development based on current zoning regulations)		Percent increase of runoff
	Acres	Runoff (acre-ft)	Acres	Runoff (acre-ft)	
Low Density Residential	663	51.17	2,591	199.99	291%
Commercial	38	24.34	234	149.93	516%
Industrial	192	79.99	70	29.16	-174%
Agriculture	3,555	433.74	6,446	786.47	81%
Grass/pasture	1,374	45.61	1,379	45.78	.37%
Forest (inc. wetlands)	27,942	463.83	23,044	382.53	-21%
Water	1,620	0	1,620	0	0%
Total acres	**35,384**		**35,384**		
Total annual volume		**1,098.72**		**1,593.89**	**145%**

*Acre-feet=volume of water necessary to cover one acre to a depth of one foot (1 acre-ft=43,560 cu ft)

Sediment was identified as the top pollutant of concern for the Ocqueoc River Watershed. Table 9 depicts sediment loading on a watershed scale based on existing land use and potential future development. Common sources of sediment include road/stream erosion, streambank erosion (rivers), access sites/road ends, construction, and shoreline erosion (lakes).

Table 9: Estimate of sediment loading to water bodies (lbs/year)

Land Use	Current conditions (based on existing land use)		Future loading (maximum development based on current zoning regulations)		Percent increase of pollutant loading
	Acres	Runoff (lbs.)	Acres	Runoff (lbs.)	
Low Density Residential	663	5,717	2,591	22,342	291%
Commercial	38	3,681	234	22,673	516%
Industrial	192	13,187	70	4,807	-174%
Agriculture	3,555	126,453	6,446	229,287	81%
Grass/pasture	1,374	124	1,379	124	0%
Forest (inc. wetlands)	27,942	1263	23,044	1,042	21%
Water	1,620	0	1,620	0	0%
Total acres	**35,384**		**35,384**		
Total annual loading (lbs)		**150,425 (75 tons)**		**280,275 (140 tons)**	**87%**

Tables 10 and 11 show the estimated nitrogen and phosphorus loading on a watershed wide scale. This information was derived from the existing land use types and projected increase in development based on current zoning conditions. The Ocqueoc River Commission prioritized nutrient loading as the second highest pollutant of concern to the watershed. Common sources of nutrient loading include riparian septic systems, fertilizer use, livestock wastes, and stormwater runoff.

Table 10: Estimate of nitrogen (N) loading to water bodies (lbs/year)

Land Use	Current conditions (based on existing land use)		Future loading (maximum development based on current zoning regulations)		Percent increase of pollutant loading
	Acres	Runoff (lbs.)	Acres	Runoff (lbs.)	
Low Density Residential	663	253	2,591	991	292%
Commercial	38	88	234	547	522%
Industrial	192	274	70	100	-174%
Agriculture	3,555	5,199	6,446	9,428	81%
Grass/pasture	1,374	87	1,379	87	0%
Forest (inc. wetlands)	27,942	884	23,044	729	21%
Water	1,620	0	1,620	0	0%
Total acres	**35,384**		**35,384**		
Total N annual loading (lbs)		**6,785**		**11,882**	**175%**

Table 11: Estimate of phosphorus (P) loading to water bodies (lbs/year)					
Land Use	Current conditions (based on existing land use)		Future loading (maximum development based on current zoning regulations)		Percent increase of pollutant loading
	Acres	Runoff (lbs.)	Acres	Runoff (lbs.)	
Low Density Residential	663	79	2,591	310	292%
Commercial	38	21	234	130	519%
Industrial	192	61	70	22	-177%
Agriculture	3,555	1,536	6,446	2,785	81%
Grass/pasture	1,374	1	1,379	1	0%
Forest (inc. wetlands)	27,942	12	23,044	10	20%
Water	1,620	0	1,620	0	0%
Total acres	**35,384**		**35,384**		
Total P annual loading (lbs)		**1,710**		**3,258**	**90%**

The Ocqueoc River Watershed is a high-quality river system that currently meets all of the State of Michigan's designated uses. Even though installing selected BMP's at erosion sites visibly contributing nonpoint source pollution will help enhance the watershed and decrease pollution levels, the key to protecting the watershed will be proactive measures to keep it at the water quality level it currently exhibits. As shown in the L-THIA model, future development has the potential to greatly disrupt the system. Understanding this, community leaders, residents, conservation groups and other stakeholders have an opportunity to manage growth in a manner that is beneficial to the community's needs as well as protecting their water resources, wildlife habitat, and rural character which are the attraction for many people who live or recreate in the area.

B. SEPTIC SYSTEM EFFLUENT

As more development occurs within rural areas that do not have centralized water management systems, the reliance for on-site wastewater treatment (septic systems) becomes greater. There also appears to be a greater demand to build vacation and retirement homes along water bodies or convert existing waterfront part-time dwellings to permanent residences. Septic systems can be very efficient at treating wastewater if they are properly sited, installed correctly, and maintained regularly. However, the cumulative impact of hundreds or thousands of individual septic systems within a watershed can lead to increased eutrophication (aging) of the lakes.

Septic systems typically consist of two components: a septic tank designed to intercept and hold partially treated solids and a drainfield which disperses wastewater to surrounding soils. Septic effluent is the substance that passes through the tank to the drainfield and eventually filters through the soils. The major water quality pollutants from septic effluent are nitrogen and pathogenic bacteria. Phosphorus is also found in septic effluent but has a tendency to rapidly adhere to soil particles limiting its ability to move to groundwater or adjacent surface water.

The most common shortcoming of septic systems is their inability to remove significant amounts of nitrogen. Only 20% of nitrogen that passes through conventional septic systems is effectively removed, although this number may be influenced by several factors (Siegrist and Janssen, 1989; Gold *et al*., 1990). Once in the drainage field, organic nitrogen are easily converted into nitrates, which are quite soluble and easily mobilized, thus increasing the potential for ground and surface water contamination (WIDILHR, 1991).

Pathogenic bacteria, parasites, and viruses are also found in septic effluent. Improperly treated wastewater from septic systems can contain unhealthy concentrations of bacteria and viruses harmful to many organisms, including humans.

Pollutants not removed by septic systems can migrate into groundwater by leaching through the soils. Ninety-five percent of the Ocqueoc watershed exhibits large areas of either sandy soils, which may not have adequate filtering capacity before pollutants reach ground or surface water, or soils with restricted permeability. Those systems located in karst areas are at an even higher risk of groundwater contamination from septic effluent. Surface water may eventually be affected as groundwater seeps into adjacent streams, lakes, rivers, and wetlands. Water bodies may also be directly affected if a nearby system fails and the effluent ponds on or just below the soil surface.

It is difficult to estimate pollutant loading from septic systems. Many factors need to be considered including soil type, age, condition, use of system, and proximity of system to ground and surface water. However, numerous studies have been conducted sampling effluent from identified septic systems. The following table was documented in the *Onsite Wastewater Treatment Systems Manual* published by the US Environmental Protection Agency in 2002 depicting several septic effluent studies and their associated pollutant levels. All of the studies in Table 12 documented septic effluent from residential homes.

Table 12: Characteristics of Domestic Septic Tank Effluent

Parameter	University of Wis. (1978)	Harkin, et al. (1979)	Ronayne, et al. (1982)	Ayres Associates (1993)	Ayres Associates (1996)
# tanks sampled	7	33	8	8	1
Location	Wisconsin	Wisconsin	Oregon	Florida	Florida
# samples	150	140-215	56	36	3
BOD mg/L[a]	138	132	217	141	179
COD mg/L[b]	327	445	-	-	-
TSS mg/L[c]	49	87	146	161	59
TN mgN/L[d]	45	82	57.1	39	66
TP mgP/L[e]	13	21.8	-	11	17
Oil/grease mg/L	-	-	-	36	37
Fecal coliforms log/L	4.6	6.5	6.4	5.1-8.2	7.0

[a]Biological Oxygen Demand (BOD) is used to determine how much oxygen is being used by aerobic microorganisms in the water to decompose organic matter. If aerobic bacteria are using too much of the dissolved oxygen in the water, there may not be enough left over for other aquatic organisms.
[b]Chemical Oxygen Demand (COD) is the quantity of oxygen used in biological and non-biological oxidation of materials in water. The higher the concentration the more oxygen the discharges demand from water bodies.
[c]Total Suspended Solids (TSS) is the amount of filterable solids in a water sample.
[d]Total Nitrogen (TN) is the organically bound nitrogen and ammonia in a water sample.
[e]Total Phosphorus (TP)

For the purpose of the Ocqueoc River Watershed Management Plan, the figures from the Harkin et al. study *Evaluation of Mound Systems for Purification of Septic Tank Effluent* were utilized. As documented by the resource inventory 315 septic systems are located with 1000 feet of a water body. For the purpose of this study estimates will be calculated for the nutrients nitrogen, phosphorous, and the pathogen fecal coliforms (the second and third ranked pollutants).

Table 13: Septic System Pollutant Load Estimates-Residential Conventional System			
Parameter	Sample pollutant load	# of septic systems	Estimate septic system effluent load
TN mg/L	82	315	25,830
TP mg/L	21.8	315	6,867
Fecal coliform log/L	6.5	315	2,048

Since model estimates represent sources potentially generated, the actual amount that might ultimately reach groundwater, well or surface water is likely to be less. The opportunity for nutrient uptake is greater in large watersheds with abundant wetlands, where shoreline buffers have high nutrient removal potential, and where septic system setbacks are farther from adjacent waterbodies (e.g. 75 foot setback from water compared to 50 foot setback).

Numerous studies have been conducted researching the effectiveness of conventional septic systems and alternative on-site waste treatment from reducing pollutant loads. The following table compares effectiveness of different waste treatment practices and was provided by the U.S. EPA document *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters.*

Table 14: Conventional and Selected Alternative Septic System Effectiveness					
On-site wastewater disposal practice	Average Effectiveness (total system reductions)				
	TSS (%)	BOD (%)	TN (%)	TP (%)	Pathogens (logs)
Conventional Septic System	72	45	28	57	3.5
Mound System	NA	NA	44	NA	NA
Anaerobic Upflow Filter	42	62	59	NA	NA
Intermittent Sand Filter	92	92	55	80	3.2
Recirculating Sand Filter	90	92	64	80	2.9
Water Separation System	60	42	83	30	3.0
Constructed Wetlands	80	81	90	NA	4.0
* an average household of 4 occupants was assumed					

The following table estimates load reductions for septic effluent in the Ocqueoc River Watershed for conventional septic systems, intermittent sand filters, recirculating sand filters, and water separation systems. Again, these figures are based on septic tank effluent, not discharge to ground or surface water. If the on-site treatment facility is properly sited and maintained the surrounding soils should effectively filter much of the effluent.

Table 15: Septic Effluent Load Reduction									
Parameter	Total septic effluent loading	Conventional Septic System		Intermittent Sand Filter		Recirculating Sand Filter		Water Separation System	
		% reduced	amount	% reduced	amount	% reduced	amount	% reduced	amount
TN mg/L	33,062.4	28	25,830	55	18,184.3	64	21,159.9	83	27,441.8
TP mg/L	10,781.2	57	6,867	80	8,625.0	80	8,625.0	30	3,234.4
Pathogens (logs)	3,150.0	3.5	2,047.5	3.2	2,142.0	2.9	2,236.5	3.0	2,205.0

C. LAWN CARE PRACTICES IN THE RIPARIAN ZONE

Lawn care practices by those living along water bodies can greatly influence the water quality of the adjacent lake or stream. Maintaining or reestablishing a native vegetative buffer (greenbelt) along the lake or river provides many benefits to water quality and wildlife habitat. Greenbelts help prevent shoreline erosion, keep river temperatures cooler, provide important habitat for aquatic and terrestrial wildlife, help reduce runoff, and filter pollutants before they can reach the water. The primary nutrient that stimulates excess growth of plants in a lake is phosphorous. One pound of phosphorous can produce up to 500 pounds of aquatic plant or algae growth once it washes into a lake (MNDNR, 1999). Common sources of nutrient loading include riparian septic systems, fertilizer use, livestock wastes, and stormwater runoff.

Results from the shoreline development survey were used to estimate the amount of phosphorous entering the lakes within the watershed. Estimates were calculated for development along lakes and do not include phosphorous loading from residential development along the river for two reasons: phosphorous is typically the pollutant of concern in lake ecosystems and data were not available for residential development and lot size along the Ocqueoc River. The total developed acres for the lake were calculated and adjusted for the assumption that nearly 70% of riparian landowners fertilize their lawns (Schueler, 2002). This provided the amount of developed acres receiving fertilizer application.

A study was conducted in Minnesota by Lake Access where six small watersheds were selected as the study sites. Three of the sites were located in a community where the use of fertilizer that contained phosphorous was restricted and three were located in a community where there are no such restrictions. Runoff from each of the study areas flowed to a single outlet pipe and phosphorous samples were collected there. (There are other sources of phosphorous to aquatic systems including grass clipping, leaves, and pet waste; however, there are no strong reasons that these alternate sources differ among the study watersheds).

