Rabbit River Watershed Management Plan

July 2009
Project No. G06302

Rabbit River Watershed Project

ALLEGAN COUNTY · 1835 · MICHIGAN · 1835 ·

ALLEGAN CONSERVATION DISTRICT

DEQ Michigan's Nonpoint Source Program

fishbeck, thompson, carr & huber
engineers • scientists • architects • constructors

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
KALAMAZOO DISTRICT OFFICE

JENNIFER M. GRANHOLM
GOVERNOR

STEVEN E. CHESTER
DIRECTOR

August 26, 2009

Ms. Becky Rininger
Allegan County Drain Commission
113 Chestnut Street
Allegan, Michigan 49010

Dear Ms. Rininger:

SUBJECT: Rabbit River Watershed Management Plan

Thank you for requesting approval from the Department of Environmental Quality (DEQ) for the Rabbit River Watershed Management Plan (Plan). The efforts and support of your organization and partners to preserve and protect our surface water resources is appreciated.

Ms. Janelle Hohm, of my staff, has reviewed the Plan dated July, 2009 (final version received on August 4, 2009) with respect to the criteria specified in the Administrative Rules for the Clean Michigan Initiative (CMI) Nonpoint Source Pollution Control Grants promulgated pursuant to Part 88, Water Pollution Prevention and Monitoring, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, effective October 27, 1999. The review indicates that the Plan, as submitted, meets these criteria and is hereby approved for the purpose of the CMI Nonpoint Source Pollution Control Grant Program.

In addition, Ms. Hohm reviewed the Plan with respect to the nine required elements as described in the United States Environmental Protection Agency's (EPA's) document entitled, "*Supplemental Guidelines for the Award of Section 319 Nonpoint Source Grants to States and Territories in FY 2003.*" As you may be aware, as of 2003, The EPA requires that all implementation projects funded under Section 319 be supplemented by a watershed plan that meets the EPA nine elements. The review indicates that the Plan, as submitted, meets these criteria.

Thank you for your efforts in the development of this Plan. The DEQ looks forward to assisting your organization with future efforts to implement this Plan.

Sincerely,

Gregory A. Danneffel
Kalamazoo District Supervisor
Field Operations Division
Water Bureau
269-567-3575

GAD:JH:DMS

cc: Mr. Robert Day, DEQ
Mr. Robert Sweet, DEQ
Mr. Peter Vincent, DEQ
Ms. Julia Kirkwood, DEQ

RABBIT RIVER

WATERSHED MANAGEMENT PLAN

PREPARED FOR:
ALLEGAN COUNTY DRAIN COMMISSIONER

JULY 2009
PROJECT NO. G06302

This Nonpoint Source Pollution Control project has been funded in part through the Michigan Nonpoint Source Program by the United States Environmental Protection Agency under assistance agreement C9975474-01 to the Allegan County Drain Commissioner for the Rabbit River Watershed Planning Project. The contents of the document do not necessarily reflect the views and policies of the EPA, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

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LIST OF ABBREVIATIONS/ACRONYMS

ACD	Allegan Conservation District
BMP	Best Management Practice
CMI	State of Michigan’s Clean Michigan Initiative
CREP	Conservation Reserve Enhancement Program
CSF	Cubic Feet Per Second
CWA	Clean Water Act
DU	Ducks Unlimited
FTC&H	Fishbeck, Thompson, Carr & Huber, Inc.
EQIP	Environmental Quality Incentive Program
GLEAS	Great Lakes and Environmental Assessment Section
HUC	Hydrologic Unit Classification
I&E	Information & Education
LCWM	Land Conservancy of West Michigan
LID	Low Impact Development
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MDOT	Michigan Department of Transportation
MNFI	Michigan Natural Features Inventory
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NRCS	USDA Natural Resources Conservation Service
PDR	Purchase of Development Rights
PLA	Prediction Level Assessment
PPP	Public Participation Process
RLA	Reconnaissance Level Assessment
RRISSC	Rapid Resource Inventory for Sediment and Stability Consequence
SEMCOG	Southeast Michigan Council of Governments
State	State of Michigan
SWAS	Surface Water Assessment Section
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
USACE	U.S. Army Corps of Engineers

USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WARSSS	Watershed Assessment for River Stability and Sediment Supply
Watershed	Rabbit River Watershed
WMP	Watershed Management Plan
WQS	Water Quality Standards
WWSL	Waste Water Sewage Lagoon
WWTP	Waste Water Treatment Plant

EXECUTIVE SUMMARY

The Rabbit River Watershed (Watershed) is located primarily in Allegan County, with parts extending into Barry, Ottawa, and Kent Counties. The Watershed encompasses approximately 187,200 acres, primarily agricultural, forested, and urban land. A large majority of the Watershed is rural. The Rabbit River originates east of Wayland, Michigan, in Leighton Township, and flows westerly to join the Kalamazoo River at New Richmond, which then flows on to Lake Michigan north of the City of Saugatuck.

History of Rabbit River Project

In the late 1980's, residents in the upper Rabbit River banded together to prevent areas of the Rabbit from being dredged or straightened, and to keep the Rabbit River a natural system. In 1992, citizens formed the Friends of the Rabbit River. In 1994, the Allegan Conservation District (ACD) began the process of submitting a Federal Clean Water Act Section 319 project to develop a Watershed Management Plan (WMP) for the Little Rabbit River. A WMP was produced in 1997.

Projects in the Watershed continued in 1999 with a Clean Water Action Plan Implementation Project. In the summer of 2000, the Little Rabbit River Watershed Project finalized its cost-share and produced a Michigan Department of Environmental Quality (MDEQ) approved WMP under the State of Michigan's Clean Michigan Initiative (CMI) criteria. The Clean Water Action Plan grant for the entire Watershed was in full swing and a new 319 planning project began for the Upper Rabbit River. The WMP for the Upper Rabbit River was completed in 2005, and an implementation grant for the entire Rabbit River was awarded in 2006 to complete a WMP for the entire Watershed to meet the federal 319 criteria and to implement wetlands restoration projects.

WMP Structure and Purpose

A WMP is a document that builds on the strengths of existing programs and resources, and addresses water quality concerns within the watershed. The purpose of the WMP is to identify and to restore the designated uses impacted by non-point source (NPS) pollution.

The Natural Resources and Environmental Protection Act (P.A. 451 of 1994, as amended) requires all waters of the State of Michigan (State) to meet eight designated uses. According to this legislation, all surface waters of the State are designated and protected for the following uses:

- Agriculture
- Industrial Water Supply
- Public water supply at the point of intake
- Navigation
- Warmwater fishery (some waterbodies are also protected as a coldwater fishery)
- Other indigenous aquatic life and wildlife
- Partial body contact recreation
- Total body contact recreation between May 1 and October 1

The Rabbit River WMP documents the existing conditions affecting the water quality and identifies actions that stakeholders can take to resolve existing problems and prevent future degradation of water resources. It contains information stakeholders found to be important, and the goals and decisions within it reflect what the community wants for the Watershed. The primary goal of the project is to restore the designated uses of the Watershed by correcting causes of sedimentation, nutrient inputs, and high-flow occurrences. The sources of sediment include stream banks, cropland, construction sites, and road crossings/road ditches. Nutrients are entering the stream from agricultural production and residential area runoff. Damaging high flows are resulting from uncontrolled storm water runoff due to development and past drainage practices.

This WMP is intended to be used by a wide variety of stakeholders and it is structured so that the main body of the plan is easily understandable. The detailed scientific explanations, analyses and assessments are placed in the appendices for individuals who would like information that is more specific.

The WMP is arranged in sections, with the first section including the Table of Contents and a list of Abbreviations and Acronyms, which are identified the first time they are used in the document. The second section is the narrative portion divided into Chapters, with several Exhibits and Tables imbedded in the text, and References Cited at the end. The third section includes all of the full size Figures referenced in the narrative. The fourth section includes the Appendices referenced in the narrative.

Mission and Vision Statements

The Mission of the Project is:

"To support our Vision of the Rabbit River Watershed, the Steering Committee will develop and implement a Watershed Management Plan."

The Vision of the Project is:

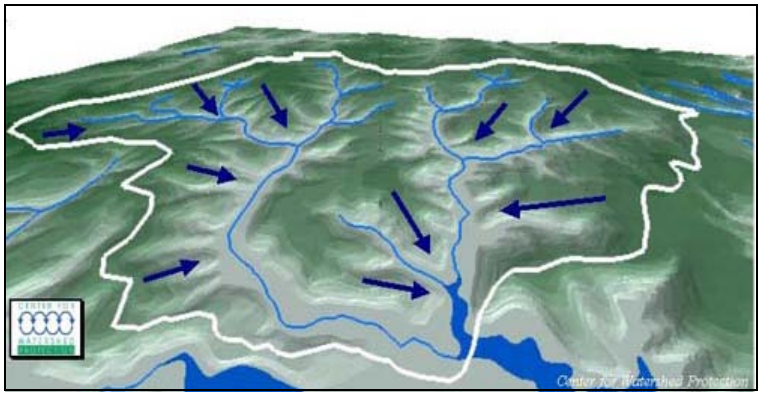
"Rabbit River as a natural flowing river that supports a healthy, diverse population of native animal and plant species within robust natural communities, while maintaining social and economic viability in the watershed."

CHAPTER 1 – INTRODUCTION

1.1 PURPOSE OF WATERSHED MANAGEMENT PLAN (WMP)

A watershed is an area of land, defined by hills and ridges, which drains to a common body of water (Exhibit 1). A WMP documents the sources and causes of water pollution and outlines a strategy to address activities that impair water quality within a watershed. The WMP gives an action-oriented approach to address the needs and proposed solutions for effectively managing the watershed and restoring all of the applicable designated uses in the watershed.

Exhibit 1 - Example of a Watershed



Applicable Designated Uses for the Rabbit River Watershed (Watershed):

- Agriculture
- Partial Body Contact Recreation
- Total Body Contact Recreation
- Warmwater Fishery
- Coldwater Fishery
- Other Indigenous Aquatic Life and Wildlife
- Industrial Water Supply

These uses are explained in more detail throughout this plan. Input from all of the interested people in the Watershed was considered during the development of the plan, so it is a reflection of the ideas and goals of what the community wants for the Watershed.

The goals and objectives developed in the plan will be accomplished by harnessing existing positive community awareness, utilizing locally driven experienced agency resources, retaining qualified staff, utilizing contractors, and by combining agricultural best management practices (BMPs) with land-use planning and ordinance review. This combination will reduce nonpoint source (NPS) pollution and improve water quality on both a site-specific basis through installation of BMPs, and on a large-scale township basis, through land-use planning, zoning, and ordinance review. Local water quality conditions will be improved by installing traditional systems of BMPs including livestock exclusion, stream bank stabilization, filter strips, and erosion control. NPS pollution will be reduced on a multi-township or countywide basis through the revision of master plans, the addition of ordinances for natural resource protection, and zoning to protect water quality.

1.2 KEY ELEMENTS OF A WMP

The key elements of a WMP are as follows:

1. Understanding the watershed characteristics, for example; land use, soils, topography, hydrology, rainfall characteristics, significant natural resources, and the community profile.

2. Identifying local agencies and citizens within the watershed and getting them involved in the watershed management planning process. Receiving input from all of the interested parties in the watershed to identify the goals of the watershed plan.

3. Identifying the designated and desired uses of the watershed, including those uses currently being met, those that are impaired, and those not being met.

4. Defining critical areas, or portions of the watershed, which are contributing a majority of the pollutants and are having a significant impact on the waterbody, then surveying the watershed to inventory the critical areas.

5. Identifying and prioritizing pollutants, sources and causes based on the inventory findings and the highest priorities of the watershed.

6. Determining objectives and tasks for meeting the watershed goals. An objective is how you will reduce pollution from a source to protect or restore a designated use. The plan will identify systems of BMPs, estimate costs associated with BMP design and installation, and estimate the pollutant load reduction expected with each BMP installation. A BMP is a

structural, vegetative, or managerial practice implemented to control sources or causes of NPS pollution, such as installation of filter strips, stream bank stabilization, or livestock exclusion fencing. Also included in the plan are estimations of the period of time needed to complete each task and the proposed order in which to complete the tasks.

7. Identifying and analyzing existing local projects, programs, and ordinances that impact water quality within the watershed. Local programs will be analyzed to determine if they are sufficient for protecting water quality or if they need to be revised and updated to include natural resource protection or additional zoning to protect water quality.

8. Informing and involving the public to motivate them to take action to protect the water quality in their watershed.

9. Developing an evaluation process to provide measures of the effectiveness of implementing the WMP and to increase the project sustainability by showing positive results.

1.3 PUBLIC PARTICIPATION PROCESS (PPP)

Local involvement in the decision-making process is vital for a watershed project to be successful. The first step in organizing this watershed project was to identify all interested and affected individuals, groups, organizations, businesses, agencies, and local governments that would put into effect, or be affected by, the planning and implementation of this project. The PPP report, which includes information on the formation of the Steering Committee and Subcommittees, is found in Appendix 1.

The Steering Committee provided input and decision-making guidance to the project through quarterly meetings. These meetings provided a forum to discuss all aspects of the development of the WMP. The members have been actively and effectively involved in the planning process of the project, discussing and evaluating the problems and remedies of the Watershed, assisting with Information and Education (I&E) activities, and offering suggestions based on their areas of expertise. Table 1.1 documents the dates for all of the Steering Committee meetings.

Table 1.1 - Steering Committee Meeting Dates

October 13, 2006
January 25, 2007
April 13, 2007
July 6, 2007
September 13, 2007
November 2, 2007
January 11, 2008
April 18, 2008
July 11, 2008
October 10, 2008
December 19, 2008

The following list of the members of the Steering Committee represents local government agencies, public interest groups, businesses, local producers, and residents:

Table 1.2 - Steering Committee Members

Name	Representing
Ms. Becky Rininger	Allegan County Drain Commissioner
Ms. Bev Green	Allegan County Drain Office
Mr. Shawn McKenney	Allegan Conservation District (ACD)
Ms. Tina Clemons	ACD
Ms. Kelly Goward	ACD
Mr. Carl Collier	ACD Board of Directors
Mr. Mark DeYoung	Allegan County
Mr. William Nelson	Allegan County Road Commission
Ms. Deborah Naer	City of Wayland
Ms. Liz Binoniemi-Smith	Gun Lake Tribe
Mr. Don Kaczanowski	Dorr Township
Mr. Bob Wagner	Dorr Township Planning Commission
Mr. Michael Sertle	Ducks Unlimited (DU)
Ms. Claire Schwartz	Fishbeck, Thompson, Carr & Huber, Inc. (FTC&H)
Ms. Wendy Ogilvie	FTC&H
Ms. Angela K. Brennan	FTC&H
Mr. Mark Evans	Hopkins Township
Mr. Jeff Spoelstra	Kalamazoo River Watershed Council
Mr. Pete DeBoer	Land Conservancy of West Michigan
Mr. Al Zuidema	Leighton Township Planning Commission
Ms. Janelle Hohm	MDEQ
Ms. Julia Kirkwood	MDEQ
Mr. Rob Zbiciak	MDEQ - Land and Water Management Division
Ms. Amy Oliver	Michigan Department of Natural Resources (MDNR)
Mr. John Lerg	MDNR
Mr. Paul Wylie	Michigan State University Extension (MSUE)
Mr. Mike Staton	MSUE

Mr. Chris Reinart	Monterey Township
Mr. Scott Sullivan	Penasee Globe
Mr. Bob Beck	Resident
Mr. Darwin Franklin	Resident
Mr. John Davis	Resident
Mr. Al Shields	Resident
Mr. Bernie Schwartz	Resident
Mr. Robert Jones	Salem Township
Mr. Jim Pitsch	Salem Township
Mr. Jim Byer	Salem Township Planning Commission
Mr. Nate Fuller	South West Michigan Land Conservancy
Mr. Jim Hazelman	U.S. Fish and Wildlife Service (USFWS)

An I&E Subcommittee was formed to allow additional participation in completing the details of the projects and specific tasks of the work plan. The goal of the I&E Subcommittee was to involve interested persons in the Watershed to assist in the creation of a successful and innovative I&E strategy. The I&E Subcommittee focused on the development of I&E tools and their dissemination throughout the Watershed. The Subcommittee met on October 23, 2007, and January 15, 2008, to develop the framework of the strategy. The I&E Strategy was reviewed by the Steering Committee at the July 2008 meeting and comments were inserted into the final strategy, which is included in Chapter 7. The I&E Subcommittee members are listed below:

Table 1.3 - I & E Subcommittee Members

Name	**Representing**
Ms. Becky Rininger	Allegan County Drain Commissioner
Mr. Shawn McKenney	ACD
Ms. Tina Clemons	ACD
Ms. Wendy Ogilvie	FTC&H
Ms. Julia Kirkwood	MDEQ
Mr. Paul Wylie	MSUE
Mr. Chris Reinart	Monterey Township

1.4 PUBLIC COMMENTING

A public meeting was held on March 20, 2007, at Salem Township Hall. The agenda for the meeting included a discussion on the boundaries of the Watershed and several characteristics of the watershed, such as land use, circa 1800 vegetation, the Natural Features Inventory, green infrastructure, and population density that were illustrated with various exhibits around the room. A brief history of the Watershed and a presentation of “Protecting and Preserving Natural Resources through Watershed Management” was given to the audience. The tasks of the work plan for the project were also explained.

The ACD recently updated their website, which allows interested individuals to view minutes from past Steering and Subcommittee meetings, future meeting schedules and locations, and contact information. The ACD website can be found online at www.alleganCD.org.

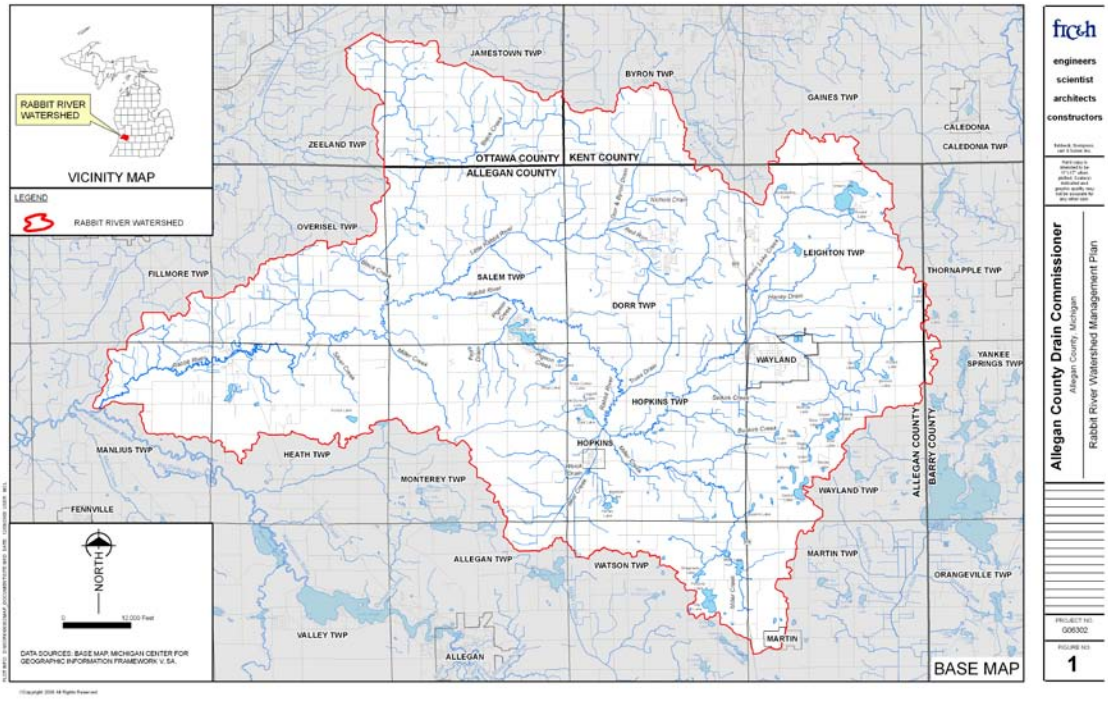
CHAPTER 2 - CHARACTERISTICS OF THE RABBIT RIVER WATERSHED

2.1 WATERSHED CHARACTERISTICS

2.1.1 GEOGRAPHIC SCOPE

The Rabbit River Watershed (Watershed) is located primarily in Allegan County, with parts extending into Barry, Ottawa, and Kent Counties (Exhibit 2). The Watershed encompasses approximately 187,200 acres; primarily of agricultural, forested, and urban land. The Watershed is a subwatershed of the Kalamazoo River Basin. A large majority of the Watershed is rural. The Rabbit River originates east of Wayland, Michigan, in Leighton Township, and flows westerly to join the Kalamazoo River at New Richmond, which then flows on to Lake Michigan (Figure 1).

Exhibit 2 - Rabbit River Watershed Base Map



2.1.2 TOPOGRAPHY

Geology and Landforms

The geology and landforms of the Rabbit River were formed and influenced most heavily by the Wisconsin Glaciation. This glacial deposition occurred about 10,000 years ago when glacial ice

receded, creating soil 50- to 400-feet-thick overlying the bedrock formations. Parts of the Watershed soils were water deposited, resulting in well-sorted layers of sands, loams, and gravel, and parts were glacially deposited, resulting in unsorted glacial till, which also provided productive farm land.

Slopes in the Watershed range from nearly level (0 %) to steep hills (45 %). Different areas of the Watershed have widely varying slopes. Several subwatersheds in the center of the Watershed, formerly wetland, now drained and farmed, have very little topographical relief and large expanses of flat land. Outer areas of the Watershed in Monterey Township, in contrast, have many hills and a rolling topography, with one hill rising more than 200 feet (elevation 951 feet) above the surrounding landscape (Figure 2).

2.1.3 SOILS

Soil type and texture class determine infiltration rates, water holding capacity, plant uptake of water, nutrient availability, erosion susceptibility and pollutant removal capability. Soils in the Watershed vary greatly (Appendix 2). The differing soils in the Watershed allow for varying rates of surface penetration and soil saturation during rain events. If a soil has a slow infiltration rate, such as loam, the soil will at first absorb water until it is saturated, then the water will infiltrate very slowly as it moves deeper into the soil. The slowness of the infiltration allows precipitation to run off the surface because the soil cannot take in the water fast enough. The runoff will enter the drainage system, either a natural system or manmade, relatively quickly. Figure 3 illustrates the hydrologic soils groups within the Watershed. Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups (Table 2.1a) according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

Table 2.1a – Hydrologic Soil Groups

Hydrologic Soil Group	Definition
A	High Infiltration
B	Medium Infiltration
C	Low Infiltration
D	Very Low Infiltration

The majority of the soils in the Watershed are hydric soils. Hydric soils are defined as poorly drained or somewhat poorly drained.

Hydric soils are:

- One of the indicators of wetlands
- Usually nutrient-rich and productive when drained for agricultural purposes
- Usually seasonally flooded and generally poorly suited for farming, except when drained
- Generally protected under wetlands regulations
- Poorly suited for development, especially for septic fields
- Locations for potential wetland restoration

Soils Relationship to Best Management Practices (BMPs)

Low impact Development (LID) is rapidly becoming the mainstream technique for storm water management. The purpose of LID is to mimic nature by managing rainfall using design techniques that infiltrate, filter, store, evaporate, and detain runoff close to the source. Many LID techniques rely on infiltrating storm water and runoff; therefore, it is important to consider soil properties, as well as geology, when implementing LID (Southeast Michigan Council of Governments [SEMCOG], 2008). LID is an extremely beneficial management technique for treating storm water in urbanizing areas of the watershed.

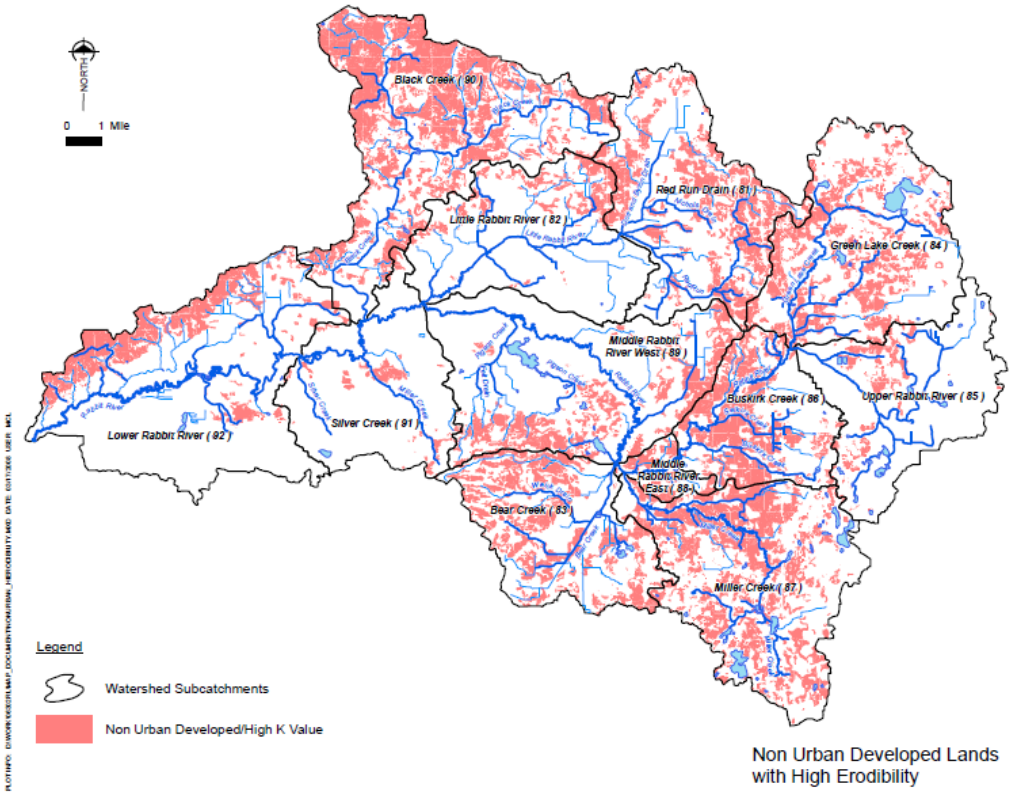
Soils Relationship to Prime Farmland

The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) defines prime farmland as land with the best combination of physical and chemical characteristics for producing crops. This land must be available for agricultural use in order to receive a prime farmland designation. Prime farmland has the combination of soil properties, growing season, and moisture supply needed to produce sustained high yields of crops in an economic manner, if it is treated and managed according to acceptable farming practices. Prime farmland soils may include those that are productive if artificially drained or managed to prevent flooding. A majority of the land in the Watershed is considered to be prime farmland, under this definition, but the placement of the farms and resulting impact from those farms has increased the potential for nonpoint source (NPS) in the Watershed.

Soils Relationship to Erosion

Certain soils have greater potential for erosion. Specifically, two types of erosion can be predicted, sheet and rill. Sheet erosion occurs when rainfall hits the ground and runs off the land in a large sheet, with little to none of the water actually penetrating the surface of the land, while at the same time taking with it loose dirt particles. An example is a plowed agricultural field being used for row crops that is not currently planted. When it rains on this field with exposed soil, water runs off the bare surface into a drainage ditch that connects to a nearby stream. Rill erosion occurs when precipitation cuts small drainage pathways into the surface of the land, giving the precipitation little time to sink into the ground. An example is a crevice in a hillside that continues to increase in size every time it rains. As more soil is carried away, a deeper crevice is carved into the hillside. Non urban developed lands, such as those used for agriculture, silviculture, and mining, with high erodibility factors can experience significant runoff in rain events (Exhibit 3).

Exhibit 3 - Highly Erodible Soils Map (High K = High Erodibility Factor)



This Watershed has many soils that are susceptible to both types of erosion. The results of an extensive investigation into the erosion potential is described in Chapter 3, Section 3.1.3, Watershed Assessment for River Stability and Sediment Supply (WARSSS).

2.1.4 HYDROLOGY

Precipitation Characteristics

Precipitation in the Rabbit River Watershed ranges from around 32 to 38 inches per year, and is well distributed throughout the year. The growing season, from May to October, receives about 19 inches of rain, 55 to 60% of the total precipitation. June is typically the wettest month of the year, with nearly four inches of rain on average.

Surface Water

The Watershed has an extensive network of streams, creeks, inland lakes, and constructed drainage ways. The Watershed was divided into eight subwatersheds to facilitate analyses and

focus the identification of impairments. Table 2.1 lists the subwatersheds, their identification number, and their acreage. Figure 4 illustrates the subwatershed delineations.

Table 2.1 - Subwatershed Acreage

Subwatershed	Acreage
Lower Rabbit River (92)	23,812.38
Silver Creek (91)	13,056.86
Black Creek (90)	22,452.22
Little Rabbit River (82)	15,006.91
Middle Rabbit River West (89)	20,797.08
Bear Creek (83)	12,860.63
Red Run Drain (81)	16,356.11
Middle Rabbit River East (88)	1,756.217
Buskirk Creek (86)	9,929.976
Miller Creek (87)	19,410.11
Green Lake Creek (84)	18,034.67
Upper Rabbit River (85)	13,710.61
TOTAL	**187,183.8**

Table 2.2 identifies the major lakes within those subwatersheds.

Table 2.2 - Major Lakes by Subwatershed

Subwatershed Name	Lake Name	Homes Serviced with Sanitary Sewer	Public Access	Outlets To
Lower Rabbit River	Sink Lake	No	No	Un-named Tributary
Silver Creek	Goose Lake	No	No	Unknown
Black Creek	Mud Lake	No	No	Black Creek
Middle Rabbit River West	Monterey Lake	No*	No	Pigeon Creek
	Cady Lake	No	No	Pigeon Creek
	Shipp Lake	No	No	Pigeon Creek
	Three Corner Lake	No	No	Unknown
	Leggett Lake	No	No	Unknown
	McDermott Lake	No	No	Un-named Tributary
	East Lake	No	No	Unknown
Bear Creek	Ingerson Lake	No	No	Un-named Tributary
	Herlan Lake	No	No	Un-named Tributary
Miller Creek	Geneva Lake	No	No	Unknown
	Selkirk Lake	Yes**	Yes	Groundwater
	Buskirk Lake	No	No	Miller Creek
	Miller Lake	No	No	Miller Creek
	Big Lake	No	Yes	Unknown
	Shagnasty Lake	No	No	Miller Creek
Green Lake Creek	Huckleberry Lake	No	No	Green Lake Creek
	Green Lake	Yes	Yes	Round Lake
	Round Lake	Yes	No	Green Lake Creek
Upper Rabbit River	Aubil Lake	No	No	Unknown
	Round Lake	Yes	No	Unknown
	Hill Lake	No	No	Un-named Tributary
	Jackson Lake	No	No	Un-named Tributary
	McIntire Lake	No	No	Un-named Tributary
	Pickerel Lake	No	No	Upper Rabbit River
	Titus Lake	No	No	Unknown
	Mud Lake	No	No	Upper Rabbit River
	Moore Lake	No	No	Unknown

*Monterey Lake (Sandy Pines) has a collection system, but it leads to a series of septic systems.
**A few mobile homes on Selkirk Lake have sewer service.

High Flows

The Michigan Department of Environmental Quality (MDEQ), Land and Water Management Division, estimated the flooding frequency discharges for the Rabbit River at M-40 in Section 6 of Heath Township (drainage area of 274 square miles) on October 18, 2004. The discharge frequencies, measured in cubic feet per second (cfs) are the predictions of the percent chance of storm events to occur within any year.

Discharge Frequencies	Flow Rate (cfs)
10-year (10% chance within any year)	4,800
50-year (2% chance within any year)	7,900
100-year (1% chance within any year)	9,500

Increased drainage in certain areas can result in excessive flows in receiving streams. This excessive flow can be exhibited by higher peak flows, longer peak flow periods, or both. The watershed inventory conducted in 2008 recorded evidence of high flows causing stream bank erosion. The results of these excess flows are increased stream bank erosion, increased stream bed scouring, sediment re-suspension, habitat destruction, and decreased diversity and number of fish and aquatic organisms.

Streams that rise and fall quickly during a storm are considered flashier than those that maintain a steadier flow. Streams become flashy when more runoff from the surface enters the streams, such is the case where increased impervious area in a watershed creates increased surface runoff to the streams. Based on the "*Kalamazoo River Watershed Hydrologic Study",* completed by the MDEQ (Fongers, 2008), it appears that the flashiness index for the Rabbit River is increasing over time, at the location near the gage station in Hopkins, Michigan. An increase in flashiness, often due to changing land use, is a common cause of stream channel instability and channel erosion. The MDEQ study indicated that large-scale solutions, for example, regional storm water management practices or Low Impact Development retrofits, may be needed to help reduce the flashiness and stabilize the river flows. Implementation of BMPs that prevent an increase in storm water runoff will help reduce the erosion effects caused by a larger volume of water than the Rabbit River is meant to handle.

Groundwater (recharge areas) and Well Head Protection

Groundwater is a crucial part of the Watershed. Groundwater is the sole source of drinking water for most of the resident dwellings within the Watershed. While this project deals mostly with

surface water and the problems associated with NPS pollution, groundwater and surface water are intimately connected, and will have great influence on each other. Groundwater in the Watershed is found in glacial deposits of sand and gravel below the surface of the land. These water-storing deposits are called aquifers. The most productive aquifers are the thickest, and those that have little or no mud, silt, or clay in them, thus allowing for more water storage. Groundwater and surface water interact in areas known as recharge or discharge zones. The Rabbit River has both recharge and discharge areas. Groundwater discharge is very important in coldwater streams. Groundwater is consistent in temperature and amount, thus providing a stable stream environment. Groundwater recharge areas are:

- Critical to protecting our drinking water sources and maintaining our high quality streams
- Usually upland areas with sandy or gravelly soils
- Found in the headwater areas, and in areas with higher elevation, mostly around the edges of the watershed

In areas where groundwater is used as the municipal drinking water supply, a critical area that contributes water to the municipal water supply well is called a well head protection area. Well head protection plans involve activities and management practices for protecting public groundwater supply systems from contamination, which limits the types and feasibility of infiltration practices. The City of Martin, in Martin Township, Allegan County, has a designated well head protection area to protect groundwater recharge areas. All of the City of Martin that is located within the Watershed is located within a designated well head protection area, including the majority of Section 19, the west side of Section 20, the north-west quarter of Section 29 and the north half of Section 30.

2.1.5 NATURAL RESOURCES

Wetlands

The Watershed is home to numerous types of wetlands, a majority of which are classified as palustrine by the National Wetland Inventory. Palustrine wetlands are associated with streams, creeks, swales, or are separate wetland features in the landscape. Other types of wetlands in the Watershed are riverine, associated with river systems, and lacustrine, associated with or adjacent to lakes. Wetlands in the Watershed range from forested wetlands like hardwood cedar or tamarack swamps to emergent vegetation such as cattail marshes and prairie fens. Many shrub-scrub wetlands are also present, including buttonbush ‘kettles’ of glacial origin. Figure 5 is a map of the approximate wetlands in the 1800’s. Figure 6 is a map of Wetland Restoration Potential

created by MDEQ. The map shows hydric soils, circa 1800 wetlands, and existing wetlands. The intersection of the hydric soils and circa 1800 wetland areas indicate areas with a high potential for wetland restoration. Appendix 3 includes the MDEQ's "Rabbit River Watershed, Wetland Status and Trends, Presettlement to 1978" report. The purpose of the MDEQ report is to note the existing (1978) size and number of wetlands present in the watershed as compared to the size and number of wetlands found in the watershed in the 1800's. The report also shows the trend, or if the number and size of wetlands is increasing or decreasing when comparing the two years.

Wetlands are invaluable for a variety of water quality functions they naturally perform. http://www.bae.ncsu.edu/programs/extension/wqg/programs/wqwm.html) cites several studies that provide information on various functions:

- Denitrification: Studies show that in certain instances, wetlands can remove from 70 to 90 percent of nitrates. One study in the southeastern U.S. projected a 20-fold increase in nitrogen loadings to streams as a result of a total conversion to adjacent bottomland hardwood forested wetlands to cropland.
- Trapping sediments can keep large amounts of phosphorus from entering adjacent rivers and reduces sedimentation.
- Flood control: Studies in the Midwest show flood water flows can be reduced by 80 percent in watersheds with wetlands, as opposed to those without them.
- Groundwater Recharge: Returning water to underground aquifers is known as "groundwater recharge." Much of the water in a wetland used for recharge would have been deposited there during wet periods, so the wetland would not only stem flooding by retaining water, but by having that water available to recharge groundwater

Approximately 58% of the watershed's wetlands have been drained/lost since the 1800's, mostly for use as agricultural land. A major function of wetlands is the preservation of water quality. Wetlands are similar to living filters. They trap pollutants such as nutrients and sediments, which can impair/impact the designated/desired uses of total and partial body contact, public water supply, and warmwater fishery. Wetlands also act as natural detention areas by storing flood waters and releasing them slowly, which reduces peak flows and protects downstream property owners from flooding. The State of Michigan (State) has set a goal of 10% wetland restoration by 2010, which will be used as a basis for setting the goal for the Watershed.

According to the MDEQ website, Michigan received authorization from the federal government in 1984 to administer Section 404 of the federal Clean Water Act in most areas of the state. A state administered 404 program must be consistent with the requirements of the federal Clean Water

Act and associated regulations set forth in the Section 404(b)(1) guidelines. In other states, where an applicant must apply to the U.S. Corps of Engineers and a state agency for wetland permits, applicants in Michigan generally submit only one wetland permit application to the DEQ. Currently, wetlands are regulated at the State under Part 303, Wetlands Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Part 303). Part 303 indicates that a wetland is regulated if it is any of the following:

- Connected to one of the Great Lakes or Lake St. Clair.
- Located within 1,000 feet of one of the Great Lakes or Lake St. Clair.
- Connected to an inland lake, pond, river, or stream.
- Located within 500 feet of an inland lake, pond, river or stream.
- Not connected to one of the Great Lakes or Lake St. Clair, or an inland lake, pond, stream, or river, but are more than 5 acres in size.
- Not connected to one of the Great Lakes or Lake St. Clair, or an inland lake, pond, stream, or river, and less than 5 acres in size, but the DEQ has determined that these wetlands are essential to the preservation of the State's natural resources and has notified the property owner.

The law requires that persons planning to conduct certain activities in regulated wetlands apply for and receive a permit from the State before beginning the activity. In accordance with Part 303, a local unit of government can also regulate wetlands by ordinance, in addition to State regulation, if certain criteria are met. However, no local wetland ordinances exist in the Rabbit River Watershed, so there is a lack of wetland protection at the local level.

Governor Granholm has proposed a plan to repeal the Michigan law and transfer wetland regulation to the U.S. Army Corps of Engineers, which would take over permit issuance and enforcement. The U.S. Environmental Protection Agency would provide oversight. No decisions have been made as of date, but environmental groups, developers, business, and local officials are watching this issue closely as it will impact them all.

Natural Features, Communities and Threatened and Endangered Species

Michigan Natural Features Inventory (MNFI) keeps records of the number of occurrences for rare, endangered, threatened species, or species of special concern throughout the State. The inventory is typically limited to public lands so even though a species is not listed for a particular area, it does not necessarily mean it’s not located there. The purpose of the MNFI is to identify areas that need to be protected. In the Watershed, over 100 element occurrences are present

(Figure 7). These include plants, animals, and natural communities. Several species of note include elements at Jackson Lake, an undeveloped inland lake owned by the Lansing School District (Ebersole Environmental Center) in the headwaters of the Rabbit River. One notable species present in the Watershed is the Eastern Massasauga Rattlesnake, Michigan's only rattlesnake, and an inhabitant of wetlands, fens, and wet prairies. The Watershed is home to several State threatened or endangered species, and one federally listed species, as tracked by MNFI (Appendix 4). The Karner Blue Butterfly is a federally listed species that lives in dry upland savannas in the Watershed. Other species of concern include the Bald Eagle and the Eastern Massasauga, a federal candidate. State Threatened or Endangered species include the King Rail, which is a marsh bird; the Red-shouldered Hawk, which is a forest bird of prey that inhabits river floodplain forest and adjacent uplands; two species of butterflies, including the Karner Blue Butterfly and the Frosted Elfin; and several rare and special plants. More information on the MNFI database can be found on-line at http://web4.msue.msu.edu/mnfi/.

Natural Rivers

The State has designated the lower reaches of the Kalamazoo River as a Wild and Scenic River under Part 305, Natural Rivers, of the Natural Resources and Environmental Protection Act 451 of 1994. The State designates a river or portion of a river as a natural river area for the purpose of preserving and enhancing its values for water conservation, its free flowing condition, and its fish, wildlife, boating, scenic, aesthetic, floodplain, ecologic, historic, and recreational values and uses. Included in this stretch is the location where the Rabbit River empties into the Kalamazoo River. The State has established that the Rabbit River is a critical tributary in the protection of the Kalamazoo River, thus protection and preservation of the Rabbit River is equally important. The Kalamazoo River Natural Rivers Plan can be found on-line at http://www.michigan.gov/dnr/0,1607,7-153-30301_31431_31442-95805--,00.html.

Regulated Dams

Dams drastically affect the ecological processes of river environments. Rivers emerging downstream of a dam may be substantially altered from the character of the river entering an impoundment above a dam. Flow patterns reflecting normal high and low water conditions over time may be altered, affecting stream channel configuration and fisheries habitat. Besides affecting the channel shape and location, dams also limit the normal movement of fish and other aquatic organisms along a river's length.

Hamilton Dam, completed in 1900, is on the Rabbit River in Heath Township, Allegan County. The dam is owned by the Heath Township Board. At normal levels, the impoundment has a surface area of 28 acres. The dam is a gravity dam, of earthen construction, with a height of 13 feet and a length of 440 feet. The maximum discharge is 7,100 cubic feet per second. The capacity is 500 acre feet, with a normal storage of 150 acre feet. The dam drains an area of 269 square miles. The Rabbit River has been stocked with steelhead and domestic rainbow trout since 1972. These fish have provided a very good winter and spring fishery at the Hamilton Dam. Also, there have been significant stray runs of salmon in the streams during the fall in recent years. Some of the anadromous fish ascending the Rabbit River have passed over the Hamilton Dam, since steelhead and salmon have been observed in the Diamond Springs to Hopkins area. The dam is considered by many to currently be in disrepair and a danger to the community. Additional information on the condition of the Hamilton Dam is contained in the Dam Safety Inspection Report, dated February 18, 1994, completed by Mr. James Hayes, P.E. from the MDEQ. A few smaller dams are found on Black Creek, Pigeon Creek, and Silver Creek.

Fisheries and Macroinvertebrate Populations

The Rabbit River is a State Designated Trout Stream under provisions of MCL 324.48701 (m), as are several of its tributaries (Figure 8). Very few rivers in southwestern Michigan are designated trout streams, making the Rabbit River a unique resource in our area. The designated trout streams of the Watershed include the entire main stem of the Rabbit River from its mouth at the Kalamazoo to the source in Wayland Township, tributaries upstream from 131, and parts of Miller Creek in Watson and Martin Township, Pigeon Creek (west branch), Silver Creek, and Miller Creek in Monterey Township. Fisheries within designated trout streams are protected through restrictive fishing regulations and restrictive National Pollutant Discharge Elimination System (NPDES) discharge guidelines. Trout stream designations take into consideration water temperature, habitat, fish population structure, and other factors. Table 2.3 lists the stream miles in the subwatersheds that are designated trout streams.

Table 2.3 - Designated Trout Streams

Subwatershed	Trout Stream Miles
Little Rabbit River (82)	0.02
Upper Rabbit River (85)	16.95
Buskirk Creek (86)	6.88
Miller Creek (87)	4.70
Middle Rabbit River East (88)	2.59
Middle Rabbit River West (89)	17.73
Silver Creek (91)	14.39
Lower Rabbit River (92)	14.62
Total	**77.88**

Fisheries in the Rabbit River are underused resources. Throughout the Watershed, very few public access areas are available, so most fishing occurs on private lands. In fact, only one public access exists on the length of the Rabbit River, located near Hamilton, below the dam. This access is in the Lower Rabbit River, so the Upper Rabbit River, a coldwater trout stream, has no public access. However, community parks such as those in Hopkins and Dorr, do allow access to other tributaries.

Macroinvertebrates are animals without a backbone that can be seen with the naked eye. These bottom-dwelling animals include crustaceans and worms but most are aquatic insects. Beetles, caddisflies, stoneflies, mayflies, hellgrammites, dragonflies, true flies, and some moths are among the groups of insects represented in streams. Macroinvertebrates are excellent indicators of local water quality conditions. Benthic (means bottom) macroinvertebrates are stationary, or they move very little in relation to a stream. The populations are generally abundant, and they are easy to catch and identify. Many macroinvertebrates are very sensitive to water conditions. Species that are filter feeders will be sensitive to suspended solids and sediment in the water column. Many species with exposed gills need very high levels of dissolved oxygen (DO). Sampling macroinvertebrates to determine species composition, diversity, and abundance will give a “snapshot” of the stream conditions at a given moment in time. Areas in the Rabbit River were found to have a wide variety of stream quality ratings, from poor to excellent. (MDEQ, A Biological and Physical Assessment of the Rabbit River Watershed. 2000.)

In the past, the Watershed’s Student Stream Science Program sampled macroinvertebrate populations in the Watershed. Sites sampled have ranged from poor (degraded) to excellent quality.

Recreation

Recreation, as full and partial body contact recreation, is one of the desired uses for the Watershed Project. Partial body recreation includes fishing, canoeing, and other activities other than swimming. The Rabbit River also offers a variety of recreational opportunities related to the designated use of native wildlife habitat including bird watching, wildlife observation, walking, and hiking.

Fishing is a recreational opportunity available throughout the Watershed, which includes many coldwater and designated trout streams. However, in some areas of the Watershed, the fishing opportunities have declined (personal communications Mr. John Schimmel, Ebersole Environmental Center). This may be due to a variety of reasons, but increasing amounts of sediments and nutrients, and loss of habitat have definite effects on fish and macroinvertebrate populations and aquatic ecosystems.

The area of public land in the Watershed varies greatly depending on township. In the lower reaches of the Watershed, the Allegan State Game Area provides many public land recreation opportunities, from hunting and canoe access, to bird and wildlife watching. In the Upper Rabbit River Watershed, public lands are fewer, but some existing and potential areas offer excellent possibilities.

The Watershed has many parks that focus on a variety of recreational uses. Parks range from primitive equestrian parks, to manicured baseball fields and picnic areas. The Watershed Project has identified increased recreational opportunities as one of its important goals for implementation in the Watershed.

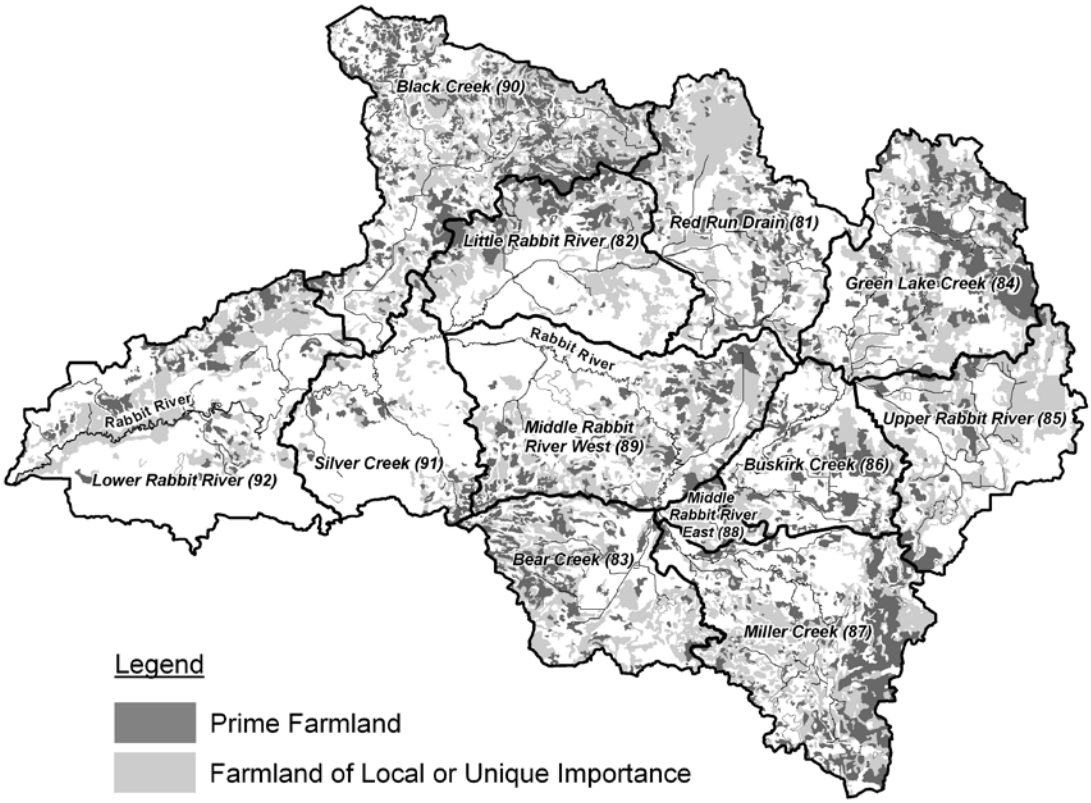
Dedicated/Protected Lands

Protected lands provide recreational opportunities, open space, wildlife habitat, and watershed protection. Generally, natural ecosystems, including animal and plant diversity, are preserved on protected lands, which make them very important to maintaining a high-quality watershed.

The Watershed has protected lands in the form of county, township, city, and village parks. There are approximately 50,000 acres of State Game Area in Allegan County, some of which is in the Watershed. Some private land has also been protected, including efforts by local land trusts, and other private acquisitions. Land in the Watershed is also enrolled in the PA-116 program, a State program to protect farmland from development for a specified number of years. Exhibit 4 is a map

showing the prime farm lands in the Watershed which are available for PDR through the Michigan Farmland Preservation Program. Figure 9 shows the green infrastructure/protected lands in the Watershed. The PA-116 lands are not mapped.

Exhibit 4 - Farmland Map



Another program that has recently been signed into law is the Purchase of Development Rights (PDR) program. PDR is a voluntary program, where a land trust or some other agency usually linked to local government, makes an offer to a landowner to buy the development rights on the parcel. Once an agreement is made, a permanent deed restriction is placed on the property which restricts the type of activities that may take place on the land in perpetuity. In this way, a legally binding guarantee is achieved to ensure that the parcel will remain agricultural or as open (green) space forever. The deed restriction may also be referred to as a conservation easement. This is an excellent step towards more permanent land protection measures. Leighton Township is the only township in the Watershed that has not approved a local PDR ordinance to allow land to qualify for PDR through the Allegan County/Michigan Farmland Preservation Program.

The three main options for land preservation are conservation easements, land donations, and bargain sales of land which are discussed in more detail in Section 6.2 of the WMP.

Green infrastructure is the interconnected network of open spaces and natural areas, such as wetlands, parks, forest preserves, and native plant vegetation, that naturally manages storm water, reduces the risk of flooding, and improves water quality. Governments generally spend less to install and maintain most green infrastructure systems, compared to traditional types of gray infrastructure. Other benefits of green infrastructure include increased recreation and open space, increased habitat for wildlife, community building opportunities and better air and water quality.

The West Michigan Strategic Alliance is striving to protect and preserve the green infrastructure of West Michigan. Many areas of green infrastructure have been removed in order for development and building to occur. The area located within the Watershed is especially important in this movement since large amounts of green infrastructure still exist, especially along the stream corridors. The Watershed Steering Committee and West Michigan Strategic Alliance can work together in their efforts to provide high quality environmental systems within the Watershed, protect ecological integrity for future generations, and promote long-term economic sustainability for West Michigan. Figure 9 illustrates the green infrastructure (natural connections) in the Watershed. The green infrastructure for West Michigan can be found on the West Michigan Strategic Alliance web site at http://www.wm-alliance.org/index.php?initiative_id=2.

2.1.6 LAND USE AND DEVELOPMENT TRENDS

Land-use in the Watershed is primarily agricultural. Approximately 63% of land in the Watershed is classified as agricultural, however, this percentage could change rapidly if the current economic conditions improve and areas begin to redevelop (Figure 10). The resulting increase in impervious surfaces could have a direct impact on water quality. Land use percentages by subwatershed are listed in Table 2.4.

Another development issue that will closely affect water quality in the Watershed is development along the US-131 corridor. A hydrologic study of the Watershed was completed as part of this project and included a build-out analysis (Appendix 5). Two of the conclusions of the study were that:

- Full development of the properties currently zoned for development will likely increase the instability of the Rabbit River, which is true even under the current storm water development rules.
- A more aggressive approach to protecting stream stability is needed, which would include better land use planning, farmland preservation integrated with water quality protection, and other land protection.

Loss of Farmland and Open Space

The loss of farmland and open space in the Watershed and in Allegan County is increasing. Much of the prime farmland in the Watershed is between the US-131 highway and the town of Dorr, within a half hour of downtown Grand Rapids. Farmland prices have increased to over $3,000 per acre in prime developable areas, partly due to increases in demand for biofuels, and these high prices show no signs of decreasing in the near future. Programs such as PA-116, PDR, and other land protection measures need to be implemented to protect water quality in the Watershed.

Farmland preservation is important in preserving water quality. The U.S. Environmental Protection Agency's (USEPA) study, *"The Impact of Farmland Preservation Programs,"* published in 1999, stated that ecological damage tied to impervious surfaces is increased by development rather than preservation. An increase to as little as 15% impervious surface cover results in a watershed's biotic integrity rating (for fish and macroinvertebrates) to drop to "fair" or worse; at a 25% impervious surface cover, only a few hardy pollution-tolerant species persist.

PDR programs in many counties have been successful in preserving land in large, contiguous clusters. Exhibit 4 is a map of the prime farm lands in the watershed which are available for PDR through the Michigan Farmland Preservation Program. The 1999 USEPA study also indicated that those large land clusters strategically located with respect to watersheds can have important implications for stream ecosystems. The preservation of as much as 75 to 85% of a watershed is critical to avoid compromising stream integrity. Table 2.5 presents land use changes over the past 30 years.

Table 2.4. - Land Use Percentages by Subwatershed (2001)

Watershed	Agriculture	Urban	Forest	Open Land	Wetland	Lakes
Red Run Drain	72.0%	8.9%	11.1%	4.0%	4.1%	0.0%
Little Rabbit River	66.2%	5.9%	14.8%	5.4%	7.7%	0.0%
Bear Creek	79.7%	4.0%	8.5%	2.0%	5.4%	0.4%
Green Lake Creek	62.4%	6.1%	14.0%	4.3%	11.0%	2.2%
Upper Rabbit River	53.5%	6.5%	17.9%	6.3%	14.3%	1.5%
Buskirk Creek	70.9%	9.1%	9.3%	4.4%	6.2%	0.2%
Miller Creek	63.5%	5.2%	15.2%	4.2%	9.4%	2.5%
Middle Rabbit River East	68.5%	2.4%	15.5%	3.8%	9.5%	0.3%
Middle Rabbit River West	58.6%	6.9%	18.1%	6.0%	8.9%	1.5%
Black Creek	81.1%	4.6%	7.9%	2.2%	4.1%	0.1%
Silver Creek	33.1%	3.9%	35.9%	12.4%	14.5%	0.2%
Lower Rabbit River	52.6%	5.9%	22.4%	7.9%	10.9%	0.3%

Michigan Department of Natural Resources IFMAP/GAP Lower Peninsula Land Cover 1997 to 2001
Total Developed (Urban) Area = 6% of land area in Watershed
Total Agricultural = 63% of land area in Watershed
Total Undeveloped (Agricultural, Open Land, Wetland, Lakes) = 94% of land area in Watershed

Table 2.5 - Land Use Changes Over the Past 30 Years

Land Use	% of Watershed (1978)	% of Watershed (2001)	% Change
Agriculture	64	63	-1
Urban	4	6	2
Forested	24	16	-8
Open Land/Non-Forested	4	5	1
Wetlands	3	9	6
Lakes	1	1	0
Total	**100**	**100**	

Michigan Department of Natural Resources 1978 Landcover/Use- Allegan, Kent, and Ottawa Counties. Michigan Department of Natural Resources IFMAP/GAP Lower Peninsula Land Cover 1997 to 2001

2.1.7 POLITICAL LANDSCAPE

2.1.7.1 COMMUNITY PROFILES

The Watershed is almost entirely contained within northwestern Allegan County, a mosaic of rural, and small urban areas, mostly agricultural and rural residential. Allegan County sits in southwestern Lower Michigan near counties with larger population centers: Kent, Ottawa, and Kalamazoo, with increased job opportunities, shopping centers, and cultural programming available all within close driving distance. Allegan County has retained a low population base, and a small-town and rural atmosphere. This rural and small-town atmosphere within driving distance of larger population centers has dramatically increased the development pressure in Allegan County, and has made the Watershed a prime target for development.

2.1.8 DEMOGRAPHICS

Population continues to increase in rural and residential areas of the Watershed. The increase of population in Allegan County from the 1990 census to the 2000 census was greater than 10%. The estimates for the population in the Watershed are projected to increase by more than 10% over the next ten years as well. Figure 11 illustrates the areas of greatest population density and where development is most likely to occur.

