# Galien River Watershed Management Plan

MDEQ Tracking Code #2000-0122



## Prepared for

## Berrien County Drain Commissioner

## by

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MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY

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# GALIEN RIVER

# WATERSHED MANAGEMENT PLAN

**BERRIEN COUNTY DRAIN COMMISSIONER**
**MDEQ TRACKING CODE: 2000-0122**

**JULY 2003**
**PROJECT NO. G01338**

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# EXECUTIVE SUMMARY

The Galien River Watershed (Watershed) encompasses areas of prime farmland, Warren Woods Preserve, and a portion of the City of New Buffalo, where the Galien River (River) flows into Lake Michigan. The Watershed is situated in the southwest corner of Berrien County, Michigan, and is included in the Little Calumet/Galien Tri-State Watershed Management Area, which spans coastal areas of Michigan, Indiana, and Illinois.

The agricultural areas in the Watershed have experienced more frequent flooding in the past decade. Changes in the land use, including increased channelization of agricultural drains, loss of wetlands, excessive amounts of log jams, and lack of maintenance on private drains, have raised concerns within the Watershed.

A detailed watershed inventory was conducted to identify the sources and causes of nonpoint source pollution in the Watershed. A sampling regime was also initiated in the Watershed through the Michigan Department of Environmental Quality's (MDEQ) Total Maximum Daily Load requirements to sample streams and reaches not meeting water quality standards. Initial findings of the inventory and water sampling indicate impaired water quality at levels high enough to classify sediment, *E. coli,* nutrients, and possibly pesticides as high priority concerns for the Watershed. The known sources of sediment were found to be streambank erosion, rill and gully erosion, and unstable tile outlets. The suspected sources of *E. coli* include manure runoff and failing septic systems. The possible sources of nutrients include manure runoff, fertilizer runoff, and failing septic systems.

The Galien River Watershed Management Plan (WMP) is the result of a nonpoint source pollution grant under the U.S. Environmental Protection Agency's (EPA) Clean Water Act Section 319 initiative, in coordination with the MDEQ. The Watershed exhibits unique hydrologic problems in addition to water quality, habitat, and soil erosion issues. The primary goal of this WMP is to improve cooperation between local residents and local and state agencies in efforts to protect, restore, and enhance the natural resources of the Watershed and Lake Michigan.

The results of the investigation completed for the plan, taken together with the hydrologic analysis and historical information, lead to the following general conclusions and recommendations in regard to water quality, wetlands restoration, land use policies, and hydrology issues in the Watershed:

Water Quality

- Prevent *E. Coli* from entering surface waters and meet Michigan Water Quality Standards of 1,000 count/100 mg for partial body contact recreation and 300 count/100 mg for total body contact recreation.

- Reduce phosphorus loading to meet EPA guidance level of 0.1 mg/l P for flowing water and possibly set a standard of 50 micrograms/l P for lakes as a bench mark in setting criteria for wetlands.

- Monitor and reduce nitrogen levels where necessary to meet water quality standards.

- Reduce Total Suspended Solids (TSS) in areas identified in the MDEQ water quality monitoring studies and volunteer monitoring programs, by preventing soil erosion and reducing sedimentation.

- Meet warmwater minimum for dissolved oxygen of 4 to 5 mg/l by maintaining cool temperatures and limiting nutrient loading.

- Monitor pH levels for extremes.

- Preserve or restore wetlands and create buffers to filter out excess nutrients before they enter rivers and streams.

Wetlands Preservation and Restoration

- Locate areas for potential wetlands restoration to increase storage capacity in rapidly developing subcatchments, based on Geographic Information System (GIS) information.

- Restore wetlands in other areas of the watershed to improve water quality, increase groundwater recharges, and provide habitat, based on GIS information.

Land Use Policies

- Enforcement of septic site ordinances.
- Require filter strips and buffers in new developments and agricultural areas.
- Require soil testing for new developments.
- Change set back ordinances to allow for cluster development.
- Adopt open space ordinances that protect forests and wetlands.
- Create conservation ordinances and tax incentives with options for the purchase of development rights (PDRs).
- Change ordinances to include design criteria for driveways, roof area, parking requirements, and road widths.
- Create a watershed master plan that considers areas where development will occur and what types will be allowed.
- Revise floodplain ordinance so no future development will occur within 100-year floodplain.
- Adopt soil erosion and sedimentation control (SESC) inspection and enforcement ordinance.
- Adopt native landscaping ordinance.
- Adopt wetland protection ordinances.
- Adopt a planning ordinance that limits amounts of impervious surfaces and requires onsite detention of storm water runoff.

Hydrology

- Remove selected obstructions and garbage.
- Restore wetlands in upper reaches of Dowling Creek and Blue Jay Drain.
- Require onsite retention for developments within or upstream of Elm Valley.
- Cut out centers of log jams and attach selected limbs to banks, especially on the downstream end of the outer bank of a meander.
- Maintain private drainage systems.
- Improve conveyance at selected sites by removing obstructions or replacing culverts.
- Consider Rosgen's stream classification and characteristics of stream reaches when planning and designing Best Management Practices (BMPs).

All of these recommendations will work toward meeting the goals of the WMP, which are to meet water quality standards for partial body contact recreation, meet water quality standards for warmwater and coldwater fisheries, provide habitats for other indigenous aquatic life and wildlife, enable navigation on partial reaches of the River, maintain water quality and water quantity needs for agricultural use, meet water quality standards for total body contact recreation in areas of public beaches, and provide an adequate water source for an industrial water supply when needed. Table 3.10 in the WMP prioritizes these goals according to the impairments of the designated uses, creating a comprehensive management strategy to address water quality concerns.

The Galien River Watershed Steering Committee (Steering Committee) for the Watershed provided continued support and direction for the development of the WMP. Several subcommittees were formed to direct specific tasks to accomplish during the planning process, namely the Information and Education (I&E) Committee and the Technical Committee.

The WMP is an investigation into the water quality and water quantity concerns of the watershed and presents recommendations to address those concerns. The recommendations are organized according to structural and vegetative BMPs, policy and management, and I&E. The specific objectives of the recommendations are quantified to estimate the cost of reducing nonpoint source pollution in the Watershed and ultimately, Lake Michigan.

# CHAPTER 1 - DESCRIPTION OF WATERSHED

## 1.1 OVERVIEW

The Galien River (River), in the most southwestern corner of Michigan (Figure 1), was named in 1829 after Rene Brehant de Galinee, a priest and mapmaker for the missionaries in the 1600s (Multimag, 2001).

The communities in the Galien River Watershed (Watershed). have expressed concerns of water resource conditions that have threatened public safety, wildlife habitats, and financial livelihoods. The Michigan Department of Environmental Quality (MDEQ) has included several reaches in the Watershed on the Clean Water Act, Section 303(d) list for not meeting water quality standards. In consequence, a Total Maximum Daily Load (TMDL) process was initiated. The identified pollutants that are impairing those uses include sediment, nutrients, and bacteria. Complaints and concerns received from the communities led the Berrien County Drain Commissioner (BCDC) to research the causes and potential solutions to water quality and quantity issues, which are described in this Galien River Watershed Management Plan (WMP).

## 1.2 FORMATION OF STEERING COMMITTEE

The Galien River Watershed Steering Committee (Steering Committee) consisted of a variety of members including landowners and various organizations and groups interested in the restoration and preservation of the Watershed. The Steering Committee members provided guidance and input on the development of the WMP. Landowners attending the Steering Committee meetings on a regular basis are:

| | | |
|---|---|---|
| Mr. Richard Wooley | Ms. Elsie Priest | Mr. Cyrus Young |
| Mr. Max & Ms. Emma Morley | Ms. Teresa Peterson | Mr. William Hannah |
| Mr. Mike Metz | Mr. Anthony Margol, Jr. | Mr. Robert Forker |
| Mr. Norris Young | Mr. Jack Chesnut | Mr.Charles & Ms. Bonnie Braje |
| Ms. Roberta Hill | Mr. Nick Young | |

There were many landowners not mentioned that showed interest in the Watershed by attending one meeting familiarizing them with the project.

Several of the landowners in the Watershed are part of an organization that have an interest in the Watershed. Organizations and groups that were also included in the Steering Committee were:

| | |
|---|---|
| Ms. E. Wendy Ogilvie | Fishbeck, Thompson, Carr & Huber |
| Mr. Mike Townley | Fishbeck, Thompson, Carr & Huber |
| Ms. Diane Hornbrook | Fishbeck, Thompson, Carr & Huber |
| Ms. Anne Hendrix | Berrien County Drain Commission |
| Mr. Lowell Bruce | Berrien County Drain Commission |
| Ms. Nicole Hill | Southwest Michigan Land Conservancy |
| Ms. Kim Herman | Michigan Department of Natural Resources |
| Mr. Rod Clute | Michigan Department of Natural Resources |
| Mr. Jay Wesley | Michigan Department of Natural Resources |
| Ms. Carole Svebakken | League of Women Voters |
| Ms. Neva Bailey | League of Women Voters |
| Mr. Merrill Clark | League of Women Voters |
| Mr. Gene Kowert | Chikaming Park Board |
| Ms. Sue Petterson | Chikaming Park Board |
| Mr. Carl Anderson | Chikaming Township |
| Ms. Jeanne Dudeck | Chikaming Township |
| Ms. Peg Kohring | Conservation Fund |
| Ms. Cathy Johnson | Conservation Fund |
| Mr. Les Hainey | Natural Resource Conservation Service |
| Mr. Bob Baetsen | Sauk Trails RC&D Council |
| Mr. Mike Staton | MSU Extension |
| Mr. Karl Hausler | Michigan Department of Agriculture |
| Mr. Joe Margol | Berrien County Road Commission |
| Ms. Chris Bauer | Michigan Department of Environmental Quality |
| Mr. Bruce Hauch | Three Oaks Public Works |
| Mr. Anthony Mrozek | Galien River Sanitation District |
| Mr. Pat Underwood | Berrien County Parks |
| Ms. Agnes Conway | New Buffalo Township |
| Mr. John Gast | Lake Charter Township |
| Mr. Charles Sittig | Three Oaks Township |
| Mr. Peter and Ms. Jean Van Nice | Chikaming Open Lands |
| Mr. Steve and Ms. Jean Smith | Chikaming Open Lands |
| Mr. Ken Priest | Berrien County Health Department |
| Mr. Laird Willard | Berrien County Health Department |
| Mr. Dick Schinkel | Berrien County Parks & Recreation Board |
| Mr. Mark Parrish | Pokagon Band of Potawatomi Indians |
| Mr. Kevin Daugherty | Pokagon Band of Potawatomi Indians |
| Mr. Warren Strefling | Galien River Conservation District |
| Mr. John Mefford | Bertrand Township |
| Mr. Tom Fox | Bertrand Township |
| Mr. Richard Chubb | Buchanan Township |
| Mr. Rich Hill | Warren Dunes State Park |
| Ms. Maryellen Schutze | Galien River Conservation District |

The Steering Committee first met on September 13, 2001, and continued meeting monthly through July 2002 and continued to meet quarterly throughout the duration of the project. All meetings were held in the Watershed at the following locations: Chikaming Township Safety Building, New Buffalo Township Hall, Buchanan Township Hall, Lake Township Hall, and River Valley High School. Most of the meetings were held during daytime hours and several meetings were held in the evening.

Announcements for the meetings for public outreach were placed in the Herald Palladium, Harbor Country News, South Bend Tribune, Berrien County Record, and Gazette. There was also a direct mailing to all Steering Committee members, and additional stakeholders who expressed an interest, through the U.S. Postal Service and electronically through e-mail. Many of the meetings had news coverage and were placed in the local papers.

A Technical Committee was formed consisting of the following people:

| | | |
|---|---|---|
| Ms. Anne Hendrix | Mr. Lowell Bruce | Ms. Chris Bauer |
| Ms. E. Wendy Ogilvie | Mr. Pat Underwood | Ms. Neva Bailey |
| Mr. Mike Townley | | |

The Technical Committee's first meeting was held in December 2001, and they continued to meet monthly through May 2002.

An Information and Education (I&E) Committee was also formed. The I&E Committee consisted of the following people:

| | | |
|---|---|---|
| Ms. Anne Hendrix | Ms. Cathy Johnson | Ms. Carole Svebakken |
| Mr. Pat Underwood | Ms. Nicole Hill | |

The I&E Committee's first meeting was held in December 2001 and they continued to meet monthly through May 2002. The Technical and I&E Committees will meet on an as needed basis as the project progresses.

Two public meetings were held. The first meeting was held on March 7, 2002, at River Valley High School. The attendees were given an overview of the history of the Watershed and Section 319 grant received by the BCDC. The designated and desired uses of the Watershed were also discussed. The second public meeting was held on September 26, 2002, at the Buchanan Township Hall. An overview of the project was given and the attendees were given the opportunity to visit information and demonstration booths.

A public tour of the Watershed was offered on October 29, 2001. The tour included five stops to view healthy portions of the Watershed along with problem areas including erosion sites and logjams. Several wildlife habitats were also viewed.

## 1.3 GEOGRAPHIC SCOPE

The branches of the River wind through southwest Michigan in Berrien County and northwest Indiana, in LaPorte, and St. Joseph Counties emptying into Lake Michigan at New Buffalo, Michigan. The entire basin is 112,222 acres, the majority of which, 82,665 acres lies in Michigan (Figure 2). Ideally, the WMP would address the entire basin as one system. Political boundaries, however, make interstate implementation efforts difficult. For the purposes of this document the Watershed will refer to the Michigan portion, only, unless otherwise stated.

The Indiana portion of the Watershed has a completed WMP that was submitted to the Indiana Department of Natural Resources in September 2001. That plan focused entirely on the Indiana portion of the Little Calumet-Galien River Watershed encompassing 139,000 acres. The Little Calumet-Galien River Watershed becomes heavily urbanized as it extends south and west along the Lake Michigan coastline toward Chicago. The plan's primary focus was to combine past studies and find gaps that exist in data and management strategies. The document also recommends BMPs for each of the three major land uses types in the Watershed: urban, rural, and transitional (O'Leary, 2001). Since the Indiana study complements the Michigan Galien River Watershed study, the project's boundary was drawn at the state line. However, stakeholders from the Indiana portion of the Watershed were invited to participate in the watershed management process.

## 1.4 TOPOGRAPHY

The Watershed consists of a mix of gently sloping moraines and till plains with nearly level lake plains and outwash plains near the mouth of the River (Figure 3). The lowest area is 500 feet above sea level at the Lake Michigan shoreline. The glacial lake plain, just inland, rises only 10 to 15 feet, and wet and muck soils are found in the low areas and depressions in this region.

The lake plain is encountered further inland extending for approximately 7 miles and rising to 40 to 80 feet above Lake Michigan. Stratified lacustrine deposits and layers of sand, remnants of the extinct Lake Chicago, characterize this area. Ancient beaches are identified by the ridges of sand, which reveal an interlaced pattern of wet and dry soils (Soil Conservation Service (SCS), 1979).

Smooth crests and high plains of the moraine 80 to 120 feet above Lake Michigan form the area that cradles the upper reaches of the Watershed. Wave action from a glacial lake may be the cause of the eroded ridges and depositions (SCS, 1979).

## 1.5 SOILS

A layer of glacial drift 100 to 400 feet thick covers the shale and bedrock of this region. The bedrock consists of Antrim Shale, which forms the edges of bowl-like rock formations that fill the Michigan Basin. The glacial drift was deposited during the Wisconsin Glacial period as the ice melted 12,000 to 13,000 years ago (SCS, 1979).

Berrien County is comprised of over 40 different soil types, most of which are represented in the Watershed. The soils have a wide range of texture, natural drainage, slope, and other characteristics; however, many of the soils in the Watershed tend to be wet (Figure 4). Artificial drainage in agricultural areas over the years has created favorable conditions for field crops (SCS, 1979).

The dominant soil type in the Watershed is the Blount Rimer association. It is described as nearly level and gently sloping, somewhat poorly drained, loamy, and sandy soils on till plains and moraines. Pockets of the Morocco-Thetford-Granby association exist close to the Lake Michigan shoreline. These soils are described as nearly level, somewhat poorly drained to poorly drained, sandy soil on moraines, till plains, outwash plains, lake plains, and beach ridges. At the Lake Michigan shoreline is the Spinks-Oatsville-Oshtemo association. These soils are nearly level to very steep, well drained, sandy and loamy soils on moraines, till plains, outwash plains, and beach ridges. Elm Valley is a low floodplain area, consisting of the Pella-Kibbie association. These soils are nearly level, poorly drained to somewhat poorly drained, silty and loamy soils, outwash plains, lake plains, and deltas. The headwaters of the River and its eastern tributaries are in the Riddles-Ockley-Oshtemo association. These soils are nearly level to very steep, well drained, loamy soils on outwash plains, moraines, and till plains. Elm Valley has the most silty and erodible soils in the Watershed.

The erosion potential for most soils on slopes in the Watershed is severe (SCS, 1979). Streambank erosion and sedimentation in the streams are identified as concerns in the Watershed.

## 1.6 CLIMATE

The Watershed lies in the temperate zone with an average annual temperature of 49$^{o}$F. Summers are warm and humid, while winters are cold and very snowy. Lake affect snows from November through February can be quite heavy, yielding an average of 65 inches of snow per year. Annual precipitation is 35 to 36 inches, over half of which falls between April and September. Table 1.1, shows recent annual temperature and precipitation averages in Berrien County. Skies are often overcast and thunderstorms occur on about 42 days per year, mainly in the summer months (SCS, 1979).

The climate is favorable for livestock, cash crops, and feed grain crops, mostly corn, wheat, soybeans, and hay. The area is also known for its fruit orchards and vineyards. Table 1.2 shows the probabilities of the dates of the first and last freezing temperatures of the year from 1948 to 1977 in Eau Claire, Berrien County (SCS, 1979).

**Table 1.1 - Climate Data**

| Year | First Frost (date) | Precipitation (inches) | Departure from Normal Precipitation | Normal Precipitation | Mean Temperature (°F) | Departure from Normal Temperature | Normal Temperature |
|---|---|---|---|---|---|---|---|
| 1999 | 10/24 | 31.87 | -3.92 | 35.79 | 51.9 | 2.4 | 49.5 |
| 1998 | 11/30 | 32.73 | -3.06 | 35.79 | 53.7 | 4.2 | 49.5 |
| 1997 | 10/23 | No data | | | | | |
| 1996 | 10/11 | 32.00 | -3.79 | 35.79 | 48.6 | -0.9 | 49.5 |
| 1995 | 11/03 | 33.62 | -2.17 | 35.79 | 50.2 | 0.7 | 49.5 |
| 1994 | 11/10 | 34.40 | -1.39 | 35.79 | 49.8 | 0.3 | 49.5 |
| 1993 | 10/13 | 42.11 | 6.32 | 35.79 | 49.3 | -0.2 | 49.5 |
| 1992 | 10/20 | 35.37 | 0.27 | 35.10 | 49.1 | -0.3 | 49.4 |
| 1991 | 10/16 | 46.03 | 11.14 | 35.79 | 52.1 | 2.7 | 49.4 |
| 1990 | 10/23 | 48.35 | 13.25 | 35.10 | 51.7 | 2.2 | 49.5 |
| 1989 | 10/09 | 32.20 | -2.9 | 35.10 | 48.7 | -0.7 | 49.4 |
| 1988 | 10/12 | 36.95 | 1.85 | 35.10 | 50.3 | 0.9 | 49.4 |
| 1987 | 10/12 | 34.20 | -0.9 | 35.10 | 52.1 | 2.7 | 49.4 |
| 1986 | 11/03 | | | | | | No data |
| 1985 | 11/08 | 37.59 | 2.49 | 35.10 | 49.6 | 0.2 | 49.4 |
| 1984 | 11/02 | 36.57 | 1.47 | 35.10 | 49.8 | 0.4 | 49.4 |
| 1983 | 11/04 | 34.12 | -0.98 | 35.10 | 50.5 | 1.1 | 49.4 |
| 1982 | 10/17 | 38.52 | 2.92 | 35.60 | 49.1 | -0.6 | 49.7 |
| 1981 | 10/03 | 34.26 | -1.34 | 35.60 | 49.3 | -0.4 | 49.7 |
| 1980 | Data not found | | | | | | |
| 1979 | 10/14 | 37.31 | 1.71 | 35.60 | 47.6 | -2.1 | 49.7 |
| **Average** | **10/24** | **36.62** | **1.17** | **35.45** | **50.19** | **0.70** | **49.49** |

* Data collected from Berrien County Road Commission Weather Station

**Table 1.2 - Frost Dates for the Galien River Watershed**

| Probability of Frost Date | Last Frost Date | First Frost Date |
|---|---|---|
| 1 year in 10 | May 15 | October 5 |
| 2 years in 10 | May 10 | October 11 |
| 5 years in 10 | May 2 | October 21 |

## 1.7 LAND USE

The land use and land cover in the Watershed are shown in Figure 5 and enumerated in Table 1.3 . The Watershed is predominantly rural and agricultural (62%). Traditional row crops are the most common type of agriculture in the area. Fruit orchards and vineyards comprise 2.5% of the Watershed.

A well-known and historic preservation area, Warren Woods, is part of the 23% forested area in the Watershed, according to Michigan Resource Information System (MIRIS) 1978 land use data. Most of the forested area is classified as deciduous broadleaved.

The urbanizing areas, which include the Lake Michigan shoreline, New Troy, and the Villages of Three Oaks and Galien, represent 5% of the land use in the Watershed. These areas are mainly residential, but include some commercial and industrial ventures.

**Table 1.3 - Land Cover**

| Category | Subcategory | Acres | Square Miles | % of Watershed |
|---|---|---|---|---|
| Agricultural Land | Confined feeding operations | 112 | 0.18 | 0.13% |
| Agricultural Land | Cropland, rotation, and permanent pasture | 48,017 | 75.03 | 56.21% |
| Agricultural Land | Orchards, vineyards, and ornamental | 2,052 | 3.21 | 2.40% |
| Agricultural Land | Other agricultural land | 13 | 0.02 | 0.01% |
| Agricultural Land | Permanent pasture | 1,363 | 2.13 | 1.60% |
| **TOTAL** | | **51,557** | **80.56** | **60.35%** |
| | | | | |
| Barren | Sand other than beaches | 10 | 0.02 | 0.01% |
| **TOTAL** | | **10** | **0.02** | **0.01%** |
| | | | | |
| Forest Land | Broadleaved forest (generally deciduous) | 18,935 | 29.59 | 22.16% |
| Forest Land | Christmas tree plantation | 19 | 0.03 | 0.02% |
| Forest Land | Pine | 214 | 0.33 | 0.25% |
| **TOTAL** | | **19,168** | **29.95** | **22.44%** |
| | | | | |
| Rangeland | Rangeland | 8,242 | 12.88 | 9.65% |
| **TOTAL** | | **8,242** | **12.88** | **9.65%** |
| | | | | |
| Urban and Built Up | Commercial, services, and institutional | 194 | 0.30 | 0.23% |
| Urban and Built Up | Extractive | 77 | 0.12 | 0.09% |
| Urban and Built Up | Industrial | 54 | 0.08 | 0.06% |
| Urban and Built Up | Cemeteries | 26 | 0.04 | 0.03% |
| Urban and Built Up | Open and other | 48 | 0.07 | 0.06% |
| Urban and Built Up | Outdoor recreation | 231 | 0.36 | 0.27% |
| Urban and Built Up | Residential | 2,985 | 4.66 | 3.49% |
| Urban and Built Up | Transportation, communication, and utilities | 541 | 0.85 | 0.63% |
| **TOTAL** | | **4,155** | **6.49** | **4.86%** |
| | | | | |
| Water | Lakes | 481 | 0.75 | 0.56% |
| Water | Streams and waterways | 60 | 0.09 | 0.07% |
| **TOTAL** | | **541** | **0.85** | **0.63%** |
| | | | | |
| Wetlands | Wooded wetland | 848 | 1.33 | 0.99% |
| Wetlands | Emergent wetland | 906 | 1.41 | 1.06% |
| **TOTAL** | | **1,754** | **2.74** | **2.05%** |
| **GRAND TOTAL** | | **85,428** | **133.48** | **100%** |

* MIRIS 1978 land use data.

The remainder of the Watershed is comprised of rangeland and open water. Rangeland totals 10% of the Watershed, while water is less than 1%. Flooding is common in the area and assessments of the amount of wetlands vary from 2%, according to the MIRIS, to 11%, according to the U.S. Fish and Wildlife Service. Approximately half of the wetlands are wooded. Much of the wetland areas are in the floodplains along the River corridor in Chikaming and New Buffalo Townships.

## 1.8 HYDROLOGY

The moisture retention of the soil and slightly hilly terrain create a winding network of many small creeks and drains throughout the Watershed.

### LAKES

The rolling topography reveals a land riddled with small lakes, ponds, and wetlands. The outlet of Dayton Lake defines the headwaters of the River. The East Branch of the River begins at Boyle Lake. The eastern portion of the Watershed includes a few small lakes and ponds nestled in the depressions of the moraine. The ultimate destination of the Watershed drainage is Lake Michigan.

### IMPOUNDMENTS

The Dayton Lake dam is the only manmade impoundment that exists in the Watershed. An estimated 200 log jams act as additional impoundments in the River. The Army Corps of Engineers has studied this problem in the past and controversy still exists concerning the cause and effects of the excessive log jams.

### STREAMS

Streams meander throughout the Watershed and flow toward the River and Lake Michigan. Approximately 243 stream miles have been measured in the 82,665 acres of the Watershed. A breakdown of the major subwatersheds and their drainage area is found in Table 1.4.

**Table 1.4 - Subwatersheds in the Galien River Watershed**

| Subwatershed | Area (acres) | Square Miles | Location of Outlet | |
|---|---|---|---|---|
| | | | Township | Section |
| East Branch Galien River | 19,008 | 29.70 | Weesaw | 17 |
| Galien River (main branch) | 14,391 | 22.49 | New Buffalo | 31 |
| Galien River (upstream of East Branch confluence) | 16,345 | 25.54 | Weesaw | 17 |
| Dowling Creek/Close Drain | 13,864 | 21.66 | Weesaw | 29 |
| Galien River (mouth) | 3,540 | 5.53 | New Buffalo | 9 |
| South Branch Galien River | 15,517 | 24.25 | New Buffalo | 36 |
| **Total** | **82,665** | **129.17** | | |

## COUNTY DRAINS

The River is not a designated county drain, however, many tributaries to the River have been designated county drains since the early 1900s. Figure 6 identifies the designated county drains, which represent a large percentage of the water courses in the Watershed. Further information about the drains, such as date of establishment, length, and history of maintenance, is included in Appendix 1. The majority of drains were established in the late 1800s and early 1900s. The BCDC has conducted extensive maintenance on the drains mostly through the 1990s.

## WETLANDS

The lowlands and high water table result in many wetlands throughout the Watershed. The National Wetlands Inventory classifies 11.52% of the Watershed as wetlands, shown in Table 1.5. Satellite imagery interpretation by the Berrien County Geographic Information System Department estimated only 8% wetlands in the Watershed. The 1978 MIRIS information identifies only 2% of the Watershed as wetlands (Figure 7).

The riparian areas of the River are wide floodplain wetlands, especially in Chikaming Township upstream of Warren Woods. Before entering Lake Michigan, the River passes through a large marsh, a portion of which is owned by Berrien County. A small portion of the marsh on the west side is owned by Lake Michigan Riviera Condominiums. Another portion on the east side was recently purchased by Chikaming Open Lands (COL). The mouth of the River has been constructed into a harbor that serves recreational and commercial watercraft.

**Table 1.5 - Classification of Wetlands in the Galien River Watershed***

| Class | Acres | % of Watershed |
|---|---|---|
| Aquatic Bed | 158.88 | 0.19% |
| Emergent | 1,621.47 | 1.96% |
| Forested | 6,657.45 | 7.94% |
| Scrub-Shrub | 358.42 | 0.43% |
| Lake | 821.52 | 0.99% |
| Non-wetland | 73,163.19 | 88.48% |
| **TOTAL** | **82,686.92** | **100.00%** |

* US Fish and Wildlife National Wetlands Inventory, 1984

## GROUNDWATER

Information on the groundwater in the Watershed was collected from the Berrien County Health Department (Health Department). Specifics of the data collected are included in Appendix 2. Information from the well logs was gathered on wells that were in the areas previously identified as having either high *E. coli* counts or nitrates above 10mg/l. Further investigation will be needed to draw any conclusions from this data, but the beginnings of this database could help determine high risk areas. Field verified well log data can be used to characterize the subsurface geology within the Watershed.

All new wells have bacteriologic and nitrate testing before they are approved by the Health Department. *E. coli* is a serious health problem if allowed into the water source, and can originate from both residential and agricultural sources. Septic tanks that are not properly maintained or are improperly placed pose a threat in some of the rural areas of the Watershed. New septic system installations must comply with the sewage ordinance, which requires a site to have a minimum of 3 feet of porous soils with no seasonal water table.

Nitrates in groundwater also poses a significant health threat. The National Drinking Standard is 10 mg/l. Shallow drift wells (40 feet to 120 feet below grade) are especially vulnerable to land surface activities that could leach nitrates through the soil. The Watershed is characterized by the permeable soils of the Spinks-Oakville-Oshtemo association. Areas with highly permeable soils, intensive agricultural operations, and shallow water tables are the greatest threat to water quality.

## 1.9 NATURAL RESOURCES

Natural Resources include aquatic and terrestrial wildlife, vegetation, and even the land itself. The Watershed is home to many unique species that are not only rare to Michigan, but are protected as federally endangered species. The extraordinary diverse species population in this region, owes itself to the widely varied landscape.

### THREATENED AND ENDANGERED SPECIES

The Watershed has many natural resources, habitats, and species. Table 1.6 lists the endangered, threatened, and special concern species in the Watershed as identified by the Natural Heritage Program. Two of the species, the Yellow-Throated Warbler and the Prairie Trillium are pictured in the Watershed logo. Chikaming Township has a keen interest in preservation and stewardship of the area and has inventoried their notable parks and open space preserves.

Long ago, the Massasauga rattle snake thrived in the swamps and marshes of the area. Early settlers in the 1900s killed off the snakes by the hundreds and by 1930 they were rarely seen (Burgh, 1937).

### FISH

Portions of the Galien River and its tributaries are designated coldwater streams. Table 1.7 presents data from the Michigan Department of Natural Resources (MDNR) for fish stocking that occurred in the Watershed from 1996 to 2000.

### VEGETATION

The pre-settlement vegetation of the Watershed was dominated by beech and sugar maple, with white oak and black oak common along the bluffs and broad ridges above the River (Figure 8). Black ash and silver maple dominated the lowland hardwood forests. Large marsh areas covered broad bands along the River. Only a few areas of the wooded corridor of the River and fragmented pockets of preserved areas contain the old-growth forests. Most of the land has been converted to agriculture through land clearing and artificial drainage. Trees in the Warren Woods Natural Area have been aged at 450 years (Johnson, 2001).

The Great Lakes Marsh, at the mouth of the River, provides valuable habitat for wildlife. The size of the marsh is quite diminished from its historical coverage, but recent efforts have placed protection measures on the remaining area. A remnant of a coastal plain marsh, near Grand Beach in New Buffalo Township, has been purchased by The Nature Conservancy to preserve this rare habitat. Increased human activities of marinas, golf courses, and residential developments have contributed to the changes of the drainage and flow patterns of this area. The remaining natural vegetation occurs along the waterways, where topography limits development.

## NATURAL FEATURES INVENTORY

COL commissioned a report in May 2001 titled *Natural Resources and Conservation Direction*, for six townships, which encompassed most of the Watershed. The report details the ecological history of the area and includes a summary of the Michigan Natural Features Inventory. Recommendations on areas for conservation and future actions to preserve the areas are described. Maps and charts from this report are included in Appendix 3.