The study found that the phosphorous runoff was .22 pounds per acre of land in communities without fertilizer restrictions, whereas, .09 pounds of phosphorous runoff per acre of land was documented in communities that have phosphorous free fertilizer ordinances. These findings were applied to the number of developed lake acres within the Ocqueoc River Watershed to estimate pollutant loading and load reduction if residents used phosphorous free fertilizers encouraged through education or forced through ordinances.

In addition, the percent parcels with good greenbelts were also taken into consideration. It is estimated that a good greenbelt reduces approximately 75% of runoff and associated pollutants (MDEQ, 1999). A “good” greenbelt is one where minimal vegetation has been removed along the shoreline providing a buffer between homes or other development and the adjacent waterbody.

The following is a description of how pollutant loading from fertilizer use was calculated using shoreline inventory data and phosphorous loading information provided by Lake Access.

Fertilized acres = Lake acres * % of lake developed * 70% (residents that fertilize)

Phosphorous loading = Fertilized acres * .22 (P loading) **or** .09 (P reduction)

P loading: no greenbelt = Phosphorous loading * % of no greenbelt

P loading good greenbelt = Phosphorous loading * % good greenbelt *.25 (adj. for greenbelt filter capacity)

Total phosphorous loading = P loading no greenbelt + P loading good greenbelt

Table 16: Phosphorous Loading from Riparian Fertilizer Use (lbs/year)						
Lake	Lake acres	% of lake developed	Fertilized acres	P loading: no greenbelt	P loading: good greenbelt	Total phosphorous
Emma	200	30%	42.00	3.97	1.32	5.29
Wilson	18	40%	5.04	0.44	0.29	0.73
Nettie	278	70%	136.22	18.41	6.10	24.51
Mud	35	15%	3.68	0.46	0.17	0.64
U. Barnhart	51	70%	24.99	3.53	1.08	4.61
L. Barnhart	67	70%	32.83	4.33	1.50	5.83
Ocqueoc	128	40%	35.84	3.83	1.86	5.69
Orchard	33	40%	9.24	1.45	0.36	1.82
Total	**810**		**289.84**	**36**	**13**	**49**

Table 17 calculates the estimated phosphorous loading if phosphorous free fertilizer is applied in place of conventional fertilizers.

Table 17: Phosphorous Reduction from Residential Use-No Phosphorous Fertilizer (lbs/year)						
Lake	Lake acres	% of lake developed	Fertilized acres	P loading: no greenbelt	P loading: good greenbelt	Total phosphorous
Emma	200	30%	42.00	1.63	0.54	2.16
Wilson	18	40%	5.04	0.13	0.08	0.21
Nettie	278	70%	136.22	5.27	1.75	7.02
Mud	35	15%	3.68	0.13	0.05	0.18
U. Barnhart	51	70%	24.99	1.01	0.31	1.32
L. Barnhart	67	70%	32.83	1.24	0.43	1.67
Ocqueoc	128	40%	35.84	1.10	0.53	1.63
Orchard	33	40%	9.24	0.42	0.10	0.52
Total	**810**		**289.84**	**11**	**4**	**15**

The estimated total phosphorous loading with no restrictions or voluntary use of p-free fertilizer is 49 pounds per year. The estimated total phosphorous loading using P-free fertilizer is 15 pounds per year, a load reduction of **34** pounds of phosphorous per year.

D. ROAD/STREAM CROSSING POLLUTANT LOADING AND REDUCTION ESTIMATES

Seventy road/stream crossing sites were located within the Ocqueoc River Watershed. The crossings ranged in size from a bridge over one hundred feet long to culverts twelve inches in diameter. The majority of the crossings were on unpaved roads with one or multiple culverts controlling the water flow under the road.

1. Road/stream crossing pollutant loading

Total sediment loading was calculated for each road/stream crossing site inventoried within the watershed. Two equations were used to calculate sediment loading. First, the Revised Universal Soil Loss Equation (RUSLE) was used to calculate sediment discharge in tons per year and cubic yards per year for each approach.

$$A = R * K * LS * C * P$$

A = average annual soil loss in tons/acre
R = rainfall-runoff erosivity factor
K = soil erodibility factor
LS = slope factor
C = cover management factor
P = support practice factor

For this application we used a cover management value of 1 for unpaved roads and a value of .12 for paved roads. The second method, Lateral Recession Rate (LRR), was used in an attempt to assess the amount of soil loss occurring at each embankment.

$$LRR = Height * Width * Erosion\ Severity$$

The following values were used for erosion severity: Slight = .02, Moderate = .14, Severe = .4, and Very Severe = .5. The total from each equation was added together for a total sediment loading estimate per site.

Estimated sediment loading for road/stream crossings is ***286 tons per year***

In addition to sediment loading, phosphorus and nitrogen loading were calculated. High amounts of nutrients in a water body accelerate vegetation and algae growth thus contributing to eutrophication of surrounding lakes.

The amount of phosphorus and nitrogen attached to sediment was calculated using information collected by USDA-ARS researchers. The estimate starts with an overall phosphorus concentration of 0.0005 lbP/lb of soil and a nitrogen concentration of 0.001 lbN/lb of soil. Soil texture is determined and a correction factor is used to better estimate nutrient holding capacity of the soil (MDEQ, 1999). Sand is the dominant soil texture for the Ocqueoc River Watershed, thus a correction factor of 0.85 was used.

Road/stream crossing phosphorus load estimate:

*286 tons/yr * 0.0005 lbP/lb soil * 2000 lb/ton * 0.85 =* ***243 pounds of phosphorus per year***

Road/stream crossing nitrogen load estimate:

*286 tons/yr * 0.001 lbN/lb soil * 2000 lb/ton * 0.85 =* ***486 pounds of nitrogen per year***

2. Road/stream crossing load reductions

A total of ten sites were identified as priorities for future BMP installation and improvement projects. The sites were chosen based on their sediment discharge and their impact on cold-water fisheries. The suggested Best Management Practices are based on the site inventories and source of nonpoint pollution. Improvement to 14% of the road/stream sites will result in 52% reduction of sediment loading to the watershed.

When implementing road/stream BMP's, priority will be given to those sites listed in Table 18 because they are contributing the most sediment to the river system. However, additional factors may be considered including the amount and availability of funding, location in the watershed, and partner involvement. These factors may contribute to the selection to a site other than those listed below.

a. Sediment Reduction

The load reduction estimates were made using the same approach for both road stream crossings and streambank estimates for the embankments. A value of .75 was used in the Load Reduction Estimate Spreadsheet (MDEQ, 1999) for the BMP efficiency. Vegetative buffers remove 75% of sediment and this application closely resembles the suggested BMP's for each site.

The load reduction for the approach work was calculated using the RUSLE. The value for the cover management factor for unpaved roads is 1. The suggested BMP is to pave both approaches lowering the cover management factor to .12.

Table 18: Sediment Load Reduction for Selected Road/Stream Crossing Sites

Site ID	Justification	Suggested BMP's		Current Loading tons/year	Estimated Load Reduction tons/year	Estimated Cost
3	Poor embankment vegetation High level of outlet erosion	Revegetation Install diversion outlets	.5 acre 2	22	19	$6,000
26	Inlet and outlet erosion Poor embankment veg. Undersized culvert(s) Fish passage issues	Revegetation Install diversion outlets Pave approaches Replace culvert: single span	.25 acre 10 500' 15'X50'	12	10	$85,000
29	Inlet and outlet erosion Poor embankment veg. Undersized culverts Fish passage issues	Revegetation Install diversion outlets Pave approaches Replace culvert: single span	.25 acre 10 400' 8'X35'	11	10	$65,000
33	Inlet and outlet erosion Poor embankment veg. Undersized culverts Fish passage issues	Revegetation Install diversion outlets Pave approaches Replace culvert: single span	.33 acres 10 1300' 8'X36'	6	5	$65,000
34	Long steep approach Poor embankment slopes Deteriorating structure Undersized structure-length	Revegetation Pave approaches Install diversion outlets Replace structure	.25 acre 1000' 8 6'X24'	36	31	$50,000
38	Inlet and outlet erosion Poor embankment veg.	Revegetation Diversion outlets Pave approaches	.25 acre 8 800'	8	7	$15,000
42	Steep approaches Poor embankment veg. Undersized culverts	Revegetation Pave approaches Install diversion outlets Replace culverts	.15 acre 225' 4 30'X75'	25	19	$150,000
43	Inlet and outlet erosion Poor embankment veg. Undersized culverts Fish passage issues	Revegetation Install diversion outlets Pave approaches Replace culvert: single span	.33 acre 4 120' 6'X40'	7	6	$60,000
46	Long steep approaches Undersized culverts (length)	Revegetation Pave approaches Install diversion outlets	.25 acre 500' 6	14	12	$7,000
50	Inlet and outlet erosion Poor embankment veg.	Revegetation Install diversion outlets Pave approaches	.25 acre 8 900'	6	5	$15,000
	Totals	**Revegetation** **Install Diversion Outlets** **Pave approaches** **Replace Culverts**	**2.81 acre** **70** **5745'** **6 culvert**	**147**	**124**	**$518,000**

b. Nutrient Reduction

Because the pollutant load estimates for nutrients were based on sediment loading, the load reduction estimated for phosphorus and nitrogen is based on the amount of sediment reduced at each site.

Table 19: Phosphorus and Nitrogen Load Reduction for Selected Road/Stream Crossing Sites

Site Id	Phosphorus (lbs/year)		Nitrogen (lbs/year)	
	Estimate Load/Year	Estimate Reduction/Year	Estimate Load/Year	Estimate Reduction/Year
3	18	16	37	32
26	10	9	20	17
29	9	8	19	16
34	3	2	60	53
38	7	6	14	12
42	21	19	42	37
43	6	5	11	10
46	12	10	24	21
50	6	5	11	9
Total	**92**	**80**	**238**	**207**

E. STREAMBANK EROSION POLLUTANT LOADING AND REDUCTION ESTIMATES

There were a total of 24 streambank erosion sites identified within the Ocqueoc River Watershed, all of which were located on the Ocqueoc River. Eleven of the erosion sites were caused by “natural” activities such as bend of the river, log jams, and bank seepage. The other 13 sites were caused by human activities including excessive foot traffic along the bank and livestock access at one site.

1. Streambank pollutant loading

The Lateral Recession Rate (LRR) was used to estimate the amount of sediment loading on identified streambank erosion sites. The following formula was used:

$$\textbf{\textit{LRR = Height} * \textit{Width} * \textit{Erosion Severity}}$$

The following values were used for erosion severity: Slight = .02, Moderate = .14, Severe = .4, and Very Severe = .5.

*The estimated sediment loading for streambank erosion is **1,406 tons per year***

The same calculations for estimating road stream nutrients were also applied to streambank nutrient loading.

Streambank phosphorus load estimate:

*1406 tons/yr * 0.0005 lbP/lb soil * 2000 lb/ton * 0.85 = **2390 pounds phosphorus per year***

Streambank nitrogen load estimate:

*1406 tons/yr * 0.001 lbN/lb soil * 2000 lb/ton * 0.85 = **1195 pounds of nitrogen per year***

2. Streambank pollutant load reduction

Load reductions were calculated for the four most severe sites. Best Management Practices were identified for each site reflecting the source and cause of sediment. In addition to these four selected sites, there are several other locations exhibiting erosion caused by human activities, which should be considered for future treatment. Improvement to 30% of the eroding streambanks will result in a sediment load reduction of 68%.

When implementing streambank BMPs priority will be given to the sites listed in Table 20 because they are contributing the majority of sediment to the river. However, other factors including landowner willingness, availability of funding, site location, and partner involvement may contribute to the selection of installing BMPs at erosion sites not listed below.

a. Sediment Reduction

The load reduction estimates for streambank erosion contributing sediment was based on the size and severity of the erosion site. A value of .75 was used in the Load Reduction Estimate Spreadsheet (MDEQ, 1999) for the BMP efficiency. Vegetative buffers remove 75% of sediment and this application closely resembles the suggested BMP's for each site.

Table 20: Sediment Load Reduction for Selected Streambank Erosion Sites

Site ID	Justification	Suggested BMP's		Current Loading (tons/year)	Estimated Load Reduction (tons/year)	Estimated Cost
1	No bank vegetation	Revegetation Installation of bio-logs Tree revetments Access management	.5 acre 75' 75' TBD	66	50	$7,500
3	Poor streambank vegetation	Revegetation Installation of bio-logs Tree revetments Access management	.75 acre 100' 100' TBD	31	23	$7,500
6	No bank vegetation	Revegetation Installation of bio-logs Access management	.5 acre 150' TBD	123	92	$15,000
11	Poor streambank vegetation	Revegetation Installation of bio-logs Tree revetments Access management	1 acre 300' 300' TBD	462	347	$7,500
12	Poor streambank vegetation	Revegetation Installation of bio-logs Tree revetments Access management	1 acre 350' 350' TBD	385	289	$7,500
13	Poor streambank vegetation	Revegetation Installation of bio-logs Tree revetments Access management	1 acre 150' 150' TBD	132	99	$7,500
23	Poor streambank vegetation	Revegetation Installation of bio-logs Tree revetments Access management	.5 acre 150' 150' TBD	83	62	$7,500
	Totals	Revegetation Installation of bio-logs Tree revetments Access management	**5.25 acres** **1275'** **1275'**	**1282**	**961**	**$60,000**

b. Nutrient Reduction

Because the pollutant load estimates for nutrients were based on sediment loading, the load reduction estimated for phosphorus and nitrogen is based on the amount of sediment reduced at each site.