CHAPTER 3 - WATERSHED CONDITIONS

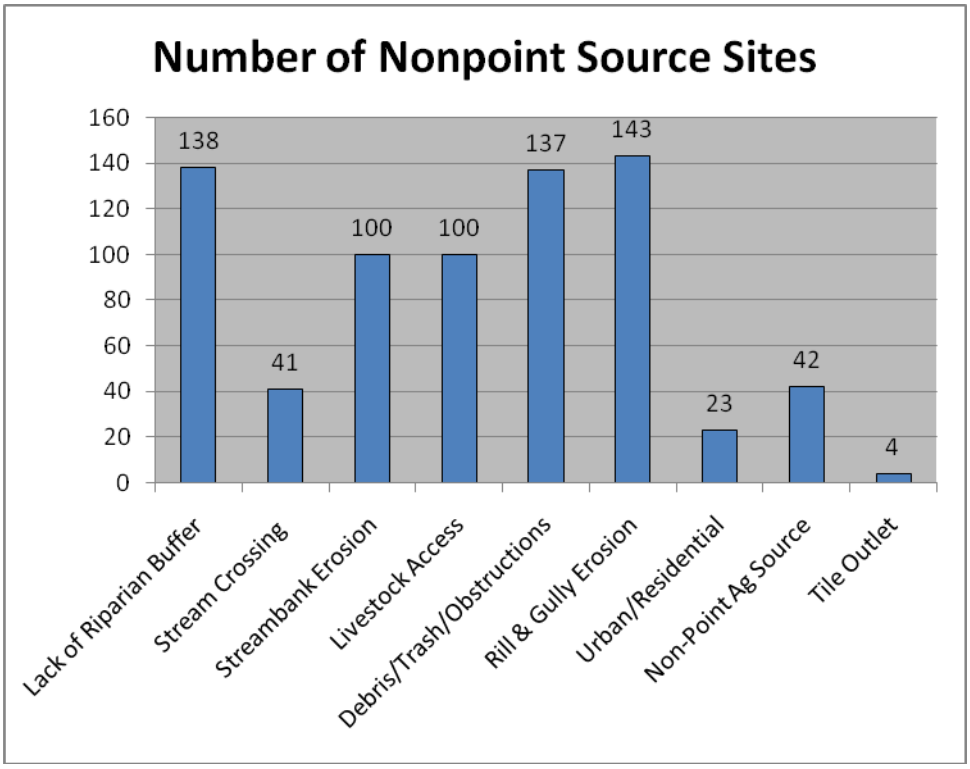
3.1 METHODOLOGY AND FINDINGS OF WATERSHED INVENTORY

In order to access the condition of the Watershed, several types of inventories/studies were conducted including a stream inventory, hydrologic study, and a Watershed Assessment of River Stability & Sediment Supply (WARSSS) study.

3.1.1 STREAM INVENTORY

Stream inventories consist of walking in the stream bed of water courses, if possible, facing upstream to minimize visual disturbance. Data sheets that ask for a description of the locations, suspected or observed pollutant sources, physical conditions, land uses, and measurements of nonpoint sources are completed at each site where observed. An example of a data sheet is included in Appendices 6a. In 1996, an inventory was completed in the Little Rabbit River Watershed, and in the spring of 2000, an inventory was completed in the Upper Rabbit River Watershed. These areas of the Rabbit River Watershed (Watershed) were inventoried to determine the sources and causes of nonpoint source (NPS) pollutants that were causing threats or impairments to the Watershed and the Best Management Practices (BMPs) needed to alleviate or reduce the impairments. In 2007 and 2008, the Watershed was again inventoried to provide an understanding of the NPS of pollution that affect the entire Watershed. The inventory focused on areas that had not been inventoried in 1996 and 2000, including Black Creek, Red Run Drain (Dorr Township), Green Lake Creek (Leighton Township), Miller Creek (Monterey Township), and the main branch of the Rabbit River. The stream reaches that were inventoried as part of the current project, as well as the Upper and Little Rabbit River Watershed projects, are included on Figure 12. The results of the inventories from 1996 to 2008, sorted by pollutant sources, are found in Appendix 6b. Nine main categories of NPS pollutants were identified in the Watershed over the course of the three projects (Chart 1).

Chart 1 - NPS of Pollutants Identified in 1996, 2000, and 2007 to 2008 Inventories



NPS pollution was identified at a total of 728 sites. Rill and gully erosion were the most frequent NPS pollutants identified, at 143 sites. Lack of riparian buffer and debris, trash, and obstructions (includes categories of garbage and log jams) were observed at 138 and 137 sites respectively. Unlimited livestock access and stream bank erosion was observed at 100 sites. Nonpoint Ag Source, such as pasture or manure runoff was observed at 42 sites. Erosion at stream crossings (due to roads, bridges, etc.) was identified at 41 sites. The remaining NPS of pollutants included urban/residential pollution, such as grass clippings in stream, at 23 sites and tile outlet erosion at 4 sites.

Appendix 6b includes the NPS inventory results. The information was sorted and listed by NPS pollutant. Only sites where issues were found are listed in the inventory results.

3.1.2 HYDROLOGIC STUDY

The *Rabbit River Watershed Hydrologic Study* (FTC&H, 2008), was completed as part of this project (Appendix 5). A hydrologic model of the Upper Rabbit River Watershed was created to help determine the impact of future development. The focus of the study was the Eastern Rabbit River Watershed, defined as those areas upstream of 135th Avenue, located in Section 5 of Hopkins Township. The contributing drainage area at 135th Avenue is approximately 125 square miles.

Several conclusions and recommendations were made as a result of this study for the purpose of preventing excessive stream bank erosion, improving water quality, and providing for flood control. Full development of the properties currently zoned for development will likely increase the instability of the Rabbit River. This is true even under the current storm water development rules. A more aggressive approach to protecting stream stability is needed.

- Adoption of LID-based development rules may improve the current conditions of the Rabbit River.
- It is possible to further reduce discharge to the Rabbit River through retention in the undeveloped areas (through wetland restoration for example).
- LID-based retention requirements for new developments are also effective for flood control.

In March 2008, the Michigan Department of Environmental Quality (MDEQ) conducted a hydrologic study of the Kalamazoo River Watershed. The hydrologic characteristics of the watershed were evaluated to provide a basis for storm water management to protect streams from increased erosion and flooding (Fongers, 2008). The report indicated that the flashiness trend at the gage station near Hopkins on the Rabbit River has been increasing over the past 25 years. Runoff volume per area (according to the 1978 land use), runoff volume increase per area (1800 to 1978 land use), imperviousness, and gage flashiness were used to score the Kalamazoo River subwatersheds in order to determine the critical subwatersheds. The report identified these critical areas based entirely on hydrology, with a maximum score of 100 being the most critical. Within the Kalamazoo River Watershed, the Battle Creek at Mouth subwatershed was determined to be the most critical with a score of 59. Buskirk Creek subwatershed had the highest score within the Rabbit River Watershed, with a score of 29. The Black Creek, Bear Creek, Green Lake Creek, Upper Rabbit River, and Miller Creek (Watson Twp) subwatersheds all scored between 11 and 25. The remaining subwatersheds in the Rabbit River Watershed scored between 1 and 10. The complete *Kalamazoo River Watershed Hydrologic Study* (Fongers, 2008) is available through the MDEQ Land and Water Management Division and can be found on-line at http://www.michigan.gov/documents/deq/lwm-nps-kalamazoo_229438_7.pdf.

3.1.3 WATERSHED ASSESSMENT OF RIVER STABILITY & SEDIMENT SUPPLY (WARSSS)

WARSSS is a three-phase framework of methods for assessing suspended and bedload sediment in rivers and streams. A stream is a body of water with a current which is confined within a bed and stream banks.

WARSSS can be used to analyze known or suspected sediment problems, develop sediment remediation and management components of watershed plans, develop sediment Total Maximum Daily Loads (TMDLs), assess sediment-impaired waters in planning for their restoration, and other uses.

The three phases of WARSSS include Reconnaissance Level Assessment (RLA), the Rapid Resource Inventory for Sediment and Stability Consequence (RRISSC) phase, and the Prediction Level Assessment (PLA). The RLA phase of the assessment is meant to be a very quick, qualitative review of likely and unlikely sediment sources and problem spots in the Watershed. The RRISSC phase of the WARSSS builds upon the data collected during the RLA to provide a finer level of analysis in regard to the affects that hill slope, hydrologic, and channel process have on a watercourse. The PLA is the most detailed level of investigation for slopes, sub-watersheds and river reaches previously identified as being high risk associated with sediment and/or river stability problems. A PLA was not completed for the Rabbit River Watershed.

The WARSSS was selected for use in the Rabbit River Watershed since the river is experiencing instability, flashiness and has several reaches on the Total Maximum Daily Load (TMDL) list for biota. A scientific approach to understanding the cause and effect of watershed inputs and river processes was desired. The Watershed encompasses an area of approximately 290 square miles, which was divided into twelve subcatchments based on MDEQ hydrologic unit classification (HUC) for the purpose of conducting the WARSSS. This section is an overview of the WARSS analysis for the watershed. A full report is available from MDEQ Water Bureau, Allegan County Drain Commissioner or Allegan Conservation District upon request.

The RLA phase of the WARSSS has three primary objectives (Rosgen, 2006):

1. To identify sediment sources and channel stability problems linked to specific processes influenced by land and river management activities;
2. To refine, clarify, or if necessary, redirect problem identification; and
3. To locate potential problem areas and reaches within a large watershed that require a more detailed level of assessment.

The RLA phase of the assessment takes on average a total of three days to complete. The method is broken down into a series of worksheets available online at the U.S. Environmental Protection Agency (USEPA) website http://www.epa.gov/warsss/index.htm or incorporated into the textbook entitled *Watershed Assessment of River Stability and Sediment Supply (WARSSS)* by David Rosgen (Rosgen 2006) that are used to guide the user in selecting the most critical subwatersheds to proceed to the RRISSC phase.

The RLA is organized to focus on surface erosion, mass erosion, streamflow change, channel processes, and direct channel impacts. These are the categories chosen by Rosgen as the most significant

indicators and/or contributors of sediment supply and stream stability. An understanding of the landscape history, critical activities, and process relations are used as background to get the user thinking about different watershed characteristics.

Worksheet 2 “Subwatershed Prioritization” is the decisive worksheet where all of the data collected during the RLA is summarized. The rankings in each of the categories are then totaled and prioritized based on the total ranking score. The subwatershed with the highest ranking score is prioritized as number 1 and so forth. The highest priority top quartile subwatersheds are highlighted as candidates for proceeding to RRISSC. A review can then be made of the top ranking activities or land changes that caused a subwatershed to be selected as a critical area (priority subwatershed).

The following subwatersheds were selected as critical due to their top quartile ranking in the WARSSS RLA.

Prioritization	**Subwatershed**
1	Green Lake Creek at Mouth (#84)
2	Middle Rabbit River West (#89)
3	Red Run Drain (#81)
4	Buskirk Creek (#86)

Since the middle of the 20th Century, urbanization has increased with a gradual reduction in land used for agriculture. In many places, a wooded riparian buffer has grown back in areas that had been grazed 50 years ago, although as a whole, the amount of woods has decreased since 1978. All subwatersheds, except the Bear Creek (#83) and the two lower subwatersheds, Silver Creek (#91) and the Lower Rabbit River (#92), have experienced an increase in urbanization since 1978 with a reduction in agriculture. In summary, the continued loss of woods and increase in urbanization would tend to increase stream discharge, but not necessarily sediment load. The overall effect could be even more channel widening which may lead the channel to balance the flow increase by picking up more sediment from within the channel, or reducing its slope through increasing or creating more curves or bends.

The RRISSC phase of the WARSSS builds upon the data collected during the RLA to provide a finer level of analysis in regard to the affects that hill slope, hydrologic, and channel process have on a watercourse. The RRISSC provides a systematic approach to identify and evaluate the parameters that impact stream stability such as sediment generating land use practices, sensitive landscapes, and hydrology. A risk rating system is then used to compare and prioritize impaired areas within a watershed or subwatershed. The following conclusions can be drawn from the results of the RRISSC.

3.1.3.1 RED RUN DRAIN (#81)

The Red Run Drain is a predominately agricultural subwatershed with an extensive network of channelized county drains, including the Byron-Dorr Intercounty Drain. Improved channels, such as the Byron-Dorr Intercounty Drain, appear to be fairly stable streams. Field observations confirm that stream bank erosion is minimal and the potential for channel enlargement is low. Although there has been some urban development within Dorr Township, these changes in land use do not appear to be enough to significantly affect the streamflow or create an impairment to watercourses within the subwatershed. The major risk of impairment appears to be in the form of channel aggradation, or the deposit of sediment which builds up the level or slope of a river bed, due to the high potential of surface erosion and sediment delivery. The combination of high risk land use practices (agriculture) with extensive amounts of exposed soils increases the potential for surface erosion, while the lack of adequate riparian buffers increases the chances of sediment actually entering a watercourse.

Byron Dorr ICD - Upstream of 22nd Avenue

Byron Dorr ICD - Downstream of 146th Avenue

3.1.3.2 GREEN LAKE CREEK AT MOUTH (#84)

The Green Lake Creek at Mouth is also a predominately agricultural subwatershed with a mix of natural and channelized sections of stream. The Green Lake Creek has a fairly well connected floodplain. Although the potential for surface erosion is high, improved riparian buffers help reduce the potential for sediment delivery from agricultural lands. The major source of channel impairment appears to be from direct channel impacts in areas with unlimited livestock access, located primarily in the lower reaches of the Green Lake Creek. In these areas, stream bank erosion (and associated sediment delivery) is much more severe due to trampling of channel banks by livestock and has resulted in an over-widening (enlargement) of the channel. Field measurements confirm that the width/depth ratio of the channel along impaired sections is almost twice that of the stable reference reach. As a result, the potential for channel aggradation along the downstream portion of the Green Lake Creek is high and has been confirmed by visual observations of excess deposition and filling of pools.

Green Lake Creek - Reference Reach

Green Lake Creek - Impaired Reach

3.1.3.3 BUSKIRK CREEK (#86/88)

The Buskirk Creek subwatershed was expanded downstream to also include the Small Middle Rabbit River East (#88) subwatershed, located between the Buskirk Creek (#86) and Middle Rabbit River West (#89) subwatersheds. The subwatershed includes the upper reaches of the Rabbit River proper from the western limits of the City of Wayland to the confluence with the Bear Swamp Drain. Agriculture is still the dominant land use, however, Buskirk Creek does have the highest percentage of urban development of all twelve Rabbit River subwatersheds and includes the western half of the City of Wayland. Overall, the subwatershed had moderate potential for surface erosion and sediment delivery. Like Green Lake Creek, the major source of channel impairment appears to be from direct channel impacts in areas with unlimited livestock access.

Two major stretches of unlimited livestock access were identified, one immediately downstream of the confluence with the Green Lake Creek and the other, just upstream of 130th Avenue, near the confluence with the Bear Swamp Drain. In these areas, stream bank erosion (and associated sediment delivery) is much more severe due to trampling of channel banks by livestock and has resulted in an over-widening (enlargement) of the channel. The width/depth ratio along the impaired stretches of the Rabbit River are approximately 1.5 times that of the corresponding reference reaches. As a result, the potential for channel aggradation along reaches of the Rabbit River with unlimited livestock access is high.

Rabbit River - Reference Reach

Rabbit River - Impaired Reach

3.1.3.4 MIDDLE RABBIT RIVER WEST (#89)

Of the four subwatersheds analyzed, the Middle Rabbit River West has the lowest percentage of agricultural land use (just under 60%) and highest percentage of woodland and wetland (27%). Even so, the potential for surface erosion is still relatively high, but the presence of riparian buffers helps reduce the potential for sediment delivery from agricultural lands. Grazing is limited along the Rabbit River proper; however, additional field inventories were not conducted to confirm the absence of livestock access along its tributaries. Evidence of potential aggradation, such as the filling of pools and formation of mid-channel bars was noted; however, additional monitoring will be required to draw any conclusive results.

In general, the potential for stream bank erosion is low to moderate due to a fairly well connected floodplain. However, localized erosion is present, especially in areas where the river has meandered against the valley wall. Extensive amounts of woody debris blockage are also an issue. Many of these problems have been mitigated through bank stabilization and woody debris management activities conducted as part of the recent petitioned county drain improvement project along the Rabbit River between 130th and 135th Avenues.

3.1.3.5 RECOMMENDATIONS

Overall, the Watershed appears to have a greater potential for channel aggradation due to the high concentration of sediment generating land uses such as agricultural production and direct channel impacts, of which, unlimited livestock access is the most significant and appears to be a major source of both excess sediment supply and channel instability.

The following measures are recommended to reduce sediment loads and improve water quality and stream stability within the watershed:

- Encourage environmentally sensitive agricultural practices to reduce the potential for surface erosion and sediment delivery to streams, including:
    - Conservation Tillage
    - Implementation of Filter Strips/Riparian Buffers
    - Key agency: Allegan Conservation District (ACD), Natural Resources Conservation Service (NRCS)
- Limit livestock access to stream channels:
    - Identify additional locations of unlimited livestock access
    - Implement BMPs that limit livestock access to stream channel
    - Key agency: ACD, NRCS, Allegan County Drain Commissioner (ACDC), engineer
- Implement a monitoring plan to assess the impact of BMPs and overall stream stability:
    - Establish permanent monitoring locations at critical areas within watershed
    - Monitor channel cross section, substrate composition (pebble count), bank erosion (bank pins, BEHI), bed load/total suspended sediment load, and macroinvertebrates
    - Key agency: ACD, NRCS, ACDC, stream morphologist
- Adopt LID rules at the county level and incorporate criteria into storm water ordinances at the township level. Ensure that new developments and redevelopments adhere to established storm water rules and criteria.
    - Key agency: ACDC, Ottawa County Drain Commissioner, Townships, engineer

3.1.4 RESULTS OF OTHER STUDIES

Many different agencies and State of Michigan (State) departments have conducted environmental studies in the Watershed.

During the Little Rabbit River Watershed project, monthly data from near the mouth of the Little Rabbit River at 140th Avenue was collected and analyzed for nutrients, dissolved oxygen (DO), and suspended solids from May 1995 to October 1999. Readings of the river's stage, water temperature, air temperature, and DO were taken on site, while samples for chemical analysis were sent to an MDEQ lab. Additional sites outside of the Watershed were included as a base for comparison to see regional trends in water quality. Typical of most agricultural watersheds, the Little Rabbit River Watershed had elevated levels of nutrients, chemical oxygen demand, and suspended solids in a majority of water samples collected. It was observed that recordings taken in the fall tended to have the lowest levels of all parameters.

Staff of the Surface Water Assessment Section (SWAS) of the MDEQ conducted a qualitative biological survey to assess point and NPS pollution in Red Run Drain in 1991. The surveys described in the report were conducted according to the guidelines of SWAS P-51. This study concluded that the overall quality of the stream was "fair" to "poor" based on the qualitative assessment of the macroinvertebrate community structure and habitat conditions. Comparisons of the results for the stations in the study suggest that sedimentation, mainly from farming operations, is adversely impacting the biological quality thus reducing the physical habitat (MDNR, 1992).

A second biological survey of the Red Run Drain and Little Rabbit River was conducted in 1998 by MDEQ. For the locations surveyed, overall stream quality ranged from poor to acceptable (Bonnette, 2000). These results showed no noticeable change from the 1991 survey, which rated the biological community from fair to poor. The Red Run Drain was extremely enriched, particularly at the uppermost stations, which may exhibit higher concentrations of nutrients due to the low flows observed during late summer. Certain locations did not meet Michigan Water Quality Standards (WQS) based on the poor biological communities observed. The 1998 Integrated Report of non-attainment waterbodies specifically listed Red Run Drain as not meeting WQS for dissolved oxygen (DO) and for a macroinvertebrate community rating of "poor."

In addition to the MDEQ biological surveys listed above, the surveys were also conducted in 1989, 1990, 1993, and the most recent in 2003. In 2003, the biological surveys were conducted at 20 stations throughout the Watershed, including Rabbit River, Miller Creek (Monterey Township), Black Creek, Little Rabbit River, Red Run Drain, Bear Creek, Miller Creek (Watson Township), Buskirk Creek, Green Lake Creek, and Tollenbar Drain. The macroinvertebrate evaluation scored "acceptable" at most of the sampling locations within the Watershed and scored "good" at the Middle Rabbit River. Red Run Drain was the only stream studied that scored "poor." Stream habitat was also evaluated, and the majority of the Watershed was listed as "slightly impaired", while the Little Rabbit River and Bear Creek were listed as "moderately impaired." Black Creek was the only stream that was labeled as "severely impaired" (Walterhouse, 2004). The MDEQ summarized that the water quality throughout the Watershed was adequate to support acceptable biological communities as long as there was suitable riparian and in-stream habitat, however, many practices in the Watershed are limiting this stable habitat.

The MDEQ conducts macroinvertebrate and habitat surveys every five years using SWAS P-51 sampling protocol, with the most recent survey occurring in summer 2008, and the next survey occurring in 2013. The 2008 results were not available for inclusion in this Watershed Management Plan (WMP).

The MDNR Fisheries Division conducted the *Kalamazoo River Assessment* in 2005 to describe the characteristics of the Kalamazoo River Watershed and its biological communities. The River assessment

provides a comprehensive reference for citizens and agency personnel who desire information about a particular aquatic resource and provides an approach to identifying fishery management opportunities and solving fishery related problems. The ultimate goal of the assessment was to provide information to enable increased public involvement in the decision making process to benefit the river and its resources. The assessment includes a river assessment, management options, and public comments and response (Wesley, 2005).

As reported in the MDNR *Kalamazoo River Assessment*, the Rabbit River connects to the Kalamazoo River at the mouth main stem valley segment. Fishery management of the Kalamazoo River main stem and tributaries is more active in the middle, lower, and mouth segments and stocking fish is the main management tool used throughout the Kalamazoo River Watershed. According to the report, coldwater fishery management has been vigorous at times and continues to be a high-priority for tributary streams. The lower 26 miles of the Watershed has an excellent fishery that consists of Chinook salmon, steelhead, walleye, and channel catfish while the salmon fishery is primarily supported by stocking with some natural reproduction from tributaries such as Rabbit River, Sand, and Bear Creeks. Agricultural activities, such as stream dredging and riparian vegetation clearing, have removed or reduced the availability of woody structure that creates excellent fish habitat and provides good substrate for production of aquatic insects and other fish food organisms. Also, the lack of public access is the largest deterrent to the recreational potential of the area (Wesley 2005).

3.1.5 WATER QUALITY STANDARD (WQS) AND CURRENT CONDITIONS

The EPA Clean Water Act requires the State to prepare a Biennial report on the quality of its water resources as a means of conveying water quality protection/monitoring information to the USEPA and the United States Congress. The Integrated Report includes Michigan water bodies that are not attaining one or more designated uses and require the establishment of Total Maximum Daily Loads (TMDLs) to meet and maintain WQS. A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still meet applicable water quality standards. The TMDL process establishes the allowable loadings of pollutants for a water body based on the relationship between pollution sources and in-stream water quality conditions. TMDLs provide a basis for determining the pollutant reductions necessary from both point and NPS pollution to restore and maintain the quality of their water resources. Appendix 7 includes a list of the TMDLs in the Watershed. This WMP focuses on TMDLs concerning flow, sediment, and DO. TMDLs for PCBs are being studied under the Kalamazoo River Watershed Remedial Action Plan. Further information regarding the MDEQ Biennial Integrated Report can be found at www.michigan.gov/deq/0,1607,7-135-3313_3686_3728-12711--,00.html.

3.1.5.1 WQS FOR SEDIMENT

Turbidity is the result of suspended solids in the water. Suspended solids are variable, ranging from clay, silt, and plankton; to industrial wastes and sewage. Turbidity affects color and temperature, which in turn has an impact on DO and photosynthesis. The Michigan WQS for turbidity (Rule 323.1050) states the following for physical characteristics:

The waters of the state shall not have any following unnatural physical properties in quantities which are or may become injurious to any designated use: turbidity, color, oil films, floating solids, foams, settleable solids, suspended solids, or deposits.

Water is a very powerful erosional agent in streams. The faster water moves in streams, the larger objects it can pick up and transport. Fine sand can be moved by streams, which carries the sediment to other locations. Sediment can come from runoff from developed urban areas and typically includes eroded road stream crossings, storm water runoff, and runoff from construction areas. Sediment can also come from agricultural sources, such as eroding croplands and animal crossings, or from recreation areas where heavy use access sites erode stream banks. Sediment pollution occurs when an excessive amount of organic and inorganic particles enter the stream system. Sedimentation is the act or process of depositing sediment. Sedimentation can be caused by high flows, which tear at the soil along unprotected banks. Flashy flows occur when the water level rises and falls extremely quickly during precipitation events. Urbanization is a major cause of flashy flows. Flashy flows cause flash floods and erosion that can damage habitat both in and out of the water. Sedimentation also contributes to a decrease in water clarity, affecting how sunlight penetrates the water, thus impacting plant growth. Sediment also absorbs heat, warming up the waterbody, and reduces DO levels in the water. Sedimentation can also cover fish spawning grounds and insect habitat, causing a decrease in fish production and loss of macroinvertebrates as a food source.

Current Conditions

Sediment is a suspected pollutant, based on both the NPS inventory and the WARSSS study completed in 2008, which identified many sites with stream bank, rill and gully, and tile outlet erosion. In 2007, FTC&H used the Hydrologic Engineering Center-Hydrologic Modeling System (HEC-HMS) computer model developed by the United States Army Corp of Engineers (USACE) to assess the hydrologic conditions of the Rabbit River and its tributaries from development-induced stream bank erosion. The HEC-HMS program is able to predict the river discharge in response to storm events. This information is included in the hydrologic study that is summarized above in Section 3.1.2 and included in Appendix 5. Stream embeddedness of the substrate is measured through the MDEQ SWAS habitat assessment and

biological survey conducted every five years. Green Lake Creek, Fales Drain, Red Run Drain, , Black Creek, and the Rabbit River are listed in the 2008 MDEQ Biennial Integrated Report as not supporting other indigenous aquatic life and wildlife due to anthropogenic substrate alterations and flow regime alterations. Red Run Drain is also listed as not supporting other indigenous aquatic life and wildlife due to sedimentation/siltation.

3.1.5.2 WQS FOR NUTRIENTS

Plant “nutrients" refer to the chemicals, including phosphorus and nitrogen, necessary for the growth and reproduction of aquatic rooted, attached, and floating plants, fungi, or bacteria.

The MDEQ does not have a specific limit for phosphorus or nitrogen, but the results from sampling can be compared to the USEPA’s, *Nutrient Criteria Technical Guidance Manual,* 2000, EPA-EPA-822-b-00-002. The USEPA nutrient criteria are identified on a scale of impairment. For example, at phosphorus levels of 0.09 mg/L, nuisance growth, which is unpleasant to the human eye, can occur. At levels of 0.075 mg/L, eutrophication of the system can occur. Ammonia concentrations above .3 to .4 mg/L are toxic to trout fry (MDNR, 1975).

Excessive nutrients can stimulate growths of aquatic rooted, attached, suspended, and floating plants, fungi, or bacteria which are or may become injurious to uses of the waterbodies in the Watershed. Michigan WQS (Rule 323.1060 Plant nutrients) state:

Rule 60. (1) Consistent with Great Lakes protection, phosphorus which is or may readily become available as a plant nutrient shall be controlled from point source discharges to achieve 1 milligram per liter of total phosphorus as a maximum monthly average effluent concentration unless other limits, either higher or lower, are deemed necessary and appropriate by the department.

(2) In addition to the protection provided under subrule (1) of this rule, nutrients shall be limited to the extent necessary to prevent stimulation of growths of aquatic rooted, attached, suspended, and floating plants, fungi, or bacteria which are or may become injurious to the designated uses of the surface waters of the state.

Current Conditions

The 2003 MDEQ biological survey indicated that phosphorus and nitrogen concentrations were similar to reference site conditions at most of the sampling stations, except where TSS concentrations were higher. The highest concentrations of phosphorus and nitrogen were found in Red Run Drain, where excessive algae growth was observed.

3.1.5.3 WQS FOR PATHOGENS

Bacterial pollution refers to the elevated amount of bacteria found in a water body. This can refer to fecal coliform or *E*. *coli*, both of which are indicators of animal or human feces entering the water body. These types of bacteria are used as indicators for the presence of unsafe bacteria and possibly dangerous viruses. Bacterial pollution can occur when manure from livestock operations is spread improperly on agricultural fields or stored improperly, thus allowing it to get into nearby water bodies. Bacterial pollution can also occur when manure is applied at a seasonally inappropriate time, such as when the ground is frozen, causing fecal matter to be washed into the streams with storm events. Even single-family homes that have failing or improperly maintained septic systems and dog and wildlife feces can contribute to bacterial pollution. Septic haulers who do not dispose of their collection tank waste properly can also cause bacterial pollution.

The criteria for E. coli will be based on WQS and attaining designated uses. The targets set for E. coli are for water bodies to meet WQS for total- and partial-body contact recreation. Total-body contact recreation standards, set by the State, are 130 counts E. coli per 100 ml as a 30-day geometric mean from May 1 to October 31. Partial-body contact recreation standards are set at 1,000 counts E. coli as a 30-day geometric mean.

Current Conditions

Municipalities and facilities with NPDES discharge permits monitor their effluent for Fecal Coliform as required in their permit. The Allegan County Health Department (ACHD) monitors surface water for *E. coli* at Dumont Lake during the summer months of May through October, however the Lake is located just outside the Watershed boundary. The ACHD does not currently conduct *E. coli* monitoring at public beaches or lakes within the Watershed. Black Creek and Red Run Drain were identified in the 2003 MDEQ Biennial Integrated Report as having unrestricted livestock access to the stream channel. *E. coli*, however, is not currently monitored as part of the MDEQ assessment.

3.1.5.4 WQS FOR TEMPERATURE

Water temperature is an important parameter in its affect on the solubility of oxygen in water, the rate of photosynthesis by algae and higher plants, the metabolic rates of aquatic organisms, and the sensitivity of organisms to toxic wastes, parasites, and diseases. Many of the physical, biological, and chemical characteristics of a surface water system are directly affected by temperature.

Rules 69 through 75 of the Michigan Water Quality Standards (Part 4 of Act 451) specify temperature standards which must be met in the Great Lakes and connecting waters, inland lakes, rivers, streams and impoundments.

Rule 75 states that in the month of July, the monthly maximum temperature should not exceed 20°C or 68°F in the mixing zone for the stream to be considered a coldwater fishery (MDEQ). Michigan WQS for Water Temperature (Rules 323.1069 to 323.1075) state the following for water temperature:

The rules state that the Great Lakes and connecting waters and inland lakes shall not receive a heat load which increases the temperature of the receiving water more than 3 degrees Fahrenheit above the existing natural water temperature (after mixing with the receiving water). Rivers, streams and impoundments shall not receive a heat load which increases the temperature of the receiving water more than 2 degrees Fahrenheit for coldwater fisheries, and 5 degrees Fahrenheit for warmwater fisheries.

Current Conditions

Temperature is measured as part of the MDEQ SWAS habitat assessment and biological survey that is conducted every five years and targets the many of the coldwater trout streams in the Watershed (portions of the Upper Rabbit River, Buskirk Creek, Miller Creek, Middle Rabbit River East, Middle Rabbit River West, Silver Creek, and Lower Rabbit River Subwatersheds). During the 2003 MDEQ habitat assessment and biological survey, the temperatures for the above subwatersheds fell within the range for coldwater fisheries (not-to-exceed 68°F), with the exception of the Middle Rabbit River West Subwatershed that had a reading of 72°F. The USGS gage station that is located on the Rabbit River near Hopkins measures temperature of the Rabbit River daily, and will do so as long as the gage station is in use.

3.1.5.5 WQS FOR DISSOLVED OXYGEN (DO)

DO, reported in units of milligrams of gas per liter of water (mg/L), refers to the volume of oxygen gas in the water. DO can be depleted through respiration, decay of organic matter, and direct chemical oxidation (Brown, 1985). Aeration and photosynthesis are the main sources of DO in stream water. Because oxygen concentrations are usually greater in air than in water, oxygen molecules will dissolve into the water due to this difference in concentration. Furthermore, by producing waves, wind serves to create more surface area for oxygen molecules to saturate, producing further diffusion of oxygen molecules. Aquatic plants also introduce oxygen as a by-product of photosynthesis, the process by which plants produce their own food.

Because oxygen is produced during photosynthesis and consumed during respiration and decomposition, daily (diurnal) DO fluctuations result. Photosynthesis, which requires light, occurs only during daylight hours, while respiration and decomposition occur 24 hours per day. Consequently, DO concentrations decline throughout the night, reaching its lowest point before dawn, when photosynthesis begins. Fish are most susceptible to stress due to the DO depletion at dawn. Seasonal variations, like diurnal variations, also affect DO concentrations. Winter months may experience lower DO levels, even though colder water holds more DO. Ice cover or increased decomposition of oxygen-demanding organic material from the previous growing season results in lower DO levels.

Other physical processes affecting DO concentrations are temperature and pollution. Because temperature has an inverse relationship with gas solubility, warmer water will hold less gas than colder water. Summertime fish kills can result if water temperatures become too warm, increasing the stress placed on fish. Furthermore, pollution from human activities may lead to unnatural decreases in DO concentrations. When large inputs of sewage or urban and agricultural runoff are introduced into the stream, microorganisms will decompose this organic matter and consume greater amounts of oxygen.

Rule 64 of the Michigan WQS (Part 4 of Act 451) includes minimum concentrations of DO which must be met in surface waters of the State. This rule states that surface waters designated as coldwater fisheries must meet a minimum DO standard of 7 mg/l, while surface waters protected for warmwater fish and aquatic life must meet a minimum DO standard of 5 mg/l.

Current Conditions

DO is measured as part of the MDEQ SWAS habitat assessment and biological survey that is conducted every five years. Red Run Drain is currently listed on the 2008 MDEQ Integrated Report as not supporting the warmwater fishery due to low DO levels.

3.2 POLLUTANT LOADINGS FROM NPS SITES

Pollutant loadings are the total quantity of pollutants in storm water runoff. Pollutant loadings help determine if the waters meet water quality standards and help to estimate the reduction in pollutants in the water once Best Management Practices (BMPs) are installed. Pollutant loadings from NPS sites were calculated for sediment, phosphorus, and nitrogen using the methods outlined in MDEQ's "Pollutant Controlled Calculations and Documentation for Section 319 Watersheds Training Manual," June 1999. No pollutant loadings were calculated on other potential pollutants such as pesticides and chemicals or pathogens and bacteria since they are only suspected pollutants.

Sediment is soil that is transported by air and water and deposited on the stream bottom. Sediment is discussed in more detail in Section 4.5.1 of the WMP. Phosphorus is a nutrient typically used in fertilizers, which is needed for plant and animal growth. Too much phosphorus in water causes algae and other aquatic plants to grow too rapidly. Nitrogen is an element that at certain levels can cause excessive algae and aquatic weed growth. Phosphorus and nitrogen together are referred as nutrients throughout this WMP and are discussed in more detail in Section 4.5.2. Unstable hydrology is the lack of storm water controls, or when the natural hydrology of the watershed changes due to an increase in storm water runoff, and is discussed in more detail in Section 4.5.3. Thermal pollution occurs when an elevation in water temperature stresses fish and aquatic insects and is discussed in more detail in Section 4.5.4. Pesticides are chemical substances used to kill pests such as weeds, insects, algae, rodents, and other undesirable agents and are discussed in more detail in Section 4.5.5. Habitat fragmentation is created by the loss of habitat, especially the draining of wetlands, and is discussed in more detail in Section 4.5.6. A pathogen is a human disease-causing bacteria or virus and is discussed in more detail in section 4.5.7.

Sediment Loadings

Erosion and sedimentation impacts include deposition, turbidity, increased pollutant loading, and destruction of wildlife habitat:

- *Deposition* affects stream morphology (shape), causing the stream to widen and become shallower, making it prone to temperature changes.
- *Turbidity* is cloudiness caused by sediment in water. Highly turbid water results in degradation of habitat and impaired aesthetics within waterways. Sediment particles affect fish, aquatic plants, and animals by causing starvation or suffocation. In fish, these sediment particles adhere to gill structures and lodge in feeding or breathing structures. Turbid water may also inhibit hunting, which disrupts the natural relationship of predator and prey.
- *Pollutant Loading* is also increased by erosion and sedimentation. Pollutants, such as heavy metals, fertilizers, and pesticides, adhere to soil and are transported to the receiving water through erosion and sedimentation.
- *Wildlife Habitat* can be destroyed as sediments fill in voids created by woody debris, rocks, and gravel that are used as cover by young fish and other aquatic species. Sedimentation also destroys fish spawning areas.

The method used to provide an estimate of sediment loadings from the NPS sites identified in the 2007 and 2008 inventories is based on the MDEQ's "Pollutant Controlled Calculations and Documentation for Section 319 Watersheds Training Manual," June 1999. Only sites that had a source that was contributing a quantifiable amount of sediment were used in the calculations. The identified NPS sites are contributing

a total of 1,499 tons of sediment to the Watershed. Table 3.1 presents the sources of sediment loadings by subwatershed. Appendices 8 and 9 include the data and assumptions used in the pollutant loading calculations.

Results of the sediment loading for the entire Watershed were based on the Kalamazoo River Watershed Management Plan Build-Out Analysis (DRAFT working report) prepared for the Kalamazoo River Watershed Council by Kieser & Associates, LLC, 2009. Baseline conditions were calculated by subwatershed for runoff volumes and TSS using the Long-Term Hydrologic Impact Assessment (L-THIA) model. The L-THIA model was developed as an accessible online tool to assess the water quality impacts of land use change. Land use changes can significantly impact groundwater recharge, storm water drainage, and water pollution. Based on community-specific climate data, L-THIA estimates changes in recharge, runoff, and nonpoint source pollution resulting from past or proposed development. The results of the L-THIA model for baseline conditions (2001) and build-out conditions (2030) are listed in Table 3.2. The estimated total loading for sediment in the Watershed is 6,843 tons per year under current baseline conditions and 7,714 tons per year under build-out conditions.

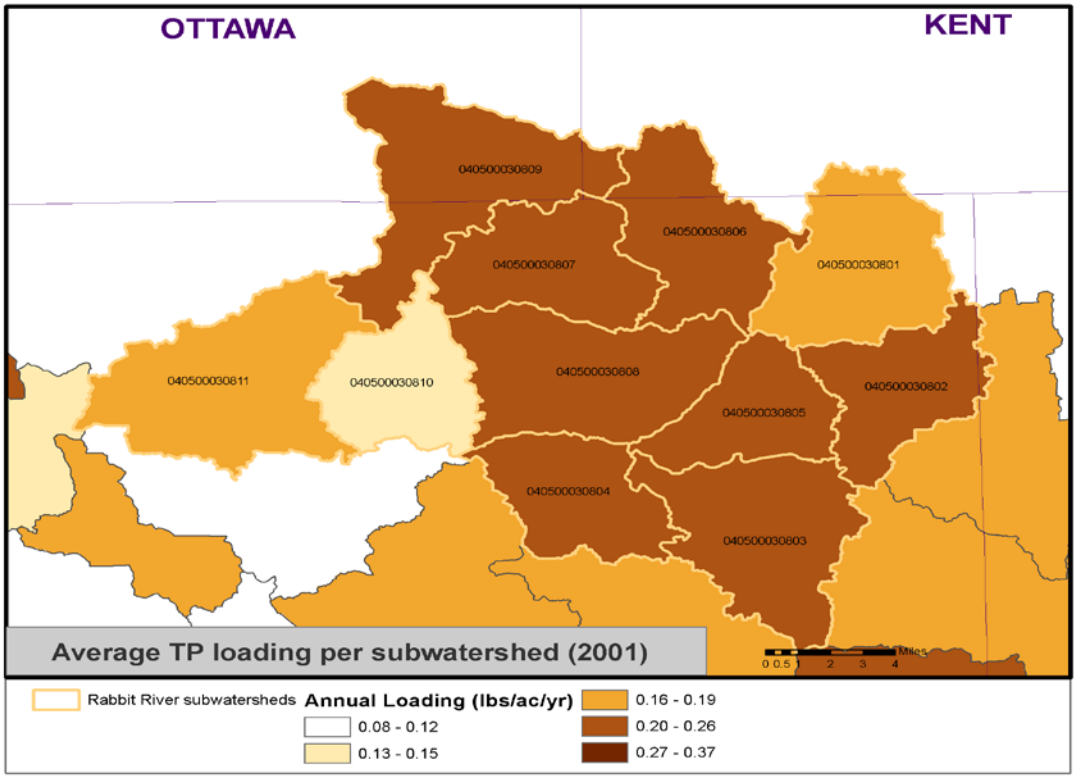


Exhibit 5 – L-THIA Model Results for Entire Watershed – Existing Conditions (Year 2001)

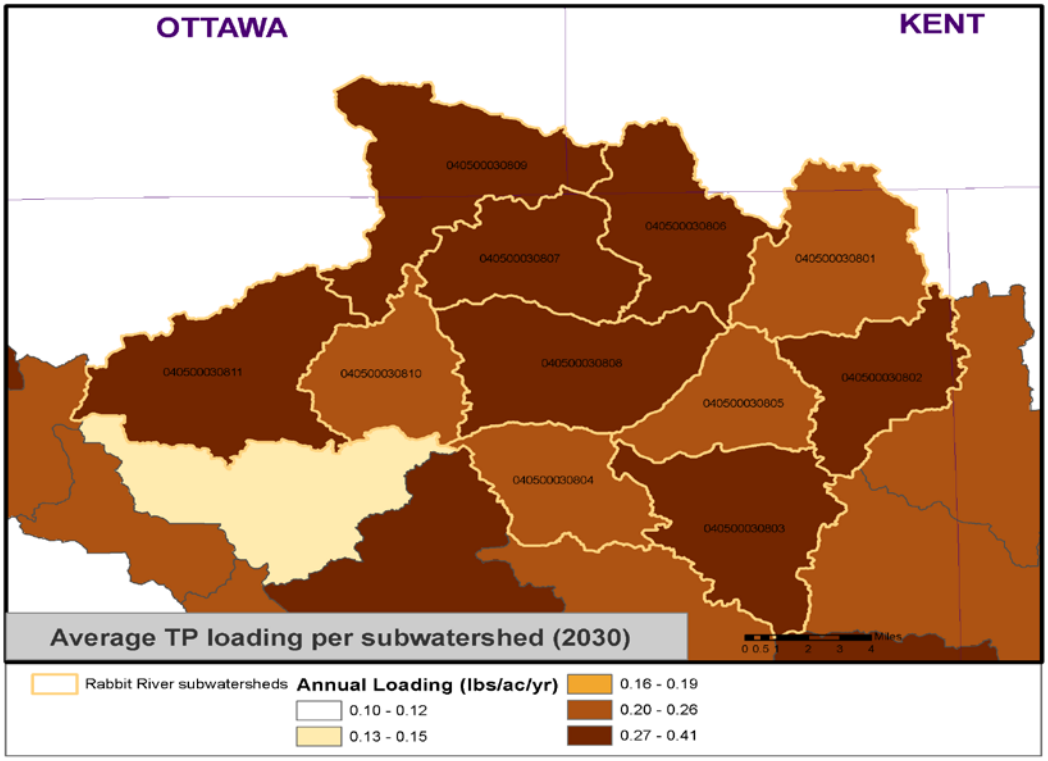


Exhibit 6 – L-THIA Model Results for Entire Watershed – Build-Out Conditions (Year 2030)

Nutrient Loadings

Phosphorus and nitrogen are commonly used in fertilizer to encourage rapid growth. Their use can increase nutrient levels in open waterways and promote algae growth in the Rabbit River. Increased levels of nitrogen and phosphorus cause algae and other aquatic plants to grow too rapidly. Rapidly growing plants in water also means plants are decaying. In the process of decaying, they use up the oxygen dissolved in the water. As a result of the low dissolved oxygen in the water, fish and other aquatic life die.

The field investigations in 2007 and 2008 determined that the sources of nutrients in the Watershed are originating from agricultural runoff, residential runoff, and possibly golf courses and failing septic systems. Excessive use and/or improper application of fertilizers on lawns and cropland cause nutrients to enter the waterways. The lack of stream buffers and other agricultural BMPs also allow nutrients to enter the streams. Failing septic systems contribute concentrated nutrients if tanks are leaking or not functioning properly. Golf courses use fertilizers to keep conditions at their prime for golfing, but excessive use can result in runoff going into the streams.

Improperly managed agricultural runoff can contribute fertilizers, pesticides, and herbicides to nearby waterbodies and can also create excess particulates from soil erosion and general ecosystem damage. Significant agricultural industry, such as livestock sites for dairy, beef, swine, and poultry, exists within the Watershed. A consistent application of agricultural BMPs, such as buffer strips to capture cropland runoff, limiting cattle access to streams to prevent nutrients and pathogens from entering streams and to protect streambanks, and implementation of Comprehensive Nutrient Management Plans (CNMPs) to properly and efficiently apply manure to cropland will reduce these impacts within the Watershed.

The method used to provide an estimate of phosphorus and nitrogen loadings from the identified NPS sites in agricultural areas is based on the MDEQ's "Pollutant Controlled Calculations and Documentation for Section 319 Watersheds Training Manual," June 1999. The agricultural NPS sites are contributing a total of 1,500 pounds of phosphorus, and 2,999 pounds of nitrogen to the Watershed, as calculated in Table 3.1. Appendices 8 and 9 include the data and assumptions used in the pollutant loading calculations. Calculations were used to determine loadings for sources of streambank erosion, livestock access, rill and gully, and tile outlets, The other sources were not quantifiable with the information available and were measured in other units to represent the magnitude of impairment.

Results of the nutrient loading for the entire Watershed were based on the Kalamazoo River WMP Build-out Analysis (Kieser & Associates, LLC, 2009). Baseline conditions, year 2001, were calculated by

subwatershed for runoff volumes, total phosphorus (TP), and total nitrogen (TN) using the L-THIA model. Build-out conditions, year 2030, were also calculated and the percent change from 2001 to 2030 in total loads per volume are reported with the other results in Table 3.2. The estimated total loading for phosphorus in the Watershed is 38,373 pounds per year. The estimated total loading for nitrogen in the Watershed is 459,477 pounds per year.

Table 3.1 - Rabbit River Watershed - Sediment and Nutrient Loading (NPS Sites from 2007-2008 inventory)

Subwatershed (% surveyed)	Sediment Loading (tons/yr)						Correct Factor	Phosphorus Content (lbs/yr)	Nitrogen Content (lbs/yr)
	Stream Bank Erosion	Rill and Gully Erosion	Tile Outlet	Road/Stream Crossing	Livestock Access	Total (tons/yr)			
Lower Rabbit River (0%)									
Silver Creek (10%)									
Black Creek (35%)	59.63	17.66	0.54		128.25	206.1	1.00	206	412
Little Rabbit River (95%)	51.40				26.24	77.6	1.00	78	155
Middle Rabbit River West (95%)	723.82	84.60	11.81			820.2	1.00	820	1640
Bear Creek (90%)									
Red Run Drain (90%)	40.43					40.4	1.00	40	81
Middle Rabbit River East (10%)					103.95	104	1.00	104	208
Buskirk Creek (25%)									
Miller Creek (90%)		3.15				3.2	1.00	3	6
Green Lake Creek (90%)	140.25				107.80	248.1	1.00	248	496
Upper Rabbit River (95%)									
Total	1,015.5	105.4	12.4	0	366.2	1,499.5		1,500	2,999

Notes:

- This table summarizes the existing sediment and nutrient loading from NPS sites. These values are assumed to be completely reduced once site specific BMPs have been implemented.
- Correction factor for loamy soil or silt = 1, Sand =0.85, and Peat =1.5
- Phosphorus content was calculated using the method prescribed in the MDEQ - Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual. (= (Sediment Loading (tons/yr) * 0.0005 (lb/lb) * 2000 (lb/ton) * Correction Factor))
- Nitrogen content was calculated using the method prescribed in the MDEQ - Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual. (= (Sediment Loading (tons/yr) * 0.001 (lb/lb) * 2000 (lb/ton) * Correction Factor))

Table 3.2 - Results of Pollutant Loadings from L-THIA Model

		Runoff Volume (acre-feet/yr)				TSS (tons/yr)				TP (lbs/yr)				TN (lbs/yr)			
Stream	**HUC**	**Year 2001**	**Year 2030**	**Change**	**% of total change**	**Year 2001**	**Year 2030**	**Change**	**% of total change**	**Year 2001**	**Year 2030**	**Change**	**% of total change**	**Year 2001**	**Year 2030**	**Change**	**% of total change**
Green Lake Creek	030801	3,220	4,137	916	1.7	585	661	76	1.7	3,302	4,204	902	1.6	37,698	44,399	6,701	1.6
Fales Drain-Rabbit River	030802	3,199	4,022	823	1.5	566	632	66	1.5	3,192	4,073	881	1.6	38,092	44,567	6,476	1.6
Miller Creek	030803	3,715	4,828	1,113	2.0	687	771	84	1.9	3,880	5,001	1,122	2.0	42,692	50,569	7,877	1.9
Bear Creek	030804	2,554	3,170	617	1.1	490	525	36	0.8	2,671	3,281	611	1.1	33,885	37,394	3,509	0.8
Buskirk Creek-Rabbit River	030805	2,485	2,904	419	0.8	441	471	30	0.7	2,562	2,994	432	0.8	28,460	31,396	2,937	0.7
Headwaters Little Rabbit River	030806	3,484	4,512	1,027	1.9	631	700	69	1.5	3,611	4,632	1,021	1.8	43,159	49,604	6,445	1.5
Little Rabbit River	030807	3,279	4,802	1,524	2.8	577	683	105	2.4	3,224	4,814	1,590	2.8	41,957	52,391	10,434	2.5
Pigeon Creek-Rabbit River	030808	4,488	5,951	1,463	2.7	790	906	116	2.6	4,418	5,983	1,566	2.8	54,829	66,156	11,327	2.7
Black Creek	030809	4,708	6,293	1,586	2.9	892	996	104	2.3	4,917	6,460	1,543	2.8	59,423	68,936	9,513	2.3
Silver Creek-Rabbit River	030810	2,244	3,202	957	1.7	358	435	77	1.7	1,979	3,013	1,034	1.8	23,989	31,632	7,643	1.8
Rabbit River	030811	4,777	6,239	1,461	2.7	826	934	108	2.4	4,617	6,205	1,588	2.8	55,293	66,378	11,085	2.7
Total:						**6,843**	**7,714**			**38,373**	**50,660**			**459,477**	**543,422**		

CHAPTER 4 - DESIGNATED AND DESIRED USES AND CRITICAL AREAS

4.1 DESIGNATED AND DESIRED USES

Water bodies have designated uses that are defined by the State of Michigan (State), as well as certain desired uses that vary from location to location. Local residents, industries, tourists, and recreational users involved with that particular water body will decide these desired uses.

4.1.1 DESIGNATED USES

The State has developed Water Quality Standards (WQS) under Part 4 of the Administrative Rules issued pursuant to Part 31 of the Natural Resources and Environmental Protection Act (1994 PA451, as amended). Rule 100 (R323.1100) of the WQS states that all surface waters of the State are designated for, and shall be protected for, all of the following uses:

- Agricultural use
- Industrial water supply
- Public water supply at the point of intake
- Navigation
- Warmwater fishery
- Coldwater fishery (where designated)
- Other indigenous aquatic life and wildlife
- Partial body contact recreation
- Total body contact recreation between May 1 and October 31

4.2 DESIGNATED USES BEING MET, IMPAIRED, OR THREATENED

4.2.1 STATUS OF DESIGNATED USES IN THE RABBIT RIVER WATERSHED (WATERSHED)

Current water quality impairments and specific threats to water quality must be identified and noted to create a focused Watershed Management Plan (WMP) for addressing nonpoint source (NPS) pollutants. The status of a designated use in a watershed can be unimpaired, impaired, threatened, or under review/unknown. Designated uses are considered impaired if the water does not meet the State's WQS. Designated uses are considered threatened when WQS may not be met in the future.

In January 2008, the Steering Committee prioritized the designated uses throughout the Watershed as detailed below. This information gathered from the Steering Committee was used, along with information

from the Watershed Assessment for River Stability and Sediment Supply (WARSSS), NPS Inventory, hydrologic study, and previous studies, to determine the impairment status of the designated uses by subwatershed as listed in Table 4.1. The designated uses are listed as known (K) if the impairment or threat of that designated use has been documented and quantified in the Watershed. Pollutants are listed as suspected (S) if some indication of an impairment or threat has been observed, but not quantified. The impaired and threatened waters are also listed in Table 4.1.

1. Agricultural Use

Surface waters used for irrigation, livestock watering, and produce spraying must be consistently available and safe. In addition to water use on farms, agricultural water supply includes irrigation for maintaining vegetative growth in nurseries, parks, and golf courses. Water resources should be free of pathogens and chemicals that could pose a health risk to livestock and humans. The Watershed is currently meeting the agricultural designated use.

2. Other Indigenous Aquatic Life and Wildlife

In addition to fish, other aquatic life and wildlife in the ecosystem should be considered in all management strategies. A stable and healthy habitat supports populations of wildlife that provide outdoor recreational opportunities like fishing, bird watching, and hunting. Healthy habitats have water conditions that are capable of supporting native plant and animal species. The Michigan Department of Environmental Quality (MDEQ) 2008 Integrated Report identifies portions of the Rabbit River, Red Run Drain, Fales Drain (Upper Rabbit River Subwatershed), Green Lake Creek, and Black Creek as not supporting the designated use of other indigenous aquatic life and wildlife due to other anthropogenic substrate alterations and other flow regime alterations, which generally means the waterbodies have been cleaned out, straightened or widened in the past. Red Run Drain is also listed as not supporting other indigenous aquatic life and wildlife due to sedimentation/siltation. This designated use is threatened throughout the remaining subwatersheds due to the potential for further degradation.

3. Warmwater Fishery

A warmwater fishery is defined by the MDEQ as a water body that is capable of supporting fish species that thrive in relatively warmwater, including bass, pike, walleye, and panfish. Generally, summer water temperatures are between 60° F and 70° F, and these streams are capable of supporting warmwater fish on a year-round basis. The warmwater fishery designated use is impaired in the Red Run Drain and threatened with further degradation throughout the remaining subwatersheds. The MDEQ 2008 Integrated Report identifies Red Run Drain as not supporting this use due to low dissolved oxygen (DO) levels.

4. Coldwater Fishery

A coldwater fishery has summer water temperatures below 60° F, and is able to support natural or stocked populations of trout. There are many designated trout streams in the Watershed, as indicated in the Fisheries section in Section 2.1.5 of Chapter 2. The coldwater fishery designated use is threatened in the subwatersheds with coldwater streams due to increased temperatures caused by runoff from impervious surfaces.

5. Partial Body Contact Recreation

Water-related activities, like fishing and boating, that do not require full body immersion are referred to as partial body contact recreation. Water quality must meet standards of less than 1,000 counts/100 ml of *E. coli* for recreational uses (MDEQ, 1999). The designated use of partial body contact recreation is threatened by bacterial inputs from the land application of manure, livestock access sites to waterbodies, septic system failures and illicit connections, livestock facility runoff, and wildlife feces throughout the entire Watershed.

6. Navigation

Waterways that provide adequate depth and width for recreational canoeing and kayaking must maintain open, navigable conditions. The designated use of navigation is threatened in localized areas of each subwatershed, due to log jams, excessive obstructions, dams, and lack of access sites.

7. Total Body Contact Recreation

Total body contact recreation refers to any activity that will result in the submersion of the head (e.g. swimming). Safety concerns arise when the eyes and nose are submerged, and the possibility of ingesting the water exists. WQS for total contact body recreation must be met between May 1 and October 31. During this time, *E. coli* must be below 130 counts per 100 ml, as a 30-day geometric mean. A number of lakes and streams in the Watershed are used for recreation. The designated use of total body contact recreation is threatened in these subwatersheds by bacterial inputs in the Watershed from the land application of manure, livestock access sites to waterbodies, septic system failures and illicit connections, livestock facility runoff, and wildlife feces.

8. <u>Industrial Water Supply</u>

Industry depends on large quantities of cool, clean water for material washing or as a coolant. The Watershed contains no industrial water intakes. However, industrial water supply is still a designated use, as water intakes may be needed in the future. The Watershed is currently meeting the industrial water supply designated use.

9. Public Water Supply at Point of Intake

Municipal water supplies that utilize surface water must have safe and adequate supplies of surface water or ground water. Water quality must be sufficient for conventional water treatment to produce safe and palatable water for human consumption and food processing. The Watershed contains no intakes for public water supply, so the designated use is not applicable.