**Table No. 1.6 - Species Requiring Special Management Strategies**

| Endangered* | Threatened* | Special Concern Species* | Unique Communities* | Galien River County Park Preserve* | State Protected Species Specific to Chikaming Township** |
|---|---|---|---|---|---|
| Prairie Vole *(Microtus orchrogaster)* | Prairie Trillium *(Trillium recurvatum)* | Blanchard's Cricket Frog *(Acris crepitans banchardi)* | Southern Floodplain Forest | Cup Plant (Threatened) *(Silphium perfoliatum)* | Cerulean Warbler *(Dendrocia cerulean)* |
| | Yellow-Throated Warbler *(Dendrocia dendrocia)* | Brown Walker (snail) *(Promatiopsis cincinnatiensis)* | Mesic Southern Forest | Starry Campion (Threatened) *(Silene stellata)* | Hooded Warbler *(Wilsonia critrina)* |
| | Rose Pink (plant) *(Sabaria angularis)* | Davis' Sedge *(Carex davisli)* | | Swamp Rose Mallow (Special Concern) *(Hibiscus moscheutos)* | Red-Shouldered Hawk (Threatened) *(Buteo lineatus)* |
| | Lake Sturgeon *(Accipenser fulvescens)* | Green Violet *(Hybanthus concolor)* | | Blanding's Turtle (Special Concern) *(Emydoidea blandingii)* | Acadian Flycatcher *(Empidonax virescens)* |
| | Goosefoot Cornsalad *(Balerianella chenopodiifolia)* | Woodland Vole *(Microtus pinetorum)* | | | Wood Thrush *(Hylocichla mustelina)* |
| | Cup Plant *(Silpium perfoliatum)* | Grey Petaltail (insect) *(Trachopteryx thoreyi)* | | | Louisiana Waterthrush (Special Concern) *(Seiurus motacilla)* |
| | Red Mulberry *(Morus rubra)* | | | | |
| | Beak Grass *(Diarrehena Americana)* | | | | |
| | Wild Oats *(Chasmanthium latifolium)* | | | | |
| | Raven's Foot Sedge *(Carex orus corvi)* | | | | |
| | Red-Shouldered Hawk *(Buteo lineatus)* | | | | |

*Identified by the Natural Heritage Program/Michigan Natural Features Inventory, January 21, 2000.
** Identified in Chikaming Township Preserve Project Proposal, June 16, 2000.

**Table 1.7 - Fish Stocking in the Galien River Watershed***

| Water | Species | Strain | Date | Number | Average Length (inches) | Fin Clips, Marks, Tags |
|---|---|---|---|---|---|---|
| Galien River | Brown Trout | Seeforellen | 05/03/2000 | 24,588 | 5.48 | None |
| | | | 05/03/1999 | 19,000 | 5.84 | None |
| | | | 04/27/1998 | 18,500 | 5.64 | None |
| | | | 04/28/1997 | 18,994 | 6.58 | None |
| | | | 05/01/1996 | 9,000 | 6.16 | None |
| | | | 05/01/1996 | 9,300 | 6.16 | None |
| | Coho | Michigan | 04/20/2000 | 27,512 | 5.56 | None |
| | | | 05/05/1999 | 25,010 | 5.64 | None |
| | | | 04/23/1998 | 20,720 | 5.60 | None |
| | | | 04/15/1997 | 25,010 | 5.44 | None |
| | | | 05/17/1996 | 25,023 | 5.56 | None |
| | Rainbow Trout | Eagle Lake | 05/02/1996 | 21,041 | 6.52 | Adipose, coded wire tag |
| | Steelhead | Steel-MI Winter | 05/16/2000 | 3,000 | 7.40 | Right pectoral clip |
| | | | 04/28/2000 | 12,000 | 7.44 | Right pectoral clip |
| | | | 04/22/1999 | 12,140 | 7.36 | Right pectoral clip |
| | | | 04/22/1998 | 12,080 | 8.00 | Right pectoral clip |
| | | | 04/22/1997 | 12,500 | 7.60 | Right pectoral clip |
| | | | 04/18/1996 | 11,600 | 7.52 | Right pectoral clip |
| | Walleye | Muskegon | 06/08/2000 | 7,877 | 1.08 | None |
| | | | 05/26/1999 | 47,719 | 1.04 | None |
| | | | 05/2719/98 | 19,776 | 1.08 | None |
| | | | 06/11/1997 | 10,015 | 1.12 | None |
| | | | 06/14/1996 | 11,332 | 1.60 | None |
| South Branch of Galien | Brown Trout | Seeforellen | 03/30/2000 | 2,780 | 5.04 | None |
| | | | 04/07/1999 | 3,000 | 5.92 | None |
| | | | 04/01/1998 | 2970 | 5.40 | None |
| | | | 04/24/1997 | 3,372 | 6.12 | None |
| | | | 05/01/1996 | 2,940 | 6.16 | None |

*MDNR Fisheries, 2000

## WARREN WOODS

Seven miles west of Warren Dunes State Park is the State Dedicated Natural Area of Warren Woods. Mr. E.K. Warren set aside this 312-acre parcel to be protected and preserved upon his death in 1919. The River enters the northeast section of the park and winds through the old growth beech-maple forests before exiting at the western boundary of the park. A parking area, accessible from the south, provides access to the foot trails and interpretive signs explain the unique features of the area.

Warren Woods Nature Study Area, classified as mesic southern and southern floodplain forests, includes one of the few remaining old growth beech-maple communities in southern Michigan and the entire Great Lakes region. Over 300 species of native plants and wildflowers have been identified within the area. White-tailed deer, Fowler's Toads, Red Shouldered Hawks, and numerous migratory songbirds can also be found. Warren Woods provides a sanctuary for many of the songbird populations that are at risk due to loss of unfragmented forests caused by urban sprawl. A map and descriptions of the area are included in Appendix 4.

# CHAPTER 2 - POLITICAL LANDSCAPE

## 2.1 DEMOGRAPHICS

Approximately 16,635 people live in the Galien River Watershed (Watershed) as projected by the proportion of residents by percent area of the township or city in the Watershed. The major population center in the Watershed is the City of New Buffalo, a coastal community on Lake Michigan. Other municipalities in the Watershed include the area of New Troy and the Villages of Three Oaks and Galien. Table 2.1 depicts the population variations by governmental unit across the Watershed.

The entirety of Weesaw Township and Three Oaks rests in the Watershed. The Townships of Galien, New Buffalo, and the City of New Buffalo have between 60% and 90% of their areas in the Watershed. The inland half of Chikaming Township and a small section of the Lake Michigan coast are in the Watershed. Bertrand, Baroda, Buchanan, Lake, and Oronoko Townships each have less than half of their area in the Watershed. The area of New Troy and the Villages of Three Oaks and Galien are all entirely within the Watershed.

The United States as a whole has a population density of 79.6 people per square mile, less than Michigan's population density of 175 people per square mile. The population density stated for Berrien County is significantly higher, at 248.5 people per square mile. The scenic Lake Michigan shoreline areas of the Watershed have a greater concentration of houses and shopping districts than the rural inland areas. However, much of the activity on the shoreline is seasonal, while year-round residents tend to live in the inland areas. Three Oaks Township, Buchanan Township, and to an even greater extent Weesaw Township, have far fewer people given the land area of the townships. The population density recorded for Oronoko Township is much higher than the other townships. Municipalities in Oronoko Township outside of the Watershed, however, account for much of that population. The population density of 405 acres of Oronoko Township within the Watershed is similar to that of Buchanan Township.

Table 2.2 shows the ethnic composition within the Watershed. The amounts of males and females are almost evenly split. Whites far outnumber other ethnic groups. The second largest group represented is African American, and Hispanics/Latinos are the third largest group. A small number of residents are included in the American Indian and Alaskan Native group, predominantly from the indigenous Pokagon band of the Potawatomi tribe. This tribe has a long history in the Watershed and is a significant part of the community.

## 2.2 COMMUNITY PROFILES

The lakeside communities on Lake Michigan are generally more populated during the warm summer months than in colder seasons. Chikaming Township has 47.6% of its housing units as seasonal residences. New Buffalo Township's housing has 42.4% seasonal residents.

Nine school districts in the Watershed serve the year-round residents. The geographical base and contact information for each are listed in Table 2.3

**Table 2.1 - Community Profiles**

| Governmental Unit | Acres in Watershed* | Square Miles in Watershed | % of Watershed in Governmental Unit (%) | % of Governmental Unit in Watershed (%) | Population 1990 Census | 1990 Population per Square Mile | Population 2000 Census | 2000 Population per Square Mile | Estimated Population In Watershed** |
|---|---|---|---|---|---|---|---|---|---|
| Baroda Township | 393 | 0.6 | 0.48 | 3% | 2,731 | 153.1 | 2,880 | 161.5 | 99 |
| Bertrand Township | 1,579 | 2.5 | 1.91 | 7% | 2,228 | 63.6 | 2,380 | 68.0 | 168 |
| Buchanan Township | 8,567 | 13.4 | 10.37 | 40% | 3,402 | 102.5 | 3,510 | 105.7 | 1,415 |
| Chikaming Township | 7,350 | 11.5 | 8.90 | 52% | 3,717 | 168.1 | 3,678 | 166.3 | 1,910 |
| Shorewood-Tower Hills-Harber (totals included in Chikaming Township) | 69 | 0.1 | 0.08 | 2% | 1,636 | 358.9 | 1,619 | 355.2 | 38 |
| Galien Township | 12,742 | 19.9 | 15.43 | 90% | 1,591 | 72.0 | 1,611 | 72.9 | 1,451 |
| Galien Village | 285 | 0.4 | 0.35 | 100% | 596 | 1,336.6 | 593 | 1,329.8 | 592 |
| Lake Township | 3,204 | 5.0 | 3.88 | 27% | 2,487 | 133.0 | 3,148 | 168.4 | 843 |
| New Buffalo Township | 9,943 | 15.5 | 12.04 | 76% | 2,419 | 117.7 | 2,468 | 120.1 | 1,865 |
| City of New Buffalo | 895 | 1.4 | 1.08 | 64% | 2,317 | 1,065.5 | 2,200 | 1,011.7 | 1,415 |
| Oronoko Township | 405 | 0.6 | 0.49 | 2% | 9,819 | 294.2 | 9.843 | 294.9 | 187 |
| Three Oaks Township | 14,360 | 22.4 | 17.39 | 100% | 2,952 | 125.8 | 2,949 | 125.7 | 2,820 |
| Three Oaks Village | 628 | 1.0 | 0.76 | 100% | 1,786 | 1,817.5 | 1,829 | 1,861.3 | 1,826 |
| Weesaw Township | 22,154 | 34.6 | 26.83 | 100% | 2,114 | 59.3 | 2,065 | 58.0 | 2,006 |
| **TOTAL** | **82,505** | **128.8** | | | **38,159** | **293.6** | 39,154 | 304 | **16,635** |
| Berrien County | | | | | 161,378 | 275.9 | 162,453 | 277.7 | 35,829 |

* Does not include Indiana portion.
** Calculated by (% of Governmental Unit In Watershed) x (Population 2000 Census)

**Table 2.2 - Ethnic composition or Population (2000 Census)**

| Governmental Unit | Total Population | Watershed % of Govt. Unit | Watershed Population | Male** | Female** | White** | African American** | American Indian & Alaska Native** | Asian** | Native Hawaiian & other Pacific Islander** | Hispanic or Latino** | Other Race** | One Race** | Two or More Races** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Baroda Township | 2,880 | 3% | 99 | 50 | 49 | 96 | 0 | 0 | 0 | 0 | 3 | 2 | 99 | 1 |
| Bertrand Township | 2,380 | 7% | 168 | 85 | 83 | 163 | 1 | 1 | 1 | 0 | 1 | 0 | 166 | 2 |
| Buchanan Township | 3,510 | 40% | 1,415 | 729 | 686 | 1,361 | 17 | 7 | 4 | 0 | 18 | 6 | 1,394 | 21 |
| Chikaming Township | 3,678 | 52% | 1,910 | 943 | 967 | 1,828 | 43 | 7 | 6 | 1 | 18 | 7 | 1,891 | 19 |
| Shorewood-Tower Hills-Harber | 1,619 | 2% | 38 | 19 | 19 | 37 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 0 |
| Galien Township | 1,611 | 90% | 1,451 | 726 | 725 | 1,400 | 7 | 3 | 6 | 0 | 12 | 4 | 1,420 | 32 |
| Galien Village | 593 | 100% | 592 | 296 | 297 | 574 | 0 | 1 | 0 | 0 | 5 | 0 | 575 | 17 |
| Lake Township | 3,148 | 27% | 843 | 412 | 431 | 824 | 6 | 2 | 2 | 0 | 8 | 2 | 836 | 7 |
| New Buffalo Township | 2,468 | 76% | 1,865 | 930 | 936 | 1,751 | 68 | 3 | 6 | 1 | 30 | 5 | 1,834 | 31 |
| City of New Buffalo | 2,200 | 64% | 1,415 | 702 | 713 | 1,367 | 6 | 3 | 7 | 1 | 41 | 18 | 1,402 | 13 |
| Oronoko Township | 9,843 | 2% | 187 | 89 | 97 | 124 | 33 | 1 | 13 | 1 | 16 | 8 | 179 | 7 |
| Three Oaks Township | 2,949 | 96% | 2,820 | 1,389 | 1,430 | 2,730 | 25 | 13 | 3 | 0 | 46 | 11 | 2,782 | 37 |
| Three Oaks Village | 1,829 | 100% | 1,826 | 895 | 932 | 1,759 | 17 | 14 | 2 | 0 | 34 | 12 | 1,804 | 22 |
| Weesaw Township | 2,065 | 100% | 2,006 | 1,022 | 984 | 1,900 | 2 | 10 | 5 | 0 | 81 | 68 | 1,985 | 21 |
| **TOTAL** | 40,773 | N/A | 16,635 | 8,286 | 8,350 | 15,915 | 224 | 66 | 55 | 3 | 312 | 143 | 16,406 | 229 |
| **% of Watershed Population** | | | | 49.81% | 50.19% | 95.67% | 1.35% | 0.39% | 0.33% | 0.02% | 1.87% | 0.86% | 98.62% | 1.38% |
| Berrien County Total | 162,453 | 22% | 16,635 | 78,738 | 83,715 | 129,459 | 25,879 | 691 | 1,849 | 73 | 4,888 | 1,845 | 159,796 | 2,657 |

*Does not include Indiana portion.
**Populations are projected based on percentage of governmental unit in watershed

**Table 2.3 - School Districts**

| Townships in Galien River Watershed | School Districts | Telephone Number |
|---|---|---|
| Baroda | Lakeshore<br>River Valley<br>Bridgman | 616-428-1400<br>616-756-9541<br>616-465-5432 |
| Bertrand | Galien<br>Brandywine<br>Niles<br>Buchanan | 616-545-3364<br>616-684-7150<br>616-683-0732<br>616-695-8401 |
| Buchanan | Galien<br>River Valley<br>Buchanan (City) | 616-545-3364<br>616-756-9541<br>616-695-8401 |
| Chikaming | River Valley<br>New Buffalo (small portion) | 616-756-9541<br>616-469-2211 |
| Galien | River Valley<br>Galien (Village) | 616-756-9541<br>616-545-3364 |
| Lake | Lakeshore<br>River Valley<br>Bridgman | 616-428-1400<br>616-756-9541<br>616-465-5432 |
| New Buffalo | River Valley<br>New Buffalo | 616-756-9541<br>616-469-2211 |
| Three Oaks | River Valley | 616-756-9541 |
| Weesaw | River Valley<br>Galien<br>New Troy-Elementary | 616-756-9541<br>616-545-3364<br>616-426-7512 |

The main local industrial employer in New Troy recently closed its plant. This loss of jobs has had drastic economic effects on the community. A sewer system was created to support the plant; however, the tax base did not allow for expansion to the majority of the residences at that time. New Troy has a need to find sources of funding for the sewer extension if another industry cannot be attracted to the area.

## 2.3 OFFICIALS

The Watershed is represented by a variety of appointed and elected officials. A list is provided in Table 2.4 of some of the key stakeholders in the Watershed. This list will be updated in future revisions of this document.

**Table No. 2.4 – Representatives and Officials for the Galien River Watershed**

| Officials | Jurisdiction | Title |
|---|---|---|
| **United States Senators** | | |
| Ms. Deborah Stabenow | U.S. Senate | Senator |
| Mr. Carl Levin | U.S. Senate | Senator |
| **United States Representative** | | |
| Mr. Fred Upton | U.S. Congressional District 6th | Congressman |
| **Tribal Representatives** | | |
| Mr. Michael Zimmeran | Pokagon Band of Potawatomi Indians | Acting Tribal Chairman |
| Mr. Mark Parrish | Pokagon Band of Potawatomi Indians | Environmental Coordinator |
| Mr. Kevin Dougherty | Pokagon Band of Potawatomi Indians | Resource Developer |
| **State of Michigan Representatives** | | |
| Mr. Harry Gast | State Senate District - 20th | Senator |
| Mr. Charles LaSata | State Representative District #9 | Representative |
| Mr. Ron Jelinek | State Representative District #78 | Representative |
| **Berrien County Representatives** | | |
| Mr. L. Paul Bailey | County Sheriff | |
| Ms. M. Louise Stine | County Clerk | |
| Ms. Lori Jarvis | County Register of Deeds | |
| Mr. William Wolf | County Treasurer | |
| Mr. Izzy DiMaggio | Drain Commissioner | |
| Ms. Anne Hendrix | Chief Deputy Drain Commissioner | |
| Mr. Gary Witkowski | Health Department | Environmental Health Director |
| Mr. Randy Rood | Parks and Recreation Commission | Director |
| Mr. Kip Miller | Parks and Recreation Commission | Chief Naturalist |
| Mr. Dennis Schuh | Public Works | Director |
| Mr. John Burt | GIS Coordinator | |
| Ms. Catherine McIlwee | Planner | |
| Mr. Robert Burkholz | Road Commission | |
| **Local Representatives** | | |
| Mr. Bill Sinclair | New Buffalo | City Manager - Interim |
| Ms. Rosann Dudiak | New Buffalo | Mayor |
| Mr. Jim Brow | Baroda Township | Supervisor |
| Mr. John Mefford | Bertrand Township | Supervisor |
| Mr. Richard Chubb | Buchanan Township | Supervisor |
| Mr. Carl Anderson | Chikaming Township | Supervisor |
| Mr. Bruce Williams | Galien Township | Supervisor |
| Mr. John Gast | Lake Township | Supervisor |
| Ms. Agnes Conway | New Buffalo Township | Supervisor |
| Mr. Ernest Hildebrand | Oronoko Township | Supervisor |
| Mr. Charles Sittig | Three Oaks Township | Supervisor |
| Mr. Michael Oman | Weesaw Township | Supervisor |
| Mr. Kenneth Everly | Galien Village | President |
| Mr. Phillip Smith | Three Oaks Village | President |

# CHAPTER 3 - WATER QUALITY

## 3.1 PAST STUDIES

The Indiana Department of Natural Resources, Division of Water, Coastal Coordination Program, conducted a Watershed Diagnostic Study of the Little Calumet-Galien River Watershed in 2001. The study summarized and integrated the plethora of information available on the area, and filled in information gaps necessary to meet project goals. The recommendations prioritized watershed and management units to provide a framework for focusing in on key parcels for the implementation of Best Management Practices (BMPs). Proposed BMPs focused on major land use categories within the Galien River Watershed (Watershed), such as rural and urban areas, and transitional areas with projections of high population increases. Management units were ranked according to impending risk to water quality, as well as practical, economical, and realistic opportunities for the implementation of the recommended BMPs. The document provided a starting point for future investigations in the Watershed.

An inventory of the flowers and ferns in Warren Woods was completed in 1925 by Cecil Billington. An abundant flora was discovered in the area, a surprise considering the small area surveyed. The study included a list of the findings comprising 79 families, 203 genera, and 358 species and varieties. The information for this study was entered into the Floristic Quality Assessment for Warren Woods in 2001. Discrepancies were found, due to re-categorizations of varieties and species. A new, comprehensive inventory was recommended for the area, since the last inventory was completed so long ago that it might not be representative of the current flora in Warren Woods. A preliminary floristic inventory was taken during a field reconnaissance in June 2000, covering the east portion of the wooded ravine, forested wetlands, and the Galien River (River) floodplain in Warren Woods. The floristic quality was 51, which indicates a rare, significant component of Michigan's native biodiversity.

The Michigan Department of Environmental Quality(MDEQ) conducted a Road Stream Crossing Survey of the Watershed in the summer of 2001. The goal of the survey was to inventory 80% of the road/stream crossings in the Watershed to assess the physical condition of the streams and to gather information on the potential sources of nonpoint source pollution in the Watershed. This information has been a useful addition to the Watershed inventory conducted by the Berrien County Drain Commissioner (BCDC) office and has also provided the Berrien County Road Commission (BCRC) with supplementary information about their structures that will be helpful in prioritizing maintenance needs.

The MDEQ Road Stream Crossing inventory accomplished a field survey of about 250 road crossing sites in the Watershed. A summary of these sites can be found in Appendix 5. Only six of the stream crossing sites were included in the high priority poor condition area. Although the list rates 221 of the sites at a low priority, they still need attention as they contribute a great deal of sediment when considered collectively. Just over 90% of the sites suffered little from nonpoint pollution at the road crossing. Other areas of concern are nonpoint sources from row crops, residential lawns, and impervious surface runoff.

Chikaming Open Lands (COL) sponsored a study of the natural resources and conservation directions of Chikaming, Galien, Lake, New Buffalo, Three Oaks, and Weesaw Townships. Few areas with natural vegetation remain in the area. COL sponsored the study to search for existing biological information for the townships. Many wildlife habitats and communities were found in the area, including old growth forests with thick canopies and open understories. Southern floodplain forests, rich central midwest type forests, dunes, sandy beaches, coastal plain marshes, a Great Lakes Marsh at the mouth of the River, a prairie fen, a wet prairie, and a bog were also found. Increased predation by raptors and invasion of nests by crows, blue jays, squirrels, raccoons, skunks, and domestic cats has led to declines in population of song, forest, and dwelling birds. Parasitism of nests by fringe dwelling cowbirds is greatly increased because of loss of continuous forest habitat. Insectivorous birds and bats are at risk from pesticide poisoning. Loss of forest and wetland habitat has led to the decline of native mammals, amphibians, and reptiles. Declines in the populations of some types of insects has consequently led to the drop in population of some plants which are dependent upon certain insects for pollination. Recommendations from the study focused on potential properties to target for conservation, areas that contain remaining native habitats along the River, its tributaries, and other smaller waterways. Future suggested actions include participation in volunteer programs and conducting an assessment of the legislation and polices that hinder conservation of biodiversity.

## 3.2 CURRENT STUDIES

The MDEQ Surface Water Quality Division submitted four water bodies to be included on the Clean Water Act Section 303(d) list for 2002, and are listed in Table 3.1. Waterbodies that are included in the Section 303(d) list are required to submit a Total Maximum Daily Load (TMDL). A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The TMDL is the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. Water quality standards are set by states, tribes, and territories. They identify the uses for each waterbody and the scientific criteria to safely support that water quality use.

**Table 3.1 - Clean Water Act Section 303(d) List for 2002**

| **Water Body** | **Deer Creek** |
|---|---|
| WBID# | 083301D |
| County | Berrien |
| RF3RchID | 4040001 4400.00 |
| Size (miles) | 7 miles |
| Location | S. Branch of Galien River confluence upstream to the vicinity of Three Oaks |
| Problem | Untreated sewage discharge, pathogens (Rule 100); macro invertebrate community rated poor; nuisance algae and bacterial slime growths |
| TMDL Year | 2002 |
| **Water Body** | **Galien River** |
| WBID# | 083301A |
| County | Berrien |
| RF3RchID | 4040001 2213.84 |
| Size | 2 miles |
| Location | Galien River in the vicinity of New Troy - Flynn Road upstream to Elm Valley Road |
| Problem | Water quality standard exceedances for *E. coli*; pathogens (Rule 100) |
| TMDL Year | 2002 |
| **Water Body** | **Galien River** |
| WBID# | 083301G |
| County | Berrien |
| RF3RchID | 4040001 220.00 |
| Size | 6 miles |
| Location | Lake Michigan confluence upstream to 1-94. |
| Problem | Fish consumption advisory for PCBs, chlordane |
| TMDL Year | 2009 |
| **Water Body** | **Galien River, East Branch** |
| WBID# | 083301F |
| County | Berrien |
| RF3RchID | 4040001 270.00 |
| Size | 9 miles |
| Location | Galien River confluence upstream to the Yellow Lake and Wagner Lake outlets |
| Problem | Nutrient enrichment, nuisance algal growths |
| TMDL Year | 2009 |

The TMDL process for *E. coli* is underway due to levels exceeding the 130 count per 100 milliliters as a 30-day geometric mean between May and October. The first season of the MDEQ sampling indicated that the problem extends further than expected in the River TMDL reach. Sampling was expanded to additional sites during the second season. The East Branch of the River is a large contributor of *E. coli* to the Main Branch. Sampling has shown that loading occurs during both wet and dry weather conditions. The locations of the sampling sites are illustrated in Figure 9. Sources have not yet been identified but suspected sources include illicit connections, agricultural production, and storm water runoff. Copies of the reports for the River and Deer Creek are included in Appendix 6. Data from the first four 2002 sample events are presented in Table 3.2. The full data set is presented in Appendix 6.

**Table 3.2 - TMDL Sampling Data**

| Colony Forming Units of *E. Coli* /100 mL | | | | |
|---|---|---|---|---|
| Sample Data Lab Location | 05/08/2002 Bio-Chem CFU/100 mL | 05/15/2002 Trace CFU/100 mL | 05/22/2002 Trace CFU/100 mL | 05/29/2002 Trace CFU/100 mL |
| GR-1B-1 | 160 | 550 | 80 | 250 |
| GR-1B-2 | 290 | 660 | 180 | 280 |
| GR-1B-3 | 210 | 38 | 200 | 260 |
| GR-2B-1 | 240 | 4,200 | 990 | 5,300 |
| GR-2B-2 | 640 | 5,900 | 1,000 | 5,400 |
| GR-2B-3 | 500 | 6,000 | 1,100 | 4,700 |
| GR-3B-1 | 38 | 630 | 260 | 390 |
| GR-3B-2 | 89 | 500 | 120 | 340 |
| GR-3B-3 | 150 | 610 | 170 | 430 |
| GR-4A-1 | 150 | 510 | 200 | 470 |
| GR-4A-2 | 260 | 420 | 220 | 440 |
| GR-4A-3 | 280 | 650 | 210 | 420 |
| GR-5B-1 | 94 | 580 | 110 | 440 |
| GR-5B-2 | 120 | 550 | 180 | 360 |
| GR-5B-3 | 45 | 490 | 120 | 430 |
| GR-6B-1 | 81 | 410 | 400 | 100 |
| GR-6B-2 | 72 | 370 | 430 | 110 |
| GR-6B-3 | 82 | 370 | 290 | 160 |
| GR-7A-1 | TNTC | 3,000 | 940 | 3,500 |
| GR-7A-2 | TNTC | 4,000 | 1,300 | 600 |
| GR-7A-3 | TNTC | 5,400 | 1,100 | 1,300 |
| GR-8A-1 | 190 | 12,000 | 5,400 | 9,200 |
| GR-8A-2 | 210 | 15,000 | 6,300 | 8,900 |
| GR-8A-3 | 170 | 14,000 | 5,900 | 7,800 |
| GR-9A-1 | 140 | 600 | 200 | 190 |
| GR-9A-2 | 90 | 530 | 210 | 190 |
| GR-9A-3 | 22 | 610 | <10 | 220 |
| ***GR-1** | **N/A** | **<10** | **<10** | **N/A** |
| ***GR-2** | **1** | **N/A** | **N/A** | **N/A** |
| ***GR-3** | **N/A** | **N/A** | **N/A** | **<3** |
| ***GR-4** | **<1** | **N/A** | **N/A** | **N/A** |
| ***GR-5** | **N/A** | **25** | **<10** | **N/A** |
| ***GR-6** | **N/A** | **N/A** | **N/A** | **<10** |
| DC-1B-1 | 310 | 500 | 410 | 150 |
| DC-1B-2 | 300 | 480 | 310 | 140 |
| DC-1B-3 | 300 | 430 | 350 | 140 |
| DC-2B-1 | 230 | 400 | 220 | 300 |
| DC-2B-2 | 220 | 350 | 180 | 310 |
| DC-2B-3 | 290 | 400 | 170 | 290 |

**Table 3.2 - TMDL Sampling Data**

| Colony Forming Units of *E. Col* /100 mL | | | | |
|---|---|---|---|---|
| Sample Data Lab Location | 05/08/2002 Bio-Chem CFU/100 mL | 05/15/2002 Trace CFU/100 mL | 05/22/2002 Trace CFU/100 mL | 05/29/2002 Trace CFU/100 mL |
| DC-3B-1 | 230 | 420 | 310 | 340 |
| DC-3B-2 | 230 | 310 | 340 | 280 |
| DC-3B-3 | 250 | 430 | 360 | 320 |
| DC-4A-1 | 120 | 30 | 40 | 140 |
| DC-4A-2 | 110 | 40 | 70 | 130 |
| DC-4A-3 | 100 | 42 | 50 | 200 |
| DC-5B-1 | 1,700 | 1,300 | 2,500 | 6,200 |
| DCR-5B-2 | TNTC | 3,300 | 2,500 | 7,800 |
| DC-5B-3 | TNTC | 3,000 | 3,100 | 5,300 |
| **DC-2 | <1 | N/A | N/A | N/A |
| **DC-3 | N/A | <10 | <10 | <10 |

GR-1B = East Branch of Galien River at Holden Road
GR-2B = Kirktown Creek at Baldwin Road
GR-3B = Galien River at Elm Valley Road
GR-4A = Galien River at Kaiser Road
GR-5B = Galien River at Flynn Road
GR-6B = East Branch of Galien River at Glendora Road, east crossing
GR-7A = Troy Drain (east drain), south of Glendora Road and State Street Intersection
GR-8A = New Troy Drain (west drain), south of Glendora and State Street Intersection
GR-9A = Dowling Creek at US-12
***GR-1 is a rinse blank taken at Station 1**
***GR-2 is a rinse blank taken at Station 2**
***GR-3 is a rinse blank taken at Station 3**
***GR-4 is a rinse blank taken at Station 4**
***GR-5 is a rinse blank taken at Station 5**
***GR-6 is a rinse blank taken at Station 6**
DC-1A = Deer Creek at Lakeside Road
DC-2B = South Branch Galien River at Lakeside Road
DC-3B = South Branch Galien River at Forest Lawn Road
DC-4A = Deer Creek at Schwark Road
DC-5A = Chestnut Drive in Three Oaks
****DC-2 is a rinse blank taken at station 2**
****DC-3 is a rinse blank taken at station 3**

The Galien River Watershed Steering Committee (Steering Committee) had questions about the condition of the Watershed that the information from the inventory could not answer. The bacterial contamination near New Troy has been documented, but the committee had concerns of the impacts of large scale agricultural operations and a waste water treatment lagoon. In response to the committee members' concerns, the Berrien County Health Department (Health Department) offered to conduct preliminary sampling in certain areas to get a snapshot of the water quality problems associated with *E. coli* in the Watershed. Two employees of the Health Department visited sites selected by the Steering Committee and took three grab samples per site. The samples were tested at the Health Department's lab facility. This data will not be used to set goals for the Watershed project, but rather to identify sites of future, more focused water quality sampling to identify sources of pollution in the Watershed. Figure 9 illustrates the locations of the water sampling. The data collected by the Health Department is presented in Table 3.3.

**Table 3.3 - Berrien County Health Department *E. Coli* Sampling Results**

| | 11/27/2001 (count100 ml) | 12/04/2001 (count/100 ml) | 05/29/2002 (count/100 ml |
|---|---|---|---|
| Deer Creek @ Schwark Road, Three Oaks, Township Section 3 | | 480 | |
| Dowling Creek @ Cleveland Road, Galien Township Section 22 | | 70 | |
| Dowling Creek @ Hampton Road, Galien Township Section 8 | 103 | | 173 |
| Dowling Creek @ Olive Branch Road, Galien Township Section 22 | | 210 | |
| Dowling Creek @ US 12, Galien Township Section 5 | 120 | | 147 |
| East Branch Galien River @ Cleveland Road, Weesaw Township Section 15 | | 100 | |
| East Branch Galien River @ Glendora Road, Weesaw Township Section 6 | | 330 | |
| East Branch Galien River @ Holden Road, Weesaw Township Section 4 | | 140 | |
| Galien River @ Dayton Lake Outlet, Bertrand Twp. Section 7 | | 10 | |
| Galien River @ Gardner Road, Galien Township Section 1 | | 150 | |
| Galien River @ Glassman Road New Buffalo Township Section 31 | 77 | | 183 |
| Galien River @ Kaiser Road, Weesaw Township Section 17 | | 4300 | |
| Galien River @ Lake Michigan, New Buffalo Township Section 4 | | 150 | |
| Galien River @ Mill Road, Weesaw Township Section 7 | 227 | | 250 |
| Galien River @ Red Arrow Highway, New Buffalo Township Section 2 | 90 | | 100 |
| South Branch Galien River @ Forest Lawn Road | 157 | | |
| South Branch Galien River @ Kruger Road | | 160 | |
| South Branch Galien River @ Lakeside Road | 210 | | 187 |
| South Branch Galien River @ Martin Road | | | 437 |
| Trib to Galien River @ Log Cabin Road | 230 | | 230 |
| Trib to Galien River @ US 12 | | 300 | |

On August 25, 2001, Mr. James Ladonski, a research scientist for the Chicago Field Museum, conducted a fish seining study from the City of New Buffalo boat launch upstream past Red Arrow Highway. It was a qualitative study, recording species found. Good diversity was found, though it was noted that the habitat was somewhat uniform. Many young gobies were found, along with all the other species listed below.