Table 21: Phosphorus and Nitrogen Load Reduction for Selected Streambank Erosion Sites

Site ID	Phosphorus (lbs/year)		Nitrogen (lbs/year)	
	Estimate Load/Year	Estimate Reduction/Year	Estimate Load/Year	Estimate Reduction/Year
1	56	42	112	84
3	26	20	52	39
6	105	79	210	158
11	393	295	785	589
12	327	246	655	491
13	112	84	224	168
23	70	53	140	105
Total	**1089**	**819**	**2178**	**1634**

F. ACCESS EROSION SITES

There were two access sites identified as contributing nonpoint source pollution to the river system. Both access sites were located at road/stream crossings where recreational users were accessing the river. Though these sites are identified in the road/stream crossing inventory, located at site 03 and site 04, their contribution of pollution was high enough to warrant individual pollutant estimates. Best Management Practices at each location includes revegetation, terracing, access control measures.

The gully erosion equation (GEE) was applied to each access site (MDEQ, 1999).

$$\frac{\text{Top Width (ft)} + \text{Bottom Width (ft)}/2 * \text{Depth (ft)} * \text{Length (ft)} * \text{Soil Weight (tons/ft}^3)}{\text{Number of Years}}$$

Table 22: Access Site Pollutant Loading and Reduction

Site ID	Sediment (tons/year)		Phosphorous (lbs/year)		Nitrogen (lbs/year)		Cost
	Estimate Load/Year	Estimate Reduction/Year	Estimate Load/Year	Estimate Reduction/Year	Estimate Load/Year	Estimate Reduction/Year	
03	13	10	11	8	22	16	$4,000
04	4	3	3	3	6	5	$4,000
Total	**17**	**13**	**14**	**11**	**28**	**21**	**$8,000**

G. AGRICULTURAL POLLUTION LOADING AND LOAD REDUCTION ESTIMATES

Sixteen agricultural sites have been identified within the critical area of the watershed. Of those, two sites were identified to have livestock access to the Ocqueoc River and are contributing a measurable amount of polluted runoff to the river system. The RUSLE was used to estimate the pollutant load and load reduction amounts. Best Management Practices (BMP) for site 11 include prescribed grazing, conservation cover, filter strips, and exclusion fencing. BMP's for site 16 include prescribed grazing, conservation cover, filter strips, exclusion fencing, and alternate water source.

Table 23: Agriculture Pollutant Loading and Load Reduction Estimates							
Site ID	Sediment (tons/year)		Phosphorous (lbs/year)		Nitrogen (lbs/year)		Costs
	Estimate Load/Year	Estimate Reduction/Year	Estimate Load/Year	Estimate Reduction/Year	Estimate Load/Year	Estimate Reduction/Year	
11	139	78	115	86	227	170	$20,000
16	145	77	120	90	236	177	$11,700
Total	**284**	**155**	**235**	**176**	**463**	**347**	**$31,700**

Table 24 lists the total pollutant loading, load reduction, and cost by source of pollutant including road/stream crossing, streambank erosion, access sites and agriculture sites. Load reduction for septic system effluent and fertilizer use is not included in this table as there is not specific sites selected and load reduction is highly dependent on the system of BMP's implemented.

Table 24: Total Load Reduction By Source of Pollution							
Source	Sediment (tons/year)		Phosphorous (lbs/year)		Nitrogen (lbs/year)		Costs
	Estimate Load/Year	Estimate Reduction/Year	Estimate Load/Year	Estimate Reduction/Year	Estimate Load/Year	Estimate Reduction/Year	
Road/Stream Crossings	147	124	92	80	238	207	$518,000
Streambank Erosion	1282	961	1089	819	2178	1634	$60,000
Access Sites	17	13	14	11	28	21	$8,000
Agriculture	284	155	235	176	463	347	$31,700
Total	**1501**	**1082**	**1236**	**940**	**2519**	**1918**	**$595,200**

CHAPTER V

Watershed Goals, Strategies and Funding

The purpose of the Watershed Project is to improve and protect the water quality of the Ocqueoc River and the lakes and streams that drain to it. Project goals were created through the collaborative efforts of the Watershed Partnership and are based on protecting designated uses. Specific objectives, or strategies, are organized under their respective goal and are used to address the source of the problem, typically by affecting the root cause.

Strategies were initially developed and prioritized through the use of a survey taken by members of the Partnership. (Results of the survey can be reviewed in Appendix B.) *Strategies were further prioritized (ranked) by the group through a nominal group voting process April 29, 2003, and are listed below.* Additional strategies were incorporated during the update of the management plan based on discussions of the Ocqueoc River Commission.

The strategies of the watershed management plan can fall into one of two categories: those focused at mitigating or restoring problem sites, and, those aimed at protecting and enhancing a high-quality water resource. Even though it is much easier to quantify restorative practices, this should not diminish the benefits that protective measures provide to a watershed such as the Ocqueoc where preservation of the resource is fundamental to maintaining high water quality and wildlife habitat.

Following the list of watershed strategies are tables showing the expected pollutants to be controlled, the potential system of Best Management Practices, estimated costs, and potential sources of funding.

A. PROJECT GOALS

Goal 1: Protect the watershed's fishery population and navigation by reducing the amount of erosion, particularly caused by human activities, negatively impacting the river.

Goal 2: Safeguard fisheries, aquatic life, public water supply, and body contact recreation by reducing the amount of nutrient loading to surface water.

Goal 3: Protect the fishery and other aquatic life by restoring a more natural flow regime to the river system.

Goal 4: Conserve important wildlife habitat areas.

Goal 5: Enhance and protect the Ocqueoc River Watershed by promoting stewardship, education, and responsible use of the watershed.

Strategies for watershed restoration in the Ocqueoc River Management Plan are used to help restore nonpoint source pollution sites, to improve water quality and to protect unique areas in the watershed, and to help maintain high water quality for years to come.

B. ACTION PLAN: STRATEGIES TO IMPROVE AND PROTECT WATER QUALITY

Under each strategy are the following categories:

- Lead organization(s) for ensuring this project is implemented: Group(s) responsible for each strategy
- Milestones needed to execute this strategy: Sub-tasks to ensure the overall strategy is being implemented (signs of success)
- Level of Effort: Specific details related to each strategy
- Water Quality Benefits: Load reduction figures where applicable, other water quality or habitat benefits that can not be quantified
- Costs: Funding needed to implement each strategy
- Funding Sources: The partners, programs, foundations, and grants where funding might be sought
- Evaluation methods: Methods to determine if the tasks are being implemented and whether they are effective at reducing nonpoint pollution
- Technical assistance: Support from experts other than the lead organization needed to properly implement the strategy
- 2005 status: Review of projects completed during 2004-2005

Goal 1: Protect the watershed's fishery population and navigation by reducing the amount of erosion, particularly caused by human activities, negatively impacting the river.

Strategy 1.1 Implement Best Management Practices (BMPs) at road/stream crossings identified as problem sites for erosion, runoff, sediment delivery, fish passage, and restricted flow. (1-10 years)

Lead organization(s) for ensuring this project is implemented:
Huron Pines RC&D, Presque Isle County Road Commission
Milestones needed to execute this strategy:
1.1.1 Conduct analysis of sites listed as moderate or severe in the nonpoint inventories in order to prioritize sites, determine appropriate treatment, and develop engineering designs. (Year One)
1.1.2 Obtain funding to implement BMPs. (Year One, Three, Five, Seven, Nine)
1.1.3 Stabilize 10 eroding road/stream crossings by implementing BMPs. (Year Two, Four, Six, Eight, Ten)
Level of Effort: 2.81 acres of revegetation, 70 diversion outlets, 5745 linear feet of pavement, 6 culvert replacements
Water Quality Benefits: Reduction of 124 tons/year sediment; 80 lbs/year phosphorous; 207 lbs/year nitrogen, improve base flow, improved fish passage
Costs: $518,000 for 10 priority sites; 25 moderate sites at $40,000/site ($1,518,000 total)
Funding Sources: 319 and CMI programs, Presque Isle Road Commission, US F&WS
Evaluation Methods: Before & after photos, stream assessment, calculate BMP load reduction
Technical Assistance: Engineering services
2005 Status: Site 39: (Little Ocqueoc River/North Silver Creek Road) two perched culverts creating downstream ponding and streambank erosion has been replaced with on bottomless single culvert to restore a more natural flow. Additional BMP's include regrading the approaches to direct runoff to the ditches and 7 diversion outlets. Total project cost was $62,872 with funding provided by Section 319 and matching funds supplied by the Presque Isle Road Commission and the US Fish & Wildlife Service for structure replacement.

Strategy 1.2 Develop a recreational access committee to regularly evaluate the condition of public access sites, ensure proper maintenance, ensure that sites are designed/and or maintained while preventing overuse, and implement BMPs at those sites contributing nonpoint source pollution. (Years One, Two, Nine, Ten)

Lead organization(s) for ensuring this project is implemented:
Ocqueoc River Commission

Milestones needed to execute this strategy:

1.2.1 Formulate ad-hoc committee. (Year One)
1.2.2 Implement an "Adopt an Access Site" program, where local conservation and service groups take responsibility for designated access sites and ensure each site is properly maintained. (Year One)
1.2.3 Conduct a usage study/survey of river users and access sites. (Year One, Nine)
1.2.4 Formulate recommendations. (Year One, Nine)
1.2.5 Obtain funding and implement recommendations as needed. (Year Two, Ten)

Level of Effort: 2.25 acres of revegetation, 130 linear feet of terrace, 300 linear feet access management
Water Quality Benefits: Gully stabilization at site 03 and site 04: reduction of 13 tons/year sediment; 11 lbs/year phosphorous; 21lbs/year nitrogen. Annual clean-ups: increased public awareness and removal of debris from sites.
Costs: $500 annually per clean-up, $8,000 erosion control at two access sites
Funding Sources: Local service/conservation groups
Evaluation Methods: Load reduction calculation after BMP installation, document number of sites and trash removed annually.
Technical Assistance: Engineering services
2005 Status: The Ocqueoc River Commission has formed a committee and will designate certain access sites to local service/conservation groups and each site will be maintained at the Annual River Celebration.

Strategy 1.3 Conduct intensive educational program to demonstrate lake-friendly methods of erosion control and minimize nutrient input. (Years One, Two, Three, Four)

Lead organization(s) for ensuring this project is implemented:
Huron Pines RC&D

Milestones needed to execute this strategy:

1.3.1 Using existing educational materials, conduct a direct mailing to property owners. (Years One, Three)
1.3.2 Conduct soil erosion workshop for contractors and landscapers to improve their practices with regard to new construction. (Years Two, Four)
1.3.3 Develop two or three bio-technical erosion control demonstration sites and conduct a public tour for property owners. (Years Two, Three, Four)

Level of Effort: Approximately 400 riparian residents
Water Quality Benefits: Reduction of 34 lbs/year phosphorous, reduced runoff and sediment input, increased wildlife habitat
Costs: $6,000/year
Funding Sources: Private foundations, 319 and CMI programs
Evaluation Methods: Attendees at workshops, post workshop survey
Technical Assistance: Groundwater Stewardship Program
2005 Status: 391 pieces of direct mail were sent to riparian landowners that included *Caring for the Ocqueoc* newsletter and *Landscaping for Water Quality* providing landowners with useful tips to protect water quality and wildlife habitat within the watershed.

Strategy 1.4 Implement BMPs at streambank erosion sites along the river. (Years Two, Three, Four)

Lead organization(s) for ensuring this project is implemented:
Huron Pines RC&D

Milestones needed to execute this strategy:

1.4.1 Contact property owners of moderate and severe streambank erosion sites. (Year Two)
1.4.2 Develop a cost-share program to help implement BMPs. (Year Two)
1.4.3 Develop designs for sites with willing property owners. (Years Two, Three)
1.4.4 Stabilize streambanks. (Years Three, Four)

Level of Effort: 5.25 acres of revegetation, 1275 linear feet of bio-logs, 1275 linear feet of tree revetment, access management at 7 locations.
Water Quality Benefits: Reduction of 961 tons/year sediment; 819 lbs/year phosphorous; 1634 lbs/year nitrogen. Improvement of wildlife habitat, decreased water temperature, improved stream morphology.
Costs: $60,000 for 7 priority sites, 6 moderate sites at $6,000/site ($96,000 total)

Funding Sources: US F&WS, property owners, 319 and CMI programs, NRCS
Evaluation Methods: Before & after photos, calculate BMP load reduction, stream assessment
Technical Assistance: Engineering services
2005 Status: No work done in 2005

Strategy 1.5 Increase county zoning setback for new development along the waterfront from the current standard of 30 feet to a minimum of 100 feet. (Years One, Two)

Lead organization(s) for ensuring this project is implemented:
Presque Isle County Planning Commission

Milestones needed to execute this strategy:
1.5.1 Review and modify model ordinances. (Year One)
1.5.2 Adopt standard within County Zoning Ordinance. (Year One)
1.5.3 Distribute materials informing land developers, contractors, zoning board of appeals, real estate agents, and townships. (Year Two)

Level of Effort: 5 townships, Village of Millersburg
Water Quality Benefits: Reduced impervious surface near water bodies, reduced polluted runoff, decreased construction infringement to water bodies, increased potential for native vegetative buffer, increase of septic system setback from water bodies.
Costs: $3,000
Funding Sources: Local government
Evaluation Methods: Adoption of increased setback in zoning ordinances, review building permits to assess whether the increased setbacks are being implemented.
Technical Assistance: Land use planning professional
2005 Status: The updated Presque Isle County Comprehensive Plan was adopted November 4, 2004 that recommends the existing waterfront setback to be increased in new development. However, the plan does not specify the building setback distance. Revised zoning ordinance are expected to be adopted by the end of 2006 and will be reviewed for any improvements to water resource protection.