Table 4.1 - Impairment Status of Designated Uses

Subwatershed	Agricultural (Irrigation)	Other Indigenous Aquatic Life and Wildlife	Warmwater Fishery	Coldwater Fishery	Partial Body Contact Recreation	Navigation	Total Body Contact Recreation	Public Water Supply	Industrial Water Supply
Lower Rabbit River	M	T (S)	T (S)	T (main branch) (S)	T (S)	T (S)	T (S)	N/A	M
Silver Creek	M	T (S)	T (S)	T (Silver Creek, Miller Creek main branch) (S)	T (S)	T (S)	T (S)	N/A	M
Black Creek	M	I (ASA*, Flow*: 42 miles) (K)	T (S)	N/A	T (S)	T (S)	T (S)	N/A	M
Little Rabbit River	M	T (S)	T (S)	N/A	T (S)	T (S)	T (S)	N/A	M
Middle Rabbit River West	M	T (S)	T (S)	T (Lower main stem, Lower Pigeon Creek, Feit Drain) (S)	T (S)	T (S)	T (S)	N/A	M
Bear Creek	M	T (S)	T (S)	N/A	T (S)	T (S)	T (S)	N/A	M
Red Run Drain	M	I (TMDL - Sedimentation: 18 miles) (K)	I (TMDL - DO: 18 miles) (K)	N/A	T (S)	T (S)	T (S)	N/A	M
Middle Rabbit River East	M	T (S)	T (S)	T (main stem) (S)	T (S)	T (S)	T (S)	N/A	M
Buskirk Creek	M	T (S)	T (S)	T (main stem) (S)	T (S)	T (S)	T (S)	N/A	M
Miller Creek	M	T (S)	T (S)	T (Miller Creek headwater) (S)	T (S)	T (S)	T (S)	N/A	M
Green Lake Creek	M	I (ASA, Flow: 2 miles) (K)	T (S)	N/A	T (S)	T (S)	T (S)	N/A	M
Upper Rabbit River	M	I (ASA, Flow: 43 miles) (K)	T (S)	T (main stem, branch) (S)	T (S)	T (S)	T (S)	N/A	M

*** I = IMPAIRED; T = THREATENED, M = MET, (K) = KNOWN, (S) = SUSPECTED, ASA = Other anthropogenic substrate alterations; Flow = Other flow regime alternations**

4.3 DESIRED USES

Resources that are not listed as a designated use in the Part 4 Rules may still have significant local importance. These uses for the Watershed's resources have been included in this WMP as desired uses.

Part of the mission of the Watershed WMP is to maintain social and economic viability in the Watershed while supporting a healthier environment. The Steering Committee understands that most residents in the Watershed depend on agriculture for their livelihood, and desire to keep this economic way of life while also supporting a healthier environment. Table 4.1a lists the desired uses identified by the Steering Committee.

Table 4.1a - Rabbit River Watershed Desired Uses

Rabbit River Watershed Desired Uses	**General Description**
Recreation Use and Infrastructure	Promote fishing, kayaking, hunting and hiking in the watershed. Improve recreational opportunities and access by establishing boardwalks, river and stream access sites or launches, natural areas, and wildlife and bird watching areas.
Habitat Preservation	Preserve and enhance habitats for waterfowl and upland game birds.
Farmland Preservation and Surface Water Protection	Promote Healthy Waters, Rural Pride Initiative, which requires farmers whose land is near water to include vegetation buffer strips. The buffer strips are intended to prevent soil erosion and insecticide or herbicide runoff from flowing into rivers and lakes.

The following goals were developed to address the desired uses identified by the Steering Committee. Objectives for these goals are listed below.

1. Improve recreational opportunities and access.
    - Build and maintain a trail/boardwalk system along sections of the river.
    - Build and maintain new river and stream access sites and launches, and maintain existing sites using bank stabilization measures and BMPs to minimize the impact of foot traffic and erosion.
    - Promote and establish public and private natural areas, and wildlife and bird watching areas.

2. Preserve and enhance habitat for waterfowl and upland game birds.

- Develop a community supported green infrastructure plan for the Rabbit River that includes creating/restoring natural and working land.
- Assist conservation organizations, local governments and landowners to preserve, protect and manage wildlife habitat.
- Minimize impacts from development to sensitive habitat areas and existing green infrastructure areas such as wetlands and stream corridors.

3. Promote farmland preservation and surface water protection.
   - Continue involvement in the Healthy Waters, Rural Pride Purchase of Development Rights (PDR) program.
   - Develop and adopt ordinance to protect prime farmland and water quality by acquiring farmland development rights voluntarily offered by landowners.
   - Implement water quality BMPs through Farm Bill Programs and the Allegan Conservation District's fee for service program.

4.4 IDENTIFICATION AND PRIORITIZATION OF POLLUTANTS TO BE CONTROLLED

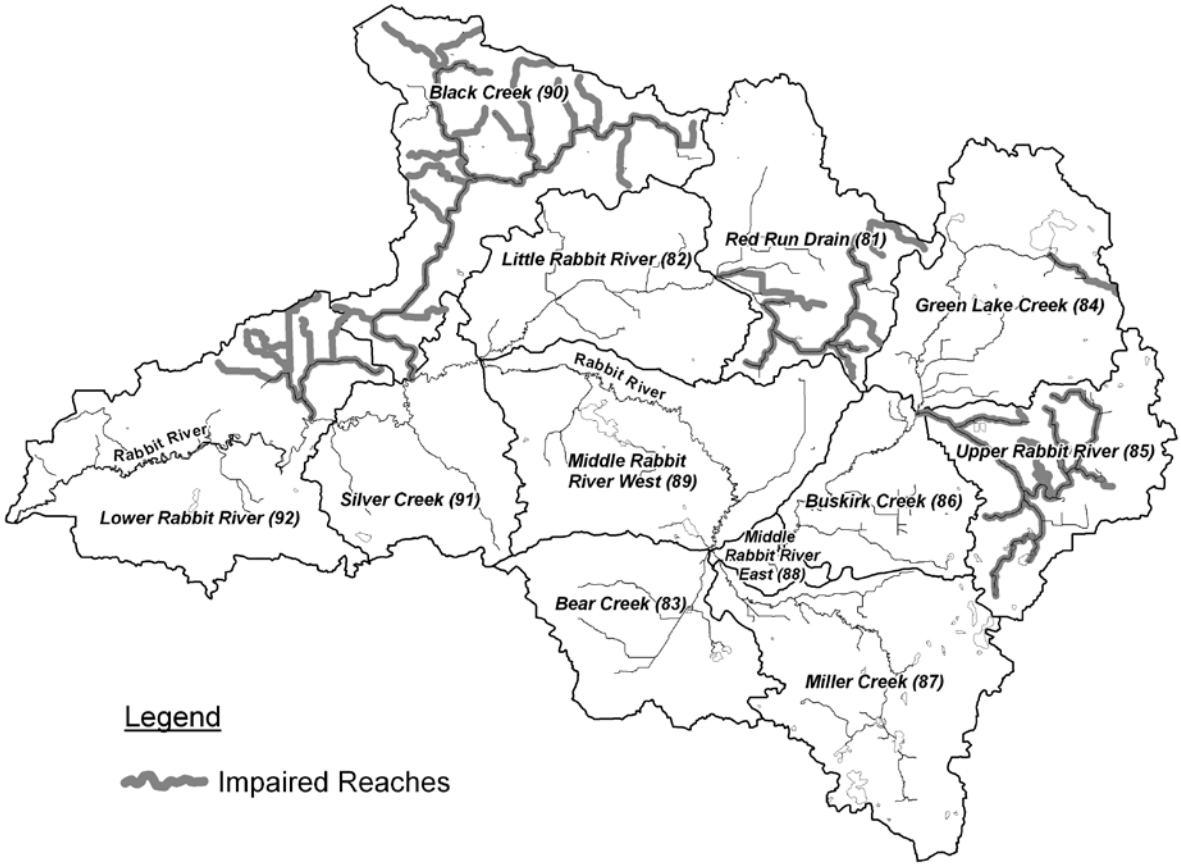
The pollutants impairing or threatening the designated uses are identified and prioritized in Table 4.2. Pollutants were listed as known (k) if the pollutant has been documented and quantified in the Watershed. Pollutants are listed as suspected (s) if some indication of their presence has been observed, but the amounts or exceedances have not been quantified. The complete list of the 2008 MDEQ Non-attainment waters in the watershed is included in Appendix 7. A map of the impaired reaches in the watershed is shown in Exhibit 7. Appendix 9 includes the NPS pollutant loading data.

Table 4.2 - Designated Uses and Associated Pollutants

Designated Use	Status of Designated Use	Impairments of Parameters of Concern
1. Agricultural Water Supply	Met - Currently meeting designated use	N/A
2. Other Indigenous Aquatic Life and Wildlife	Impaired - 2008 Integrated Report reaches for other anthropogenic substrate alterations and other flow regime alterations includes 42 miles of Black Creek, 18 miles of Red Run Drain, 2 miles of Green Lake Creek, and 43 miles of the Upper Rabbit River Threatened - Waterbodies in the following subwatersheds: Lower Rabbit River, Silver Creek, Little Rabbit River, Middle Rabbit River West, Bear Creek, Middle Rabbit River East, Buskirk Creek, and Miller Creek	1. Sediment (k) 2. Nutrients (k) 3. High Flow (k) 4. Habitat Fragmentation (s) 5. Pesticides and Chemicals (k)
3. Warmwater Fishery	Impaired - 2008 TMDL reach for low dissolved oxygen includes 18 miles of Red Run Drain Threatened - Waterbodies in the following subwatersheds: Lower Rabbit River, Silver Creek, Black Creek, Little Rabbit River, Middle Rabbit River West, Bear Creek, Middle Rabbit River East, Buskirk Creek, Miller Creek, Green Lake Creek and Upper Rabbit River	1. Low DO (k) 2. Sediment (s) 3. High flow (s)
4. Coldwater Fishery	Threatened - Designated coldwater trout streams: Lower Rabbit River (main branch), Silver Creek (main branch), Miller Creek (main branch), Middle Rabbit River West (lower main stem), Pigeon Creek, Feit Drain, Middle Rabbit River East (main branch), Buskirk Creek (main branch), Miller Creek (headwater), Upper Rabbit River (main branch and tributaries)	1. Temperature (k) 2. Low DO (s) 3. Sediment (s) 4. High Flow (s)
5. Partial Body Contact Recreation	Threatened - All subwatersheds	1. Pathogens/Bacteria (s)
6. Navigation	Threatened - All subwatersheds	1. Obstructions (k)
7. Total Body Contact Recreation	Threatened - All subwatersheds	1. Pathogens/Bacteria (s)
Public Water Supply	N/A	
Industrial Water Supply	Met	

(s) = suspected
(k) = known

Exhibit 7 - Map of Impaired Reaches



4.5 IDENTIFICATION AND PRIORITIZATION OF POLLUTANTS, SOURCES, AND CAUSES

In order to reduce the pollutants impairing the designated uses of the Watershed, it was necessary to determine where the pollutants originate as well as why the pollutant is impairing the Watershed. The sources and causes of pollutants were verified through NPS inventories, MDEQ biological surveys, the WARSSS, and results of other studies included in Section 3.1.5. The Steering Committee also provided input on the sources and causes of pollutants throughout the project. Both known, suspected, and potential sources are included in Table 4.3. The suspected sources will be either confirmed or eliminated through continuous additional data collection and observation. By identifying the cause of the pollutant source, it directs implementation efforts to correct the condition that is generating the pollutant. This helps to assure the most appropriate designs and successful control measures are implemented or installed.

Table 4.3 lists the prioritized impaired and threatened designated uses, pollutants of concern contributing to the degradation of the designated uses, the known, suspected, and potential sources of these pollutants, and summarizes data that documents the presence of the sources or causes based on the Watershed assessments. The pollutants and sources of pollutants are identified as known (K), if they were documented during any of the inventory methods. Pollutants and sources were identified as suspected (S) if indications or impacts of them were observed or measured, but the pollutants or sources themselves were not observed. Potential sources (P) are those that have historically been observed in similar watersheds.

More detailed information about the exact locations identified in the 1996 and 2000 inventories for the Little Rabbit River can be found in the Little Rabbit River WMP at: http://www.alleganCD.org. Information from the inventory conducted in the Upper Rabbit River can be found at http://www.michigan.gov/documents/deq/ess-nps-wmp-upper-rabbit_209163_7.pdf. The GPS information is available in Appendix 6b for those sites inventoried in 2007 and 2008. Additional inventories will be conducted within ten years to reassess the watershed and determine if potential or suspected sources have become known.

Table 4.3 Sources and Causes of Impairments

Designated Use To be Restored, Improved, or Protected	**Impairment Of Concern**	**Source Of Pollution**	**Causes for Release of Pollutants**	**Documented Presence in Watershed**
1. Agriculture: Met	N/A			
2. Other Indigenous Aquatic Life and Wildlife: Impaired - 2008 TMDL reaches for other anthropogenic substrate alterations and other flow regime alterations includes 42 miles of Black Creek, 18 miles of Red Run Drain, 2 miles of Green Lake Creek, and 43 miles of the Upper Rabbit River	1. Sediment (K)	1. Streambank Erosion (K)	Lack of riparian vegetation Inadequate soil erosion and sedimentation control Flashy flows from changes in land use and lack of storm water storage areas	100 sites inventoried showed streambank erosion and 4 sites showed tile outlet erosion
		2. Cropland Erosion (K)	Conventional tillage practices Plowing adjacent to water bodies	Agriculture is the predominant land use in the Watershed (63% agricultural)
		3. Straightening of Waterways and Channel Improvements (K)	Plowing adjacent to water bodies Straightening of waterways and channel improvements	315 miles of drains exist within the Watershed with 63% of the land use within the Watershed being agriculture
		4. Livestock Access Sites (K)	Unlimited livestock access to water bodies	100 livestock crossings or unlimited livestock access to stream
		5. Road and Bridge Crossings (K)	Undersized culverts, poorly designed and maintained bridges and road crossings	41 sites inventoried showed sediment erosion caused by stream crossings
		6. Storm Water Runoff (P)	Loss of floodplains and wetlands as retention Discharge from impervious surfaces and developed areas Ineffective storm water management	The Watershed is experiencing urban growth (2% population increase since 1978) due to the US131 corridor and potential for an increase in impervious surfaces (Dorr) due to the proximity to Grand Rapids; 23 urban/residential sites inventoried had pollutants in storm water runoff
	2. Nutrients (K)	1. Fertilizers (K)	Improper application adjacent to water bodies	Agriculture is the predominant land use in the Watershed (63% agricultural); 42 non-point source agricultural sites were inventoried
		2. Land Application of Manure (K)	Lack of manure management plans Manure management plans not enforced Improper manure handling and spreading	Approximately 88,452 acres (75% of all agricultural lands) are used for manure spreading
		3. Livestock Access Sites (K)	Unlimited livestock access to water bodies	100 livestock crossings or unlimited livestock access to stream
		4. Livestock Facility Runoff (K)	Improper manure storage and feedlot runoff	Number of medium to large livestock facilities in watershed to be determined
		5. Septic System Failures and Illicit Connections (S)	Improperly designed, installed, and maintained septic systems Unknown illicit connections	Septic systems are widespread throughout the Watershed
	3. High Flow (K)	1. Straightening of Waterways and Channel Improvements (K)	Plowing adjacent to water bodies Straightening of waterways and channel improvements	315 miles of drains exist within the Watershed with 63% of the land use within the Watershed being agriculture
		2. Storm Water Runoff (P)	Loss of floodplains and wetlands as retention Discharge from impervious surfaces and developed areas Ineffective storm water management	The Watershed is experiencing urban growth (2% population increase since 1978) due to the US131 corridor and potential for an increase in impervious surfaces (Dorr) due to the proximity to Grand Rapids; 23 urban/residential sites inventoried had pollutants in storm water runoff

Table 4.3 Sources and Causes of Impairments

Designated Use To be Restored, Improved, or Protected	**Impairment Of Concern**	**Source Of Pollution**	**Causes for Release of Pollutants**	**Documented Presence in Watershed**
	4. Habitat Fragmentation (S)	1. Loss of Habitat (K)	Filling and draining wetlands Development of open space for agriculture and urban development	Agriculture makes up 63% of the Watershed, and urban areas are developing (2% population increase since 1978)
2. Other Indigenous Aquatic Life and Wildlife: Impaired continued	5. Pesticides & Chemicals (K)	1. Cropland Erosion (S)	Conventional tillage practices Plowing adjacent to water bodies	Agriculture is the predominant land use in the Watershed (63% agricultural)
3. Warmwater Fishery: Impaired - 2008 TMDL reaches for low dissolved oxygen includes 18 miles of Red Run Drain	1. Low Dissolved Oxygen (K)	1. Lack of Riparian Habitat (K)	Due to agriculture and urban land use and development	Stream miles of unprotected riparian areas (125 miles)
		2. Plant and algae growth (K)	Excessive nutrients and decay of organic materials	Red Run Drain is enriched and exhibits higher concentrations of nutrients due to low flows observed during summer.
		3. Storm Water Runoff (P)	Loss of floodplains and wetlands as retention Discharge from impervious surfaces and developed areas Ineffective storm water management	The Watershed is experiencing urban growth (2% population increase since 1978) due to the US131 corridor and potential for an increase in impervious surfaces (Dorr) due to the proximity to Grand Rapids; 23 urban/residential sites inventoried had pollutants in storm water runoff
	2. Sediment (S)	1. Streambank Erosion (K)	Lack of riparian vegetation Inadequate soil erosion and sedimentation control Flashy flows from changes in land use and lack of storm water storage areas	100 sites inventoried showed streambank erosion and 4 sites showed tile outlet erosion
		2. Cropland Erosion (K)	Conventional tillage practices Plowing adjacent to water bodies	Agriculture is the predominant land use in the Watershed (63% agricultural)
		3. Straightening of Waterways and Channel Improvements (K)	Plowing adjacent to water bodies Straightening of waterways and channel improvements	315 miles of drains exist within the Watershed with 63% of the land use within the Watershed being agriculture
		4. Livestock Access Sites (K)	Unlimited livestock access to water bodies	100 livestock crossings or unlimited livestock access to stream
		5. Road and Bridge Crossings (K)	Undersized culverts, poorly designed and maintained bridges and road crossings	41 sites inventoried showed sediment erosion caused by stream crossings
		6. Storm Water Runoff (P)	Loss of floodplains and wetlands as retention Discharge from impervious surfaces and developed areas Ineffective storm water management	The Watershed is experiencing urban growth (2% population increase since 1978) due to the US131 corridor and potential for an increase in impervious surfaces (Dorr) due to the proximity to Grand Rapids; 23 urban/residential sites inventoried had pollutants in storm water runoff
	3. High flow (S)	1. Straightening of Waterways and Channel Improvements (K)	Plowing adjacent to water bodies Straightening of waterways and channel improvements	315 miles of drains exist within the Watershed with 63% of the land use within the Watershed being agriculture

Table 4.3 Sources and Causes of Impairments

Designated Use To be Restored, Improved, or Protected	**Impairment Of Concern**	**Source Of Pollution**	**Causes for Release of Pollutants**	**Documented Presence in Watershed**
		2. Storm Water Runoff (P)	Loss of floodplains and wetlands as retention Discharge from impervious surfaces and developed areas Ineffective storm water management	The Watershed is experiencing urban growth (2% population increase since 1978) due to the US131 corridor and potential for an increase in impervious surfaces (Dorr) due to the proximity to Grand Rapids; 23 urban/residential sites inventoried had pollutants in storm water runoff
4. Coldwater Fishery: Threatened - Designated coldwater trout streams: Lower Rabbit River (main branch), Silver Creek (main branch), Miller Creek (main branch), Middle Rabbit River West (lower main stem), Pigeon Creek, Feit Drain, Middle Rabbit River East (main branch), Buskirk Creek (main branch), Miller Creek (headwater), Upper Rabbit River (main branch and tributaries)	1. Temperature (K)	1. Lack of Riparian Habitat (K)	Due to agriculture and urban land use and development	Stream miles of unprotected riparian areas (125 miles)
4. Coldwater Fishery: Threatened Continued	1. Temperature (K) continued	2. Storm Water Runoff (P)	Loss of floodplains and wetlands as retention Discharge from impervious surfaces and developed areas Ineffective storm water management	The Watershed is experiencing urban growth (2% population increase since 1978) due to the US131 corridor and potential for an increase in impervious surfaces (Dorr) due to the proximity to Grand Rapids; 23 urban/residential sites inventoried had pollutants in storm water runoff
	2. Low Dissolved Oxygen (S)	1. Lack of Riparian Habitat (K)	Due to agriculture and urban land use and development	Stream miles of unprotected riparian areas (125 miles)
		2. Storm Water Runoff (P)	Loss of floodplains and wetlands as retention Discharge from impervious surfaces and developed areas Ineffective storm water management	The Watershed is experiencing urban growth (2% population increase since 1978) due to the US131 corridor and potential for an increase in impervious surfaces (Dorr) due to the proximity to Grand Rapids; 23 urban/residential sites inventoried had pollutants in storm water runoff
	3. Sediment (S)	1. Streambank Erosion (K)	Lack of riparian vegetation Inadequate soil erosion and sedimentation control Flashy flows from changes in land use and lack of storm water storage areas	100 sites inventoried showed streambank erosion and 4 sites showed tile outlet erosion
		2. Cropland Erosion (K)	Conventional tillage practices Plowing adjacent to water bodies	Agriculture is the predominant land use in the Watershed (63% agricultural)
		3. Straightening of Waterways and Channel Improvements (K)	Plowing adjacent to water bodies Straightening of waterways and channel improvements	315 miles of drains exist within the Watershed with 63% of the land use within the Watershed being agriculture
		4. Livestock Access Sites (K)	Unlimited livestock access to water bodies	100 livestock crossings or unlimited livestock access to stream
		5. Road and Bridge Crossings (K)	Undersized culverts, poorly designed and maintained bridges and road crossings	41 sites inventoried showed sediment erosion caused by stream crossings
		6. Storm Water Runoff (P)	Loss of floodplains and wetlands as retention Discharge from impervious surfaces and developed areas Ineffective storm water management	The Watershed is experiencing urban growth (2% population increase since 1978) due to the US131 corridor and potential for an increase in impervious surfaces (Dorr) due to the proximity to Grand Rapids; 23 urban/residential sites inventoried had pollutants in storm water runoff
	4. High flow (S)	1. Straightening of Waterways and Channel Improvements (K)	Plowing adjacent to water bodies Straightening of waterways and channel improvements	315 miles of drains exist within the Watershed with 63% of the land use within the Watershed being agriculture

Table 4.3 Sources and Causes of Impairments

Designated Use To be Restored, Improved, or Protected	**Impairment Of Concern**	**Source Of Pollution**	**Causes for Release of Pollutants**	**Documented Presence in Watershed**
		2. Storm Water Runoff (P)	Loss of floodplains and wetlands as retention Discharge from impervious surfaces and developed areas Ineffective storm water management	The Watershed is experiencing urban growth (2% population increase since 1978) due to the US131 corridor and potential for an increase in impervious surfaces (Dorr) due to the proximity to Grand Rapids; 23 urban/residential sites inventoried had pollutants in storm water runoff
5. Partial body contact recreation: Threatened - All subwatersheds	1. Pathogens/Bacteria (S)	1. Land Application of Manure (S)	Lack of manure management plans Manure management plans not enforced Improper manure handling and spreading	Approximately 88,452 acres (75% of all agricultural lands) are used for manure spreading
		2. Livestock Access Sites (S)	Unlimited livestock access to water bodies	100 livestock crossings or unlimited livestock access to stream
		3. Septic System Failures and Illicit Connections (S)	Improperly designed, installed, and maintained septic systems Unknown illicit connections	Septic systems are widespread throughout the Watershed
		4. Livestock Facility Runoff (S)	Improper manure storage and feedlot runoff	Number of medium to large livestock facilities in watershed to be determined
		5. Wildlife (S)	Overpopulations of geese and other waterfowl Lack of riparian vegetation	Overpopulations of geese exist around open water bodies (10 medium-sized lakes, large enough for recreational purposes)
6. Navigation: Threatened - All subwatersheds	1.Obstructions (K)	1. Unstable Stream System (K)	Poor storm water management practices Loss of floodplains and wetlands as retention Increased impervious surfaces, less infiltration	The Watershed is experiencing urban growth (2% population increase since 1978) due to the US131 corridor and potential for an increase in impervious surfaces (Dorr) due to the proximity to Grand Rapids
7. Total body Contact Recreation: Threatened - All subwatersheds	1. Pathogens/Bacteria (S)	1. Land Application of Manure (S)	Lack of manure management plans Manure management plans not enforced Improper manure handling and spreading	Approximately 88,452 acres (75% of all agricultural lands) are used for manure spreading
		2. Livestock Access Sites (S)	Unlimited livestock access to water bodies	100 livestock crossings or unlimited livestock access to stream
		3. Septic System Failures and Illicit Connections (S)	Improperly designed, installed, and maintained septic systems Unknown illicit connections	Septic systems are widespread throughout the Watershed
		4. Livestock Facility Runoff (S)	Improper manure storage and feedlot runoff	Number of medium to large livestock facilities in watershed to be determined
		5. Wildlife (S)	Overpopulations of geese and other waterfowl Lack of riparian vegetation	Overpopulations of geese exist around open water bodies (10 medium-sized lakes, large enough for recreational purposes)

(K) Known,
(S) Suspected
(P) Potential

4.5.1 SOURCES, CAUSES, AND IMPACTS OF SEDIMENT ON DESIGNATED USES

The most significant NPS pollutant in the Watershed is sediment. The MDEQ biological surveys for the watershed have continuously documented that there are high amounts of fine sediment found in stream substrate. The deposit of an excessive amount of sediment in a stream will cover spawning habitat, clog fish gills, and generally degrade the aquatic habitat of fish and macroinvertebrate species. The NPS inventories identified 526 sites as contributing sediment to the Watershed due to flashy or high flows, stream bank erosion, cattle crossings or livestock access, stream crossings, tile outlets and culverts, extensive drainage systems, and storm water runoff. The primary sources of sediment for these water bodies are agricultural and, to a lesser degree, rural development. Nutrients, bacteria, pesticides, and other contaminants, often adhere to sediment particles and are transported along with the sediment to surface waters. Reducing sediment inputs will improve fisheries, recreation (canoeing and fishing) and habitat for other indigenous aquatic life and wildlife.

The causes of release of the sediment in the Watershed include inadequate soil erosion and sedimentation control at road/stream crossing sites and new construction sites, undersized culverts, poorly designed and maintained bridges and road crossings, flashy flows from changes in land use and lack of storm water storage areas, discharge from impervious surfaces and developed areas, loss of floodplains and wetlands as retention, ineffective storm water management, lack of riparian vegetation, conventional tillage practices on croplands, plowing adjacent to water bodies, unlimited livestock access to water bodies, and channelized drainageways.

The 2008 MDEQ Biennial Integrated Report lists reaches of Black Creek (42 miles), Red Run Drain (18 miles), Green Lake Creek (2 miles), and the Upper Rabbit River (43 miles) as not meeting the designated uses of other indigenous aquatic life and wildlife due to anthropogenic substrate alterations and other flow regime alterations and sedimentation/siltation.

4.5.2 SOURCES, CAUSES, AND IMPACTS OF NUTRIENTS ON DESIGNATED USES

Nutrients, including phosphorus and nitrogen, are necessary for the growth and reproduction of aquatic plants and for a healthy river. Nutrient levels have become out of balance, however, and are threatening the Watershed's designated uses of coldwater fishery and other indigenous aquatic life and wildlife. The primary sources of nutrients are agricultural, and to a lesser degree, rural residential land uses and overpopulation of nuisance wildlife. The NPS inventories identified 550 sites as contributing nutrients to the Watershed.

The causes of release of the nutrients in the Watershed include lack of manure management practices, manure management plans that are not enforced, improper application of manure and fertilizers adjacent

to water bodies, feedlot runoff, inadequate or improper manure storage facilities, unlimited livestock access to water bodies, improperly designed, installed, and maintained septic systems, and unknown illicit connections. Residential fertilizer use will drastically change with the recent adoption of an ordinance by the Allegan County Board of Directors to ban fertilizers containing phosphorus. The ordinance takes effect on January 1, 2009.

Excessive nutrients, carried by storm water runoff, can cause dense algal growths known as an algal bloom. After the elevated nutrient source has been depleted, the algal bloom will die and decompose, reducing DO levels. Healthy fish and macroinvertebrate populations require DO levels to remain around 5 mg/L. When DO drops below 5 mg/L, a fish kill may result, fish and macroinvertebrate communities change to more tolerant species, and the stream or lake will no longer support game fish, like trout and salmon (MDEQ, 1999). If DO levels are consistently low, a shift toward more tolerant aquatic species will arise, reducing species diversity within the stream. Phosphorus has been identified as the limiting nutrient to impact the Watershed's surface waters. Polluted runoff can result from a variety of sources related to agricultural and urban land use practices.

4.5.3 SOURCES, CAUSES, AND IMPACTS OF UNSTABLE HYDROLOGY ON DESIGNATED USES

Lack of storm water controls can affect water quality, and increased drainage in certain areas can result in excessive flows in receiving streams. This excessive flow can be exhibited by higher peak flows, longer peak flow periods, or both. Ineffective storm water management can also impact streams through increased severe flooding due to loss of wetlands and floodplains as retention, and discharge from impervious surfaces and developed areas. The inventory recorded evidence of high flows causing streambank erosion. The results of these excess flows are increased stream bank erosion, increased stream bed scouring, sediment re-suspension, habitat destruction, and decreased diversity and number of fish and aquatic organisms.

A hydrologic study conducted by the MDEQ concluded that the flashiness trend has been increasing over the past 25 years at the gage station near Hopkins on the Rabbit River. Flashiness is discussed in more detail in Section 2.1.4 – Hydrology.

As mentioned in Section 4.5.1, the 2008 MDEQ Biennial Integrated Report lists reaches of Black Creek (42 miles), Red Run Drain (18 miles), Green Lake Creek (2 miles), and the Upper Rabbit River (43 miles) as not meeting the designated uses of other indigenous aquatic life and wildlife due to anthropogenic substrate alterations and other flow regime alterations and sedimentation/siltation.

4.5.4 SOURCES, CAUSES, AND IMPACTS OF THERMAL POLLUTION ON DESIGNATED USES

Thermal pollution occurs when a waterbody is greatly influenced by an influx of water above or below its natural temperature, usually making the water warmer. Generated by development (storm water runoff, lack of stream canopy, and riparian habitat) and farming (water withdrawals reducing stream depth, water inputs from agricultural drains, lack of stream canopy), thermal pollution can result in increased water temperatures and reduced DO levels. This is detrimental to the aquatic life in the water body, especially if the water temperature historically supported a coldwater fishery and can no longer do so because of the temperature increase.

In Red Run Drain, the warmwater fishery designated use is impaired for 18 miles due to low DO most likely caused by an increase in water temperature, agricultural runoff and decay of organic material. The coldwater trout streams in the Watershed are considered threatened due to temperature. Often times warmer water is added to the surface water through storm water runoff, industrial discharges, municipal waste water treatment plant (WWTP) discharges, and irrigation and/or runoff from agricultural fields. A lack of Best Management Practices (BMPs) in riparian areas could allow storm water runoff from many agricultural fields to have an impact on water temperature.

Portions of the Watershed are supporting a population of brown trout and are considered State Designated Trout Streams, as shown in Figure 8, which in past years has been stocked by the Michigan Department of Natural Resources (MDNR). If the temperature rises to the range of a warmwater fishery, the Rabbit River could lose its “coldwater fishery” designation.

4.5.5 SOURCES, CAUSES, AND IMPACTS OF PESTICIDES AND CHEMICALS ON DESIGNATED USES

Pesticides may have negative impacts on indigenous aquatic wildlife. Certain pesticides may also cause other environmental problems such as increased health risks through direct exposure or drinking water contamination. Preventing these pesticides from reaching surface water by using proper application methods and amounts, and the use of filter and buffer strips will prevent these problems. The main source of pesticides in the Watershed is from cropland erosion due to conventional tillage practices and plowing adjacent to waterbodies. Spills of pesticides have been documented in the Watershed.

4.5.6 SOURCES, CAUSES, AND IMPACTS OF HABITAT FRAGMENTATION ON DESIGNATED USES

The indigenous aquatic life and wildlife is threatened in the Watershed, with the greatest cause of impairment being the loss of habitat. The loss of habitat, mainly wetland loss and fragmentation, is a very

high priority in regard to aquatic life and wildlife. Habitat loss has been caused by the filling and draining of wetlands in the Watershed, as well as the development of open space for agriculture and urban development

4.5.7 SOURCES, CAUSES, AND IMPACTS OF PATHOGENS/BACTERIA ON DESIGNATED USES

Bacterial pollution impairs the river's designated uses of partial and total body contact recreation. The primary pathogen sources for these waterbodies are agricultural and, to a lesser degree, rural residential land uses and overpopulation of nuisance wildlife. Specific causes include a lack of manure management practices, manure management plans not enforced, improper manure handling and spreading, unlimited livestock access sites, improper manure storage and feedlot runoff, improperly designed, installed, and maintained septic systems, unknown illicit connections, overpopulations of geese and other wildfowl, and lack of riparian vegetation.

Pathogens and bacteria are present in manure and septic run-off, and may reach surface water from failing or improperly installed septic systems, over application and field run-off of manure, and run-off from feedlots and barnyards. High concentrations of bacteria and pathogens in surface water may pose severe health risks. The impact of the *E. coli* pollution is a health and safety issue for the users of the Watershed, those participating in fishing, boating, and swimming. Fecal coliform bacteria, bacteria found in manure or septic waste, can be a health problem on its own, and is also an indicator of other serious pathogens and disease-carrying organisms.

The Hopkins Wastewater Sewage Lagoon (WWSL), Moline WWTP, Green Lake WWTP, Hamilton Community Schools, and the Rabbit River Mobile Home Community, are permitted to discharge sanitary wastewater to surface water that must be properly disinfected and meet stringent effluent limits. The Wayland WWTP,is permitted to discharge to groundwater.

4.5.8 SOURCES, CAUSES, AND IMPACTS OF OBSTRUCTIONS AND OTHER POLLUTANTS ON DESIGNATED USES

Obstructions

Many downed trees obstruct the Rabbit River and tributaries, which makes navigation very difficult. Dumping of garbage (refrigerator, oil drums, and cars) and tree blockages are often located near road crossings. Log jams and debris are often due to an unstable stream system caused by poor storm water management practices, loss of floodplains and wetlands as retention, and increased impervious surfaces.

Other Pollutants

Several pollutants, such as oils, grease, salt, and toxins are considered secondary pollutants in the Watershed, but may be important in localized areas of high run-off, or in specific conditions.

4.6 IDENTIFICATION OF PRIORITY AND CRITICAL AREAS

The watershed was divided up into two areas of priority, critical areas for restoration and critical areas for protection. Figure 7 shows areas critical for protection as threatened, endangered or special concern species may be found there.

4.6.1 CRITICAL AREAS FOR RESTORATION

Critical areas for restoration of the Watershed are the geographic regions, or subwatersheds, that have the greatest potential of contributing the greatest amounts of NPS pollution which impair or threaten water quality. The identification of critical sites within the critical areas defines the locations to target the implementation of BMPs. In the case of the Watershed, the Steering Committee determined the critical areas for restoration based on the results of the WARSSS analysis, the results of the L-THIA model, identified waterbodies on the State's 303(d) list for not supporting designated uses, concentrations of livestock operations, urban runoff, density of septic systems, and lack of access to river. Overall, Black Creek and Green Lake Creek Subwatersheds are the highest priority ranking subwatersheds for restoration (Table 4.4).

4.6.1.1 CRITICAL AREAS FOR SEDIMENT AND FLOW

As stated above, Black Creek and Green Lake Creek Subwatersheds were ranked the most critical subwatersheds overall based on a variety of factors. The same is true when just looking at sediment and flow impairments. The Black Creek and Green Lake Creek Subwatersheds are identified as most impaired due to sediment and flow based on the results of the WARSSS (Section 3.1.3), acres of cropland erosion and sedimentation identified through the inventories, results of L-THIA, and the stream reaches on the State's 303(d) list for anthropogenic substrate alterations, flow regime alterations, and sediment/siltation. The Red Run Drain and Buskirk Creek Subwatersheds are also considered critical based on the results of WARSSS, L-THIA, cropland erosion and sedimentation, and TMDL results as identified in Table 4.4. Critical sites within the critical areas are identified as lack of riparian buffer, stream bank erosion, rill and gully erosion, tile outlet erosion, stream crossing, and livestock access sites listed in Appendix 6b and illustrated in Figure 12.

4.6.1.2 CRITICAL AREAS FOR NUTRIENTS

The critical areas for nutrients are identified through pollutant loading estimates using L-THIA as well as results from the NPS inventories. Black Creek, Miller Creek, Little Rabbit River, and Green Lake Creek Subwatersheds had the highest contributions of nutrients and are, therefore, the critical areas for nutrients. Critical sites within the critical areas include sites with lack of riparian buffer, stream bank erosion, rill and gully erosion, tile outlet erosion, debris/trash/obstructions, urban/residential areas with non-point source pollution, and agricultural and livestock access sites listed in Appendix 6b and illustrated in Figure 12.

4.6.1.3 CRITICAL AREAS FOR TEMPERATURE AND DO

Red Run Drain is listed in the MDEQ 2008 Integrated Report as not supporting the warmwater fishery due to low DO levels, and is therefore a critical area for DO as well as for temperature. Data collected by MDEQ staff in 2003 as part of the biological survey indicated that the designated trout streams continue to meet the requirements of a coldwater or cool water stream and could support trout populations. The critical areas for temperature are the riparian areas along the streams identified in Figure 8 as designated trout streams and designated coldwater streams.

4.6.2 PRIORITY AREAS FOR PRESERVATION

Priority areas for protection and preservation include subwatersheds that have high quality features necessary for a healthy ecosystem. The identification of critical sites within the priority areas is to target ecologically significant parcels to protect.

The Land Conservancy of West Michigan (LCWM) has an interest in the protection of property along and near the Rabbit River for the purposes of connecting a greenway along the direct riparian area of the river. Also, the LCWM has specific interest in the area surrounding the confluence of the Rabbit River and Kalamazoo River and lands buffering the Allegan State Game Area. These areas contain high biological diversity and have remained similar to their pre-European settlement composition.

The Steering Committee determined the priority areas for protection and preservation based on the LCWM interests, areas of prime farmland for farmland preservation, the lands and protection zones in the Figure 9, the areas where hydric soils intersect historic wetlands, the occurrences of endangered, threatened, or special concern species, location of coldwater trout streams, and areas of headwater lakes. Middle Rabbit River West and Upper Rabbit River Subwatersheds are the highest priority ranking subwatersheds for preservation based on the above criteria (Table 4.5).

Table 4.4 - Critical Areas for Restoration

Subwatershed	Critical Areas for Restoration						
	WARSSS/L-THIA (stream bank erosion and sedimentation)	**303(d) list (as listed)**	**Wetlands (% Loss of Total Wetlands)**	**Livestock Operations/L-THIA (nutrients and pathogens)**	**Urban Areas/Septic Systems (hydrology, temperature, nutrients, and pathogens)**	**Fisheries (access sites)**	**Ranking % of Acres of Cropland (cropland erosion and sedimentation)**
Lower Rabbit River (#92)			36%			X	#9
Silver Creek (#91)			36%			X	#12
Black Creek (#90)	#3 WARSSS (with est. results if Ottawa County included) #1 L-THIA	Flow alterations, Substrate alterations	74%	X #1 L-THIA			#3
Little Rabbit River (#82)	#3 L-THIA		74%	#3 L-THIA			#8
Middle Rabbit River West (#89)	#2 WARSSS		59%				#9
Bear Creek (#83)			59%		Hopkins		#1
Red Run Drain (#81)	#3 WARSSS	Low DO, Sediment/Siltation	74%	X	Dorr		#6
Middle Rabbit River East (#88)			59%				#2
Buskirk Creek (#86)	#3 WARSSS		48%		Wayland		#4
Miller Creek (#87)	#2 L-THIA		59%	X #2 L-THIA	Martin		#5
Green Lake Creek (#84)	#1 WARSSS #4 L-THIA	Flow alterations, Substrate alterations	48%	#4 L-THIA		X	#7
Upper Rabbit River (#85)		Flow alterations, Substrate alterations	48%		Wayland		#11

Highlighted Rows are highest Watershed critical areas for restoration.

Table 4.5 - Priority Areas for Preservation

Subwatershed	Priority Areas for Preservation					
	Farmland Preservation (Prime Farmland)	Green Infrastructure (Permanently or potentially protected lands)	Wetlands (Most hydric soils and existing)	Michigan Natural Features Inventory	Trout Streams	Headwater Lakes
Lower Rabbit River (#92)		Mouth of River, State Game Area		X (10-25 occurrences)	X	
Silver Creek (#91)		Main stem of Rabbit, State Game Area		X (100+ occurrences)	X	
Black Creek (#90)	X (north)					
Little Rabbit River (#82)	X (north)					
Middle Rabbit River West (#89)		Main stem of Rabbit	X		X	X
Bear Creek (#83)			X			X
Red Run Drain (#81)	X (north)		X			
Middle Rabbit River East (#88)					X	
Buskirk Creek (#86)	X	Main stem of Rabbit			X	
Miller Creek (#87)					X	X
Green Lake Creek (#84)	X (Leighton Twp - no PDR)		X	X (10-25 occurrences		X
Upper Rabbit River (#85)	X (Leighton Twp - no PDR)	Main stem of Rabbit	X	X (25-50 occurrences)	X	X

Highlighted Rows are highest Watershed priority areas for preservation.

CHAPTER 5 - DETERMINING GOALS AND OBJECTIVES OF THE WATERSHED

5.1 GOALS FOR THE RABBIT RIVER WATERSHED

The Steering Committee used past studies, reports, and the results of the Watershed inventory and WARSSS to determine the goals for the Watershed. The goals are based on reducing and/or eliminating the impacts of NPS pollutants within the Watershed, and restoring or maintaining the designated uses. The goals have been developed on a watershed-wide basis and have been prioritized based on decisions by the Steering Committee. The following goals for the Watershed have been determined:

1. Restore and maintain the impaired designated uses of the Watershed: Other indigenous aquatic life and wildlife (Black Creek, Red Run Drain, Green Lake Creek, and Upper Rabbit River), Warmwater fishery (Red Run Drain).
2. Protect and preserve the threatened designated uses (Coldwater fishery - designated trout streams in Watershed, Navigation - all subwatershed, and Total and Partial body contact recreation - all subwatersheds), the designated uses being met (Agriculture), as well as high quality areas.
3. Educate stakeholders about the Watershed and the impacts that stakeholders have on the Watershed.
4. Create a sustainable strategy for implementing the watershed management plan (WMP).

Table 5.1 relates the goals and objectives to segments of the impaired or threatened water bodies within the Watershed, as well as to the pollutants, sources, and causes.

5.2 OBJECTIVES FOR THE WATERSHED GOALS

The objectives of the WMP will be accomplished by harnessing existing positive community awareness, utilizing locally driven experienced agency resources, retaining qualified staff, and by utilizing contractors.

The objective to meet the first goal of restoring and maintaining other indigenous aquatic life and wildlife and the warmwater fishery is to reduce the amount of sediment, flashy or unstable flow, thermal, and nutrient pollution inputs in the Watershed by addressing the identified causes of the sources of NPS pollution, as shown in Table 5.1. This objective will be accomplished by:

1. Implementing BMPs.
2. Developing and implementing township-specific land-use recommendations using a Watershed protection approach.

3. Work one-on-one with townships, local officials, and planning commissions to protect water quality and reduce NPS pollution on a multi-township or county-wide basis through the revision of master plans, the addition of ordinances for natural resource protection, and zoning to protect water quality.

The detailed objectives for Goal 1 - *Restore and maintain the impaired designated uses* are listed in Table 5.1 .

The second goal of protecting and preserving the threatened designated uses (Coldwater fishery, Navigation, and Total and Partial body contact recreation), the designated uses being met (Agriculture), as well as high quality areas, can be achieved by reducing the amount of sediment, flow, thermal, and nutrient pollution inputs identified in Table 5.1. This objective will be accomplished by:

1. Implementing BMPs.
2. Developing and implementing township-specific land-use recommendations using a Watershed protection approach.
3. Work one-on-one with townships, local officials, and planning commissions to protect water quality and reduce NPS pollution on a multi-township or county-wide basis through the revision of master plans, the addition of ordinances for natural resource protection, and zoning to protect water quality.
4. Increase recreational opportunities in the Watershed by improving public access, partial body contact recreation, and recreation associated with wildlife and aquatic habitat.

The Steering Committee discussed the objectives for Goal 2 - *Protect and preserve threatened designated uses, designated uses being met, and high quality areas* with assistance from MDEQ and MDNR to identify the tools and programs available for preservation and conservation. The detailed objectives are listed in Table 5.1.

The third goal will be addressed with the implementation of the information and education (I&E) strategy. Objectives for Goal 3 - *Educate stakeholders about the Watershed and their impacts on the Watershed* are presented in Chapter 7 - I&E Strategy.

Objectives for the fourth goal of *Creating a sustainable strategy for implementing the WMP* are presented in Chapter 9. The Steering Committee will continue to work toward meeting the goals and objectives established for the Watershed through the Healthy Waters, Rural Pride Purchase of Development Rights (PDR) program and by operating under the Kalamazoo River Watershed Council (Council).

Table 5.1 - Goals and Objectives				
Designated Use and Status	**Pollutants and Impairments to Designated Uses**	**Sources**	**Causes**	**Objectives (Based on Inventory of NPS Sites and Calculations of NPS Loadings)**
Goal No. 1 - Restore and maintain the impaired designated uses of the Watershed.				
Priority Areas for Goal No. 1 - Other Indigenous Aquatic Life and Wildlife (Black Creek, Red Run Drain, Green Lake Creek, and Upper Rabbit River); Warm Water Fishery (Red Run Drain)				
Other indigenous aquatic life and wildlife: Impaired - 2008 TMDL reaches for other anthropogenic substrate alterations and other flow regime alterations includes 42 miles of Black Creek, 18 miles of Red Run Drain, 2 miles of Green Lake Creek, and 43 miles of the Upper Rabbit River	1. Sediment (K)	1. Stream bank Erosion (K)	Lack of riparian vegetation Inadequate soil erosion and sedimentation control Flashy flows from changes in land use and lack of storm water storage areas	Stabilize stream flows to moderate hydrology, reduce suspended solids, and maintain the floodplain. Reduce sediment by 1027.9 tons. Implement stream bank stabilization, filter strips, and erosion control BMPs at 100 stream bank erosion and 4 tile outlet erosion NPS sites identified.
		2. Cropland Erosion (K)	Conventional tillage practices Plowing adjacent to water bodies	Encourage cover crops and reduced tillage, as well as grassed waterways and windbreaks; implement watershed focused land-use planning. Reduce sediment by 105.4 tons. Implement BMPs at 143 rill and gully NPS sites identified.
		3. Straightening of Waterways and Channel Improvements (K)	Plowing adjacent to water bodies Straightening of waterways and channel improvements	Install riparian filter strips and encourage reduced tillage, implement watershed focused land-use planning. Implement BMPs along the 125 miles where stream buffers are needed.
		4. Livestock Access Sites (K)	Unlimited livestock access to water bodies	Exclude livestock from streams. Reduce sediment by 366.2 tons. Implement BMPs at 100 NPS sites identified.
		5. Road and Bridge Crossings (K)	Undersized culverts, poorly designed and maintained bridges and road crossings	Install properly sized culverts, annual bridge maintenance and obstruction removal. Implement BMPs at 41 NPS sites identified.
		6. Storm Water Runoff (P)	Loss of floodplains and wetlands as retention Discharge from impervious surfaces and developed areas Ineffective storm water management	Encourage infiltration in urban areas, implement watershed focused land-use planning and storm water management, implement BMPs to address 23 urban/residential NPS sites with pollutants in storm water runoff, protect existing 16,075 acres of wetlands, restore 2,175 acres of wetlands (10% of lost acres).
	2. Nutrients (K)	1. Fertilizers (K)	Improper application adjacent to water bodies	Establish filter strips or other riparian buffers at 42 NPS agriculture NPS sites, encourage proper fertilizer application (soil testing), implement watershed focused land-use planning.
		2. Land Application of Manure (K)	Lack of manure management plans Manure management plans not enforced Improper manure handling and spreading	Establish filter strips or other riparian buffers, encourage manure management planning and proper enforcement of the plans on 25% of the 88,452 acres used for manure spreading.
		3. Livestock Access Sites (K)	Unlimited livestock access to water bodies	Exclude livestock from streams. Reduce sediment by 366.2 tons. Implement BMPs at 100 NPS sites identified.
		4. Livestock Facility Runoff (K)	Improper manure storage and feedlot runoff	Identify livestock operations adjacent to rivers, establish filter strips or other riparian buffers along the 125 miles where stream buffers are needed, increase canopy cover, reduced tillage.
		5. Septic System Failures and Illicit Connections (S)	Improperly designed, installed, and maintained septic systems Unknown illicit connections	Identify and correct 100% of illicit connections in the Watershed, repair or replace aging septic systems and recommend regular maintenance of systems.
	3. High Flow (K)	1. Straightening of Waterways and Channel Improvements (K)	Plowing adjacent to water bodies Straightening of waterways and channel improvements	Install riparian filter strips and encourage reduced tillage, implement watershed focused land-use planning. Implement BMPs along the 125 miles where stream buffers are needed.
		2. Storm Water Runoff (P)	Loss of floodplains and wetlands as retention Discharge from impervious surfaces and developed areas Ineffective storm water management	Encourage infiltration in urban areas, implement watershed focused land-use planning and storm water management, implement BMPs to address 23 urban/residential NPS sites with pollutants in storm water runoff, protect existing 16,075 acres of wetlands, restore 2,175 acres of wetlands (10% of lost acres).
	4. Habitat Fragmentation (S)	1. Loss of Habitat (K)	Filling and draining wetlands Development of open space for agriculture and urban development	Net gain of 10% wetland acres (2,175 acres), install riparian buffers along 25% of the 125 miles identified, implement watershed focused land-use planning.

Table 5.1 - Goals and Objectives				
Designated Use and Status	**Pollutants and Impairments to Designated Uses**	**Sources**	**Causes**	**Objectives (Based on Inventory of NPS Sites and Calculations of NPS Loadings)**
Goal No. 1 - Restore and maintain the impaired designated uses of the Watershed.				
Priority Areas for Goal No. 1 - Other Indigenous Aquatic Life and Wildlife (Black Creek, Red Run Drain, Green Lake Creek, and Upper Rabbit River); Warm Water Fishery (Red Run Drain)				
	5. Pesticides & Chemicals (K)	1. Cropland Erosion (s)	Conventional tillage practices Plowing adjacent to water bodies	Encourage cover crops and reduced tillage, as well as grassed waterways and windbreaks; implement watershed focused land-use planning. Reduce sediment by 104.5 tons. Implement BMPs at 143 rill and gully NPS sites identified.
Warmwater fishery: Impaired - 2008 TMDL reach for low dissolved oxygen includes 18 miles of Red Run Drain	1. DO (K)	1. Lack of Riparian Habitat (K)	Due to agriculture and urban land use and development	Implement BMPs at 125 miles where riparian buffers are needed based on review of aerial photos, implement watershed focused land-use planning.
		2. Storm Water Runoff (P)	Loss of floodplains and wetlands as retention Discharge from impervious surfaces and developed areas Ineffective storm water management	Encourage infiltration in urban areas, implement watershed focused land-use planning and storm water management, implement BMPs to address 23 urban/residential NPS sites with pollutants in storm water runoff, protect existing 16,075 acres of wetlands, restore 2,175 acres of wetlands (10% of lost acres).
	2. Sediment (S)	1. Stream bank Erosion (K)	Lack of riparian vegetation Inadequate soil erosion and sedimentation control Flashy flows from changes in land use and lack of storm water storage areas	Stabilize stream flows to moderate hydrology, reduce suspended solids, and maintain the floodplain. Reduce sediment by 1027.9 tons. Implement stream bank stabilization, filter strips, and erosion control BMPs at 100 stream bank erosion and 4 tile outlet erosion NPS sites identified.
		2. Cropland Erosion (K)	Conventional tillage practices Plowing adjacent to water bodies	Encourage cover crops and reduced tillage, as well as grassed waterways and windbreaks; implement watershed focused land-use planning. Reduce sediment by 105.4 tons. Implement BMPs at 143 rill and gully NPS sites identified.
		3. Straightening of Waterways and Channel Improvements (K)	Plowing adjacent to water bodies Straightening of waterways and channel improvements	Install riparian filter strips and encourage reduced tillage, implement watershed focused land-use planning. Implement BMPs along the 125 miles where stream buffers are needed.
		4. Livestock Access Sites (K)	Unlimited livestock access to water bodies	Exclude livestock from streams. Reduce sediment by 366.2 tons. Implement BMPs at 100 NPS sites identified.
		5. Road and Bridge Crossings (K)	Undersized culverts, poorly designed and maintained bridges and road crossings	Install properly sized culverts, annual bridge maintenance and obstruction removal. Implement BMPs at 41 NPS sites identified.
		6. Storm Water Runoff (P)	Loss of floodplains and wetlands as retention Discharge from impervious surfaces and developed areas Ineffective storm water management	Encourage infiltration in urban areas, implement watershed focused land-use planning and storm water management, implement BMPs to address 23 urban/residential NPS sites with pollutants in storm water runoff, protect existing 16,075 acres of wetlands, restore 2,175 acres of wetlands (10% of lost acres).
	3. High Flow (S)	1. Straightening of Waterways and Channel Improvements (K)	Plowing adjacent to water bodies Straightening of waterways and channel improvements	Install riparian filter strips and encourage reduced tillage, implement watershed focused land-use planning. Implement BMPs along the 125 miles where stream buffers are needed.
		2. Storm Water Runoff (P)	Loss of floodplains and wetlands as retention Discharge from impervious surfaces and developed areas Ineffective storm water management	Encourage infiltration in urban areas, implement watershed focused land-use planning and storm water management, implement BMPs to address 23 urban/residential NPS sites with pollutants in storm water runoff, protect existing 16,075 acres of wetlands, restore 2,175 acres of wetlands (10% of lost acres).

Table 5.1 - Goals and Objectives				
Designated Use and Status	**Pollutants and Impairments to Designated Uses**	**Sources**	**Causes**	**Objectives**
Goal No. 2 - Protect and preserve the threatened designated uses, designated uses being met and high quality areas.				
Priority Areas for Goal No. 2 - Threatened designated uses = Coldwater fishery (designated trout streams in Watershed), Navigation (all subwatersheds), and Total and Partial body contact recreation (all subwatersheds); Designated Uses being Met = Agricultural and Industrial Water Supply; High Quality Areas (Middle Rabbit River and Upper Rabbit River subwatersheds)				
Agriculture: Met	1. Sediment (S)	1. Stream bank Erosion (K)	Lack of riparian vegetation Inadequate soil erosion and sedimentation control Flashy flows from changes in land use and lack of storm water storage areas	Stabilize stream flows to moderate hydrology, reduce suspended solids, and maintain the floodplain. Reduce sediment by 1027.9 tons. Implement stream bank stabilization, filter strips, and erosion control BMPs at 100 stream bank erosion and 4 tile outlet erosion NPS sites identified.
		2. Cropland Erosion (K)	Conventional tillage practices Plowing adjacent to water bodies	Encourage cover crops and reduced tillage, as well as grassed waterways and windbreaks; implement watershed focused land-use planning. Reduce sediment by 105.4 tons. Implement BMPs at 143 rill and gully NPS sites identified.
		3. Straightening of Waterways and Channel Improvements (K)	Plowing adjacent to water bodies Straightening of waterways and channel improvements	Install riparian filter strips and encourage reduced tillage, implement watershed focused land-use planning. Implement BMPs along the 125 miles where stream buffers are needed.
		4. Livestock Access sites (K)	Unlimited livestock access to water bodies	Exclude livestock from streams. Reduce sediment by 366.2 tons. Implement BMPs at 100 NPS sites identified.
		5. Road and Bridge Crossings (K)	Undersized culverts, poorly designed and maintained bridges and road crossings	Install properly sized culverts, annual bridge maintenance and obstruction removal. Implement BMPs at 41 NPS sites identified.
		6. Storm Water Runoff (P)	Loss of floodplains and wetlands as retention Discharge from impervious surfaces and developed areas Ineffective storm water management	Encourage infiltration in urban areas, implement watershed focused land-use planning and storm water management, implement BMPs to address 23 urban/residential NPS sites with pollutants in storm water runoff, protect existing 16,075 acres of wetlands, restore 2,175 acres of wetlands (10% of lost acres).
	2. Nutrients (S)	1. Fertilizers (K)	Improper application adjacent to water bodies	Establish filter strips or other riparian buffers at 42 NPS agriculture NPS sites, encourage proper fertilizer application (soil testing), implement watershed focused land-use planning.
		2. Land Application of Manure (K)	Lack of manure management plans Manure management plans not enforced Improper manure handling and spreading	Establish filter strips or other riparian buffers, encourage manure management planning and proper enforcement of the plans on 25% of the 88,452 acres used for manure spreading.
		3. Livestock Access Sites (K)	Unlimited livestock access to water bodies	Exclude livestock from streams. Reduce sediment by 366.2 tons. Implement BMPs at 100 NPS sites identified.
		4. Livestock Facility Runoff (S)	Improper manure storage and feedlot runoff	Identify livestock operations adjacent to rivers, establish filter strips or other riparian buffers along the 125 miles where stream buffers are needed, increase canopy cover, reduced tillage.
		5. Septic System Failures and Illicit Connections (S)	Improperly designed, installed, and maintained septic systems Unknown illicit connections	Identify and correct 100% of illicit connections in the Watershed, repair or replace aging septic systems and recommend regular maintenance of systems.
	3. Pathogens/Bacteria (S)	1. Land Application of Manure (S)	Lack of manure management plans Manure management plans not enforced Improper manure handling and spreading	Establish filter strips or other riparian buffers, encourage manure management planning and proper enforcement of the plans on 25% of the 88,452 acres used for manure spreading.
		2. Livestock Access Sites (S)	Unlimited livestock access to water bodies	Exclude livestock from streams. Reduce sediment by 366.2 tons. Implement BMPs at 100 NPS sites identified.
		3. Septic System Failures and Illicit Connections (S)	Improperly designed, installed, and maintained septic systems Unknown illicit connections	Identify and correct 100% of illicit connections in the Watershed, repair or replace aging septic systems and recommend regular maintenance of systems.