- Johnny Darter
- Blackside Darter
- Banded Killifish
- White Sucker
- Central Mudminnow
- Emerald Shiner
- Bluntnose Minnow
- Smallmouth Bass
- Largemouth Bass
- Pumpkinseed
- Bluegill
- Rock Bass
- Green Sunfish
- Tadpole Madtom

- Pirate Perch
- Round Goby
- Not clearly identified species: Grass Pickerel or Small Northern Pike

A report released in March 2000 (MI/DEQ/SWQ-99/114) presented the results of bio-surveys conducted in the Watershed from August 19, 1997, to August 25, 1997. Biological sampling was conducted to assess point source and nonpoint source impacts to the streams in the Watershed. Habitat, fish communities, macro invertebrate communities, and water chemistry were examined. The 13 sampling stations were on Main Branch, Dowling Creek, the River mainstem, East Branch Galien River, Troy Meadow Drain, South Branch Galien River, Blood Run, Squaw Creek, Spring Creek, and an unnamed tributary to Spring Creek (Figure 9). Of the water bodies Galien River Main Branch, East Branch, and South Branch contain coldwater reaches.

Two sites on the River were rated acceptable, tending toward excellent, with the downstream site providing evidence of flashy flows and high sand bed load. The fish community in Dowling Creek received an acceptable rating. The macro invertebrate community was acceptable, but tending toward poor. Habitat received a good rating. In the South Branch Galien River, the fish community could not be scored, but the macro invertebrate community was acceptable tending toward excellent and the habitat was good at the first site and fair at the second. Spring Creek scored acceptable, and the unnamed tributary tended toward excellent. Blood Run and Squaw Creek macro invertebrate communities tended toward poor and habitats were rated fair. Fish diversity is low in the East Branch Galien River, with less than 1% of the total number of fish as salmonids. Macro invertebrate communities were acceptable but tending toward poor and habitat was fair. The Troy Meadow Drain had acceptable, but tending toward poor, macro invertebrate communities and habitat was rated as good.

Most of the water quality parameters were within the range of reference stream data. Nitrate and nitrite concentrations were very high at Spring Creek (0.04 mg/l). Magnesium and conductivity were higher at the Forest Lawn landfill channel than reference streams, but still within water quality standards. Levels of chromium, copper, lead, and zinc had decreased since the last survey. No conclusions as to what caused the reduction could be drawn.

## 3.3 HYDROLOGIC AND HYDRAULIC STUDY

### INTRODUCTION

Many Best Management Practices (BMPs) designed to address water quality problems in a watershed will also have an effect on the hydrology of the stream. A stream has hydrologic stability when the drainage area maintains an identical response to an identical rainfall over a long period of time. Identical response is expected if land uses, soils, and drainage characteristics within the watershed are not changing. Hydrologic changes occur when forests are cleared, artificial drainage is expanded, or impervious cover is increased, which increases the rate and duration of these flows. Changes can cause the stream to become unstable. This instability can manifest itself as streambank erosion, streambed scour, and other changes in geomorphology, including sinuosity. The more frequently occurring flows, those with a 1.5- to 2-year recurrence interval, are generally the dominant channel-forming flows in stable, natural streams.

The stream pattern of the Watershed includes many stream branches and tributaries with a meandering main channel. The River has been channelized and drained in the Elm Valley region, which is the southern, central portion of the watershed. This stretch of the River is in silty and loamy soils, which are naturally poorly drained soils and have seasonal high water tables. The area was mixed, hardwood swamp during presettlement times and was later artificially drained to allow farming.

### BACKGROUND AND PROBLEM AREAS

Both MDEQ and the Steering Committee are concerned about the stability of water courses in the Watershed. An assessment of stream stability was included in this study to ensure a longer design-life for proposed in-stream measures and to select appropriate BMPs that address the cause of the instability and do not move the problem to another location. Streams experiencing excessive instability contribute sediment to the water column, increasing turbidity, and impairing the designated uses of a stream. Changes in hydrology and flow regime, due to changing land uses and drainage patterns within the watershed, may make streams unstable.

The region of Elm Valley is a particular concern to the Steering Committee. This area is located in the south central part of the watershed, where previously existing wetlands have been heavily drained and channelized. Streambeds tend to be very sandy in this region, as noted in the MDEQ road stream crossing survey, and sediment is a serious concern. This area has undergone significant drain maintenance activities in recent decades. Problems include accelerated meandering, streambank

erosion, and loss of trees due to channel bank undercutting. This Hydrologic and hydraulic analysis includes the stretch of the River in Elm Valley and its major contributors, the Blue Jay Drain and Dowling Creek. Most of these drains were constructed while settlement was occurring in the early 1900s. Less than 20% of the drains were established after the start of World War II.

The Steering Committee is also concerned about the effects of log jams on flood levels and soil erosion. Conveyance capacities of road crossings and open channels in upper reaches of the watershed are concerns of the BCRC and the BCDC. The BCDC has removed log jams from the River upstream of Minnich Road where it is a designated county drain. In 1998, the U.S. Army Corps of Engineers (ACOE) conducted a study to evaluate the effects of log jam removal downstream from Minnich Road. They have concluded the water surface elevation at Minnich Road is raised by 0.5 to 1 foot during most storms because of the presence of log jams. However, they noted this increase in water surface elevation does not affect valuable farmland or structures. The backwater effects upstream of Minnich Road were not studied by the ACOE. Flooding of structures and valuable farmland occurs much further upstream in the Watershed as shown in Figure 12. Much of the floodplain along the River in the Elm Valley region upstream from the confluence with the East Branch of the River experiences flooding. Additional areas, located on upstream tributaries, are also flooded regularly, and some of the more frequently flooded areas are shown in Figure 12.

## HYDROLOGY AND MORPHOLOGY

### METHODS OF EVALUATION

A morphological assessment was performed using the Rosgen Level II classification system to assess the stability of the River system. Four locations in the Watershed were selected for the assessment. The parameters of the channel measured for the assessment included entrenchment ratio, width/depth ratio, sinuosity, channel slope, and channel materials.

A field inventory, conducted in the fall of 2001, revealed the most commonly identified problems as streambank erosion, log jams, and erosion at road crossings. The investigators visited every region of the River and its tributaries that was accessible from road crossings. The lower portion of the River was inventoried more thoroughly by kayak. Additional information including regions of flooding and typical duration of high water was gained from landowners, some of whom provided pictures.

A Geographic Information System (GIS) was used to study 1978 Michigan Resource Information System (MIRIS) presettlement vegetation, which is available from the Michigan Center for Geographic Information.

County drain information was made available by the BCDC. Frequent maintenance on a stream may indicate that the reach is unstable. It is not uncommon for trees to fall into the stream at the bank. The frequency of this occurrence varies widely, depending on soil type, topography, vegetation type, and flow rates. A fallen tree will cause the stream to change flow paths, but normally the stream will maintain the channel with slight alteration of the banks. It may scour the streambed below and the banks around the obstacle, creating an increased sediment load in the River (Photographs 1 and 2). This sediment load may be deposited downstream in the form of a sandbar. It may also alter a fast flowing channelized system into a slower meandering system with riffles, pools, and snags, which provide fish habitat. Major changes to flow paths and heavy sediment load are causes for concern.

Photograph 1: Fallen Tree Diverting Flow

Photograph 2: Erosion from Diverted Flow at Root Mass

Past changes in the land use the River and stream channels were examined through the USDA Farm Service Agency aerial photographs from 1981 and 1993. Digital orthophotographs with 2-meter resolution from 1996 were studied as well. Changes in land cover, such as forest clearing, wetland loss, and increased imperviousness were identified. Channel alterations, including movement of meanders, straightening, and state of bank vegetation were also noted.

## STABILITY OF THE GALIEN RIVER SYSTEM

An assessment of the morphological stability of a river system is an important step in selecting remediation techniques for water quality impairments. The Rosgen Level II classification system uses five morphological measurements for assessing a stream reach: entrenchment ratio, width/depth ratio, sinuosity, channel slope, and channel materials. The resulting classification identifies the stability of the reach of the stream, which is important to recognize whether an erosion problem is localized or systemic.

Concepts of Stream Stability

A stream is considered stable when allowed to develop a stable dimension, pattern and profile, which are maintained over time, with the stream system neither aggrading or degrading (Rosgen, 1996). A stable stream is able to transport its sediment load through local deposition and scour. Channel instability occurs when the excessive deposition leads to aggradation or excessive scour leads to degradation. A stream is considered “active” or “dynamic” when it laterally migrates but maintains its bankfull width/depth ratio.

Assessment of the Galien River System

The bankfull discharge was used in the assessment to represent the stream forming discharge or channel forming flow. Four reaches of the stream were selected according to the criteria by Rosgen, and the morphological measurements were calculated from available information. The first site selected was near the mouth of the River, where it flows into Lake Michigan at New Buffalo. The reach is in Sections 2 and 3 of New Buffalo Township. The second area selected was also a reach of the River, near New Troy, at Minnich Road. The Blue Jay Drain, a tributary of the River, was selected as the third site, in Sections 21 and 28 of Weesaw Township. Dowling Creek, another tributary to the River, was the fourth site selected, in Section 8 of Galien Township. The data and calculations to determine the classifications are included in the document, Galien River Hydraulic and Hydrologic Study, July, 2003, housed at the BCDC’s office.

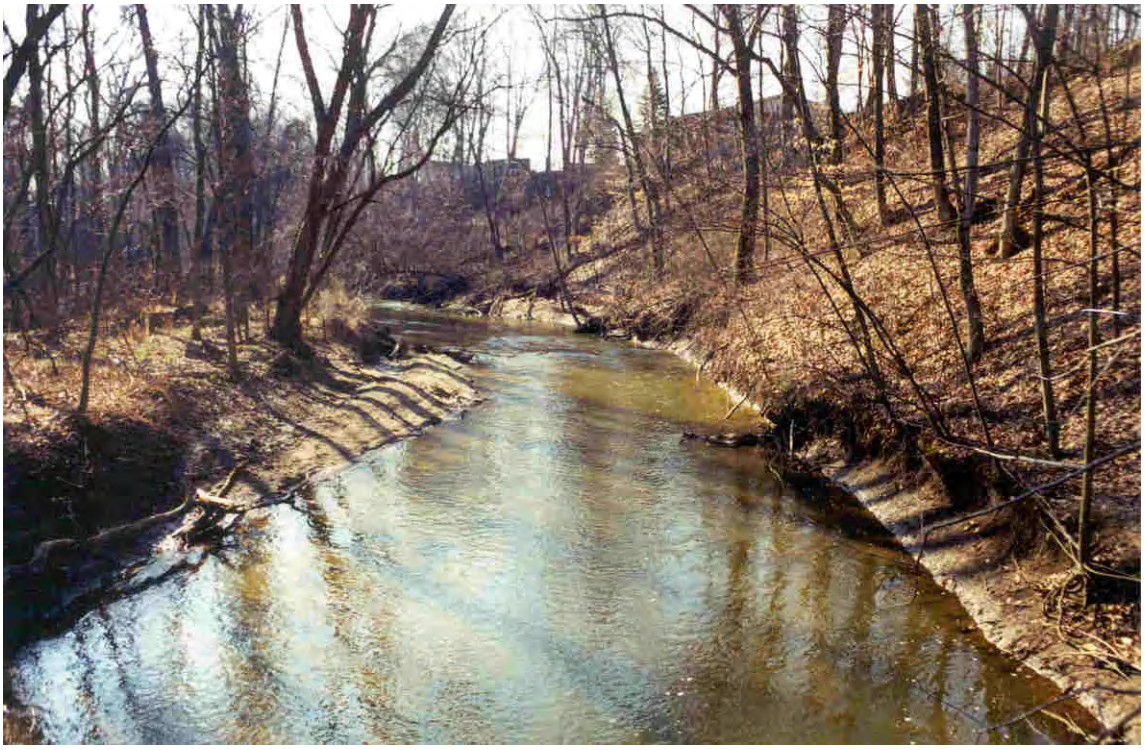
Reach 1 - Galien River Between Lake Michigan Channel and Red Arrow Highway

This reach of the River was classified as E6 (Photograph 3). An E classification represents the developmental “end-point” of channel stability and fluvial process efficiency for certain alluvial streams undergoing a natural dynamic sequence of system evolution (Rosgen, 1996). The E stream types are typically slightly entrenched (>2.2), exhibit very low channel width/depth ratios (<12), and display very high channel sinuosity (>1.5). This reach is very slightly entrenched (22), since it is mostly a low marshy area and forested floodplain. The width/depth ratio is 9.6, indicating a wide, relatively deep river. The sinuosity is not as high as a typical type E stream, calculated at 1.3, but the number does indicate meandering, which is evident in the historical photographs. The slope (0.0012) and channel materials (Aquents and Histosols) identify the stream as E6. The relatively deep channels maintain a high resistance to change, resulting in channel stability. The stability can be compromised, however, when streambanks are disturbed or significant changes occur in the sediment loads or flows.

Photograph 3: Galien River Between Lake Michigan Channel and Red Arrow Highway

Reach 2 - Galien River at Minnich Road

This reach of the River was also classified as E6 (Photograph 7). The E stream types are typically slightly entrenched (>2.2), exhibit very low channel width/depth ratios (<12), and display very high channel sinuosity (>1.5). The entrenchment ratio of 25 for a single stream indicates either a type C or E stream. The width/depth ratio of 8 indicates a wide, relatively deep river, resulting in an E classification. The sinuosity (1.4), slope, (0.0023) and channel material (Cohoctah sandy loam) yields a classification of E6. The relatively deep channels maintain a high resistance to change, resulting in channel stability. The stability can be compromised, however, when streambanks are disturbed or significant changes occur in the sediment loads or flows.



Photograph 4: Galien River at Minnich Road

Reach 3 - Blue Jay Drain Between Holden Road and Pardee Road

The Blue Jay Drain was classified as E6 (Photograph 5). An E classification represents the developmental “end-point” of channel stability and fluvial process efficiency for certain alluvial streams undergoing a natural dynamic sequence of system evolution (Rosgen, 1996). The E stream types are typically slightly entrenched (>2.2), exhibit very low channel width/depth ratios (<12), and display very high channel sinuosity (>1.5). The entrenchment of this reach is slight (6), as it is located in an area that was a Black Ash swamp in presettlement days. The channel width/depth ratio is very low (5.8), indicating that the narrow and relatively deep channels maintain a high resistance to change, which results in channel stability, unless streambanks are disturbed and significant changes in the sediment loads or flows occur. A tributary to this reach had maintenance performed in 1996, which could have added a large sediment load and increased flows to the stream, thus creating an unstable condition. The reach has moderate sinuosity (1.2). The slope (0.0009) and channel materials (silt loam) are indicative of the E6 classification.

Photograph 5: Blue Jay Drain Between Holden and Pardee Roads

Reach 4 - Dowling Creek East of Hampton Road

Dowling Creek is classified as C5 (Photograph 6). The C stream types have a well developed floodplain, are relatively sinuous, and have a low relief channel (Rosgen, 1996). Channels of these types of streams can be significantly altered when the effects of changes in bank stability, watershed condition, or flow regime are combined to cause an exceedance of the channel stability threshold. Dowling Creek is very slightly entrenched (3.3), located in the Elm Valley area of glacial outwash in the Watershed. The channel has a moderately high width/depth ratio (14) and a high sinuosity (1.21), indicative of the depositional characteristics of the stream bed and the active meandering. The slope of the channel (0.0018) identifies the reach as C5. This stream type is susceptible to shifts of stability caused by direct channel disturbance and changes in the flow and sediment regimes of the contributing watershed, but is able to recover quickly if no further disturbances occur.

Photograph 6: Dowling Creek East of Hampton Road

## FINDINGS

The reaches analyzed in this study represent different areas of the watershed that have specific land uses and various degrees of stream channel modifications. The difficulty with this analysis, however, is that significant alterations have been made to many of these areas, which are designated county drains, thus the classifications do not always fit the actual conditions. Generally, streams classified in the E category tend to be the most stable. Table 3.4 summarizes the findings of the assessment, which indicate that the River appears to be fairly stable in the lower reaches, but susceptible to streambank erosion in the upper reaches and tributaries where the channels have been altered for agricultural use.

**Table 3.4 - Results of Rosgen's Level II Classification Assessment of the Galien River System**

| Location | Galien River Between Lake Michigan Channel and Red Arrow Highway | Galien River at Minnich Road | Blue Jay Drain Between Holden and Pardee Roads | Dowling Creek East of Hampton Road |
|---|---|---|---|---|
| Entrenchment Ratio | 22 | 25 | 6.0 | 3.3 |
| Width/Depth | 9.6 | 8 | 5.8 | 14 |
| Sinuosity | 1.3 | 1.4 | 1.2 | 1.21 |
| Slope | 0.0012 | .0023 | .0009 | .0018 |
| Channel Materials | Silt/clay | Sandy loam | Silt | Sand |
| Classification | E6 | E6 | E6 | C5 |
| Characteristic | Very stable unless streambanks are disturbed or changes in sediment supply occur. | Very stable unless streambanks are disturbed or changes in sediment supply occur. | Very stable unless streambanks are disturbed or changes in sediment supply occur. | Susceptible to shifts in stability caused by channel disturbances and changes in flow and sediment regimes of the contributing watershed. |

The watershed inventory found many areas with streambank erosion caused by increased flows or obstructions diverting the natural flow path. Although many obstructions were observed in the lower reaches of the River, few areas of erosion were found, which indicates the stability of the River near the mouth.

Streambank erosion was present in the areas around New Troy, an area which also had significant numbers of obstruction and was determined to be susceptible to streambank erosion if disturbed.

Upstream areas and tributaries are susceptible to streambank erosion if flows increase from drain maintenance activities or increased development.

## EVALUATION OF MORPHOLOGY

### Galien River

A qualitative evaluation was performed on the Watershed using various sources to determine changes in the Watershed, including flow paths, geomorphology, channelization, land cover, vegetation type, canopy, imperviousness, and exposed soil. The following tasks were part of the evaluation:

- Examine survey information, including topography, land use, soils, wetlands, and presettlement vegetation, other data available, to determine geomorphologic characteristics of the watershed.

- Analyze the drainage system and review the maintenance activities performed on the county drains.

- Examine aerial photographs for changes in land cover over an approximately 15-year period, using 1981 and 1993 Farm Service Agency aerial photographs and 1996 Berrien County GIS Department digital orthophotographs.

- Examine aerial photographs for changes in stream channel and movement of meanders over a 15-year period, using 1981 and 1993 Farm Service Agency aerial photographs and 1996 Berrien County GIS Department digital orthophotographs.

The River, through most of its course, is highly meandering and equi-width from bank to bank. In forested areas, evidence of past meanders can be found, which form crescent shaped ponds and marshes adjacent to the River (Photograph 7).

Photograph 7: Past Meanders on the Galien River

Continual maintenance of the designated drains in the upper portion of the Watershed has occurred over the past decade, mainly in the form of brush removal or channel clean out. Of the 239 drains in the county, 161 (or 67%) have had improvements since 1981, with many requiring future additional work in the coming years.

The lower portion of the River, downstream of Minnich Road, has been left in a more natural state with large meanders and broad forested floodplains. The River passes through Warren Woods Preserve, which includes very unique southern floodplain forest and old growth upland forest. The relative stability of water levels and lack of fire in the Warren Woods Preserve (Preserve) has also allowed the formation of a climax of old growth upland forest in the low rises of the Preserve. The Preserve is a highly valued resource.

The River in this lower area of the Watershed has a wide floodplain and the pattern of its sinuosity has shifted over time. It is a constantly changing river with meanders that slowly move as trees fall in at the banks. Its history can be seen in the convoluted meanders and oxbow lakes (Photograph 8).

Photograph 8: Log Jams on the Galien River

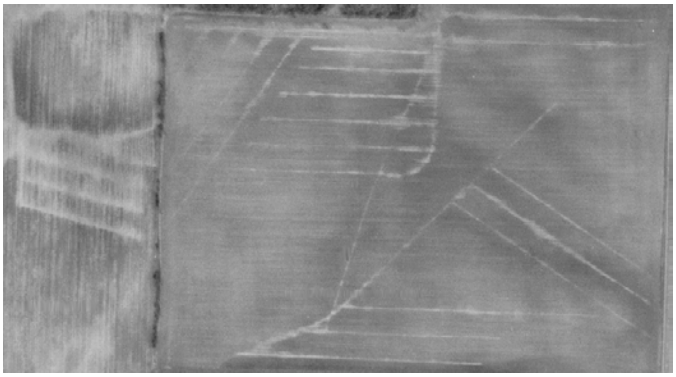
The meander in the southwest quarter of Section 13 in Chikaming Township appears to be moving toward Flynn Road. Meanders in the southwest quarter of Section 7 in Weesaw Township are decreasing (Photograph 9).

Photograph 9: Decreasing Meander of the Galien River

Tributaries

The most significant change in the natural hydrology of the Watershed was the loss of a 5-square-mile wetland in Elm Valley, located in the southern central portion of the watershed around Avery Road (Figure 8). This wooded wetland system not only stored water, but through evapotranspiration and infiltration, prevented much of the runoff from entering the stream system. Artificial drainage in the form of tiles in fields and trenched open drains has converted this wetland into cropland (Photograph 10). The major wetlands that were drained were in Galien Township, Sections 5, 6, 7, and 8, as well as Weesaw Township, Sections 31 and 32. Restoring wetlands in these areas would reduce the volume and velocity of flows. The more water stored in this region, the less flooding will occur in Elm Valley. There are some

large tracts of land that may be available to enroll in the Wetlands Reserve Program, but even small wetlands will reduce flooding. An alternative to restoring the wetlands is to reduce drainage and grow specialty crops that require or can withstand greater moisture. New developments in and upstream of Elm Valley should be required to have onsite retention and detention of storm water.



Photograph 10: Tile Network Draining Wetland of Elm Valley

### FINDINGS

- Streambank restoration work upstream of the Preserve should be selectively and carefully completed so as to not alter flows or increase sediment downstream.

- Restoring wetlands in the areas where presettlement wetlands existed, in northern Galien Township and southern Weesaw Township, would reduce the volume and velocity of flows.

- New developments, in and upstream of Elm Valley, should be required to have onsite detention or retention of storm water.

## HYDRAULIC ANALYSIS

The hydraulic analysis studied both extreme and more frequent flows to assess the conveyance capacities of the River and its major tributaries.

### GALIEN RIVER

A hydraulic model was developed to determine the bankfull conveyance capacity of a critical portion of the River.

Methodology

The ACOE HEC-RAS 3.0 computer program (HEC-RAS) was used. HEC-RAS was selected due to its universal use, availability, and acceptance as a hydraulic modeling tool. The model was used to calculate both stage and velocity of the 2-year event and larger flows for the length of the River approximately 2 miles upstream and downstream of the area of New Troy. It was also used to evaluate the backwater effects and the impacts of log jams not included in the ACOE analysis. Figure 12 shows the extent of this model, indicated as the Obstruction Study Area.

Findings

The 1-year water surface elevations in the Galien River from Warren Woods Road to Mill Road (Locations 2, 3, and 4) correlate with bankfull conditions (Figure 11). The 2-year water surface elevation at Minnich Road (Location 1) exceeds the top of bank by 3.5 feet. Often, the 2-year flow is generalized as an approximation for the channel-forming flow and bankfull discharge, but in the Watershed, these flows apparently occur every one to two years. This indicates a section of the River that may be in the process of stabilizing, although, no bank erosion was reported at this location. The peak water depths and velocities associated with the 2-year storm event at Locations 1 through 4 are listed in Table 3.5 and shown in Figure 11. The selection and placement of habitat structures, however, should be based on completed peak flows and velocities for the 10-year storm (Schueler, 2000).

The backwater effects of removing log jams downstream from Minnich Road reduced water surface elevations for about 4,000 feet upstream of Carpenter Road for the 2-, 5-, 10-, 50-, and 100-year precipitation events. The floodplain east of Minnich Road, however, is undeveloped forest, where structural or crop flooding damage is not a concern. These results agree with the conclusions in the ACOE analysis conclusions.

Log jam removal upstream from Minnich Road was completed in 1997. Landowners have reported shorter sustained flooding since the log jams have been removed, which confirms the model results.

**Table 3.5 - Depth and Velocity of Two-Year Rainfall Event Discharges**

| Location # | Peak 2-year Flow (cfs) | Actual Bankfull Height (ft) | Peak 2-year Flow Depth (ft) | Peak 2-year Flow Velocity (fps) |
|---|---|---|---|---|
| 1 | 1,500 | 6.5 | 10.0 | 1.3 |
| 2 | 1,500 | 4.0 | 4.0 | 3.1 |
| 3 | 1,100 | 7.5 | 7.5 | 2.4 |
| 4 | 850 | 10.5 | 10.5 | 1.0 |
| 5 | 250 | 10.0 | 4.0 | 2.6 |
| 6 | 70 | 8.0 | 4.7 | 1.0 |
| 7 | 70 | 10.0 | 3.0 | 2.1 |
| 8 | 70 | 10.5 | 1.9 | 3.8 |
| 9 | 70 | 5.0 | 2.9 | 1.7 |
| 10 | 70 | 5.0 | 5.4 | 0.6 |
| 11 | 30 | NA | NA | NA |
| 12 | 30 | 5.0 | 2.0 | 1.5 |
| 13 | 30 | 7.0 | 1.5 | 2.5 |
| 14 | 30 | 8.0 | 0.8 | 3.1 |
| 15 | 30 | 10.0 | 1.8 | 2.3 |
| 16 | 130 | 14.0 | 3.2 | 2.0 |
| 17 | 130 | 7.0 | 2.7 | 1.9 |
| 18 | 50 | 7.0 | 3.4 | 1.2 |
| 19 | 50 | 8.0 | 2.8 | 1.9 |
| 20 | 50 | 10.5 | 2.8 | 1.9 |
| 21 | 50 | 9.0 | 3.3 | 1.4 |
| 22 | 50 | 9.0 | 2.8 | 1.9 |
| 23 | 70 | 10.0 | 2.7 | 2.0 |
| 24 | 70 | 2.5 | 1.3 | 2.9 |
| 25 | 90 | 6.0 | 1.8 | 1.9 |

Locations 1 through 4 are modeled in HEC-RAS
All other locations modeled using the Principles of Hydraulic Design Series No. 5, Hydraulic Design of Highway Culverts (1985) as prepared for the U.S. Federal Highway Administration
NA = Not applicable

Much of the Elm Valley upstream from the confluence of the River and the East Branch of the River is farmed in the 2- to 5-year floodplain. Private drainage systems can be maintained to expedite the conveyance of water from the fields to the River once its level has gone down. Photograph 11 shows a blocked culvert that prevents drainage of water into the channel on the other side. Water will back up in the fields and overtop the driveway, causing both flooding conditions and erosion of the driveway.

Photograph 11: Blocked Driveway Culvert

## TRIBUTARIES TO THE GALIEN RIVER

### Methodology

Weesaw and Galien Townships have experienced historical flooding. *The Principles of Hydraulic Design Series No. 5, Hydraulic Design of Highway Culverts* (1985) as prepared for the U.S. Federal Highway Administration was used to evaluate the crossings. Channel conveyance was evaluated using Manning's formula. Twenty-five crossing locations were evaluated (Figure 11).

The evaluation of upstream crossings includes the following data inputs:

- Peak discharges for the 2-, 5-, and 10-year rainfall events used in the hydrologic analysis are provided by the MDEQ. The document, Galien River Hydraulic and Hydrology Study, June, 2003, details the estimates of the flood frequency discharges.

- Crossing and channel geometry are based on BCDC record drawings and BCRC culvert and bridge assessment information. FTC&H staff conducted field visits to confirm geometry and to photograph each road crossing.

- The roughness coefficients are based on channel and floodplain photographs, and the slope of the channel is from record drawings and USGS topographical maps.

The evaluation was conducted to determine if current 2-year peak flow conditions exceed bankfull conveyance capacities along tributaries to the River and the present level of flood protection.

Findings

Twenty-five sites on tributaries in the upper reaches of the River were evaluated for conveyance capacity (Figure 11). Many of the channels are much deeper than the depth that water flows during a 2-year storm. On average, the depth of flow during a 2-year event was 4 feet lower than the top of bank or about 50% of the actual channel depth. Two-year event peak velocities are reported in Table 3.5.

All but two of the crossings evaluated provide conveyance for the 5-year storm, or greater. Locations 11 and 2, shown in Figure 11, provided enough conveyance for only the 2-year storm event. Locations 3, 5, 10, 12, 13, 18, 22, and 24 provided conveyance for the 5-year storm, while all other locations provide conveyance for the 10-year storm or greater (Table 3.6).

**Table 3.6 - Upper Galien Crossing Capacity Analysis**

| Location # | Peak 2-Year Flow (cfs) | Peak 5-Year Flow (cfs) | Peak 10-Year Flow (cfs) | Capacity* (cfs) | Structure Description |
|---|---|---|---|---|---|
| 1 | 1,500 | 2,200 | 2,700 | NC | Bridge |
| 2 | 1,500 | 2,200 | 2,700 | 1,700* | Bridge |
| 3 | 1,100 | 1,600 | 2,000 | 1,656* | Bridge |
| 5 | 250 | 400 | 500 | 400 | 16'x9.5' multi-plate CMP |
| 6 | 70 | 180 | 280 | 280 | 16'x8.5' bridge opening |
| 7 | 70 | 180 | 280 | >280 | 12'x8.5' bridge opening |
| 8 | 70 | 180 | 280 | >280 | 8"x6' CMP Arch |
| 9 | 70 | 180 | 280 | 280 | 12'x6' bridge opening |
| 10 | 70 | 160 | 270 | 160 | 6'x10' elliptical CMP half full of sediment |
| 11 | 30 | 80 | 140 | 30 | 1580' LF of 36" concrete pipe |
| 12 | 30 | 80 | 140 | 80 | 48" conc. with 1' of sediment + 15" PVC |
| 13 | 30 | 80 | 140 | 80 | 150 LF of 36" concrete pipe |
| 14 | 30 | 80 | 140 | >140 | 6' CMP |
| 15 | 30 | 80 | 140 | >140 | 5'x5' concrete box culvert |
| 16 | 130 | 300 | 470 | >470 | Twin 19'-3" span x 12'-4" rise steel plate |
| 17 | 130 | 300 | 470 | 470 | 3 wood 8'x7' box culverts |
| 18 | 50 | 110 | 170 | 110 | 7' steel structural plate culvert |
| 19 | 50 | 110 | 170 | 170 | 7' steel structural plate culvert |
| 20 | 50 | 110 | 170 | 170 | 7' steel structural plate culvert |
| 21 | 50 | 110 | 170 | 170 | 7' steel structural plate culvert |
| 22 | 50 | 110 | 170 | 110 | 7' steel structural plate culvert |
| 23 | 70 | 180 | 280 | >280 | 13.8'x7.5' Concrete Box |
| 24 | 70 | 160 | 260 | 160 | 14'x6.5' Concrete Bridge |
| 25 | 90 | 140 | 230 | >230 | 13.8'x7.5' Concrete Box |

* = Capacity calculations account for tail water control of the downstream channel and crossing hydraulics.
** = According to design calculations by design engineer.
NC = Not calculated because flooding was not reported in these areas or not enough information was available.
CMP = Corrugated Metal Pipe
Location No. 4 was not analyzed.

Flooding problems have been reported at Locations 18 and 24. Photographs of Location 18 show thick brush on the channel banks (Photograph 12). Channel conveyance will approach the 10-year storm event at this location with selective brush removal. Replacing the crossing and excavating additional channel will increase this location's conveyance capacity to the 25-year event. A channel's flow capacity is related to the channel roughness. Decreasing channel roughness often results in an increase of the channel's capacity. Selective brush removal within the channel can reduce a channel's roughness and increase the channel's capacity. Proper selective brush removal can also maintain the streambank vegetative cover, which benefits the stream by both shading the stream to maintain temperatures and stabilizing the streambank from possible erosion.