Goal 2: Safeguard fisheries, aquatic life, public water supply, and body contact recreation by reducing the amount of nutrient loading to surface water.

Strategy 2.1 Adopt zoning regulation to require that aquatic buffers (i.e., shoreline greenbelts) are maintained along the waterfront for all new development. (Years One, Two)

Lead organization(s) for ensuring this project is implemented:
Ocqueoc River Commission, County Planning Commission

Milestones needed to execute this strategy:
2.1.1 Review model buffer zone ordinances and select the most suitable for Presque Isle County. (Year One)
2.2.2 Approve this provision in new county zoning ordinance. (Year One)
2.2.3 Provide alternatives to traditional landscaping practices, (Year One)
2.2.4 Distribute materials informing land developers, contractors, zoning board of appeals, real estate agents, townships, riparian landowners, landscape companies and lawn care of the newly adopted section of the zoning ordinance. (Year Two)

Level of Effort: 5 townships, Village of Millersburg
Water Quality Benefits: Reduced impervious surface near water bodies, reduced polluted runoff, decreased construction infringement to water bodies, wildlife habitat improvement, increased privacy.
Costs: $3,000
Funding Sources: Local governments
Evaluation Methods: Document number of new developments with greenbelts constructed before and after ordinance takes effect.
Technical Assistance: Land use planning professional
2005 Status: The updated Presque Isle County Comprehensive Plan was adopted November 4, 2004 and encourages adopting a greenbelt ordinance to preserve native vegetation along water bodies, but does not specify width of the greenbelt.

Strategy 2.2 Conduct septic system outreach program to educate property owners regarding maintenance and management of their systems. (Year Two)

Lead organization(s) for ensuring this project is implemented:
District Health Department

Milestones needed to execute this strategy:

2.2.1 Develop and submit press releases to media and use already-developed information for mailing to property owners. (Year Two)

2.2.2 Contact septic pumpers and set up a promotional, reduced-cost inspection and pump-out of septic system for property owners calling at a certain time such as during a "watershed week". (Year Two)

Level of Effort: Approximately 400 riparian landowners
Water Quality Benefits: Reduction of failing septic systems leaching to ground and surface waters, improved efficiency of system.
Costs: $3,000/yr ($30,000)
Funding Sources: Education grants, private foundations
Evaluation Methods: Property owner pre- and post-survey
Technical Assistance: N/A
2005 Status: The updated Presque Isle County Comprehensive Plan was adopted November 4, 2004 and encourages cooperation with the Health Department to conduct septic system educational programs. An article was published in the Presque Isle Advance and septic information was distributed to riparian landowners in the *Caring for the Ocqueoc* newsletter.

Strategy 2.3 Provide technical staff to assist property owners with re-establishing 5 acres of vegetation along the waterfront and assist with appropriate turf management techniques, etc. (Years One thru Ten)

Lead organization(s) for ensuring this project is implemented:
Presque Isle Conservation District and MSU Extension

Milestones needed to execute this strategy:

2.3.1 Promote soil testing program for property owners. (Yearly)

2.3.2 Use Real Estate Agents and local contractors to distribute materials to future property owners on lakefront/riverfront friendly property management techniques. (Yearly)

2.3.3 Mail information to all lakefront property owners with poor greenbelts and offer free on-site visits to provide them with practical suggestions. (Bi-yearly)

Level of Effort: 5 riparian acres
Water Quality Benefits: Reduction of 1.1 lbs/year phosphorous, reduce polluted runoff and sediment to water bodies, improve habitat.
Costs: $8,000/yr ($80,000)
Funding Sources: Private foundations, 319 and CMI programs, Great Lake Commission
Evaluation Methods: Before & after photos, document number of reestablished greenbelts.
Technical Assistance: Erosion control/landscaping professional
2005 Status: Hosted a riparian workshop featuring a hands-on native greenbelt demonstration at the Ocqueoc Outdoor Center. Provided riparian property owners with greenbelt and native planting literature.

Strategy 2.4 Implement ordinance to require inspection of septic systems every several years or at the time of property transfer, with requirements of upgrades for substandard systems. (Years One, Three, Four)

Lead organization(s) for ensuring this project is implemented:
District Health Department Number 4 and Presque Isle County

Milestones needed to execute this strategy:

2.4.1 Adopt ordinance. (Year One)

2.4.2 Begin inspection program, phased in over several years. (Year Three)

2.4.3 Develop and maintain database for all on-site wastewater treatment systems. (Yearly)

2.4.4 Develop a cost-share funding program to assist property owners and reduce the expense of installing on-site wastewater treatment systems at those sites where substandard systems are presently located. (Year Three, Four)

Level of Effort: 5 townships, Village of Millersburg
Water Quality Benefits: Reductions based on new system installed, refer to Table 15
Costs: $3,000
Funding Sources: 319 and CMI programs
Evaluation Methods: Baseline water sampling

Technical Assistance: N/A
2005 Status: No work done in 2005

Strategy 2.5 Install exclusion fencing to prevent unrestricted livestock access to streams. (Years Two, Three)

Lead organization(s) for ensuring this project is implemented:
Natural Resources Conservation Service

Milestones needed to execute this strategy:
2.5.1 Contact agriculture producers where this is occurring and develop conceptual solution with them. (Year Two)
2.5.2 Identify source of cost-share funding. (Year Two)
2.5.3 Complete engineering designs. (Year Two)
2.5.4 Develop a BMP maintenance agreement with the property owner. (Year Two)
2.5.5 Install appropriate agriculture BMPs. (Year Three)

Level of Effort: 1,800 linear feet of fencing, 2 acres of revegetation, 1 alternate water source
Water Quality Benefits: Reduction of 155 tons/year sediment; 176 lbs/year phosphorous; 347 lbs/year nitrogen.
Costs: $31,700
Funding Sources: USDA cost share programs, landowner
Evaluation Methods: Before & after photos, stream sampling
Technical Assistance: N/A
2005 Status: No action in 2005

Goal 3: Protect the fishery and other aquatic life by restoring a more natural flow regime to the river system.

Strategy 3.1 Identify and inventory existing human-made impoundments within the watershed.

Lead organization(s) for ensuring this project is implemented:
State of Michigan -- Department of Natural Resources and Dept. of Environmental Quality, Ocqueoc River Commission, Presque Isle Drain Commissioner

Milestones needed to execute this strategy:
3.1.1 Work with DEQ and DNR to form a collaborative effort to address impoundments. (Year Two)
3.1.2 Document condition, ownership, and impact on watershed of all human-made impoundments. Years Two, Three)
3.1.3 Host public meeting and share results with the community. (Years Three)
3.1.4 Develop treatment options, such as removal, repair, lowering of the dam, etc, on a site by site basis. (Years Three thru Eight)
3.1.4 Repair, replace, or remove impoundments that are significantly disrupting the river's flow regime. (Years Two thru Eight)

Level of Effort: Approximately 25 man-made impoundments within with watershed
Water Quality Benefits: Restore more natural flow regime, improve fish passage, and increase stream diversity.
Costs: $320,000
Funding Sources: US Army Corps of Engineers, CMI, US F&WS
Evaluation Methods: Establish monitoring program
Technical Assistance: Engineering services
2005 Status: Presque Isle County Drain Commissioner is inventorying existing impoundments and will present the findings in 2006.

Strategy 3.2 In areas where commercial or residential development and its associated transportation system is directly discharging stormwater runoff to surface water; work with the site owner/developer to implement a retrofit of the drainage system so that it is treated or redirected away from surface water. (Years Three, Four, Five)

Lead organization(s) for ensuring this project is implemented:
Huron Pines RC&D

Milestones needed to execute this strategy:

3.2.1 Review sites where direct discharge is occurring and meet with property owners to discuss conceptual solutions. (Yearly)
3.2.2 Develop a funding mechanism to address historic problem sites. (Years Four, Five)
3.2.3 Complete detailed engineering designs (Years Four, Five)
3.2.4 Install stormwater BMPs. (Years Four, Five)

Level of Effort: Developed areas
Water Quality Benefits: Reduce runoff, sediment, nutrients, oils & grease, salts, etc. Decrease temperature of surface water, and decrease fluctuating flows associated with stormwater runoff.
Costs: $100,000
Funding Sources: 319 and CMI programs, landowner
Evaluation Methods: Water quality sampling
Technical Assistance: Engineering services
2005 Status: No action in 2005

Strategy 3.3 Promote the use of Low Impact Development (LID) and/or Better Site Design techniques to ensure future development does not increase runoff to the river. (Years One thru Ten)

Lead organization(s) for ensuring this project is implemented:
Huron Pines RC&D

Milestones needed to execute this strategy:
3.3.1 Conduct presentations to Planning Commission, townships, Homebuilder's Association, Road Commission, and land developers. (Bi-yearly)
3.3.2 Work with County to ensure that basic Better Site Design standards are included in zoning ordinance. (Years One, Two)
3.3.3 Identify local land developer to model an example of this concept in a new development in the region, showcasing the economic, social, and environmental benefits.

Level of Effort: 5 townships, Village of Millersburg, land developers
Water Quality Benefits: Reduce polluted runoff and sediment to water bodies, mimic natural infiltration to groundwater.
Costs: $33,000
Funding Sources: 319 and CMI programs
Evaluation Methods: Review new site plan designs
Technical Assistance: Engineering services
2005 Status: Two land use planning roundtable discussions were held in 2005 where LID concepts were presented to the Ocqueoc River Commission and local officials.

The water runoff from the residential street is directed into bio-retention areas along the road. Low Impact Development techniques, show here in a Seattle neighborhood, can help eliminate stormwater runoff while increasing privacy, calming traffic, beautifying the landscape and increasing property values.

Goal 4: Conserve important wildlife habitat areas.

Strategy 4.1 Conduct regular presentations and disseminate materials to community organizations and property owners to link the concept of land use stewardship and high water quality. (Years Two thru Ten)

Lead organization(s) for ensuring this project is implemented:
Huron Pines RC&D

Milestones needed to execute this strategy:
4.1.1 Provide technical assistance to landowners wishing to improve wildlife habitat and water resources. (Yearly)
4.1.2 Provide maps of land cover and natural features to county planning officials, townships, and resource agencies. (Year Two)

Level of Effort: Watershed residents, community organizations
Water Quality Benefits: Protection of high quality resources through sounds planning and stewardship.
Costs: $5,000/yr; ($50,000 total)
Funding Sources: Private foundations
Evaluation Methods: Property owner survey
Technical Assistance: N/A
2005 Status: Information was disseminated to 391 riparian landowners, information kiosks were displayed at the Rogers City and Onaway District Libraries.

Strategy 4.2 Place voluntary conservation easements on 600 acres of significant ecological properties (see Strategy 4.3) that also have an interested landowner. (Years One thru Ten)

Lead organization(s) for ensuring this project is implemented:
HeadWaters Land Conservancy

Milestones needed to execute this strategy:
4.2.1 Promote the concept of conservation easements to landowners in the watershed. (Yearly)
4.2.2 Obtain funding to direct staff to work in the Ocqueoc Watershed. (Bi-yearly)
4.2.3 Develop permanent deed restrictions with property owners. (Yearly)
Level of Effort: 600 acres of riparian land
Water Quality Benefits: Reduction of 40.2 tons/year sediment, 162 lbs/year phosphorous, 3,000 lbs/year nitrogen. Protection of wildlife habitat and unique watershed features.
Costs: 80,000
Funding Sources: Private funding, 319 and CMI programs
Evaluation Methods: Document number of easements (acres), river miles and wetlands protected.
Technical Assistance: N/A
2005 Status: HeadWaters Land Conservancy conducted a land protection workshop, disseminated information to riparian property owners with 20+ acres, and met with landowners interested in land protection.

Strategy 4.3 Identify key ecological corridors and habitat areas.