		4. Livestock Facility Runoff (S)	Improper manure storage and feedlot runoff	Identify livestock operations adjacent to rivers, establish filter strips or other riparian buffers along the 125 miles where stream buffers are needed, increase canopy cover, reduced tillage.
Table 5.1 - Goals and Objectives				
Designated Use and Status	**Pollutants and Impairments to Designated Uses**	**Sources**	**Causes**	**Objectives**
Goal No. 2 - Protect and preserve the threatened designated uses, designated uses being met and high quality areas.				
Priority Areas for Goal No. 2 - Threatened designated uses = Coldwater fishery (designated trout streams in Watershed), Navigation (all subwatersheds), and Total and Partial body contact recreation (all subwatersheds); Designated Uses being Met = Agricultural and Industrial Water Supply; High Quality Areas (Middle Rabbit River and Upper Rabbit River subwatersheds)				
Agriculture: Met Continued	3. Pathogens/Bacteria (S) Continued	5. Wildlife (S)	Overpopulations of geese and other waterfowl Lack of riparian vegetation	Identify areas where overpopulation of geese and other waterfowl are an issue, implement BMPs related to wildlife control at 50% of the sites.
	4. Pesticides and Chemicals (S)	1. Cropland Erosion (S)	Conventional tillage practices Plowing adjacent to water bodies	Encourage cover crops and reduced tillage, as well as grassed waterways and windbreaks; implement watershed focused land-use planning. Reduce sediment by 105.4 tons. Implement BMPs at 143 rill and gully NPS sites identified.
Coldwater fishery: Threatened - Designated coldwater trout streams: Lower Rabbit River (main branch), Silver Creek (main branch), Miller Creek (main branch), Middle Rabbit River West (lower main stem), Pigeon Creek, Feit Drain, Middle Rabbit River East (main branch), Buskirk Creek (main branch), Miller Creek (headwater), Upper Rabbit River (main branch and tributaries)	1. Temperature (K)	1. Lack of Riparian Habitat (K)	Due to agriculture and urban land use and development	Implement BMPs at 125 miles where riparian buffers are needed based on review of aerial photos, implement watershed focused land-use planning.
		2. Storm Water Runoff (P)	Loss of floodplains and wetlands as retention Discharge from impervious surfaces and developed areas Ineffective storm water management	Encourage infiltration in urban areas, implement watershed focused land-use planning and storm water management, implement BMPs to address 23 urban/residential NPS sites with pollutants in storm water runoff, protect existing 16,075 acres of wetlands, restore 2,175 acres of wetlands (10% of lost acres).
	2. Dissolved Oxygen (S)	1. Lack of Riparian Habitat (K)	Due to agriculture and urban land use and development	Implement BMPs at 125 miles where riparian buffers are needed based on review of aerial photos, implement watershed focused land-use planning.
		2. Storm Water Runoff (P)	Loss of floodplains and wetlands as retention Discharge from impervious surfaces and developed areas Ineffective storm water management	Encourage infiltration in urban areas, implement watershed focused land-use planning and storm water management, implement BMPs to address 23 urban/residential NPS sites with pollutants in storm water runoff, protect existing 16,075 acres of wetlands, restore 2,175 acres of wetlands (10% of lost acres).
	3. Sediment (S)	1. Stream bank Erosion (K)	Lack of riparian vegetation Inadequate soil erosion and sedimentation control Flashy flows from changes in land use and lack of storm water storage areas	Stabilize stream flows to moderate hydrology, reduce suspended solids, and maintain the floodplain. Reduce sediment by 1027.9 tons. Implement stream bank stabilization, filter strips, and erosion control BMPs at 100 stream bank erosion and 4 tile outlet erosion NPS sites identified.
		2. Cropland Erosion (K)	Conventional tillage practices Plowing adjacent to water bodies	Encourage cover crops and reduced tillage, as well as grassed waterways and windbreaks; implement watershed focused land-use planning. Reduce sediment by 105.4 tons. Implement BMPs at 143 rill and gully NPS sites identified.
		3. Straightening of Waterways and Channel Improvements (K)	Plowing adjacent to water bodies Straightening of waterways and channel improvements	Install riparian filter strips and encourage reduced tillage, implement watershed focused land-use planning. Implement BMPs along the 125 miles where stream buffers are needed.
		4. Livestock Access Sites (K)	Unlimited livestock access to water bodies	Exclude livestock from streams. Reduce sediment by 366.2 tons. Implement BMPs at 100 NPS sites identified.
		5. Road and Bridge Crossings (K)	Undersized culverts, poorly designed and maintained bridges and road crossings	Install properly sized culverts, annual bridge maintenance and obstruction removal. Implement BMPs at 41 NPS sites identified.
		6. Storm Water Runoff (P)	Loss of floodplains and wetlands as retention Discharge from impervious surfaces and developed areas Ineffective storm water management	Encourage infiltration in urban areas, implement watershed focused land-use planning and storm water management, implement BMPs to address 23 urban/residential NPS sites with pollutants in storm water runoff, protect existing 16,075 acres of wetlands, restore 2,175 acres of wetlands (10% of lost acres).

	4. High Flow (S)	1. Straightening of Waterways and Channel Improvements (K)	Plowing adjacent to water bodies Straightening of waterways and channel improvements	Install riparian filter strips and encourage reduced tillage, implement watershed focused land-use planning. Implement BMPs along the 125 miles where stream buffers are needed.
		2. Storm Water Runoff (P)	Loss of floodplains and wetlands as retention Discharge from impervious surfaces and developed areas Ineffective storm water management	Encourage infiltration in urban areas, implement watershed focused land-use planning and storm water management, implement BMPs to address 23 urban/residential NPS sites with pollutants in storm water runoff, protect existing 16,075 acres of wetlands, restore 2,175 acres of wetlands (10% of lost acres).
Partial Body Contact Recreation: Threatened - All subwatersheds	1. Pathogens/Bacteria (S)	1. Land Application of Manure (S)	Lack of manure management plans Manure management plans not enforced Improper manure handling and spreading	Establish filter strips or other riparian buffers, encourage manure management planning and proper enforcement of the plans on 25% of the 88,452 acres used for manure spreading.
		2. Livestock Access Sites (S)	Unlimited livestock access to water bodies	Exclude livestock from streams. Reduce sediment by 366.2 tons. Implement BMPs at 100 NPS sites identified.
		3. Septic System Failures and Illicit Connections (S)	Improperly designed, installed, and maintained septic systems Unknown illicit connections	Identify and correct 100% of illicit connections in the Watershed, repair or replace aging septic systems and recommend regular maintenance of systems.
		4. Livestock Facility Runoff (S)	Improper manure storage and feedlot runoff	Identify livestock operations adjacent to rivers, establish filter strips or other riparian buffers along the 125 miles where stream buffers are needed, increase canopy cover, reduced tillage.
		5. Wildlife (S)	Overpopulations of geese and other waterfowl Lack of riparian vegetation	Identify areas where overpopulation of geese and other waterfowl are an issue, implement BMPs related to wildlife control at 50% of the sites.
Navigation: Threatened - All subwatersheds	1. Obstructions (K)	1. Unstable Stream System (K)	Poor storm water management practices Loss of floodplains and wetlands as retention Increased impervious surfaces, less infiltration	Reduce suspended solids, implement watershed focused land-use planning, protect existing 16,075 acres of wetlands, restore 2,175 acres of wetlands (10% of lost acres).
Total body contact recreation: Threatened - All subwatersheds	1. Pathogens/Bacteria (S)	1. Land Application of Manure (S)	Lack of manure management plans Manure management plans not enforced Improper manure handling and spreading	Establish filter strips or other riparian buffers, encourage manure management planning and proper enforcement of the plans on 25% of the 88,452 acres used for manure spreading.
		2. Livestock Access Sites (S)	Unlimited livestock access to water bodies	Exclude livestock from streams. Reduce sediment by 366.2 tons. Implement BMPs at 100 NPS sites identified.
		3. Septic System Failures and Illicit Connections (S)	Improperly designed, installed, and maintained septic systems Unknown illicit connections	Identify and correct 100% of illicit connections in the Watershed, repair or replace aging septic systems and recommend regular maintenance of systems.
		4. Livestock Facility Runoff (S)	Improper manure storage and feedlot runoff	Identify livestock operations adjacent to rivers, establish filter strips or other riparian buffers along the 125 miles where stream buffers are needed, increase canopy cover, reduced tillage.
		5. Wildlife (S)	Overpopulations of geese and other waterfowl Lack of riparian vegetation	Identify areas where overpopulation of geese and other waterfowl are an issue, implement BMPs related to wildlife control at 50% of the sites.
Goal No. 3 - Educate Stakeholders about the Watershed and the impacts that stakeholders have on the Watershed. - See Chapter 7: Information and Education Strategy				
Goal No. 4 - Create a sustainable strategy for implementing the watershed management plan (WMP) - See Chapter 9: Sustainability				

(K) known,
(S) suspected
(P) potential

CHAPTER 6 - BEST MANAGEMENT PRACTICES

6.1 RECOMMENDED BEST MANAGEMENT PRACTICES (BMPS)

The 2007 and 2008 inventory was conducted to determine the needed BMPs for each subwatershed. A large number of BMPs are recommended to solve non-point source (NPS) pollution problems in the Rabbit River Watershed (Watershed).

Watershed-wide, the greatest NPS pollutant is sediment. Large areas of cropland erosion are the greatest contributors of sediment. In specific local areas, the largest sources of NPS pollution are livestock access, roadside erosion, local field erosion, and stream bank erosion. Reducing the amount of sediment that enters surface water will also reduce the amounts of other NPS pollutants, such as nutrients and pesticides, which absorb to soil particles. Local inputs of nutrients in the Watershed are very high, from heavily manured fields, farm run-off, and feedlot run-off. The most commonly needed BMP in the Watershed is filter strips. In Allegan County, filter strips, conservation tillage practices, stream buffer ordinance, wetland restoration, two-stage channel design, livestock exclusion fencing, watercourse crossings, and alternative water supply will be critical BMPs in reducing erosion, runoff, and phosphorus delivery into surface water tributaries. Developing manure management plans, animal waste storage facilities, and feedlot management would also be very effective in reducing nutrient input into surface water. Wetland restoration will also be effective in reducing flashiness and flooding of watercourses throughout the Watershed.

The BMPs were selected from the comprehensive list of BMPs in Appendix 10, which includes the MDEQ BMP list, the Michigan Department of Transportation's (MDOT) list of BMPs, the MDEQ's Agricultural BMP manual, and the MDEQ's Wetland Protection Guide to identify structural and vegetative BMPs needed to control NPS pollution from areas in the Watershed. A list of managerial BMPs, such as manure management, zoning ordinances, and land use policies, was developed using those same resources to identify managerial strategies to control NPS pollution. The BMPs were prioritized based on the landowner participation in past projects in the watershed and acceptance of practices. The quantities of recommended BMPs are based on the NPS inventories conducted for this project, as well as recommendations from the Steering Committee. An inventory will need to be conducted on areas not yet assessed in order to quantify the BMPs for those areas. The Action Plan outlined in Table 6.1 includes a detailed list of activities that describe the actions taken to accomplish the project goals and objectives.

6.1.1 CRITICAL/PRIORITY AREAS AND SITES - QUANTITY/LOCATIONS

The critical areas are where the BMPs will be implemented to address the sources and causes of pollutants, which cause impairments or threats to the designated uses. The locations are identified in

Section 4.6.1 and in Table 6.1 by subwatershed, community, or specific site as applicable, along with the quantity of the BMP to be implemented, such as miles of filter strip or number of communities. Priority areas are the places identified for protection to prevent future impacts to water quality. These areas are described in Section 4.6.2. Assumptions and pollutant removal efficiencies are described for each BMP in Table 6.1.

6.1.2 ESTIMATED UNIT COSTS

Costs associated with the BMPs are listed and can be used as a guide to estimate future budgets and funding needed from landowners and partner participation. The BMP unit costs include the total cost of implementing the BMP, as well as any operations and maintenance costs associated with that BMP. This information was derived from past experience and is included in more detail in Table 6.1.

6.1.3 TOTAL COSTS

The total cost for implementation is tallied in this column. Totals from this action plan will be added with the totals in the information and education (I&E) chapter to summarize the level of effort recommended to address the water quality impairments and threats.

6.1.4 MEASURABLE MILESTONES

The measurable milestones follow a timeline of short-term (most specific actions to occur by 2010), mid-term (to be completed by 2013), and long-term (assessing goals of reduction and documenting amount completed by 2018). Specific numbers, benchmarks, phases, or steps are identified for each action listed in Table 6.1.

6.1.5 TYPE, AMOUNT, AND SOURCE OF TECHNICAL ASSISTANCE

Not all of these actions can be accomplished by one entity in the timeframes listed, but the timeframes are feasible for each action on its own. For each action, the technical assistance needed, and the amount of assistance, usually in hours, was calculated. Particular agencies that are capable of providing those technical services are listed. The regulatory authority is identified, if the action requires a change in policy or rules and regulations that impact water quality. Additional information about technical assistance is included in Table 6.1.

Assistance in the implementation of the BMPs are provided by a number of local agencies, such as the Allegan Conservation District (ACD), County U.S. Department of Agriculture (USDA), USDA Natural Resources Conservation Service (NRCS), Farm Service Agencies, Allegan County Drain Commissioner (ACDC), and the Allegan County Road Commission (ACRC). State agencies that provide guidance

include the MDEQ (Water Bureau), the Michigan Department of Natural Resources (MDNR), and the Michigan Department of Agriculture (MDA). Landowners, local government officials, conservation organizations, private consultants, and engineers participate as well.

6.1.6 FINANCIAL ASSISTANCE

The activities proposed for the project implementation can be funded through a variety of sources. Federal funding from the USDA through the Farm Bill programs, such as the Environmental Quality Incentive Program (EQIP), Conservation Reserve Enhancement Program (CREP), and Wetlands Reserve Program could assist in the implementation of the agricultural practices. Other federal funding through U.S. Environmental Protection Agency (USEPA) Section 319 funds and state funding from any remaining State of Michigan's Clean Michigan Initiative (CMI) funds could supplement these efforts. Local funding through community foundations, county departments, and conservation organizations should also be explored and are identified where appropriate in Table 6.1.

Known or potential sources of funding assistance are listed for each action, focusing on the short-term measurable milestones. More general information is listed for the future milestones.

6.2 MANAGERIAL STRATEGIES

6.2.1 WETLAND RESTORATION/PRESERVATION

Wetlands slow and retain surface water, providing water storage and streambank/shoreline stabilization. Different wetlands have different storage capacities, depending upon their size, depth, frictional resistance, shoreline shape, and position within a watershed. For more detailed information on wetlands, please see Section 2.1.5.

A wetland restoration and preservation partnership has been organized between local government and non-profit agencies in the Watershed to preserve and restore wetlands in the Watershed and Southwest Michigan. This partnership includes the U.S. Fish and Wildlife Service (USFWS), Ducks Unlimited (DU), Allegan Conservation District (ACD), MDEQ Wetlands Protection Program and township and city officials. This working partnership is utilizing multiple funding avenues to pursue wetland restoration projects in the Watershed using the specific qualifications of each group to implement "on the ground" restorations.

Under the Watershed Implementation Project (2005 to 2008), 34 acres of wetlands were restored using MDEQ 319 funds. An additional 77 acres were restored along the Bear Swamp Drain by the ACDC as a mitigation bank. These five restorations were implemented on private lands within the Watershed including the Bear Swamp Drain, Ritz Drain, Boerman Drain, Gulch Drain and the Rabbit River. These

projects demonstrate private landowner interest in wetland preservation and restoration and the need for funding to protect and restore the valued resources.

Figure 6 is a map of the Wetland Restoration Potential created by the MDEQ. The map shows hydric soils, circa 1800 wetlands, and existing wetlands. The intersection of the hydric soils and circa 1800 wetland areas indicate areas with high potential for wetland restoration. Appendix 3 includes the MDEQ's "Rabbit River Watershed, Wetland Status and Trends, Presettlement to 1978" report.

Wetland preservation/protection can be accomplished in two different ways - Conservation Easements and Local Wetland Ordinances. For more information on Conservation Easements see the Dedicated/Protected Lands in Section 2.1.5.

6.2.2 PRESERVATION OF OTHER LANDS

Basically, three main tools are available for land preservation: conservation easements, land donations, and bargain sales of land. Each tool can be configured to fit the landowner's idea of what to do with the land. However, each tool differs from the others in significant ways that must be kept in mind when making decisions about how to preserve land. Also, because the specific land conservancy or organization may have a specific mission in what type of land they protect, a discussion must be had to determine the best tool to protect the land.

Private landowners have several conservation options for their land. Following are a few of those options, summarized from information provided by the Land Conservancy of West Michigan (LCWM) and several other land protection agencies across the State of Michigan (State). A Conservation Easement booklet that provides a concise summary of these options is included in Appendix 11.

The following are land protection and management options for private lands:

Conservation easement: Legal agreement between a landowner and a land conservancy or government agency permanently limiting a property's uses. It is an option for those who wish to keep the property in the family and only give up the development rights to the land. Conservation easements are very helpful for people who want to preserve their land, but maintain ownership and use of it, and maintain the ability to transfer the land by sale or other conveyance. The development rights are donated to ensure preservation of other rights or values inherent in the land. Added benefits may involve significant cuts in property taxes, income taxes, and estate taxes. Conservation easements may offer tax incentives too. By donating a conservation easement, the landowner is giving up many of his development rights into the future. These development rights have a value placed on them (by a qualified land appraiser) and that

non-cash value is a donation that can be taken over a number of years against the landowners federal income taxes. Also, a recent change in the State of Michigan allows land protected by a conservation easement to avoid the “pop-up” taxes, which is a large incentive for families that wish to keep the property in the family. A description of the law, P.A. 446, is included in Appendix 11. Estate and reduced property taxes are also incentives to donations of conservation easements.

Outright land donation: Land is donated to the land conservancy. Some land donations can provide for lifetime incomes through annuity payments or a charitable remainder unitrust. The land would no longer be theirs, but the grantor would still receive some benefits from it during their lifetime. Land donation can be either preserved land that the land trust will keep or commercial land that will be sold to raise money for caring for preserved land. This ensures an income tax reduction for the landowner and may also reduce estate taxes. If a landowner wishes to donate land to a land conservancy during his or her lifetime, but needs to continue to receive income from the land, they can use a land donation that establishes a life income. This can be done through a charitable gift annuity where the landowner entrusts the land to a land trust’s care, but has the land trust make annuity payments to beneficiaries for life. This also can have some income tax benefit, based on the value of the land versus the expected annuity payments. The land trust must have financial resources to make the annuity payments.

Donation of land by will: Land is specifically designated for donation to the land conservancy in the landowner’s will.

Donation of remainder interest in land with reserved life estate: If the landowner wishes to remain on the land during their lifetime, or perhaps wants a specified beneficiary to live on the land during their lifetime, the owner can donate a remainder interest in the land. Then the owners or beneficiaries may live out their lives on the land, with the land trust only receiving control afterwards (or possibly sooner if the specified persons release their life interests in the land.) At the time of donation, the owner may receive some income tax benefits, but they reserve their right to enjoy the property for the rest of their lives.

Bargain sale of land: Land is sold to the land conservancy below fair market value. It provides cash, but may also reduce capital gains tax, and entitle you to an income tax deduction.

Another option for land preservation is the Purchase of Development Rights, or PDR, program. It is a voluntary program where a land trust or some other agency usually linked to local government makes an offer to a landowner to buy the development rights on the parcel. More information on the PDR program is included in the Dedicated/Protection Lands section in 2.1.5.

For farmland protection/preservation, the PA-116 program is administered through the USDA Farm Services Agency that protects farmland from development for a specified number of years.

6.2.3 LAND USE PLANNING

The way the land is managed, its patterns, relationship to natural resources and how water is managed onsite all have impacts on the water quality in the watershed. Land management generally occurs at the local level.

Ordinances can be used as a foundation for the institutionalization of watershed stewardship behavior. The Upper Rabbit River Watershed Management Plan (WMP) highlighted the importance of water resources as a vital component when determining land use decisions at the local level. Communities in the Upper Rabbit River Watershed are interested in achieving sustainable development, defined as economic and social growth that also protects local water quality and natural resources. A Water Quality Zoning in Review document was created in 2006 to highlight the water quality ordinances adopted by townships in the watershed to protect water quality and develop economic growth through land use planning. The document also identified gaps in water resource protection. As a result, the ACD developed a set of model ordinances for the Watershed that includes standards and consistent language for communities to use for the following concerns:

- Storm Water Management/Impervious Surface Mitigation Standards
- Private Road Ordinance
- Floodplain Management Standards
- Post Construction Runoff Ordinance (Site-plan review)
- Lake/Funnel Access Ordinance

The complete document and ordinances are included in Appendix 11. A summary of which townships have adopted which ordinances is included in Table 6.1a. In addition, a wetland protection ordinance was modified from an ordinance being developed through the Huron River Watershed Council for use by communities in the Watershed. This model wetland ordinance is also included in Appendix 11.

Table 6.1a – Status of Ordinance and Regulation Adoptions

	Master Plan Updates	Funnel Ordinance	Riparian Corridor	Storm Water Management Plans	Floodways and Flood Fringe Regulations
Allegan County				Standards for development	
Dorr Township	Yes		50' overlay zone		
Hopkins Township	Yes	Yes	50' overlay zone		
Leighton Township	Yes	Yes	50' overlay zone		
Monterey Township	Yes	Yes	Yes	Single family developments of 5 or more houses and commercial and industrial developments	Yes
Salem Township	Yes		50' overlay zones		
Wayland Township			50' overlay zone		
City of Wayland	Yes	Yes	50' overlay zone		

The LCWM developed a Conservation Easement Contract Template, included in Appendix 11, to ensure that the donated properties will be perpetually preserved in their predominantly natural, scenic, historic, agricultural, forested, or open space condition. The purposes of the Conservation Easement Contract are to have the parties agree to protect the property's natural resource and watershed values; to maintain and enhance biodiversity; to retain quality habitat for native plants and animals, and to maintain and enhance the natural features of the property.

The *Rabbit River Watershed Hydrologic Study* (FTC&H, 2008), was completed as part of this project (Appendix 5). A hydrologic model of the Upper Rabbit River Watershed was created to help determine the

impact of future development. The study recommended adoption of LID-based development rules and encouraged wetland restoration. Both options should be taken into consideration as new ordinances are developed to help preserve and protect water quality. A summary of the study was discussed in Section 3.1.2

6.3 ESTIMATED POLLUTION REDUCTIONS FROM PROPOSED ACTIONS AND BMPS

6.3.1 POLLUTANT LOADINGS AND REDUCTIONS FROM NPS SITES

According to the "Pollutant Controlled Calculations and Documentation for Section 319 Watersheds Training Manual," June 1999, MDEQ assumes 100% pollutant reductions from the implementation of BMPs on the identified NPS sites, which means that once the system of BMPs is established, the stabilized condition is assumed to control all of the erosion. Using the information from the NPS sites collected in 2007 and 2008, the total pollutant reductions from those sites are 1,499.5 tons of sediment, 1,500 pounds of phosphorus, and 2,999 pounds of nitrogen.

The goal established by the Steering Committee for the Watershed is to reduce sediment and nutrients by 50 percent in 5 years and 100 percent in 10 years from the identified sites.

6.3.2 POLLUTANT LOADINGS AND REDUCTIONS FROM OTHER AREAS

Table 3.2 presents the estimates of the loadings of the Watershed, based on the L-THIA model calculation. The goal is to reduce sediment and nutrients by 15 percent (889 tons of sediment, 4,912 pounds of phosphorus, and 63,945 pounds of nitrogen) in 5 years and 25 percent (1,482 tons of sediment, 8,187 pounds of phosphorus, and 106,575 pounds of nitrogen) in 10 years.

Table 6.1 - Rabbit River Action Plan

Recommended Prioritized BMPs	Causes of Source of Pollutant	Critical and Priority Areas/Sites - Quantity/Locations	Estimated Unit Cost (Includes Operations and Maintenance Costs)	Total Cost (Over 10 Years)	Measurable Milestones - 2010	Measurable Milestones - 2013	Measurable Milestones - 2018	Technical Assistance	Financial Assistance
Goal No. 1 - Restore and maintain the impaired designated uses of the Watershed: Other indigenous aquatic life and wildlife (Black Creek, Red Run Drain, Green Lake Creek, and Upper Rabbit River), Warmwater Fishery (Red Run Drain)									
1. Filter strips	Lack of riparian vegetation (sediment, nutrients, temperature, DO, pesticides and chemicals), plowing adjacent to water bodies (sediment), conventional tillage practices (sediment), feedlot runoff (nutrients), and improper manure handling and spreading (*E. Coli,* nutrients)	Fields adjacent to TMDL reaches and waterbodies in critical subwatersheds - Section 4.6, Table 4.4 125 miles identified through aerial photos without riparian vegetation x 50 ft wide of filter strip needed = 758 acres (3 ac/filter strip = 253 filter strips)	$1,500/acre establishment (design, seed, labor), $125/acre/year rental	$1,137,000 establishment, $94,750 rental	Identify landowners of parcels without filter strips. Contact landowners. Provide incentives to install filter strips. Install 8 acres (10%).	Install additional 68 acres of filter strips (25%)	Increased participation in programs, and 114 acres filter strips installed (100%)	DU, Pheasants Forever, TU, NRCS, ACD, golf courses, and landowners 20 hours/filter strip = 5,060 hours	Farm Bill Program, 319 grants, Pheasants Forever, TU, CCRP
2. Exclusion fencing	Unlimited livestock access to water bodies (nutrients, sediment, *E. coli*), and lack of riparian vegetation (sediment, nutrients, temperature, DO, pesticides and chemicals)	100 sites identified in inventory. Average 350 ft/site = 35,000 ft)	$1.50/linear foot	$52,500	Contact all landowners. Develop 10 contracts with landowners to install fencing to keep livestock out of waterways. (10%)	Install exclusion fencing at 15 sites. (25%)	Install fencing at additional 75 sites. 100%	NRCS, ACD, MDA, MDEQ, local farmers 10 hours/site = 1,000 hours	CCRP, EQIP, AWEP
3. Watercourse crossings and alternative watering supply	Unlimited livestock access to water bodies (nutrients, sediment, *E. coli*), and lack of riparian vegetation (sediment, nutrients, temperature, DO, pesticides and chemicals)	100 sites identified in inventory.	$3,700 each	$370,000	Contact all landowners identified in NPS inventory to install alternative water supplies. Develop designs and install at 10 sites (10%)	Develop designs and install at additional 15 sites (25%)	Install BMPs at additional 75 critical sites (100%)	NRCS, ACD, MDA, MDEQ, local farmers 20 hours/site = 2,000 hours	CCRP, EQIP, AWEP
4. Conservation tillage practices	Conventional tillage (sediment, nutrients)	Fields adjacent to TMDL reaches and waterbodies in critical subwatersheds - Section 4.6, Table 4.4 Black Creek Subwatershed – 18,186 ag acres, Green Lake Creek subwatershed – 11,181 ag acres	$260 - 460/acre	$7.6 million - $13.5 million	Identify highest erodible fields, implement practices on 2,937 acres (10%)	Implement practices on 4,404 acres (25%)	Implement practices on 22,025 acres (100%)	NRCS, ACD, MSUE agent 1 hour/10 ac = 2,937 hours	CRP, EQIP, AWEP
5. River Restoration	Lack of riparian vegetation (sediment, nutrients, temperature, DO, pesticides and chemicals), Flashy flows from changes in land use and lack of storm water storage areas (sediment, nutrients, temperature, DO)	100 sites identified in inventory with streambank erosion. 4 sites with tile erosion Critical areas for sediment and flow: Black Creek, Green Lake Stream, Red Run Drain, Buskirk Creek	$5,000 - $20,000/site	$500,000 - $2 million	Assess and repair 10 streambank and 1 tile outlet site (10%)	Assess and repair 15 streambank and 1 tile outlet site (25%)	Assess and repair 75 streambanks and 2 tile outlet sites (100%)	NRCS, ACD, consultant, ACDC, MDEQ, MDNR 40 hours/site = 4,160	ACDC Drain assessments, 319 implementation
6. Wetland restoration	Flashy flows from changes in land use and lack of storm water storage areas (sediment, nutrients, temperature, DO), loss of floodplains and wetlands as retention (sediment, nutrients, temperature, DO), filling and draining wetlands (loss of habitat)	Areas identified with cross-hatching on the MDEQ Wetland Restoration Potential map, Figure 6 as well as critical areas (Section 4.6, Table 4.4) 2,175 acres (20 ac/wetland = 108 wetlands)	$2,000 - $10,000/acre	$4.3 million - $21.7 million	Complete designs for 218 acres of wetlands. (10%)	Work with landowners, agencies and organizations to design and restore 326 acres of wetland. (25%)	Complete wetland restoration on 1,631 acres. (100%)	MDEQ, NRCS, ACD, DU, TU, USFWS, Wetland consultants, golf courses 60 hours/wetland – 6,480 hours	MDEQ, DU, USFWS, EPA Region 5 Wetland Program Development grant, WRP, CCRP, Wildlife Habitat Foundation

Table 6.1 - Rabbit River Action Plan

Recommended Prioritized BMPs	Causes of Source of Pollutant	Critical and Priority Areas/Sites - Quantity/Locations	Estimated Unit Cost (Includes Operations and Maintenance Costs)	Total Cost (Over 10 Years)	Measurable Milestones - 2010	Measurable Milestones - 2013	Measurable Milestones - 2018	Technical Assistance	Financial Assistance
7. LID	Urban runoff	Urban areas	TBD	TBD	Review current standards/ordinances and add LID techniques.	TBD	TBD	Township and Village planners, (regulatory authority for the ordinance), ACD, ACDC	People and Land Grants, 319 Implementation grants, Five Star Restoration Grants, NACO Coastal Counties Restoration Initiative grants
8. Two-stage channel design	Straightening of waterways and channel improvements	315 miles of County drains in watersheds	$10/LF	$16,632,000	Work with ACDC to identify most critical, approximately 30 miles, to design projects for two-stage channel functions	Design next most critical, approximately 80 miles for two-stage channel functions.	Complete designs for remainder of areas in need to two-stage channel functions, total of 315 miles	ACDC, consulting engineers	Fee-based, drain assessments
9. Repair and/or replace road/stream crossings	Inadequate soil erosion and sedimentation control at road/stream crossing sites (sediment, nutrients), undersized culverts and poorly designed and maintained bridges and road crossings (sediment, nutrients, obstructions)	41 sites identified in inventory	$20,000 - $200,000/each	$820,000 - $8.2 million	Contact Road Commission to develop plan for 10 most critical sites.	Repair or replace 10 most critical road/stream crossings (25%)	Repair or replace 31 more crossings, create schedule for remaining repairs (100%)	ACRC, landowners 50 hours/crossing = 5,000 hours	ACRC, Rural development programs, Fish & Wildlife Fish passage grants
10. Develop manure management plans	Lack of manure management plans or manure management plans not enforced (nutrients, *E. coli*), improper manure handling and spreading (nutrients, *E. coli)*	Fields adjacent to TMDL reaches and waterbodies in critical subwatersheds - Section 4.6, Table 4.4 20 Manure Management Plans	$6,000	$120,000	Contact NRCS to review maps of field tiles in critical areas, locate tile outfalls, and identify sources of discharge. Contact 40 of those producers and provide education on new GAAMPs.	Encourage MDEQ to review existing spreading plans and enforce them. Prioritize farms for development of manure management plans. Develop 5 plans. (25%)	Develop additional 15 plans for priority farms. (100%)	NRCS, ACD, MDA (regulatory authority for GAAMPs), MDEQ (regulatory authority for CAFOs), Farmers, TSPs, Farm Bureau 100 hrs/plan = 2,000 hours	MDA, MDEQ, CCRP, CCPI, AWEP
11. Animal waste storage facilities	Improper manure storage and feedlot runoff (nutrients, *E. coli*)	Farms adjacent to TMDL reaches and waterbodies in critical subwatersheds - Section 4.6, Table 4.4 5 Facilities	$50,000/facility	$250,000	Identify operations with manure management challenges. Contact 10 producers to present information. Inspect existing facilities.	Design and construct 2 manure storage facilities. (25%)	Design and construct additional 3 manure storage facilities. (100%)	TSP, NRCS, ACD, MDA, MDEQ, Farmers, engineers 400 hours/facility = 2,000 hours	Farm Bill Programs, 319 Grants
12. Critical area planting for riparian habitat.	Lack of riparian vegetation (sediment, nutrients, temperature, DO, pesticides and chemicals), plowing adjacent to waterbodies (sediment, nutrients, pesticides and chemicals), and inadequate soil erosion and sedimentation control (sediment, nutrients)	Subwatersheds listed in section 4.6 and Table 4.4 as critical. 100 sites of stream bank erosion identified in inventory	$3,000/site	$300,000	Revisit all sites to assess severity of erosion and most probable cause. For localized problems, contact landowners of 10 most critical sites. (10%)	Work with riparian land owners to restore native vegetation on 15 sites (25%)	Stabilize remaining 75 identified sites with vegetative practices. (100%)	NRCS, ACD, MDA, MDEQ, MDNR, local farmers, riparian landowners 20 hours/site = 2,000 hours	319 Grants, Landowners, EQIP, AWEP

Table 6.1 - Rabbit River Action Plan

Recommended Prioritized BMPs	Causes of Source of Pollutant	Critical and Priority Areas/Sites - Quantity/Locations	Estimated Unit Cost (Includes Operations and Maintenance Costs)	Total Cost (Over 10 Years)	Measurable Milestones - 2010	Measurable Milestones - 2013	Measurable Milestones - 2018	Technical Assistance	Financial Assistance
13. Feedlot management	Feedlot runoff (sediment, nutrients, *E. coli*)	Farms adjacent to TMDL reaches and waterbodies in critical subwatersheds - Section 4.6, Table 4.4 42 NPS ag sites identified in inventory	$5,000	$210,000	Assess areas where feedlots drain into waterbodies, develop 1 model feedlot management plan, including fencing, manure management, roof runoff management, watering facility	Identify 10 sites and develop comprehensive feedlot management plans. (25%)	Identify 32 additional sites and develop comprehensive plans. (100%)	NRCS, ACD, MDA, MDEQ, Farmers, Farm Bureau 40 hours/site = 1,680 hours	AWEP, CCPI
14. Septic system maintenance	Improperly designed, installed, and maintained septic systems (nutrients, *E. coli*)	Inspect and perform maintenance on 50% systems adjacent to TMDL reaches and in critical subwatersheds - Section 4.6, Table 4.4	$TBD	$TBD	Identify areas of old/failing septic systems, hold public meeting to address septic system maintenance. Work with septic haulers to provide incentives for clean outs and repairs.	Inspect systems and verify maintenance.	Inspect additional systems verify all maintenance. Remove 100% of leaching or failing systems found	ACHD, septic system businesses, TU, golf courses, businesses 10 hours/system = TBD hours	ACHD, landowners
15. Methane digester	Improper manure storage (nutrients, *E. coli*)	Farms adjacent to TMDL reaches and waterbodies in critical subwatersheds - Section 4.6, Table 4.4 1 digester	$3 Million	$3 Million	Notify producers of digester benefits and identify producers interested in investing in a digester.	Work with engineers and distributors to design and construct the system.	Have regional methane digester in place accepting manure from 3 farms. (100%)	Local energy producer, Economic Development Committees, Producers 300 hours/facility = 300 hours	Rural Development grants, Conservation innovation grants, Frey Foundation
16. Coordinate with County Health Departments to adopt septic regulations	Improperly designed, installed, and maintained septic systems (nutrients, *E. coli*)	Allegan and Ottawa Counties	$7,500/county for assistance	$15,000	Increase or maintain the ability to enforce the correction of failures. Assist with implementation and enforcement of septic system regulations.	Assist with promotion of septic ordinance	Eliminate 100% of failing septic systems found	Health Departments, Clean Water Action, developers, TU, golf courses, businesses 100 hours/county = TBD hours	People and Land Grants, Health Departments, Community Foundations
17. Identify and prohibit illicit sanitary connections	Unknown illicit connections (nutrients, *E. coli*)	Villages of Hopkins, Dorr, Wayland, and Martin	$600/Dye Test; $100/Staff Investigation per property	$TBD	Inventory all storm sewer outfalls for dry and wet weather flow. Test flow for temperature, DO, phosphorus, conductivity, and *E. coli.*	Develop maintenance strategy. Conduct tracing to determine source of illicit discharge.	Remove 100% of illicit connections found	Villages of Hopkins, Dorr, Wayland, and Martin, ACDC, ACRC, businesses 4 hours/home = TBD hours	Villages of Hopkins, Dorr, Wayland, and Martin, MDEQ, Wastewater Treatment Plant and Sewage Lagoon fees
18. Wildlife management	Overpopulations of geese and other waterfowl (*E. coli*)	Lands adjacent to TMDL reaches and waterbodies in critical subwatersheds - Section 4.6, Table 4.4 1 wildlife management plan	$4,000/plan	$4,000	Work with MDNR and urban critter control businesses to develop plan to manage wildlife populations	Implement recommendation in plan, such as hired dogs for good management	Reduction of wildlife population to MDNR recommendations.	MDNR, TU, DU, local animal control businesses 60 hours/plan = 60 hours	MDNR Land & Water Great Lakes Fish & Wildlife Restoration Grants, 319 funding, landowners
Goal No. 2 - Protect and preserve the threatened designated uses (Coldwater Fishery - designated trout streams in Watershed, Navigation - all subwatersheds, and Total and Partial body contact recreation - all subwatersheds), the designated uses being met (Agriculture and Industrial Water Supply), as well as the high quality areas.									

Table 6.1 - Rabbit River Action Plan

Recommended Prioritized BMPs	Causes of Source of Pollutant	Critical and Priority Areas/Sites - Quantity/Locations	Estimated Unit Cost (Includes Operations and Maintenance Costs)	Total Cost (Over 10 Years)	Measurable Milestones - 2010	Measurable Milestones - 2013	Measurable Milestones - 2018	Technical Assistance	Financial Assistance
1. Stream buffer ordinance	Lack of riparian vegetation (sediment, nutrients, temperature, DO, pesticides and chemicals), discharge from impervious surfaces and developing areas (sediment, temperature, DO), inadequate soil erosion and sedimentation control (sediment, nutrients), improper application of fertilizers adjacent to waterbodies (nutrients), loss of floodplains and wetlands as retention (sediment, nutrients, temperature, DO), ineffective storm water management (sediment, nutrients, temperature, DO)	Townships in critical subwatersheds - Section 4.6, Table 4.4 Jamestown, Zeeland, Salem, Overisel, Byron, Leighton Townships (6 communities)	$5,000/community	$30,000	Contact to present information at Board meetings to establish buffer ordinance for consistent setbacks from waterways. Assess enforcement of ordinances already adopted. Ordinances adopted since 2005 – City of Wayland; Dorr, Hopkins, Leighton, Monterey, Salem, Wayland Townships (Riparian Corridor Ordinance (50' overlay)	Complete final ordinance. Work with Jamestown, Zeeland, Overisel, and Byron, communities to get ordinances approved.	Approved ordinance enforced in all communities.	Township and Village planners, (regulatory authority for the ordinance), ACD 50 hours/ordinance = 300 hours	People and Land Grants, 319 Implementation grants, Five Star Restoration Grants, NACO Coastal Counties Restoration Initiative grants
2. Conservation easements and farmland preservation	Lack of riparian vegetation (sediment, nutrients, temperature, DO, pesticides and chemicals), inadequate soil erosion and sedimentation control (sediment, nutrients), development of open space for agriculture and urban development (loss of habitat)	Subwatersheds listed in Table 4.5. Middle Rabbit River West and Upper Rabbit River	$24,750 contract development, plus $2,000/acre (purchase price)	$TBD	Contact Land Conservancies or other organizations that are legally able to hold easements and accept land donations. Identify number of acres and landowners of parcels eligible for conservation easements.	Identify areas to be assessed. Negotiate easements and preservation of land. Develop contracts for conservation easements	Contracts for additional acres.	Appraiser, tax advisor, legal review, closing agent, professional surveyor, Land Conservancy of West Michigan, The Nature Conservancy, TU, golf courses, businesses 40 hours/easement = TBD hours	Land Conservancy, Great Lakes Fish and Wildlife Restoration Act grants
Goal No. 3 - Educate Stakeholders about the Watershed and the impacts that stakeholders have on the Watershed. - See Chapter 7: Information and Education Strategy									
Goal No. 4 - Create a sustainable strategy for implementing the watershed management plan (WMP) - See Chapter 9: Sustainability									

MDA - Michigan Department of Agriculture
MDEQ - Michigan Department Environmental Quality
MDNR - Michigan Department of Natural Resources
MSUE - Michigan State University Extension
NPS - Nonpoint Source
NRCS - USDA Natural Resources Conservation Service
TBD – To be determined
TMDL - Total Maximum Daily Load
TSP - Technical Service Providers
TU - Trout Unlimited
USEPA - U.S. Environmental Protection Agency
USFWS - U.S. Fish and Wildlife Service
Watershed - Rabbit River Watershed
WRP - Wetland Reserve Program

Total BMP Implementation Cost = $18,585,250 - $41,885,250
Total Technical Assistance Cost = 33,097 hours x $50/hr = $1,654,850

CHAPTER 7 - INFORMATION AND EDUCATION STRATEGY

7.1 GOALS AND OBJECTIVES OF I&E STRATEGY

A goal of the Rabbit River Watershed (Watershed) Project is to reduce nonpoint source (NPS) pollution by increasing knowledge and awareness of water quality and watershed issues through information and education (I&E), including encouraging and maintaining a high level of stakeholder participation. Stakeholder knowledge and awareness will lead to improved stewardship of the Watershed. Local community leaders, Watershed residents, and landowners continue to become involved, and express their concerns about water quality and land-use practices that affect it.

The I&E strategy targets specific groups about the impairments of the Watershed, the sources of those impairments, and how to reduce the impacts from those sources. The I&E strategy has been formulated into a working document that outlines major educational opportunities and actions needed to successfully maintain and improve water quality in the Watershed.

7.2 IDENTIFYING TARGET AUDIENCES

The target audiences include individuals or groups known to impact or be impacted by the project and whose support is needed to achieve the goals of the project. The I&E Committee identified the following targeted audiences associated with identified pollutants:

- Builders - Sediment, hydrology, and habitat fragmentation
- Developers - Sediment, hydrology, and habitat fragmentation
- Drain Commissioners - Sediment
- General Public - All watershed pollutants
- Golf Courses - Nutrients
- Local Agricultural Producers - Sediment, nutrients, pathogens, dissolved oxygen (DO)/temperature, obstructions/trash/debris, and pesticides/chemicals
- Local Businesses (industrial, non-industrial, and agricultural) - Invasive species
- Local Officials - Sediment, nutrients, hydrology, pathogens, habitat fragmentation, dissolved oxygen/temperature, and obstructions/trash/debris
- Prime Farmland Owners - Nutrients
- Residents and Landowners - Sediment, nutrients, habitat fragmentation, and pesticides/chemicals
- Riparian Landowners - Sediment, nutrients, hydrology, pathogens, habitat fragmentation, dissolved oxygen/temperature, and obstructions/trash/debris
- Students - Obstructions/trash/debris

Characterizing each target audience is an important part of implementing an I&E strategy. Collecting demographic information will help define the socio-economic structure of each target audience. Information on existing knowledge of watershed issues, current attitudes and beliefs, and existing communications channels will also be relevant and should be determined before initiating an education campaign. This information will ensure that appropriate messages are reaching the designated target audiences using effective formats and distribution methods.

One of the key target audiences of the Watershed is students. The Watershed includes parts of seven different school districts, but is dominated by three: Hopkins, Wayland, and Hamilton. Potential activities include school programs, assemblies, and bulletin boards or displays. Students are the future influences of our watershed, and will be the ones who decide the course of water quality. Our targeted student audience includes Kindergarten through 12th grade. School programs range from an Enviroscape presentation and watershed activities for first graders, to a field workshop on erosion and best management practice (BMP) controls for high school students. Encouraging NPS pollution-related curriculum in area schools are examples of other potential activities.

7.3 DEVELOPING MESSAGES

Implementation of the I&E strategy will need to effectively communicate with the wide range of audiences that make up the community. Specific messages will need to be developed that raise awareness, educate individuals on the problems and solutions, and inspire action. These messages should be repeated frequently to be effective. Each audience will respond differently to the information presented, and it is critical that the information be tailored to each audience. Each target audience must have a clear understanding of the watershed problems being addressed and how the project is addressing these problems before any behavioral changes are to take place. Members of the I&E Committee developed the following messages, as noted in Table 7.1, based on the known pollutants in the Watershed.

- Excessive sediment from erosion and runoff impairs aquatic habitats and alters natural hydrology.
- Nutrient rich waters cause excessive plant growth, depleting oxygen and impairing aquatic habitats.
- Changes in land use impact stream flows creating water quality, stream stability, and flooding concerns.
- Bacterial contamination from failing septic systems, agricultural runoff, and concentrated wildlife populations create unsafe water for human contact.
- Preserving ecologically important areas and natural wildlife corridors prevents fragmentation and isolation of habitats.

- Agricultural runoff, lack of riparian habitats, and urban storm water runoff all cause increased stream temperatures and decreased amounts of dissolved oxygen.
- Illegal dumping impedes recreational opportunities for canoeing and kayaking waterways.
- Harmful toxins can enter waterways through excessive use and accidental spillage of pesticides and chemicals.
- Non-native and exotic species, introduced by choice or unknowingly, reduces biodiversity and suitable habitats for native species.
- We all live in a watershed and our day to day activities affect water quality either positively or negatively.

An effective activity to first increase awareness of the Rabbit River as a unique resource is to collect and disseminate local historical knowledge of the Watershed. Old newspaper stories, photographs, oral histories, and previous studies can all contribute to establishing a sense of place and pride for a watershed. This activity should be initiated before the implementation of the strategy to address specific concerns.

7.4 SELECTING DELIVERY MECHANISMS AND ACTIVITIES

Because the collective target audience is broad, multiple formats will be necessary to reach each audience and to reinforce messages over time. Formats should be phased in as each audience moves from awareness to education and finally to action. Initially, efforts should largely focus on media outlets and printed materials to raise awareness and educate audiences on water quality issues. Formats that focus on solutions and actions should be developed as the audiences become more aware of the existing water quality concerns. These formats could include workshop, presentations, and other events.

Formats should be distributed through a variety of delivery mechanisms (Table 7.1). One of the most effective means of distributing information is to piggyback with existing material distributions already received by the target audience. This approach helps to leverage resources, and materials are more likely to be seen by the audience since they are already familiar with the format. Some of the activities included in Table 7.1 are as follows:

- Use of project logo in communications
- Watershed signs at tillage demonstration sites in Allegan County
- Develop and distribute brochures and flyers
    - Rabbit River “Hoppenings” newsletter
- Articles in local newspapers, county publications, MSUE and USDA Service Center newsletters
- Displays for fairs, events (Conservation District Open House), and meetings

- Presentations at public, county, township, village, and city meetings
- Watershed tours of problem sites
- Community survey
- Volunteer water quality monitoring
- Storm drain marker installation
- Involve Future Farmers of America (FFA) in I&E component of the project
- Comparison plots of BMPs on farmers' properties
- Encourage participation in Farm*A*Syst, Home*A*Syst, CREP, CCRP, and EQIP
- Present the Rabbit River Watershed Management Plan (WMP)
- One-on-one contact with individuals at informational gatherings
- Offer incentive payments to agricultural producers for long-term enrollment in programs
- Organize Clean Sweep for farm chemicals and pesticides, as well as HHW collection
- Trash cleanup
- Riparian tree planting
- Involvement in MSU Turf Grass Program

7.4.1 TASKS AND SCHEDULES

The implementation of the I&E strategy follows three steps: 1) awareness; 2) education; and 3) action.

Awareness

General information about what a watershed is and providing examples of NPS pollution will increase awareness of target audiences about the issues. The public will be made aware that they live in a watershed and that their day-to-day activities can affect water quality. They will learn about the impacts that land use activities have on water quality, and general approaches to minimize these impacts. Awareness will be raised through signage, logos, brochures, and articles in local newspapers.

Education

The public will have opportunities for more in-depth education through a variety of opportunities, including public meetings, presentations, displays, tours, and articles. Many of these opportunities will allow the public to comment and respond to the findings of the project. Open meetings and one-on-one contacts will provide further opportunity for the public to offer their opinions and concerns.

Action

Actions occur when audiences change behaviors and develop programs and events that influence and improve water quality. Such actions include participation in Adopt-A-Stream, implementing BMPs to improve water quality, and making informed decisions on land use planning. Taking ownership for the solutions of water quality concerns provides a framework for sustainability and ensures the continuation of the project's objectives.

Sustainability for the I&E efforts will be developed throughout the project since the protection of the Watershed will be a long-term endeavor. The schedule for implementation is included in Table 7.1.

7.4.2 POTENTIAL PARTNERS

Many groups and organizations are active within the Watershed and will provide support and assistance in educational efforts. The Steering Committee was formed to actively participate in the development of the WMP. At the Steering Committee meetings, community members have had an opportunity to give input and share ideas and concerns. Assistance for the I&E activities includes the Allegan Conservation District (ACD); Allegan County Drain Commissioner (ACDC); Township, City, and Village Officials; Michigan Department of Environmental Quality (MDEQ); Michigan Department of Natural Resources (MDNR); Allegan County Health Department (ACHD); Allegan County Road Commission (ACRC); Michigan State University Extension (MSUE) Office; Natural Resource Conservation Service (NRCS); Allegan Farmland Preservation Board; Kalamazoo Watershed Council; Great Lakes Commission; Farm Bureau; Sporting and Environmental Groups; local newspapers; local businesses; landowners/farmers; schools; and local residents. Table 7.1 lists the potential partners associated with the different I&E messages and objectives.

7.4.3 EVALUATION MEASURES

Evaluation of the education campaign provides a feedback mechanism for continuous improvement of the I&E Strategy. Evaluation tools should be built into the strategy at the beginning to ensure that accurate feedback is generated.

In regard to specific I&E tasks, the purpose, theme, and objective (learning, behavioral, and emotional) of each delivery mechanism should be defined prior to implementation. An I&E worksheet template developed for completing such an assessment is provided on the last page of this chapter. This worksheet will help define each activity during its initial development and result in a more fine-tuned product and one that can be more easily evaluated based on its initial purpose and objectives. Table 7.1

recommends evaluation methods to assess the success of each delivery mechanism, in accordance with the I&E worksheet.

Although evaluation of specific components within the I&E Strategy will occur continuously, the I&E Strategy will be periodically reviewed and adjusted as necessary. Questions that should be considered during implementation of the I&E Strategy are listed below.

- Are the planned activities being implemented according to the schedule?
- Is additional support needed?
- Are additional activities needed?
- Do some activities need to be modified or eliminated?
- Are the resources allocated sufficient to carry out the tasks?
- Are all of the target audiences being reached?
- What feedback has been received, and how does it affect the I&E strategy program?
- How do the BMP implementation activities correspond to the I&E strategy?