Channel excavation changes both channel roughness and flow area, usually increasing the channel's capacity (Figure 13). An increase in channel and culvert capacity can create or increase downstream channel instability, often causing excessive streambank erosion. These measures to increase flow capacity should always be fully studied to ensure that the erosion and water quantity problems are not just moving downstream from the site of where improvements are made. Maintaining vegetated streambank cover downstream of stream improvement efforts lessens erosive effects that can result from these changes to the hydraulics of the stream.

Photograph 12: Thick Brush on Banks

At location 11, on a tributary to the Blue Jay Drain at Holden Road shown in Figure 11, the capacity of the 1,580 linear feet of 36-inch storm sewer limits conveyance to the 2-year event. Replacement of the 36-inch pipe with a larger diameter storm sewer or open channel could increase conveyance to the 5- or 10-year event.

## CONCLUSIONS

The following conclusions are based on the findings of the hydrologic study and hydraulic modeling:

- Restoring wetlands in the upper reaches of Dowling Creek, the Blue Jay Drain, and the River will retain water and reduce flooding in Elm Valley. Target areas to restore wetlands are Galien Township, Sections 5, 6, 7, and 8, as well as Weesaw Township, Sections 31 and 32. These areas are agricultural and eligible for many of the wetland restoration programs.

- Streambank restoration work upstream of the Preserve should be selectively and carefully completed so as to not alter flows or increase sediment downstream.

- Onsite retention or detention should be required for developments within or upstream of Elm Valley, based on stream protection volumes and flood control volumes.

- The River appears to be fairly stable in the lower reaches and the main tributaries. The instability of the River appears to be within and downstream of the agricultural areas in the western part of Galien Township and the eastern part of Three Oaks Township, where the natural hydrology of the system has been altered for agricultural drainage and the River is disconnected from the floodplain.

- Rosgen's stream classification assessment should be used when determining the types of remediation efforts to solve streambank erosion problems in the Watershed.

- Peak water surface elevations in flooded areas upstream of the confluence of Kirktown Creek will not be lowered by removing log jams in the River downstream from Minnich Road.

- Flooding in the 2- to 5-year floodplain of the River is to be expected. Private drainage systems can be maintained to decrease flood damage and provide drainage once the River stage decreases.

- Most of the crossings and channels in the upper reaches of the River provide conveyance for the 5-year event or greater. Conveyance improvements can be made by selectively removing obstructions and replacing culverts, although the effects that these improvements may have on streambank erosion and flooding downstream must be thoroughly evaluated.

## 3.4 WATERSHED INVENTORY

### METHODS

Accurate assessment of the condition of the Watershed is best done by first-hand observation. The Watershed inventory consisted of kayaking the lower reaches of the River and collecting data on the River and its major tributaries from accessible road/stream crossing sites in the Watershed. The BCDC office staff conducted the inventory during the summer of 2001, the spring of 2002, and conducted additional inventories in the summer and fall of 2002.

At each site where evidence of nonpoint source pollution was found, a data sheet was completed. Seven sources of pollutants were included on the data sheet: debris and trash, construction sites, stream crossings, rill and gully erosion, tile outlets, streambank erosion, and other types including algal blooms. At all points, basic information was recorded about the size of the stream, surrounding land use, buffers, and weather. Within each major category of pollutant were descriptive subcategories which would later be used to group and prioritize these sites.

Each site was located geographically with a Global Positioning System (GPS) unit when available, or drawn on a map. A photograph was taken to document the “before” condition of the site.

The sites were numbered using an identification system that consisted of four parts. The first part of the identification was based on the EPA Reach File 3 numbering system, which assigns a number 1, 2, or 3 digit to streams. Streams that were not numbered were given a number based on the major tributary into which it fed. For example, an unnumbered stream that flowed into reach number 867 could be numbered 8671. Unnumbered streams were given extension numbers in a consecutive manner heading upstream. The second part of the site number was the first three letters of the township. The third part was the two-digit township’s section number. The final part was a two-digit number heading upstream along the tributary. As an example, a completed site identification number in Section 07 in Bertrand Township is 255BER0701. The data collected is included in Appendix 7.

The data was verified and checked for inconsistencies and converted to a DBF(IV) file to enter as a point file into the ArcView 3.2 GIS system. Photographs were linked to the points if available. The sites of the nonpoint source pollution identified during the Watershed inventory are displayed in Figure 14.

## FINDINGS

A summary of the inventory findings is shown in Table 3.7. The most abundant sources of pollution or impairments in the Watershed were road/stream crossings and debris. The overwhelming majority of the debris sites were due to log jams, which have been noted as particularly abundant in this Watershed. Numerous road/stream crossing problems were found in relation to the other sources, since most of the observations were recorded directly upstream and downstream of the crossing. Other inventory methods, such as wading in the streams, would likely reveal many more instances of rill and gully erosion, streambank erosion, tile outlet erosion, or illicit discharges. Additional stream wading was done in the summer and fall of 2002 and completed in the spring of 2003. Findings from these inventories will be included in future revisions of the WMP.

**Table 3.7 - Summary of Galien River Watershed Inventory**

| Type of Pollution or Impairment | Severe | Moderate | Low | Total |
|---|---|---|---|---|
| Cattle Access | | 2 | | 2 |
| Erosion | 28 | 38 | 12 | 78 |
| Illicit Discharge | | 1 | 1 | 2 |
| Obstructions | 10 | 23 | 33 | 66 |
| Runoff | 5 | 7 | 4 | 16 |
| Sediment | 6 | 5 | 1 | 12 |
| Trash | 2 | 10 | 3 | 15 |
| Turbidity | 4 | 9 | 33 | 46 |
| Vegetation Disturbance | 2 | 4 | 1 | 7 |
| **Total** | **57** | **99** | **88** | **244** |

*Currently there are 184 inventory sites

Two major types of problems were associated with tile outlets: erosion and discharge. The tile outlet may cause erosion if the placement is too high and water falls a great enough distance to gouge the stream bottom. Additionally, if water rises, eddy currents form around the outlet and the area around the outlet erodes. In some cases outlet discharge was a source of pollution having black or milky water with a foul odor.

Although only five unlimited livestock access locations were found, four of these sites included over 100 feet of eroded streambanks, which contributed excessive amounts of sediment and nutrients to the stream.

Livestock traffic can denude vegetation and can compact or scour soils in surrounding streambanks. This can accelerate or increase erosion since it creates unstable soil conditions. Another concern with livestock is the chance of the excrement being immediately discharged in the watercourse.

## 3.5 DESIGNATED USES OF THE GALIEN RIVER WATERSHED

The following designated uses have been assigned by the State of Michigan for all “waters of the state.” The status of the below uses and whether the Watershed is meeting the use criteria is shown in Table 3.8.

**Table 3.8 - Designated Uses**

| Designated Use | Meeting Use | Threatened Use | Impaired Use |
|---|---|---|---|
| Partial body contact recreation | | | X |
| Total body contact recreation | | | X |
| Warmwater fishery (coldwater) | | | X |
| Other indigenous aquatic life and wildlife | | | X |
| Navigation | | | X |
| Agriculture water supply | | | X |
| Industrial water supply* | | | |
| Public water supply* | | | |

*Not identified as a designated use in the Watershed by the Steering Committee

- **Partial Body Contact Recreation** includes activities where some skin contact is made with the water, but generally not submersion. Fishing and boating are examples. Water quality must meet minimum standards for health and safety reasons. For example, *E. coli* must be below 1,000 count per 100 ml.

- **Total Body Contact Recreation** includes activities such as swimming, when prolonged exposure to the water and contact with most of the body exists. Safety concerns arise when eyes and nose are submerged in the water or the possibility of ingestion exists. The season to consider is May 1 to October 31, when water quality monitoring for pathogens, chemicals, and *E. coli* (which must be below 130 count per 100 ml as a 30-day geometric mean) is important for assurance of public safety.

- **Warmwater Fishery** must allow warmwater fish, such as bass, pike, walleye, or panfish to live in these waters. Not only is water quality a concern, but temperature and habitat should also be maintained. Dissolved oxygen should not fall below 7 mg/l for rivers and streams. Populations should be sustainable so all needs for various stages of the life cycle must be considered.

- **Coldwater Fisheries** must not have summer temperatures that cannot sustain trout (typically about 50°F to 60°F not to exceed 68°F). Habitat is also important to maintain.

- **Other Indigenous Aquatic Life and Wildlife** is similar to warmwater fishery in considering water quality. Habitat concerns include floodplains and forests. Large contiguous areas of forest, wetlands, etc., are important for many species. Fragmentation of habitats cuts wildlife areas into smaller non-contiguous pieces.

- **Navigation** in a watershed is identified for areas that would be of interest to boaters and fishers. Areas with pleasant viewscapes and sufficient flow are usually targeted.

- **Agriculture** can pertain to irrigation and livestock watering. Agriculture is considered an important part the Watershed used for irrigation. Water quality and quantity must be maintained for all uses to be feasible and not health hazards.

- **Industrial Water Supply** concerns are temperature, clarity, and water quality for efficient production with water use.

- **Public Water Supply** must be protected if municipalities draw their drinking water from a surface water source.

## IMPAIRMENTS TO DESIGNATED USES

The following pollutants and impairments have had the greatest impact on the designated uses in the Watershed. The linkages between the designated uses, impairments, sources, and causes are summarized in Appendix 8.

*E. coli* bacteria is an indicator of other pathogens in the water. Current TMDL studies in the Watershed concluded that agricultural runoff and illicit discharges are likely the primary sources of *E. coli* to the River. Storm water runoff could also be a source in the more urbanized areas. *E. coli* is impairing the designated uses of partial and total body contact recreation and agriculture for livestock watering.

Sediment originates from streambank erosion, cropland runoff, and runoff from unimproved roads. Log jams in the Watershed have caused excessive streambank erosion, which results in more trees falling in the river. Unlimited livestock access at numerous sites also adds to the sedimentation of the stream. In some areas, groundwater seeps cause the toes of the slopes to fail, thus creating unstable streambanks. Sediment is impairing the warmwater and coldwater fisheries by covering the substrate and degrading the spawning habitat. Sediment is a minor impairment to agriculture for irrigation, since excessive sediment can clog intake pipes and reduce efficiency. The Watershed inventory identified many road/stream crossings that were eroding and adding sediment to the stream.

Elevated nutrients in surface waters results in the overpopulation of select aquatic plant species that are able to absorb nutrients, grow quickly, and adapt to changing conditions. The presence of excess nutrients and algae impairs partial body contact recreation by creating unsightly conditions of the waterways. Excess nutrients impair warmwater and coldwater fisheries by decreasing the dissolved oxygen in the water when oxygen is consumed to aid in the decomposition of the plants. Overabundance of exotic aquatic plant species crowd out other indigenous species, changing the balance of the system.

Much of the River is clogged with log jams and debris, which cause extensive streambank erosion and an impassible navigational course. A few properties that traverse the River are delineated by cables strung across the River. These cables often catch debris floating down the River and create an obstruction. Instances of illegal dumping were recorded in the inventory. Tires, appliances, trash, and other debris are not only unsightly, detracting from recreational enjoyment, but are also often a hazard to recreationists and can potentially leach contaminants into rivers and streams.

Changes in flow patterns, especially increased peak flows and decreased attenuation, have caused multiple problems in the lower reaches of the Watershed. Development and wetland destruction increase the amount of impervious surfaces in the Watershed. Storm water runoff reaches the streams faster and with greater volume than if allowed to seep into the ground. A greater amount of water enters the stream, eroding the banks and causing flooding. Fluctuations in water levels and velocities damage fish and wildlife habitats by changing the physical characteristics of the stream. The fluctuations also affect recreation, such as fishing, boating, and swimming, occasionally creating treacherous or unmanageable conditions.

Chemicals from pesticides and fertilizers intended to eradicate insects on lawns and crops are often captured in rainwater and washed into the streams. Indigenous aquatic species are affected as well as other wildlife. The abundance of orchards and crops in the area increase the potential for chemicals to impair the designated uses of supporting indigenous aquatic life and other wildlife, warmwater fisheries, and coldwater fisheries.

Increased temperatures can quickly degrade a coldwater fishery by creating temperatures above the limits of what the species can endure to be productive. The removal of riparian vegetation for agricultural and rural residential land use is evident in the Watershed. When cover vegetation is removed sunlight can warm stream water significantly.

A few species have been identified in the Watershed that are considered invasive and a threat to the indigenous aquatic life and the unique ecosystems found in Warren Woods. Road fill is often trucked from sites that contain seeds of these invasive species and are spread when the fill is used in other areas. Boats and bait buckets can transfer species from water body to water body. The extensive drainage network that exists in the Watershed also acts as a conduit for many of these species.

Urban storm water runoff, especially from roads with heavy traffic, often contain heavy metals. These compounds become bound to sediment and are absorbed by macro invertebrates and other aquatic organisms. The metals may have toxic effects on these organisms, especially in industrialized areas. Mercury bioaccumulates in fatty tissue and fish may contain such high levels of mercury, that they become toxic to predators or are unfit for human consumption.

## PRIORITIZATION PROCESS

The Technical Committee in attendance on December 13, 2001, discussed the prioritization of the designated uses that were identified by the Steering Committee. The members ranked the categories, and the results were averaged. Based on the above descriptions, the Technical Committee ranked the designated uses as shown in the following table. The Steering Committee reviewed the ranking and provided comments. The impairments to each designated use were then prioritized using a worksheet detailing pollutants and their sources (Appendix 8). The prioritization summary is presented in Table 3.9.

**Table 3.9 - Priority Ranking of Designated Uses**

| Designated Use | Mean | Tech No.1 | Tech No.2 | Tech No. 3 |
|---|---|---|---|---|
| Partial body contact recreation | 1.67 | 1 | 3 | 1 |
| Warmwater fishery (coldwater) | 1.67 | 2 | 2 | 1 |
| Other indigenous and aquatic wildlife | 3.33 | 4 | 1 | 5 |
| Navigation (partial) | 3.67 | 3 | 4 | 4 |
| Total body contact recreation (May 1 to October 31) | 4.33 | 5 | 5 | 3 |
| Agriculture (irrigation) | 6 | 6 | 6 | 6 |
| Industrial water supply | 7 | 7 | 7 | 7 |

## DESIRED USES

The community has expressed concerns over many natural features that are threatened in the Watershed. Many valuable assets, such as Warren Woods, are found in the Watershed and it is recognized that they must be preserved. The following are desired uses of preservation in the Watershed.

- Threatened and Endangered Species Preservation
- Warren Woods and the River Corridor Preservation
- Members of the Steering Committee suggested that Warren Woods boundary should be expanded and the bridge replaced.

- Forest floodplains and other natural resources preservation

- Development pressures are encroaching on the River corridor and are threatening species habitat. Forest floodplains are jeopardized not only by development pressures, but also by altered hydrology and alluvial sediment deposits. Therefore, floodplain development must be prohibited.

- The tenets of "Smart Growth@ stem from the idea that communities are growing in a manner that degrades the natural resources and the overall quality of life. Unplanned growth ultimately degrades the overall quality of the economy, environment, health, housing, and transportation. The Steering Committee aims to create a balanced community through holistic analysis, asset recognition, setting sustainable goals, and cooperation.

## 3.6 WATER QUALITY SUMMARY

### GOALS AND OBJECTIVES

In order to provide direction, the Technical Committee set, and the Steering Committee approved goals and objectives, shown in Table 3.10. The goals were based on the impairments to the designated uses and improving water quality of the River. They were then prioritized through a discussion and voting process to ascertain the most important issues with regard to each designated use. The objectives were created by examining the goals and determining how these goals would be met. The objectives described sources and methods of meeting the goal with thought given to land use and management practices as well as socio-political and environmental influences. All goals and objectives are intended to address not only the current situation of the River, but also to continue to improve water quality and watershed conditions over time.

### COORDINATION OF PLANNING IN THE WATERSHED

Many parties have a vested interest in the future of the Watershed and must communicate so efforts can be coordinated and compatible. A goal of the Steering Committee is to act as a means of communication among these parties and form the most efficient plan with coordination among the partners.

**Table 3.10 - Water Quality Goals and Objectives**

| Designated Use | Goal | Objective |
|---|---|---|
| **#1** - Partial body contact recreation<br><br>(fishing, boating) minimum water standard E. coli - 1,000 count/100 ml | **#1** - Prevent increases in E. coli levels to keep below Michigan water quality standard of 1,000 count/100 ml for fishing and boating | Find sources from residential areas and prevent from entering surface waters |
| | | Find sources from agricultural areas and implement BMPs to prevent contamination of surface waters |
| | **#2** - Prevent excessive nutrient loading | Increase filter strips and fencing |
| | | Encourage nutrient management |
| | **# 3** - Maintain integrity of existing filter strips and conservation areas | Encourage townships to implement planning resource-based |
| | | Offer tax incentives for conservation areas |
| | **#4** - Remove obstructions and garbage in identified problem areas | Jail crew remove log jams |
| | | Volunteer groups for stream clean ups |
| | **#5** - Restore natural hydrology | Follow recommendations from hydrologic model |
| **#2** - Warmwater fishery<br><br>(bass, pike, walleye) minimum water quality standard DO ≥ 7 mg/l | **#1** - Maintain existing habitat and improve areas for habitat | Continue fish monitoring including a creel census |
| | | Offer tax incentives for conservation areas |
| | **#2** - Prevent excessive sediment loading[2] | Improve SESC BMPs of the BCRC |
| | | Remove log jams causing flow diversions and streambank erosion |
| | **#3-** Prevent excessive nutrient loading[2,7] | Increase filter strips and fencing |
| | | Encourage nutrient management |
| | **#4** - Restore natural hydrology | Follow recommendations from hydrologic model |
| | **#5** - Prevent chemical contamination | Publish results of MDEQ monitoring to define problems |
| | **#6** - Maintain stable temperatures | Establish volunteer monitoring programs to isolate problem areas |
| **#3** - Coldwater fishery<br><br>(S. Branch - from Martin Road downstream to Forest Lawn, by landfill) | **#1** - Maintain coldwater temperatures | Maintain or increase canopy by not clearing south and west sides of drains |
| | **#2** - Prevent excessive sediment loading | Improve SESC BMPs of the BCRC |
| | | Promote riparian buffers |
| | | Remove log jams causing flow diversions and streambank erosion |

**Table 3.10 - Water Quality Goals and Objectives**

| Designated Use | Goal | Objective |
|---|---|---|
| **#4** - Other indigenous aquatic life and wildlife (habitat condition and continuity) | **#1** - Maintain existing healthy ecosystems and improve areas for other wildlife habitats | Preserve riparian corridors |
| | | Use proper drain maintenance techniques |
| | **#2** - Maintain management practices for controlling invasive/exotic species and prevent more from entering<br><br>(Purple loosestrife, garlic mustard, zebra mussels, rusty crayfish, reed canary grass) | Encourage native plantings |
| | | Distribute educational brochures |
| | | Identify sites of high population of invasive species and remove by hand |
| | **#3** - Prevent excessive sediment loading[2] | Improve SESC BMPs of the BCRC |
| | | Promote riparian buffers |
| | | Remove log jams causing flow diversions and streambank erosion |
| | **#4** - Prevent excessive nutrient loading[7] | Increase filter strips and fencing |
| | | Encourage nutrient management |
| | **#5** - Restore natural hydrology | Follow recommendations from hydrologic model |
| | **#6** - Prevent chemical contamination | Publish results of MDEQ monitoring to define problems |
| | **#7** - Prevent heavy metals from entering surface waters | Implement storm water management practices |
| | | Harvest of cattails, etc. that absorb metals |
| **#5** - Navigation<br><br>(partial reaches of Galien) | **#1** - Restore open channels by selectively removing obstructions | Identify partial reaches for navigation for future potential use |
| | **#2** - Maintain water levels high enough for navigation | Restrict irrigation in certain areas where flow must be maintained |
| **#6** - Agriculture<br><br>(irrigation and livestock watering) | **#1** - Prevent increases in E. coli levels | Find sources from residential areas and prevent from entering surface waters |
| | | Find sources from agricultural areas and implement BMPs to prevent contamination of surface waters |
| | **#2** - Restore natural hydrology | Follow recommendations from hydrologic model |
| | | Remove log jams causing flow diversions and streambank erosion |
| | **#3** - Prevent excessive sediment loading[2] | Improve SESC BMPs of the BCRC |
| | | Promote riparian buffers |
| | **#4** - Reduce flooding impacts[1] | Identify floodplain for townships to use in developing ordinances |

**Table 3.10 - Water Quality Goals and Objectives**

| Designated Use | Goal | Objective |
|---|---|---|
| **#7** - Total body contact not historically a use in the Galien River<br><br>(swimming at New Buffalo public beach between May 1 and October 1) | **#1** - Prevent increases in E. coli levels to keep below Michigan water quality standards of 300 count/100 ml for swimming | Find sources from residential areas and prevent from entering surface waters |
| | | Find sources from agricultural areas and implement BMPs to prevent contamination of surface waters |
| | **#2** - Prevent excessive nutrient loading[7] | Increase filter strips and fencing |
| | | Encourage nutrient management |
| | **#3** - Prevent petroleum products from entering surface waters | Monitor storm water runoff and manage |
| | ***#4*** - Prevent chemical contamination | Publish results of MDEQ monitoring to define problems |
| **#8** - Industrial water supply | **#1** - Prevent excessive sediment loading[2] | Monitor BCRC SESC |
| | | BMPs |
| | | Promote riparian buffers |
| | | Remove log jams causing flow diversions and streambank erosion |
| | **#2** - Prevent excessive nutrient loading[7] | Increase filter strips and fencing |
| | | Encourage nutrient management |
| | **#3** - Restore natural hydrology | Follow recommendations from hydrologic model |
| | **#4** - Prevent chemical contamination | Publish results of MDEQ monitoring to define problems |

1. Johnson, Cathy. 2001. Natural Resources and Conservation Directions. Berrien County, Michigan - Chikaming, Galien, Lake, New Buffalo, Three Oaks, and Weesaw Townships. Prepared for Chikaming Open Lands
2. Michigan Department of Environmental Quality, Surface Water Quality Division. A biological and physical assessment of the Galien River Watershed, Berrien County, Michigan. August 19-25, 1997.
3. Inventory conducted by Ms. Anne Hendrix and Mr. Mike Mahler of the Office of the Berrien County Drain Commissioner, August-October, 2001.
4. Quote of Spike Bruce in “Galien River Log Jam Clearing Begins” by Stan Maddux in the South Bend Tribune.
5. Observations during Galien Watershed Tour, October 2001.
6. Technical Team discussions.
7. MDEQ – SWQD, GLEAS, 303(d) list.

## INITIAL WATER QUALITY STATEMENT

The water quality of the River and its tributaries impairs many of the designated and desired uses due to nonpoint source pollution. The River, the East Branch of the River, and Deer Creek have been placed on the MDEQ 303(d) list of impaired waters. Identified pollutants include, pathogens, sediment, and excess nutrients. Biological surveys conducted by the MDEQ have found a number of the stream reaches have poor macro invertebrate communities. Sedimentation of streambeds, increased water temperatures, and the limited numbers of macro invertebrates impairs fisheries.

The 303(d) listings for a 2-mile portion of the River and a 7-mile segment of Deer Creek require that the TMDL reaches be monitored for *E. coli* bacteria and measures be taken to meet water quality standards for *E. coli.* High levels of *E. coli* in the past has forced the Health Department to close public beaches generating a negative public attitude about the safety of recreation in the Watershed. Livestock access and failing septic systems are suspected sources of bacterial contamination. Ironically, the same livestock that may be contributing to this pollution are also highly susceptible to sickness caused by pathogens in their drinking water. Potential pathogen sources impairing Deer Creek are suspected to be from storm water from the Village of Three Oaks, illicit connections, sewage over flows, and agricultural inputs.

The water quality statement includes many interconnected sources of nonpoint source pollution. Focus on reducing one source of pollution may have positive effects on reducing another pollution. The impairments were prioritized using a worksheet and the designated use ranking (Appendix 8). The Water Quality Summary ranks the impairments from the highest to the lowest priority.

**Known Impairment:** ***E. Coli***

Description: *E. coli* has been a documented problem in the River, the East Branch of the River, and Deer Creek. The health risks this bacteria poses necessitates its inclusion in this plan to prevent *E. coli* from being a continual problem.

Suspected Sources: *E. coli* is found in the digestive system of warm-blooded animals and is spread through feces. The detection of *E. coli* often indicates that other dangerous types of bacteria might be present. *E. coli* cannot live for long periods of time outside of a host body, therefore, when found in surface water, the source must be relatively close. Potential sources include livestock in the stream, wildlife, septic systems, and manure storage areas.

Suspected Causes: Unlimited access to streams allows livestock and wildlife to spread bacteria. Leaking and undersized septic systems allow *E. coli* to enter water bodies. Leaching or overflowing manure storage areas can also add bacteria to the streams.

Priorities: *E. coli* can cause serious illnesses in humans and animals, and is therefore a high priority impairment to agriculture and partial and total body contact recreation. *E. coli* affects many designated and desired uses and a TMDL goal has been established to meet the Total Body Contact Recreation designated use. Therefore, *E. coli* is the number one pollutant to the top ranked designated use and it has been placed at the top of the impairment list.

Goal: Prevent *E. coli* from entering surface waters and strive to meet applicable water quality standards.

Objectives: Encourage continual testing and selective monitoring in high risk areas.
Create a volunteer monitoring program.
Limit livestock access to high risk areas.
Form a committee to lead/coordinate TMDL implementation.
Encourage proper management of manure storage areas.
Encourage proper installation and maintenance of septic systems.

**Known Impairment: Degraded habitat**

Description: Many areas, especially in the southwest of the Watershed, are developing rapidly, taking large tracts of forest and cropland out of the ecosystems. Many species, including the state threatened Yellow Throated Warbler, are reliant on large tracts of territory and/or migration corridors. Land use changes downsize these areas and wildlife may be forced onto fringe lands. This can lead to conditions where wildlife takes on new niches that may conflict with new land uses. Fringe species may now have access to forest communities that cannot compete in this new habitat.

The other problem associated with the degradation of habitat is the loss of riparian corridor canopy. Buffers around stream corridors not only provide shade to maintain cool water temperatures, they also filter nutrients and sediments from entering the stream. Sediments cover sand and gravel beds that are essential spawning grounds for walleye and trout.

Known Sources: Development of large tracts of land are disrupting continuous areas of riparian corridor habitat.

Suspected Causes: Lack of planning for controlled growth causes haphazard development to occur in the Watershed.

Priorities: Preventing fragmentation of habitat is a high level priority to warmwater fisheries, indigenous aquatic life, and wildlife.

Goal: Minimize habitat fragmentation, promote the use of buffer strips, and discourage clearing of stream canopy on the south and west sides of county drains if maintained.

Objectives: Encourage riparian buffers.
Encourage townships to adopt responsible land use planning ordinances.
Create tax incentives for conservation easement.

**Known Impairment: Sediment**

Description: Excess sediment covers riffles, destroys spawning habitat, and causes turbidity.

Known Sources: Sediment comes from both upland and in-stream sources. Cropland, construction sites, gullies, and stream crossings were identified as sources.

Known Causes: Conventional tillage practices that leave soil exposed to water and wind erosion cause erosion. Exposed soil erodes from construction sites where proper SESC practices are not installed or maintained. Active gully erosion on fields without filter strips or stabilized outlets adds sediment to the stream. Unrestricted livestock and vehicle access to the stream causes streambank erosion.

Priorities: Sediment is a high priority impairment to warmwater and coldwater fisheries. It is a medium level priority to other indigenous aquatic life and agriculture. It may pose a threat to industrial water use in the future.

Goals: Prevent soil erosion and reduce sedimentation in river and streams.

Objectives: Increase use and quality of filter strips and windbreaks.
Encourage cover crops.
Promote no-till farming.
Review SESC inspection and enforcement.
(See objectives under the degraded habitat section)

**Known Impairment:** **Nutrients**

Description: Excess nutrients, such as phosphorus and nitrogen, cause eutrophication, a cycle which depletes oxygen and increases plant growth to an extent where many species cannot survive. Algae grows at a rapid rate due to the excess nutrients, mainly phosphorus. The algae settles on slow moving stream bottoms as it dies and forms a thick layer of organic matter. The decomposition process depletes oxygen, causing anoxic conditions which creates methane. The process destroys the balance of water chemistry and food webs.

Known Sources: Nutrients in fertilizers used in agricultural applications, residential applications, and landscaping enter the river and streams in storm water runoff. Nutrients concentrated in human and animal wastes are introduced into surface waters through leaking manure storage areas, failing septic systems, and direct discharges from livestock access or runoff. Yard waste, especially leaves and grass clippings, dumped in the waterways decompose quickly into available nitrogen and organic matter, adding to the nutrient levels.

Known Causes: Improper fertilizer and manure application and storage allow nutrients to enter surface water and groundwater. Septic system failures and direct discharges are a speculated contributor. Yard wastes piled on the banks of streams may blow directly into the water adding nutrients or enter during a flooding event. Lack of buffer strips in agricultural and residential areas allow unfiltered field runoff to enter streams and drains.

Priorities: Nutrients are high priority impairments to partial and total body contact recreation and warmwater fisheries. They are medium priority impairment to other aquatic life and wildlife in the Watershed.

Goal: Reduce nutrient (especially phosphorus) loading.

Objectives: Encourage Nutrient Management Plans and increase the use of filter strips and cattle exclusion fencing.
Use integrated crop management.
Practice better manure utilization.
Address residential septic systems.
Provide educational brochures.

**Known Impairment:** **Flow**

Description: Changes in flow affect water levels and the rate of water movement. Flashy flows, signified by swift moving high water shortly after a rain and very low levels during dry periods, can be the result of increased artificial drainage. Changes in land use can increase flooding, erosion, and sedimentation.

Known Sources: Alteration of drainage patterns and changes in land use affect the natural hydrology of a stream.

Known Causes: Establishment and improvements of drains, elimination of wetlands, and increases of impervious surfaces destabilize hydrology.

Priorities: Flow is a high priority impairment to navigation and agriculture. It is a medium priority impairment to warmwater fisheries and partial body contact recreation. It may also affect the future use of the Watershed as an industrial water supply.

Goal: Stabilize stream flows to moderate hydrology and increase base flows.

| | |
|---|---|
| Objectives: | Restrict or limit irrigation in areas where flow must be maintained.<br>Work with townships to create planning ordinances that limit impervious surfaces.<br>Establish irrigation scheduling.<br>Encourage wetland restoration programs and conservation easements. |
| **Known Impairment:** | **Obstructions** |
| Description: | Obstructions in the Watershed include log jams, trash and debris, and sediment. These obstructions impair navigation for recreational boaters, and in some cases divert stream flow into the banks causing further erosion to undercut even more trees. |
| Known Sources: | Organic sources, such as fallen trees and branches, either fall from the streambanks or are washed down during high flows. Trash and debris is intentionally dumped in the stream or can also be washed down in high flows. Cables, representing property lines, strung across the River may block navigation or catch floating debris. Sediment can accumulate in culverts or the culvert may be too small to allow boaters safe passage. |
| Suspected Causes: | Streambank erosion causes trees to fall in the river. Illegal dumping and lack of enforcement perpetuate the problem of trash in the River. Sediment from bank erosion and runoff. |
| Priorities: | Obstructions are high level impairments to navigation and partial body contact recreation in Galien River. |
| Goals: | Restore recreational boating to designated reaches of the Galien River and to prevent damage to streambanks from log jams. |
| Objectives: | To identify and remove high priority obstructions that are completely blocking navigation or causing streambank erosion.<br>Identify partial reaches for navigation.<br>Work with BCRC to repair and replace culverts.<br>Volunteer river clean-ups. |

**Known Impairment:** **Invasive species**

Description: Invasive species, specifically zebra mussels, garlic mustard, and Eurasian water milfoil, have been found in the Watershed. In fringe areas, the Brown-headed cow bird has been a threat to song birds.

Known Sources: Invasive species are spread by physical transport, such as on boats and cars, or through environmental sources such as wind, on birds, and on or inside other animals. Garlic mustard can be spread unintentionally by using offsite fill dirt that contains viable seed banks.

Suspected Causes: Unstable or disturbed areas are more susceptible to invasion than healthy ecosystems. Lack of knowledge about invasive species often spreads them unintentionally. The extensive drain network in the Watershed has acted as a conduit for invasive aquatic species.

Priorities: Invasive species are a high level priority impairment to indigenous aquatic life and wildlife.