Lead organization(s) for ensuring this project is implemented:
HeadWaters Land Conservancy, Huron Pines RC&D

Milestones needed to execute this strategy:
4.3.1 Work with resource professionals and develop criteria to determine what constitutes a significant ecological area in the watershed. (Year One, Two)
4.3.2 Use GIS to identify and map all of the parcels meeting the criteria. (Year One, Two)
4.3.3 Present map to HeadWaters Land Conservancy for their use in prioritizing potential conservation easements. (Year Two)
Level of Effort: Critical area (35,384 acres)
Water Quality Benefits: Prioritize sensitive habitats for the protection of water quality.
Costs: $15,000
Funding Sources: Private foundations, 319 and CMI programs
Evaluation Methods: Peer review
Technical Assistance: GIS professional
2005 Status: No action in 2005

Strategy 4.4 Conduct a Natural Features Inventory to catalog unique wildlife, ecosystems, and other natural features within the watershed.

Lead organization(s) for ensuring this project is implemented:
Ocqueoc River Commission, Huron Pines RC&D
Milestones needed to execute this strategy:
4.4.1 Establish an ad-hoc committee to coordinate the program (Year One)
4.4.2 Secure funding and implement the inventory
Level of Effort: Watershed scale (94,394 acres)
Water Quality Benefits: A catalogue of natural features will help guide future land use planning and direct development to more suitable areas.
Costs: $8,000
Funding Sources: Private foundations, Audubon Society, The Nature Conservancy

Evaluation Methods: Use of the inventory in local decision making and prioritizing land protection options.
Technical Assistance: N/A
2005 Status: No action in 2005

Goal 5: Enhance and protect the Ocqueoc River Watershed by promoting stewardship, education, and responsible use of the watershed.

Strategy 5.1 Establish and maintain a permanent Ocqueoc River Commission to address concerns related to the river system. (Annual)

Lead organization(s) for ensuring this project is implemented:
Ocqueoc River Commission, Huron Pines

Milestones needed to execute this strategy:
5.1.1 Obtain a commitment and Memorandum of Understanding from the River Commission. (Year One)
5.1.2 Host regular meetings to review the plan. (Annual)
5.1.3 Suggest and review projects to be completed. (Annual)
5.1.4 Assess funding needs and seek various grant opportunities. (Annual)

Level of Effort: Presque Isle County residents, service groups, stakeholders, resource professionals
Water Quality Benefits: Serve as a forum for public input regarding water quality issues, prioritize project selection, seeking funding, implement projects.
Costs: $5,000 annually ($50,000)
Funding Sources: Private foundations, local sponsors
Evaluation Methods: Increased meeting attendance, projects completed, and fundraising
Technical Assistance: N/A
2005 Status: The Ocqueoc River Commission has formalized their bylaws, established an executive committee and is developing an annual strategic plan and budget. They have been involved with numerous educational and clean-up programs during 2004 and 2005.

Strategy 5.2 Develop a water quality monitoring program to establish a baseline, track water quality changes over the years, and serve as an education tool for residents, school groups and local officials. (Year One thru Ten)

Lead organization(s) for ensuring this project is implemented:
Huron Pines RC&D

Milestones needed to execute this strategy:
5.2.1 Work with DEQ to design monitoring protocol and identify areas of concern. (Year One)
5.2.2 Approved QAPP. (Year One)
5.2.3 Obtain funding for monitoring equipment, testing samples, and data evaluation. (Year One, as needed)
5.2.4 Train volunteer groups. (Year One, as needed)
5.2.5 Take water quality samples. (Yearly)
5.2.6 Develop database and track results. (Yearly)
5.2.7 Evaluate data and share results. (Yearly)

Level of Effort: Areas of concern (road/stream crossing, developed areas, etc)
Water Quality Benefits: Safeguard high-quality resources by tracking changes in water chemistry and stream habitat allowing stakeholders to respond as necessary. Foster stewardship through education of monitoring programs. Pre and Post water resource survey of volunteer monitors.
Costs: $12,000 year one; $5,000 year two thru ten ($60,000)
Funding Sources: CMI, 319, local sponsors
Evaluation Methods: Evaluate sampling procedures to ensure QAPP is being implemented appropriately.
Technical Assistance: DEQ, DNR, USDA
2005 Status: No action taken in 2005.

Strategy 5.3 Host an Annual Ocqueoc River Day or Watershed Week to focus on those actions the community can take to help care for the river system. (Year One thru Ten)

Lead organization(s) for ensuring this project is implemented:

Ocqueoc River Commission

Milestones needed to execute this strategy:

5.3.1 Plan, publicize and host the event. (Yearly)

Level of Effort: Watershed residents, school groups, service groups
Water Quality Benefits: Promote pubic involvement, increase awareness of the watershed, encourage water friendly stewardship practices to attendees.
Costs: $5,000/year ($50,000)
Funding Sources: Local sponsors
Evaluation Methods: Attendance, survey attendees
Technical Assistance: Resource professionals
2005 Status: Hosted the Ocqueoc Watershed Celebration with educational speakers, a stream clean-up, and resource materials were provided. The 2006 Watershed Celebration will be 2 days and include local school groups.

Strategy 5.4 Establish a Speakers Forum to meet with various target audiences, and any necessary literature to distribute. (Year One thru Ten)

Lead organization(s) for ensuring this project is implemented:

Ocqueoc River Commission

Milestones needed to execute this strategy:

5.4.1 Educate willing participants so they can present watershed information to various civic groups. (Year One, Two)
5.4.2 Present information to target audiences. (Yearly)

Level of Effort: 400 riparian landowners, local officials, developers, school groups
Water Quality Benefits: Promote pubic involvement, increase awareness of the watershed, encourage water friendly stewardship practices to attendees.
Costs: $3,000/year ($30,000)
Funding Sources: Local sponsors, private foundations, 319 and CMI program
Evaluation Methods: Interview participants
Technical Assistance: Resource professionals
2005 Status: Hosted three speaker's forum in 2005.

Strategy 5.5 Create a resource library of recommended practices for riparian homeowners (lawn care practices), local officials (regulations to protect water quality and habitat), teachers (learning tools for students), and other stakeholders. (Year One, Two)

Lead organization(s) for ensuring this project is implemented:

Huron Pines RC&D

Milestones needed to execute this strategy:

5.5.1 Gather resource information. (Year One)
5.5.2 Compile information and provide to local libraries, conservation district, MSUE, Ocqueoc Outdoor Center, and other appropriate locations. (Year Two)
5.5.3 Update resource library as necessary (Year three thru ten)

Level of Effort: 400 riparian landowners, local officials, teachers
Water Quality Benefits: Document water resource protection and make available to target audiences. Encourage water quality and habitat protection.
Costs: $5,000 first year; $1,000 annual updates ($15,000 total)
Funding Sources: Local sponsors, private foundations, 319 and CMI program
Evaluation Methods: Survey viewers for feedback on content
Technical Assistance: Resource professionals/organizations
2005 Status: No action in 2005

Strategy 5.6 Promote responsible guidelines to reduce future conflicts from activities such as fishing, canoeing, etc. (Year Two, Three)

Lead organization for ensuring this project is implemented:

Ocqueoc River Commission

Milestones needed to execute this strategy:

5.6.1 Bring in various stakeholder/user groups and develop guidelines. (Year Two)
5.6.2 Post signage at access points and send out news releases. (Year Three)

Level of Effort: Recreational users
Water Quality Benefits: Awareness and responsible use of water resources.
Costs: 8,000
Funding Sources: Local sponsors, DNR
Evaluation Methods: Interview property owners and recreational users
Technical Assistance: Fishery/wildlife biologist
2005 Status: No action in 2005

Strategy 5.7 Work with regulatory officials to enforce trespassing rules along the banks of the river in order to reduce severe Streambank erosion resulting from recreational foot traffic. (Year One thru Ten)

Lead organization(s) for ensuring this project is implemented:
Ocqueoc River Commission, MDNR Conservation Officer and County Prosecutor's Office

Milestones needed to execute this strategy:

5.7.1 Work with local law enforcement to organize a collaborative monitoring program. (Year One)
5.7.2 Conduct an intensive monitoring and enforcement effort at peak trespassing time such as the salmon run at identified problem areas. (Yearly)
5.7.3 Write specific tickets to violators. (Yearly)
5.7.4 Prosecute violators. (Yearly)
5.7.5 Publicize penalties. (Yearly)

Level of Effort: 5 Townships, Village of Millersburg, law enforcement
Water Quality Benefits: Reduction of streambank erosion.
Costs: $0
Funding Sources: N/A
Evaluation Methods: Interview property owners and Conservation Officers
Technical Assistance: Law enforcement
2005 Status: No action in 2005

C. IMPLEMENTATION SCHEDULE

One question of watershed management is “Are the strategies being implemented in a timely fashion?” Each strategy and sub-task shows “signs of success” and the expected years in which they will be implemented. Due to unforeseen circumstances, such as the availability of funding, increased project needs, the capacity of the lead organization to implement the project; the years may vary slightly from the timeline. In order to evaluate the effectiveness of implementation, the Ocqueoc River Commission must devote one meeting per year to review the watershed plan strategies and determine whether they are being implemented in a timely manner. There are 24 strategies overall. The way in which the timeline is laid out, approximately half of these are targeted each year. Success will be determined if at least 50% of the strategies are implemented in a given year.

Table 25 identifies the management strategy and what watershed pollutant it is controlling. Several strategies address numerous pollutants.

Table 25: Watershed Pollutants Controlled, by Strategy

Strategy	Primary Pollutant Controlled	Secondary Pollutants Controlled
1.1	Sediment	Oils & Greases, Fluctuating Water Flow
1.2	Sediment	Nutrients
1.3	Sediment	Nutrients, Temperature
1.4	Sediment	Nutrients, Temperature
1.5	Sediment	Nutrients, Pesticides
2.1	Nutrients	Sediment, Pesticides, Oils & Greases
2.2	Nutrients	Pathogens
2.3	Nutrients	Sediment, Pesticides
2.4	Nutrients	Pathogens
2.5	Nutrients	Pathogens, Sediment
3.1	Temperature	Fluctuating Water Flow
3.2	Sediment	Fluctuating Water Flow, Oils & Greases
3.3	Sediment	Temperature, Fluctuating Water Flow, Oils & Greases
4.1	All	N/A
4.2	All	N/A
4.3	All	N/A
4.4	Sediment	Nutrients, Elevated Water Temperature
5.1	All	N/A
5.2	All	N/A
5.3	All	N/A
5.4	All	N/A
5.5	All	N/A
5.6	All	N/A
5.7	Sediment	Nutrients

In order to mitigate the pollutants degrading the Ocqueoc River Watershed, Best Management Practices (BMPs) need to be in place. BMPs can either be vegetative, structural, or managerial. Table 26 is categorized by strategy highlighting the potential BMP, number of sites or years to completion, and the estimated costs of implementing the recommended BMP.

Table 26: Potential Systems of BMPs and Estimated Costs, by Strategy:

Strategy	Potential system of BMPs or management tools	Number of priority sites or # of years	*Estimated* cost (averaged for all the sites in a category)
1.1	Watercourse crossings (replace culvert, extend culvert, realign culvert with stream, stabilize outlets); detention basins; surface hardening; flatten the embankment slope and revegetate	10 priority sites 25 moderate sites	$518,000-priority sites $40,000/moderate site ($1,518,000 total)
1.2	Access management, stabilize eroding banks	2 sites	$4,000/site $500 clean-up
1.3	Educational outreach program, workshops	10 years	$6,000/yr
1.4	Streambank stabilization, revegetation, access management	7 priority sites, 6 moderate sites	$60,000-priority sites $6,000/moderate site ($96,000 total)
1.5	Ordinance	Single event	$3,000 total
2.1	Ordinance	Single event	$3,000 total
2.2	Education outreach program	Yearly	$3,000/yr ($30,000 total)
2.3	Education outreach program, workshops	10 years	$8,000/yr ($80,000 total)
2.4	Ordinance	Single event	$3,000 total for adoption, program itself is self-funded
2.5	Exclusion fencing, alternate water source, livestock access, revegetation	2 sites	$31,700
3.1	Remove, repair, or lower impoundment	4 sites	$320,000
3.2	Detention basin, oil/grit separator, constructed wetland, infiltration trench	5 sites	$100,000
3.3	Education outreach program, Ordinance	10 years	$3,000/yr education $3,000 ordinance
4.1	Education outreach program, workshops	10 years	$5,000/yr ($50,000 total)
4.2	Land Protection	20 sites	$4,000/site ($80,000 total)
4.3	Research	Single event	$15,000
4.4	Research	Single event	$8,000
5.1	Ocqueoc River Commission	Yearly	$5,000/yr ($50,000 total)
5.2	Grab samples, temperature loggers, macroinvertebrate samples, groundwater samples	Yearly	$12,000/1st year ($60,000)
5.3	Education outreach program	Yearly	$5,000/yr ($50,000 total)
5.4	Education outreach program, workshops	Yearly	$3,000/yr ($30,000 total)
5.5	Education outreach program	Yearly	$5,000 first year $1,000/yr updates
5.6	Education outreach program	4 years	$2,000/yr ($8,000 total)
5.7	Enforcement	Yearly	$0; no change to staffing

Once strategies to reduce nonpoint source pollutants have been identified, funding sources must be sought to ensure the implementation of the management plan. Table 27 highlights several different funding sources based on specific management practices. Funding sources include the Clean Michigan Initiative (CMI), EPA's 319 Clean Waters Program, US Fish and Wildlife Service, Private Foundations, Local Communities, and others.