Table 7.1 - Information and Education Strategy

Pollutant: Sediment (Critical Areas: Black Creek, Green Lake Creek, Red Run Drain, Buskirk Creek subwatersheds)						
Message: Excessive sediment from erosion and runoff impairs aquatic habitats and alters natural hydrology						
Target Audience	**Measurable Milestones**			**Estimated Costs**	**Evaluation Methods**	**Potential Partners**
	Awareness (within 1 year)	**Education (within 3 years)**	**Action (within 5 years)**			
Local Agricultural Producers	Articles in USDA Service Center newsletter about impacts of soil erosion (fall and spring) and impacts of increasing the buffer strips along waterways.	Meet one on one with local agricultural producers over breakfast.	Assistance with 10 applications for cover crops, filter strips, or grassed water ways to reduce erosion.	No cost for articles, $25/breakfast meeting, (36 meetings) $100 for printing and mailing, no cost for application assistance Total = $1,000	Number of one-on-one breakfasts attended, number of responses, requests, and comments.	MSU Extension Office; Farmland Preservation Board; ACD; NRCS
Riparian Property Owners/Drain Commissioners	Articles about streambank erosion, the impacts of stream buffers and where to find technical assistance to design a stream buffer in local newspapers.	Conduct demonstration for residents about riparian habitat management. Conduct workshop on how to design your own stream buffer. Conduct workshop on how to design a two-stage ditch, the water quality benefits, sediment reduction and drainage capacity of a two-stage ditch.	Assistance to 15 riparian landowners with streambank stabilization techniques on localized problem areas.	No cost for articles, $1,000 for printing and mailing fact sheets, no cost for application assistance, if conducted under an existing program, $200/workshop Total = $1,600	Number of responses, requests, and comments.	Local Planning Commissions; NRCS
Developers and Builders	Create and distribute fact sheet to 25 local contractors explaining WARSSS and effect of excess sedimentation.	Conduct workshop on how to reduce soil erosion and sedimentation during construction, therefore reduce development costs during site development.	MDEQ continuing to train developers, builders and contractors on correct soil erosion and sedimentation control techniques.	$1,000 for printing and mailing fact sheets $200/workshop, no cost for presentation. Total = $1,200	Number of attendees at workshops. Number of trainees at sessions.	Kalamazoo Nature Center, MDEQ, ACD

Table 7.1 - Information and Education Strategy

Pollutant: Sediment (Critical Areas: Black Creek, Green Lake Creek, Red Run Drain, Buskirk Creek subwatersheds)						
Message: Excessive sediment from erosion and runoff impairs aquatic habitats and alters natural hydrology						
Target Audience	**Measurable Milestones**			**Estimated Costs**	**Evaluation Methods**	**Potential Partners**
	Awareness (within 1 year)	**Education (within 3 years)**	**Action (within 5 years)**			
		Presentation to Grand Rapids/Kalamazoo Home Builders Association.				
Local officials (managers, planning commissions)/Road Commission	Create and distribute fact sheet to 14 townships and 5 municipal offices explaining WARSSS and effect of excess sedimentation	Conduct workshop for road commissions and their contractors on proper culvert design and installation techniques. Presentation at Michigan Township Association explaining WARSSS and effect of excess sedimentation.	Use info determined by WARSSS to revise Soil Erosion and Sediment Control (SESC) regulations.	$1,000 for printing and mailing fact sheets, $200/workshop, no cost for presentations. Total = $1,200	Number of townships using WARSSS information.	Allegan Farmland Preservation Board, Kalamazoo Watershed Council
Residents and landowners in WARSSS identified high priority subwatersheds	Create and distribute fact sheet to 2,000 residents in priority subwatersheds (drainage districts) explaining WARSSS and effect of excess sedimentation	Site visit to landowners who respond to fact sheets.	Provide technical assistance to 10 landowners.	$1,000 for printing and distributing fact sheets, $50 - 100/site visit (20 visits), no cost for technical assistance Total = $2,500	Number of site visits. Number of landowners who were provided technical assistance.	Allegan County Drain Commissioner (ACDC), ACD, Landowners, Kalamazoo Watershed

Table 7.1 - Information and Education Strategy

Pollutant: Nutrients (Critical Areas: Black Creek, Miller Creek, Little Rabbit River, and Green Lake Creek subwatersheds)						
Message: Nutrient rich waters cause excessive plant growth, depleting oxygen and impairing aquatic habitats.						
Goal No. 1: Restore and maintain the impaired designated uses of the Watershed. **Goal No. 3:** Educate stakeholders about the Watershed and the impacts that stakeholders have on the Watershed.						
Target Audience	**Measurable Milestones**			**Estimated Costs**	**Evaluation Methods**	**Potential Partners**
	Awareness (within 1 year)	**Education (within 3 years)**	**Action (within 5 years)**			
Riparian Landowners	Develop and distribute 2,000 brochures about the Greenbelt Initiative and its relationship to phosphorus loading	Conduct 2 workshops about implementing the Greenbelt Initiative. Conduct tour/open house of the completed green belts in the area.	Enroll 5 landowners in the Greenbelt Initiative program.	$2,000 to develop and print brochure, $200/workshop, no cost for tour, no cost for enrollment if provided through existing program Total $2,400	Number of landowners enrolled in Greenbelt Initiative program	Local Planning Commissions, ACD, Sandy Pines
	Create display about effects of, and BMPs to control, excessive nutrients for fairs, events, meetings, and Conservation District Open House	Attend workshop, sponsored by retailers, to calibrate applicators	Test soil for 200 landowners and send samples to MSUE for analysis.	$1,200 to create display, $1,000 to create second, $500/workshop, $13/sample Total $5,300	Number of people in attendance at events	Lawn and Garden Retailers, MSU Master Gardeners, TMDL Committee, WWTP
Local Agricultural Producers	Expand distribution of information about Farm*A*Syst program, MAEAP, and Groundwater Stewardship Program	Conduct a case study Farm*A*Syst/MAEAP workshop (participants ID issues themselves).	Work with 20 landowners committed to having a Farm*A*Syst evaluation completed.	$250 to reprint brochures, $750 for case study, $500/workshop Total $1,500	Number of Farm*A*Syst evaluations completed	MSU Extension, NRCS, ACD
	Distribute information on Comprehensive Nutrient Management Plans	Conduct 1 workshop, or 5 one on one site visits with small farmers to ID specific needs/assistance in	Assist 5 farmers in completing a CNMP using proper manure spreader calculations and to become	$7,500 to develop each CNMP plan, $200/workshop Total $37,900	Number of CNMPs completed	MSU Extension, NRCS, ACD, MAEAP Tech

Table 7.1 - Information and Education Strategy

Pollutant: Nutrients (Critical Areas: Black Creek, Miller Creek, Little Rabbit River, and Green Lake Creek subwatersheds)						
Message: Nutrient rich waters cause excessive plant growth, depleting oxygen and impairing aquatic habitats.						
Goal No. 1: Restore and maintain the impaired designated uses of the Watershed. **Goal No. 3:** Educate stakeholders about the Watershed and the impacts that stakeholders have on the Watershed.						
Target Audience	**Measurable Milestones**			**Estimated Costs**	**Evaluation Methods**	**Potential Partners**
	Awareness (within 1 year)	**Education (within 3 years)**	**Action (within 5 years)**			
	(CNMP) and publish test results of phosphorous levels in the soil in the Gun River and Kalamazoo River Watersheds. Distribute information on problems caused by high phosphorous levels in surface water.	regards to different aspects of the CNMPs. Conduct 1 workshop on the cost/benefit analysis in regards to having a CNMP in place.	MAEAP certified. Assist 10 small farmers conducting soil tests.			
Residents and Landowners	Create and distribute fact sheet to 2,000 residents in priority subwatersheds explaining healthy lawn care practices	Create a map of businesses/locations where to buy P free fertilizer. Distribute map to 2,000 residents and place on website. Create a fact sheet on the companies that adopt water quality lawn care practices.	Work with a landowner to create a lawn care demonstration for local residents to demonstrate innovative practices with conventional ones.	$2,000 to develop and print fact sheets, $4,000 to develop and print map, $200 for demonstration Total $6,200	Number of applicators using low or no-phosphorous fertilizers. Number of applicators using IPM techniques.	MSU Extension Office, Great Lakes Commissioner

Table 7.1 - Information and Education Strategy

Pollutant: Nutrients (Critical Areas: Black Creek, Miller Creek, Little Rabbit River, and Green Lake Creek subwatersheds)						
Message: Nutrient rich waters cause excessive plant growth, depleting oxygen and impairing aquatic habitats.						
Goal No. 1: Restore and maintain the impaired designated uses of the Watershed. **Goal No. 3:** Educate stakeholders about the Watershed and the impacts that stakeholders have on the Watershed.						
Target Audience	**Measurable Milestones**			**Estimated Costs**	**Evaluation Methods**	**Potential Partners**
	Awareness (within 1 year)	**Education (within 3 years)**	**Action (within 5 years)**			
Golf Courses	Create and distribute fact sheet to the golf courses in the watershed explaining healthy lawn care practices	Conduct 1 workshop for golf courses in the watershed to teach about the Turf Grass Program, the benefits of using buffers along their waterways, and using low or no-phosphorous fertilizers.	Work with a golf course to implement healthy lawn care practices and advertise results through newspaper articles and on-site signage.	$1/fact sheet distributed, $200/workshop, $500 for golf course signage (10 sites) Total $5,200	Number of applicators using low or no-phosphorous fertilizers. Number of applicators using IPM techniques.	MSU Extension Office, Great Lakes Commissioner
Local officials (managers, planning commissions)	Develop and print 2,000 brochures about effects of excessive phosphorus and the reason for the phosphorus ban in Allegan County	Work with media to develop success story of the phosphorus reductions in the watershed over the past 20 years.	Enact resolution to support the County's phosphorus ban.	$1,500 to develop brochures, $2,500 for printing Total $4,000	Number of local governments passing resolution	ACD, Health Departments, Townships
Prime Farmland Owners	Healthy Waters, Rural Pride PDR program	Distribute information to advertise PDR program incentives to agricultural landowners.	Apply for grant funding to implement program in Allegan County.	$3,000 - 5,000/acre enrolled in program, $200 for brochure development, $300 for brochure printing Total $80,500	Number of acres enrolled in PDR, number of linear feet put in buffer strips, amount of state and federal matching funds	ACD, Allegan County Board of Commissioners, Allegan County Farm Preservation Board

Table 7.1 - Information and Education Strategy

Pollutant: Hydrology (Critical Areas: Black Creek, Green Lake Creek, Red Run Drain, Buskirk Creek subwatersheds)						
Message: Changes in land use impact stream flows creating water quality, stream stability, and flooding concerns.						
Goal No. 1: Restore and maintain the impaired designated uses of the Watershed. **Goal No. 3:** Educate stakeholders about the Watershed and the impacts that stakeholders have on the Watershed.						
Target Audience	**Measurable Milestones**			**Estimated Costs**	**Evaluation Methods**	**Potential Partners**
	Awareness (within 1 year)	**Education (within 3 years)**	**Action (within 5 years)**			
Developers and Builders, Road Commission	Develop brochure about new storm water criteria and results of the hydrologic analysis	Conduct workshop explaining how to meet local storm water regulations while marketing the site as "green".	Assist developers in choosing aesthetically pleasing LID practices for site storm water management. Assist Road Commission in updating maintenance practice procedures for better water quality through a series of workshops.	$1,500 to develop, $2,500 for printing, $200/workshop Total $4,200	Number of developers using LID practices for storm water management. Reduction of the number of road crossings contributing sediment into the waterways.	Road Commission; Sustainable Business Forum; West MI Strategic Alliance; MDEQ; MDOT
Local officials (managers, planning commissions)	Present new criteria at 6 board meetings	Provide model storm water ordinance language to all townships and municipalities that includes new criteria.	Assist 6 local governments with adoption of storm water ordinance.	$50/presentation, $3,000 to assist with ordinance adoption Total $3,300	Number of local governments adopting storm water ordinance	Allegan Conservation District; ACDC; Allegan County Board of Commissioners

Table 7.1 - Information and Education Strategy

Pollutant: Hydrology (Critical Areas: Black Creek, Green Lake Creek, Red Run Drain, Buskirk Creek subwatersheds)						
Message: Changes in land use impact stream flows creating water quality, stream stability, and flooding concerns.						
Goal No. 1: Restore and maintain the impaired designated uses of the Watershed. **Goal No. 3:** Educate stakeholders about the Watershed and the impacts that stakeholders have on the Watershed.						
Target Audience	**Measurable Milestones**			**Estimated Costs**	**Evaluation Methods**	**Potential Partners**
	Awareness (within 1 year)	**Education (within 3 years)**	**Action (within 5 years)**			
Riparian landowners	Develop and distribute 2,000 brochures about basics of hydrology and stream stability, the need for preserving wetlands and floodplains, and an explanation of the "Potential Restoration Map".	Conduct 2 workshops about wetlands restoration and floodplain regulations. Help distribute 2,000 Tipp of the Mitt Living with Wetland Landowners Guides.	Develop tour of wetlands	$1,500 to develop and $2,500 for printing brochure, $200/workshop, $2,500/wetland restoration tour Total $6,900	Acres of restored wetlands and decrease in floodplain development violations	Local Planning Commissions; Ducks Unlimited; US Fish and Wildlife; ACD; ACDC; Allegan Co parks; DNR; MDEQ

Pollutant: Pathogens						
Message: Bacterial contamination from failing septic systems, agricultural runoff, and concentrated wildlife populations create unsafe water for human contact.						
Goal No. 1: Restore and maintain the impaired designated uses of the Watershed. **Goal No. 3:** Educate stakeholders about the Watershed and the impacts that stakeholders have on the Watershed.						
Target Audience	**Measurable Milestones**			**Estimated Costs**	**Evaluation Methods**	**Potential Partners**
	Awareness (within 1 year)	**Education (within 3 years)**	**Action (within 5 years)**			
Local Agricultural Producers	Articles in USDA Service Center newsletter about impacts of manure applied fields and feedlot runoff	Direct mailings to 100 producers about Farm Bill programs available runoff management.	Assistance with 10 applications for Farm Bill programs to reduce runoff.	No cost for articles, $300 for printing and mailing, no cost for application assistance, if provided through existing programs Total $300	Number of applications to Farm Bill programs for soil erosion control practices	USDA NRCS and FSA, MDA, MDEQ, ACD, Farm Bureau
	Distribute information about CREP, CCRP, and EQIP programs for managing manure and feedlot runoff	Work with 20 producers to develop Manure Management (MM) Plans.	Complete manure testing and soils testing on 250 acres, or complete 5 MM plans and to become MAEAP certified.	$300 for printing and mailing, No cost for application assistance, if provided through existing program Total $300	Number of mailings to target audiences, Compliance reporting in plan, Acres receiving manure following GPS variable rate manure application	USDA NRCS and FSA, MDA, MDEQ, ACD, Farm Bureau
Riparian Landowners	Develop and print 5,000 septic maintenance brochures	2 presentations on septic maintenance.	Assistance with technical and financial issues for 25 septic system repairs.	$7,500 to develop, print, and distribute. $500 to update, print and distribute. $50 per presentation. No cost for technical and financial assistance, if provided through existing programs Total $8,100	Number of flyers distributed to target audiences. Number of septic repairs made.	Local Planning Commissions, Allegan County Health Department
Local officials (managers, planning commissions)	Develop and print brochures about pet waste disposal and goose management	Identify priority locations for pet waste stations and goose management BMPs.	Install 25 pet waste stations and goose management techniques at 10 locations.	$300 to develop and print brochure, $100/station Total $2,800	Number of flyers distributed to target audiences, number of pet waste station installed, amount of pet waste prevented from entering waterways	Allegan Farmland Preservation Board, Parks and Recreation Departments

Table 7.1 - Information and Education Strategy

Pollutant: Habitat Fragmentation						
Message: Preserving ecologically important areas and natural wildlife corridors prevents fragmentation and isolation of habitats.						
Goal No. 2: Protect and preserve the threatened designated uses, the designated uses being met, as well as high quality areas. **Goal No. 3:** Educate stakeholders about the Watershed and the impacts that stakeholders have on the Watershed.						
Target Audience	**Measurable Milestones**			**Estimated Costs**	**Evaluation Methods**	**Potential Partners**
	Awareness (within 1 year)	**Education (within 3 years)**	**Action (within 5 years)**			
Residents and Landowners	Conduct 1 presentation about Transfer of Development Rights	One-on-one visits with 15 producers to review information.	Enroll 5 producers in program.	$250/presentation, $50/site visit Total $1,000	Number of producers in program.	MSU Extension Office, Allegan PDR Board, West Michigan Land Conservancy
Riparian Landowners	Develop and print 2,000 brochures about importance of riparian habitats and conservation easements; air PSAs on sediment reduction actions	Meet with 25 landowners to explain conservation easements .	Enroll 5 landowners in conservation easement contracts.	$3,000 for brochure development and printing $50/meeting $5,000/easement or $0 for donated land Total $29,500 (assumes payment for easements)	Number of landowners actually enrolled in conservation easement contracts, number of web survey responses on PSAs	Southwest Michigan Land Conservancy; Land Conservancy of West Michigan
Developers and Builders	Publish newspaper articles on the benefits of open space development and the transfer of development rights	Distribute brochures on open space development and the transfer of development rights.	Conduct 1 presentation about Transfer of Development Rights and Open Space Development.	$1,000 for brochures, $750 for presentation Total $1,750	Number of presentation participants, exit questionnaire results, number of acres of new development impacted	Kalamazoo Nature Center, 4 Townships Water Resource Council
Local officials (managers, planning commissions)	Attend Planning Board meetings of 14 townships and 5 municipalities to present Greenbelt Initiative	Explain enforcement issues with overlay zone.	Update storm water ordinances to include green space preservation.	$5,000/ordinance assistance Total $5,000	Number of ordinances which have addressed green space preservation.	Allegan Farmland Preservation Board
	Advertise clearing house through newspaper articles and website	Serve as a clearinghouse of information: Gather and disseminate information to	Develop outdoor educational trails and facilities. Preserve high quality natural	Costs to be determined	Acres of areas preserved or protected.	ACD, Kalamazoo River Watershed Council, Allegan County Board of Commissioners

		township and city officials, planning commissions, and other planners for use as tools for planning.	areas and protect prime farmland in partnership with local land trusts, township officials and planning commissions.			

Table 7.1 - Information and Education Strategy

Pollutant: Low Dissolved Oxygen/Temperature (Critical Areas: Red Run Drain and the riparian areas along the streams identified in Figure 8 as designated trout streams and designated coldwater streams)						
Message: Agricultural runoff, lack of riparian habitats, and urban storm water runoff all cause increased stream temperatures and decreased amounts of dissolved oxygen.						
Goal No. 1: Restore and maintain the impaired designated uses of the Watershed. **Goal No. 3:** Educate stakeholders about the Watershed and the impacts that stakeholders have on the Watershed.						
Target Audience	**Measurable Milestones**			**Estimated Costs**	**Evaluation Methods**	**Potential Partners**
	Awareness (within 1 year)	**Education (within 3 years)**	**Action (within 5 years)**			
Local Agricultural Producers	Articles in USDA Service Center and MSUE newsletters about impacts of manure applied to fields, and feedlot runoff	Direct mailings to 100 producers about CCRP and EQIP programs to manage manure and feedlot runoff, and proper manure spreader calculations.	Assistance to 10 producers to reduce runoff and become MAEAP certified.	No cost for articles, $300 for printing and mailing, no cost for assistance Total $300	Number of mailings to target audiences	MSU Extension Office, NRCS, ACD
Riparian Landowners	Develop and advertise program for riparian tree planting in local newspapers, drain notices	Conduct 2 workshops with ACDC about importance of riparian habitats and tree sales.	Assist 10 riparian landowners with planting trees.	$500 to develop tree planting program, $200/workshop, $1,000/buffer Total $10,900	Number of trees planted in the riparian zone.	ACD, ACDC, Local Planning Commissions
Local officials (managers, planning commissions)	Conduct workshop on Low Impact Development practices to reduce impervious surfaces	Contact communities that have not yet adopted storm water criteria for LID.	Adopt LID ordinance in all communities in Watershed to reduce impervious surfaces.	$200/workshop $3,000/ordinance assistance Total $3,200	Number of LID ordinances adopted.	MTA, ACDC, ACD, local planning board

Table 7.1 - Information and Education Strategy

Pollutant: Obstructions, trash, and debris						
Message: Illegal dumping impedes recreational opportunities for canoeing and kayaking waterways.						
Goal No. 3: Educate stakeholders about the Watershed and the impacts that stakeholders have on the Watershed.						
Target Audience	**Measurable Milestones**			**Estimated Costs**	**Evaluation Methods**	**Potential Partners**
	Awareness (within 1 year)	**Education (within 3 years)**	**Action (within 5 years)**			
Local Agricultural Producers						MSU Extension Office
Riparian landowners	Conduct 1 presentation on "Woody Debris Management 101"	Coordinate hands-on workshop demonstrating Woody Debris Management.	Remove obstructions at 10 priority sites.	$50/presentation, $200/workshop, $1,500/event Total $15,250	Miles of stream cleared of obstructions	Drain Commissioner, DNR, ACD, Kalamazoo Downstreamers, Boy Scouts
Local officials (managers, planning commissions)	Conduct investigation to extent of illegal dumping	Present information about extent of illegal dumping at 2 workshops.	Assist local governments in adopting and enforcing illegal dumping ordinance.	$4,000 for investigation, $50/presentation, $3,000/ordinance assistance Total $7,100	Reduction of incidences of illegal dumping	Road Commission
Students	Advertising of annual trash cleanup events in all local newspapers	Addition of 3 groups to collect trash in priority areas.	1 event/year.	$1,500/event Total $1,500	Miles of stream cleared of trash and debris	Kalamazoo River Council; Kalamazoo Downstreamers; Drain Commissioner

Table 7.1 - Information and Education Strategy

Pollutant: Pesticides and Chemicals						
Message: Harmful toxins can enter waterways through excessive use and accidental spillage of pesticides and chemicals.						
Goal No. 1: Restore and maintain the impaired designated uses of the Watershed. **Goal No. 3:** Educate stakeholders about the Watershed and the impacts that stakeholders have on the Watershed.						
Target Audience	**Measurable Milestones**			**Estimated Costs**	**Evaluation Methods**	**Potential Partners**
	Awareness (within 1 year)	**Education (within 3 years)**	**Action (within 5 years)**			
Residents and Landowners	Develop and print 2,000 brochures about proper disposal of chemicals and pesticides	Write newspaper articles to advertise locations of collection sites for household hazardous waste.	Organize Clean Sweep for Household Hazardous Waste and collect from 25 homes.	$3,000 for brochure Total $3,000	Number of Home*A*Syst conducted and number of homeowners committed to change or meet the highest level of protection. Amount of waste collected during household collection days.	Health Department; Allegan County Solid Waste
Local Agricultural Producers	Write articles for USDA newsletter about proper disposal and storage of chemicals and pesticides	Participation of 25 farms in Farm*A*Syst program.	Organize Clean Sweep for farm chemicals and pesticides. Establish a permanent site in the watershed for chemical collection.	No cost for articles	Number of Farm*A*Syst conducted and number of farms committed to change or meet the highest level of protection. Amount of waste collected during chemical collection days.	MSU Extension; Groundwater Stewardship Program; ACD, MDA

Table 7.1 - Information and Education Strategy

Pollutant: Invasive species						
Message: Non-native and exotic species, introduced by choice or unknowingly, reduces biodiversity and suitable habitats for native species.						
Goal No. 2: Protect and preserve the threatened designated uses, the designated uses being met, as well as high quality areas. **Goal No. 3:** Educate stakeholders about the Watershed and the impacts that stakeholders have on the Watershed.						
Target Audience	**Measurable Milestones**			**Estimated Costs**	**Evaluation Methods**	**Potential Partners**
	Awareness (within 1 year)	**Education (within 3 years)**	**Action (within 5 years)**			
Road Commission	Create and distribute 500 fact sheets to County Road Commission offices about invasive species and how seeds are contained in typical road fill	Conduct 2 workshops about identifying invasive species and how to reduce amounts of typical road fill in biologically sensitive areas.	Use of alternative road fill material in biologically sensitive areas.	$500 to develop and distribute fact sheet, $200/workshop, cost of alternative fill varies Total $900	Amount of alternative fill materials used in biologically sensitive areas	MDNR
Local Businesses (Landscape Companies, Plant and Garden Stores)	Develop and distribute 2,000 brochures about invasive plants and their impacts on native ecosystems	Conduct a workshop about invasive plants and their impacts on native ecosystems	Work with a local park or nature center to address their invasive species population and advertise results in the newspaper and through signage.	$1,000 for brochure, $200/workshop, $750 for signage, $5,000 for invasive species control/native plant establishment Total $6,950	Number of people attending the workshop, area converted from invasive vegetation to native vegetation	Sarett Nature Center, MDNR, parks and recreation departments

Table 7.1 - Information and Education Strategy

Pollutant: All Watershed Pollutants						
Message: We all live in a watershed and our day-to-day activities affect water quality either positively or negatively.						
Goal No. 3: Educate stakeholders about the Watershed and the impacts that stakeholders have on the Watershed.						
Target Audience	**Measurable Milestones**			**Estimated Costs**	**Evaluation Methods**	**Potential Partners**
	Awareness (within 1 year)	**Education (within 3 years)**	**Action (within 5 years)**			
General Public	Presentations about storm drain stenciling or drain markers	5 storm drain stenciling events or 200 drain marker installations in separate areas.	Secure financial support and materials for permanent, annual events.	$50/presentation, $250/event for stenciling or $3.25/drain marker Total $1,500	Number of storm drains that have been stenciled or marked.	Road Commission, DPWs
	Identification of priority sites for restoration and preservation and arrangement of Watershed tour	Conduct 2 watershed tours of priority sites.	Schedule tour in ACD's annual calendar of events.	$500/tour Total $1,000	Number of people attending watershed tours.	ACD
	Publish newspaper articles on the cost analysis campaign based on continued traditional drain practices vs. innovative practices	Develop and distribute 2,000 brochures about the campaign.	Conduct a workshop on the campaign.	$3,000 for brochures, $200/workshop Total $3,200	Exit questionnaire to evaluate workshop topics and potential future actions of participants	ACD
	Use logo on all materials, install signs "Entering Rabbit River Watershed – Ours to Protect"	Develop updates to website, distribute River Smart Campaign materials on becoming a River Network Partner, distribute "Storm water Savvy" materials.	Implement information and education strategies in accordance with the Watershed Management Plan. Continue existing information and educational programs, such as a quarterly newsletter, and	$150/sign, (10 signs), $1,000/year to maintain website, 3 years, $1.50/brochure, (200 brochures) program budgets to be determined Total $4,800	Number of residents that can identify logo and roadway signage locations via a questionnaire, number of website hits, number of I&E Strategies and programs implemented, number of watershed topics adopted into school curricula	ACD, MDEQ, Road Commission, DPWs, Kalamazoo River Watershed Council

			adoption of watershed topics in school curricula.			

INFORMATION AND EDUCATION ACTIVITY WORKSHEET TEMPLATE

Activity:_____

Purpose of Activity:

Target Audience:

Learning Objectives (What do you want the target audience to learn from this activity?):

Behavioral Objectives (What do you want the target audience to act on after this activity?):

Emotional Objectives (What do you want the target audience to feel from this activity?):

Distribution Method (e.g. workshop, flyer):

Date of Completion:

Budget:

Project Evaluation

Quantitative Evaluation:

Qualitative Evaluation:

Level of Success (After Implementation):

CHAPTER 8 - METHODS OF MEASURING PROGRESS

Measures of success are essential to any project to evaluate and assess the achievements of the project and determine the benefits to water quality and the quality of life that resulted. The success of the project toward improving water quality and restoring the designated uses of the Rabbit River Watershed (Watershed) depends on many factors, all of which need to be continuously evaluated. The Michigan Department of Environmental Quality (MDEQ) and Michigan Department of Natural Resources (MDNR) are the most active groups currently conducting monitoring activities in the Watershed. Establishing monitoring targets, against which observed measurements are compared, helps the Steering Committee determine whether progress is being made. The targets set are not enforceable, just a measure that the Steering Committee can use to gauge the implementation efforts.

Local counties, municipalities, and organizations within the Watershed will do much of the evaluation. The MDEQ and MDNR, however, are best suited to conduct certain environmental measurements.

8.1 INDICATORS TO MEASURE PROGRESS

8.1.1 QUANTITATIVE MEASUREMENTS

Quantitative measurements are used in this evaluation to determine the level and rate of water quality improvements, focusing on areas of physical, chemical, and biological improvements. Methods of evaluation will be used to monitor the success of the project, both immediately following implementation and for continual monitoring of the water quality.

Quantitative measurements are further defined by categories of indirect indicators and direct environmental indicators. Indirect indicators are measures of practices and activities that often indicate water quality improvements. These indicators are not, however, measures of the water quality itself. For example, estimating the pollutant reduction that a practice will achieve determines the quantity of that pollutant that will be prevented from entering the stream. Another indirect indicator would be the miles of filter strips installed as a percentage of the total miles of riparian areas without buffers. This percentage of installation could be compared to the goals of the Watershed in order to measure success.

Direct environmental indicators involve measuring the quality of the water through scientific investigation. Sediment load reduction could be measured by a Secchi disk, which is a circular disk, mounted on a pole or line, used to measure water transparency by being lowered slowly down in the water. The depth at which the pattern on the disk is no longer visible is taken as a measure of the transparency of the water.

Nutrient load reductions could be measured through chemical analysis of the water. Macroinvertebrate surveys are also direct environmental indicators of water quality since some insects are very sensitive to changes in a stream's health.

Sediment

As indicated in Section 3.1.6.1, the State standard for sediment reads, "the waters of the State shall not have any following unnatural physical properties in quantities which are or may become injurious to any designated use: turbidity, color, oil films, floating solids, foams, settleable solids, suspended solids, or deposits." The Watershed has severe sediment loading issues largely due to agriculture, lack of riparian buffers, and wetland loss.

The criteria for sediment evaluation are to address the causes of sedimentation identified above to meet the goals of the MDEQ Integrated Report implementation of BMPs on all identified NPS sites of sediment loading, and a measurable increase in the water quality and macroinvertebrate rating, as rated through the SWAS survey. The qualitative measurements for sediment reduction will include photographs of the site before and after implementation of BMPs.

Nutrients

The State standard for nutrients is indicated in Section 3.1.6.2, which is a narrative standard. The criteria for nutrient evaluation are therefore visual assessments of aquatic plant and algae growth. The criteria could also include a decrease in phosphorus and nitrogen exceedances compared to state recommendations and as measured by local, county, or state laboratory, or WWTP, and implementation of BMPs on all identified NPS sites of nutrient loading. The qualitative measurements for nutrient reduction will include photographs of the site before and after implementation of BMPs.

Temperature/Dissolved Oxygen

The State standard for Temperature/Dissolved Oxygen is indicated in Sections 3.1.6.4 and 3.1.6.5 respectively. The criteria for temperature evaluation for coldwater streams are based on the increase of the number of streams with average temperatures cold enough to support trout population.

Red Run Drain will be assessed to address why the Warmwater Fishery designated use is not being supported due to low DO levels as identified in the MDEQ Integrated Report. The criteria for DO evaluation for warmwater fishery will be to meet the requirements identified in the MDEQ Integrated Report.

Hydrology

Increased drainage in certain areas can result in excessive flows in receiving streams. This excessive flow can be exhibited by higher peak flows, longer peak flow periods, or both. The criteria for assessing flow are to use the hydrologic model and flow measurements to determine the effects of build-out and what might happen if the storm water management practices are not put in place. The Rabbit River, Fales Drain, Green Lake Creek, and Black Creek will be assessed to address the causes of sedimentation due to anthropogenic substrate alterations and flow regime alterations to meet the requirements identified in the MDEQ Integrated Report

Biological Communities

The MDEQ has developed a system to estimate the health of the predicted fish and macroinvertebrate benthic communities. Fresh water benthic macroinvertebrates are animals without backbones that are larger than 0.5 millimeter (the size of a pencil dot). These animals live on rocks, logs, sediment, debris, and aquatic plants during some period in their life.

These macroinvertebrates include crustaceans, such as crayfish, mollusks (such as clams and snails), aquatic worms, and immature forms of aquatic insects, such as stonefly and mayfly nymphs. Benthic macroinvertebrates are an important part of the food chain, especially as prey for fish. Many macroinvertebrates feed on algae and bacteria, which are on the lower end of the food chain. Some shred and eat leaves and other organic matter that enters the water. Because of their abundance and position as middlemen in the aquatic food chain, these organisms play a critical role in the natural flow of energy and nutrients. As these macroinvertebrates die, they decay, leaving behind nutrients that are reused by aquatic plants and other animals in the food chain. When these macroinvertebrates are found in large quantities, the waters are generally classified as clean or unpolluted by organic wastes. Without too much organic matter, the waters usually have lots of oxygen. For example, stoneflies are often considered to be clean water organisms. However, when thinking about pollution-tolerant worms and midges, water quality professionals often view these as indicators of dirty water, especially in rivers and streams.

The criteria for assessing the macroinvertebrate community are that the preferred result of all SWAS P-51 macroinvertebrate surveys fall within the “good” category.

Habitat Fragmentation

The criteria for habitat and habitat fragmentation evaluation are based on an increase in SWAS P-51 survey scores, and a restoration of 10% of historic loss of wetlands within the Watershed.

Obstructions

Dumping of trash and debris in the water can add nutrients, degrade fish habitat, and create unsightly and unhealthy conditions for enjoying the Watershed. Stream clean-ups and information and education (I&E) programs will reduce the amount of trash and debris in the Watershed. A measurement of the number of volunteers year after year participating in the stream clean-ups and participation in the I&E program along with a measure of the amount of trash removed at each clean up are the evaluation measurements.

Pathogens

The criteria for *E. coli* evaluation are based on the MDEQ Water Quality Standards (WQS) for partial and total body contact recreation, and by attaining the designated uses. The goal for *E. coli* is for water bodies to meet WQS for total and partial body contact recreation as indicated in Section 3.1.6.3 WQS for Pathogens. The criteria for evaluating *E. coli* will be based on whether WQS are exceeded for partial and total body contact recreation, and an elimination of all identified *E. coli* contributing sources, such as failing septic systems and manure spreading under inappropriate conditions.

Pesticides

The criteria for pesticide evaluation are based on implementing BMPs on areas where pesticide loading and spills are documented. Pesticides and chemicals will be prevented from reaching surface water by using proper application methods and amounts, and the use of filter and buffer strips.

Table 8.1 identifies the monitoring components and criteria to evaluate sediment, nutrients, hydrology, pesticides, habitat fragmentation, pathogens, temperature, and DO in the Watershed. The evaluation criteria are based on the WQS as determined by the MDEQ, as well as indirect and direct quantitative indicators. Table 8.1 establishes a strategy for assessing the need for Watershed Management Plan (WMP) revisions. The task of measuring progress is a necessary component of creating a dynamic and effective management plan. The evaluation criteria provide an indication of how impairments can be assessed to evaluate success. The review process and evaluation strategy are described further in Section 8.4 Evaluation Framework. Table 5.1 ties the pollutants and impairments listed in Table 8.1 to the sources and goals of the WMP.

Table 8.1 - Monitoring Components and Evaluation Criteria for Rabbit River Watershed Project Implementation Phase

Prioritized Impairment/Source/ Cause	Monitoring Components	Potential Parties to Implement Monitoring	Schedule for Implementation	Units of Measurement	Current Conditions	Evaluation Criteria
1. Sediment	Pollutant Reduction Calculations	ACD, MDEQ, MDNR, Consultant	Short-term (2010) and then annually thereafter	Tons of sediment prevented from entering surface water	1,499.5 tons per year estimated from NPS erosion sites (2007-2008)	Prevent 100% of sediment from NPS sites (2007-2008) from entering surface waters
	BMPs implemented to reduce sediment	ACD, ACDC, MDNR, MDEQ, ACRC, KRWC	Long-term (2018)	Number and location of BMPs implemented	100 sites of stream bank erosion, 100 livestock access locations have de-stabilized stream banks 143 sites of rill and gully erosion	Implement BMPs at 100% of all identified NPS sites (2007-2008) of sediment loading
	Photographs of BMPs installed to reduce sediment	ACD, ACDC, MDNR, MDEQ, ACRC, KRWC	As BMPs are completed (Short to Long-term)	Before and after photographs	Existing before photographs of sites	Portfolio of photographs with supporting documentation
	Macroinvertebrate sampling	ACD, MDEQ, Consultant, Volunteers	Short-term (Assess in 2013, and every 5 years thereafter)	Numerical score based on quantity and diversity	Red Run Drain scored “poor,” Middle Rabbit River scored “good,” and the remaining sampling sites in the Watershed scored “acceptable” (MDEQ Bio. Assess., 2003)	100% of locations score “good” rating
	Water quality monitoring	ACD, MDEQ, MDNR, ACDC, Consultant	Long-term (2018) (Assess in 2013, and every 5 years thereafter)	TSS ranges	Rabbit River, Black Creek, Little Rabbit River, and Red Run Drain TSS concentrations around 30 mg/l (MDEQ, 2003)	Decrease amount of suspended solids to Rabbit River reference conditions by at least 50% (max. 15 mg/l)
2. Nutrients	Pollutant Reduction Calculations	ACD, MDEQ, MDNR, Consultant	Short-term (2010) and then annually thereafter	Pounds of phosphorus and nitrogen prevented from entering surface water	1,500 pounds per year of phosphorus and 2,999 pounds per year of nitrogen estimated from NPS erosion sites (2007-2008)	Prevent 100% of phosphorus and nitrogen from NPS sites (2007-2008) from entering surface water
	BMPs implemented to reduce nutrients	ACD, ACDC, MDNR, MDEQ, KRWC	Long-term (2018)	Number and location of BMPs implemented	Prevalence of farming creates potential for excess nutrients	Implement BMPs on 100% of NPS sites (2007-2008) identified with nutrient loading
	Photographs of BMPs installed to reduce sediment	ACD, ACDC, MDNR, MDEQ, ACRC, KRWC	As BMPs are completed (Short to Long-term)	Before and after photographs	Existing before photos of sites	Portfolio of photographs with supporting documentation
	Water quality monitoring (Phosphorus (P), Nitrate/Nitrite (N))	ACD, MDEQ, Wayland WWTP, Consultant	Long-term (2018) (Assess in 2013, and every 5 years thereafter)	Water quality rating	<0.05 mg/l phosphorus <3.0 mg/l nitrogen	Visually inspect 100% of the impaired reaches to assess plant growth
3. Temperature and DO	Water temperature and DO monitoring	ACD, MDEQ, MDNR, KRWC, Consultant, Volunteers	Long-term (2018) (Assess in 2013, and every 5 years thereafter)	Stream temperatures and DO during the summer months	Total of 78 stream miles in the Watershed that are coldwater designated trout streams. Red Run Drain is not supporting warmwater fishery due to low DO levels	Maintain average temperatures cold enough to support trout populations on 100% of the trout stream miles while removing Red Run Drain from the TMDL list by 2018
4. Hydrology (High Flow)	Impervious cover calculations	ACD, MDNR, MDEQ, KRWC, Consultant	Long-term (2018)	Amount of impervious cover by subwatershed	Hydrologic study completed with recommendations and conclusions	Change in development rules to limit amounts of impervious cover in developments and encourage LID-based development regulations
	USGS flow gauge data	USGS, MDEQ, Consultant	Short-term (2010) and then annually thereafter	Cubic feet per second	Flow gauges record hydrographs during storm events, with peak flows and duration of high flows	Document reduction of peak flows and duration of high flows in small storm events.
5. Habitat Fragmentation	Wetland inventory and assessment and conservation easements	ACD, ACDC, MDNR, MDEQ, SMLC, SWMPC, Consultant	Long-term (2018)	Acres of and photos of wetlands protected or restored, records of conservation easements	16,075 acres of wetlands in 1978 compared to pre-settlement conditions of 37,821 acres (MDEQ, Wetland Status and Trends, June 2008)	Restore 10% of historic loss of wetlands within the Watershed. Increase the amount of permanently protected lands or lands categorized as green infrastructure by 10%.
	MDEQ Habitat Survey	MDEQ	Long-term (2018) (Assess in 2013, and every 5 years thereafter)	Habitat evaluation score	Portion of Black Creek “severely impaired,” Little Rabbit River and Bear Creek “moderately impaired,”	Increase habitat evaluation scores throughout the entire Watershed to slightly impaired

Table 8.1 - Monitoring Components and Evaluation Criteria for Rabbit River Watershed Project Implementation Phase

Prioritized Impairment/Source/ Cause	Monitoring Components	Potential Parties to Implement Monitoring	Schedule for Implementation	Units of Measurement	Current Conditions	Evaluation Criteria
					remaining watershed "slightly impaired" (MDEQ, 2003)	
6. Obstructions (Log Jams/Trash/Debris)	Volunteer and agency programs	ACD, ACDC, KRWC, SMLC, County and Local Government, Volunteers	Short-term (2010), and annually thereafter	Number of clean-up programs	137 sites (2007-2008) identified with debris & trash	Perform annual stream clean-ups and reduce the amount of trash/debris and obstructions by 20% throughout the entire Watershed
	Implement I&E programs relating to trash and debris and the effects on water quality	ACD, KRWC, SMLC, County and Local Government	Short-term (2010), and annually thereafter	Number of I&E programs held and number of participants	None known at this time	75% participation from residents, students, organizations, and businesses that were targeted by the I&E program
7. Pathogens	Water quality monitoring	ACD, MDEQ, ACHD, Local government, Hopkins WWSL, Universities, Consultant	Short-term (2010), and annually thereafter	Bacteria counts/100 ml	No current conditions known	Meet WQS for partial body contact recreation and total body contact recreation 100% of the time in the Watershed
	BMPs implemented to eliminate sources	ACD, ACDC, MDNR, MDEQ, KRWC, Consultant	Long-term (2018)	Number and location of sources eliminated	Septic systems and inappropriate agricultural practices are throughout the Watershed	Eliminate all identified *E. coli* contributing sites
8. Pesticides	BMPs implemented to reduce pesticides	ACD, ACDC, MDNR, MDEQ, University, Consultant	Long-term (2018)	Number and location of BMPs implemented	No current conditions known	Implement BMPs on areas where pesticide loading is a problem

ACD - Allegan Conservation District
ACDC - Allegan County Drain Commissioner
ACRC - Allegan County Road Commission
BMP - Best Management Practice
DO - Dissolved Oxygen
I&E - Information and Education
KRWC – Kalamazoo River Watershed Council
LID - Low Impact Development
MDEQ - Michigan Department of Environmental Quality
MDNR - Michigan Department of Natural Resources
NPS - Nonpoint Source
SMLC – Southwest Michigan Land Conservancy
SWMPC - Southwest Michigan Planning Commission
TMDL - Total Maximum Daily Load
TSS - Total Suspended Solids
Watershed - Rabbit River Watershed
WQS - Water Quality Standards
WWSL – Waste Water Sewage Lagoon
WWTP - Waste Water Treatment Plant

8.2 ONGOING WATERSHED MONITORING DATA

There are some ongoing monitoring activities within the Watershed as detailed in Chapter 3, Watershed Conditions. This monitoring has been conducted, for the most part, by the State. The information presented in Chapter 3 serves as the basis for developing the recommended environmental monitoring component for this WMP. There are also several municipalities and private businesses within Allegan County that discharge to surface water and groundwater and therefore must continuously comply with State effluent standards for water quality based on their National Pollutant Discharge Elimination System (NPDES) discharge permit. These municipalities and businesses are listed in Appendix 12.

8.3 RECOMMENDED ENVIRONMENTAL MONITORING COMPONENT

8.3.1 WATER QUALITY

The recommended environmental monitoring component of the WMP builds on the past monitoring and the existing monitoring that is currently being conducted in the Watershed and suggests how a complete monitoring program could work by filling in the gaps. Table 8.2 describes the Watershed monitoring and evaluation plan that could be possible in terms of the agency or organization responsible for conducting the monitoring, parameters and locations of the monitoring, and status of the monitoring programs. These parameters are described in further detail below. Figure 13 illustrates the location of the recommended sampling locations, if and when the entire program could be conducted, which builds on the previous and existing locations and parameters tested.

Sediment

TSS and stream embeddedness of the substrate are measured through the MDEQ SWAS habitat assessment and biological survey conducted every five years, the next assessment occurring in 2013 at twenty stations in the Watershed. Future monitoring will take place as part of the five-year rotating basin monitoring, or more often if the opportunity arises, and will target potential sources of sediment, including conventional tillage practices, flashy flows from changes in land use and lack of storm water storage areas, lack of riparian vegetation, and inadequate soil erosion and sedimentation control. Recommendations for future monitoring include an erosional assessment of sediment contribution, to be monitored by the ACDC focusing on the headwater subwatersheds; TSS monitoring by the MDNR and ACD; and stream embeddedness, substrate composition, channel cross-section, and bank erosion by the ACD as prioritized through the WARSSS study.

Nutrients

Permitted waste water facilities continue to monitor for nutrients as defined by their NPDES discharge permit, and often test for chlorine and fecal coliform. Some facilities test water at their intakes for water quality indicators, including ammonia nitrogen, total phosphorus, total residual chlorine, mercury, and copper. Recommendations for future monitoring include phosphorus and nitrogen monitoring throughout the Watershed by the ACD, with the help of volunteers consultants, and the MDEQ.

Biological

The MDEQ conducts macroinvertebrate surveys every five years at twenty stations in the Watershed using SWAS P-51 sampling protocol, with the next survey occurring in 2013. Habitat surveys are also completed in conjunction with the benthic survey, as described in Section 8.1.1, every five years. Comparing these results to the most recent survey in 2008 will show whether the installation of BMPs has actually improved water quality. Recommendations for future monitoring include macroinvertebrate surveys, conducted annually throughout the Watershed by the ACD with the help of volunteers and school groups.

The MDNR will continue to monitor brown trout populations in the coldwater streams in the Watershed. The trout are currently stocked in the Watershed, however, it is the goal to increase the number of sites that have water temperatures cold enough to support a breeding trout population.

Temperature and DO

Temperature and DO are currently measured through the MDEQ SWAS habitat assessment and biological survey conducted every five years, the next assessment occurring in 2013 at twenty stations in the Watershed. Future monitoring will take place as part of the five-year rotating basin monitoring, or more often if the opportunity arises, and will target the coldwater trout streams in the Watershed (portions of the Upper Rabbit River, Buskirk Creek, Miller Creek, Middle Rabbit River East, Middle Rabbit River West, Silver Creek, and Lower Rabbit River Subwatersheds), as well as Red Run Drain that is currently listed on the MDEQ Integrated Report as not supporting the warmwater fishery due to low DO levels. The USGS gage station that is located on the Rabbit River near Hopkins continues to measure temperature of the River daily, and will do so as long as the gage station is in use. Recommendations for future monitoring include temperature and DO monitoring, as part of the Fisheries assessment that would be conducted once every 5 years by the MDNR; and temperature and DO monitoring throughout the Watershed by the ACD with the help of volunteers, school groups, and MDEQ.

Hydrology

High flow rates, generally caused by urbanization, are accelerated because of the amount of channelization and lack of riparian buffer that has occurred throughout the Watershed. Stream bank erosion caused by this altered hydrology is causing the brown trout spawning gravel beds to be covered with fine sediment. The USGS gage station on the Rabbit River near Hopkins continuously measures flow daily and will do so as long as the gage is in operation. Recommendations for future monitoring include flow monitoring as part of the fisheries assessment, conducted once every 5 years by the MDNR; and a post-BMP performance assessment of wetland hydrologic function by the ACD.

Obstructions

The ACDC continuously removes woody debris and obstructions to the drains and culverts on an as-needed basis and as funding allows. Recommendations for future trash and debris clean-up and woody debris management include annual trash and debris removal with the help of the ACD, local governments, volunteers, and school groups; and annual woody debris and obstruction removal with the help of local governments and the ACD. This will allow for better access to the Rabbit River for recreation, and a cleaner and more enjoyable environment.

Pathogens

WWSLs and WWTPs currently monitor their effluent for fecal coliform depending on the amount of flow being released from the plants, as required in their NPDES discharge permit. Recommendations for future monitoring include *E. coli* monitoring by the MDEQ as part of their Watershed-wide biological survey every 5 years; *E. coli* monitoring by the ACHD in lakes that are not currently monitored, but that are used by the public; and *E. coli* monitoring by local governments (Dorr Township, City of Wayland, and the Village of Hopkins) that have septic systems.

Table 8.2 - Monitoring and Evaluation for the Watershed

Organization(s)	Monitoring Site(s)	Parameter Target	Type of Analysis	Protocol	Status	Recommended Frequency	Test Agent
MDEQ- Water Bureau	Watershed - Biological Survey[1] Rabbit River (Stations 1-6), Unnamed trib. east of Hamilton (Station 7), Miller Creek-Monterey Township (Station 8), Black Creek (Stations 9-11),Little Rabbit River (Stations 12, 13), Red Run Drain (Stations 14, 15), Bear Creek (Station 16), Miller Creek-Watson Township (Station 17), Buskirk Creek (Station 18), Green Lake Creek (Station 19), Tollenbar Drain (Station 20)	*Macroinvertebrates, Habitat, S, N, DO, T[2], Metals, Pathogens*	Macroinvertebrate Survey	MDEQ Protocol/SWAS Procedure 51	Conducted, most recently, in summer 2008	Once every 5 years (2013)	MDEQ
			Habitat Survey	USEPA Rapid Bioassessment	Conducted, most recently, in summer 2008	Once every 5 years (2013)	MDEQ
			TSS	MDEQ Protocol	Conducted, most recently, in summer 2008	Once every 5 years (2013)	MDEQ
			Substrate embeddedness	MDEQ Protocol	Conducted, most recently, in summer 2008	Once every 5 years (2013)	MDEQ
			Total Phosphorus/ Ortho-phosphorus	MDEQ Protocol	Conducted, most recently, in summer 2008– no longer included in routine monitoring	Once every 5 years (2013)	MDEQ
			Kjeldahl Nitrogen, Nitrate + Nitrite	MDEQ Protocol	Conducted, most recently, in summer 2008– no longer included in routine monitoring	Once every 5 years (2013)	MDEQ
			DO	Handheld DO Meter	Conducted, most recently, in summer 2008	Once every 5 years (2013)	MDEQ
			Temperature	Handheld Temperature Probe	Conducted, most recently, in summer 2008	Once every 5 years (2013)	MDEQ
			Aluminum, arsenic, barium, copper, iron, manganese, nickel, sodium, strontium, sulfate, titanium, vanadium, and zinc	MDEQ Protocol	Conducted, most recently, in summer 2008 – no longer included in routine monitoring	Once every 5 years (2013)	MDEQ
			E.coli	*E.coli* MPN/100 ml	Not currently monitored	Once every 5 years (2013)	MDEQ

Table 8.2 - Monitoring and Evaluation for the Watershed

Organization(s)	Monitoring Site(s)	Parameter Target	Type of Analysis	Protocol	Status	Recommended Frequency	Test Agent
MDNR	Rabbit River Subwatersheds - Upper Rabbit River, Buskirk Creek, Miller Creek, Middle Rabbit River East, Middle Rabbit River West, Silver Creek, and Lower Rabbit River; Selkirk Lake, Big Lake	*S, T, DO, Fisheries, Discharge*	TSS	MDEQ Protocol	Not currently monitored	Once every 5 years (by 2018)	MDNR
			Temperature	Handheld Temperature Probe	Monitored in 1995-1996	Once every 5 years (by 2018)	MDNR
			DO	Handheld DO Meter	Monitored in 1995-1996	Once every 5 years (by 2018)	MDNR
			Fishery survey (number of brown trout)	MDEQ Protocol, electroshocking	Monitored in 1995-1996	Once every 5 years (by 2018)	MDNR
			Flow	Flow meter	Not currently monitored	Once every 5 years (by 2018)	MDNR
ACHD	Green Lake, Monterey Lake, East Lake, Big Lake, Selkirk Lake	*Pathogens*	*E. coli*	*E. coli* MPN/100 ml	Not currently monitored	Monthly, May-October (2013)	ACHD, Monterey Lake Association
ACD	Focus on TMDL, critical areas, and prioritized subwatersheds based on WARSSS study: (Little Rabbit River, Fales Drain, Black Creek, Miller Creek, Green Lake Creek, Buskirk Creek, Middle Rabbit River West, Red Run Drain, and Upper Rabbit River)	*S, N, Macroinvertebrates, DO, T*	TSS	MDEQ Protocol	Not currently monitored	Annually (by 2018)	ACD, MDEQ
			Stream embeddedness/ Substrate composition	MDEQ Protocol	Not currently monitored	Annually (by 2018)	ACD, ACDC, Volunteers, School groups, MDEQ
			Channel cross-section/Bank erosion	MDEQ Protocol/BEHI	Not currently monitored	Annually (by 2018)	ACD, ACDC, Volunteers, School groups, MDEQ
			Total Phosphorus/ Ortho-phosphorus	MDEQ Protocol	Not currently monitored	Annually (by 2018)	ACD, Volunteers, MDEQ
			Kjeldahl Nitrogen, Nitrate + Nitrite	MDEQ Protocol	Not currently monitored	Annually (by 2018)	ACD, Volunteers, MDEQ
			Macroinvertebrate Survey	MDEQ Protocol/SWAS P-51	Not currently monitored	Annually (by 2018)	ACD, Volunteers, School groups, MDEQ

Table 8.2 - Monitoring and Evaluation for the Watershed

Organization(s)	Monitoring Site(s)	Parameter Target	Type of Analysis	Protocol	Status	Recommended Frequency	Test Agent
			DO	Handheld Specific Conductance/DO Meter	Not currently monitored	Annually (by 2018)	ACD, Volunteers, School groups, MDEQ
			Temperature	Handheld Temperature Probe	Not currently monitored	Annually (by 2018)	ACD, Volunteers, School groups, MDEQ
	Wetland/hydrologic assessment of post BMP performance subwatersheds: Black Creek, Little Rabbit River, and Middle Rabbit River West	*Wetlands assessment*	Hydrology, post-BMP performance	MDEQ Protocol	Not currently monitored	2010, every 5 years thereafter	ACD, MDNR, MDEQ, Consultants
ACDC	Throughout the Watershed	*Trash and debris, Woody debris management*	Trash and debris	N/A	Minimal, if any	Annually	ACDC, ACD, local government, Volunteers, School groups
			Woody debris/ Obstruction removal	N/A	Currently conducted "as needed"	Annually	ACDC, ACD, Local government
	Focus on TMDL, critical areas, and prioritized subwatersheds based on WARSSS study: (Little Rabbit River, Fales Drain, Black Creek, Miller Creek, Green Lake Creek, Buskirk Creek, Middle Rabbit River West, Red Run Drain, and Upper Rabbit River)	Erosion assessment	Extent of erosion, sediment contribution	MDEQ Protocol	Some NPS sites have been identified, however, a more thorough assessment is needed	2010, every 5 years thereafter	ACD, MDNR, MDEQ, Consultants

Table 8.2 - Monitoring and Evaluation for the Watershed

Organization(s)	Monitoring Site(s)	Parameter Target	Type of Analysis	Protocol	Status	Recommended Frequency	Test Agent
Local Government	Dorr Township, Villages of Hopkins and Martin, and City of Wayland	*Pathogens*	*E. coli* MPN/100 ml	IDEX method, membrane filtration method	Not currently monitored	Annually (by 2013)	Local laboratory, WWTP, MDEQ
Local WWSLs and WWTP	WWSL and WWTP discharge locations	*S, N, Pathogens, N, Chlorine, Metals*	TSS	MDEQ Protocol	3-5x/week	Weekly	WWSL or WWTP
			Ammonia Nitrogen	MDEQ Protocol	Monthly	Weekly	WWSL or WWTP
			Total Phosphorus	MDEQ Protocol	3-5x/week	Weekly	WWSL or WWTP
			Fecal coliform	MDEQ Protocol	3-5x/week	Weekly	WWSL or WWTP
			Total Chlorine	MDEQ Protocol	Not currently monitored	Weekly	WWSL or WWTP
			Mercury	MDEQ Protocol	Not currently monitored	Weekly	WWSL or WWTP
			Copper	MDEQ Protocol	Not currently monitored	Weekly	WWSL or WWTP
USGS	Rabbit River near Hopkins	*Discharge, T*	Flow	Gage-height telemeter	Daily since 1965	Daily	USGS
			Temperature	Probe	Daily since 1965	Daily	USGS

1) Specific sites will be included as part of MDEQ Water Bureau's rotational water quality monitoring program
2) S= Sediment, N= Nutrients, DO= Dissolved Oxygen, T= Temperature

Allegan - Conservation District
ACDC - Allegan County Drain Commissioner
ACHD - Allegan County Health Department
BMP - Best Management Practice
DO - Dissolved Oxygen
SWAS - Great Lakes and Environmental Assessment Section
MDEQ - Michigan Department of Environmental Quality
MDNR - Michigan Department of Natural Resources
NPS - Nonpoint Source
TMDL - Total Maximum Daily Load
TSS - Total Suspended Solids
USEPA - U.S. Environmental Protection Agency
USGS - U.S. Geological Survey

WARSSS - Watershed Assessment for River Stability and Sediment Supply
Watershed - Rabbit River Watershed
WWSL – Waste Water Sewage Lagoon
WWTP - Waste Water Treatment Plant

8.4 EVALUATION FRAMEWORK

To evaluate the success of this WMP and to be able to keep it flexible for unknown future needs, the following evaluation strategy will be implemented.

Step 1 - Developing Evaluation Questions with an Evaluation Team

The team will identify the goal(s) of the evaluation and generate a list of questions related to the criteria stated in Tables 6.1 and 8.1. The evaluation will look specifically at the progress toward improving water quality through the recommended actions.

Step 2 - Developing the Evaluation Approach and Tools

Multiple tools will be used to evaluate the success of the implementation of the WMP. The first tool is a short bi-annual survey of the stakeholders to be passed out and collected at public meetings. The purpose of the survey will be to find out if publications are circulating correctly, if the group is still focused on the same goals, and if new information has surfaced requiring a change in the WMP.

To ensure that there is a meaningful evaluation to work with, specific questions measuring the positive results of the WMP, such as any implementation of BMP recommendations, water resource protection, watershed management planning, participation in workshops, and interest in water chemistry sampling, will be developed that will assist the evaluation team in focusing their efforts to what is working.

Another form of evaluation will be the project's ability to respond to needs voiced in public comments and incorporation of those needs into the I&E strategy. Filling out the project surveys, voicing opinions at public meetings, and contacting the ACD directly or through their website are just a few ways for the public to comment on the project in the future.

Step 3 - Collecting and Analyzing Data

Data review will be specifically important, showing the restoration of impaired uses through the evaluation criteria identified in Section 8.1.1 or the protection of threatened uses, which will be used as an indicator of success. This WMP includes a well thought out evaluation plan to evaluate the effectiveness of the implementation strategies in addressing water quality goals. The evaluation techniques relate to the proposed activities in the action plan. The WMP would need to be revised if milestones are not being met as identified in Table 6.1, if the monitoring and I&E components are not adequately meeting the evaluation criteria, as listed in Tables 7.1 and 8.1, if the pollution reductions are not being achieved, or progress is not being made toward meeting WQS. If additional watershed concerns are discovered, the milestones, actions, and commitments would also need to be updated. The evaluation criteria provide an

indication of how BMPs can be assessed to evaluate success. Table 6.1 includes the measurable milestones for determining the success of the BMPs that are implemented.

The monitoring components included in Table 8.2 will be used to evaluate the effectiveness of the implementation efforts over time, and whether load reductions are being achieved and the goals of supporting other indigenous aquatic life and wildlife (Rabbit River, Green Lake Creek, Fales Drain, Red Run Drain, and Black Creek) and supporting the warmwater fishery (Red Run Drain) are being met.

The appropriate data collection and analysis method will depend on the use to be evaluated. An evaluation meeting will occur at the end of each project year, and may involve meeting with individual members of the evaluation team or the evaluation team as a whole. This evaluation will contain both quantitative and qualitative results.

Step 4 - Prepare Draft and Final Evaluation Summary

An evaluation summary will be completed every year starting from the first year the evaluation team is formed and the WMP is approved by MDEQ. Each year will build on previous years making one comprehensive report. The products of this evaluation strategy or evaluation tools include, but are not limited to, the tools (bi-annual surveys, additional I&E activities, and a review of water quality data), and comprehensive annual reports. The evaluation team will then determine if enough additional information has been collected or water quality monitoring results have shown changes to require a revised WMP. The recommended date of the next revision is 2014.

Through this evaluation process, communities and agencies will be better informed about public response and the success of the project, which improvements are necessary to the project, and which BMPs need to continue as part of the project. The implementation of the WMP is assumed to have a positive impact on the water quality, even though some components (such as I&E) may not be directly tied to water quality measurements. The monitoring components listed in Table 8.2, however, are designed to directly evaluate changes in water quality.

Total Cost Estimate

To implement this plan and to achieve water quality goals, many activities must occur. The estimated cost of BMPs and I&E activities are broken down in Table 8.3, along with the cost of staffing such a project.

Table 8.3 - Total Cost Estimate

Activities/Items	Cost Materials	Technical Assistance Total Hours	Subtotal Cost for Hours $50/Hour	Total Cost
BMPs Subtotal:	$18,585,250 to $41,885,250	33,097	$1,654,850	$20.2 to $43.5 Million
I&E Subtotal:	$272,950	Included		$272,950
Total Cost	$18.8 to $42.2 Million	33,097	$1,654,850	$20.5 to $43.8 Million

CHAPTER 9 – SUSTAINABILITY

The Rabbit River Steering Committee (Steering Committee) was reassembled in 2006 to oversee the current Rabbit River Watershed (Watershed) Project Implementation Project. During this two-year project, Steering Committee members worked to improve water quality within the Watershed and reduce nonpoint source (NPS) pollution through the implementation of agricultural best management practices (BMPs), wetlands restorations, land-use planning reviews, and information and education (I&E) activities. The Steering Committee also developed an EPA 9 Elements Watershed Management Plan (WMP), which identified the sources and causes of NPS pollution and the practices necessary to address impairments to water quality. After the conclusion of the grant project, the Steering Committee will continue to work toward meeting the goals and objectives established for the Watershed through the programs described below.