Goal: Minimize spread of exotic species.

Objectives: Increase public awareness about exotic species transport and its effects.
Encourage planting native vegetation.
Distribute educational brochures.
Identify sites of high exotic populations and physically remove them.

**Suspected Impairment:** **Temperature**

Description: Temperature is significant to coldwater fisheries. Coldwater fish species require water temperatures to remain below 68°F during summer months. Temperature is also a minor priority to warmwater fisheries.

Suspected Sources: Surface runoff, especially near parking lots and heavily paved areas, contributes warmwater to streams. Limited groundwater gains to the stream and low base flows prolong exposure to summer heat and solar radiation. Lack of streamside vegetation also exposes the water to solar radiation.

Suspected Causes: Increases in impervious surfaces reduces infiltration, causing low base flows and increased water temperatures. Excessive irrigation also causes low flows which increase temperatures. Removal of streamside vegetation eliminates shading from the sun.

Priorities: Coldwater species need summer water temperatures below 68°F; therefore, temperature is considered a high priority impairment to the coldwater fishery. It is a medium priority impairment to warmwater fisheries.

Goal: Maintain coldwater fishery.

Objective: Minimize impervious surfaces, low base flows, and open riparian canopies.
Preserve riparian shade using planning ordinances.
Limit impervious surfaces or require retention ponds in new development.
Establish irrigation scheduling.
Promote the planting of trees using the annual Conservation District Tree Sale.

**Suspected Impairment:** **Aesthetics**

Description: Aesthetics create a positive attitude in recreational users of the Watershed. This positive attitude translates into enthusiastic stewardship and participation in recreational activities in the Watershed. Aesthetics are essential for maintaining a tourism industry in Berrien County.

Suspected Sources: Development of riparian areas and clearing of buffer vegetation.

Suspected Causes: Lack of riparian protection in land use/planning ordinances.

Priorities: Aesthetics are a medium priority for navigational uses of the Watershed.

Goal: Restore and protect riparian areas in designated navigation areas.

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| Objective: | Improve township ordinances that offer little protection for riparian corridors.<br>Conservation easements.<br>Greenbelt protection specifications.<br>Model development ordinance. |
| **Suspected Impairment:** | **Hydrocarbons** |
| Description: | Hydrocarbons, usually from automotive petroleum products, contaminate fish and macro invertebrate populations and may travel great distances downstream. |
| Suspected Sources: | Irrigation pumps and other machinery along the banks of the streams can leak fuel and oils. The main suspected source for the Galien Watershed is runoff from parking lots and streets and illegal dumping of motor oil into storm drains. |
| Suspected Causes: | Old, inefficient, leaking, or faulty pumps and machines that release petroleum by-products into the river. Cars that leak oil or gas onto impervious surfaces. Lack of knowledge about the ultimate discharge of storm drains. |
| Priorities: | Hydrocarbons are a medium priority to total body contact recreation. |
| Goal: | Reduce potential for hydrocarbon contamination. |
| Objective: | Switch to electric or solar powered pumps.<br>Evaluate fuel storage facilities through Farm*A*Syst.<br>Use of storm drain stencils.<br>Public education announcements in newspaper and radio. |

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| **Known Impairment:** | **Chemicals (PCBs)** |
| Description: | Many types of chemicals may find their way into streams either intentionally or by accident. Polychlorinated biphenyl and other fat soluble chemicals can accumulate in the fatty tissue of fish and other wildlife making them toxic to large predators or even humans. Pesticides used for control of insects and weeds in agricultural areas pose the greatest threat to wildlife in the Watershed. |
| Suspected Sources: | Historical PCB contamination is still in sediment. Improper storage, transport, or application of chemicals. Runoff from parking lots and impervious surfaces may contain anti-freeze, yard care products, or improperly contained chemical spills. |
| Suspected Causes: | Runoff from agriculture is the most likely cause for contamination. Over application of pesticides or application just before a rain event can cause runoff of the pesticide into drain systems and eventually into rivers and streams. |
| Priorities: | Chemicals are a medium priority to warmwater fisheries, total body contact recreation, and industrial water supplies. |
| Goal: | Reduce potential for chemical contamination. |
| Objective: | Improve pesticide application techniques.<br>Monitoring by the MDEQ may define problems.<br>Offer education to agricultural operators interested in proper application technology.<br>Educate land owners about dangers of chemical contamination. |

**Known Impairment:** **Flooding**

Description: High water velocity and ponding of water can do severe damage to vegetation and streambanks. Flooded soils can suffocate roots and create soil surfaces that are too soft for farm equipment. Flooding waters also transport debris, trash, logs, and exotic species throughout the Watershed. Once waters subside, streambanks can be bare, sediment has been deposited, stream paths could be altered, and crops are destroyed.

Known Sources: Flashy streams, inadequately sized culverts, obstructions, and floodplain development.

Known Causes: Loss of wetlands reduces a watershed's capacity to store water. Improved drainage and impervious surfaces speed the velocity and volume of water that passes through the Watershed. Construction and farming in the floodplain can turn a natural occurrence into a disaster.

Priorities: Flooding is a medium priority to agriculture and a low priority to aquatic life and wildlife.

Goal: Reduce impacts of flooding.

Objective: Promote the use of Conservation Reserve Program (CRP) and Wildlife Habitat Incentive Program (WHIP).
Work with BCRC to repair or replace culverts.
Develop township ordinances that prohibit development in floodplains.
Complete the Federal Emergency Management Agency mapping of 100-year floodplain.

**Suspected Impairment:** **Heavy Metals**

Description: Heavy metals bioaccumulate in all levels of the food web. Plants absorb heavy metals from soil and are eaten by consumers, and consumers are eaten by predators, etc. At each level the metals are concentrated to the point they become toxic.

| | |
|---|---|
| Suspected Sources: | Storm water and parking lot runoff. |
| Suspected Causes: | Heavy metals present in gasoline are deposited on streets and parking lots from car exhaust. |
| Priorities: | Heavy metals are a low priority for aquatic life and wildlife. |
| Goal: | Prevent heavy metals from contaminating surface water. |
| Objective: | Implement storm water management practices.<br>Township ordinances that require detention of parking lot runoff and harvesting of cattails in detention basins to remove heavy metals. |

# CHAPTER 4 - IMPLEMENTATION STRATEGY

## 4.1 TOTAL MAXIMUM DAILY LOAD STUDY

The Total Maximum Daily Load (TMDL) program created in Section 303(d) of the Federal Clean Water Act requires states to develop strategies for monitoring and restoring areas that are not meeting Water Quality Standards (WQS) for a particular pollutant. The TMDL establishes allowable levels for that pollutant based on the pollution source and the TMDL area water quality. A TMDL program has been used in the Watershed to identify allowable levels of *E. coli* that will maintain the quality of the Watershed. Two TMDL studies have been prepared for water bodies in the Watershed: one for a segment of the Galien River and one for Deer Creek.

The TMDLs state that total body contact recreation was not being met due to pathogens, *E. coli* in particular. Elevated levels were found during the 2001 monitoring which required the limits of the Galien River (River) TMDL to be expanded to Elm Valley Road as the upstream limit, and Flynn Road as the downstream limit. A wastewater sewage lagoon exists in this area, but assuming it meets its discharge permitted limit of 200 count/100 ml of fecal coliform, it would be discharging less than the 130 count/100 ml set as the Michigan WQS. A map showing EPA, MDEQ, and the Health Department sampling sites is shown in Figure 9.

The TMDL goal for the River and Deer Creek is 130 count/100 ml, which is the WQS held by the State of Michigan for Total Body Contact Recreation. The TMDL proposes that agricultural runoff and illicit discharges are the main sources for *E. coli* in the identified stretch of the River. Storm water illicit connections, sewage overflows, and agriculture inputs are listed as potential sources for Deer Creek.

The Combined Sewer Overflow (CSO) identified in the Section 303(d) list for the River has been deleted in the 2002 since no CSOs exist in this area. The extent of the TMDL reach and monitoring has been extended for the 2002 listing, because all sample sites that were studied in 2001 exceeded limits. Therefore, the true extent of the *E. coli* exceedances is still unknown. Sampling in the 2002 season reached further into the East Branch of the River and further upstream on the River in hopes of being able to set boundaries on the *E. coli* problem area and find the sources.

The TMDLs mention that Phase II communities will be required to implement activities to reduce pathogen input to storm water runoff. However, no communities in the Watershed are designated Phase II. This WMP makes recommendations that will reduce the pollutants in runoff, essentially addressing the pathogens as well, resulting in lower *E. coli* levels in future years of monitoring. (Copies of the TMDLs can be found in Appendix 6).

## 4.2 CRITICAL AREAS

The Technical Committee met on March 14, 2002, to designate areas considered as the most critical based on the goals and objectives already created. The Technical Committee members in attendance discussed issues that had been brought up during Steering Committee and Technical Committee meetings to address the most serious issues in the Watershed. Table 4.1 shows the results of examining goals and their related objectives to determine which areas of the Watershed are most critical to meeting these goals. Figure 15 shows the geographic distribution of the critical areas.

**Table 4.1 - Critical Areas**

| Goals | Objectives | Critical Areas |
|---|---|---|
| Reduce *E. coli* levels to below 130 count/100 ml | Find sources from residential areas | New Troy area (2002 TMDL study area)<br>Deer Creek (2002 TMDL study area) |
| | Find sources from agricultural areas | Large livestock operations |
| Reduce excessive nutrient loading | Increase use of filter strips and fencing | 1/4 wide riparian corridors |
| | Encourage nutrient management planning | Large livestock operations |
| Remove obstructions and garbage | Establish volunteer clean up days | Stream corridors |
| Prevent excessive sediment loading | Improve SESC BMPs of BCRC | Severely eroded road crossings as identified in inventory |
| | Remove obstructions causing streambank erosion | Stream corridors |
| | Promote riparian buffers and conservation farming practices | Areas of highly erodible soils and intense land use activities |
| Maintain coldwater temperatures | Maintain or increase canopy | Riparian corridors |
| Maintain management practices for controlling invasive and exotic species | Identify sites of invasive species and control their spread | Warren Woods and Robinson Woods Preserve (preservation area) |
| Prevent heavy metals from entering surface waters | Implement storm water management practices | New Buffalo and other urbanizing areas in the Watershed |
| Reduce flooding impacts | Identify floodplain delineations for municipalities to use in creating ordinances | 100-year floodplain delineations for main branches of the River |

One of the major concerns in this Watershed is the high levels of *E. coli*. The MDEQ sampling has shown the New Troy area and Deer Creek as the center of concentration. Residential areas where septic systems are failing or are inadequate may be the leading source, but livestock operations are also under consideration.

Riparian corridors are the focus of many water quality issues, such as nutrient loading, obstructions, debris, and canopy integrity. Livestock operations may contribute not only *E. coli*, but also excess nutrients. Streambank erosion is a problem in the Watershed, but efforts should focus first on areas of highly erodible soils and intense land use activities. Urbanizing areas such as New Buffalo and high traffic areas such as Interstate 94 may be a source of heavy metals.

Preservation is something that is innately at the heart of the watershed community. Pearls such as Warren Woods and the Robinson Woods preserve, among others, should be kept in their pristine state. Flooding is also part of the history of the Watershed and care should be taken within the 100-year floodplain delineation. Municipalities should be aware of where these areas are and the risks associated with certain activities within the floodplain.

## 4.3 NONPOINT SOURCE BEST MANAGEMENT PRACTICE

### RECOMMENDATIONS

The Watershed inventory collected information about the sites of nonpoint pollution in the Watershed. Details about the sites, such as length of gully, height of streambank, and amount of trash were used to determine the extent of the problems. The total estimates for costs of the BMPs are calculated in Tables 4.2 to 4.7. Recommendations are based on generalizations about sites, but each specific site must be revisited before final plans are made for implementation. The property owner must be a cooperative partner in the decision making process for practices done on his or her land. The Natural Resource Conservation Service (NRCS) has experience using many of these techniques and is a good resource for assessing sites to recommend the most appropriate BMPs for each site. The MDEQ may be involved where a permit is needed for BMP installation. The MDEQ and the MDNR may also be involved as partners through provisions of grant funding.

## E. COLI

There are serious human health hazards as well as ecological damage associated with *E. coli* contamination. Water quality monitoring by the MDEQ, the Health Department, and other agencies has shown *E. coli* to be at levels high enough for concern. *E. coli* is one of many types of fecal coliform bacteria found in the digestive system of warm-blooded animals, such as humans, livestock, or geese. Presence of *E. coli* indicates that other human or animal waste pathogens are present. These pathogens can cause illness to humans and other warm-blooded wildlife.

The first step to combating an *E. coli* problem is finding its source. Since *E. coli* needs warm temperatures to survive, it does not live very long in surface water and is rarely found in moving streams for more than 24 hours after release from its source. The most common sources of *E. coli* are livestock operations, failing septic systems, illicit sewage connections, and combined sewer overflows. All of these are potential sources in the Watershed and there are most likely many of each type of source. The Health Department should work with homeowners to maintain proper septic systems through education, brochures, and technical assistance. Homeowners should be educated about both septic system maintenance and *E. coli*. Ordinances regarding septic systems must be enforced or even changed if current ordinances are found to allow pollution to occur.

A good time to inform homeowners of septic system maintenance is during the home buying process. Since septic systems must be inspected when a house is bought, this is an opportunity to provide the buyers with literature, show them where the septic tank and leach fields are located on the property, point out the steps to maintaining the septic system, and what the indicators are that the septic system is failing. These procedures could be done by the Health Department, realtor, mortgage company, Michigan State University (MSU) Extension, or through a cooperative effort of these groups.

Municipalities may choose to upgrade to municipal sewer services. This would reduce septic failure problems and illicit connections. Municipalities should also consider separating storm water from sanitary sewers to reduce the amount of waste that enters the surface waters during a storm event.

Another source of *E. coli* is from warm-blooded animals. The Humane Society could disseminate educational material about managing pet waste. Kennels should not be hosed off into a nearby water body. Feed lots, animal holding areas, and manure storage should not be placed adjacent to a water body. Buffers and containment, if applicable, should be used to block animal waste from reaching water bodies, which will not only prevent *E. coli* contamination, but also phosphorus and nitrogen. Farm*A*Syst is a program available through the Michigan Department of Agriculture (MDA) and MSU Extension and gives assistance to farmers to protect groundwater, surface water, and prevent health and safety risks.

## LIVESTOCK ACCESS

The effects of livestock access to streams can be severe. There is a twofold problem: waste elimination into the water and destruction of streambanks. *E. coli* and excessive nutrients pollute the streams from livestock waste. Even if livestock are allowed near the bank, their waste can wash directly into a water body. As livestock climb the banks of the river, the integrity of the banks suffers. Pictures 7 and 8 show the devastation that the weight of the cattle cause to streambanks. Livestock should be excluded from streams by use of fencing. Cattle crossings can be constructed of materials that will not erode under their weight. There should be substantial sized buffers, preferably 100 feet, between the fencing and the stream, especially on a slope. If gullies form, livestock should also be kept away from this region with fencing.

Picture 7: Unlimited Livestock Access (May 1982).

Picture 8: Improved streambank conditions from prohibiting livestock access (May 2002).

## DEBRIS AND TRASH

Log jams are common in the Watershed. These are natural parts of the ecosystem, but often they can cause flooding of crops and erosion at the banks or streambed. Sites, basic recommendations, and costs are listed in Table 4.2. The Obstruction Flowchart will assist with decision making at each site.

## OBSTRUCTION FLOWCHART

1. Is there trash present?

Yes - Remove trash and go to question 2.
No - Go to question 2.

2. Will flooding of structures or cropland occur?

Yes - Investigate hydrology. If obstruction will cause flooding, go to question 4, if not, go to question 3.
No - Go to question 3.

3. Will the obstruction cause erosion at the streambank or streambed?

Yes - Go to question 4.
No - If there are no other substantial reasons for action, do nothing.

4. Are the erosion causing flows slow to moderate?

Yes - Go to question 5.
No - Use of riprap with bioengineering may be warranted. Design appropriately and apply for appropriate permits.

5. Are the erosion causing flows directly toward the bank or are they from groundwater seep?

Yes - Use of riprap with bioengineering may be warranted. Design appropriately and apply for appropriate permits.
No - Go to question 6.

6. Can the obstruction be used as a revetment?

Yes - Assess flow pattern and bind the limbs to the bank according to flow and apply for appropriate permits.
No - Design proper bioengineering system of BMPs with other resources and apply for appropriate permits.

The River and its tributaries are sometimes treated as dumping grounds for unwanted items. Flooded areas can pick up trash from yards and roadways, carrying it back into the streams as the water recedes. Tires, bottles, drywall, concrete, and garbage were found at numerous sites in the Watershed. Volunteer stream clean-up efforts can remove these items from the waterways, and participation can educate or inform volunteers about the health of local streams. Yard waste, especially grass clippings and leaves are high in nutrients and should not be thrown in the water or on the bank. Long-term educational efforts about the impacts of litter and debris in the streams will increase the stewardship of the Watershed and encourage residents to recognize the value of their water resources. A volunteer clean-up grant could be sought to involve local residents in stewardship activities. It not only promotes respect for and interest in the Watershed, but also provides an enthusiastic workforce. Local match for the grant can include the use of canoes, dump trucks, landfill tipping fees (if tires are included), and communication radios for safety. It is important to inform volunteers of safety concerns and have release of liability forms for them to sign.

### STREAMBANK EROSION

Many techniques have been demonstrated to reduce streambank erosion. Hard structures, such as riprap, can protect the toe of a streambank. Tree revetments, fascines, and live plantings are softer methods that are generally preferred since they absorb energy from the stream unlike riprap that reflects energy downstream. Bioengineering, an integrated approach based in physics, chemistry, and engineering principles that uses biological methods of control, can be very effective in establishing long-term and adaptable solutions to erosive problems. Bioengineered systems are designed using non-destructive techniques that often have the ability to adapt to changing conditions over time. Materials can usually be found locally or even onsite, reducing cost and incorporating native resources. Sites, potential BMPs, and costs are given in Table 4.3. Each site should be examined and the principles described in this section should be applied.

Cooperation with the BCDC on work proposed for county drains is necessary. The remedies must not interfere with the regular maintenance and cleaning of the drains. Generally, most vegetative remedies, grasses and shrubs are acceptable, but trees may interfere with drain maintenance and roots too close to the edge may actually exacerbate erosion. Mixtures of rhizomatous woody shrubs and herbaceous plants are ideal unless the goal is to reduce water temperature. Trees may be used on the south and west sides of drains, because the canopy shade helps keep the water cool and is good for habitat and reducing algal growth. Responsibilities for maintenance of the remedy is a concern as well. If additional plantings are recommended on a site that requires drain maintenance, the BCDC would have to pass the additional costs on to the landowners. The landowners should be allowed to decide if they are willing to absorb any costs associated with increased maintenance in favor of having trees on or near the banks in the drain right of way. At this time, no drain maintenance activities are scheduled within the Watershed.

The U.S. Army Corps of Engineers has an experiment station in which testing is done on different techniques. Brush bundles and tree revetments incorporate the use of plant material to protect the bank in slow and moderate flows, as well as reestablishing bank vegetation which grows from the sediment that is deposited in the crevasses. These cost about $10 per yard since it is usually done with vegetation found onsite and can be done with little equipment and labor. Equipment can be rented for $125 per hour. In heavier flows, especially those with tall banks, live stakes of trees and shrubs with rhizomatous roots, such as red osier dogwoods and willows can be used to hold down brush mattresses or coir logs, rolls of coconut fiber. The live staking is done in late autumn or early spring when the trees are dormant. These stakes will grow into short shrubby trees with complex root systems as the growing season progresses. The coconut fiber costs around $3,800 for a 250-foot project.

Tree revetments are placed at the toe of a streambank to divert the flow away from the bank and catch sediment. Sediments accumulate behind the revetment and stabilize the bank. Many sites within the Watershed could benefit from this vegetative remedy to just divert the flow rather than needing bank protection. Previous projects implementing this river restoration technique have bid average costs of $320 per 100 feet of streambank.

The Technical Committee recommended that riprap be used on the toe of a slope, if it has failed due to groundwater seepage from a perched water table or frequent channel forming flows. A tile could also be placed along the stream to catch the groundwater flows and direct them to a stable outlet. The placement of riprap must follow NRCS standards and specifications, which includes placing geotextile under the riprap. The site preparation is often expensive. Estimates for riprap for streambank erosion using D50 stone is $70/square foot, which includes the delivery to the site. Riprap tends to be less cost effective and does not meet as many of the goals outlined in this plan as the bioengineering techniques. Therefore, it should only be used where flow velocities and direction will not sustain bioengineering.

## RILL AND GULLY EROSION

Rill and Gully erosion is generally found in agricultural areas where fields are tilled by conventional methods and plowed up to the streambank where no filter strips exist. Typical BMPs include drop structures, weirs, and stone spillways. Sites, recommended BMPs, and costs are listed in Table 4.4. All structures need adequate preparation to ensure the water flows where intended. NRCS has installed many of these structures over the years. Average costs per site are $600, assuming reasonable accessibility and using 4 inches to 12 inches of crushed limestone of various sizes. Geotextile vegetated chutes are designed for smaller sites with less runoff. The construction costs are estimated to be $700 per site.

The construction of a berm and tube structure must ensure stable vegetation, good compaction around the outlet, and adequate overflow protection. The outlet must be 1 foot off the bottom of the streambed and protected with a splash pad. The average cost for this BMP is $1,500.

Cover crops can be an effective remedy to gully and rill erosion, and are relatively inexpensive to implement. A cover crop program offering $20 per acre in the Watershed, in which a maximum of 14,000 acres would be eligible, could total $280,000. Setting a goal of 1,400 acres to be enrolled in a cover crop program would result in a total cost of $28,000 for the program.

Filter strips are also beneficial in preventing gully and rill erosion. Buffer programs typically offer rental rates for taking that land out of production and a 75% cost share rate for the establishment of the buffer. Cost estimates for this BMP assumed 0.5 acre for each buffer and a cost of $150 per acre for rental and establishment. The implementation of filter strips might be covered under the Conservation Reserve Enhancement Program (CREP) if program funding is available. CREP is administered through the Conservation District, the MDA, and the Farm Service Agency.

### ROAD/STREAM CROSSINGS

An initial survey of the road/stream crossings in the Watershed yielded few problems overall. Fifty-three sites were reported as having any erosion and most were gullies forming along the sides of the structures. Undersized or blocked culverts can be replaced with box culverts or bridges. Box culverts and bridges are preferred since they preserve the stream channel's natural bottom materials and hydraulic processes. Cost estimates and a brief site description are listed in Table 4.5.

### TILE OUTLETS

Outlets should be upsized when constructed to plan for future capacity needs. Rodent guards should always be included. The outlet should be lined with geotextile and stone should be placed in the trench. Many sites in the Watershed are eroding where the storm sewer outlets are eroding back into the streambanks and causing gullies. Tiles can be installed next to the gullies and outletted upstream. Catch basins and old tile lines could be adding sediment to the stream system. Stabilizing a tile outlet has an average cost of $70 per square foot of riprap. Sites, recommendations, and cost totals are shown in Table 4.6.

## OTHER SITES

Other pollutants were found in the Watershed that did not fit into the established categories and were collected under the "other" category. These would have to be evaluated on a site-by-site basis to determine the costs for removal or finding the source of the excessive nutrients entering the streams, but a list of sites and basic recommendations are listed in Table 4.7.

It has been established that sediment is the major pollutant in the Watershed. Sections 91 and 51 of Public Act 451 were established to regulate SESC during construction or earthmoving activities. Sites of 1 acre or greater, or sites that are within 500 feet of a waterway, must be permitted and inspected regularly for compliance with SESC regulations. The enforcement of these rules by the appointed county enforcing agency or authorized public agency is imperative in the southern region of the Watershed, where development is occurring rapidly. Phase II of the National Pollutant Discharge Elimination System (NPDES) will begin in March 2003. Sites of greater than 1 acre with a discharge to surface water will be required to abide by the provisions of the MDEQ's permit-by-rule. Sites greater than 5 acres with a discharge to surface water must submit a notice of coverage for MDEQ's permit-by-rule. These requirements will be in addition to the existing local SESC requirements.

## BEST MANAGEMENT PRACTICES PLANNING

The BMP recommendations and cost estimates are prioritized in Tables 4.2 to 4.7. Costs are given as estimates and based on worst case scenarios from the given description. For example, a site listed with a recommendation of riprap should not be treated according to the recommendations described in this narrative where it is not warranted. Costs will change as each site is investigated, and generally costs are lower when multiple sites are done simultaneously. Those sites requiring immediate attention were determined to be high priority and scheduled to be completed within 5 years. Those of medium priority were scheduled to be implemented in 5 to 10 years. Those of low priority were scheduled to be implemented in 10 to 20 years.

Some areas of the Watershed have yet to be inventoried. The information can be added to the spreadsheets and BMPs and costs can be estimated in the same manner when the inventory is completed. The recommendations in this plan are a guideline to follow for future work in the Watershed.

## 4.4 HABITAT RESTORATION

### WETLAND RESTORATION

Many ecological benefits result from preserving and restoring wetlands. Water quality is greatly improved as it passes through a wetland system. A fully functioning wetland has a large amount of biomass and biological activity that is capable of absorbing flood waters and pollutants. Wetlands are complex ecosystems that include submergent and emergent herbaceous plants, shrubs, trees, algae, migratory and resident birds, amphibians, reptiles, mammals, insects, microorganisms, and fish. Biological activity that occurs above and below the water surface, in the mucky bottom, and at the fringe of the wetland can process many types of pollutants like nutrients and heavy metals. Many communities maintain trails along wetlands and educate citizens so that they might fully appreciate the diversity of animals and plants in this ecosystem.

Hydrologic benefits are also realized from wetland restoration. Wetlands act like a sponge and allow infiltration over a longer period of time. Water volumes and speed are more constant and stable, which may reduce flooding and erosion problems downstream. When flows are allowed to infiltrate, they also contribute to the stream's base flow. This base flow of cool groundwater is essential to support fisheries.

#### IDENTIFICATION OF WETLAND RESTORATION SITES

Wetlands are characterized by distinctive plant communities, soil types, and hydrology. When soil is saturated for long periods of time, a unique ecosystem evolves at its surface. Wetland soils, also known as hydric soils, often have a high organic matter content or have gray subsoil due to chemically reduced iron and manganese compounds.

While most wetlands do have standing water at some time during the year, it is not necessary for a wetland to have standing water at all times. In fact, while some wetlands have standing water all year, and others are flooded only seasonally, some wetlands may never exhibit standing water.

#### PRIORITIZING SITES FOR WETLANDS RESTORATION

The determination of wetland restoration sites depends considerably on the presence of hydric soils (Figure 4). Areas where hydric soils are present are more likely to have good chemical and physical properties for wetlands than upland soils. Where wetlands have been eliminated by artificial drainage, restoration may be as simple as plugging a ditch or breaking a tile that drains the wetland area. Studies

have shown that wetlands constructed in historically upland areas are not as successful and do not have the functional capacity of restored wetlands, therefore, hydric soils should be sought. The most amenable areas are usually agricultural fields that remain wet during the spring planting season or frequently flood during the growing season. Other idle fields or pasture areas are also good possibilities.

Flooding has been documented to be a problem in middle sections of the River. Wetland restoration activities anywhere in the Watershed would have a positive impact on water quality, groundwater recharge, and wildlife.

## PROGRAMS AVAILABLE FOR FUNDING AND TECHNICAL ASSISTANCE

Programs are available to landowners wishing to restore wetlands on their property. The most common programs for agricultural land are the Wetland Reserve Program (WRP) and the CRP. Each of these programs provides technical assistance and other resources toward wetland restoration. Varying amounts of soil rental rates are paid to the landowner for taking their land out of production. Contact the local NRCS office for more details on the WRP and CRP programs.

The Michigan Wildlife Habitat Foundation and United States Fish and Wildlife Service (USFWS) are also active in restoring wetlands for wildlife throughout the state. Generally, there are no costs to the landowner, and the land does not have to be in agriculture to be eligible. Home owners can enhance their properties through backyard habitat programs offered by the Galien Conservation District.

## ALTERNATIVES TO WETLAND RESTORATION

Wetland plants extract excess nutrients out of the water, and though it is not always necessary, harvesting these plants, especially in more polluted waters, can be a way to remove the nutrients from the system. Constructing a wetland may also be a great way to filter gray water discharge from homes or farm outbuildings. Gray water systems utilize laundry, sink, and other non-toxic systems, as long as owners are careful about what is put into lines that connect to the system. Gray water can be used for irrigation of greenhouses, lawns, and gardens.

Wetland mitigation may be an option. The MDEQ may issue a permit in special circumstances to allow a wetland to be destroyed under the stipulation that for every acre of wetland destroyed, two acres of wetland must be constructed or restored. The new wetlands are called mitigated wetlands, and contractors normally pay landowners well for the construction of these wetlands. Mitigated wetlands may also be banked. These wetlands are constructed or restored in advance of losses through the MDEQ regulatory program and sold or used as needed.

## STREAM HABITAT RESTORATION

One of the priority designated uses in the Watershed is as a warmwater fishery. This should be addressed when implementing BMPs when possible. Many bank protection structures can have habitat measures incorporated. These structures include lunkers and J-hooks, which are used to create riffles, spawning sites, and cover for fish. Half logs with wood block spacers underneath can provide the same cover as tree revetments, but can be used in areas where erosion is not occurring.