Table 27: Potential Sources of Funding for Implementing Strategies

Strategy	Estimated cost for next 10 years	Potential sources of funding
1.1	$1,518,000	PI County, 319, CMI, USF&WS
1.2	$13,000	Private foundation, MDNR, conservation groups, CMI, 319
1.3	$60,000	Private Foundation, 319, CMI
1.4	$96,000	Property owners, NRCS, CMI, 319, USF&WS
1.5	$3,000	Local governments, foundations, CMI, 319
2.1	$3,000	Local governments, foundations, CMI, 319
2.2	$30,000	Private foundations, CMI, 319
2.3	$80,000	319 and CMI programs, Great Lakes Commission
2.4	$3,000	Local governments, foundations, CMI, 319
2.5	$31,700	NRCS, private landowner
3.1	$320,000	US Army Corps of Engineers, CMI, USF&WS, 319
3.2	$100,000	Landowner, developer, CMI, 319
3.3	$33,000	319 program, CMI
4.1	$50,000	Private foundations
4.2	$80,000	Private foundations, local sponsors, CMI, 319
4.3	$15,000	Private foundations, local sponsors
4.4	$8,000	Private foundations, Audubon, The Nature Conservancy
5.1	$50,000	Private foundations, local sponsors
5.2	$60,000	CMI, 319, local sponsors
5.3	$50,000	Local sponsors
5.4	$30,000	Private foundations, local sponsors, CMI, 319
5.5	$15,000	Private foundations, local sponsors, CMI, 319
5.6	$8,000	MDNR, conservation groups
5.7	$0	None needed

Clean Michigan Initiative (CMI)-State of Michigan Program to remediate, protect and enhance surface waters
Section 319 program-Federally designated program to remediate, protect and enhance surface waters
US Fish and Wildlife service (USF&WS)-Programs to improve wildlife habitat and natural resources
Natural Resources Conservation Service-Programs to assist with agricultural restoration to protect surface waters
Michigan Department of Natural Resources (MDNR)-Restoration and user conflict funding assistance

Each estimated cost was classified into the following management categories; Structural & Vegetative BMPs, Education, Land Protection, and Managerial Practices. Table 28 shows each management category, number of strategies to implement, and the estimated costs.

Table 28: Costs by Strategy Type

Type of managerial strategy	# of mgt. strategies	Total estimated implementation cost
Structural & Vegetative BMPs	7	$2,148,700
Education	10	$ 311,000
Land Protection	2	$ 95,000
Managerial Practices	5	$ 92,000
Total for 10 years	24	$2,646,700

CHAPTER VI

Information and Education Outreach Strategy

The long-term ecological health of the Ocqueoc River Watershed will depend on the values and actions of this and future generations. Informing the residents, recreational users, local officials and resource managers of the Ocqueoc River Watershed about how their actions affect water quality is a high priority with the Ocqueoc River Commission. Increasing awareness and ultimately changing behavior is a long-term strategy for restoring and protecting water quality.

An information and education (I&E) strategy is a tool that informs the public and must motivate them to take action. It is a coordinated strategy tailored to both the specific water quality concerns and the people who live and recreate in the watershed.

An I&E strategy is effective because most behavioral changes that are required to minimize or eliminate pollution in the watershed are voluntary. Before individuals will consider changing their behavior, they need to understand the concerns for the watershed and how their individual activities can help protect the quality of water in the region. The (I&E) activities will involve a variety of approaches, such as a coordinated outreach campaign, project demonstration sites, regular media coverage, the sponsoring of seminars and the distribution of education materials.

A common complaint of many environmental education efforts is that they often end with little subsequent change in affecting the behavior of those the programs targeted. The efforts of the Education Committee should take this into consideration and strive to foster change. Strapp noted in 1969 in the inaugural issue of the Journal of Environmental Education that, "Environmental education is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve those problems, and motivated to work toward their solution."

A. SUMMARY OF OUTREACH ACTIVITIES CONDUCTED DURING 2002-2003 PLANNING PHASE and the 2004-2005 TRANSITION/IMPLEMENTATION PHASE OF OCQUEOC RIVER WATERSHED PROJECT

Some of the information and education activities that have already been implemented as part of the watershed planning efforts include:

- An April 2003 mailing to all property owners within the watershed (1000+ households), describing the watershed project and providing an opportunity to add their input.
- Presentations to the PI County Planning Commission, PI Conservation District (Annual Meeting), Rogers City Kiwanis Club; and all local government units.
- Publication and distribution of an Ocqueoc River Watershed Project brochure.
- Sixteen public meetings of the Watershed Partnership (Ocqueoc River Commission) at varied times and locations.
- Publication of quarterly newsletter.
- Numerous articles regarding the watershed project in the Alpena News and Presque Isle Advance.

- A dedicated World Wide Web page on Huron Pines RC&D Web site.
- Meetings of an education sub-committee for the watershed project, made up of representatives from Hammond Bay Anglers, MSU Extension, PICD, Huron Pines RC&D, and local residents.
- Two river clean-ups with presentations from Representative Matt Gillard and numerous resources professionals.
- Hosted a Watershed Appreciation Day at the Ocqueoc Outdoor Center with hands-on presentations on topics including stream ecology, groundwater pollution, sea lamprey control and watershed management.
- Hosted two land use planning roundtable discussions with local officials and the Ocqueoc River Commission to discuss the importance of local planning to protect water quality.
- Prepared watershed education kiosks for the Onaway and Rogers City District Library.
- Hosted a riparian landowner workshop and hands-on greenbelt planting at the Ocqueoc Outdoor Center.
- Mailed the Ocqueoc Newsletter and Landscaping for Water Quality booklets to 391 riparian landowners.
- Provided each township and the planning commission with “Filling in the Gaps” book and model ordinances to protect water quality.

B. INFORMATION AND EDUCATION PLAN FOR COMMUNITY EDUCATION EFFORTS

The identification of groups or individuals whose support or action will be needed to achieve the Watershed Project goals is integral to successfully implementing the Information & Education strategy. The Watershed Target Audiences were prioritized based upon the impact of the pollution source and the relative acceptance of the message by the proposed target audience. Public participation in Steering Committee meetings suggests that lakefront owners are willing to be pro-active in protecting water quality, but need specific guidance to make informed “watershed friendly” decisions.

Listed in Table 29 are the target audiences identified for specific pollutant problems along with specific messages and delivery mechanisms for each target audience.

Table 29: I&E Target Audiences, Key Messages, and Methods for Reaching Audience

Pollutant source or water quality problem	Specific target audience	Key message(s)	Method of reaching audience
Septic systems	Riparian homeowners	Septic system should be inspected/maintained on a regular schedule.	Direct mailing to all watershed landowners
Land development practices	Developers, engineers, real estate professionals	Incorporating Better Site Design development practices can lead to more profits and water resource protection	Host workshop

Table 29: I&E Target Audiences, Key Messages, and Methods for Reaching Audience (cont.)			
Pollutant source or water quality problem	**Specific target audience**	**Key message(s)**	**Method of reaching audience**
Livestock access to streams	Riparian agricultural producers	Unrestricted access to surface water by livestock leads to water quality problems – use Ag BMPs	Agriculture producers in the critical area
Fertilizer use	Riparian homeowners, agricultural producers	Maintaining aquatic buffers is the best method for limiting fertilizer runoff Get your soil tested apply fertilizer based on the needs of the soil, avoid applications right along the water	Direct mailing
Eroding streambanks	Recreational users, riverfront homeowners	Proper use of BMPs can minimize excessive erosion Actions of property owners can reduce or contribute to the problem Sand is a major pollutant The most natural (i.e., "softest") solution should be used – vegetation wherever possible	Meet on site with homeowners and discuss solutions; use signage for anglers
Road/stream crossings	Road Commissions; State Road Management Agencies	BMPs at R/S crossings will result in water quality improvement Increased costs to implement water quality BMPs will result in long-term cost savings	Review inventory results with Road Commission, host Better Backroads workshop
Waterfront development	Real estate agents, developers, homeowners, zoning officials, local officials	Living along the waterfront carries a responsibility for protecting those water resources New property owners need to be given information or directed to sources of information about waterfront stewardship practices	Packet of materials for distribution at time of sale
Poor zoning standards for water quality protection	County Planning Commission	Aquatic buffers are the number one tool for water resource protection and cannot be maintained with a setback of only 30 ft. Zoning setbacks and aquatic buffers do not decrease property values, can protect property owners, and are legally justified for new development.	Presentations and training workshops for commissioners; highlight local examples and hold officials accountable for lax standards.
Lack of appreciation for watershed characteristics	General public	Photo Essay Guidebook Describe why the Ocqueoc is unique and worth protecting Highlight areas of improvement and provide contact information	Selective mailing, distribute at local events, and provide at desirable locations within the community

CHAPTER VII

Evaluation of Implementation Strategies

A. EVALUATING SUCCESS OF WATERSHED PLANNING PROJECT

While the Ocqueoc Watershed Project is intended to restore and protect, it is important to periodically evaluate the implementation efforts to determine: 1) whether the project is on track and the tasks are implemented in a timely manner, and 2) whether the projects are successful in restoring and protecting water resources and that funds are spent wisely.

Evaluating the success of the strategies themselves can be a daunting task and is rarely done effectively in most watershed projects. Inherent problems with evaluation of implementing watershed strategies include lack of funding to complete the work; change in personnel over time creating a loss of consistency and understanding of the project; the natural lag time between implementation and recognizable improvement in the watershed; and, poor methods of designing studies to evaluate the actual results of a project, as opposed to the administrative success of the effort.

For example, a typical sign of success for a particular strategy might be to “implement BMPs at 5 road/stream crossings in the next 5 years.” While easy to evaluate whether this occurred, it is not really an indicator for stream improvement. Another typical evaluation statement might be “the planning commission will adopt a greenbelt ordinance.” While they may do this, again, it does not show improvement in the watershed. On the other hand, if there were 20 new developments in the watershed last year and all but 5 removed their aquatic buffers, and there were 20 new developments along the waterfront after the ordinance and they maintained their aquatic buffers, one can presume that it is an effective strategy.

Possible methods of evaluating whether a strategy is actually successful are such things as before and after photographs, a creel census, a before and after survey of property owner awareness, before and after water quality testing, documentation of water quality trends through a long-term monitoring program, and replicating the field inventories several years from the initial inventory.

The Ocqueoc River Watershed is considered “high-quality” meaning all of the designated uses are being met. Since this is the case the most important aspect of watershed management is the protection and preservation of the resource as opposed to the more costly remediation many watersheds are faced with. In cases where erosion has been identified, monitoring the water quality benefits can be fairly easy. We know how much nonpoint pollution is entering the river at each site and we also know the effectiveness of the chosen best management practices to reduce the pollution. We are able to conduct before and after stream assessments and photos to document the reduction of pollution from the site. However, when managerial and educational practices are implemented measuring the water quality benefits becomes much more difficult though in the long-term are the solution to protecting water quality in a more cost effective manner.

Though detailed watershed wide monitoring studies have not been conducted, there have been a few studies documenting the current condition of the river system. Numerous fishery surveys preformed by

the Department of Natural Resources indicated that the fishery in selected lakes were either “good” or “excellent” (detailed reports can be found in Chapter I). In addition to the fishery survey the Department of Environmental Quality conducted a biological survey in 1995 and 2000 of the Ocqueoc River and selected tributaries. Again the fish community, macroinvertebrate community, and habitat were rated either “good” or “excellent”. The DEQ is replicating the biological survey in 2005 and results will be compared to the previous study to determine if water quality has improved, remained the same, or declined. Comparing data collected in past studies to data from future studies will provide an overall watershed indicator of water quality. Public input from users of the watershed, though not quantitative, will also serve as an indicator of water quality and if has perceived to have change after implementation.

The purpose of the Watershed Management Plan is to maintain and enhance the water quality of the river system. In order to evaluate the effectiveness of implementation measures over time we will compare the results of the fishery and biological surveys as they are repeated. It would also be wise to begin a monitoring program as soon as possible to establish baseline data of water quality in the watershed. Types of sampling may include temperature loggers, periodic grab samples, routine sampling at identified areas of concern, groundwater monitoring, and macroinvertebrate sampling.

Other indicators of overall watershed improvement would be to re-inventory nonpoint erosion sites. If there are fewer moderate and severe sites in 5 or 10 years that it would indicate water quality is being protected.

Table 30 lists each monitoring component based on the strategy being implemented. A detailed discussion of measuring social behavior and change can be found in Appendix F. This report provided by the Northeast Michigan Community Service Agency highlights different methods to gather social information and measure change after education activities have taken place. It discusses the pros and cons of various methods and provides detailed information on how to organize, write, distribute, and tabulate surveys.