The Steering Committee plans to continue their involvement with the Healthy Waters, Rural Pride Purchase of Development Rights (PDR) program. Through this initiative, the Allegan County Farm Preservation Board and the Allegan Conservation District (ACD) worked with Allegan County Board of Commissioners to adopt an ordinance intended to protect prime farmland and water quality by acquiring farmland development rights voluntarily offered by landowners. The ordinance requires a filter strip conservation easement to permanently preserve water quality in Allegan County on all properties entered into the PDR program. These filter strip easements are intended to prevent soil erosion and the introduction of insecticides and herbicides into rivers and lakes within the Watershed.

In addition, the Steering Committee, in coordination with ACD and the Natural Resources Conservation Service (NRCS), will continue to implement water quality BMPs through Farm Bill Programs and the ACD's fee for service program. To assist in addressing additional water quality impairments, the Steering Committee and the ACD plan to pursue funding to implement the recommendations outlined in the 9 Elements Watershed WMP.

During the implementation of new and ongoing initiatives, the Steering Committee will operate under the umbrella of the Kalamazoo River Watershed Council (Council). The mission of the Council is to "work, in cooperation with groups and individuals from the community, government agencies, and elected offices to improve and protect the environmental quality of the Kalamazoo River and its watershed." By working collaboratively with the Council, the Steering Committee will be able to share resources and build on their existing programs to get the greatest benefit to cost ratio for the Watershed. Specific goals of the Steering Committee and Council include 1) promoting stewardship and wise use of the natural resources; 2) educating a variety of diverse groups in the Watershed about environmental, health, economic, and

social issues; 3) supporting the work of others in addressing Watershed issues; and 4) implementing a Remedial Action Plan for the greater Kalamazoo River and Watershed.

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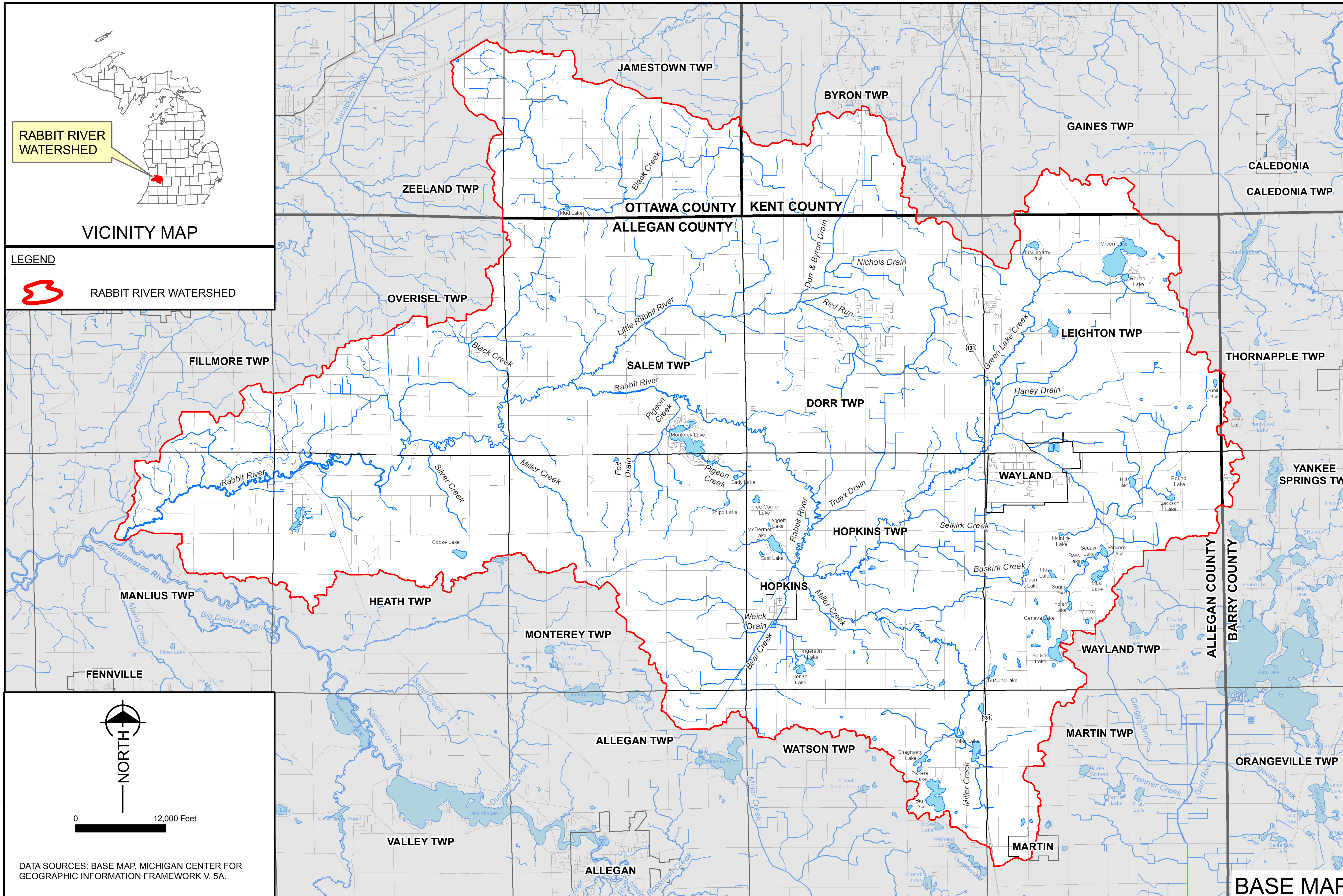
Figures

Figures


VICINITY MAP
RABBIT RIVER WATERSHED
LEGEND
RABBIT RIVER WATERSHED
NORTH
0
12,000 Feet
DATA SOURCES: BASE MAP, MICHIGAN CENTER FOR GEOGRAPHIC INFORMATION FRAMEWORK V. 5A.
JAMESTOWN TWP
BYRON TWP
GAINES TWP
CALEDONIA
CALEDONIA TWP
ZEELAND TWP
OTTAWA COUNTY
KENT COUNTY
ALLEGAN COUNTY
OVERISEL TWP
FILLMORE TWP
SALEM TWP
LEIGHTON TWP
THORNAPPLE TWP
DORR TWP
WAYLAND
YANKEE SPRINGS TWP
HOPKINS TWP
HOPKINS
MANLIUS TWP
HEATH TWP
MONTEREY TWP
WAYLAND TWP
FENNVILLE
ALLEGAN TWP
WATSON TWP
MARTIN TWP
ORANGEVILLE TWP
VALLEY TWP
ALLEGAN
MARTIN
BARRY COUNTY
Black Creek
Little Rabbit River
Rabbit River
Pigeon Creek
Miller Creek
Silver Creek
Felt Drain
Dorr & Byron Drain
Nichols Drain
Red Run
Green Lake Creek
Haney Drain
Truax Drain
Selkirk Creek
Buskirk Creek
Weick Drain
Bear Creek
Kalamazoo River
Green Lake
Monterey Lake
Goose Lake
BASE MAP

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scientist

architects

constructors

fishbeck, thompson, carr & huber, inc.

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Allegan County, Michigan

Rabbit River Watershed Management Plan

PROJECT NO.
G06302

FIGURE NO.
1

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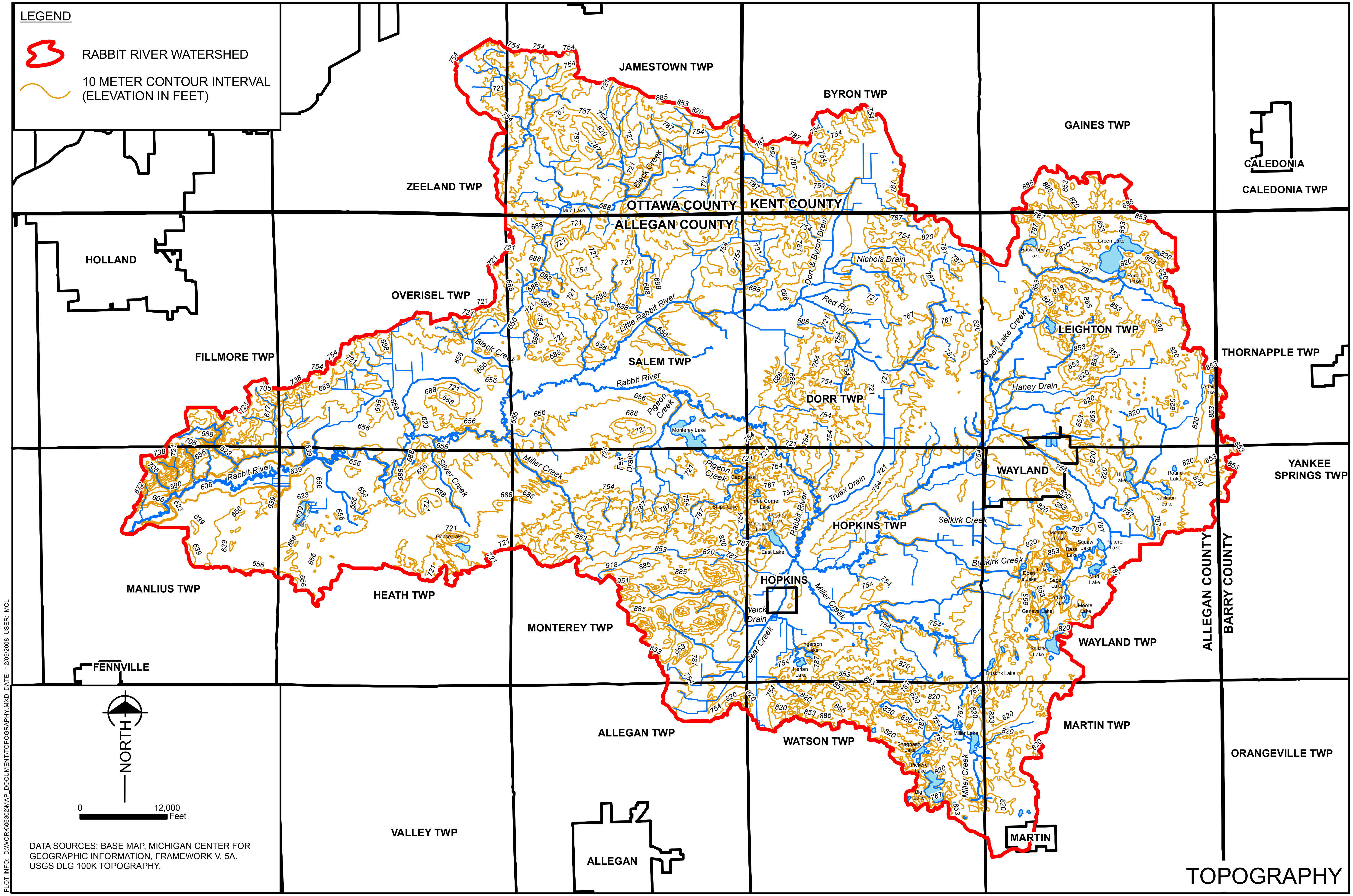
LEGEND
RABBIT RIVER WATERSHED
10 METER CONTOUR INTERVAL (ELEVATION IN FEET)
JAMESTOWN TWP
BYRON TWP
GAINES TWP
CALEDONIA
CALEDONIA TWP
ZEELAND TWP
OTTAWA COUNTY
KENT COUNTY
ALLEGAN COUNTY
HOLLAND
OVERISEL TWP
SALEM TWP
LEIGHTON TWP
THORNAPPLE TWP
FILLMORE TWP
DORR TWP
WAYLAND
YANKEE SPRINGS TWP
HOPKINS TWP
HOPKINS
MANLIUS TWP
HEATH TWP
MONTEREY TWP
WAYLAND TWP
BARRY COUNTY
FENNVILLE
ALLEGAN TWP
WATSON TWP
MARTIN TWP
ORANGEVILLE TWP
VALLEY TWP
ALLEGAN
MARTIN
Rabbit River
Little Rabbit River
Black Creek
Pigeon Creek
Miller Creek
Silver Creek
Felt Drain
Dorr & Byron Drain
Nichols Drain
Red Run
Green Lake Creek
Haney Drain
Truax Drain
Selkirk Creek
Buskirk Creek
Bear Creek
Weick Drain
NORTH
0
12,000
Feet
DATA SOURCES: BASE MAP, MICHIGAN CENTER FOR GEOGRAPHIC INFORMATION, FRAMEWORK V. 5A. USGS DLG 100K TOPOGRAPHY.
TOPOGRAPHY
PLOT INFO: D:\WORK\06302\MAP DOCUMENT\TOPOGRAPHY.MXD DATE: 12/09/2008 USER: MCL

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Allegan County, Michigan

Rabbit River Watershed Management Plan

PROJECT NO.
G06302

FIGURE NO.
2

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LEGEND

RABBIT RIVER WATERSHED

HYDROLOGIC SOIL GROUP

- A-HIGH INFILTRATION
- A/D-IMPROVED/NATURAL CONDITION
- B-MEDIUM INFILTRTION
- B/D-IMPROVED/NATURAL CONDITION
- C-LOW INFILTRATION
- C/D-IMPROVED/NATURAL CONDITION
- D-VERY LOW INFILTRATION
- NO DATA

JAMESTOWN TWP
BYRON TWP
GAINES TWP
CALEDONIA
CALEDONIA TWP
ZEELAND TWP
OTTAWA COUNTY
KENT COUNTY
ALLEGAN COUNTY
HOLLAND
OVERISEL TWP
FILLMORE TWP
SALEM TWP
LEIGHTON TWP
THORNAPPLE TWP
DORR TWP
WAYLAND
YANKEE SPRINGS TWP
HOPKINS TWP
HOPKINS
WAYLAND TWP
ALLEGAN COUNTY
BARRY COUNTY
MANLIUS TWP
HEATH TWP
MONTEREY TWP
FENNVILLE
ALLEGAN TWP
WATSON TWP
MARTIN TWP
ORANGEVILLE TWP
VALLEY TWP
ALLEGAN
MARTIN

Black Creek
Mud Lake
Dorr & Byron Drain
Nichols Drain
Red Run
Little Rabbit River
Green Lake Creek
Haney Drain
Huckleberry Lake
Green Lake
Round Lake
Rabbit River
Silver Creek
Goose Lake
Pigeon Creek
Monterey Lake
Miller Creek
Felt Drain
Cady Lake
Shipp Lake
Three Corner Lake
McDermott Lake
Leggett Lake
East Lake
Truex Drain
Selkirk Creek
Buskirk Creek
Hill Lake
Jackson Lake
Mcintire Lake
Bass Lake
Squaw Lake
Pickerel Lake
Titus Lake
Doan s Lake
Sages Lake
Mud Lake
Indian Lake
Moore Lake
Geneva Lake
Selkirk Lake
Buskirk Lake
Weick Drain
Bear Creek
Ingerson Lake
Herlan Lake
Miller Lake
Shagnasty Lake
Pickerel Lake
Big Lake

NORTH

0 12,000 Feet

DATA SOURCES: BASE MAP, MICHIGAN CENTER FOR GEOGRAPHIC INFORMATION FRAMEWORK V. 5A.
SOILS, NRCS SSURGO SOILS.

SOILS

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Allegan County Drain Commissioner
Allegan County, Michigan

Rabbit River Watershed Management Plan

PROJECT NO.
G06302

FIGURE NO.
3

LEGEND

RABBIT RIVER WATERSHED

CRITICAL AREAS
FOR RESTORATION: 90, 81, 84

PRIORITY AREAS
FOR PRESERVATION: 89, 85

JAMESTOWN TWP
BYRON TWP
GAINES TWP
CALEDONIA
CALEDONIA TWP
ZEELAND TWP
OTTAWA COUNTY
KENT COUNTY
ALLEGAN COUNTY
HOLLAND
OVERISEL TWP
FILLMORE TWP
SALEM TWP
DORR TWP
LEIGHTON TWP
THORNAPPLE TWP
YANKEE SPRINGS TWP
WAYLAND
HOPKINS TWP
HOPKINS
WAYLAND TWP
ALLEGAN COUNTY
BARRY COUNTY
MANLIUS TWP
HEATH TWP
MONTEREY TWP
ALLEGAN TWP
WATSON TWP
MARTIN TWP
ORANGEVILLE TWP
VALLEY TWP
FENNVILLE
ALLEGAN
MARTIN

Black Creek (90)
Little Rabbit River (82)
Red Run Drain (81)
Green Lake Creek (84)
Middle Rabbit River West (89)
Upper Rabbit River (85)
Buskirk Creek (86)
Silver Creek (91)
Lower Rabbit River (92)
Middle Rabbit River East (88)
Bear Creek (83)
Miller Creek (87)

Black Creek
Mud Lake
Nichols Drain
Dorr & Byron Drain
Red Run
Little Rabbit River
Rabbit River
Pigeon Creek
Monterey Lake
Felt Drain
Truex Drain
Three Corner Lake
Leggett Lake
McDermott Lake
Shipp Lake
East Lake
Goose Lake
Miller Creek
Silver Creek
Selkirk Creek
Buskirk Creek
Weick Drain
Bear Creek
Ingerson Lake
Herlan Lake
Buskirk Lake
Selkirk Lake
Huckleberry Lake
Green Lake
Round Lake
Green Lake Creek
Haney Drain
Auburn Lake
McIntire Lake
Squaw Lake
Bass Lake
Pickerel Lake
Mud Lake
Doan Lake
Sager Lake
Moore Lake
Geneva Lake
Hill Lake
Jackson Lake
Cady Lake
Shagnasty Lake
Big Lake

NORTH

0 12,000 Feet

DATA SOURCES: BASE MAP, MICHIGAN CENTER FOR GEOGRAPHIC INFORMATION, FRAMEWORK V.5A.

SUBWATERSHEDS

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Allegan County, Michigan
Rabbit River Watershed Management Plan

PROJECT NO.
G06302

FIGURE NO.
4

LEGEND

RABBIT RIVER WATERSHED

LAND COVER CIRCA. 1800

- HARDWOOD FOREST AND SAVANNA
- PINE-HARDWOOD FOREST
- PINE FOREST
- BARRENS
- FORESTED WETLANDS
- UNFORESTED WETLANDS
- WATER BODIES

JAMESTOWN TWP
BYRON TWP
GAINES TWP
CALEDONIA
CALEDONIA TWP
ZEELAND TWP
OTTAWA COUNTY
KENT COUNTY
ALLEGAN COUNTY
OVERISEL TWP
FILLMORE TWP
SALEM TWP
LEIGHTON TWP
THORNAPPLE TWP
DORR TWP
WAYLAND
YANKEE SPRINGS TWP
HOPKINS TWP
HOPKINS
MANLIUS TWP
HEATH TWP
MONTEREY TWP
WAYLAND TWP
ALLEGAN COUNTY
BARRY COUNTY
FENNVILLE
ALLEGAN TWP
WATSON TWP
MARTIN TWP
ORANGEVILLE TWP
VALLEY TWP
ALLEGAN
MARTIN

Black Creek
Mud Lake
Little Rabbit River
Black Creek
Rabbit River
Pigeon Creek
Monterey Lake
Dorr & Byron Drain
Nichols Drain
Red Run
Green Lake Creek
Haney Drain
Huckleberry Lake
Green Lake
Round Lake
Auburn Lake
Rabbit River
Silver Creek
Goose Lake
Miller Creek
Felt Drain
Pigeon Creek
Cady Lake
Shipp Lake
Three Corner Lake
Leggett Lake
McDermot Lake
East Lake
Rabbit River
Truax Drain
Selkirk Creek
McIntire Lake
Bass Lake
Squaw Lake
Pickerel Lake
Hill Lake
Round Lake
Jackson Lake
Buskirk Creek
Titus Lake
Doan s Lake
Sager Lake
Mud Lake
Indian Lake
Moore Lake
Geneva Lake
Selkirk Lake
Buskirk Lake
Weick Drain
Miller Creek
Bear Creek
Ingerson Lake
Herlan Lake
Miller Lake
Shagnasty Lake
Pickerel Lake
Big Lake
Miller Creek

NORTH

0 12,000 Feet

DATA SOURCES: BASE MAP, MICHIGAN CENTER FOR GEOGRAPHIC INFORMATION FRAMEWORK V. 5A. LAND COVER CIRCA. 1800, MICHIGAN NATURAL FEATURES INVENTORY.

PRESETTLEMENT VEGETATION

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scientist
architects
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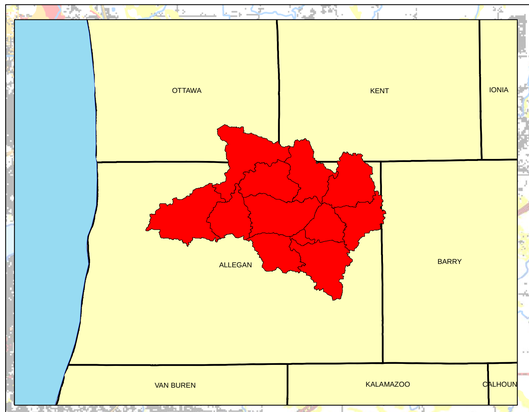
Allegan County, Michigan
Rabbit River Watershed Management Plan

PROJECT NO.
G06302

FIGURE NO.
5

RABBIT RIVER
POTENTIAL WETLAND RESTORATION AREAS



KENT

ALLEGAN

BARRY

Map Information:

This map is intended to be used as one tool to assist in identifying potential areas for wetland restoration. The MDEQ produced this map from the following data obtained from other agencies or organizations:

1. The National Wetland Inventory (NWI) conducted by the US Fish and Wildlife Service through interpretation of aerial photos and topographic data.
2. Hydric Soils and hydric soil complexes as mapped by the US Department of Agriculture, Natural Resource Conservation Service (NRCS).
3. Land Cover as mapped by the Michigan Resource Inventory System (MIRIS), Michigan Department of Natural Resources, through interpretation of aerial photographs.
4. Basemap features as mapped by the MI Dept. of Geographic Information (MCGI).
5. Presettlement Wetlands created from Michigan Natural Features Inventory 1800 Land Cover layer
6. Urban areas as mapped by MI DNR in 2001 IFMAP land cover layer

The Potential Wetland Restoration Areas GIS layer was created by merging NRCS hydric soils w/ MNFI Presettlement Wetlands, then performing an erase command in ESRI Arc-INFO on the resulting layer to remove NWI, MIRIS Wetlands, Hydrography, and Urban polygons from the coverage area. This map is not intended to be used to determine the specific locations and jurisdictional boundaries of wetland areas subject to regulation under Part 303, Wetlands Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. Only an on-site evaluation performed by the MDEQ in accordance with Part 303 shall be used for jurisdictional determinations. A permit is required from the MDEQ to conduct certain activities in jurisdictional wetlands.

KEY

Potential Wetland Restoration Areas

- **HIGH POTENTIAL (Hydric and Presettlement Wetland Overlay)**
- **MEDIUM POTENTIAL (Only Hydric Soils)**
- **LOW POTENTIAL (Only Presettlement Wetlands)**
- **Existing Wetlands (1978 NWI + MIRIS)**
- **Sub-Watershed Boundaries**
- **Urbanized Areas (IFMAP Land Cover 2001)**

N W E S 1 Miles

Department of Environmental Quality

Land and Water Management Division

Map Created: June 2008
By: Jeremy Jones

LEGEND

RABBIT RIVER WATERSHED

NUMBER OF THREATENED, ENDANGERED OR SPECIAL CONCERN SPECIES PER QUARTER-QUARTER SECTION

- 0.01 - 10
- 10 - 25
- 25 - 50
- 50 - 100
- 100 +

JAMESTOWN TWP
BYRON TWP
GAINES TWP
CALEDONIA
CALEDONIA TWP
ZEELAND TWP
OTTAWA COUNTY
KENT COUNTY
ALLEGAN COUNTY
OVERISEL TWP
FILLMORE TWP
SALEM TWP
DORR TWP
LEIGHTON TWP
THORNAPPLE TWP
YANKEE SPRINGS TWP
WAYLAND
HOPKINS TWP
HOPKINS
WAYLAND TWP
ALLEGAN COUNTY
BARRY COUNTY
MANLIUS TWP
HEATH TWP
MONTEREY TWP
FENNVILLE
ALLEGAN TWP
WATSON TWP
MARTIN TWP
ORANGEVILLE TWP
VALLEY TWP
ALLEGAN
MARTIN

Rabbit River
Black Creek
Mud Lake
Little Rabbit River
Nichols Drain
Dorr & Byron Drain
Red Run
Green Lake Creek
Haney Drain
Huckleberry Lake
Green Lake
Round Lake
Auburn Lake
Pigeon Creek
Monterey Lake
Silver Creek
Miller Creek
Feit Drain
Cady Lake
Three Corner Lake
Leggett Lake
McDermott Lake
East Lake
Shipp Lake
Truax Drain
Selkirk Creek
Buskirk Creek
McIntire Lake
Squaw Lake
Bass Lake
Pickerel Lake
Titus Lake
Doan Lake
Sager Lake
Mud Lake
Indian Lake
Moore Lake
Geneva Lake
Selkirk Lake
Buskirk Lake
Hill Lake
Round Lake
Jackson Lake
Veick Drain
Bear Creek
Ingerson Lake
Herlan Lake
Shagnasty Lake
Pickerel Lake
Big Lake
Miller Lake
Goose Lake
Silver Lake

NORTH

0 12,000 Feet

DATA SOURCES: BASE MAP, MICHIGAN CENTER FOR GEOGRAPHIC INFORMATION, FRAMEWORK V. 5A. MICHIGAN NATURAL FEATURES INVENTORY, MICHIGAN STATE UNIVERSITY EXTENSION.

NATURAL FEATURES INVENTORY

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Allegan County, Michigan
Rabbit River Watershed Management Plan

PROJECT NO.
G06302

FIGURE NO.
7

LEGEND

RABBIT RIVER WATERSHED

TROUT STREAMS

JAMESTOWN TWP

BYRON TWP

GAINES TWP

CALEDONIA

CALEDONIA TWP

ZEELAND TWP

OTTAWA COUNTY

KENT COUNTY

ALLEGAN COUNTY

HOLLAND

OVERISEL TWP

FILLMORE TWP

SALEM TWP

DORR TWP

LEIGHTON TWP

THORNAPPLE TWP

YANKEE SPRINGS TWP

WAYLAND

HOPKINS TWP

HOPKINS

WAYLAND TWP

BARRY COUNTY

MANLIUS TWP

HEATH TWP

MONTEREY TWP

WATSON TWP

MARTIN TWP

ORANGEVILLE TWP

FENNVILLE

ALLEGAN TWP

ALLEGAN

VALLEY TWP

MARTIN

Black Creek

Mud Lake

Little Rabbit River

Nichols Drain

Dorr & Byron Drain

Red Run

Green Lake Creek

Haney Drain

Huckleberry Lake

Green Lake

Round Lake

Rabbit River

Pigeon Creek

Monterey Lake

Silver Creek

Miller Creek

Feit Drain

Cady Lake

Three Corner Lake

Leggett Lake

McDermott Lake

East Lake

Shipp Lake

Goose Lake

Truax Drain

Selkirk Creek

Buskirk Creek

Hill Lake

Round Lake

Jackson Lake

McIntire Lake

Squaw Lake

Bass Lake

Pickerel Lake

Titus Lake

Doan Lake

Sager Lake

Mud Lake

Indian Lake

Moore Lake

Geneva Lake

Selkirk Lake

Buskirk Lake

Veick Drain

Bear Creek

Ingerson Lake

Herlan Lake

Shagnasty Lake

Pickerel Lake

Big Lake

Miller Lake

Auble Lake

NORTH

0 12,000 Feet

DATA SOURCES: BASE MAP, MICHIGAN CENTER FOR GEOGRAPHIC INFORMATION, FRAMEWORK V.5A. TROUT STREAMS, MICHIGAN DEPT OF NATURAL RESOURCES.

TROUT STREAMS

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Allegan County, Michigan

Rabbit River Watershed Management Plan

PROJECT NO.
G06302

FIGURE NO.
8

LEGEND

- RABBIT RIVER WATERSHED
- IMPORTANT SITES
- CONSERVATION EASEMENTS
- COMMITTED GREENSPACE LANDS
  PROTECTED NATURAL LANDS, NATIONAL FORESTS, STATE PARKS, STATE GAME AREAS, OTHER STATE LANDS, LOCAL PARKS, NATURE PRESERVES, NATURE CENTERS, AND CAMPS ARE REPRESENTED.
- GREEN INFRASTRUCTURE ZONES
  PRIORITY AREAS THAT MAY HAVE THE GREATEST POTENTIAL FOR SUPPORTING A REGIONAL GREEN INFTRASTRUCTURE NETWORK BUT ARE NOT CURRENTLY IN PROTECTED STATUS.

JAMESTOWN TWP
BYRON TWP
GAINES TWP
CALEDONIA
CALEDONIA TWP
ZEELAND TWP
OTTAWA COUNTY
KENT COUNTY
ALLEGAN COUNTY
OVERISEL TWP
FILLMORE TWP
SALEM TWP
DORR TWP
LEIGHTON TWP
THORNAPPLE TWP
WAYLAND
YANKEE SPRINGS TWP
HOPKINS TWP
HOPKINS
MANLIUS TWP
HEATH TWP
MONTEREY TWP
WAYLAND TWP
BARRY COUNTY
FENNVILLE
ALLEGAN TWP
WATSON TWP
MARTIN TWP
ORANGEVILLE TWP
VALLEY TWP
ALLEGAN
MARTIN

Black Creek
Mud Lake
Little Rabbit River
Nichols Drain
Dorr & Byron Drain
Red Run
Green Lake Creek
Huckleberry Lake
Green Lake
Round Lake
Haney Drain
Rabbit River
Pigeon Creek
Monterey Lake
Silver Creek
Goose Lake
Miller Creek
Feil Drain
Cady Lake
Shipp Lake
Three Corner Lake
Leggett Lake
McDermott Lake
East Lake
Truax Drain
Selkirk Creek
Buskirk Creek
McIntire Lake
Squaw Lake
Bass Lake
Pickerel Lake
Titus Lake
Doan Is Lake
Sager Lake
Mud Lake
Indian Lake
Moore Lake
Geneva Lake
Selkirk Lake
Buskirk Lake
Hill Lake
Round Lake
Jackson Lake
Veick Drain
Bear Creek
Ingerson Lake
Herlan Lake
Shagnasty Lake
Pickerel Lake
Big Lake
Miller Lake

NORTH
0 12,000 Feet

DATA SOURCES: BASE MAP, MICHIGAN CENTER FOR GEOGRAPHIC INFORMATION, FRAMEWORK V. 5A.
GREEN INFRASTRUCTURE, NATURAL CONNECTIONS, GVSU LAKE MICHIGAN CENTER
ANNIS WATER RESOURCES INSTITUTE,
AND SOUTHWEST MICHIGAN LAND CONSERVANCY.

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GREEN INFRASTRUCTURE

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Allegan County, Michigan
Rabbit River Watershed Management Plan

PROJECT NO.
G06302

FIGURE NO.
9

LEGEND

RABBIT RIVER WATERSHED

CENSUS BLOCK GROUPS- PERSONS/SQ.MILE

- 0 - 100
- 101 - 200
- 201 - 400
- 401 - 800
- GREATER THAN 800

JAMESTOWN TWP
BYRON TWP
GAINES TWP
CALEDONIA
CALEDONIA TWP
ZEELAND TWP
OTTAWA COUNTY
KENT COUNTY
ALLEGAN COUNTY
OVERISEL TWP
FILLMORE TWP
SALEM TWP
DORR TWP
LEIGHTON TWP
THORNAPPLE TWP
YANKEE SPRINGS TWP
WAYLAND
HOPKINS TWP
HOPKINS
WAYLAND TWP
ALLEGAN COUNTY
BARRY COUNTY
MANLIUS TWP
HEATH TWP
MONTEREY TWP
WATSON TWP
MARTIN TWP
ORANGEVILLE TWP
FENNVILLE
ALLEGAN TWP
VALLEY TWP
ALLEGAN
MARTIN

Black Creek
Mud Lake
Nichols Drain
Dorr & Byron Drain
Red Run
Little Rabbit River
Black Creek
Rabbit River
Pigeon Creek
Monterey Lake
Green Lake Creek
Haney Drain
Huckleberry Lake
Green Lake
Round Lake
Auble Lake
Rabbit River
Silver Creek
Goose Lake
Miller Creek
Feit Drain
Pigeon Creek
Cady Lake
Shipp Lake
Three Corner Lake
Leggett Lake
McDermott Lake
East Lake
Rabbit River
Truax Drain
Selkirk Creek
Buskirk Creek
McIntire Lake
Squaw Lake
Bass Lake
Pickerel Lake
Titus Lake
Doan Lake
Sager Lake
Mud Lake
Indian Lake
Moore Lake
Geneva Lake
Selkirk Lake
Buskirk Lake
Hill Lake
Round Lake
Jackson Lake
Veick Drain
Bear Creek
Ingerson Lake
Herlan Lake
Miller Creek
Shagnasty Lake
Pickerel Lake
Big Lake
Miller Lake
Miller Creek

NORTH

0 12,000 Feet

DATA SOURCES: BASE MAP, MICHIGAN CENTER FOR GEOGRAPHIC INFORMATION, FRAMEWORK V.5A. U.S. CENSUS BUREAU 2000.

POPULATION DENSITY

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scientist
architects
constructors

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Allegan County, Michigan

Rabbit River Watershed Management Plan

PROJECT NO.
G06302

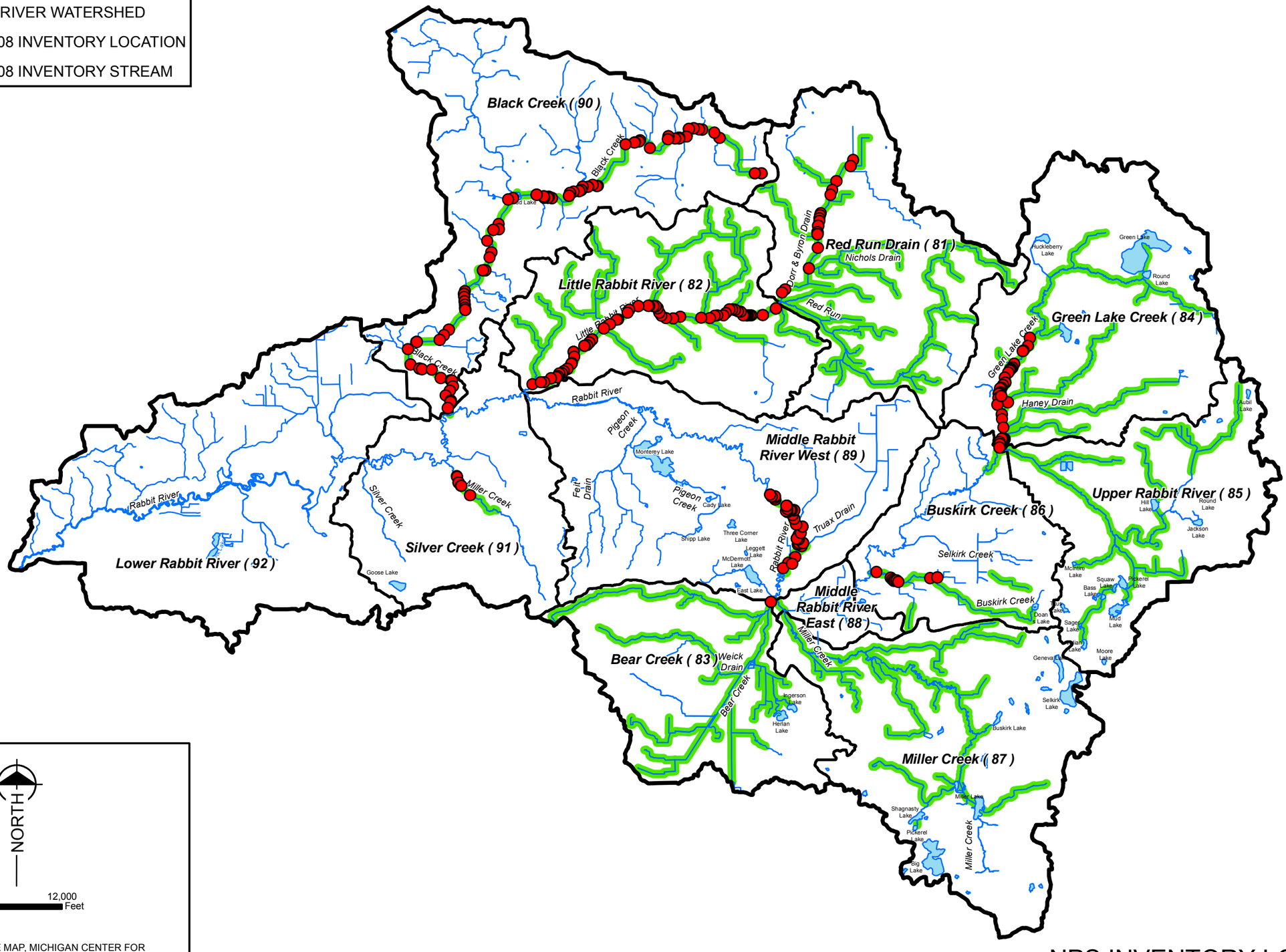
FIGURE NO.
11

LEGEND

RABBIT RIVER WATERSHED

2007-2008 INVENTORY LOCATION

2000-2008 INVENTORY STREAM



NORTH

0 12,000 Feet

DATA SOURCES: BASE MAP, MICHIGAN CENTER FOR GEOGRAPHIC INFORMATION, FRAMEWORK V.5A.

NPS INVENTORY LOCATION

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engineers

scientist

architects

constructors

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Allegan County, Michigan

Rabbit River Watershed Management Plan

PROJECT NO.
G06302

FIGURE NO.
12

PLOT INFO: D:\WORK\06302\MAP_DOCUMENT\NPSINVENTORY.MXD DATE: 12/09/2008 USER: MCL

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LEGEND

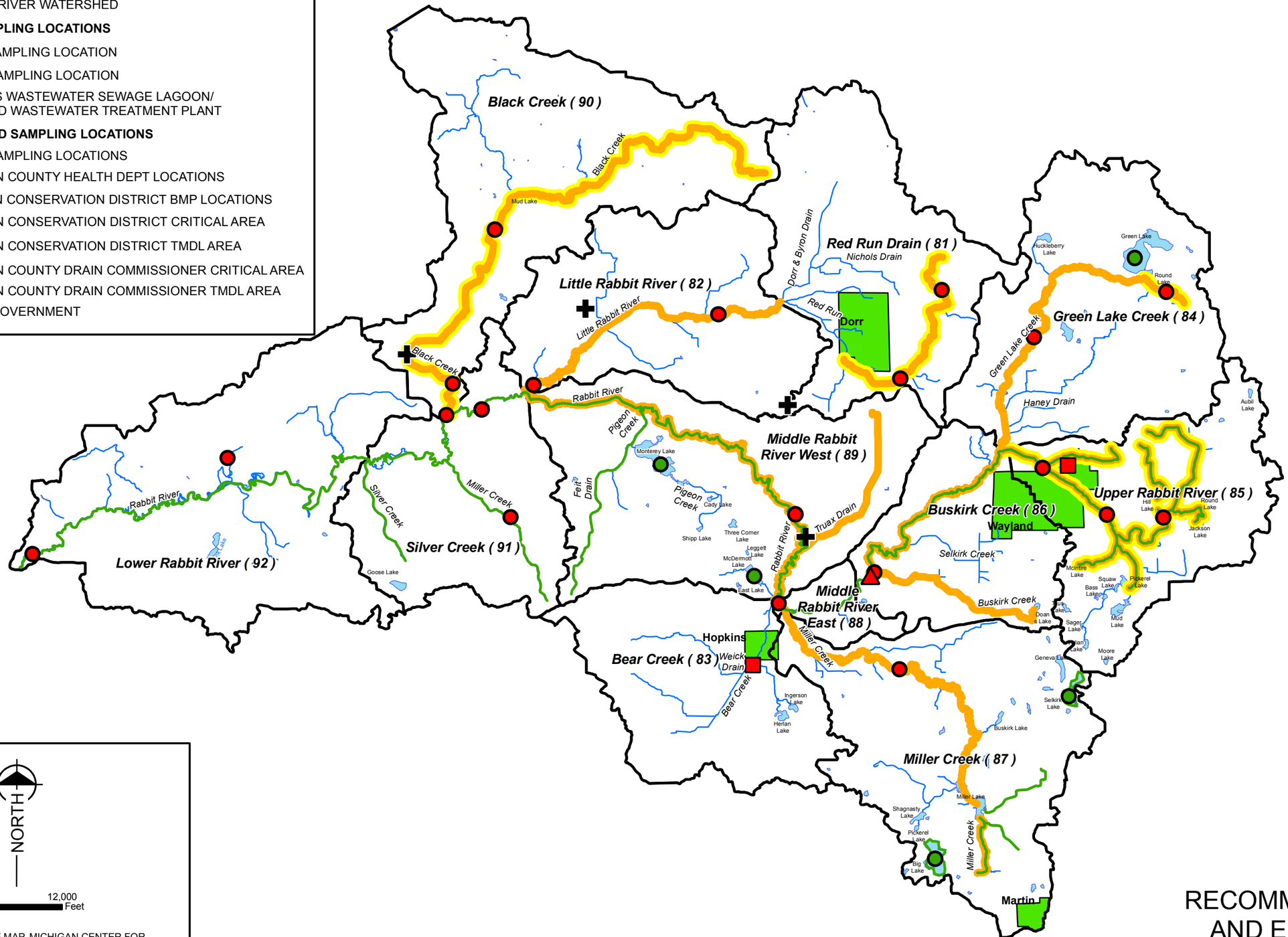
RABBIT RIVER WATERSHED

EXISTING SAMPLING LOCATIONS

- USGS SAMPLING LOCATION
- MDEQ SAMPLING LOCATION
- HOPKINS WASTEWATER SEWAGE LAGOON/ WAYLAND WASTEWATER TREATMENT PLANT

RECOMMENDED SAMPLING LOCATIONS

- MDNR SAMPLING LOCATIONS
- ALLEGAN COUNTY HEALTH DEPT LOCATIONS
- ALLEGAN CONSERVATION DISTRICT BMP LOCATIONS
- ALLEGAN CONSERVATION DISTRICT CRITICAL AREA
- ALLEGAN CONSERVATION DISTRICT TMDL AREA
- ALLEGAN COUNTY DRAIN COMMISSIONER CRITICAL AREA
- ALLEGAN COUNTY DRAIN COMMISSIONER TMDL AREA
- LOCAL GOVERNMENT



NORTH

0 12,000 Feet

DATA SOURCES: BASE MAP, MICHIGAN CENTER FOR GEOGRAPHIC INFORMATION, FRAMEWORK V.5A.
2004 MDEQ BIOLOGICAL SURVEY.

RECOMMENDED AND EXISTING SAMPLING LOCATIONS

fr&h

engineers
scientist
architects
constructors

fishbeck, thompson, carr & huber, inc.

Hard copy is intended to be 11"x17" when plotted. Scale(s) indicated and graphic quality may not be accurate for any other size.

Allegan County Drain Commissioner

Allegan County, Michigan

Rabbit River Watershed Management Plan

PROJECT NO.
G06302

FIGURE NO.
13

PLOT INFO: D:\WORK\06302\MAP_DOCUMENT\SAMPLINGLOCATIONS.MXD DATE: 12/09/2008 USER: MCL

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Appendix 1

PUBLIC PARTICIPATION PROCESS

FOR THE

RABBIT RIVER WATERSHED

DECEMBER 2006
PROJECT NO. G06302

Fishbeck, Thompson, Carr & Huber, Inc. Engineers • Scientists • Architects • Constructors
1515 Arboretum Drive, SE, Grand Rapids, MI 49546 Telephone: 616-575-3824

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PUBLIC PARTICIPATION PROCESS FOR THE RABBIT RIVER WATERSHED

GENERAL INFORMATION

The Rabbit River Watershed (Watershed) covers 187,200 acres of land in Allegan, Barry, Ottawa, and Kent counties. The Watershed Implementation Project is a voluntary community-driven watershed project which identifies the problems, needs, and solutions for the management of the Watershed. A diverse Rabbit River Steering Committee (Committee), coordinated by the Allegan County Drain Commissioner, works on various levels with government agencies and private landowners to improve water quality and the quality of life in the Watershed.

This Public Participation Process (PPP) has been developed to raise community awareness of the word and concept "watershed," to promote stewardship of water resources as a model of good citizenship, and to solicit participation in the development of the Watershed Management Plan (WMP). All community members should understand that they live, learn, and work in a watershed and that they rely on its water as a basic resource. The Watershed is an important element of "place" and efforts will be made to encourage people to identify with their own watershed just as they identify with their local municipality or school district. Citizens must also understand that what they do on land can have a direct impact on the present and future quality of surface and ground water in their watershed. The goal is to elevate public understanding of these connections and to encourage actions that maintain the highest water quality and a healthy watershed ecosystem.

BUILDING THE TEAM

A description of the outreach and awareness activities and programs taking place in the Watershed has been provided by the participants of the Committee. This Committee is responsible for the outreach effort for soliciting public participation in the development of a Rabbit River WMP. Table 1 provides information on the identified stakeholders in the Watershed. Categories of stakeholders include government agencies, natural resource and environmental organizations, citizen groups, businesses, planning/development organizations, and education/outreach organizations. The mechanisms for soliciting participation in the development of the WMP will include websites, newsletters, newspaper articles, letters and personal invitations, press releases, watershed signage, presentations, and e-mail distribution lists. Those responsible for implementing the mechanisms are identified in Table 1.

COMMUNICATION DURING THE PLANNING PHASE

Many groups and organizations in the region are currently involved in watershed planning. Efforts will be made to coordinate educational activities with the larger regional activities of the Kalamazoo River Total Maximum Daily Load (TMDL) Implementation Committee, the Kalamazoo Storm Water Management Group, the Kalamazoo River Watershed Council and any other endeavor that can drive water quality and watershed improvements. The Steering Committee will work with the organizations above and utilize their documents to develop the Rabbit River WMP, ensuring that it satisfies the U.S. Environmental Protection Agency 9 elements.

The successful development of a WMP keeps citizens and local governments continually informed about the status of the WMP. Mechanisms for communication, listed in Table 1, will be used to reach the stakeholders, and have their voices heard, since not all will be able to attend every Committee meeting. Several modes of communication will be used to diversify the avenues of communication given the variety of the target audiences and the way they receive information.

Public comment about the Rabbit River WMP will be routed through the Committee to all the stakeholders. The Committee will determine how the WMP can respond to any concerns and suggestions and will decide on the WMPs contents. The following list of communication mechanisms will be used to inform stakeholders about the WMP initiative, solicit input for the WMP content, communicate with the Committee, and update the public on the project status.

MEETINGS

Bi-monthly meetings will be held by the Committee during the WMP planning process. Meetings will be announced through press releases, signs posted on library and municipal bulletin boards, on community websites, and through e-mail distribution lists. All Committee meetings will be open to the public and will give attendees the opportunity for comment. A list of individuals to represent the communities will be generated.

WEBSITE

A website format is a “living document,” in which updates can easily be communicated to the community. Kalamazooriver.net is the current website for information about the Kalamazoo River Watershed. Access to specific education and data resources for the subwatersheds, such as the Rabbit River Watershed, is provided. A discussion page allows for continuous feedback, and the electronic structure allows alterations to be made relatively easily with instant accessibility to any user logging onto the site.

The Committee will arrange for the information to be submitted to the website to update stakeholders and Committee members about the WMP planning process. The website will contain information about upcoming meetings, meeting minutes, public outreach activities, and links to more information about storm water quality. Once the WMP is made into a final draft, it will be posted on the website for a public comment period. Interested parties will be able to access the WMP and make comments to the Committee via e-mail, telephone, or written correspondence. The WMP will also be posted on other websites as available, such as the Allegan Conservation District (ACD), and municipalities within the Watershed.

NEWSLETTERS AND PRINT MEDIA

The ACD currently publishes a yearly newsletter for the District. This distribution will continue to relate information about the WMP to their readers. Press releases will be made to the local papers to announce public meetings and opportunities for public involvement. Several articles about the Watershed project and storm water education will be printed in the local newspaper. Additional articles will be distributed to all communities to use in their newsletters, such as the MSU quarterly newsletter and the FSA newsletter.

PRESENTATIONS

Personal invitations will be sent to some of the stakeholders listed in Table 1. Presentations at township board meetings, community group gatherings, county commissioners meetings, the Farm Bureau Annual meeting, the ACD annual meeting and/or local organizations will offer the attendees an opportunity to get more information about the WMP and what implications the WMP will have for their stakeholder group. Comments from those attending the presentations will be incorporated into the WMP before being submitted to the Michigan Department of Environmental Quality (MDEQ).

PUBLIC MEETINGS

Public meetings will be held to announce the beginning of the planning process and to present the draft Rabbit River WMP to obtain input on the WMP process and recommendations. The public meetings will be announced in a press release to local newspapers and in local government newsletters. Public comments will be incorporated into the WMP before being submitted to the MDEQ. The draft WMP will also be posted on the website.

BUSINESS SECTOR SPECIFIC APPROACHES

The Farm-A-Syst program, under the Groundwater Stewardship Program, addresses the agricultural component in identifying potential environmental risks posed by their farmstead operations. Several operators have volunteered to participate in this program with the ACD. One-on-one meetings, knocking on doors, breakfast meetings and coffee break meetings are several ways to meet with local businesses.

Other operators in the Watershed, such as greenhouse growers, will be identified to use other programs developed by MSU Extension, such as Greenhouse-A-Syst, Field-A-Syst, and Turf-A-Syst.

WATERSHED IDENTIFICATION SIGNAGE

The placement of roadside and pedestrian signage identifying boundaries of the Watershed helps citizens and visitors to recognize what ordinarily is missed. This is the first step toward building awareness and interest in the Watershed. Waterway identification signs at key points of road crossings could include the regionally used "Clean Water" logo. This water drop logo with its message, “We all live in a watershed. You make the difference,” was first used by The City of Battle Creek. The logo and message have since been adopted by the Kalamazoo River TMDL Committee for use throughout the Kalamazoo River Watershed. Common use of this logo will help unify educational efforts from various projects and will build “watershed” awareness, a primary objective of this WMP.

STUDENT GROUP ACTIVITIES

A previously very successful endeavor to pursue again in the future is the Student Stream Science Project. The project was created to enhance educational opportunities in the Watershed by combining resources with the Allegan Area Math and Science Center. The Watershed Coordinator visited classes of various grade levels to teach students about the Watershed, stream habitats, and how land use affects water quality. Volunteer groups also participated in this project, such as the Lake Associations and Cub Scouts. School and volunteer groups were trained in macroinvertebrate sampling and habitat assessment.

DEVELOPING EDUCATIONAL MESSAGES

Identification with one’s own watershed should involve a basic understanding of the term and concept “watershed.” Once that understanding is established, the recognition of the watershed’s characteristics including its merits, challenges, and problems in relation to oneself can be realized. The goal is to get to the realization of how one can become part of the solution to problems and a protector of that which should be preserved.

This understanding and realization leads stakeholders from awareness and education to action. The messages to the stakeholders will be developed to answer the following common questions:

Where is my watershed?

How am I connected to my watershed?

What is good in the watershed?

What is impaired in my watershed?

What activities contribute to watershed problems?

What Can I Do?

TIMELINE

The WMP planning process is a continual effort that will extend through September 1, 2007, when the final WMP is submitted to the MDEQ. Figure 2 outlines the schedule for the development and evaluation of the components of the WMP.

The PPP is designed to solicit input and document how the public is participating in the development of the WMP to improve water quality in the Watershed. It's design is also intended to create awareness, educate, and inspire the public to take action toward improving water quality in storm water runoff.

Throughout the first year of the project implementation, the Committee will be developing partnerships with organizations and agencies that already have education services that could be adapted to fit the needs of the Watershed project. The potential partners are identified in Table 1 and will be invited to participate in the development of the WMP.

COMING TO AGREEMENT

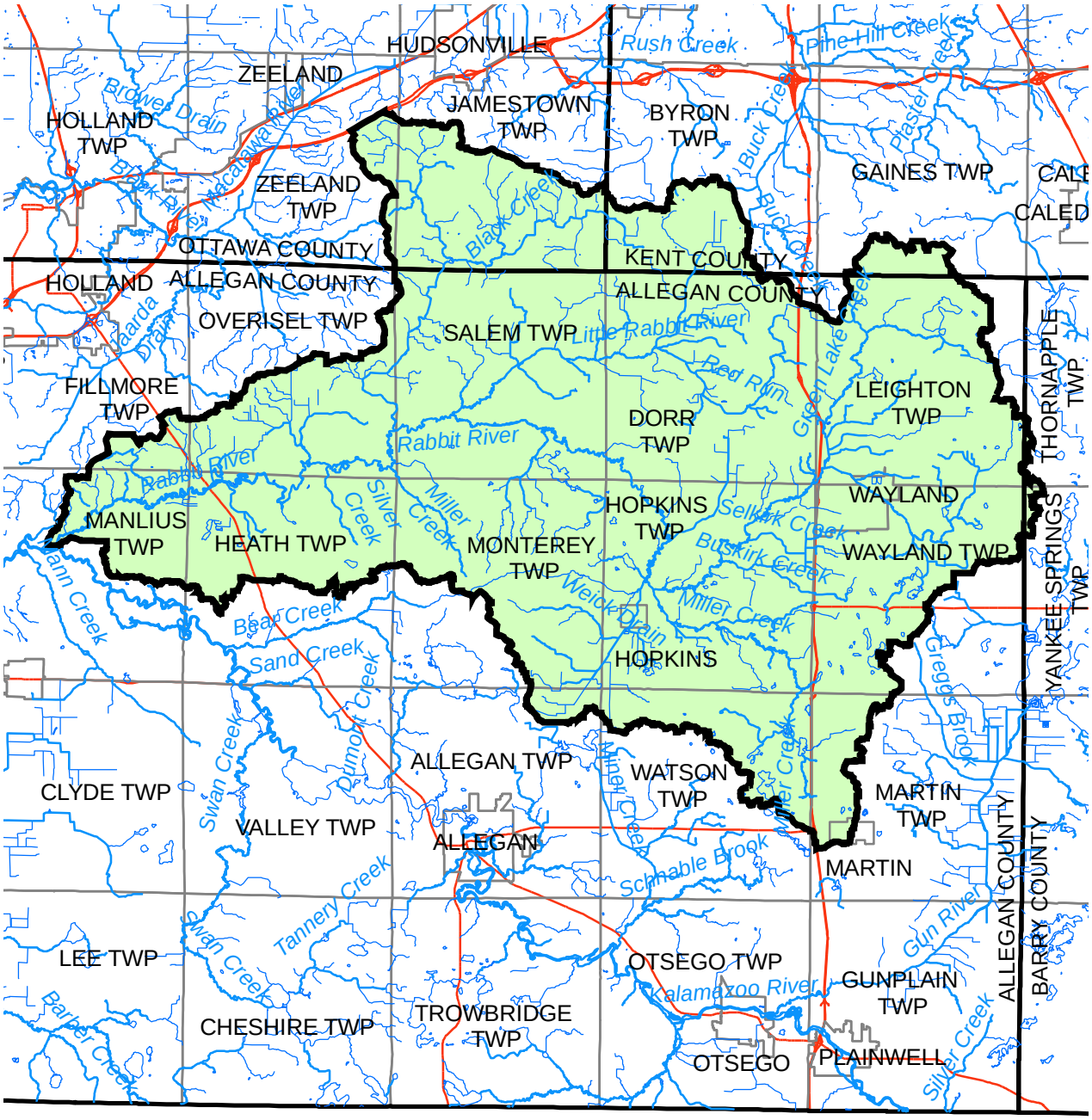
The Committee, composed of representatives from different facets of the Watershed, as identified in Table 1, will make decisions by consensus. If a disagreement persists, the different points of view will be documented in the minutes of the meetings and discussed as necessary at the next meeting to ensure that all members have a clear understanding of all of the viewpoints. Members will be asked to present alternatives to points with which they differ. Meetings will be facilitated by a chairperson and difficult topics that cannot be quickly resolved will be tabled for the next meeting. After additional discussion, if consensus still cannot be reached, the decision will be made through orderly discussions using Robert's Rules of Order. A majority vote will be used if one representative from at least five of the targeted stakeholder groups, listed in Table 1, is present.

ADAPTIVE MANAGEMENT

The PPP includes many mechanisms for engaging the public in the development of the WMP. These mechanisms will be evaluated for their effectiveness by measuring the number and type of participants in the planning process. The planning process covers a relatively short time frame, therefore, the evaluation must occur early in the planning process. Evaluation can be tracked efficiently by the amount of participation in meetings. The public meetings will be important for engaging the general public with the ideas put forth in the WMP.

Exit surveys at the public meetings will ask attendees how they heard about the meeting. The outreach methods that appear to be the most successful in getting the public to the meetings will be emphasized for future public meetings. The exit surveys will also gather information from the attendees about their satisfaction with the planning process and will ask for comments on how the process could be improved. If inadequate public participation occurs, alternative outreach methods will be implemented until a steady and significant participation level is attained.