**Table 4.2 - Recommendations and Cost Estimates for Trash and Debris Sites**

| Site ID† | Description | Buffer Width Right | Buffer Width Left | Proposed Improvements | Estimated Cost/Site | Estimated Total Cost | Priority | Potential Responsible Partners |
|---|---|---|---|---|---|---|---|---|
| 22NBU3603 | Extensive log jams | - | - | See debris BMP flowchart | $10/yd and $125/hr | $1,000 | H | BCDC, MDNR, Landowners, and MDEQ |
| 22NBU3602 | Extensive log jams | - | - | See debris BMP flowchart | $10/yd and $125/hr | $1,500 | H | BCDC, MDNR, Landowners, and MDEQ |
| 22NBU3601 | Extensive log jams | - | - | See debris BMP flowchart | $10/yd and $125/hr | $1,000 | H | BCDC, MDNR, Landowners, and MDEQ |
| 22NBU3607 | Extensive log jams. River diverted around jams and eroded a new channel | - | - | See debris BMP flowchart | $10/yd and $125/hr | $1,600 | H | BCDC, MDNR, Landowners, and MDEQ |
| 22WEE0721 | Huge tree fell in stream blocking it, river eroding bank behind roots | - | - | See debris BMP flowchart | $10/yd and $125/hr | $800 | H | BCDC, MDNR, Landowners, and MDEQ |
| 460NBU3603 | | >10' | >10' | See debris BMP flowchart | $10/yd | * | H | BCDC, MDNR, Landowners, and MDEQ |
| 254BER0702 | Soil and debris covering most of the culvert | 1'-3' | 1'-3' | See debris BMP flowchart | $10/yd | $100 | H | BCDC, MDNR, Landowners, Road Commission, and MDEQ |
| 22NBU0101 | Two log jams blocking 80% channel. Log jams next 200' to 300' | - | - | See debris BMP flowchart | $10/yd and $125/hr | $5,000 | H | BCDC, MDNR, Landowners, and MDEQ |
| 4503GAL1101 | Branches and dirt obstructing half of the culvert opening | 1'-3' | 1'-3' | See debris BMP flowchart | $10/yd | $500 | M | BCDC, MDNR, Landowners, BCRC, and MDEQ |
| 433THR2301 | Culvert 1 inch above water debris blocking flow and causing buildup of sediment | - | - | See debris BMP flowchart | $10/yd | $100 | M | BCDC, MDNR, Landowners, BCRC, and MDEQ |
| 22NBU0209 | Dead tree in channel downstream from wastewater treatment plant | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | Drain Commissioner, MDNR, Landowners, and MDEQ |
| 22NBU0205 | Dead tree in channel under the bridge | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | Drain Commissioner, MDNR, Landowners, Road Commission, and MDEQ |

**Table 4.2 - Recommendations and Cost Estimates for Trash and Debris Sites**

| Site ID† | Description | Buffer Width Right | Buffer Width Left | Proposed Improvements | Estimated Cost/Site | Estimated Total Cost | Priority | Potential Responsible Partners |
|---|---|---|---|---|---|---|---|---|
| 22NBU0304 | Dead tree in middle of river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22WEE0722 | Dead trees in channel blocking river, moderate | - | - | See debris BMP flowchart | $10/yd and $125/hr | $500 | M | BCDC, MDNR, Landowners, and MDEQ |
| 430THR1501 | Downed trees, both sides of bridge | - | - | See debris BMP flowchart | $10/yd and $125/hr | $500 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22NBU0206 | Four log jams in this section of river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $1,000 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22WEE0723 | Log jam blocking river, main log above water, another log jam u/s above water | - | - | See debris BMP flowchart | $10/yd and $125/hr | $500 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22NBU0202 | Log jam in river blocking 50% of channel | - | - | See debris BMP flowchart | $10/yd and $125/hr | $500 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22WEE0711 | Log jam in river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22CHI1203 | Log jam in river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22WEE0707 | Log jam in river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22WEE0706 | Log jam in river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22WEE0710 | Log jam in river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22WEE0709 | Log jam in river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22WEE0720 | Log jam in river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22CHI1204 | Log jam in river. | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |

**Table 4.2 - Recommendations and Cost Estimates for Trash and Debris Sites**

| Site ID† | Description | Buffer Width Right | Buffer Width Left | Proposed Improvements | Estimated Cost/Site | Estimated Total Cost | Priority | Potential Responsible Partners |
|---|---|---|---|---|---|---|---|---|
| 22CHI1202 | Log jam in river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22WEE0716 | Log jam in river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22WEE0719 | Log jam in river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22WEE0718 | Log jam in river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22WEE0705 | Log jam in river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22WEE0702 | Log jam in river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22WEE0715 | Log jam in river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22WEE0701 | Log jam in river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22WEE0713 | Log jam in river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22WEE0712 | Log jam in river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22CHI1205 | Log jam in river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22WEE0717 | Log jam in river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22CHI1206 | Log jam in river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22WEE0708 | Log jam in river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |

**Table 4.2 - Recommendations and Cost Estimates for Trash and Debris Sites**

| Site ID† | Description | Buffer Width Right | Buffer Width Left | Proposed Improvements | Estimated Cost/Site | Estimated Total Cost | Priority | Potential Responsible Partners |
|---|---|---|---|---|---|---|---|---|
| 22WEE0703 | Log jam in river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22WEE0704 | Log jam in river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22NBU0207 | Log jams across from boat ramp | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 459WEE0702 | Log jams blocking the stream near the bridge 30' downstream from bridge | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22NBU0102 | Log jams completely blocking river, many log jams over next 500'-800' | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22WEE0725 | Log jams in river about 200' downstream from bridge | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22CHI1301 | Logs in the river | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22NBU3605 | Lots of log jams at this site | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, ,MDNR, Landowners, and MDEQ |
| 22NBU0203 | One tree has fallen into the water blocking 50% of channel | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 412ANBU0203 | Sediment | - | - | See debris BMP flowchart | $10/yd | $100 | M | BCDC, MDNR, Landowners, and MDEQ |
| 460NBU3601 | | >10' | >10' | See debris BMP flowchart | $10/yd | $200 | M | BCDC, MDNR, Landowners, and MDEQ |
| 27WEE0303 | Several log jams in the stream upstream from Holden Road bridge | 1'-3' | 1'-3' | See debris BMP flowchart | $10/yd and $125/hr | $500 | M | BCDC, MDNR, Landowners, and MDEQ |

**Table 4.2 - Recommendations and Cost Estimates for Trash and Debris Sites**

| Site ID† | Description | Buffer Width Right | Buffer Width Left | Proposed Improvements | Estimated Cost/Site | Estimated Total Cost | Priority | Potential Responsible Partners |
|---|---|---|---|---|---|---|---|---|
| 276WEE2101 | Tires and snowmobile body in the stream, on the up stream side of bridge | 3'-10' | 3'-10' | See debris BMP flowchart | 1 Lump Sum | $1,500 | M | BCDC, MDNR, Landowners, and MDEQ |
| 4401THR0801 | Tires, drained oil container | >10 | >10 | See debris BMP flowchart | Volunteer pickup | $60 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22CHI2301 | Trees have fallen into river. | 1'-3' | 1'-3' | See debris BMP flowchart | $10/yd and $125/hr | $500 | M | BCDC, MDNR, Landowners, and MDEQ |
| 22NBU0208 | Two more log jams on the left hand side of river about 100' apart | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | M | BCDC, MDNR, Landowners, and MDEQ |
| 4136NBU2401 | | 1'-3' | 1'-3' | See debris BMP flowchart | $10/yd | * | M | BCDC, MDNR, Landowners, and MDEQ |
| 35NBU0101 | Wire across culvert is collecting debris and blocking culvert | >10' | >10' | See debris BMP flowchart | $10/yd | * | M | BCDC, MDNR, Landowners, Road Commission, and MDEQ |
| 459WEE0701 | A couple of logs in the stream (slight) | - | - | See debris BMP flowchart | $10/yd and $125/hr | $250 | L | BCDC, MDNR, Landowners, and MDEQ |
| 252ABER0601 | Dirt and debris | >10' | >10' | See debris BMP flowchart | $10/yd | $150 | L | BCDC, MDNR, Landowners, and MDEQ |
| 263LAK2902 | Grass clippings in stream next to small tile outlet | 3'-10' | 3'-10' | See debris BMP flowchart | $10/yd | * | L | BCDC, MDNR, Landowners, and MDEQ |
| 2751CHI1301A | Slight. Island in stream with log jams around it & in the stream | - | - | See debris BMP flowchart | $10/yd | $250 | L | BCDC, MDNR, Landowners, and MDEQ |
| 255BER0701 | Some erosion | >10' | >10' | See debris BMP flowchart | $10/yd | * | L | BCDC, MDNR, Landowners, and MDEQ |

**Table 4.2 - Recommendations and Cost Estimates for Trash and Debris Sites**

| Site ID† | Description | Buffer Width Right | Buffer Width Left | Proposed Improvements | Estimated Cost/Site | Estimated Total Cost | Priority | Potential Responsible Partners |
|---|---|---|---|---|---|---|---|---|
| 34WEE2102 | Some log jams in the stream (slight) | 0 | 0 | See debris BMP flowchart | $10/yd | $250 | L | BCDC, MDNR, Landowners, and MDEQ |
| 276WEE2102 | Three tires in the stream where stream 276 meets 2761 | >10' | >10' | See debris BMP flowchart | Volunteer pickup | $60 | L | BCDC, MDNR, Landowners, and MDEQ |
| | | | | | High Priority | $11,000 | | |
| | | | | | Medium Priority | $15,210 | | |
| | | | | | Low Priority | $960 | | |
| | | | | | **TOTAL** | **$27,170** | | |

*Unable to estimate cost until more details are obtained
† Exact location of all NPS sites are available at BCDC office
H = High priority, implemented within 5 years
M = Medium priority, implemented in 5 to 10 years
L = Low priority, implemented in 10 to 20 years

**Table 4.3 - Recommendations and Cost Estimates for Streambank Erosion**

| Site ID† | Buffer Width Right | Buffer Width Left | Streambank Erosion Length | Streambank Erosion Height | Erosion Severity | Streambank Erosion | Erosion Area ft$^2$ | Proposed Improvements | Estimated Unit Cost | Estimated Total Cost | Priority | Potential Responsible Partners** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 434GAL1801 | No | No | <10' | 3'-6' | Mostly bare bank | Entire bank | 44 | Seeding | $5/LF | $50 | H | BCDC, MDNR, MDEQ, municipalities, and townships |
| 2201CHI2302 | 0 | 0 | >100' | 50' | Washout | Entire bank | 5,500 | Soil bioengineering | $5/SY | $3,000 | M | BCDC, MDNR, MDEQ, municipalities, and townships |
| 4406THR0901 | >10' | >10' | 10'-25' | 3'-6' | Mostly bare bank | Entire bank | 90 | Seeding | $5/LF | $20 | H | BCDC, MDNR, MDEQ, municipalities, and townships |
| 22NBU0201 | | | 10'-25' | >6' | Mostly bare bank with rills | Entire bank | 75 | Seeding/regrading bank | $70/SY | $580 | H | BCDC, MDNR, MDEQ, municipalities, and townships |
| 412NBU0201 | >10' | >10' | 10'-25' | <3' | Some bare bank | Toe | 30 | Riprap toe of slope protection | $70/SY | $230 | M | BCDC, MDNR, MDEQ, municipalities, and townships |
| 36NBU0102 | >10' | >10' | 10'-25' | 3'-6' | Washout | Entire bank | 45 | Spillway | $70/SY | $350 | M | BCDC, MDNR, MDEQ, municipalities, and townships |
| 459WEE0704 | | | 10'-25' | >6' | Washout | Entire bank | 45 | Spillway | $70/SY | $350 | M | BCDC, MDNR, MDEQ, municipalities, and townships |
| 451GAL1201 | >10' | >10' | 26'-100 | >6' | Bare bank with rills | Entire bank | 180 | Seeding/regrading bank | $20/LF | $400 | M | BCDC, MDNR, MDEQ, municipalities, and townships |
| 2710NBU3101 | >10' | >10' | 26'-100' | >6' | Washout | Entire bank | 180 | Spillway | $70/SY | $1,400 | M | BCDC, MDNR, MDEQ, municipalities, and townships |
| 22WEE0714 | | | 6' | 4' | Minor | Entire bank | 24 | Seeding | $5/LF | $20 | L | BCDC, MDNR, MDEQ, municipalities, and townships |

**Table 4.3 - Recommendations and Cost Estimates for Streambank Erosion**

| Site ID† | Buffer Width Right | Buffer Width Left | Streambank Erosion Length | Streambank Erosion Height | Erosion Severity | Streambank Erosion | Erosion Area $ft^2$ | Proposed Improvements | Estimated Unit Cost | Estimated Total Cost | Priority | Potential Responsible Partners** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22NBU3606 | | | | | | | | | | * | | |
| RDCHI2801 | | | | | | | | | | * | | |
| 263LAK2904 | 0 | 0 | | | | | | | | * | | |

| | |
|---|---|
| High Priority severe erosion | $650 |
| Medium Priority Moderate erosion | $5,730 |
| Low Priority minor erosion | $20 |
| **TOTAL** | **$6,400** |

*Unable to estimate until further information is obtained
†Exact location of all NPS sites are available at BCDC office
**For all streams that are designated county drains
H = High priority, implemented within 5y ears
M = Medium priority, implemented in 5 to 10 years
L = Low priority, implemented in 10 to 20 years

**Table 4.4 - Recommendation and Cost Estimates for Rill and Gully Erosion**

| Site ID† | Buffer Width Right | Buffer Width Left | Rill & Gully Length | Rill & Gully Height | Rill & Gully Depth | Rill & Gully Width | Rill & Gully Volume | Proposed Improvements | Estimated Cost/Site | Estimated Total Cost | Priority | Potential Responsible Partner |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2773THR1101 | | | 15' | >6' | 1-3' | 4-5' | 120 feet$^3$ | Berm and tube with filter strip | $1500/each tube and berm; $190/acre filter strip | $1,690 | H | NRCS, Landowner, Conservation District, and the MDEQ |
| 272WEE1301 | 1'-3' | 1'-3' | 15' | >6' | 3' | 5' | 225 feet$^3$ | Berm and tube with filter strip | $1500/each tube and berm; $190/acre filter strip | $1,690 | H | NRCS, Landowner, Conservation District, and the MDEQ |
| 34BNBU1801 | >10' | >10' | 25' | <3' | 2' | 1-3' | 100 feet$^3$ | Berm and tube with filter strip | $1500/each tube and berm; $190/acre filter strip | $1,690 | H | NRCS, Landowner, Conservation District, and the MDEQ |
| 412NBU1102 | >10' | >10' | 25' | <3' | 1' | 2' | 50 feet$^3$ | Bioengineering | $12/yd | $100 | M | NRCS, Landowner, Conservation District, and the MDEQ |
| 4956CHI1201 | 0 | 0 | 6' | 3'-6' | 1' | 2' | 12 feet$^3$ | Filter strip | $190/acre | $190 | M | NRCS, Landowner, Conservation District, and the MDEQ |
| 4400THR0801 | >10' | >10' | 6' | >6' | 2' | 2-3' | 30 feet$^3$ | Bioengineering | $12/yd | $50 | M | NRCS, Landowner, Conservation District, and the MDEQ |
| 35ANBU0601 | >10' | >10' | 6' | 3'-6' | 3-6' | 2-3' | 67.5 feet$^3$ | Berm and tube with filter strip | $1500/each tube and berm; $190/acre filter strip | $1,690 | M | NRCS, Landowner, Conservation District, and the MDEQ |
| 34WEE3401 | 0 | 0 | | >6' | | | | Filter strip | $190/acre | $95 | M | NRCS, Landowner, Conservation District, and the MDEQ |

**Table 4.4 - Recommendation and Cost Estimates for Rill and Gully Erosion**

| Site ID† | Buffer Width Right | Buffer Width Left | Rill & Gully Length | Rill & Gully Height | Rill & Gully Depth | Rill & Gully Width | Rill & Gully Volume | Proposed Improvements | Estimated Cost/Site | Estimated Total Cost | Priority | Potential Responsible Partner |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 27WEE0402 | 1'-3' | 1'-3' | 3' | 3'-6' | 0.5' | 2' | 3 feet$^3$ | Filter strip | $190/acre | $190 | L | NRCS, Landowner, Conservation District, and the MDEQ |
| 34WEE2103 | 0 | 0 | 3' | >6' | 6" | 3' | 4.5 feet$^3$ | Filter strip | $190/acre | $190 | L | NRCS, Landowner, Conservation District, and the MDEQ |
| 36NBU1601 | >10' | >10' | 4' | <3' | 1' | 2' | 8 feet$^3$ | Filter strip | $190/acre | $190 | L | NRCS, Landowner, Conservation District, and the MDEQ |
| 25WEE3401 | >10' | >10' | 6' | 3'-6' | 1' | 1' | 6 feet$^3$ | Filter strip | $190/acre | $190 | L | NRCS, Landowner, Conservation District, and the MDEQ |
| | | | | | | | | | High Priority | $3,570 | | |
| | | | | | | | | | Medium Priority | $3,175 | | |
| | | | | | | | | | Low Priority | $670 | | |
| | | | | | | | | | **TOTAL** | **$7,955** | | |

† Exact location of all NPS sites are available at County Drain Office
H = High priority, implemented within 5y ears
M = Medium priority, implemented in 5 to 10 years
L = Low priority, implemented in 10 to 20 years

**Table 4.5 - Recommendations and Cost Estimates for Road/Stream Crossing Sites**

| Site ID† | Location | Buffer Width | Erosion Extent | Comments | Proposed Improvements | Estimated Unit Cost | Estimated Total Cost | Priority | Potential Responsible Partners |
|---|---|---|---|---|---|---|---|---|---|
| RDCHI2302 | Embankment | 1'-3' | Severe | Erosion above the culvert forming a hole in the ground. The hole is 2' long and 2' deep | Bioengineering and riprap repair | $10/yd - tree revet. $70/yd$^2$ - riprap | $190 | H | BCRC and BCDC |
| 460NBU3602 | Culvert outlet | | Severe | Culvert 3' too high, pooling and causing erosion under culvert | Work with BCRC | 1 Lump Sum | $1,000 | H | BCRC and BCDC |
| 34BNBU1801 | Embankment | >10' | Severe | Gully off road, severe, gully min. on other side of bridge, may be a spring | Bioengineering and riprap | $10/yd - tree revet. $70/yd$^2$ - riprap | $240 | H | BCRC and BCDC |
| 225CHI2301 | Embankment | | Severe | Culvert 1' above stream bed. Bank sparse veg. & road runoff erosion 50' wide & 60' long. Clear/rusty water possibly due to iron in gw | Bioengineering | $10/yd - tree revetment | $3,300 | H | BCRC and BCDC |
| 35ANBU0601 | Shoulder/ditch | >10' | Severe | Located at top of culvert | Riprap | $70/yd$^2$ - riprap | $1,050 | H | BCRC and BCDC |
| 442THR3201 | Embankment | >10' | Severe | Both sides of road, potential for dirt sliding into creek, rocks placed at end of culvert & banks to help possible erosion. BCRC put dirt on road and banks, no riprap | Bioengineering and riprap | $10/yd - tree revet. $70/yd$^2$ - riprap | $3,000 | H | BCRC and BCDC |
| 263LAK2904 | Embankment | 0 | Severe | | Bioengineering and riprap | $10/yd - tree revet. $70/yd$^2$ - riprap | $800 | H | BCRC and BCDC |
| RDCHI2801 | Culvert outlet | | Severe | | Bioengineering and riprap | $10/yd - brush mats $70/yd$^2$ - riprap | $600 | H | BCRC and BCDC |
| 34CTHR1701 | Embankment | >10' | Severe | Left bank gully erosion 6' wide, 20' long, 2' deep | Riprap | $70/yd$^2$ - riprap | $1,050 | H | BCRC and BCDC |
| 27BUC1801 | Embankment | | Severe | Erosion on both sides of the road. Some work done to fix problem. | SESC, riprap | $70/yd$^2$ - riprap | $2,100 | H | BCRC and BCDC |
| 643WEE0201 | Embankment | 3'-10' | Severe | | Bioengineering and riprap | $10/yd - tree revet. $70/yd$^2$ - riprap | $600 | H | BCRC and BCDC |

**Table 4.5 - Recommendations and Cost Estimates for Road/Stream Crossing Sites**

| Site ID† | Location | Buffer Width | Erosion Extent | Comments | Proposed Improvements | Estimated Unit Cost | Estimated Total Cost | Priority | Potential Responsible Partners |
|---|---|---|---|---|---|---|---|---|---|
| 222CHI1301 | Embankment | 0 | Severe | Stream obstructed by concrete blocks & culvert is 2' above stream bed. Right side of culvert has severe erosion caused by runoff from road | Riprap outlet protection, remove obstruction | $70/yd$^2$ - riprap | $1,250 | H | BCRC and BCDC |
| 603BUC0801 | Embankment | | Severe | Erosion from road down to outflow and around culvert | Bioengineering | $10/yd | $50 | H | BCRC and BCDC |
| 275CHI2401 | Embankment | | Severe | Stream partly obstructed by erosion from rd. TOs 12" metal comes off branch. Washout on rt of branch, u/s side. washout 6' wide,4'deep, & 15' long. Erosion left of bridge | Bioengineering and riprap repair | $10/yd - tree revet. $70/yd$^2$ - riprap | $770 | H | BCRC and BCDC |
| 413NBU1301 | Embankment | >10' | Severe | Whole bank sliding in, road runoff, sediment in stream end of gully, erosion off road, problems both sides of road | Work with Road Commission | | $1,000 | H | BCRC and BCDC |
| 441THR3201 | Embankment | >10' | Severe | Rocks obstruct flow, 200' embankment washing in towards creek both sides. BCRC put dirt on rd & banks, no riprap for dirt, eros next to culvert | Bioengineering and riprap repair | $10/yd - tree revet. $70/yd$^2$ - riprap | $770 | H | BCRC and BCDC |
| 228CHI2201B | Shoulder/ditch | | Severe | | Bioengineering and riprap repair | $10/yd - tree revet. $70/yd$^2$ - riprap | $800 | H | BCRC and BCDC |
| 2710NBU3101 | Culvert outlet | >10' | Severe | Culverts are too high, large amount of garbage in the way, near landfill | Work with BCRC | | $1,000 | H | Landfill operator BCRC and BCDC |
| 224CHI1201 | Embankment | 3'-10' | Severe | End of culvert is crushed almost closed. Bad erosion 3' from edge of road down & around culvert. Avg. width 2'-3', length 10'-15', & depth 1'-2' | Replace culvert, riprap outlet projection | $70/yd$^2$ - riprap, $50/LF of culvert | $2,280 | H | BCRC and BCDC |
| 220CHI2701 | Embankment | | Severe | Embankment erosion both sides road. u/s ditch eros w/ embankment eros. D/s side culvert too high - eroded pool & bank across | Rip rap outlet protection | $70/yd$^2$ - riprap | $1,400 | H | BCRC and BCDC |

**Table 4.5 - Recommendations and Cost Estimates for Road/Stream Crossing Sites**

| Site ID† | Location | Buffer Width | Erosion Extent | Comments | Proposed Improvements | Estimated Unit Cost | Estimated Total Cost | Priority | Potential Responsible Partners |
|---|---|---|---|---|---|---|---|---|---|
| 412BNBU1101 | Shoulder/ditch | >10' | Moderate to severe | Lot of sandy silt length of riverbed 1/4 mi N side. S side stag, 2' wide roadside eros, 1' w, 1' d 20' l. Tree debris u/s. Sand wash to floodplain (no veg) & creek | Bioengineering and riprap | $10/yd - tree revet. $70/yd$^2$ - riprap | $200 | M | BCRC and BCDC |
| 35ATHR1701 | Embankment | >10' | Moderate to severe | Tube 18" above bed, some rocks underneath, gully 1'-2' wide 1' deep 30' long, spring in hill | Riprap outlet protection | $70/yd$^2$ - riprap | $280 | M | BCRC and BCDC |
| 227CHI2201A | Embankment | | Moderate | | Bioengineering and riprap | $10/yd - tree revet. $70/yd$^2$ - riprap | $240 | M | BCRC and BCDC |
| 271THR0502 | Embankment | >10' | Moderate | Road side gully erosion, some trees/limbs down in front of culvert, other side of road culvert too high scoring out and pooling. | Riprap outlet protection | $70/yd$^2$ - riprap | $1,050 | M | BCRC and BCDC |
| 4584BUC0701 | Embankment | 0 | Moderate | Erosion above & around culvert. Also on left streambank there is erosion and the bank is bare. | Riprap outlet protection | $70/yd$^2$ - riprap | $1,050 | M | BCRC and BCDC |
| 430THR2101 | Culvert outlet | | Moderate | Bank is obstructing flow and diverting the water to the side of the culvert | Pull back bank | $10/SY grading | $300 | M | BCRC and BCDC |
| 450GAL0402 | Culvert outlet | >10' | Moderate | Laid cement at end of culvert causing fast flow down to water bed and digging bed, also left side 6' bank is erosion | Bioengineering and riprap | $10/yd - tree revet. $70/yd$^2$ - riprap | $280 | M | BCRC and BCDC |
| 450GAL0301 | Embankment | 1'-3' | Moderate | Eros both sides culvert, 6' bank, block & stone obstruction 20' from culvert downstream, no buffer at culvert, film on water, at Norris' Country Corner | Riprap outlet protection | $70/yd$^2$ - riprap | $1,400 | M | BCRC and BCDC |
| RSCHI2901 | Embankment | | Moderate | Runoff from road is running down the embankment & eroding two holes on top of the culvert. | Riprap outlet protection | $70/yd$^2$ - riprap | $350 | M | BCRC and BCDC |
| 275CHI2302 | Embankment | | Moderate | Embankment on both sides of the road is eroding away. Bank is about 5' high | Riprap outlet protection | $70/yd$^2$ - riprap | $700 | M | BCRC and BCDC |
| 2713THR3201 | Embankment | No | Moderate | Road run off about 20', 1-3' wide, 1' deep, culvert too high causing pooling, no buffer - mowed up to creek. Frog and veg | Bioengineering and riprap | $10/yd - tree revet. $70/yd$^2$ - riprap | $3,150 | M | BCRC and BCDC |

**Table 4.5 - Recommendations and Cost Estimates for Road/Stream Crossing Sites**

| Site ID† | Location | Buffer Width | Erosion Extent | Comments | Proposed Improvements | Estimated Unit Cost | Estimated Total Cost | Priority | Potential Responsible Partners |
|---|---|---|---|---|---|---|---|---|---|
| 2201CHI2301 | Culvert outlet | <1' | Moderate | Culvert 3' above stream surface. Water from culvert eroded streambed forming deep pool below. Water stagnant | Bioengineering and riprap | $10/yd - tree revet. $70/yd$^2$ - riprap | $300 | M | BCRC and BCDC |
| 221CHI2801A | Culvert outlet | | Moderate | Discharge from culvert has formed a pool below it | Riprap outlet protection | $70/yd$^2$ - riprap | $1,050 | M | BCRC and BCDC |
| 458BUC0701 | Embankment | | Moderate | U/s gravel parking lot slopes to river-runoff & eros. D/s br. rt bank veg removed & replaced with dirt & stones | Bioengineering | $10/yd - tree revet. | $1,000 | M | BCRC and BCDC |
| 252BBER0101 | Embankment | <1' | Moderate | Metal culvert flows into catch basin and out an obstructed and broken clay tile outlet, pools water | Remove obstruction/ replace tile | $40/LF of tile | $1,000 | M | BCRC and BCDC |
| RS2CHI2902 | Shoulder/ditch | | Moderate | Length of ditch & where it empties into stream there is erosion causing island in stream channel. Ditch is in section 30. Culvert is deteriorating | Riprap outlet protection | $70/yd$^2$ - riprap | $1,050 | M | BCRC and BCDC |
| 34WEE3601 | Streambank | | Moderate | Stream drops at least a foot to the surface of the stream. Culvert is too high. | Riprap outlet protection | $70/yd$^2$ - riprap | $1,400 | M | BCRC and BCDC |
| 228CHI2201A | Embankment | | Moderate | Erosion down embankment caused by runoff from road ditch has eroded a path down to stream. Also eroded dirt from behind culvert outlet | Bioengineering and riprap | $10/yd - tree revet. $70/yd$^2$ - riprap | $750 | M | BCRC and BCDC |
| RS2CHI2901 | Embankment | | Moderate | Eroded material from embankment has blocked the stream channel in front of the culvert | Bioengineering/ remove sediment | $10/yd - tree revet. | $200 | M | BCRC and BCDC |
| 221CHI2802 | Culvert outlet | | Moderate | U/s of road, culvert blocked by logs. d/s culvert 1'-2' above stream surface, eroding pool in streambed | Remove logs, outlet riprap protection | $70/yd$^2$ - riprap | $640 | M | BCRC and BCDC |
| 271THR3201 | Embankment | >10' | Moderate | Replace pipe & realign. Suck hose, pipe rusted, headwall down front culvert. Eros on rd, dirt washes to creek, rd could cave in | Replace culvert | Depending on culvert size | $2,000 | M | BCRC and BCDC |
| 4451CHI2701 | Embankment | 3'-10' | Minor | | | | | L | BCRC and BCDC |

**Table 4.5 - Recommendations and Cost Estimates for Road/Stream Crossing Sites**

| Site ID† | Location | Buffer Width | Erosion Extent | Comments | Proposed Improvements | Estimated Unit Cost | Estimated Total Cost | Priority | Potential Responsible Partners |
|---|---|---|---|---|---|---|---|---|---|
| 265WEE0401 | Culvert outlet | 1'-3' | Minor | Culvert outlet 1‘ above water surface. | Riprap outlet protection | $70/yd$^2$ - riprap | $350 | L | BCRC and BCDC |
| 459WEE0703 | Embankment | | Minor | Very steep embankment with some erosion also run off from road | Bioengineering | $10/yd - tree revet. | $1,000 | L | BCRC and BCDC |
| 450GAL0503 | Culvert outlet | 3'-10' | Minor | Culvert 6" too high, digging, pooling, some minor erosion, 4-6' banks | Riprap outlet protection | $70/yd$^2$ - riprap | $1,050 | L | BCRC and BCDC |
| 2772THR1102 | Culvert outlet | | Minor | Culvert too high, water green and stagnant | Riprap outlet protection | $70/yd$^2$ - riprap | $350 | L | BCRC and BCDC |
| 456BUC2001 | Embankment | | Minor | Erosion or road runoff above & down right side of culvert | Riprap outlet protection | $70/yd$^2$ - riprap | $350 | L | BCRC and BCDC |
| 263LAK2901 | Embankment | 3'-10' | Minor | On both sides of the road there is erosion on top of the culvert eroding behind concrete wall & to the left of culvert | Bioengineering | $10/yd - tree revet. | $1,000 | L | BCRC and BCDC |
| 603BUC0901 | Embankment | | Minor | Erosion from road down to stream next to culvert | Bioengineering | $10/yd - tree revet. | $1,000 | L | BCRC and BCDC |
| 2775THR0101 | Embankment | | Minor | Runoff from the road causing erosion of embankment | Riprap outlet protection | $70/yd$^2$ - riprap | $350 | L | BCRC and BCDC |
| 2412THR3601 | Embankment | | Minor | Upstream side has minor erosion caused by runoff from road. Downstream side the culvert outlet is obstructed by sediment | Remove sediment | $20/CY | $100 | L | BCRC and BCDC |
| 34WEE2001 | Streambank | >10' | Minor | Lots of runoff from bridge/road | | | | L | BCRC and BCDC |
| 22NBU3606 | Left bank after bridge | | Minor | | | | | L | BCRC and BCDC |
| 22CHI1201 | None | | None | Logs caught up in the suspension on the underside of bridge | Remove Logs | Lump sum | $1,000 | L | BCRC and BCDC |
| 445CHI2701 | None | 1'-3' | None | Culvert is 1' above the water's surface. Discharge from culvert has eroded out the stream bottom making a pool. The stream no longer flows | Riprap outlet protection | $70/yd$^2$ - riprap | $1,050 | L | BCRC and BCDC |

**Table 4.5 - Recommendations and Cost Estimates for Road/Stream Crossing Sites**

| Site ID† | Location | Buffer Width | Erosion Extent | Comments | Proposed Improvements | Estimated Unit Cost | Estimated Total Cost | Priority | Potential Responsible Partners |
|---|---|---|---|---|---|---|---|---|---|
| 459LAK3101 | None | 3'-10' | None | Tire blocking culvert and there is scum on the water surface | Remove tire | Lump sum | $50 | L | BCRC and BCDC |
| 227CHI2201B | None | | None | Culvert a big concrete box 5' high and about 3' wide. hole cut in bottom to let stream flow into box. Log blocking culvert outlet | Remove log | Lump sum | $200 | L | BCRC and BCDC |
| 273BUC1801 | None | | None | Culvert 90% blocked by mud | Cleanout culvert | Lump sum | $500 | L | BCRC and BCDC |
| 458BUC0602 | None | >10' | None | | | | | L | BCRC and BCDC |
| 443CHI2801 | None | 3'-10' | None | Lots of logs in stream in front of culvert. Also on the other side of road there is a white wooden fence across the stream | Remove logs | Lump sum | $1,000 | L | BCRC and BCDC |
| 458BUC0503 | None | >10' | None | Railroad tie & other objects blocking culvert | Remove objects blocking culvert | Lump sum | $1,500 | L | BCRC and BCDC |
| 34WEE2701 | None | 3'-10' | None | | | | | L | BCRC and BCDC |
| 272WEE1301 | None | 1'-3' | None | Culvert is mostly blocked by sediment | Cleanout culvert | Lump sum | $500 | L | BCRC and BCDC |
| 645BUC2101 | None | | None | Water was clear, but amber in color. Culvert covered by mud & vegetation | Cleanout culvert | Lump sum | $500 | L | BCRC and BCDC |
| 22NBU0204 | None | | None | | | | | L | BCRC and BCDC |

**Table 4.5 - Recommendations and Cost Estimates for Road/Stream Crossing Sites**

| Site ID† | Location | Buffer Width | Erosion Extent | Comments | Proposed Improvements | Estimated Unit Cost | Estimated Total Cost | Priority | Potential Responsible Partners |
|---|---|---|---|---|---|---|---|---|---|
| 2771THR1401 | | | | | | | | L | BCRC and BCDC |
| 2774THR0201 | | | | Culvert broken | Replace culvert | $60/LF | $2,760 | L | BCRC and BCDC |
| | | | | | | High Priority | $23,250 | | |
| | | | | | | Medium Priority | $18,390 | | |
| | | | | | | Low Priority | $14,610 | | |
| | | | | | | | **$56,250** | | |

† Exact location of all NPS sites are available at County Drain Office
H = High priority, implemented within 5y ears
M = Medium priority, implemented in 5 to 10 years
L = Low priority, implemented in 10 to 20 years