B. EVALUATION OF IMPLEMENTATION ACTIVITIES

Table 30: Evaluation Measures for Watershed Implementation Strategies

Strategy	Methods for evaluating success
1.1 R/S Crossing BMPs	Before & after photos. Stream sampling (before and several years after) for physical and biological parameters.
1.2 Access Site BMPs	Before and after photographs of all access sites, load reduction calculations, document trash picked up at each site.
1.3 Education: Erosion Control for property owners	Survey riparian property owners before starting education program and after.
1.4 Streambank BMPs	Use streambank "re-inventory" form to document the effectiveness of BMP treatment
1.5 Increase setback	Review building permits for three years prior to adoption of the setback standard and three yeas after to determine whether implementation of the standard is acceptable.
2.1 Aquatic Buffer Ordinance	Use soil erosion formula to calculate runoff at nonpoint sites, compare data between sites with buffers and those without.
2.2 Septic System Education	Property owner survey
2.3 Technical assistance for property owners wanting aquatic buffers	Before and after photos, number of reestablished greenbelts
2.4 Septic System Inspection Program, adopt ordinance	Select two lakes within watershed that have a developed shoreline and two lakes with no development and conduct a baseline water quality sampling program for all four. Repeat several years after ordinance adoption.
2.5 Ag BMPs	Stream sampling (before and several years after) for physical and biological parameters.
3.1 Impoundment study & possible implementation	Use volunteers (high school students) to measure stream flow, temperature and depth above and below impoundments.
3.2 Stormwater BMPs	Sample outfalls pre- and post-treatment
3.3 Better Site Design	Conduct a review, using aerial photographs and site visits if permitted, of new developments in the watershed and compare the impact on natural resources with those that incorporate Better Site Design/Low Impact Development with those that do not.
4.1 Education: Wildlife habitat improvement	Property owner survey
4.2 Conservation easements on significant properties	Track population records of indicator species, such as Common Loon, to help determine whether easements on ecologically sensitive parcels of land are successful in protecting habitat.
4.3 Identify key ecological corridors	Interview property owners and resource managers to determine whether all appropriate areas are mapped.
4.4 Natural Features Inventory	Use of the plan in decision making and land conservation
5.1 Establish Ocqueoc Watershed Council	Document meeting attendance, projects completed, and funds raised
5.2 Water Monitoring Program	Document if QAPP is being implemented, pre and post survey of volunteers
5.3 Host annual watershed event	Conduct survey of attendees.
5.4 Speakers Forum	Interview participants of forum.
5.5 Resource Library	Feedback survey from users
5.6 Promote responsible user guidelines	Interview property owners to determine whether program is working.
5.7 Enforce regulations	Meet with property owners in affected areas and solicit their input on whether increased enforcement is an effective deterrent.

CHAPTER VIII

Final Water Quality Summary

The Ocqueoc River Watershed maintains high quality waters and is one of the most unspoiled areas in northern Michigan. However, the increasing development pressures in the region, existing erosion problems, and current managerial mindset are all threatening the resources. Currently five designated uses are threatened: 1) cold and warm water fisheries, 2) indigenous aquatic life and wildlife, 3) partial/total body contact, 4) navigation, and 5) public water supply. The project goals are directed at restoring and protecting the threatened designated uses and are designed to take an action-oriented approach to watershed management.

Project Goal 1: Protect the watershed's fishery population and navigation by reducing the amount of erosion, particularly caused by human activities, negatively impacting the river.

Fisheries (coldwater and warmwater)
Little Ocqueoc River and Silver Creek are the two main tributaries that feed into the Ocqueoc and both are coldwater streams. However, increased sediment, nutrients, elevated water temperature, exotic species, and pesticides have threatened this use. Sediment was identified as the number one pollutant concern within the watershed and can have an adverse effect on the fishery populations. Sediment can cover vital spawning areas, block fish gills, and increase the turbidity of the water. Road/stream crossings, access sites, construction activities, and shoreline erosion all contribute to the amount of sediment entering the river system. In the case of Little Ocqueoc River and Silver Creek, road/stream crossings are the primary source of sediment input.

Elevated water temperatures, nutrients, pesticides, and exotic species also contribute to the decline of this designated use. Loss of riparian shade through construction practices and improper riparian management; the presence of impoundments; and surface runoff all contribute to increased water temperatures.

Navigation
Increased sediment, exotic species, and fluctuating water flow are threatening navigation in the Ocqueoc River Watershed. Sedimentation from road/stream crossings is usually the result of short culverts, steep embankments, sand or gravel road surfaces, and inadequate diversion outlets. Streambank and lakeshore erosion also contributes to increased sediment. Oftentimes, erosion occurs from excessive foot traffic, loss of riparian vegetation, off road vehicle use, and fluctuations in water levels. In order to protect several designated uses sediment needs to be addressed.

Exotic species, primarily Eurasian watermilfoil in the chain of lakes, needs to be addressed in order to protect the navigation and prevent further dispersal of the weed. Milfoil is a rapidly spreading exotic plant in northern Michigan and can be transported from lake to lake via boats and trailers.

Project Goal 2: Safeguard fisheries, aquatic life, public water supply, and body contact recreation by reducing the amount of nutrient loading to surface water.

Aquatic Life
Nutrients, sediment, pesticides, exotic species, bacteria, and heavy metals are pollutants that are threatening the indigenous aquatic life in the watershed. Nutrient inputs from failing septic systems, excessive fertilizer use, unrestricted livestock access, and stormwater runoff have been identified within

the watershed. Regular septic maintenance and updates are critical to protecting this river system. All of the homes in the Ocqueoc watershed utilize on-site wastewater treatment. Many of these homes do not have up-to-date systems or regularly maintain their systems.

Heavy metals and other harmful chemicals such as oil, grease, pesticides, and fertilizers can potentially affect the life cycle of indigenous species by decreasing immunity and reproductive health, and in high enough concentrations, cause death. Exotic species, including the sea lamprey, can have a disastrous effect on native populations. In many cases, exotics out-compete native species because they typically have no natural enemies. In the case of sea lampreys, which spawn in the river and spend up to seven years in a larval stage there, the exotic fish will prey upon native populations and has been one of the primary causes of the Great Lakes fishery decline.

Partial/Total Body Contact Recreation

Recreation was identified as being threatened by increased nutrients, pesticides, exotic species, bacteria, and solid wastes. High levels of nutrients, pesticides and bacteria can make fishing, swimming, canoeing, and other water activities harmful. Even though this has not become a problem within the watershed, preventative measures need to be in place to protect this designated use.

Nutrients and bacteria can enter the watershed through poor septic systems, livestock waste, excessive fertilizer use, and stormwater runoff. Septic system malfunction can result from systems being installed prior to adequate regulations, undersized systems, and poorly maintained systems. Livestock management practices including unrestricted access, incorrect manure application, and improper waste storage can lead to increased bacteria and nutrients entering the river system. Restricting livestock access by erecting fences and creating proper crossings can reduce the amount of nutrients, bacteria, and sediment from entering the river system. Building and maintaining proper waste storage facilities and properly applying manure to fields can also decrease the amount of bacteria and nutrients in the watershed.

Fertilizer or stormwater runoff can be reduced by maintaining an adequate buffer between fields, lawns, impervious surfaces, and water. Proper application of fertilizers is important and soils tests should be conducted prior to application to determine the amount of fertilizer needed. Low impact development practices should be required in any new construction to ensure that runoff remains on-site and does not enter the river system.

Project Goal 3: Protect the fishery and other aquatic life by restoring a more natural flow regime to the river system.

Fishery and Aquatic Life

Excessive sediment, and impoundments along the river, either natural or man-made, can alter the river's natural flow. Removal of impoundments that are significantly disrupting the stream's flow regime will provide a more suitable habitat for the watershed's aquatic species.

Sediment loading occurs when a net import of sediment exceeds export; the consequences of such loading can be detrimental to the biology and structure of the river system. Such a situation can lead to the overall degradation of the river. Sediment loading gradually fills in a stream channel and the water is typically displaced laterally. Lateral spread of the channel results in an overall decrease in depth with the variability in depth being nearly eliminated, resulting in a homogeneous stream channel. A change in the stream channel can also result in increased streambank erosion thus compounding the problem.

It is also important to maintain a healthy amount of woody material in a stream. Woody debris is utilized by many aquatic species for breeding, feeding, and as a hiding place from predators. It also protects the river's banks, thus reducing the amount of sediment loading.

Project Goal 4: Conserve important wildlife habitat areas.

Fishery and Aquatic Life
All of the pollutants listed in Table 5 contribute to the decline of wildlife habitat. Sediment, nutrients, pathogens, increased water temperatures, fluctuating water flow, exotic species, and pesticides all have potential to harm instream habitats. The causes of these pollutants vary and it is important to remember that non-aquatic species are dependant upon good water quality and intact habitat.

Many species dependant on terrestrial and near-shore habitat can suffer from the removal of riparian buffers. Near shore vegetation not only offers shade, bank stability, and pollutant filtering abilities, but it also serves as an important wildlife corridor upon which many terrestrial animals are dependent. Permanently protecting sensitive lands and working with riparian landowners to preserve this buffer zone is vital to protecting water quality and wildlife habitat.

Project Goal 5: Enhance and protect the Ocqueoc River Watershed by promoting stewardship, education, and responsible use of the watershed.

Fishery, Aquatic Life, Body Contact Recreation, Navigation, and Public Water Supply
Whether it's streambank erosion, poor road/stream crossings, removal of riparian buffers, inadequate water quality ordinances, apathy, or lack of awareness, the opportunity exists to work with targeted individuals to maintain a healthy river system. Promoting education, stewardship, and responsible land use has the potential to restore and enhance all of the designated uses. As the Ocqueoc Watershed currently exhibits good water quality, there is an opportunity to maintain that level and also work to eliminate future problems.

The watershed management plan has a section dedicated to promoting education and stewardship in the watershed. Specific target audiences were identified based on the cause of the pollutants. Key messages were drafted which would provide the target audience with "water-friendly" information. Education and responsible land use practices will be fundamental in upholding the high water quality the Ocqueoc River currently exhibits.

CHAPTER IX

EPA Nine Required Elements

Beginning with FY 03 grants, the United States Environmental Protection Agency (EPA) is requiring all implementation, demonstration, and outreach-education projects funded under Section 319 of the federal Clean Water Act to be supported by a Watershed Plan which includes the following nine listed elements. To be eligible for Section 319 funding the watershed plan must address all nine elements. The nine EPA required elements and location within the watershed management plan are listed below.

A. An identification of the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this watershed-based plan (and to achieve any other watershed goals identified in the watershed-based plan), as discussed in item (b) immediately below. Sources that need to be controlled should be identified at the significant subcategory level with estimates of the extent to which they are present in the watershed (e.g., X numbers of dairy cattle feedlots needing upgrading, including a rough estimate of the number of cattle per facility; Y acres of row crops needing improved nutrient management or sediment control; or Z linear miles of eroded streambank needing remediation).

- The “level of effort” is found in Chapter V under each goal and strategy.

B. An estimate of the load reductions expected for the management measures described under paragraph (c) below (recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time). Estimates should be provided at the same level as in item (a) above (e.g., the total load reduction expected for dairy cattle feedlots; row crops; or eroded streambanks).

- Estimates of load reductions expected for management measures recommended for implementation can be found in Chapter IV and also in Chapter V under the specific Strategy.

C. A description of the NPS management measures that will need to be implemented to achieve the load reductions estimated under paragraph (b) above (as well as to achieve other watershed goals identified in this watershed-based plan), and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan.

- Table 26 page 63 describes which management measure is proposed per Strategy. Specific sites for BMP installation can be found in Chapter IV.

D. An estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon, to implement this plan. As sources of funding, States should consider the use of their Section 319 programs, State Revolving Funds, USDA's Environmental Quality Incentives Program and Conservation Reserve Program, and other relevant Federal, State, local and private funds that may be available to assist in implementing this plan.

- Technical and financial assistance can be found under each Strategy in Chapter V.

E. An information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the NPS management measures that will be implemented.

- An information and education component is located in Chapter VI with specific information located in Table 29 on page 67.

F. A schedule for implementing the NPS management measures identified in this plan that is reasonably expeditious.

- A timeline for each Strategy can be found in Chapter V.

G. A description of interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented.

- Milestones for each strategy can be found in Chapter V.

H. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether this watershed-based plan needs to be revised or, if a NPS TMDL has been established, whether the NPS TMDL needs to be revised.

- Criteria to determine whether load reductions are being achieved are located in Chapter VII.

I. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above.

- Table 30 on page 71 describes evaluation measures for each Strategy. Information specific to using social input as a means of evaluation can be found in Appendix F.