RABBIT RIVER WATERSHED



NORTH

0 25,000 Feet

LEGEND

- Major Rivers
- Tributaries
- County Boundary
- Communities
- Highways / Roads
- Subwatershed Bounday

DATA SOURCES: BASE MAP , MICHIGAN CENTER FOR GEOGRAPHIC INFORMATION FRAMEWORK V4B. WATERSHED, MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY, DIGITAL SHEDS, 2005

PLOT INFO: D:\WORK\Rabbit River\MAP_DOCUMENT\Rabbit River Watershed.MXD DATE: 04/04/2005 USER: MB2

Fishbeck, Thompson, Carr & Huber
Engineers • Scientists • Architects
GrandRapids, Michigan (616) 575-3824

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Allegan County Drain Commissioner
Allegan County, Michigan

Rabbit River Watershed

PROJECT NO.
PROJECT

FIGURE NO.
1

Figure 2: Timetable for Development of Rabbit River WMP

Organization: Allegan County Drain Commissioner
Project Name: Rabbit River Watershed Implementation Project
Tracking Code: 2005-0143
Period Covered: March 27, 2006 - December 31, 2008

		2006										2007											
		M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
TASK 1:	**UPDATE RABBIT RIVER WMP WITH EPA NINE ELEMENTS**																						
A.	Update and expand information on geographic scope												**D**	**N**	**R**								
B.	Update water quality summary													**D**	**N**	**R**							
C.	Update BMP recommendations													**D**	**N**	**R**							
D.	Review I&E component														**D**	**N**	**R**						
E.	Develop measurable milestones, criteria for revision to WMP, and monitoring component														**D**	**N**	**R**						
F.	Submit final updated WMP to MDEQ																	**X**					
	Ongoing																						
D	- Draft																						
R	- Review																						
F	- Final																						
RC	- Release of Claims Statement																						
X	- Submittal																						

Notes:
BMP - Best Management Practice
I&E - Information and Education
WMP - Watershed Management Plan
MDEQ - Michigan Department of Environmental Quality

RABBIT RIVER WATERSHED STEERING COMMITTEE

Representing	Name	Title	Street	Street 2	City	State	Zip Code
ACD Board of Directors	Mr. Carl Collier		2547 - 127th Avenue		Allegan	MI	49010
Allegan Conservation District	Mr. Shawn McKenney		1668 Lincoln Road (M-40 North)		Allegan	MI	49010
Allegan Conservation District	Ms. Tina Clemons		1668 Lincoln Road (M-40 North)		Allegan	MI	49010
Allegan County Drain Commissioner	Ms. Becky Rininger		113 Chestnut Street		Allegan	MI	49010
Allegan County Parks	Mr. Kevin Ricco		113 Chestnut Street		Allegan	MI	49010
Allegan County Road Commission	Mr. William Nelson		1308 Lincoln Road		Allegan	MI	49010
City of Wayland	Ms. Deborah Naer		103 South Main Street		Wayland	MI	49348
Dorr Township	Mr. Don Kaczanowski	Supervisor	4196 - 18th Street		Dorr	MI	49323
Dorr Township Planning Commission	Mr. Bob Wagner		4196 - 18th Street		Dorr	MI	49323
FTC&H	Ms. Clare Schwartz		1515 Arboretum Drive, SE		Grand Rapids	MI	49546
FTC&H	Ms. Wendy Ogilvie		1515 Arboretum Drive, SE		Grand Rapids	MI	49546
Hopkins Township	Mr. Mark Evans		309 East Main Street		Hopkins	MI	49328
Leighton Township Planning Commission	Mr. Al Zuidema		563 - 145th Avenue		Caledonia	MI	49316
MDEQ	Ms. Janelle Hohm		7953 Adobe Road		Kalamazoo	MI	49009
MDEQ	Ms. Julia Kirkwood		7953 Adobe Road		Kalamazoo	MI	49009
Michigan Department of Natural Resources	Ms. Amy Oliver		2879 - 116th Avenue		Allegan	MI	49010
Michigan State University Extension	Mr. Paul Wylie		3255 - 122nd Avenue		Allegan	MI	49010
Monterey Township	Mr. Chris Reinart	Supervisor	3323 - 30th Street		Hopkins	MI	49328
Penasee Globe	Mr. Scott Sullivan		133 East Superior		Wayland	MI	49348
Resident	Mr. Bob Beck		P.O. Box 181		Hopkins	MI	49328
Resident	Mr. Darwin Franklin		2026 - 132nd Avenue		Hopkins	MI	49328
Salem Township	Mr. Robert Jones	Supervisor	4010 - 30th Street	P.O. Box 103	Burnips	MI	49314
Salem Township Planning Commission	Mr. Jim Byer		3003 - 142nd Avenue		Burnips	MI	49314
South West Michigan Land Conservancy			6851 Sprinkle Road		Portage	MI	49002
	Mr. Bernie Schwartz		2032 - 135th Avenue		Hopkins	MI	49328
	Mr. Bill Wykhuis		313 Academy Street		Allegan	MI	49010
	Mr. Daniel Hooker		2334 138th Avenue		Dorr	MI	49323
	Mr. Ed Hoover		2595 - 5th Street		Shelbyville	MI	49344
	Mr. Jack VanderBaan		447 Falcon Drive		Wayland	MI	49348
	Mr. Mark DeYoung		4169 Hickory Drive		Dorr	MI	49323
	Mr. Randy Marklevitz		416 - 131st Avenue		Wayland	MI	49348
	Mr. Stephen Schulz		3037 - 118th Avenue		Allegan	MI	49010
	Mr. Terry Sturgis		1824 - 10th Street		Martin	MI	49070
	Mr. Terry Weick		134 Goodell Street		Hopkins	MI	49328
	Mr. Tom Tuinstra		1488 - 125th Avenue		Hopkins	MI	49328
	Mr. Wayne Belka		445 133rd Avenue		Wayland	MI	49348
	Ms. Barbara VanGelderen		3134 - 57th Street		Fennville	MI	49408
	Ms. Elizabeth Bieonimi		1743 - 142nd Avenue	P.O. Box 218	Dorr	MI	49323
	Ms. Lisa Battjes		1514 - 135th Avenue		Wayland	MI	49348

Appendix 2

According to the United States Department of Agriculture Natural Resources Conservation Service, the soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A: Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B: Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C: Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D: Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

KEY TO FIGURE 2: GENERAL SOILS OF THE RABBIT RIVER WATERSHED

Hydrologic Code	Soils Series	Slope Range (Percent)	Hydric Area	Description
A	Oakville fine sand	0-45	No	Gently rolling, undulating, fine sand, well drained
A	Thetford loamy fine sand	0-4	Yes	Somewhat poorly drained. Broad depressions. Loamy fine sand.
A	Oakville fine sand	0-6	No	Moderately well drained. Flats and knolls. Dark brown loamy sand.
A	Covert sand	0-4	Yes	Moderately well drained, broad flats, narrow ridgetops. Black-gray sand.
A	Urban land-Oakville	0-6	N/A	Urban land, well-drained Oakville soil. Streets, houses, etc.
B	Ockley Loam	0-30	No	Rolling, well-drained, side slopes, hills, ridges, sandy clay loam
B	Marlette Loam	6-35	No	Hilly and very hilly areas, well-drained, loam, clay loam

Hydrologic Code	Soils Series	Slope Range (Percent)	Hydric Area	Description
B	Brady sandy loam	0-3	Yes	Nearly level, on plains, small depressions and drainageways, somewhat poorly drained. Brown sandy loam.
B	Matherton loam	0-3	Yes	Somewhat poorly drained. Dark gray loam. Permeability rapid.
B	Pipestone Sand	0-4	Yes	Nearly level or undulating, somewhat poorly drained, flats and small depressions. Gray and mottled sand.
B	Metea loamy fine sand	1-12	No	Undulating and gently rolling, well drained. Loamy fine Sand, bands of loamy sand.
B	Tekenink loamy fine sand	2-35	No	Undulating, gently rolling, or very hilly, well drained soil. Slopes, hills, ridges. Dark brown loamy fine sand.
B	Kibbie fine sandy loam	0-3	Yes	Nearly level, somewhat poorly drained. Fine sandy loam, silt loam, silty clay loam.
B	Metamora sandy loam	0-4	Yes	Undulating, slightly convex plains. Somewhat poorly drained. Gray to mottled sandy loam.
B	Tedrow fine sand	0-4	Yes	Somewhat poorly drained, flats, convex areas. Dark fine sand.
B	Seward loamy fine sand	0-6	No	Moderately well drained. Knolls, convex plains, side slopes. Brown loamy fine sand.
B	Riddles loam	0-12	Yes	Well-drained. Undulating to rolling. Loam and clay loam.
B	Morocco fine sand	0-3	Yes	Somewhat poorly drained. Broad flats, depressions. Black fine sand.

Hydrologic Code	Soils Series	Slope Range (Percent)	Hydric Area	Description
B	Algansee loamy sand, protected	0-3		On floodplains, poorly drained, but protected by flooding due to channelization, dredged streams, drains. Black loamy sand.
B/D	Morocco-Newton	0-3	Yes	Nearly level, on plains, depressions, drainageways. Poorly drained, black sand or mucky sand, rapid permeability.
B-A	Oshtemo-Chelsea complex	0-35	No	Rolling, on hills, knolls, ridges, well-drained to excessively drained, loamy sand
B-C	Marlette-Capac loams	0-6	Yes	Moderately well to poorly drained. Plains, knolls, small depressions. Brown loam, clay loam.
C	Glenwood clay loam	0-12	No	Level to undulating. Moderately well drained. Slow permeability
C	Capac Loam	0-6	Yes	Undulating on flats, low ridges or foot slopes. Loam, clay loam and firm clay loam. Permeability slow to moderate.
C	Rimer loamy sand	0-4	Yes	Nearly level, undulating, slightly convex ridges, knolls and short side slopes. Somewhat poorly drained. Dark brown loamy sand.
C	Blount silt loam	0-4	Yes	Nearly level, undulating, convex slopes, depressions, somewhat poorly drained. Gray brown silt loam, and mottled silty clay loam.
C-B	Capac-Wixom	0-4	Yes	Nearly level and undulating, on plains and small depressions, somewhat poorly drained. Sandy to sandy clay loam.
D/A	Glendora loamy sand	Level	Yes	Poorly drained, high water table, rapid permeability

Hydrologic Code	Soils Series	Slope Range (Percent)	Hydric Area	Description
D/A	Houghton Muck	Level	Yes	Black organic (12”), poorly drained
D/A	Adrian Muck	Level	Yes	Black organic (13-32”), poorly drained, ponded
D/A	Palms Muck	Level	Yes	Black organic, (20-24”), poorly drained, run-off slow
D/A	Granby loamy sand	Level	Yes	Poorly drained. Broad flats and depressions. Gray loamy sand, mottled sand.
D/A	Napoleon Muck	Level	Yes	Very poorly drained. Depressions. Brown-black muck.
D/A	Newton mucky fine sand	Level	Yes	Very poorly drained. Broad flats, depressions. Black mucky fine sand. High water table, frequently ponded.
D/A	Glendora loamy sand, protected	Level	Yes	Poorly drained. Floodplains. Protected from flooding by dredged streams or drains. Black loamy sand.
D/B	Brookston loam	Level	Yes	Depressions, frequently ponded. Gray clay loam.
D/B	Sebewa loam	Level	Yes	Poorly drained, low flats, depressions. Black loam, clay loam, Runoff slow, frequently ponded.
D/B	Cohoctah silt loam	Level	Yes	Poorly drained, floodplains and along rivers and streams. Frequently flooded. Dark silt loam. High water table.
D/B	Colwood silt loam	Level	Yes	Poorly drained, flats and depressions, frequently ponded. Dark gray silt loam, fine sandy loam.
D/B	Corunna sandy loam	Level	Yes	Poorly drained, flats and depressions. Frequently ponded. Dark gray sandy loam.
D/B	Belleville loamy sand	Level	Yes	Poorly drained. Low flats and depressions. Black loamy sand.

Hydrologic Code	Soils Series	Slope Range (Percent)	Hydric Area	Description
D/B	Sloan silt loam	Level	Yes	Very poorly drained. Floodplains. Dark silt loam.
D/B	Belleville-Brookston	Level	Yes	Poorly drained. Broad drainageways, depressions. Black loamy sand.
D/B	Martisco Muck	Level	Yes	Poorly drained. Frequently ponded. Black muck.
D/C	Pewamo silt loam	Level	Yes	Poorly drained, drainageways and narrow to broad depressions. Frequently ponded. Dark gray silt loam.
	Pits	N/A	N/A	Open excavations, actively mined, may be ponded
	Aquents, sand and loam	N/A	N/A	Areas that have been filled and leveled. Poorly drained areas.
	Aquents and Histosols	Level	Yes	Marshes and swamps, ponded
	Udipsamments	N/A	N/A	Areas where soil has been removed or mined. Sandy. Well-drained.

Source: Soil Survey of Allegan County, 1987

Appendix 3

Rabbit River Watershed

WETLAND STATUS AND TRENDS

PRESETTLEMENT TO 1978

Department of Environmental Quality

Land and Water Management Division

June 2008

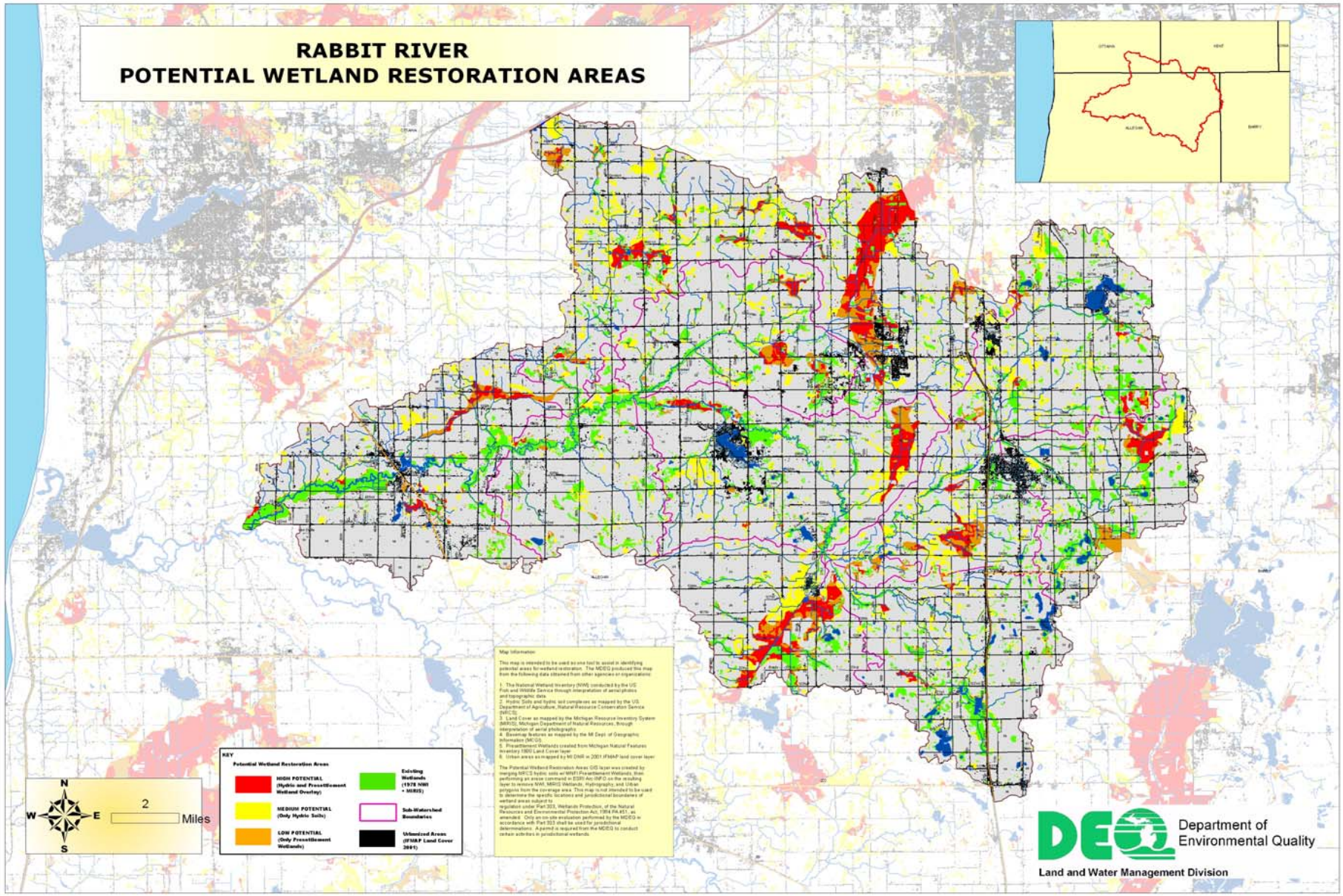
DATA LIMITATIONS AND DISCLAIMER

- Wetland boundaries determined from Aerial Imagery
- Last updated in 1978
- Obvious limitations to Aerial Photo Interpretation:
  - Errors of Omission (forested and drier-end wetlands)
  - Errors of Comission (misinterpretation of aerials)

The 1978 NWI data was used in this analysis to report status and trends, as this is currently the best data source available. However, this data may not accurately reflect current conditions on the ground.

THE MDEQ-Land and Water Mgmt Division has begun a joint project with Ducks Unlimited, Inc. to update the 1978 NWI using 1998 aerial imagery and 2005 aerial imagery. The expected completion date is Summer of 2008, and this data will be used for all future Wetland Status and Trends analysis.

Rabbit River Watershed



Rabbit River Wetland Resources Status and Trends

Pre-settlement Wetland conditions

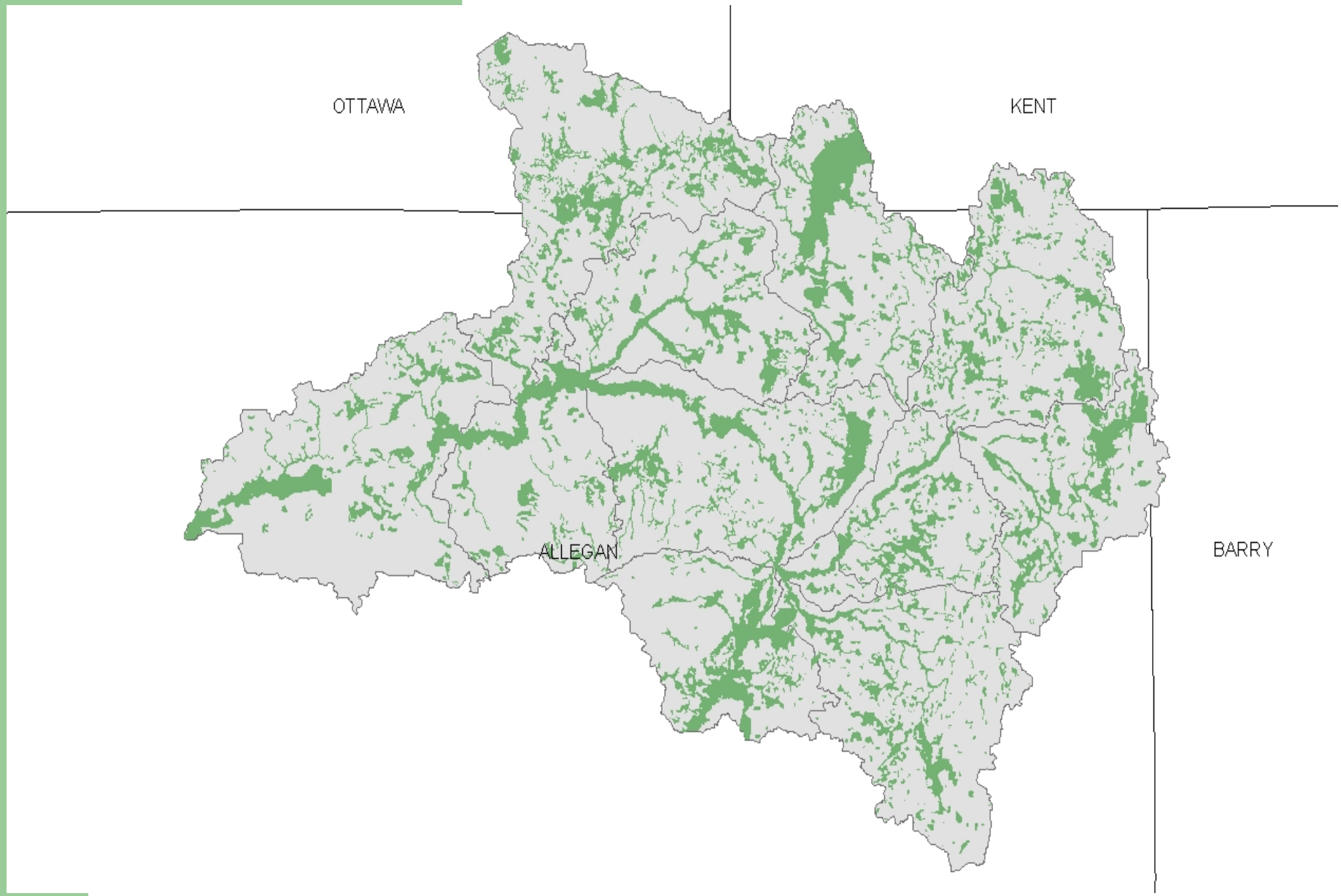
- 37,821 Acres of Wetlands
- 1863 Polygons
- Average Size – 20 Acres

1978 Wetland Condition***

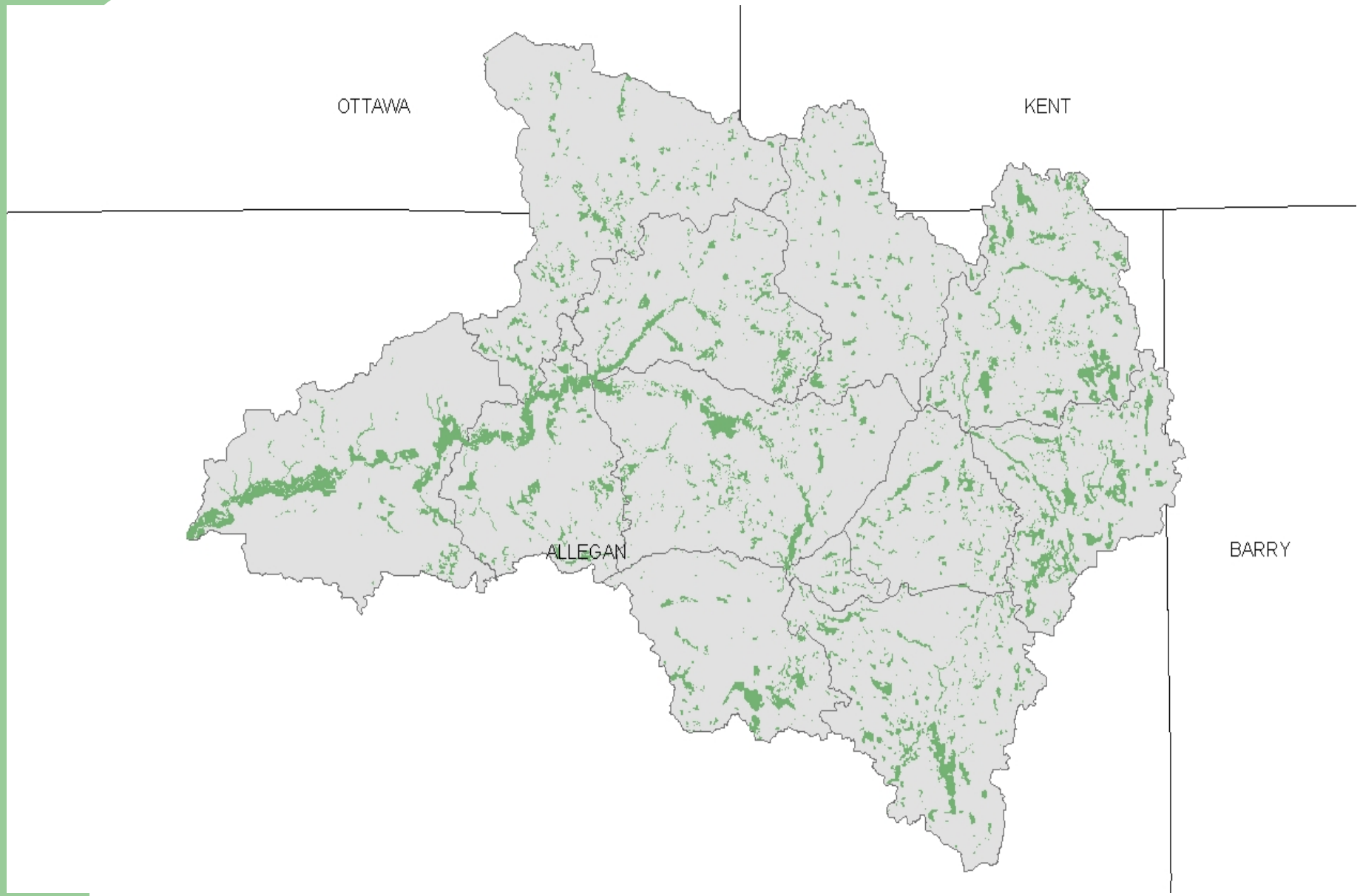
- 16,075 Acres of Wetlands
- 3614 Polygons
- Average Size – 4.5 Acres

42% OF ORIGINAL WETLAND ACREAGE REMAINS
58% LOSS OF TOTAL WETLAND RESOURCE

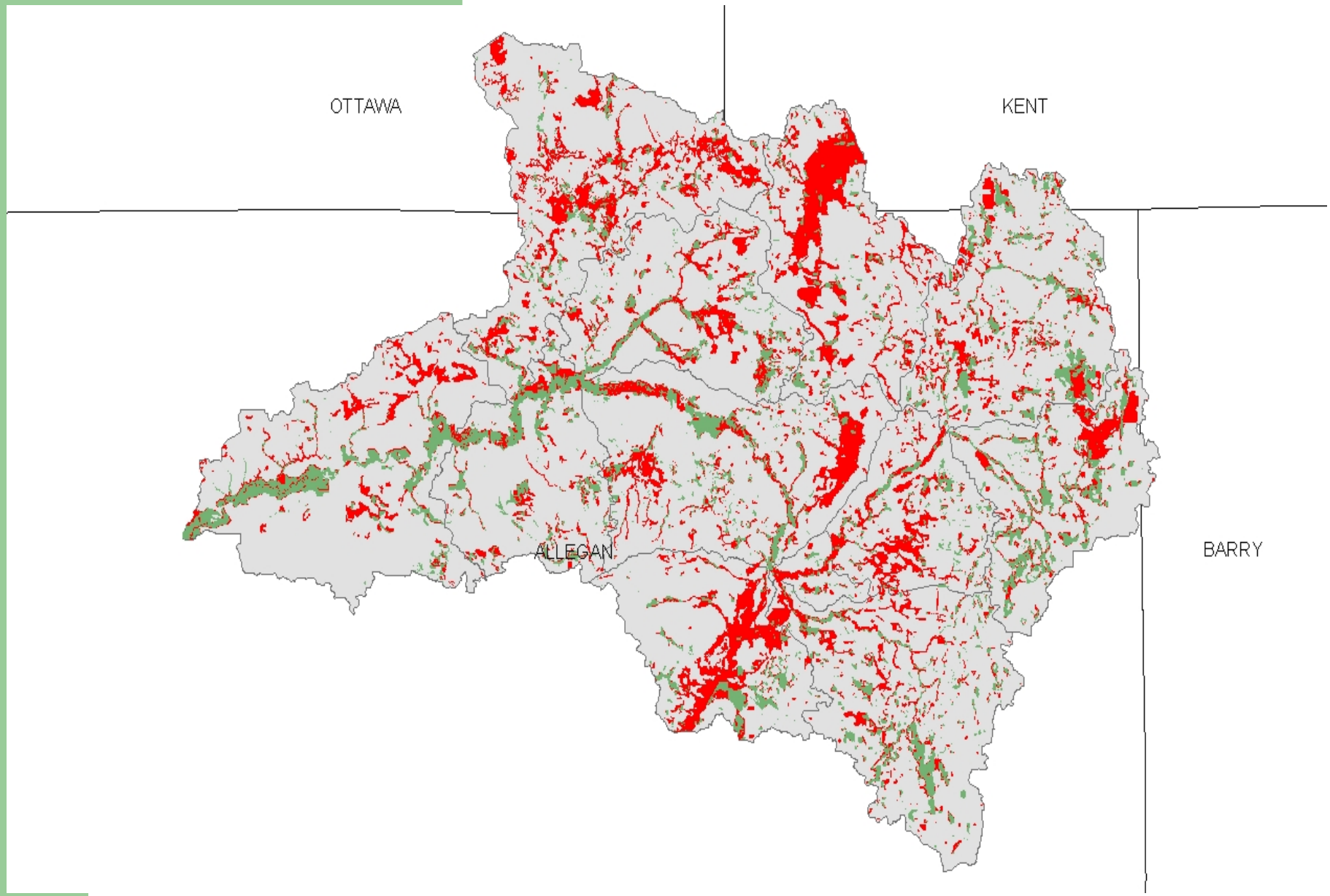
Rabbit River: Pre-Settlement Wetlands



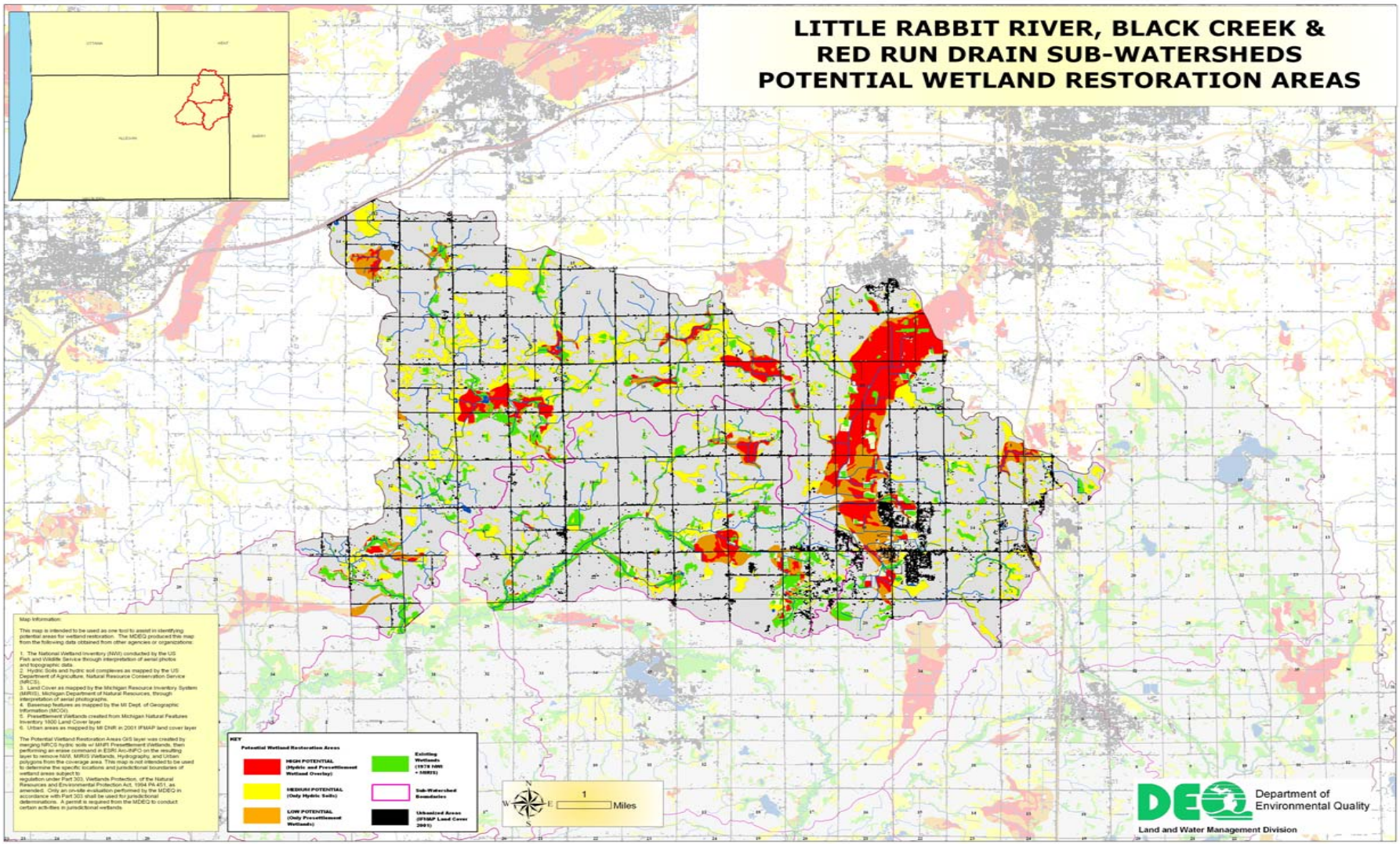
Rabbit River: 1978 Wetlands



Rabbit River: Approximate Areas of Wetland Loss



Little Rabbit River, Black Creek & Red Run Drain Sub-Watersheds



Little Rabbit River, Black Creek & Red Run Drain Sub-Watersheds: Status and Trends

Pre-settlement Wetland conditions

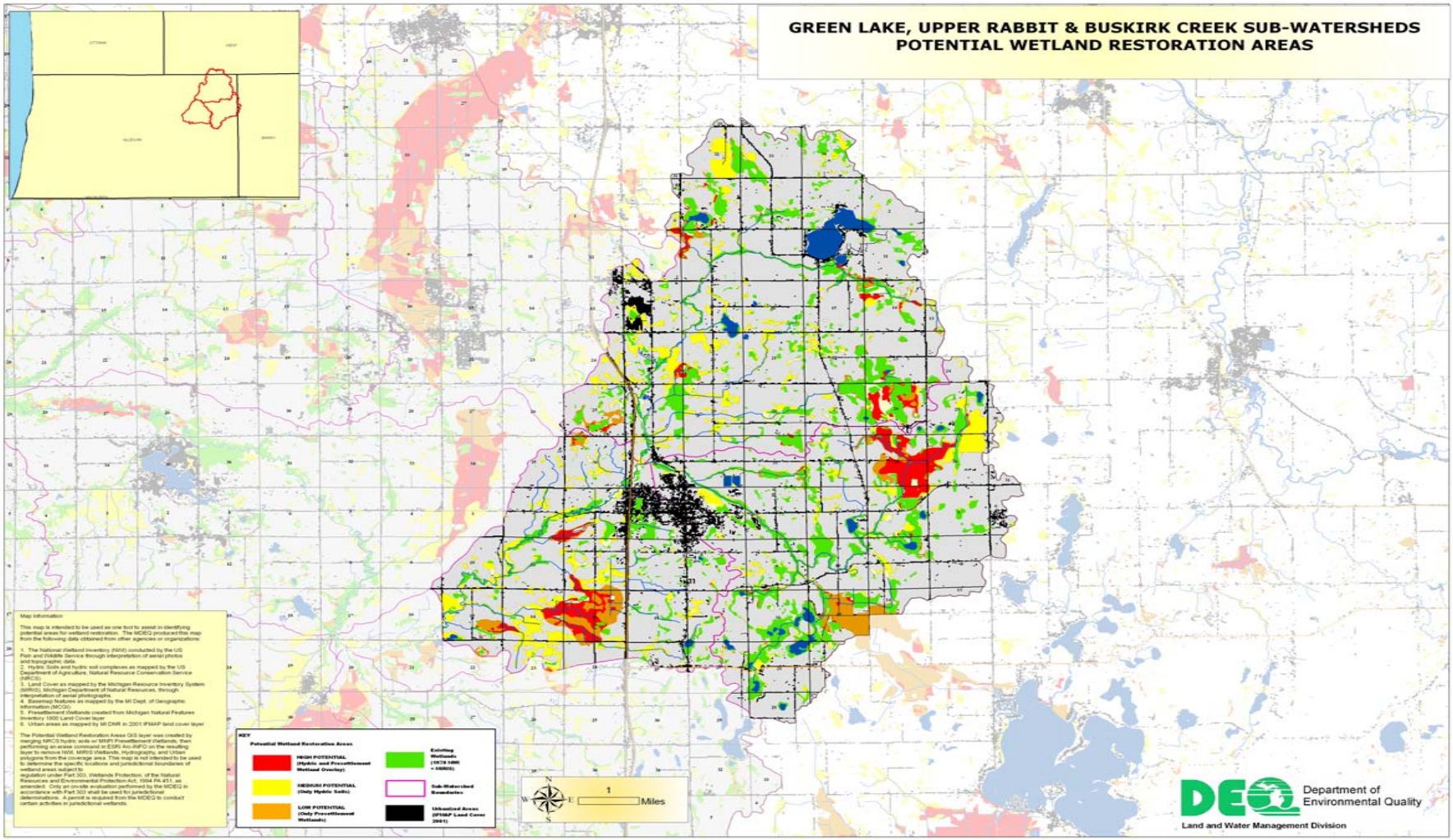
- 11,833 Acres of Wetlands
- 584 Polygons
- Average Size – 20 Acres

1978 Wetland Condition***

- 3,091 Acres of Wetlands
- 995 Polygons
- Average Size – 3.1 Acres

26% OF ORIGINAL WETLAND ACREAGE REMAINS
74% LOSS OF TOTAL WETLAND RESOURCE

Green Lake Creek, Upper Rabbit River & Buskirk Creek Sub-Watersheds



Green Lake Creek, Upper Rabbit River & Buskirk Creek Sub-Watersheds: Status and Trends

Pre-settlement Wetland conditions

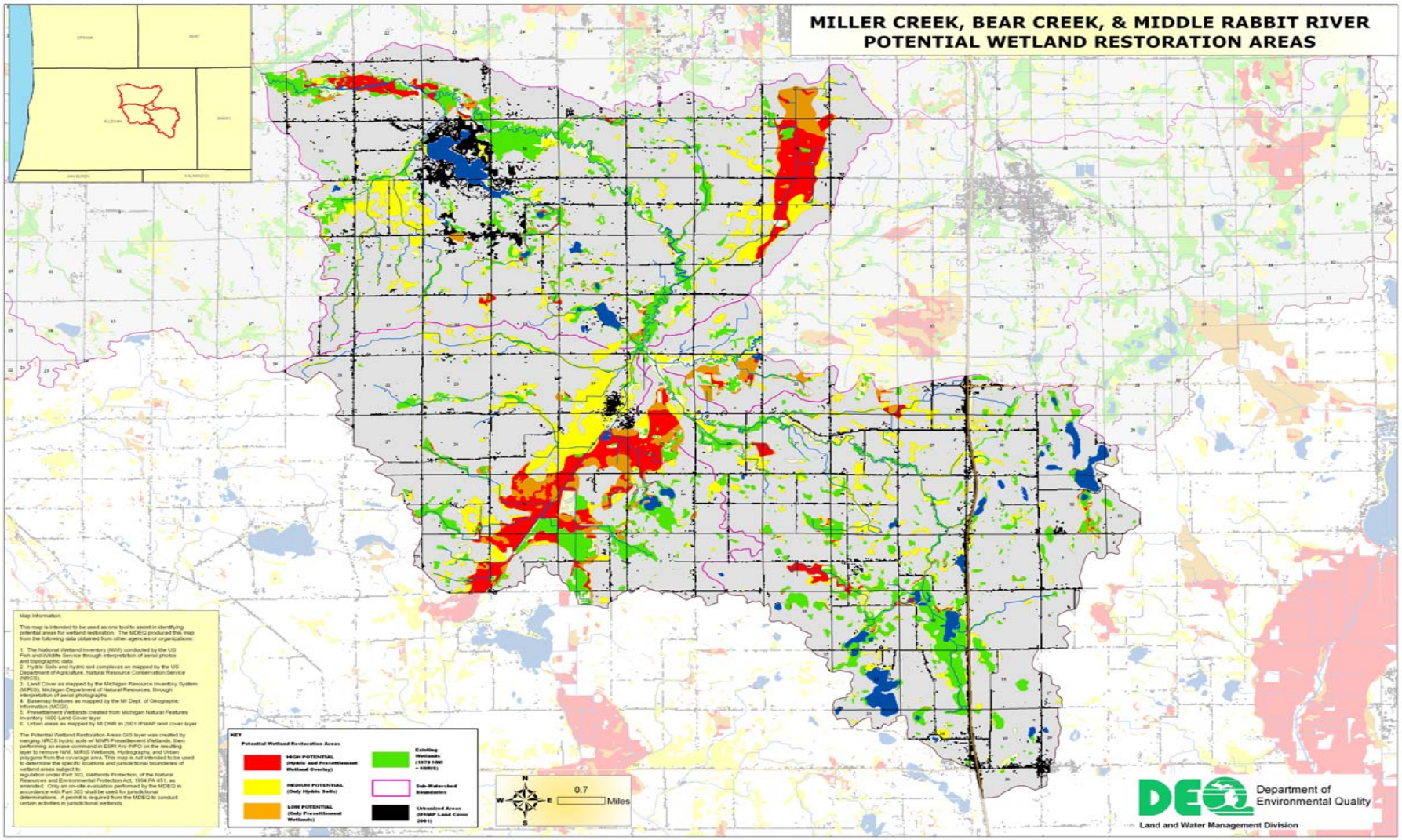
- 8,925 Acres of Wetlands
- 478 Polygons
- Average Size – 19 Acres

1978 Wetland Condition***

- 4,648 Acres of Wetlands
- 1003 Polygons
- Average Size – 4.6 Acres

52% OF ORIGINAL WETLAND ACREAGE REMAINS
48% LOSS OF TOTAL WETLAND RESOURCE

Miller Creek, Bear Creek, & Middle Rabbit River Sub-Watersheds

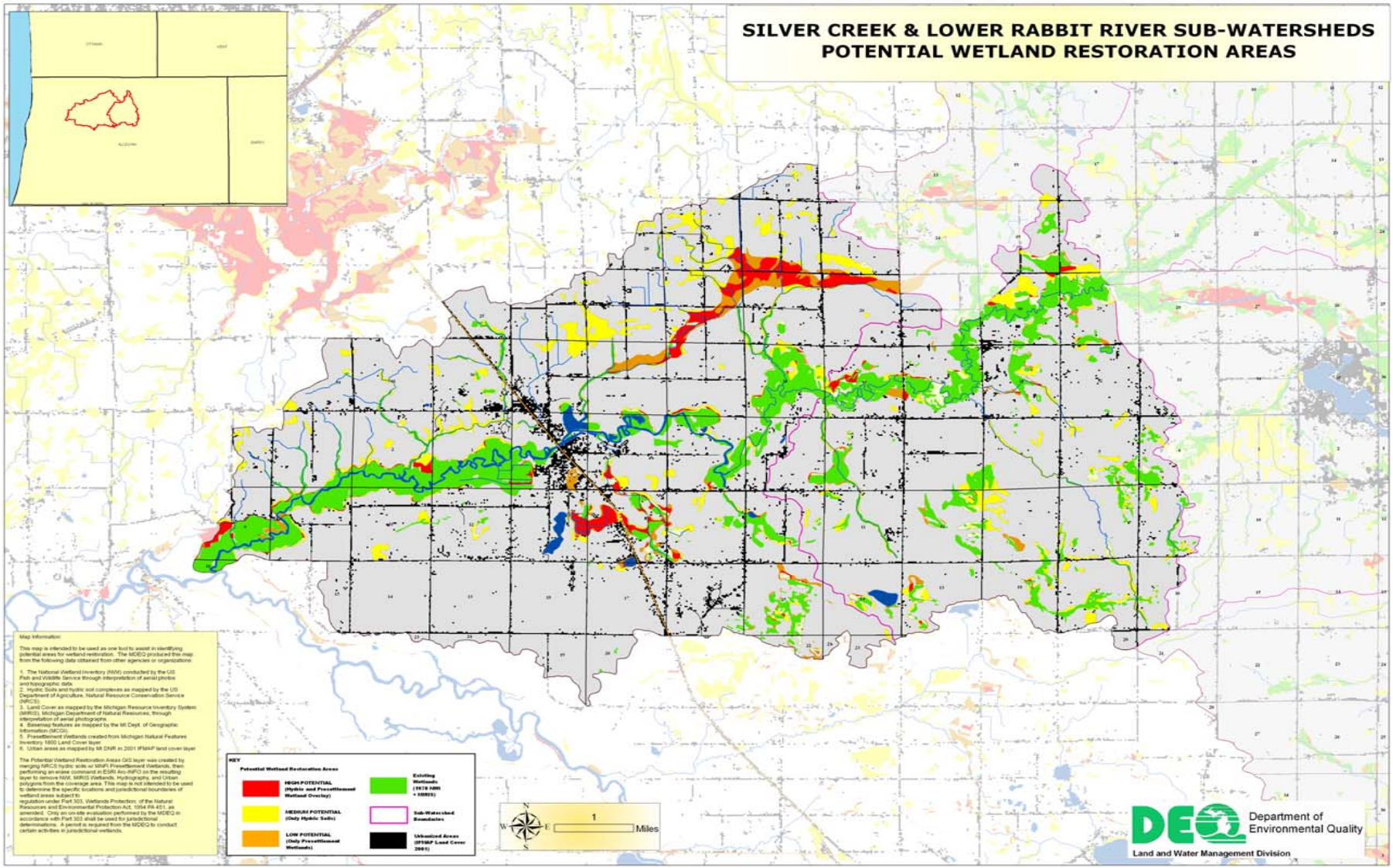


Miller Creek, Bear Creek, & Middle Rabbit River Sub-Watersheds: Status and Trends

Pre-settlement Wetland conditions	1978 Wetland Condition***
• 11,081 Acres of Wetlands	• 4,521 Acres of Wetlands
• 570 Polygons	• 1176 Polygons
• Average Size – 19 Acres	• Average Size – 4 Acres

41% OF ORIGINAL WETLAND ACREAGE REMAINS
59% LOSS OF TOTAL WETLAND RESOURCE

Silver Creek & Lower Rabbit River Sub-Watersheds



Silver Creek & Lower Rabbit River Sub-Watersheds: Status and Trends

Pre-settlement Wetland conditions

- 5,982 Acres of Wetlands
- 250 Polygons
- Average Size – 24 Acres

1978 Wetland Condition***

- 3,808 Acres of Wetlands
- 445Polygons
- Average Size – 9 Acres

64% OF ORIGINAL WETLAND ACREAGE REMAINS
36% LOSS OF TOTAL WETLAND RESOURCE

Appendix 4

Appendix 4: Rare Species Occurrences in the Rabbit River Watershed

Scientific Name	Common Name	Federal State Element	Status	Last Observed	Category	Township	Section	Town	Range
RALLUS ELEGANS	KING RAIL		E	1949-12-04	Animal	Martin	5	02N	11W
PANAX QUINQUEFOLIUS	GINSENG		T	1982-09-04	Plant	Wayland	2	03N	11W
CHAMPION TREE	HACKBERRY (*CELTISOCCIDENTALIS*)			1981-05-30	Other	Wayland	8	03N	11W
SISTRURUS CATENATUS CATENATUS	EASTERN MASSASAUGA RATTLESNAKE	C	SC	1995-08-24	Animal	Wayland	11	03N	11W
TERRAPENE CAROLINA CAROLINA	EASTERN BOX TURTLE		SC	1980-10-01	Animal	Wayland	11	03N	11W
PRAIRIE FEN	ALKALINE SHRUB/HERB FEN, MIDWEST TYPE			1981-08-19	Community	Wayland	11	03N	11W
OECANTHUS LARICIS	TAMARACK TREECRICKET		SC	2000-08-14	Animal	Wayland	11	03N	11W
TRADESCANTIA BRACTEATA	LONG-BRACTED SPIDERWORT		X	1938-06-17	Plant	Wayland	17	03N	11W
SISTRURUS CATENATUS CATENATUS	EASTERN MASSASAUGA RATTLESNAKE	C	SC	1997-07-08	Animal	Hopkins	5	03N	12W
ELEOCHARIS ENGELMANNII	ENGELMANN'S SPIKERUSH		SC	1989-09-26	Plant	Monterey	7	03N	13W
OAK-PINE BARRENS				1989-09-26	Community	Monterey	7	03N	13W
ECHINODORUS TENELLUS	DWARF BURHEAD		E	1989-10-06	Plant	Monterey	7	03N	13W
SCIRPUS HALLII	HALL'S BULRUSH		T	1989-10-06	Plant	Monterey	7	03N	13W
LAKEPLAIN WET-MESICPRAIRIE	ALKALINE TALLGRASS PRAIRIE, MIDWEST TYPE			1989-10-06	Community	Monterey	7	03N	13W
COASTAL PLAIN MARSH	INFERTILE POND/MARSH, GREAT LAKES TYPE			1989-10-06	Community	Monterey	7	03N	13W
ROTALA RAMOSIOR	TOOTH-CUP		SC	1989-09-26	Plant	Monterey	7	03N	13W

ELEOCHARIS TRICOSTATA	THREE-RIBBED SPIKERUSH		T	1989-10-06	Plant	Monterey	7	03N	13W
JUNCUS SCIRPOIDES	SCIRPUS-LIKE RUSH		T	1989-09-26	Plant	Monterey	7	03N	13W
DRY SAND PRAIRIE	DRY SAND PRAIRIE, MIDWEST TYPE			1989-09-29	Community	Monterey	7	03N	13W
GENTIANAPUBERULENTA	DOWNY GENTIAN		E	1990-09-18	Plant	Monterey	7	03N	13W
GREAT BLUE HERON ROOKERY	GREAT BLUE HERON ROOKERY			1983-06-18	Other	Monterey	14	03N	13W
BAPTISIA LACTEA	WHITE OR PRAIRIE FALSE INDIGO		SC	1981-SU	Plant	Monterey	15	03N	13W
PAPAIPEMA MARITIMA	MARITIME SUNFLOWER BORER		SC	1997-09-30	Animal	Monterey	18	03N	13W
LAKEPLAIN WET-MESIC PRAIRIE	ALKALINE TALLGRASS PRAIRIE, MIDWEST TYPE			1989-09-16	Community	Monterey	18	03N	13W
ELEOCHARIS TRICOSTATA	THREE-RIBBED SPIKERUSH		T	1989-10-06	Plant	Monterey	18	03N	13W
JUNCUS SCIRPOIDES	SCIRPUS-LIKE RUSH		T	1989-10-06	Plant	Monterey	18	03N	13W
SISYRINCHIUM ATLANTICUM	ATLANTIC BLUE-EYED-GRASS		T	1989-10-06	Plant	Monterey	18	03N	13W
PAPAIPEMA BEERIANA	BLAZING STAR BORER		SC	1994	Animal	Monterey	18	03N	13W
PAPAIPEMA SCIATA	CULVERS ROOT BORER		SC	1992	Animal	Monterey	18	03N	13W
ARABIS MISSOURIENSIS VAR DEAMII	MISSOURI ROCK-CRESS		SC	1972-05-04	Plant	Heath	9	03N	14W
OAK-PINE BARRENS				1989-09-30	Community	Heath	11	03N	14W
INCISALIA IRUS	FROSTED ELFIN		T	1997-05-22	Animal	Heath	12	03N	14W
FLEXAMIA DELONGI	LEAFHOPPER		SC	1995-08-15	Animal	Heath	12	03N	14W
LAKEPLAIN WET-MESICPRAIRIE	ALKALINE TALLGRASSPRAIRIE, MIDWEST TYPE			1990-10-10	Community	Heath	12	03N	14W
ROTALA RAMOSIOR	TOOTH-CUP		SC	1989-09-26	Plant	Heath	12	03N	14W
POLYGALA CRUCIATA	CROSS-LEAVED MILKWORT		SC	1989-09-26	Plant	Heath	12	03N	14W

RHYNCHOSPORA MACROSTACHYA	TALL BEAK-RUSH		SC	1989-09-26	Plant	Heath	12	03N	14W
RHYNCHOSPORA GLOBULARIS	GLOBE BEAK-RUSH		E	1995-09-26	Plant	Heath	12	03N	14W
ELEOCHARIS TRICOSTATA	THREE-RIBBED SPIKERUSH		T	1989-09-26	Plant	Heath	12	03N	14W
ROTALA RAMOSIOR	TOOTH-CUP		SC	1989-09-26	Plant	Heath	12	03N	14W
COASTAL PLAIN MARSH	INFERTILE POND/MARSH, GREAT LAKES TYPE			1989-09-26	Community	Heath	12	03N	14W
SISYRINCHIUM ATLANTICUM	ATLANTIC BLUE-EYED-GRASS		T	1989-09-26	Plant	Heath	12	03N	14W
PYCNANTHEMUM VERTICILLATUM	WHORLED MOUNTAIN MINT		SC	1989-09-26	Plant	Heath	12	03N	14W
JUNCUS SCIRPOIDES	SCIRPUS-LIKE RUSH		T	1989-09-26	Plant	Heath	12	03N	14W
SCLERIA TRIGLOMERATA	TALL NUT-RUSH		SC	1989-09-26	Plant	Heath	12	03N	14W
RHEXIA MARIANA VARMARIANA	MARYLAND MEADOW BEAUTY		T	1990-08-31	Plant	Heath	12	03N	14W
JUNCUS BRACHYCARPUS	SHORT-FRUITED RUSH		T	1989-09-26	Plant	Heath	12	03N	14W
POTAMOGETON BICUPULATUS	WATER THREAD PONDWEED		T	1989-09-26	Plant	Heath	12	03N	14W
JUNCUS VASEYI	VASEY'S RUSH		T	1989-09-26	Plant	Heath	12	03N	14W
ELEOCHARIS TRICOSTATA	THREE-RIBBED SPIKERUSH		T	1989-09-26	Plant	Heath	12	03N	14W
LECHEA PULCHELLA	LEGGETT'S PINWEED		T	1990-09-18	Plant	Heath	12	03N	14W
RHEXIA VIRGINICA	MEADOW-BEAUTY		SC	1989-09-26	Plant	Heath	12	03N	14W
ELEOCHARIS ENGELMANNII	ENGELMANN'S SPIKERUSH		SC	1989-09-26	Plant	Heath	12	03N	14W
PAPAIPEMA SCIATA	CULVERS ROOT BORER		SC	1995-09-10	Animal	Heath	12	03N	14W
ECHINODORUS TENELLUS	DWARF BURHEAD		E	1989-09-26	Plant	Heath	13	03N	14W
ROTALA RAMOSIOR	TOOTH-CUP		SC	1989-09-26	Plant	Heath	13	03N	14W
ELEOCHARIS	THREE-RIBBED		T	1989-09-09	Plant	Heath	13	03N	14W

TRICOSTATA	SPIKERUSH								
PANICUM LONGIFOLIUM	LONG-LEAVED PANICGRASS		T	1989-09-26	Plant	Heath	13	03N	14W
COASTAL PLAIN MARSH	INFERTILE POND/MARSH, GREAT LAKES TYPE			1989-09-09	Community	Heath	13	03N	14W
LAKEPLAIN WET-MESIC PRAIRIE	ALKALINE TALLGRASS PRAIRIE, MIDWEST TYPE			1989-09-09	Community	Heath	13	03N	14W
RHEXIA MARIANA VARMARIANA	MARYLAND MEADOWBEAUTY		T	1989-09-26	Plant	Heath	13	03N	14W
ELEOCHARIS ENGELMANNII	ENGELMANN'S SPIKERUSH		SC	1989-09-26	Plant	Heath	13	03N	14W
SPOROBOLUSHETE ROLEPIS	PRAIRIE DROPSEED		SC	1989-04-09	Plant	Heath	13	03N	14W
RHEXIA VIRGINICA	MEADOW-BEAUTY		SC	1989-09-26	Plant	Heath	13	03N	14W
ROTALA RAMOSIOR	TOOTH-CUP		SC	1989-09-09	Plant	Heath	13	03N	14W
PANICUM LONGIFOLIUM	LONG-LEAVED PANICGRASS		T	1989-09-26	Plant	Heath	13	03N	14W
COASTAL PLAIN MARSH	INFERTILE POND/MARSH, GREAT LAKES TYPE			1989-09-09	Community	Heath	13	03N	14W
ISOETES ENGELMANNII	APPALACHIAN QUILLWORT		E	1989-09-26	Plant	Heath	13	03N	14W
ELEOCHARIS MELANOCARPA	BLACK-FRUITED SPIKERUSH		SC	1989-09-09	Plant	Heath	13	03N	14W
POTAMOGETON BICUPULATUS	WATER THREAD PONDWEED		T	1989-09-26	Plant	Heath	13	03N	14W
JUNCUS SCIRPOIDES	SCIRPUS-LIKE RUSH		T	1989-09-26	Plant	Heath	13	03N	14W
ELEOCHARIS TRICOSTATA	THREE-RIBBED SPIKERUSH		T	1989-09-09	Plant	Heath	13	03N	14W
COASTAL PLAIN MARSH	INFERTILE POND/MARSH, GREAT LAKES TYPE			1990-09-02	Community	Heath	14	03N	14W
INCISALIA IRUS	FROSTED ELFIN		T	1993-05-21	Animal	Heath	14	03N	14W
POTAMOGETON BICUPULATUS	WATERTHREAD PONDWEED		T	1989-09-09	Plant	Heath	14	03N	14W

COASTAL PLAIN MARSH	INFERTILE POND/MARSH, GREAT LAKES TYPE			1989-09-09	Community	Heath	14	03N	14W
LAKEPLAIN WET-MESIC PRAIRIE	ALKALINE TALLGRASS PRAIRIE, MIDWEST TYPE			1989-09-13	Community	Heath	14	03N	14W
RHYNCHOSPORA MACROSTACHYA	TALL BEAK-RUSH		SC	1989-09-09	Plant	Heath	14	03N	14W
ELEOCHARIS MELANOCARPA	BLACK-FRUITED SPIKERUSH		SC	1989-09-09	Plant	Heath	14	03N	14W
RHEXIA VIRGINICA	MEADOW-BEAUTY		SC	1989-09-09	Plant	Heath	14	03N	14W
ELEOCHARIS TRICOSTATA	THREE-RIBBED SPIKERUSH		T	1989-09-26	Plant	Heath	14	03N	14W
ELEOCHARIS MELANOCARPA	BLACK-FRUITED SPIKERUSH		SC	1989-09-09	Plant	Heath	14	03N	14W
RHEXIA MARIANA VARMARIANA	MARYLAND MEADOW BEAUTY		T	1990-05-01	Plant	Heath	14	03N	14W
COASTAL PLAIN MARSH	INFERTILE POND/MARSH, GREAT LAKES TYPE			1989-09-13	Community	Heath	15	03N	14W
JUNCUS SCIRPOIDES	SCIRPUS-LIKE RUSH		T	1989-09-13	Plant	Heath	15	03N	14W
RHEXIA VIRGINICA	MEADOW-BEAUTY		SC	1980-08-21	Plant	Heath	15	03N	14W
PYCNANTHEMUM VERTICILLATUM	WHORLED MOUNTAINMINT		SC	1989-09-13	Plant	Heath	15	03N	14W
TERRAPENE CAROLINA CAROLINA	EASTERN BOX TURTLE		SC	1995-06-15	Animal	Heath	22	03N	14W
PANICUM LONGIFOLIUM	LONG-LEAVED PANICGRASS		T	1989-09-29	Plant	Heath	22	03N	14W
COASTAL PLAIN MARSH	INFERTILE POND/MARSH, GREAT LAKES TYPE			1989-09-29	Community	Heath	22	03N	14W
ELEOCHARIS TRICOSTATA	THREE-RIBBED SPIKERUSH		T	1989-09-29	Plant	Heath	22	03N	14W
ELEOCHARIS MELANOCARPA	BLACK-FRUITED SPIKERUSH		SC	1989-09-09	Plant	Heath	23	03N	14W
RHEXIA MARIANA VARMARIANA	MARYLAND MEADOWBEAUTY		T	1989-09-09	Plant	Heath	23	03N	14W

RHEXIA VIRGINICA	MEADOW-BEAUTY		SC	1990-08-31	Plant	Heath	23	03N	14W
COASTAL PLAIN MARSH	INFERTILE POND/MARSH, GREAT LAKES TYPE			1989-09-09	Community	Heath	23	03N	14W
SCIRPUS HALLII	HALL'S BULRUSH		T	1989-09-09	Plant	Heath	24	03N	14W
PYCNANTHEMUM VERTICILLATUM	WHORLED MOUNTAINMINT		SC	1989-09-09	Plant	Heath	24	03N	14W
SISYRINCHIUM ATLANTICUM	ATLANTIC BLUE-EYED-GRASS		T	1995-08-22	Plant	Heath	24	03N	14W
SCLERIA TRIGLOMERATA	TALL NUT-RUSH		SC	1989-09-26	Plant	Heath	24	03N	14W
BUTEO LINEATUS	RED-SHOULDERED HAWK		T	2001-05-30	Animal	Heath	24	03N	14W
INCISALIA IRUS	FROSTED ELFIN		T	1984	Animal	Manlius	3	03N	15W
DRY-MESIC SOUTHERN FOREST				1989-07-18	Community	Manlius	14	03N	15W
LYCAEIDES MELISSASAMUELIS	KARNER BLUE	LE	T	1992	Animal	Manlius	14	03N	15W
BUTEO LINEATUS	RED-SHOULDERED HAWK		T	2000-05-01	Animal	Manlius	23	03N	15W
HALIAEETUSLEUCO CEPHALUS	BALD EAGLE	PS	T	1998	Animal	Manlius	24	03N	15W
SISTRURUS CATENATUS CATENATUS	EASTERN MASSASAUGA RATTLESNAKE	C	SC	1995-06-29	Animal	Dorr	20	04N	12W
NOTROPIS TEXANUS	WEED SHINER		X	1939-09-23	Animal	Overisel	25	04N	14W
HELIANTHUS HIRSUTUS	WHISKERED SUNFLOWER		SC	1894-08-21	Plant	Overisel	31	04N	14W
CLEMMYS INSCULPTA	WOOD TURTLE		SC	1975-09	Animal	Overisel	36	04N	14W
BOG				1991-08-15	Community	Gaines	33	05N	11W
MERTENSIA VIRGINICA	VIRGINIA BLUEBELLS		T	1889-05-07	Plant	Byron	26	05N	12W
GYMNOCLADUS DIOICUS	KENTUCKY COFFEETREE		SC	1889-07-10	Plant	Byron	26	05N	12W
MERTENSIA VIRGINICA	VIRGINIA BLUEBELLS		T	1901	Plant	Byron	36	05N	12W

SOURCE: Data Guidelines: (Source: Michigan Natural Features Inventory (MNFI)) These data are a list of Element Michigan Natural Features Inventory Occurrences (EO) at the section level. The sections contain the centroid of the EO. In some cases, the P.O. Box 30444extent of an animal's range or a community type may extend past the section containing the centroid. Lansing, MI 48909-7944 These data represent the best available information regarding elements tracked by MNFI. This list, PH: (517) 373-1552 however, is not a definitive statement on the presence, absence, or condition of the natural features in FAX: (517) 373-9566 any given locality. Plant and animal populations and natural communities change with time. Also, not every site has been specifically surveyed. Therefore, the information provided should not be regarded as a complete statement on the occurrence of special natural features of the area in question. The recipient(s) of the data understand that state endangered and threatened species are protected under state law (Act 451 of 1994, the Natural Resources and Environmental Protection Act, Part 365, Endangered Species Protection). Any questions, observations, new findings, violations or clearance of project activities should be conducted with the Michigan Department of Natural Resources, Wildlife Division. Contact Lori Sargent or Pat Lederle at (517) 373-1263. The recipient(s) of the data understand that federally endangered and threatened species are protected under federal law (Endangered Species Act of 1973). Any questions, observations, new findings, violations or clearance of project activities should be conducted with the U.S. Fish and Wildlife Service in East Lansing. Their phone number is (517) 351-2555. Recipients of the data are responsible for ensuring the protection of protected species and obtaining proper clearance before project activities begin. For questions about MNFI and the data, contact Ed Schools, MNFI, (517) 373-0798, or schoolse@michigan.gov.