**Table 4.6 - Recommendations and Cost Estimates for Tile Outlets**

| Site ID† | Buffer Width Right | Buffer Width Left | Diameter | Tile Outlet Height | Erosion Area $ft^2$ | Proposed Improvements | Estimated Unit Cost | Estimated Total Cost | Priority | Potential Responsible Partner |
|---|---|---|---|---|---|---|---|---|---|---|
| 4132NBU1802 | | | 2-12"&24" | 6-12&12-36 | 16 | Filter strip | $150/ac | $150 | H | Landowners, BCRC, BCDC, and Natural Resources Conservation Service |
| 22NBU0210 | >10' | >10' | 12" | >36" | 16 | Filter strip | $150/ac | $150 | H | Landowners, BCRC, BCDC, and Natural Resources Conservation Service |
| 22CHI2301 | 1'-3' | 1'-3' | 12" | >36" | 16 | Outlet stabilization | $70/$yd^2$ | $124 | H | Landowners, BCRC, BCDC, and Natural Resources Conservation Service |
| 263LAK2903 | 3'-10' | 3'-10' | 12" | 0"-6" | 2 | Filter strip | $70/$yd^2$ | $16 | H | Landowners, BCRC, BCDC, and Natural Resources Conservation Service |
| 455WEE1301 | 0 | 0 | 6"-12" | 6"-12" | 4 | Outlet stabilization | $70/$yd^2$ | $31 | H | Landowners, BCRC, BCDC, and Natural Resources Conservation Service |
| 23WEE2901 | >10' | >10' | 6"-8" | >36" | 12 | Outlet stabilization | $70/$yd^2$ | $93 | H | Landowners, BCRC, BCDC, and Natural Resources Conservation Service |
| 22WEE0724 | | | unknown | 0"-6" | 2 | Outlet stabilization and filter strip | $70/$yd^2$ - rip rap $150/ac - filter strip | $166 | H | Landowners, BCRC, BCDC, and Natural Resources Conservation Service |
| 277THR1201 | | | 18" | >36" | 16 | Outlet stabilization and filter strip | $70/$yd^2$ - rip rap $150/ac - filter strip | $274 | H | Landowners, BCRC, BCDC, and Natural Resources Conservation Service |
| 22NBU3604 | | | 4" | 6"-12" | 4 | Outlet stabilization | $70/$yd^2$ | $31 | H | Landowners, BCRC, BCDC, and Natural Resources Conservation Service |

**Table 4.6 - Recommendations and Cost Estimates for Tile Outlets**

| Site ID† | Buffer Width Right | Buffer Width Left | Diameter | Tile Outlet Height | Erosion Area $ft^2$ | Proposed Improvements | Estimated Unit Cost | Estimated Total Cost | Priority | Potential Responsible Partner |
|---|---|---|---|---|---|---|---|---|---|---|
| 454WEE0901 | 0 | 0 | 4" | 12"-36" | 12 | Outlet stabilization and filter strip | $70/$yd^2$ - rip rap $150/ac - filter strip | $93 | M | Landowners, BCRC, BCDC, and Natural Resources Conservation Service |
| 273WEE1701 | | | 4" | 6"-12" | 4 | Outlet stabilization and check inlet | $70/$yd^2$ | $31 | M | Landowners, BCRC, BCDC, and Natural Resources Conservation Service |
| 273WEE1701 | | | 4" | 6"-12" | 4 | Outlet stabilization | $70/$yd^2$ | $31 | M | Landowners, BCRC, BCDC, and Natural Resources Conservation Service |
| 2751CHI1301B | | | 8"-12" | 12"-36" | 12 | Outlet stabilization | $70/$yd^2$ | $93 | M | Landowners, BCRC, BCDC, and Natural Resources Conservation Service |
| 36NBU1601 | >10' | >10' | 48" | 6"-12" | 4 | Outlet stabilization | $70/$yd^2$ | $31 | M | Landowners, BCRC, BCDC, and Natural Resources Conservation Service |
| 2772THR1102 | | | | 12"-36" | 12 | Outlet stabilization | $70/$yd^2$ | $93 | M | Landowners, BCRC, BCDC, and Natural Resources Conservation Service |

| | |
|---|---|
| High Priority | $1,036 |
| Medium Priority | $373 |
| Low Priority | $0 |
| | **$1,409** |

† Exact location of all NPS sites are available at County Drain Office
H = High priority, implemented within 5y ears
M = Medium priority, implemented in 5 to 10 years
L = Low priority, implemented in 10 to 20 years

**Table 4.7 - BMP Recommendations for Other Sites****

| Site ID† | Buffer Width | Land Use Left Bank | Land Use Right Bank | Comments | Proposed Improvements* | Priority |
|---|---|---|---|---|---|---|
| 27WEE1001 | 0 | Agricultural | Agricultural | Livestock access on both banks for 100 feet. Vegetation is sparse. | Cattle exclusion fence, crossing improvements, and Streambank BMPs | H |
| 459WEE0601 | 0 | Agricultural | Agricultural | Livestock access on both banks for 25 feet. Vegetation is sparse. | Cattle exclusion fence, crossing improvements, and Streambank BMPs | H |
| 4381THR1501 | No | Agriculture | Agriculture | Livestock access on right bank for 100 feet. Vegetation is sparse and banks are severely eroded. | Cattle exclusion fence, crossing improvements, and Streambank BMPs | H |
| 4381THR1602 | No | Agriculture | Agriculture | Livestock access on both banks for 100 feet. Vegetation is sparse. | Cattle exclusion fence, crossing improvements, and Streambank BMPs | H |
| 4511GAL1102 | No | Agriculture | Agriculture | Cattle have complete access on both banks. Vegetation is stable. | Cattle exclusion fence, crossing improvements, and Streambank BMPs | M |
| 255ABER0703 | No | Agriculture | Agriculture | No buffer, plowing perpendicular to field. | Turf management BMPs | L |
| 22NBU0301 | <1' | Res/comm | Wetland | Fertilized lawn without buffer. Possible site for pesticide and fertilizer contamination. | Turf management BMPs | L |
| 22NBU0302 | 3'-10' | Res/comm | Wetland | Fertilized lawn without buffer. Possible site for pesticide and fertilizer contamination. | Turf management BMPs | L |
| 22NBU0303 | <1' | Res/comm | Wetland | Fertilized lawn without buffer. Possible site for pesticide and fertilizer contamination. | Turf management BMPs | L |
| | | | | | High Priority | 4 |
| | | | | | Medium Priority | 1 |
| | | | | | Low Priority | 4 |

*Turf management BMPs = soil testing, filter strips, education, shade trees on south & west sides of stream
*Streambank BMPs = depending on severity, live stakes, facines, tree revetments, or worst case riprap
† Exact location of all NPS sites are available at County Drain Office
** Costs will be identified when the sites have been more thoroughly assessed. Potential partners include landowners, NRCS, and the conservation district.
H = High priority, implemented within 5y ears
M = Medium priority, implemented in 5 to 10 years
L = Low priority, implemented in 10 to 20 years

## 4.5 POLICY REVIEW

Maintaining organized and sound land use decisions requires direction from local ordinances and master plans. A vital component of these ordinances is water resources. Many land uses require access to water as a natural feature or as a necessary component for production. Examining existing policies is crucial to create carefully crafted municipal codes that reflect the diverse communities of the Watershed. Since development is unavoidable, quality developments must be placed in the right place to preserve open space, farmland, and urban cores.

Ordinances and master plans for the townships and communities in the Watershed were analyzed for their effectiveness at protecting water resources. Using the Center for Watershed Protection's Code (CWP) and Ordinance Worksheet, each community's ordinances and master plans were scored on a common scale. Scoring is based on the theory that protecting water quality through master planning and ordinances requires the reduction of impervious cover. Impervious cover is defined as surfaces that do not allow permeation of storm water, for example, roof tops, parking lots, and roads. Studies collected by the CWP, show that urbanized areas with impervious cover greater than 10% have a significant impact on water quality (CWP, 1998). As impervious cover increases, the amounts of storm water runoff increases in direct proportion. Thus increasing the amounts of heavy metals, hydrocarbons, thermal pollution, and sediment that enter rivers and streams.

The township and community ordinances in the Watershed were developed in the 1970s and have since become outdated for rapid modern development patterns. To help direct new development, communities have recently begun to develop master plans. Oronoko Township, Weesaw Township, New Buffalo City, Chikaming Township, Three Oaks Township, and Buchanan Township have developed master plans that provide a vision or goal of what they would like their communities to look like in the future. The master plans have included provisions for the protection of water resources and open space; however, the ordinances in these communities do not support the goals of the master plan.

### CODE AND ORDINANCE WORKSHEET

The Code and Ordnance Worksheet (COW) used in the ordinance assessment was a three-part survey of the ordinances that determine parking and transportation design, community planning, and open space conservation. Each of the three categories are broken into a number of components that relate to opportunities that community's have to protect water quality by reducing impervious cover. The COW asks questions about the existence of ordinances that directly or indirectly have a means to reduce the amount of impervious surfaces in new developments. For example, the COW asks in the community

planning section, “What is the minimum requirement for front set backs of residential lots.” If the answer is less than 20 feet, the community will receive one point. Once completed, there are a total of 40 points possible in the parking and transportation category, 36 points in community planning, and 24 points in open space conservation, for a total of 100 points. The communities that participated in the policy review and their respective scores are listed in Table 4.8.

**Table 4.8 - Code and Ordinance Worksheet Scores**

| Community | Parking and Transportation (40 pts) | Community Planning (36 pts) | Open Space Conservation (24 pts) | Total (100 pts) |
|---|---|---|---|---|
| Weesaw Township | 1 | 6 | 0 | 7 |
| Oronoko Charter Township | 0 | 1 | 1 | 2 |
| New Buffalo City | 0 | 3 | 1 | 4 |
| Chikaming Township | 0 | 2 | 2 | 4 |
| Three Oaks Township | 0 | 2 | 1 | 3 |
| Baroda Township | 0 | 2 | 1 | 3 |
| Bertrand Township | 2 | 4 | 0 | 6 |
| Buchanan Township | 0 | 0 | 2 | 2 |
| Galien Township | 0 | 3 | 0 | 3 |
| Lake Township | 0 | 8 | 3 | 11 |

A review of the responses in the COW reveals specific areas of the existing development rules that need improvement. Parking and transportation ordinances lacked minimum and maximum lot sizes, number of required spaces, road width minimums, sidewalk designs, etc. Adding these requirements along with innovative site design ordinances will assist the communities in the Watershed in resource protection. Since this was only an initial survey of development policies, there are likely oversights in master plans and ordinances that are not accounted for in the scoring. If a more thorough analysis is completed the scores would increase.

## POLICY RECOMMENDATIONS

The principles in the COW are not all applicable to the Watershed and should be considered as guidelines rather than milestones. Future revisions to the ordinances and master plans should focus on a watershed-based approach and develop a cooperative beyond their jurisdictional boundaries. The strictly jurisdictional approach can lead to quick fixes rather than addressing the actual problem within an entire watershed. A watershed planning perspective will encourage local planners and developers to look at the entire area contributing to a water body and determine its needs for management and protection. Chapter 3 in this WMP outlines the goals and objectives to reduce nonpoint pollution in the Watershed. When revising ordinances the changes should reflect the priorities developed by the Steering Committee.

Many policy sections need improvement if the Watershed communities wish to protect their natural resources. Although this is only an initial policy review, there are already visible trends in current policies that could be amended to provide safeguards for water quality. Some general policy recommendations are as follows:

- Enforcement of septic site ordinances.
- Require filter strips and buffers in new developments and agricultural areas.
- Require soil testing for new developments.
- Change set back ordinances to allow for cluster development.
- Adopt open space ordinances that protect forest and wetlands.
- Create conservation ordinances and tax incentives with options for the PDRs.
- Change ordinances to include design criteria for driveways, roof area, parking requirements, and road widths.
- Create a watershed master plan that considers areas where development will occur and what types will be allowed.
- Revise floodplain ordinance so no future development will occur within 100-year floodplain.

- Adopt SESC inspection and enforcement ordinance.

- Adopt native landscaping ordinance.

- Adopt wetland protection ordinances.

- Adopt a planning ordinance that limits amounts of impervious surfaces and requires onsite detention of storm water runoff.

## MODEL ORDINANCES

Many communities around the country have adopted ordinances using model ordinances developed by organizations, such as the EPA and the CWP. A model ordinance should be used as a framework for developing ordinances that include the unique features in the community. For example, wetland and native vegetation ordinances could include more specifics about local vegetation resources that are particular to the Watershed. Examples of model ordinances can be found by visiting the Storm Water Center online at http://www.stormwatercenter.net/ and clicking on the ordinances link.

# CHAPTER 5 - COMMUNITY OUTREACH PROGRAM

## 5.1 INTRODUCTION

I&E strategies are designed to involve the public in a way that increases their awareness of water quality issues and motivates them to take action. The WMP will use the following I&E strategy to achieve its goals and objectives by identifying target audiences and outreach methods. I&E strategies were developed by the following I&E Subcommittee members:

- Mr. Carol Svebakken - League of Women Voters
- Mr. Pat Underwood - Berrien County Parks and Recreation Department
- Ms. Cathy Johnson - Conservation Funds
- Ms. Anne Hendrix - Berrien County Deputy Drain Commissioner

## 5.2 TARGET AUDIENCES

All those that make decisions, implement those decisions, and are affected by decisions should be included into the target audience. The I&E Subcommittee organized the target audience list into the following groups:

- General Public: Homeowners (permanent and seasonal), schools and youth groups, agricultural producers (fruit, row crops, and livestock)

- Conservation Organizations: Conservation districts, parks, Farm Bureau, the Galien River Watershed Council, Land Trusts, Pokagon Band. Nature Centers: (Fernwood and Sarett), Friends of St. Joseph River

- Government: Federal (EPA), state (MDEQ, MDNR, MDA, IDNR, Indiana Department of Environmental Management (IDEM), local governments planning committees, townships, county, and MSU Cooperative Extension

- Developers

- Corporate golf courses, forestry, and landscaping companies

## 5.3 GOALS AND OBJECTIVES

The main goal of the I&E strategy is building and retaining high levels of stakeholder awareness and involvement in the Watershed project so that community values related to stewardship for the Watershed can be sustained. Public consciousness about the relationship between their daily activities and water quality is a typical weakness in most citizens. Public consciousness about the relationship between daily activities and water quality is a typical gap in watershed management. To increase this understanding, watershed residents must participate in activities that benefit water quality.

To achieve the goal of increasing public awareness of watershed issues and involvement in stewardship, programs must build and retain the following:

- Watershed recognition
- Knowledge of water quality impairments
- Knowledge of watershed-friendly land use practices
- Maintaining and identifying partnerships

## 5.4 DEVELOPING MESSAGES

While most citizens are not aware of how water quality and resource uses become impaired, most have some knowledge that water resources are in jeopardy. When residents see beach closings, algal blooms, and aesthetically unpleasing streams and lakes they are experiencing water use impairments, even though they may have a limited understanding of how this happened. Public education messages will incorporate these interests into messages that relate to concerns the public already holds.

## 5.5 COMMUNICATION TOOL BOX

Communication materials that are essential to the success of the community outreach efforts will be compiled into a Communication Tool Box that will contain the following:

- **Galien River Watershed Project Logo**: A River Project logo has been created to connect communications about watershed activities to the project and to increase awareness.

- **General Information Brochure**: A simple, self-mailer brochure containing general information about the Watershed (definition, goals, and practices) will be developed. The brochure will include the logo, contact information, and relevant graphics. The brochure should be easy to read and be eye-catching.

- **Website**: Berrien County Government web site serves as an educational and informational tool for the public to access the Watershed project newsletters and to learn about the Watershed in one convenient place, www.berriencounty.org.

- **Newsletters & Fact Sheets**: Two- to four-page newsletters and one-page fact sheets are to be distributed to stakeholders, conservation organizations, and government elected officials.

- **News Releases**: Provide regular news release to local media and radio to expand the area of coverage to the public about the education and information of the Watershed Project.

- **Galien River Watershed Signage**: Create signs featuring the Watershed logo which indicates that the people who display the sign have implemented watershed friendly land use practices. The signs will make the progress and accomplishments of the Watershed project more visible to the public.

- **Signs**: Will identify the boundary of the Watershed.

- **Fact Sheets**: Displays and other informational materials for distribution at community events.

- **Kiosk**: At an easily accessible public site, the kiosk will provide a map and information on the Watershed and project activities.

## 5.6 INFORMATION AND EDUCATION ACTIVITIES

When comparing target audiences one will find that they are a diverse group that will not respond to the same types of messages and delivery methods. The following list relates I&E activities to the target audience.

## HOMEOWNERS

**Objectives**:

- To increase awareness and adoption of water quality, protective lawn care, landscaping, yard maintenance practices, and refuse accumulation and disposal.

- To increase awareness of the Galien River and its tributaries' values to local quality of life.

- To increase awareness of invasive species, dangers of failing septic systems, and conservation easement options.

**Activities**:

- Event Participation: Develop a display and public information material to be available at community events such as the county fair and township celebrations.

- The Galien River Days: Get a proclamation for the Galien River Days and support and design specific community activities to support.

- Newsletters: *History of the Galien River.* Continue providing newsletters and fact sheets to demonstrate the importance of the Galien River and its tributaries to the community and raise awareness of the value of the Watershed to local quality of life. Newsletters will also inform residents of activities and water quality issues directing them to information and assistance.

- Volunteer Projects: Develop and encourage programs that enable the landowner to get more involved with land conservation and water quality.

- Signage/Awards: The use of recognizable signage for conservation landscaping methods along with conservation awards program.

- Field Days: To demonstrate sites that highlight the effectiveness of BMPs in protecting water quality.

## SCHOOLS AND YOUTH GROUPS

**Objectives**:

- To increase awareness of water quality and watershed ecology.

- To increase awareness of the value of the Galien River to local quality of life.

**Activities**:

- Presentations/Field Days: Coordinate with Berrien County Parks and other conservation organizations such as land trusts, MDNR, etc., to provide presentations regarding conservation and watershed management at grade appropriate levels to local schools and youth organizations. Coordinate with Berrien County Parks and others to design field days with conservation messages that school age appropriate classes could participate in.

- Volunteer Projects: Identify, support, and encourage volunteer projects appropriate for school groups including awards programs for conservation conscience school, class, individual, or teacher and the support of agriculture in the classroom program. Design school targeted projects and programs in association with Galien River Days using essay contests, coloring contest, etc.

- Publications: Develop and distribute grade appropriate conservation and watershed management information.

## AGRICULTURAL PRODUCERS

**Objectives**:

- To increase the number of agricultural producers and acreage in filter strips, grassed waterways, and other stewardship and conservation farming practices. To encourage conversion of marginal farmland back to permanent cover or natural vegetation.

- To increase the number of producers using a comprehensive nutrient management plan and to decrease the number of producers that allow their livestock access to surface water.

- To increase the attendance of agricultural producers at workshops, presentations, and training sessions on land use practices that benefit water quality.

**Activities**:

- Articles in Specialty Publications: Educational and informational articles to appear in county specific publications in the *Conservation District Newsletter*, *Southwest Michigan Land Conservancy Newsletter*, and in agricultural organization newsletters/circulars that target this audience. Articles would highlight services to agricultural producers to assist them in implementing BMPs.

- Show Participation: Display conservation information at agricultural events and trade shows. Invite speakers to events with first-hand experience in conservation farming, current nutrient management practices, and opportunities for assistance. Recognizable signage on lands using conservation farming methods or other conservation related activities along with conservation awards programs. Target activities for Galien River Days.

- Develop Partnership with Agricultural Service Providers: Develop partnerships with equipment and supply dealers. Distributing information through information stands at these businesses to farmers about fertilizers, soil testing, and nutrient management during the spring.

- Field Days: To demonstrate conservation farming methods and results.

## CONSERVATION ORGANIZATIONS

**Objectives**:

- To ensure continued encouragement and support in assistance with the implementation of the WMP.

**Activities**:

- Publications: Circulate newsletters and regular progress reports. Prepare letters of encouragement and support/appreciation for involvement.

## GOVERNMENT

### LOCAL

**Objectives**:

- To foster a sense of ownership and investment in the Watershed project among area officials and planning commissions.

- To increase coordination between agencies to maximize benefits of available programs and protect water quality.

- To raise awareness of BMPs that could be implemented to reduce erosion, reduce pollution, and encourage conservation.

**Activities**:

- Develop appropriate technical information in a useable format (maps, newsletters, reports) to support water quality protective ordinances and for future land-use planning strategies.

- Recognize members of the local units of government who have contributed to improving water quality by distributing articles on these officials and their accomplishments as they relate to water quality.

- Coordinate Meetings: Host working group meetings with agencies to discuss ways to incorporate BMPs and opportunities for the agencies to apply for cost-share programs. Newsletters and fact sheets will serve as supplemental educational pieces.

- Demonstration Sites: Develop demonstration sites that highlight the effectiveness of BMPs in protecting water quality and the benefits of these practices in reducing costs to the agency in decreased maintenance.

- Watershed Tour: Host a watershed tour to highlight project activities and progress.

## STATE AND FEDERAL AGENCIES

**Objectives**:

- To increase awareness of the Watershed progress.
- To increase support to implement water quality initiatives.

**Activities**:

- Publications: Keep governmental officials and agencies informed of the Watershed project progress and issues with progress reports, newsletters, news releases, and by personal contact.
- Public Contact: Invite, as appropriate, officials to meetings as speakers.
- Galien River Days: Involve officials in Galien River Days and encourage involvement in significant events.

## DEVELOPERS

**Objectives:**

- To increase awareness of impact from developing land in the Watershed.
- To increase awareness of the use of BMPs during construction.

**Activities:**

- Publications: Fact sheets and other informational literature to increase developers awareness of BMPs, the desire to disrupt as little land as possible, and the preservation of natural resources.
- Provide literature and guidance for BMPs from SESC county enforcing agency.
- Invite developers to create demonstration sites using BMPs to provide onsite homeowner education.

## CORPORATE GROUPS

**Objectives**:

- To increase awareness of impacts from land use activities in the Watershed.

- To increase awareness of over use and appropriate use of fertilizer and pesticides.

**Activities**:

- Publications: By the use of fact sheets and other informational literature, increase golf course's awareness of BMPs and the desire to use preservation of natural landscaping. Through fact sheets and other informational literature, promote native (organic plants and methods) and the elimination of invasive species and the preservation of conservation methods to landscaping groups and for sustainable forestry.

- Encourage local nurseries and landscapers to provide the appropriate literature to clients and offer native planting options.

- Invite corporations (golf courses, nursery) to develop demonstration sites using BMPs, giving recognition, and using the demonstration sites for onsite homeowner education.

## ALL STAKEHOLDERS

**Objectives**:

- To increase the level of participation among stakeholders through increased meeting attendance and regular attendance.

- To keep stakeholders involved in protecting water quality even after the grant ends.

**Activities**:

- Develop a watershed organization: Develop a "Friends of the Galien River" group to monitor and undertake activities that affect water quality, environmental issues, and recreational uses of the river.

- Meeting Mailings: Maintain and expand stakeholder mailing list to be used for communication about meetings and other project status issues.

## 5.7 SCHEDULE AND COSTS

Coordinating the various activities for all the above stakeholders will require a strategic timeline and a qualified full-time Public Education Coordinator. Table 5.1 summarizes the activities and assigns a schedule of implementation and estimated costs. The Public Education Coordinator would solicit the partners suggested on this table within the first quarter of I&E implementation strategy.

**Table 5.1 - Outreach Plan**

| Activity | Partners | Schedule | Costs |
|---|---|---|---|
| **General Public (all groups)** | | | |
| Event participation | ● Townships<br>● County | (Based on county fair and township celebrations) | $5,000 - 2 displays |
| Galien River Days | ● County level | Annual | $5,000 - annually, First year to establish event may require greater funds |
| Newsletters: history and information on the Galien River | ● All citizens and groups<br>● Historians<br>● Conservation districts<br>● Conservation organizations<br>● Nature centers<br>● Farm Bureau<br>● MSU Ext. | Up to 4 times a year | $1,600 - paper<br>$3,500 - printing |
| Signage/awards: show participation | ● NRCS<br>● Chikaming open lands<br>● SWMLC<br>● County | On-going | $7,500 - 100 signs at $75 each |
| **Homeowners** | | | |
| Volunteer projects | ● County<br>● Landowners<br>● Land trusts<br>● Corporations<br>● Townships<br>● Neighborhoods<br>● Towns/villages | On-going, 4 per year | $200 each, $800/year |
| Field days | • NRCS - backyard habitat program<br>• Land trusts<br>• Townships<br>• County<br>• Parks planning | 1/year | $200/year |

**Table 5.1 - Outreach Plan**

| Activity | Partners | Schedule | Costs |
|---|---|---|---|
| **Schools and Youth Groups** | | | |
| Presentations/field days | ● Berrien County Parks<br>● Conservation organizations<br>● MDNR<br>● MDEQ<br>● Schools and youth groups<br>● 4-H<br>● Farm Bureau - Ag in classroom | ● Varies - based on community events<br>● 4 per year | $200 - misc. |
| Volunteer projects, scout groups, and stream monitoring | ● Schools and youth groups<br>● County<br>● Township | ● On-going | $200/yr |
| Publications, contests, and drawings | ● Schools and Youth Groups<br>● Parks<br>● Conservation organizations | ● Annual poster<br>● Recognition awards | $1,000 - 5,000 copies |
| **Agricultural Producers** | | | |
| Articles in specialty publications | ● Conservation district, NRCS<br>● Southwest Michigan Land Conservancy<br>● Chikaming open lands<br>● Farm Bureau<br>● Michigan Farmers Exchange | Based on publication schedule of organization | No charge |
| Displays at trade shows, speakers and presentations | ● NRCS<br>● MDA<br>● MSU Ext.<br>● County | Up to 4 times a year | $800 - $1,000 |
| Develop partnership with agricultural service providers | ● Farm equipment suppliers | On-going | No charge |
| Field days | ● NRCS<br>● Farm Bureau<br>● MSU Ext.<br>● County<br>● Conservation organizations | 2 times a year | $2,000 |

**Table 5.1 - Outreach Plan**

| Activity | Partners | Schedule | Costs |
|---|---|---|---|
| **Conservation Organizations** | | | |
| Publications - distribution | ● SWMLC<br>● Chikaming open lands<br>● Nature centers (Love Creek, Fernwood) | Quarterly | $20.00 - postage per quarter |
| Field days | ● SWMLC<br>● Chikaming open lands<br>● MDNR | With other agencies | See homeowner and agriculture |
| **Local Government** | | | |
| Develop appropriate technical information in a useable format | ● SWMLC<br>● Sea grant<br>● Michigan land use inst.<br>● Townships | On-going | $1,000 |
| Recognize members of the local units of government who have contributed to water quality | ● Township | Annually and on-going | $500.00 - printing |
| Coordinate meetings | ● SWMLC<br>● Chikaming open lands<br>● Depends on issue | As needed | $200 |
| Demonstration sites | ● See other sections | See other sections | See agriculture and homeowner |
| Watershed tour | ● See other sections | | |
| **State and Federal Agencies** | | | |
| Publications - distribution | ● USFWS<br>● MDNR<br>● MDEQ<br>● NRCS<br>MSU - Ext | Quarterly | $100 - postage |
| Public contact | ● MDNR<br>● MSU Ext.<br>● MDEQ<br>● MDA<br>● USFWS | Up to 4 times a year | $100 |
| Galien River days | ● See general section | | |

**Table 5.1 - Outreach Plan**

| Activity | Partners | Schedule | Costs |
|---|---|---|---|
| **Corporate Groups** | | | |
| Publications - distribution | ● NRCS<br>● MSU Ext.<br>● County<br>● Township<br>● SWMLC<br>● COL<br>● Farm bureau | Specific publication of partners | $1,000 |
| Encourage local nurseries and landscapers to provide appropriate literature | ● SWMLC<br>● COL<br>● County<br>● Township<br>● MDNR<br>● MDEQ<br>● NRCS | On-going | $11,000 - copies, stand for copies |
| Invite corporations to develop demonstration sites | ● Golf courses<br>● Nursery | On-going | No cost |
| **Stakeholders** | | | |
| Develop a watershed organization | ● All groups and citizens | Quarterly meetings | $500/year |
| Meeting mailings | | Quarterly updates/newsletters | $2,000 - postage<br>$500 - printing |

Require to implement work plan is a COMMUNICATION SPECIALIST/PROJECT MANAGER
- $30,000 to $35,000/year plus benefits and expenses for 3 years.

## 5.8 EVALUATION

Evaluating the Community Outreach Program is an ongoing task that will allow adjustments as needed to keep the program on track. The evaluation will also allow the program manager to know when and where to proceed with the implementation phase of the project.

The Information & Education Subcommittee members established evaluation methods and measurable goals for the Community Outreach Program. Methods to evaluate each activity were considered and the most feasible in terms of time and cost were selected. Measurable goals were determined through experience and knowledge of the I&E Subcommittee members. The evaluation techniques and the evaluation schedule for each Community Outreach activity are listed in Table 5.2.

**Table 5.2 – Evaluation Strategy for Galien River Watershed Community Outreach Program**

| Community Outreach Activities | Implementation Schedule | Evaluation Techniques | Measurable Goal | Evaluation Schedule | Evaluation Partners |
|---|---|---|---|---|---|
| Event participation | During County Fair and Township celebrations | Number of participants | Continued participation in event every year | Count number of participants after each event | County, townships |
| Galien River Days for the general public and to involve State and Federal Agencies | Annual | Number of attendees | Continued participation every year | Count number of attendees after event | USFWS, NRCS, MDNR, MDEQ, county, MSU extension |
| Newsletters/publications to the general public | 4 times per year | Number of calls for additional information | Increase number of calls after each newsletter is distributed | Monitor calls after dissemination | Citizens, Historians, Conservation District, Nature Centers, Farm Bureau, MSU Extension |
| Signage to show participation | On-going | Number of call in response to seeing signage | Increase in calls | Monitor after signs are installed | NRCS, Chikaming Open Lands, SWMLC, county |
| Signage to show watershed boundaries | On-going | Public recognition | Increase in public recognition of watershed project based on number of inquiries | Monitor calls or comments after signs are installed | Berrien County Road Commission, Berrien County Drain Commissioner, Townships and Villages |
| Volunteer projects for homeowners | 4 times per year, on-going | Number of volunteers participating in project | Maintain number of volunteers for each project | Tally number of volunteers after each project | County, landowners, corporations, townships and villages, neighborhood associations |
| Field days for homeowners | Once per year | Number of attendees | Continued participation every year | Count number of attendees after yearly event | NRCS Backyard Habitat Program, townships and villages, county, parks departments |
| Presentations and field days for schools and youth groups | During community events, 4 times per year | Number of requests for presentations from schools and youth groups | Maintain number of presentations to meet requests each year | Schedule presentation after each request | Schools and youth groups, 4-H, Farm Bureau, FFA, Conservation Organizations, MDNR, MDEQ, Berrien County Parks |

| Community Outreach Activities | Implementation Schedule | Evaluation Techniques | Measurable Goal | Evaluation Schedule | Evaluation Partners |
|---|---|---|---|---|---|
| Volunteer projects for scout groups and stream monitoring | On-going | Number of volunteers participating in project | Maintain number of volunteers for each project | Tally number of volunteers after each project | Scout groups and schools, parks departments, townships and villages, county |
| Publications, contests and drawings for school and youth groups | Annual poster Bi-yearly drawings | Number of students and youths participating | Increase number of students participating | Count number of participants after each event | School and youth groups, parks departments, conservation organizations |
| Articles in specialty publications for agricultural producers | According to schedules of publications | Space in publication allocated to topic | Maintenance of space for articles each year | Monitor calls after each publication is distributed | Farm Bureau, Michigan Farmer Exchange, Conservation District, NRCS, SWMLC, Chikaming Open Lands |
| Displays at trade shows, speakers and presentation for agricultural producers | 4 times per year | Number of people stopping to view display | Increase in number of flyer, publications, and brochures picked up at display locations | Count after each event where display is set up | NRCS, MDA, MSU Extension, County |
| Partnerships with agricultural service providers | On-going | Number of partnerships agreements developed | Increase number of partners every year | Yearly | Farm equipment suppliers |
| Field days for agricultural producers | 2 times per year | Number of attendees | Continued participation every year | Count number of attendees after yearly event | NRCS, Farm Bureau, MSU Extension, county, Conservation District |
| Publications for Conservation Organizations | Quarterly | Number of calls for additional information | Increase number of calls after each publication is distributed | After distribution | SWMLC, Chikaming Open Lands, Love Creek and Fernwood Nature Centers |
| Field days for Conservation Organizations | Coordinate schedule with other agencies | Number of attendees | Continued participation every year | Count number of attendees after yearly event | SWMLC, Chikaming Open Lands, MDNR |
| Technical information for local governments | On-going | Number of calls for additional information | Increase number of calls after each information is available | After distribution | SWMLC, Sea Grant, Michigan Land Use Institute, Townships and Villages |
| Recognition awards for local officials | Annual and on-going | Number of local officials nominated for award | Increase in nominations | Tally number of nominations every year | Townships and villages |
| Meetings for local officials | As needed | Comments received from exit surveys | Increase in number of requests for meetings | Surveys tallied after each meeting | SWMLC, Chikaming Open Lands, other agencies that relate to issue |

| Community Outreach Activities | Implementation Schedule | Evaluation Techniques | Measurable Goal | Evaluation Schedule | Evaluation Partners |
|---|---|---|---|---|---|
| Watershed tour and demonstration sites for local officials | Once per year | Number of representatives attending tour for their area | Increase of attendance to eventually have all areas represented. | Yearly after tour | Planning departments, Berrien County Drain Commissioner, NRCS, Conservation District |
| Publications of state and federal agencies | Quarterly | Number of calls for additional information as a result of reading the article | Increase in number of calls | Monitor calls after each publication is distributed | USFWS, NRCS, MDNR, MDEQ, MSU Extension |
| Public contact with state and federal agencies | 4 times per year | Number of public contacts | Increase number of contacts to eventually have all areas represented | Tally number of contacts after every event | USFWS, NRCS, MDNR, MDEQ, MSU Extension |
| Publications of corporate groups | Coordinate schedule with groups' publications | Number of calls for additional information | Increase number of calls after each newsletter is distributed | After dissemination | Agribusiness companies, golf courses, nurseries |
| Literature in local businesses | On-going | Number of people stopping to view display | Increase in number of flyer, publications, and brochures picked up at display locations | After each event where display is set up | Local nurseries and landscapers, SWMLC, Chikaming Open Lands, MDNR, MDEQ, NRCS, County |
| Demonstration sites on corporate property | On-going | Number of corporations installing demonstration site | Increase in installations every year | Monitor number of demonstration sites installed | Golf courses, nurseries |
| Develop Watershed organization | Quarterly meetings | Number of representatives attending meetings for their area | Increase of attendance to eventually have all areas represented | Quarterly after each meeting | All groups and stakeholders |
| Direct mailings | Quarterly updates | Number of calls for additional information | Increase number of calls after each mailing | Monitor calls after each mailing | All groups and stakeholders |

The “Activity Summary Sheet”, Table 5.3, will be completed after each Community Outreach activity. Evaluating each activity on its effectiveness in getting the message to the audience will be beneficial in determining the continuation or modification of that activity. This will provide for an easy to read summary of the event and a measurable component of the public outreach strategy allowing the event to be evaluated at different levels.