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Contacts: Presque Isle County Local Officials:

Presque Isle County Board of Commissioners	
District 1 Robert Shell (D) 4492 Co. Road. 489 Box 432 Onaway, Mi. 49765 (989) 733-8601 Serving: Bearinger Twp., North Allis Twp., Allis Twp., City of Onaway	District 2 Allan H. Bruder (R) 14708 Twin School Hwy Millersburg, Mi. 49759 (989) 733-8476 Serving: Ocqueoc Twp., Case Twp., Bismarck Twp., Moltke Twp., Rogers B (Rogers Twp. portion lying north of M-68 Hwy.)
District 3 Michael A. Darga (D) 1113 Dettloff Box 108 Rogers City, Mi. 49779 (989) 734-7219 Serving: City of Rogers City lying east of US-23 except the portion bounded by Linden Street on the east, Larke Avenue on the south, and Third Street on the north (Precincts 1 & 2)	District 4 Gary L. Wozniak (D) 5309 Darga Hwy. Box 15 Posen, Mi. 49776 (989) 766-2547 Serving: Remainder of City of Rogers City (Pct.3), remainder of Rogers Twp. (Rogers A), Belknap Twp., Pulawski Twp., Posen Twp. Portion bounded by M-65 on the east and 634 Hwy. on the south, Village of Posen (Posen B)
District 5 Stephen Lang (R) 17815 Grand Lake Blvd. Presque Isle, Mi. 49777 (989) 595-2411 (W) Serving: Remainder of Posen Twp. (Posen A), Krakow Twp. Presque Isle Twp.	Clerk to the Board of Commissioners: Susan M. Rhode (989) 734-3200 (800) 334-5698

Board of Commissioner meetings are open to the public and are held at the County Courthouse, 151 East Huron Avenue, Rogers City, Michigan in regular bi-monthly sessions as follows (except for October statutory meeting): Second Wednesday at 7:00 p.m.; Last Friday at 9:30 a.m.

Local Elected Officials in the Ocqueoc River Watershed

Bearinger Township, Presque Isle County

Supervisor: Richard D. Mowers, II (989) 734-4935
10296 Ocqueoc Lake Rd., Ocqueoc, Mi. 49759

Clerk: Irene Seelye (989) 733-0325
10099 Ocqueoc Lake Rd., Ocqueoc, Mi. 49759

Treasurer: Nancy Mowers (989) 734-4935
10296 Ocqueoc Lake Rd., Ocqueoc, Mi. 49759

Trustee: Margaret A. Pilaczynski (989) 938-6435
116098 Glen Eagle, Ocqueoc, Mi. 49759

Trustee: Kathleen S. Wilson (989) 733-8484
18168 Town Hall Hwy., Ocqueoc, Mi. 49759

Meetings: 1st Monday of every other month at 7:00 at the Bearinger Twp. Hall, 17034 Town Hall Hwy., Ocqueoc, Mi. 49765

Bismarck Township, Presque Isle County

Supervisor: John F. Kleiber (989) 734-4669
5385 W. Metz Hwy., Hawks, Mi. 49743

Clerk: Shelby J. Schwiesow (989) 734-2625
7567 Schleben Rd., Hawks, Mi. 49743

Treasurer: Scott Cordes (989) 734-7012
7028 W. 638 Hwy., Hawks, Mi. 49743

Trustee: Wesley Bruning (989) 734-7229
8264 Co. Rd. 451, Rogers City, Mi. 49779

Trustee: Kenneth C. McNealy (989) 734-2636
8170 Rasche Rd., Hawks, Mi. 49743

Meetings: 2nd Monday of each month at 7:00 at the Bismarck twp. Hall, 7662 Claus Rd. Hawks, Mi. 49743

Case Township, Presque Isle County

Supervisor: Dean Storms (989) 733-2032
9527 Pine Rd., Millersburg, Mi. 49759

Clerk: Glenna Campbell (989) 733-8700
P.O. Box 260, Millersburg, Mi. 49759

Treasurer: Daniel E. Milbocker (989) 733-8726
P.O. Box 162, Millersburg, Mi. 49759

Trustee: Allen R. Pardike (989) 733-2549
4207 Corriveau Rd., Millersburg, Mi. 49759

Trustee: Rita Tollini (989) 733-2584
13582 Six Mile Hwy., Millersburg, Mi. 49759

Meetings: 1st Monday of every month at 7:00 at the Case Twp. Hall, 5280 Maple St., Millersburg, Mi. 49759

Village of Millersburg

President: Quinn Kimball (989) 733-8203
P.O. Box 113, Millersburg, Mi. 49759

Clerk: Melody M. Beswick (989) 733-2000
P.O. Box 135, Millersburg, Mi. 49759

Treasurer: Esther Nichols (989) 733-4200
5201 Peterman Street, Millersburg, Mi. 49759

Trustees: Larry Dittmar, Florence Hughes, Wendy Robins, Carleen Degan, Sheila Zinke, Cindy Williams

Meetings: 2nd Monday of the month at 7:00 at the Village Hall, 5525 Main Street, Millersburg, Mi. 49759

Moltke Township, Presque Isle County

Supervisor: Neil G. Sorgenfrei (989) 734-2697
1743 Ward Branch Rd., Rogers City, Mi. 49779

Clerk: Caroline D. LaLonde (989) 734-2213
1650 N. Ward Branch Rd., Rogers City, Mi. 49779

Treasurer: Janis Little (989) 734-3585
7028 M-68 Hwy., Rogers City, Mi. 49779

North Allis Township, Presque Isle County

Supervisor: Dave Webster (989) 733-8025
20340 North Allis Hwy., Onaway, Mi. 49765

Clerk: Roberta Lynn Northcott (989) 733-4585
2337 N. M-211, Box 306, Onaway, Mi. 49765

Treasurer: Cindy Trepanier (989) 733-6451
4012 County Road 489, Onaway, Mi. 49765

Trustee: Gary Lee Klein (989) 734-7208 7605 Church Hwy. Rogers City, Mi. 49779 Trustee: Marlowe Paul (989) 734-4853 2291 Angle Rd., Rogers City, Mi. 49779 Meetings: 2nd Monday of each month at 7:30 at the Clerk's home from November through April. May through October the meetings are held at the Moltke Twp. Hall at 7:30 p.m., 5928 M-68 Hwy., Rogers City, Mi. 49759	Trustee: Ruth Koronka (989) 733-8334 19897 North Allis Hwy., Onaway, Mi. 49765 Trustee: Andrew J. Bischer (989) 733-6200 1864 N. Palmer Rd., Onaway, Mi. 49765 Meetings: 2nd Tuesday of each month at 6:00 p.m. at a Board member's home from November through February. March through October the meetings are held at 7:30 p.m. in the North Allis Twp. Hall, 1940 M-211 Hwy., Onaway, Mi. 49765
Ocqueoc Township, Presque Isle County Supervisor: Larry E. Foster (989) 733-8659 14610 Pomranke Hwy., Ocqueoc, Mi. 49759 Clerk: Pamela S. Schaedig (989) 733-8238 1032 S. Ocqueoc Rd., Millersburg, Mi. 49759 Treasurer: Delores Merchant (989) 733-8340 5093 Merchant Rd., Ocqueoc, Mi. 49759 Trustee: Jerry C. Counterman (989) 733-2052 6339 Domke Rd., Ocqueoc, Mi. 49759 Trustee: Valentine L. Jaroch (989) 733-3045 13719 N. River Lane, Ocqueoc, Mi. 49759 Meetings: 2nd Thursday of each month at 7:00 at the Ocqueoc Twp. Hall, 14101 North Allis Hwy, Ocqueoc, Mi. 49759	Rogers Township, Presque Isle County Supervisor: Ralph J. Kortman (989) 734-4082 1218 Heythaler Hwy., Rogers City, Mi. 49779 Clerk: Donna M. Hopp (989) 734-4240 2290 County Road 451, Rogers City, Mi. 49779 Treasurer: Thomas F. Radka (989) 734-4221 1660 E. Heythaler Hwy., Rogers City, Mi. 49779 Trustee: Henry C. Cetus (989) 734-4435 3245 Birchwood Dr., Rogers City, Mi. 49779 Trustee: Randall Smolinski (989) 734-4632 6966 Chipmunk Lane, Rogers City, Mi. 49779 Meetings: 3rd Monday of each month at 6:30 at the Rogers Twp. Hall, 2442 County Road 451, Rogers City, Mi. 49779
Montmorency Township, Montmorency County	Montmorency Township continued
Supervisor and Assessor: Gary Boldrey (989) 742-3619 24305 County Rd. 628, Hillman, Mi. 49746 Clerk: Connie Brandt (989) 742-4183 24336 Co. Rd. 452, Hillman, Mi. 49746 Treasurer: Janelle Herrick (989) 742-3619 23499 Co. Rd. 452, Hillman, Mi. 49746	Trustee: Gerald C. Steinke (989) 742-4483 20820 Morrow Rd., Hillman, Mi. 49746 Trustee: Kendall Hardies (989) 742-3045 21545 County Rd. 451, Hillman, Mi. 49746 Zoning Administrator: Scott VanPamel (989) 742-7037 22541 Co. Rd. 628, Hillman, Mi. 49746 Meetings: 2nd Tuesday of each month at 7:30 at the Montmorency Township Hall, 20841 N. Co. Rd. 459, Hillman

Presque Isle County Planning Commission (3 year term) Meetings are held the 3rd Thursday of Jan., Mar., May, July, Sept. and Nov. at 7:30 p.m. in the Courthouse	
Roger Fleming **(12-31-06)** 7132 S. Rogers Rd., Hawks, Mi. 49743	Dennis Felax **(12-21-05)** 2236 Shore Rd., Rogers City, Mi. 49779
Richard Wright **(12-21-07)** 3646 Birchwood Dr., Rogers City, Mi. 49779	Jerry Counterman **(12-31-07)** 6339 Domke Rd., Ocqueoc, Mi. 49759
Tom Harkleroad **(12-21-06)** 19655 US-23 Hwy., Ocqueoc, Mi. 49759	Julian Pilarski **(12-21-07)** 14250 Polaski Rd., Posen, Mi. 49776
Louis Spens **(12-21-05)** 7615 Spens Dr., Ocqueoc, Mi. 49759	Michael Libby, Chairman **(12-31-06)** 18400 Gibbons Hwy., Onaway, Mi. 49765
Carl Altman **(12-31-05)** 1104 W. Hawks Hwy., Hawks, Mi. 49743	James Zakshesky Ex-Officio Member, Box 110, Rogers City, Mi. 49779
Public School Board Member – vacant **12-31-07**	
Water Well Advisory Committee (3 year term)	
Mike Darga (County Commissioner) **(05-31-07)** 1113 Detloff, Box 108, Rogers City, Mi. 49779	Dennis Felax (Citizen) **(05-31-07)** 2236 Shore Rd., Rogers City, Mi. 49779
Virgil Freel (Citizen) **(05-31-08)** 11592 Hwy. 638, Millersburg, Mi. 49759	Charles Krueger (Well Driller) **(05-31-08)** 3208 F-21 Hwy., Hawks, Mi. 49743
Mark Badgero (Builder) **(05-31-08)** 7490 S. County Line Rd., Onaway, Mi. 49765	Scott Smith (DHD#4) **(05-31-06)** Box 236, Rogers City, Mi. 49779
Joe Antkoviak (Well Driller) **(05-31-06)** 6587 Antkoviak Rd., Levering, Mi. 49755	Charles Lyon (County Drain Commissioner) Box 110, Rogers City, Mi. 49779
James Zakshesky (County Building Official) Box 110, Rogers City, Mi. 49779	
Soil Erosion and Sediment Control Advisory Committee (3 year term)	
Pat Henry **(05-31-06)** 666 S. Lake St. Rogers City, Mi. 49779	Dennis Felax **(05-31-07)** 2236 Shore Rd., Rogers City, Mi. 49779
Clifford Tollini **(05-31-08)** 18212 Three Mile Hwy., Onaway, Mi. 49765	
Board of County Road Commission (6 year term)	
Superintendent, Eric Rose 20782 Fardon St., Onaway, Mi. 49765	Ronald Bischer **(12-21-08)** 2326 N. Cold Creek Rd., Onaway, Mi. 49765
Charles Rhode **(12-21-10)** 3372 W. 638 Hwy., Hawks, Mi. 49743	Thomas Catalano, Chairman **(12-21-06)** 1606 Peltz Rd., Rogers City, Mi. 49779
Other Pertinent Presque Isle County Contacts	
Drain Commissioner Charles M. Lyon (989) 766-3568 Box 110, Rogers City, Mi. 49779	**Building/Zoning Official** James Zakshesky (989) 734-2916 Box 110, Rogers City, Mi. 49779
MSU Extension Director David J. Glenn (989)734-2168 Box 110, Rogers City, Mi. 49779	**DHD#4 Environmental Health Dir.** Scott Smith (989) 734-4723 Box 236, Rogers City, Mi. 49779
USDA County Executive Director Carmen Church (989) 733-8323 4050 Michigan Ave., Onaway, Mi. 49765	**USDA Natural Resources Conservation Service District Conservationist** Perry Smeltzer (989) 733-8323 4050 Michigan Ave., Onaway, Mi. 49765
Presque Isle Conservation District Executive Director: Pat Henry (989) 734-4000 248 N. Bradley Hwy, Rogers City, Mi. 49779	**Equalization Director** Sharyn Malone (989) 734-3810 Box 110, Rogers City, Mi. 49779
Appraiser Mary Zinke (989) 734-3810 Box 110, Rogers City, Mi. 49779	**County Surveyor** Norman Quaine, Jr. (989) 734-7175 239 E. Woodward, Rogers City, Mi. 49779