**Table 5.3 – Summary Evaluation Sheet**

| **GALIEN RIVER WATERSHED**<br>**Summary Evaluation Sheet** |
|---|
| **ACTIVITY:** |
| **TARGET AUDIENCE:** |
| **OBJECTIVE:** |
| **RESOURCE CONCERN:** |
| **MESSAGE:** |
| **DATE COMPLETED:** |
| **TOTAL COST:** |
| **EVALUATION METHOD:** |
| **MEASURABLE GOAL:** |
| **LEVEL OF SUCCESS:** |
| **COMMENTS:** |

# CHAPTER 6 - EVALUATION METHODS

The evaluation of a project is a means of measuring its effectiveness. It is a way of learning from experience and identifying areas in need of improvement. Methods of assessment are varied and different types of evaluation should be combined to gain the most insight about why elements of a project may have succeeded or failed. An evaluation process should be formed at the conception of the project, and should be used as a learning tool until completion. Setting measurable goals to be achieved by a certain date allows progress to be continually gauged and a dynamic plan can adjust to meet changing demands or specified goals.

Each quarter a report is due to the MDEQ that describes the progress made within the work plan's schedule and budget. This quarterly review not only helps the MDEQ recognize that grant funds are being used to complete the original goals and scope of the project, but it helps everyone involved to adhere to time tables in a project focused manner.

Part of this project's focus is to increase awareness of water quality issues in the Watershed. To obtain this goal requires the dedication of all involved in the project, as well as those living in the Watershed. The dilemma to this approach is, how can dedication be measured?

One way to gauge dedication is to assess whether more parties have become interested in providing funds or in-kind services to the project. As the project continues, there should not be a waning interest in workshops and meetings. The parties involved in this endeavor should be a diverse representation of all stakeholders to ensure that fresh ideas are always being incorporated into the plan and that the momentum of the project never slows.

The most difficult task to developing a WMP is the transition from the planning phase to the implementation phase. It is often difficult to weigh different interests and arrive at solutions which please everyone in a timely manner. For this reason, a completion schedule should be formalized to make certain that programs are implemented on schedule. Table 6.1 shows the goals of this WMP and the techniques that will be used to evaluate the desired planning goals.

## 6.1 PLANNING PROJECT EVALUATION CRITERIA

The first phase of the Watershed project is to gather stakeholders to devise a plan to improve the water quality in the Watershed. Local involvement is key to establishing the basis for identifying problems, sites, sources, corrective actions, and partners. A Steering Committee provided oversight, while an I&E Subcommittee and a Technical Subcommittee provided expertise and additional work to bring products to the Steering Committee.

**Table 6.1 - Evaluation Techniques for Galien River Watershed Project Planning Phase**

| Goals | Evaluation Techniques | Units of Measurement | Measurable Goals | Scheduled Completion |
|---|---|---|---|---|
| Form Galien River watershed steering committee | Documentation of stakeholder participation | Number of committed members and diversity of representation | Increase number of returning members and groups represented by 25% in the second year | June 2003 |
| Establish I&E subcommittee and create educational strategy | Documentation of stakeholder participation and educational strategy | Number of committed members and diversity of representation, creation of educational strategy | Increase number of returning members and groups represented by 25% in the second year, and completion of educational strategy | June 2003 |
| Establish technical subcommittee and draft water quality statement | Documentation of stakeholder participation and water quality statement | Number of committed members and diversity of representation, and creation of water quality statement | Increase number of returning members and groups represented by 25% in the second year, and completion of water quality statement | June 2003 |
| Prepare resource library | Extent of bibliography | Number of references and documents collected | Categorized list of resources | June 2003 |
| Submit quarterly reports to MDEQ | Timely submittal of reports with minimal revisions | Dates of submittal | Submittal date and number of revisions | Quarterly July 2001-June 2003 |
| Conduct watershed tour | Record attendance of watershed tour | Attendance of watershed tour and positive feedback | Minimum 50% attendance of Steering Committee and over 50% positive feedback responses | June 2002 |
| Increase amount of local match toward implementation | Calculate percent of local match | Percentage change of local match | Net positive change in local match | June 2003 |
| Develop an approvable watershed management plan | Watershed management plan approved by the MDEQ | The MDEQ letter of approval | Have plan approved by July 2002 | July 2002 |
| Present watershed management plan to individual stakeholders | Lessons learned presentation | Number and type of comments received and utilized | More than 50% of comments are positive and all comments responded to or incorporated into revised plan | June 2003 |

## 6.2 IMPLEMENTING PROJECT EVALUATION CRITERIA

The WMP gives recommendations of BMP systems and the critical areas where implementation should occur. The number and location (inside or outside the critical areas, spread evenly across the Watershed or just in certain areas) of BMPs implemented gives an indication of whether the goals are being met across the Watershed and in the critical areas.

Calculating pollutant reductions for each BMP helps assess the overall impact on the Watershed and water quality. One way to assess their impact is to compare the cost of the BMPs to the amount of pollutant reduced. The goals of implementation should be revisited and compared with the BMPs that have been installed to make sure they are meeting the goals. A portfolio of before and after photographs not only allows different sites and practices to be assessed against one another, but is also a valuable I&E tool. Sites should be visited and landowners interviewed to determine what unforeseen problems or ancillary benefits were encountered. Table 6.2 lists the water use impairments, water quality goals, and the techniques to evaluate set goals.

Ongoing and recurring physical and biological water quality monitoring is taking place. *E. coli* is measured by the MDEQ as part of the TMDL process, and the Health Department tests various sites and beaches for this pollutant. The MDEQ also conducts biosurveys approximately every five years. Other studies that can be done by a variety of groups, for example the BCDC and science students, are impervious cover calculations and macro invertebrate surveys. These simple tests give a qualitative assessment of stream conditions and are even more valuable when testing is done regularly to establish trends.

**Table 6.2 - Summary of Evaluation Techniques for Galien River Watershed Project Implementation Phase**

| Impairment/Source/Cause | Evaluation Techniques | Units of Measurements | Measurable Goals | Schedule |
|---|---|---|---|---|
| Sediment | Pollutant Reduction Calculations | Tons of sediment prevented from entering surface water | 25% reduction of sediment from entering surface waters in 5 years* | Add results of sediment reduction calculations every year |
| | BMPs implemented to reduce sediment | Number and location of BMPs implemented | Implement BMPs on all identified NPS sites of sediment loading | Running tally during implementation phase |
| | Photographs of BMPs installed to reduce sediment | Before and after photographs | Portfolio of photographs with supporting documentation | Before and after BMP installation |
| | Cost/benefit comparison | Cost of BMP implementation and pollutant load reduction | Economic impact of pollutant load reduced outweighs cost of BMP implementation | Running tally during implementation phase |
| | Macro invertebrate surveys | Water Quality Rating (from SOS: Stream Quality Survey) | Increase rating of water quality | After MDEQ macroinvertebrate survey cycle is completed |
| Nutrients | Pollutant Reduction Calculations | Pounds of phosphorus and nitrogen prevented from entering surface water | 25% reduction of phosphorus and nitrogen from entering surface water in 5 years* | Add results of phosphorus reduction calculations every year |
| | BMPs implemented to reduce nutrients | Number and location of BMPs implemented | Implement BMPs on all identified NPS sites of nutrient loading | End of implementation phase |
| | Photographs of BMPs installed to reduce nutrients | Before and after photographs | Portfolio of photographs with supporting documentation | Before and after BMP installation |
| | Cost/benefit compensation | Cost of BMP implementation and pollutant load reduction | Economic impact of pollutant load reduced outweighs cost of BMP implementation | End of implementation phase |
| Obstructions | Mediation of obstructions which inhibit flow and cause erosion | Number and location of obstructions removed | Number and location of obstructions removed consistent with watershed management plan | After construction season every year |
| | Obstruction altered to alleviate problems | Type of alterations to obstructions | Alterations of obstructions done in a manner consistent with WMP | After construction season every year |
| *E. coli* | Water quality monitoring for *E. coli* | Bacteria counts/100 ml | Meet water quality standards for total body contact recreation (130 count/100 ml) in all water bodies in the watershed | Coordinate with the MDEQ sampling schedule for interim measure |

**Table 6.2 - Summary of Evaluation Techniques for Galien River Watershed Project Implementation Phase**

| Impairment/Source/Cause | Evaluation Techniques | Units of Measurements | Measurable Goals | Schedule |
|---|---|---|---|---|
| | Eliminate sources of *E. coli* | Number and location of sources eliminated | Eliminate all identified *E. coli* contributing sites | End of scheduled date for TMDL implementation |
| | Cost/benefit compensation | Cost and health risk of eliminating source and pollutant load reduction | Economic impact and health risk reduction of E. coli reduced outweighs cost of BMP implementation | End of implementation phase |
| Degraded fish populations | MDEQ biological surveys | Populations and diversity of fish species | Increase fish community rating to acceptable level | After MDEQ fish survey cycle is completed |
| | Creel survey of fishers | Amount, size, and species of fish caught | Increase number of fishers using the streams and the number of fish caught | Yearly surveys |
| Hydrology | Hydrologic Analysis | Peak flows shown on hydrographs | Reduce peak flows on hydrographs by limiting impervious cover, minimizing channelization of streams, and restoring wetlands | Run hydrologic model at end of implementation |
| Temperature | MDEQ biological surveys | Habitat evaluation | Increase ratings for stream cover | After MDEQ habitat survey cycle is completed |
| | Impervious cover calculations | Amount of impervious cover by subwatershed | Changing development rules to limit amounts of impervious cover in developments | End of implementation phase |
| Dissolved oxygen and pH<br>Pesticides<br>Oil and Grease<br>Metals | MDEQ biological surveys | Biological, chemical, and physical indicators | Increase water quality ratings | After MDEQ biological survey cycle is completed |
| | Landowner awareness of problems and assistance availability | Amount of landowners visited | 90% of landowners with identified sources in critical areas visited | Yearly assessment of meeting goal |
| | Compare installed BMPs to goals of implementation | Type of BMPs installed address implementation goals | At least 90% of BMPs installed directly address implementation goals | Yearly assessment of meeting goal |

*Once base loads are measured, a quantitative reduction goal can be set. For example, Prevent x tons/year of pollutant y from entering surface waters.

## 6.3 PARTNERS IN CONDUCTING EVALUATIONS

The MDEQ routinely conducts a biosurvey of the Watershed, assessing water quality and stream health. The MDEQ also oversees the TMDL and will be monitoring *E. coli* levels in known problem areas.

The BCDC is responsible for maintaining the drains in the Watershed, which lie mainly in the eastern portion of the Watershed. Bank stability and nonpoint source pollution entering the drains are concerns. Corrective action taken on the drains is the responsibility of the BCDC, and progress should be evaluated regularly.

# CHAPTER 7 - SUSTAINABILITY

Members of the Steering Committee provided information about existing water quality projects, programs, and ordinances in the Watershed throughout the planning process. The Berrien County area has many organizations that are working toward a common goal of land and water conservation and improved water resources. Building upon and coordinating with these identified programs will help meet the goals of this WMP. Long-term sustainability is possible for restoring this Watershed due to the high level of involvement in preserving and protecting the unique resource of the River. The Steering Committee will be able to join forces with these efforts to continue its own mission of providing direction for the development of a community-based, sustainable WMP for the Watershed and support the implementation of the plan.

Many partners have already stepped forward to implement portions of the WMP. The following activities are planned:

- The Conservation Fund will coordinate the overall effort to implement the recommendations in the WMP.

- The Conservation Fund will write and submit a grant to install buffer strips.

- The Galien River Conservation District will reprint the Galien River Watershed newsletters in the Conservation District newsletter to generate more interest.

- Weesaw Township will continue to look for funding to improve the sewer infrastructure.

- The Tri-State Watershed project will serve as an umbrella under which other watershed grants will function.

- The National Fish and Wildlife Foundation is developing a proposal that will be reviewed by the Berrien County Board and The Conservation Fund.

- The PALS/Kellogg Foundation is offering grants that The Conservation Fund will apply for and will match NFW funding.

- The League of Women Voters and Chikaming Township will sponsor a land use planning workshop with funding through the Coastal Zone Management Program.

- Chikaming Township will submit a grant proposal to the Michigan Trust Fund to restore native vegetation on 256 acres of newly acquired parkland.

- Chikaming Township will submit a grant proposal to the Michigan Trust Fund to restore native vegetation on 256 acres of newly acquired parkland.

The Galien River Watershed Steering Committee will support these efforts through the end of the project, at which time The Conservation Fund will assume responsibility for monitoring the progress and assisting with finding funding opportunities.

## 7.1 LONG-TERM PLANNING

The WMP outlines the actions over the next 20 years that stakeholders can take to continue the implementation of the plan. Immediate and short-term remedies need to fit into the overall long-term planning for a community. Growth and development can be guided in ways that are sustainable and appropriate for the community. Policies can be put in place that can collectively shape how development happens in a watershed. Specific rules and regulations can be implemented through zoning and other ordinances that address those long-term concerns.

Long-term improvements to the Watershed through physical measures of BMPs depend on the type of structures and the operation and maintenance plans. Often, ongoing maintenance is neglected, resulting in shortened life spans of BMPs or even detrimental conditions depending on the type of BMP. Costs and responsibilities should be revisited on a regular basis, such as when annual budgets are recalculated.

Private landowners who are interested in implementing structural BMPs must ensure that time and money is allocated to maintain and repair these structures. A well designed system should withstand most weathering, but some systems may require regular maintenance such as cleaning sediment basins or harvesting vegetation (necessary where cattails absorb heavy metals from urban runoff or excessive nutrients from agricultural or lawn care runoff in basins).

## 7.2 EXISTING MANAGEMENT STRATEGIES

Prior to the Watershed project, organizations have participated in watershed management in the Watershed without the use of a comprehensive watershed management plan. Their efforts include: development of planning and zoning ordinances, environmental education, and land conservation. The coordination of these efforts would build a stronger coalition to improve the Galien River and surrounding areas.

A small portion of the Watershed is located in Warren Woods and the Chikaming Township Park Preserve. Both areas have been recognized as prize lands for conservation since they have the most diverse species populations in the State of Michigan. Inventories in the Chikaming Township Park Preserve by the Michigan Natural Features Inventory have identified six state threatened species and three of Special Concern. The Nature Conservancy and the Southwest Michigan Land Conservancy have also expressed a special interest in preserving this unique portion of the State.

An 86-acre parcel of land adjacent to Lake Michigan was purchased with assistance from a state grant by the Berrien County Parks Department to be managed as a nature area known as the Galien River County Park. The County plans to construct a nature center, trails, and improved access to the Galien River for fishing and canoeing. The area is adjacent to the Great Lakes marsh donated to the COL.

The Great Lakes Marsh encompassing 156 acres of undeveloped land on the Lake Michigan shoreline and was donated to the COL by the New Buffalo area Sima family. This area is possibly Southwest Michigan's largest continuous undeveloped marsh. Future management plans for the area include restoring the marshland to its original state. Native plant growth will be encouraged and the elimination and control of invasive and non-indigenous plants will be initiated. Public access will provide recreational opportunities for nature lovers, bird watchers, researchers, and students; however, no roads or trails will be built in accordance to the deed restrictions that prohibit increased human access.

The above examples of management strategies have all been focused on the protection of land from future development by buying the property or its conservation easements. There are other opportunities for townships to develop their own planning ordinances to restrict development of natural areas and to control land use within the Watershed to lessen the impacts from development. Other proactive strategies, like the ones listed below, include a variety of programs ranging from wetland restoration programs to farmland leasing.

## 7.3 ONGOING PROGRAMS AND OPPORTUNITIES

The **USDA Farm Services Agency (FSA) and NRCS** provide technical and financial assistance to landowners to address resource concerns of soil, water, air, plants, and animals. The agencies offer cost-share opportunities through many federal programs and coordinate with state and local programs to maximize benefits. http://www.mi.nrcs.usda.gov/

The **Wetland Reserve Program (WRP)** is administered by the NRCS. The landowner controls access to the land and may use it for recreational activities such as hunting and fishing. There are three options for the WRP.

1. 10-Year Cost Share Agreement

This agreement is a cost share program where the NRCS pays 75% of the restoration costs and the landowner signs an agreement to keep the wetland in place for 10 years. This option is very similar to the U.S. Fish and Wildlife Service's Partners for Wildlife Program.

2. 30-Year Easement Option

The NRCS "purchases" a 30-year conservation easement over the property. The NRCS will pay 75% of all restoration costs and pay the landowner 75% of the appraised agricultural value of the property under the easement.

3. Permanent Easement Option

The NRCS "purchases" a permanent conservation easement over the property. The NRCS will pay 100% of all restoration costs and pay the landowner 100% of the appraised agricultural value of the property under the easement.

An example of a successful wetlands restoration is the Mullet Muck Farm Restoration in Sanilac County, Michigan. The 836-acre restoration was originally under a 30-year easement, but has now been transferred to the MDNR. Serpentine channels were created in the previously leveled farm field, which resulted in more shoreline for wading birds. http://www.nrcs.usda.gov/

The Community Status Book lists all of the communities participating in the **National Flood Insurance Program.** The following communities are participating in the Watershed:

| Community | Date Entered into Program |
|---|---|
| Chikaming Township | 06/01/1978 |
| Buchanan Township | 03/02/1998 |
| Lake Township | 11/01/1979 |
| New Buffalo Township | 12/04/1979 |
| Oronoko Township | 06/17/1986 |
| City of New Buffalo | 12/04/1979 |

The community rating system rewards mitigation efforts in local communities with discounts on the flood insurance premiums paid by policy holders in the communities. Floodplain management is a goal of the WMP. The development and enforcement of sound floodplain management ordinances is important, not only for the economical element of making flood insurance affordable, but also the environmental element of protecting a functioning floodplain for a healthy ecosystem.

The **CRP** was created in 1985 as part of the Food Security Act. A farmer may enter into a long-term contract to set aside land and establish a permanent cover. In return, the farmer receives an annual per acre rent and up to half the cost of establishing cover on land that has recently been farmed and is highly erodible or environmentally sensitive. In the first five years of the program, 33.9 million acres were enrolled in the CRP. Additional Acts in 1990 and 1996 have allowed continued enrollment and expanded the scope from reducing soil erosion to include habitat conservation. Participants may sign up at any time to perform the following practices on their land:

- Filter Strips
- Riparian Buffers
- Shelterbelts, Field Windbreaks, and Living Snow Fences
- Grass Waterways
- Shallow Water Areas for Wildlife
- Salt-Tolerant Vegetation
- Certain Approved Public Wellhead Protection Areas

Today, the Environmental Benefits Index (EBI) is used to prioritize land offered for enrollment. Scores are based on a cost factor, plus six environmental factors, as follows:

- Wildlife
- Water Quality
- Erosion
- Enduring Benefits
- Air Quality Benefits from Reduced Wind Erosion
- State or National Conservation Priority Areas (CPAs). The Great Lakes, along with Long Island Sound, the Chesapeake Bay, the Longleaf Pine region, and the Prairie Pothole region comprise the national CPAs.

The goals of CREP in Michigan focus on reducing nonpoint source pollution in the forms of sediment (by 784,000 metric tons), nitrogen (by 1.6 million pounds), and phosphorus (by 0.8 million pounds) over the next 15 to 20 years. Goals also include protecting water supplies used by over one million people and improving wildlife habitat. This program seeks to protect 5,000 linear miles of streams against sedimentation.

The **Farmland Protection Program** in the recently enacted Farm Bill has up to $50 million in funds to assist in the purchase of development rights on agricultural lands. Development pressure on the urban fringe causes large amounts of land to be converted to non-agricultural uses. Proposals must be submitted to the NRCS state offices. The American Farmland Trust is an organization that works toward sustainable agriculture through education and financial assistance to communities and landowners. http://www.farmland.org/

The **BCDC** assists with surface water activities that are associated with designated drains. Some projects, such as subdivision development, require specific site plan criteria. The Drain Commissioner is responsible for drain improvements and keeping the integrity and appropriate function of the drains intact.

**MSU Extension** utilizes the resources of Michigan State University and works on community outreach, especially with agriculture and families. MSU Extension offers a wide variety of technical assistance and employs individuals with high levels of expertise in their area of concentration to meet specific needs of producers. They are also involved with research to better the services and technology available. Demonstration plots and training workshops involve the landowners in the implementation of practices they can adopt to address resource concerns.

The **Future Farmers of America** involves youth in farming activities and teaches them skills they will need to be farmers including soil identification and livestock care. There is an opportunity to involve them in implementation of BMPs on farms in the Watershed.

The **Boy Scouts of America and the Girl Scouts of the U.S.A.** involve many children in Berrien County with personal growth and community stewardship. Boy Scouts and Girl Scouts work on community and natural resource projects and learn through service. A great opportunity exists to use these groups in volunteer stream and river enhancement and monitoring projects. The collaboration of the Watershed project and these groups would have mutual benefits.

**Forest Lawn Landfill**

In September of 1999, the MDEQ entered a consent agreement with Forest Lawn Landfill, Inc. (FLL) to resolve violations of the Solid Waste Management Act. The order requires FLL to develop a groundwater remediation system and to prevent further leachate and runoff from entering the Galien River. In addition to the above requirements, FLL is required to undertake a Supplemental Environmental Project that provides 85 acres of riparian habitat near the landfill site on the banks of the Galien River (MDEQ Waste Management Division). This stretch of river could be used as a public park to permanently protect riparian habitat from development pressures.

# CHAPTER 8 - RESOURCE LIBRARY

The following resources have been made publicly available by the BCDC. The library will temporarily be located at the Drain Commissioner's office in St. Joseph, Michigan.

1. *Methods for Collecting Benthic Invertebrate Samples as part of the National Water-Quality Assessment Program*. By US Geological Survey, Open-file Report 93-406.

2. *Methods for Collecting Algal Samples as Part of the National Water-Quality Assessment Program*. By U.S. Geological Survey, Open-file Report 93-409.

3. *Wildflowers, Peterson Field Guides*. By Roger Tory Peterson/Margaret McKenny.

4. *Field Guide to Eastern Birds, Peterson Field Guide*. By Roger Tory Peterson. 1998.

5. *Benthic Macro Invertebrates in Clean Water*. By United Stated Environmental Protection Agency.

6. *Galien River Watershed Road Stream Crossing Survey*. By the MDEQ, 2000.

7. *Galien River Stream/Road Crossings*. By Berrien County Road Commission.

8. *Upper Rouge River (Draft) Subwatershed Management Plan*. By Upper Rouge River Subwatershed Advisory Group.

9. *An Evaluation of River Restoration Techniques in Northwestern Ohio*. By U.S. Army Corps. of Engineers, May 1984.

10. *A Guide to the George Palmiter River Restoration Techniques*. By Institute of Environmental Sciences, Miami University.

11. *Watershed Diagnostic Study of the Little Calumet-Galien River Watershed*. By Applied Ecological Service, Inc. September 2001.

12. *State Natural Areas in Michigan*. By Department of Natural Resources, Michigan.

13. *Michigan Agricultural Pollution Prevention Directory*. Department of Environmental Quality, Environmental Assistance Division.

14. *The Flowering Plants and Ferns of Warren Woods, Berrien County, Michigan*. By Cecil Billington.

15. *Floristic Quality Assessment with Wetland Categories and Examples of Computer Applications for the State of Michigan*, Revised, 2nd Edition - October 2001. MDNR.

16. *Serving America's Farmers and Ranchers*. Farm Service Agency.

17. *The U.S. Department of Agriculture's Natural Resources Programs. Financial, Technical, and Educational Assistance for Landowners.* USDA, Farm Service Agency, NRCS and Forest Service.

18. *Fact Sheet: Conservation Reserve Program*. Farm Service Agency.

19. *Farm Storage Facility Loan Program*. USDA.

20. *The Conservation Reserve Program*. Farm Service Agency, USDA.

21. *Unified National Strategy for Animal Feeding Operations*. USDA, U.S. EPA.

22. *Conservation Buffers Work...Economically and Environmentally*. USDA.

23. *Your Guide to Managing Agricultural Wastes*. MSU Extension.

24. *The Conservation Reserve Program: Innovation in Environmental Improvement*. USDA.

25. *Helping you Conserve Michigan Forests. New Opportunities for Landowners*. MDNR, USDA Forest Service, State and Private Forestry Program.

26. *Michigan Native American Environmental Quality Incentives Program;* Farm Bill Stewardship Programs. USDA.

27. *Groundwater Monitoring*. MSU Extension.

28. *Polluted*. U.S. EPA, Office of Water, Washington, DC.

29. *The Conservation Reserve Program. Innovation in Environmental Improvement*. USDA.

30. *People in Partnership for a Healthy Land*. USDA, and NRCS.

31. *Buffer Strips: Common Sense Conservation*. USDA.

32. *Establishing Cool Season Grasses and Legumes for Conservation Cover*. USDA.

33. *Southwestern Michigan Progressive Pork Producer Program*. MSU Extension.

34. *Keys to Sustainable Forest Management. A pocket guide for Michigan Private Forest Landowners, Stewards of Tomorrow's Forests*. Michigan Forest Resource Alliance.

35. *Wind Erosion and Its Control*. USDA SCS.

36. *Minority Farmers, Enriching the Tapestry of American Agriculture*. FSA.

37. *Construction Engineers. Soil Surveys Can Help You.* USDA SCS.

38. *It's About Nature. It's About the Earth*. Michigan Envirothon.

39. *USDA Pesticide Recordkeeping Requirements*. USDA.

40. *Natural Disaster Assistance*. FSA.

41. *Growing Carbon: A New Crop That Helps Agricultural Producers and the Climate Too*. USDA, NRCS.

42. *Irrigation Water Management To Protect AG Resources.* NRCS, 1997.

43. *Chikaming, Galien, Lake, New Buffalo, Three Oaks and Weesaw Townships Natural Resources and Conservation Directories, May 2001*. Prepared for COL by Cathy Johnson.

44. *Aquacide Company*, Bulletin 2002.

45. www.epa.gov/owow/wetlands, (wetlands fact sheets - upper right hand corner).

46. www.cwp.org

47. www.epa.gov/win

48. www.cdoe.org/rougeriver

49. http://www.census.gov/geo/www/ua/uafedreg031502.pdf final criteria for determining urban areas from the 2000 census.

50. http://www.cwp.org/COW_worksheet.htm codes and ordinances review.

51. *Guidebook of BMPs for Michigan Watersheds*, reprinted August 2001, MDEQ, SWQD.

52. *Agricultural BMPs Manual for Michigan's Nonpoint Source Pollution Program*, MDEQ, SWQD.

53. http://www.cwp.org slideshow presentations, "Why Watersheds?" available on CD-ROM.

54. http://www.msu.edu/habrong/miwtrshd.htm, link to useful Michigan Watershed websites and maps.

55. April 23, 1990 - Galien River Watershed Nonpoint Source Pollution Control Grant. Section 205j and 319 grant proposal. Southwest Commission 1990. (Not funded)

56. September 26, 1991 - Galien River Watershed Nonpoint Pollution Control Plan. Section 319 grant proposal. Southwest Michigan Commission. 1991. (Not funded)

57. April 4, 1994 - Galien River Watershed Nonpoint Pollution Control Plan. Section 319 grant proposal. Southwest Michigan Commission. 1994. (Not funded)

58. 1999 - Galien River Project. Berrien County Drain Commissioner. Inland Fisheries Grant. (Not funded)

59. December 29, 1999 - Little Calumet-Galien Watershed Diagnostic Study. Indiana Department of Natural Resources, Division of Water, Coastal Coordination Program. Grant Proposal.

60. Galien River Flood Mitigation and Natural Resource Project. Request for Proposal. Peg Kohring.

61. March 2000 - A Biological and Physical Assessment of the Galien River Watershed. Berrien County, Michigan. August 19-25, 1997. MDEQ-SWQD MI/DEQ/SWQ-99/114.

62. 2000 - Chikaming Township Park Preserve. Grant Proposal to MNRTF.

63. March 16, 2000 - Galien River County Park Preserve. Grant Proposal to MNRTF. County of Berrien, Parks and Recreations Commission.

64. June 16, 2000. - Floristic Inventory. Michigan Department of Natural Resources.

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66. Herman, K. D., L. A. Masters, M. R. Penskaer, A. A. Reznicek, G. S. Wilhelm, W. W. Brodovich, and K. P. Gardiner. 2001 Floristic Quality Assessment with Wetland Categories and Examples of Computer Applications for the State of Michigan - Revised, 2nd Edition. Michigan Department of Natural Resources, Wildlife, Natural Heritage Program. Lansing, MI. 19 pp. + Appendices.

67. Michigan Department of Environmental Quality, Waste Management Division. Recently Resolved Cases, http://www.michigan.gov/deq/1,1607,7-135-3312_9280-33542--,00.html.

68. Berrien County Parks and Recreation Commission, AGrant Application for Michigan Natural Resources Trust Fund, Galien River County Park Preserve,@ March 16, 2000.

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# ACRONYMS

| | |
|---|---|
| BCDC | Berrien County Drain Commissioner |
| BCHD | Berrien County Health Department |
| BMP | Best Management Practice |
| CAFO | Concentrated Animal Feeding Operation |
| COL | Chikaming Open Lands |
| COW | Code and Ordinance Worksheet |
| CREP | Conservation Reserve Enhancement Program |
| CRP | Conservation Reserve Program |
| CSO | Combined Sewer Overflow |
| EPA | United States Environmental Protection Agency |
| FEMA | Federal Emergency Management Agency |
| GIS | Geographic Information System |
| GPS | Global Positioning System |
| I&E | Information and Education |
| IDEM | Indiana Department of Environmental Management |
| IDNR | Indiana Department of Natural Resources |
| MDEQ | Michigan Department of Environmental Quality |
| MDNR | Michigan Department of Natural Resources |
| MIRIS | Michigan Resource Information System |
| NPDES | National Pollutant Discharge Elimination System |
| NRCS | Natural Resources Conservation Service |
| PCB | Polychlorinated Biphenyls |
| PDR | Purchase of Development Rights |
| SESC | Soil Erosion and Sedimentation Control |
| TMDL | Total Maximum Daily Load |
| USFWS | United States Fish and Wildlife Service |
| WHIP | Wildlife Habitat Incentive Program |
| WMP | Watershed Management Plan |
| WQS | Water Quality Standards |
| WRP | Wetland Reserve Program |