These data are used to guide conservation and land management activities. Some of the data records are historical. While these data may not be important for regulatory purposes, they are important for management and restoration purposes and for scientific use. The following codes are used for the Federal and State status:

Federal Status:

C = Candidate - species being considered for federal status
LE = Listed endangered
LT = Listed threatened
LELT = Listed endangered in part of the range, threatened in a different part.
PE = Proposed endangered
PT = Proposed threatened
PS = Partial status - status in only a portion of the range

State status:

E = Endangered (Legally protected)
T = Threatened (Legally protected)
SC = Special Concern (Rare or status uncertain; not legally protected)
X = Presumed extirpated (Legally threatened if rediscovered)

Appendix 5

RABBIT RIVER WATERSHED

HYDROLOGIC STUDY

PREPARED FOR:
ALLEGAN COUNTY DRAIN COMMISSIONER
AND
MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

JANUARY 2008
PROJECT NO. G06302

MDEQ TRACKING CODE: 2005 - 0143

Fishbeck, Thompson, Carr & Huber, Inc. Engineers • Scientists • Architects • Constructors
1515 Arboretum Drive, SE, Grand Rapids, MI 49546 Telephone: 616-575-3824

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LIST OF ACRONYMS/ABBREVIATIONS

ac	acre
ac-ft	acre-feet
BMPs	Best Management Practices
cfs	cubic feet per second
cfs/acre	cubic feet per second per acre
CN	Natural Resources Conservation Service curve number
ft	feet
GIS	Geographic Information System
HSG	Hydrologic Soil Group
in	inches
LID	Low Impact Development
MDEQ	Michigan Department of Environmental Quality
mi^2	square miles
min	minutes
USGS	U.S. Geological Survey

INTRODUCTION

The purpose of this hydrologic study is to evaluate the impact of future development on the stability of the Rabbit River and to suggest ways in which future development can occur without degrading the Rabbit River.

The entire Rabbit River Watershed is shown in Figure 1. The focus of the study is the eastern Rabbit River Watershed, defined as those areas upstream of 135th Avenue, located in Section 5 of Hopkins Township. The contributing drainage area at 135th Avenue is approximately 125 square miles.

Allegan County Land Information Services (ACLIS) provided the 1996 land use and zoning map layers used to determine the level of build-out. At present, 8% of this drainage area is developed. For the purpose of this study, *developed* is defined as land uses consisting of residential (mid to high density), commercial, industrial, institutional, cemeteries, utilities, and transportation corridors. *Undeveloped* land is defined as natural areas (woods, meadow, water, and wetland), agricultural land use (working farms and ranches), and recreational land uses (golf course, campgrounds, and parks). Undeveloped land includes both land that has not been developed yet, but is zoned for development, and land zoned for preservation of natural areas, agricultural, and recreational uses. Of the 92% (114 square miles) that is currently undeveloped, almost 15 square miles are zoned for development purposes. When these developable areas are fully developed, the eastern Rabbit River Watershed will reach 20% development. Figure 2 shows a map of the eastern Rabbit River Watershed. The areas shaded in red are those currently undeveloped, but zoned for development purposes. These areas fall into one of three categories: areas surrounding Wayland, areas surrounding Green Lake, and the US-131 corridor. In the remainder of this report, these areas will be referred to as “developing.”

The fundamental nature of flow in streams relates to the equilibrium between sediment load and particle size, channel slope, and channel discharge. When a stream is stable, it consistently transports its sediment load without erosion or deposition. When a stream is unstable, there is a scouring process that leads to degradation, or there is excessive sediment deposition causing aggradation. The basic relationship for any stream, including the Rabbit River, is expressed in the following equation:

$$(\text{Sediment Load}) \times (\text{Sediment Size}) \propto (\text{Stream Slope}) \times (\text{Stream Discharge})$$

The left side of the equation must always balance the right side. So an increase in discharge may cause the channel to attempt to decrease its slope to restore balance. This may be done by increased channel meandering and lateral bank erosion with deposition of sediment in downstream reaches. An increase in discharge also has the effect of increasing the sediment-carrying capacity and the ability of the river to carry larger size particles.

Development in a watershed produces larger runoff volumes that, if not adequately controlled, result in higher peak stream discharges and subsequently higher stream velocities. Erosion occurs when stream velocities are high enough to start moving soil particles on the stream bank. The stability of the stream can be quantified by identifying the total amount of erosion that occurs during a particular storm event. This total erosion is a function of both the magnitude and duration (time) of erosive stream velocities. Existing storm water detention policies are designed to reduce the magnitude of the peak discharge (and velocity) but, in doing so, they also increase the duration of higher than normal flows. The net effect may still be excessive stream bank erosion and stream instability. The ultimate goal of this study is to determine a set of rules to be applied to all future developments that best protect the stream bank by reducing the impact of erosive velocities. The effect of this criteria on major flood events was also evaluated.

ANALYSIS

A hydrologic model of the upper Rabbit River Watershed was created to help determine the impact of future development. The computer program used was HEC-HMS, developed by the U.S. Army Corps of Engineers. This program is able to predict the river discharge in response to storm events. GIS software techniques were used to determine the model parameters. These techniques are summarized in the sections below.

EXISTING CONDITION

The HEC-HMS software was first used to model existing conditions. The various steps in model development are summarized below.

- The 125-square-mile watershed was subdivided into 32 sub-watersheds varying in size from 0.4 to 20 square miles. The larger sub-watersheds are in areas with little future development, and the smaller basins are in areas that have a great potential for future development. The stream reaches required to collect the flow from all 32 sub-watersheds were also identified. The sub-watersheds and connecting stream reaches are shown in Figure 2.

- The HEC-HMS model schematic was developed based on the identified sub-watershed and stream reach configuration. This is shown in Figure 3.

- The Natural Resources Conservation Service CN was computed for each sub-watershed by using GIS software to identify all combinations of land cover and soil type within a sub-watershed. The land cover data is from the National Land Cover Dataset 2001, and the soils data is from the Soil Survey Geographic Database. Each land use/hydrologic soil group combination was then associated with a CN value, and a weighted average was then computed for all sub-watersheds.

- Flow paths within each sub-watershed were identified in GIS using a topographic map background. These flow paths were then split into sheet flow, waterway, and small tributary sections as defined in the MDEQ document, *Computing Flood Discharges for Small Ungaged Watersheds* (Sorrell, 2003). Lengths and slopes of each section were identified using GIS software, along with Digital Elevation Model data. Flow times were computed for each path based on the methods in *Computing Flood Discharges for Small Ungaged Watersheds* (Sorrell, 2003). These times were added, resulting in a calculation of the time of concentration for each sub-watershed.

- The HEC-HMS model uses a Clark Unit Hydrograph to calculate a hydrograph for each sub-watershed. The Clark method uses a storage coefficient to model the impact of ponding within the watershed. If there is no storage, then the storage coefficient has the same value as the time of concentration. GIS-based wetlands maps were used to identify the percentage of ponding within each

sub-watershed. This value was then used to select a ponding adjustment factor (Sorrell, 2003) for a two-year storm frequency. A storage coefficient value was then selected that reduced the peak (two-year) discharge by this amount. The area, CN, time of concentration, and storage coefficient for each sub-watershed are listed in Table 1. The sub-watershed names are based on the Rabbit River branch names (BS for Bear Swamp, GL for Green Lake, MC for Miller Creek, LR for lower Rabbit, MR for middle Rabbit, and UR for upper Rabbit).

- The lag method was used to route the flood hydrograph along the stream reaches. This required a lag time for each reach. The lag time was based on reach length and slope, as computed with the GIS software. The formula for small tributary velocities in *Computing Flood Discharges for Small Ungaged Watersheds* (Sorrell, 2003) was used to calculate the lag time.

- Several storm events were used to check the model's validity and to perform model calibration. The storm events included real storms from April 1972, 1975, and 1993, as well as a hypothetical two-year storm. The three April storms were selected because they were all close to a two-year frequency return interval, they did not include runoff from frozen ground, and both rainfall and stream flow data were available for each event. The stream flow data comes from the USGS gage at 18th Street, located in Section 16 of Hopkins Township. Modeled and measured peak discharges at 18th Street were compared for each of the three April storms. The modeled peak discharge for the two-year hypothetical storm was compared to the two-year peak discharge at the gaging station (based on flood frequency analysis). Finally, the two-year peak discharge at 135th Avenue was compared to MDEQ estimates of the two-year flood at the same location. Calibration of the model involved a uniform reduction in the stream reach lag times, until a weighted mean squared prediction error was minimized. Table 2 gives the calibrated lag times for each reach.

FULL DEVELOPMENT WITHOUT STREAMBANK PROTECTION

The existing condition model was next used as the starting point for a full development model. This model assumes full build-out of all developing areas (i.e., those that are currently undeveloped, but zoned for developed uses). Redevelopment was not considered. Current zoning was selected as the basis of the full build-out scenario to illustrate the potential development impacts under present zoning guidelines, with the understanding that further projections made in future land use plans would only serve to magnify the effects. The first step was to use the GIS data to identify the portion of each sub-watershed that was undeveloped (and zoned to stay undeveloped), recently developed (excluding "old" development in the City of Wayland), or developing (undeveloped, but zoned for development). The HEC-HMS watershed elements (pictured in Figure 3) either remained as-is, were split into two elements, or were split into three elements, depending on the amount of recently developed or developing area within the sub-watershed. A piece of the sub-watershed was split off for recently developed land if the sub-watershed was more than 10% developed. A piece of the sub-watershed was split off for developing land if the sub-watershed

was more than 15% developing. GIS data was used to calculate the CN for the undeveloped and recently developed portion of each sub-watershed. The developing areas were assumed to be 72% impervious (as a conservative average of all residential, commercial, and industrial land use types). Table 3 shows the parameters for the sub-watershed in the full development model. The time of concentration and storage coefficient for the split off sub-watersheds remained the same as the parent sub-watershed.

FULL DEVELOPMENT WITH EXISTING DETENTION RULES

Current development rules for stream bank protection require that detention basin release rates be limited to 0.05 cubic foot per second (cfs) per impervious acre for a two-year rainfall event. To model this condition, reservoir elements were added to the outlet of the developing sub-watershed elements in the HEC-HMS model. To simplify the modeling, the reservoirs were assumed to have vertical sides and reach peak discharge at a depth of 3 feet. The orifice area could then be calculated directly for each sub-watershed. A two-year storm event was then modeled, and the reservoir areas were iteratively adjusted until the peak reservoir depth just reached 3 feet. The resulting detention pond parameters are shown in Table 4.

FULL DEVELOPMENT WITH LID-BASED RETENTION

Low Impact Development (LID) is a comprehensive land planning and engineering design approach with a goal of maintaining and enhancing the pre-development hydrologic regime of urban and developing watersheds. For the purpose of this study and subsequent hydrologic modeling, the approach described in the document, *Low-Impact Development Hydrologic Analysis* (Prince George's County Maryland, 2000), was followed.

The target for LID-based storm water management is to develop a site in which the post-development hydrology is nearly identical to pre-development hydrology for a particular design storm. In the state of Maryland, this approach is taken even further in that the pre-development hydrology is interpreted to be pre-settlement hydrology. Creating a post-development hydrology to mimic pre-settlement hydrology requires both controlled runoff volume and peak discharge. To effect this, the following must be done:

- The development should be designed to minimize any increase in runoff CN. This can be accomplished by preserving as much undisturbed area as possible, by minimizing the amount of impervious surface, and by implementing best management practices (BMPs) that compensate for hydrologic alterations.

- The development should be designed to maintain the existing time-of-concentration. This is one of the best ways to control peak discharge rates. Time-of-concentration is controlled by increasing the flow resistance at the upper ends of the watershed, by increasing the flow path length to the outlet, by

reducing the number of direct connections from impervious surfaces to the outlet, and by decreasing flow path slope.

- The development needs retention and/or detention storage to further compensate for changes to the site hydrology. Retention storage (no outlet) is preferred and is, therefore, the first choice, because it best mimics the pre-development (or pre-settlement) rainfall abstraction.

Once the site is designed with minimal CN increase and no change in the time-of-concentration, the retention/detention storage volumes must be calculated. This involves several steps. The first step is to determine the amount of retention storage required to keep the post-development runoff volume equal to the pre-settlement runoff volume. This is shown for a hypothetical case in Figure 4. This figure compares the pre-settlement hydrograph to the post-development hydrograph for a case where there is no retention or detention storage and where the time-of-concentration has been maintained. Since the area under a hydrograph is simply water volume, the area between the hydrographs (shown with shading in the figure) is the amount of retention storage needed for runoff volume control. Retaining this amount of rainfall simply means that the receiving water bodies will see the same volume of water discharged before and after development (for a particular design rainfall event). If the Maryland standards of pre-settlement conditions are applied, then the receiving water bodies will receive less runoff volume after development has occurred.

The second step is to determine the amount of retention storage required to keep the post-development peak discharge equal to the existing or, better yet, the pre-settlement peak discharge. This is shown graphically in Figure 5. This figure also shows how the watershed actually responds to retention storage. Retention storage will accept all of the runoff until its volume is full. After the storage volume is filled, all the remaining runoff discharges from the watershed. In Figure 5, the peak pre-settlement discharge is 10 cfs. By retaining the shaded volume, water is not discharged until the magnitude is at the desired level. This results in a post-development hydrograph (Figure 5), which mimics the pre-settlement hydrograph shown in Figure 4.

If the runoff control volume (shown in Figure 4) is greater than the peak discharge control volume (shown in Figure 5), then both runoff and peak discharge control can be accomplished by implementing runoff control volume. If runoff control volume is less than peak discharge control volume, then a combination of retention and detention can be implemented to provide both types of control. In many cases, these two volumes will be of similar size.

In all of the previous discussion, the goal is to match pre-settlement hydrology with post-development hydrology for a particular rainfall event. Since runoff volumes increase with precipitation depth, the choice of rainfall event is important. Our hydrologic models divide the precipitation into “hydrologic loss” and “rainfall excess.” The rainfall excess is that part of the precipitation that becomes runoff. The hydrologic

loss is the remainder. It includes abstractions (surface depression, vegetative surface, etc.) and infiltration. The retention volume designed for a particular development is intended to make up for the reduction in hydrologic loss that has occurred between pre-settlement and post-development states. The initial abstraction is that part of the hydrologic loss that occurs before any runoff has started. Using the CN approach, it is usually computed (in inches over the watershed) as:

$$I_a = 0.2\left(\frac{1000}{CN} - 10\right)$$

If the precipitation depth is less than the initial abstraction, the models will predict no runoff volume. The design rainfall depths should, therefore, be greater than the initial abstraction. The State of Maryland uses a design rainfall that is based on 1.5 times the initial abstraction, assuming the land use is "woods in good condition." These values are shown in column 3 of Table 5 for the four hydrologic soil groups. It can be seen that sandier soils (types A and B) require larger design storms and, therefore, larger retention volumes, because in the pre-settlement state, virtually nothing ran off. With heavier soils (types C and D), less hydrologic loss volume needs to be designed, since less loss occurred in the pre-settlement case. Limits need to be applied to these design rainfall depths. At the low end (types C and D soils), the design precipitation depth is less than the 1-year rainfall depth (1.95 inches in Allegan County). Control of the 1-year event is necessary to maintain stream stability. The Maryland standards use the 1-year, 24-hour event as the minimum design storm depth. At the upper end, a design depth of 9 inches is just not practical. This should be limited to the 100-year, 24-hour depth of 6.15 inches. The resulting design rainfall depths are shown in column 5 of Table 5.

The HEC-HMS hydrologic model for the Rabbit River was modified to model the effect of LID-based design. The steps taken were the following.

- LID BMPs are designed to decrease the amount of impervious surface throughout the development, to maintain existing times-of-concentration, and to reduce direct connections of impervious surfaces to the outlet. To model these LID practices, the percent impervious was assumed to be 60%, instead of 72% (as used in the full development model). Furthermore, it was assumed that only 50% of the impervious surfaces are directly connected to the outlet. This resulted in adjustments to the CNs. As a result, the CNs for developing sub-watersheds in HSG C areas were reduced from 91 to 85. CNs for developing sub-watersheds in HSG B areas were reduced from 88 to 78. The net result was that the post-development CNs were only slightly higher than the pre-development CNs.

- The detention basin reservoir elements (in the developing sub-watersheds) were replaced with diversion elements. The diversion element diverts all of the discharge, until a volume limit is reached. After the volume limit is reached, all of the discharge is released.

- The required retention volumes were computed for the developing sub-watersheds. The first method used was based on controlling the runoff volume (as explained above). This is computed as the post-development runoff volume minus the pre-settlement runoff volume. This is calculated as:

$$V = \frac{\left(P - .2\left(\frac{1000}{CN_{LID}} - 10\right)\right)^2}{P + .8\left(\frac{1000}{CN_{LID}} - 10\right)} - \frac{\left(P - .2\left(\frac{1000}{CN_{PRE}} - 10\right)\right)^2}{P + .8\left(\frac{1000}{CN_{PRE}} - 10\right)}$$

  where CN_{PRE} is the pre-settlement CN (woods in good condition), CN_{LID} is the post-development CN with LID assumptions listed above, and P is the design precipitation depth. The retention volume is computed in units of inches over the watershed. The results for each of the developing sub-watershed elements in the HEC-HMS model are given in column 7 of Table 6.

Next, the retention volume for discharge control was calculated. The initial calculation was based on a method outlined in *Low Impact Development Hydrologic Analysis* (Prince George's County Maryland, 2000). The computed values are shown in column 8 of Table 6. These values were also iteratively verified by HEC-HMS modeling. Modeling indicates they may be about 10% too low. Since columns 7 and 8 are nearly identical, modeling was based on the volumes in column 7, which is an easier calculation.

RESULTS

COMPARISON OF STREAM PROTECTION METHODS

Figures 6 and 7 show some of the results from the hydrologic models. Both figures show hydrographs for the Rabbit River, near 135th Street. This location was selected because river cross-section data was available from a previous project on the Bear Swamp Drain, when this section of the river was surveyed by FTC&H in 2005. Each figure shows the existing, fully developed without detention, fully developed with 0.05 cfs per impervious acre detention release rate, and LID-based retention. For comparison purposes, the pre-settlement hydrograph is also shown. The pre-settlement hydrograph is based on the entire watershed being wooded. Figure 6 shows the results from a 1-year rainfall and Figure 7 shows the results from a 2-year rainfall. In both cases, the peak discharge and duration of high discharge values are increased for the fully developed case. The detained hydrograph shows a lower peak discharge, but since runoff volumes are detained and not retained, there is a longer duration of high discharges. The LID approach not only reduces the peak discharge, but it also reduces the duration of high discharges. To properly compare the impact that different development rules will have on the river, a measure is needed of the potential erosive impact of both high discharges and long flood durations. One way to achieve this is by using a work index approach.

The work index is a measure of the work done by bank shear stresses during periods of high flow. The bank shear stress can be computed as $\tau = \gamma d s_o$ where γ is the unit weight of water, *d* is the depth of flow, and s_o is the stream bed slope. Streambank erosion begins when the shear stress exceeds some critical value, τ_c, often referred to as the critical shear stress for bed mobility. The erosive power for per unit area of stream bank is $P = (\tau - \tau_c)V$, where V is the stream velocity. The erosive work is the erosive power integrated over the duration of the flood event or $W = \int_{Flood} P dt = \int_{Flood} (\gamma d s_o - \tau_c)^e V dt$. In this equation, *e* is an exponent between 1 and 2.5 (MacRae 1992, 1996). An alternative is to write the equation in terms of the critical depth for bed mobility, d_c. The critical shear stress can then be computed as $\tau_c = \gamma d_c s_o$. When this is substituted into the above equation for erosive work, the following results: $W = \gamma s_o \int_{Flood} (d - d_c)^e V dt$. Since the unit weight and channel slope are not affected by detention policy an effective measure of the impact of channel forming flows is the Work Index, $W' = \int_{Flood} (d - d_c)^e V dt$.

The velocity and depth can be computed from the modeled flood hydrograph, as long as the stream cross section, Manning's n, and bed slope are known. This is possible in the reach between 130th and 135th Avenues, since several cross sections were recently surveyed there.

Table 7 shows the results of work index calculations for the existing and future cases shown in Figures 6 and 7. In all cases, it was assumed that the critical depth for bed mobility is 75% of the bankfull depth and that the exponent *e* has a value of 1. Sensitivity analysis showed that the final results were quite insensitive to these two assumptions. For example, results of the sensitivity analysis to determine the critical depth for bed mobility are shown for the 1-year rainfall event in Figure 8. The graphs indicate that the work index ratio is virtually unchanged from a bankfull depth fraction of zero to 0.75. Therefore, the value of 75% represents the upper end of the range of insensitivity.

The work index was calculated for each of the four hydrographs shown in Figures 6 and 7. The actual magnitude of this number is not as important as the relative value. The numbers reported in Table 7 are the ratio of work index for the three future case scenarios divided by the work index for the existing case. So a number greater than 1 indicates that more stream bank erosion may result; a value less than 1 indicates an improvement over existing conditions. As is expected, the LID-based retention approach results in a significant reduction in this work index ratio. Less expected is that a 0.05 cfs per impervious acre detention policy may be no better than the case with no detention at all. This is simply a result of a longer flood duration above the critical depth (selected as 75% of the bankfull height). This suggests that a lower allowable release rate is needed for the detention approach. The Curve Number Method developed for the *Gun River Watershed Management Plan* (FTC&H, 2004) would provide for a better level of protection because it takes into account soil type and degree of imperviousness in determining the allowable release rate that will detain the 1.5-year post-development runoff for 24 hours and, therefore, will have a greater chance of reducing the resulting peak discharge below bankfull height. Although prior studies (Anchor Bay, Gun River) have shown that the work index value is still greater than 1, this method also showed the lowest increase in comparison with other methods (including the 0.05 cfs per impervious acre fixed release rate). The Curve Number Method graph is provided in Figure 9.

It should be noted that the work index will only provide a measure of stream stability relative to the present condition. A detailed physical study of stream stability in the Rabbit River is needed to determine whether the stream is even stable under existing conditions. The report *Applications of the Richards-Baker Flashiness Index to Gaged Michigan River and Streams* (MDEQ 2007) lists the USGS gage at 18th Street in Section 16 of Hopkins Township (gage 04108600) as having increasing flashiness during the 40-year period between 1965 and 2005. Therefore, changing hydrology, or increased stream discharge in the stream balance relationship given on Page 1, appears to be a contributing factor to the state of the Rabbit River. Further evaluation, such as a Watershed Assessment of River Stability and Sediment Supply, will aid in making that determination.

RUNOFF VOLUME DIFFERENCES (FUTURE BUILD-OUT WITH LID VERSUS PRE-SETTLEMENT)

Figures 6 and 7 also show how the hydrographs have changed from pre-settlement to the present. For comparison purposes only, the amount of retention storage required to return to a pre-settlement condition was calculated. Water volume can be computed by adding up the area under the appropriate hydrograph. Using the full development, with LID retention storage as the assumed future condition, the area between the LID hydrograph and the pre-settlement hydrograph is 1,570 ac-ft for the 1-year event and 2,160 ac-ft for the 2-year event. Assuming that this retention storage is distributed uniformly over the 100 square miles that are currently undeveloped and not zoned for development would result in 15.7 ac-ft per square mile for the 1-year event and 21.6 ac-ft per square mile for the 2-year event. This amounts to a 7-acre retention pond, 3 feet deep in every undeveloped (square mile) section of the watershed. It should be noted that this is not recommended, but is included here for comparison only. The target amount of additional retention (which could be implemented as wetland restoration, for example) necessary for each sub-watershed will be much less, and can only be determined after a stability assessment is completed for the Rabbit River.

FLOOD CONTROL IMPACTS WITH A LID APPROACH TO STREAM PROTECTION

Flood control standards for new developments in Allegan County limit detention basin release rates to 0.13 cfs per acre for a 100-year storm. This standard seeks to keep downstream peak discharges at or below existing values. The 25- and 100-year events were simulated with the existing condition and LID models to see what would happen if only LID-based retention volumes were used for flood control.

Figures 10 and 11 show the results at two locations: a location downstream of most of the developing areas at the USGS gaging station (18th Street) and an upstream location along the Green Lake branch at 140th Avenue. At the USGS gaging station (and subsequently further downstream at 135th Avenue), the LID-based retention models reproduce the existing peak discharge for both 25- and 100-year events. This is to be expected, since the LID model used the same times-of-concentration and only a small increase in CN in the developing areas. Further upstream, the LID-based retention volumes provide reduced 25- and 100-year flood discharges. The conclusion is that LID-based design (i.e., a combination of minimal CN increase, no time-of-concentration decrease, and retention storage to return design storm hydrology to pre-settlement) can and does provide for flood control, since flooding along a river system is volume driven (sufficient runoff volume is needed to fill floodplain storage areas and raise water elevations). The extent to which this occurs and the determination of adequacy must be determined on a watershed-by-watershed basis through storm water master planning.

CONCLUSIONS AND RECOMMENDATIONS

Several conclusions and recommendations can be made as a result of this study for the purpose of preventing excessive streambank erosion, improving water quality, and providing for flood control.

- Full development of the properties currently zoned for development will likely increase the instability of the Rabbit River. This is true even under the current storm water development rules. A more aggressive approach to protecting stream stability is needed.

- Adoption of LID-based development rules may improve the current conditions of the Rabbit River. These rules make use of a variety of techniques. The most important are time-of-concentration control and retention storage. Retention storage means that a significant portion of the additional runoff produced by the development is not allowed to leave the site. This approach has far greater positive impacts than a more restrictive detention approach.

- The CN approach for extended detention of the stream protection volume (the more restrictive detention approach) should be considered as an alternative for site developments only where LID-based onsite retention requirements cannot be met due to site constraints.

- It is possible to further reduce discharge to the Rabbit River through retention in the undeveloped areas (through wetland restoration for example). An estimate of the volume difference between pre-settlement conditions and full-development conditions (based on current zoning with LID-based storm water requirements), indicates approximately 21 ac-ft per square mile of undeveloped area (100 square miles in the eastern watershed). A target amount of additional retention necessary for each sub-watershed can be set after a stability assessment is completed for the Rabbit River.

- LID-based retention requirements for new developments are also effective for flood control. Adoption of LID-based storm water rules may eliminate the need for an artificially low release rate (0.13 cfs/acre) and subsequently large volume for onsite detention of the 100-year storm.

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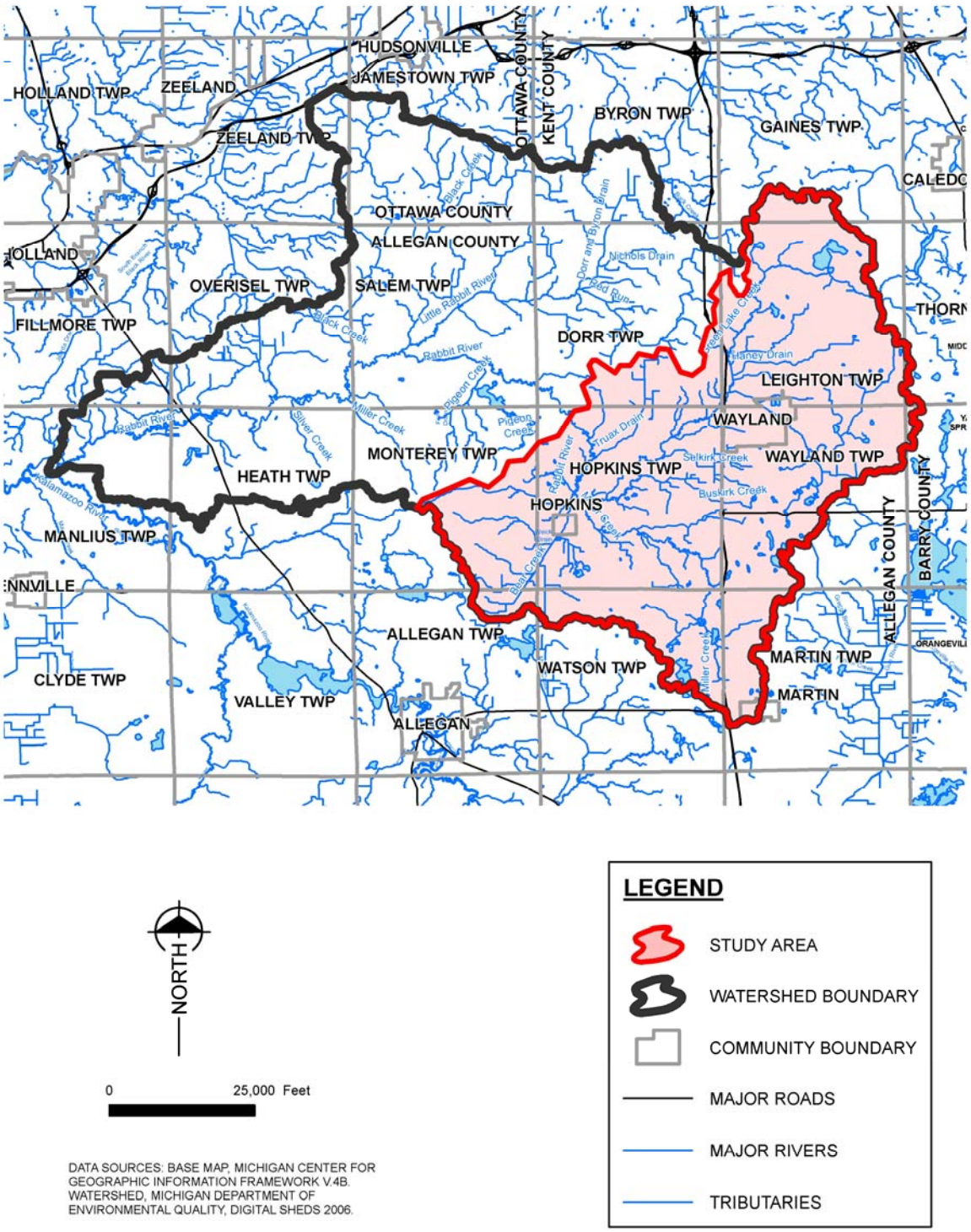

Figure 1 • Rabbit River Watershed

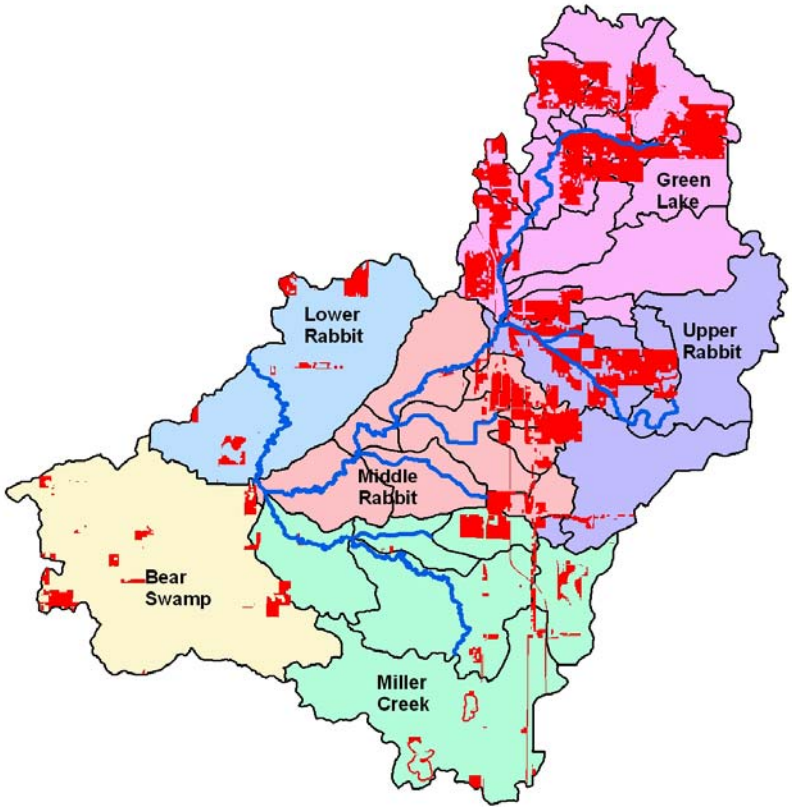

Figure 2 • Watershed Delineation Showing Developing Areas (in red)

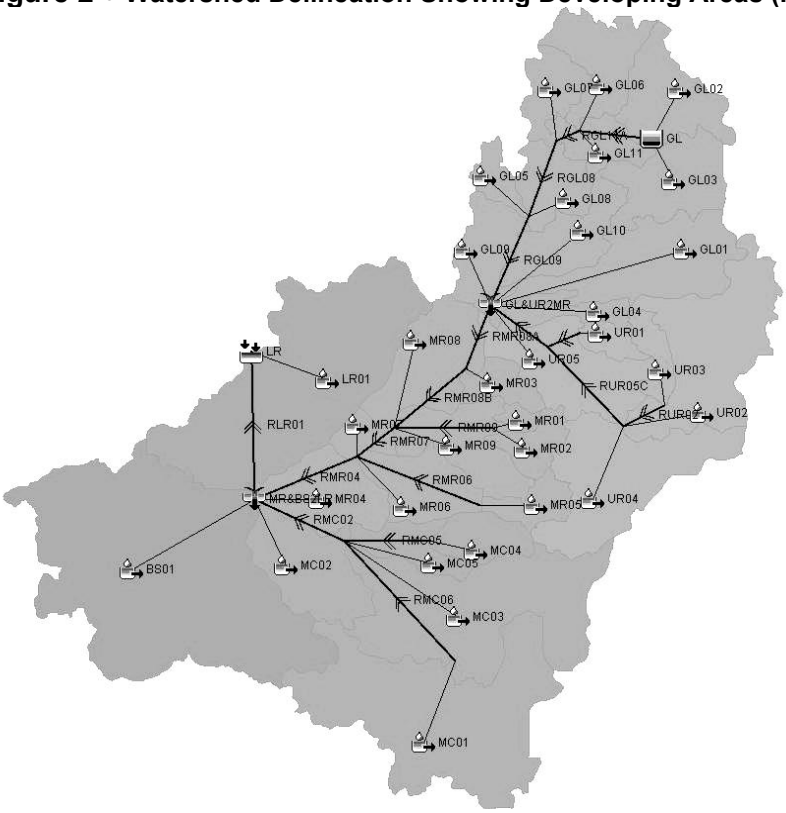

Figure 3 • HEC-HMS Model Schematic

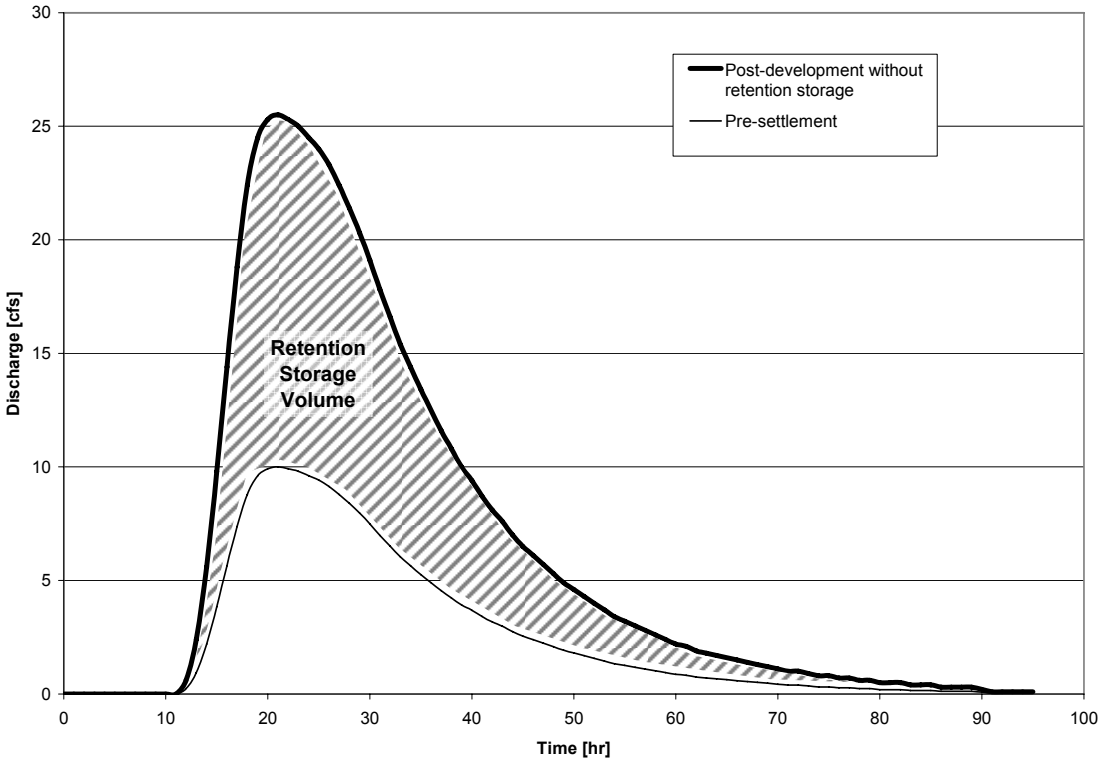

Figure 4 • Retention Storage for Runoff Volume Control

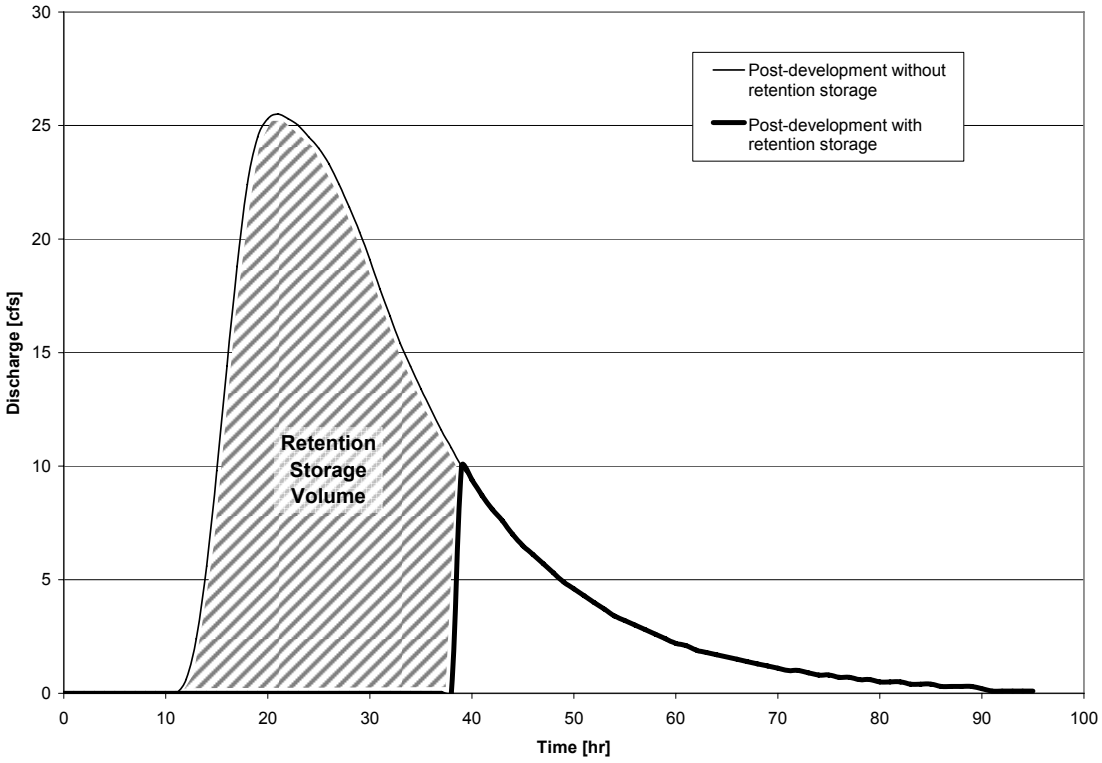

Figure 5 • Retention Storage for Peak Discharge Control

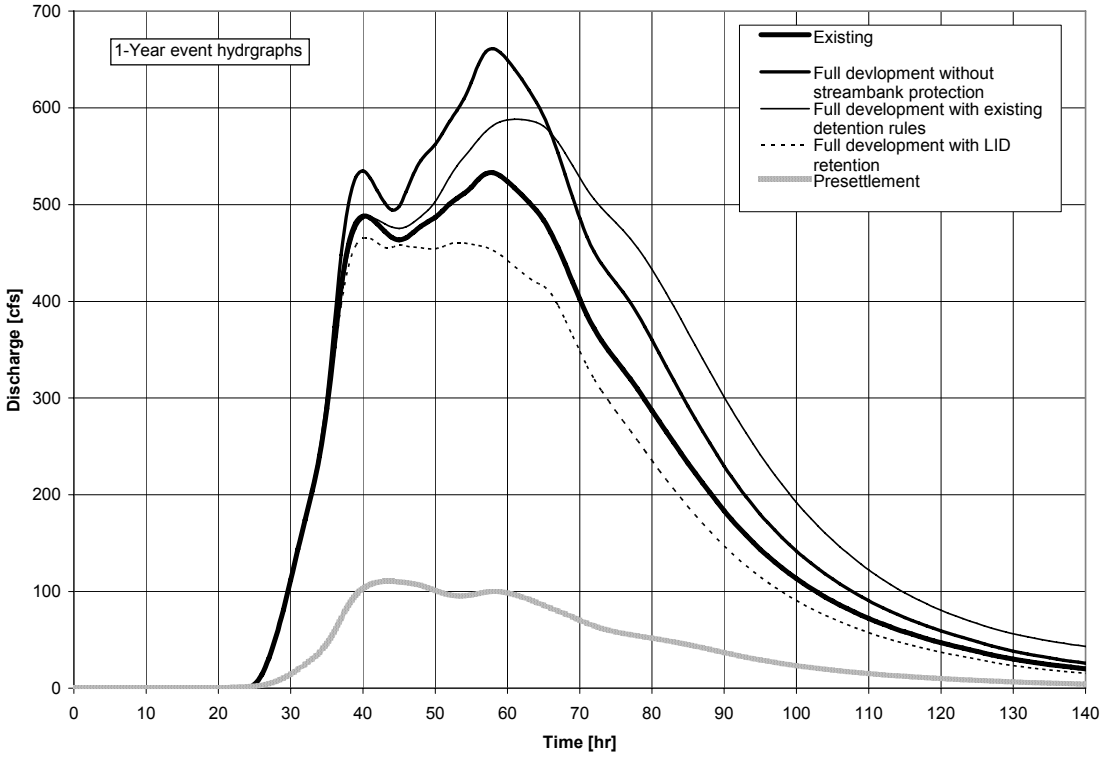

Figure 6 • Modeled 1-Year Hydrographs at 135th Avenue

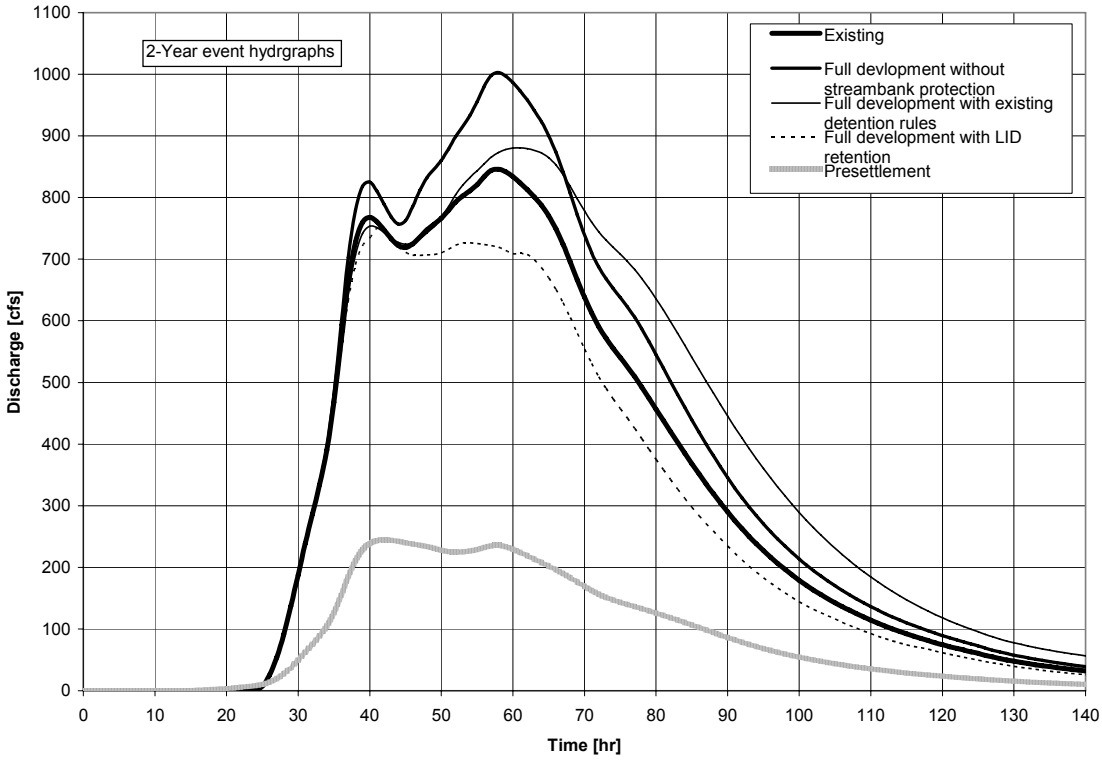

Figure 7 • Modeled 2-Year Hydrographs at 135th Avenue

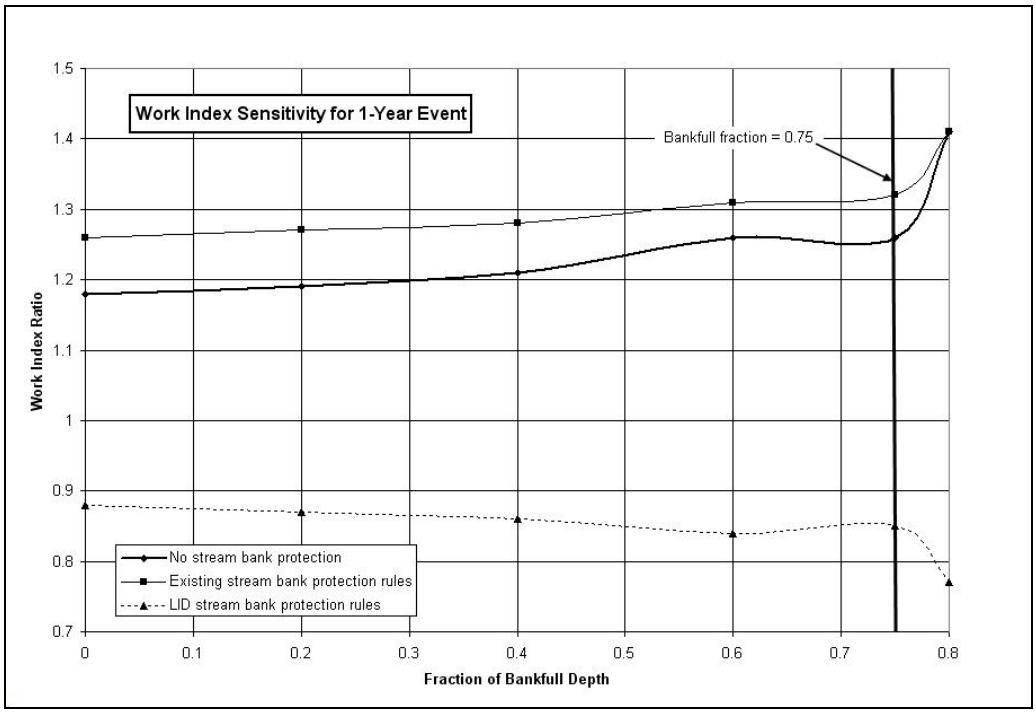

Figure 8 ● Results of Sensitivity Analysis for Critical Depth for Bed Mobility for a 1-year Event.

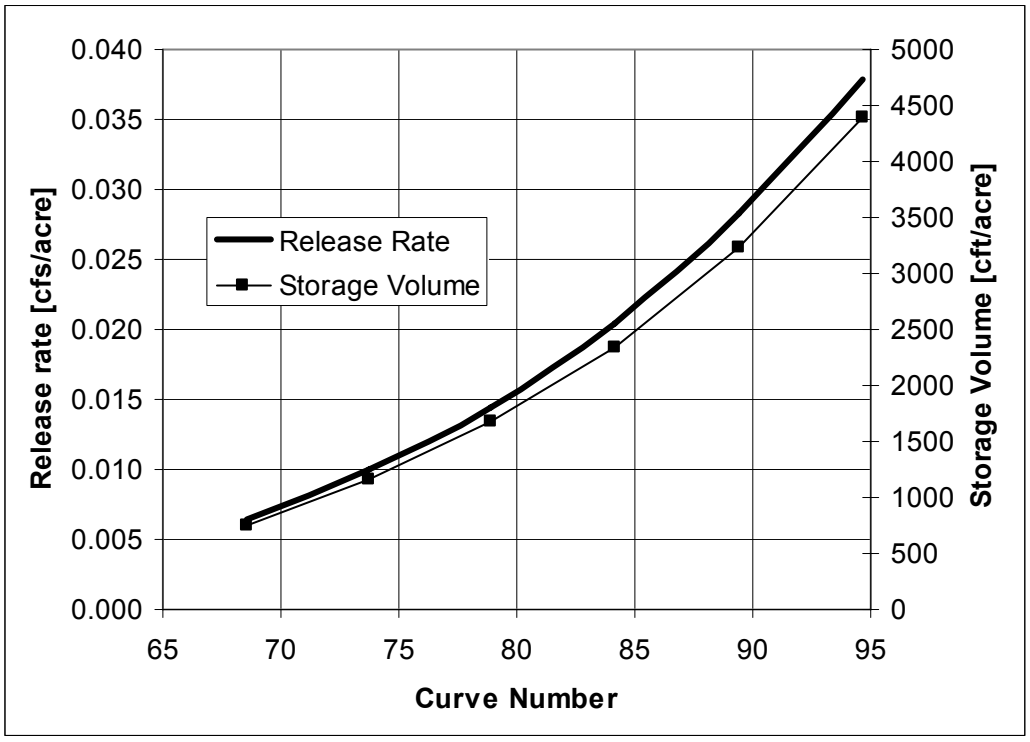

Figure 9 ● Release Rate as a Function of Curve Number for Stream Protection

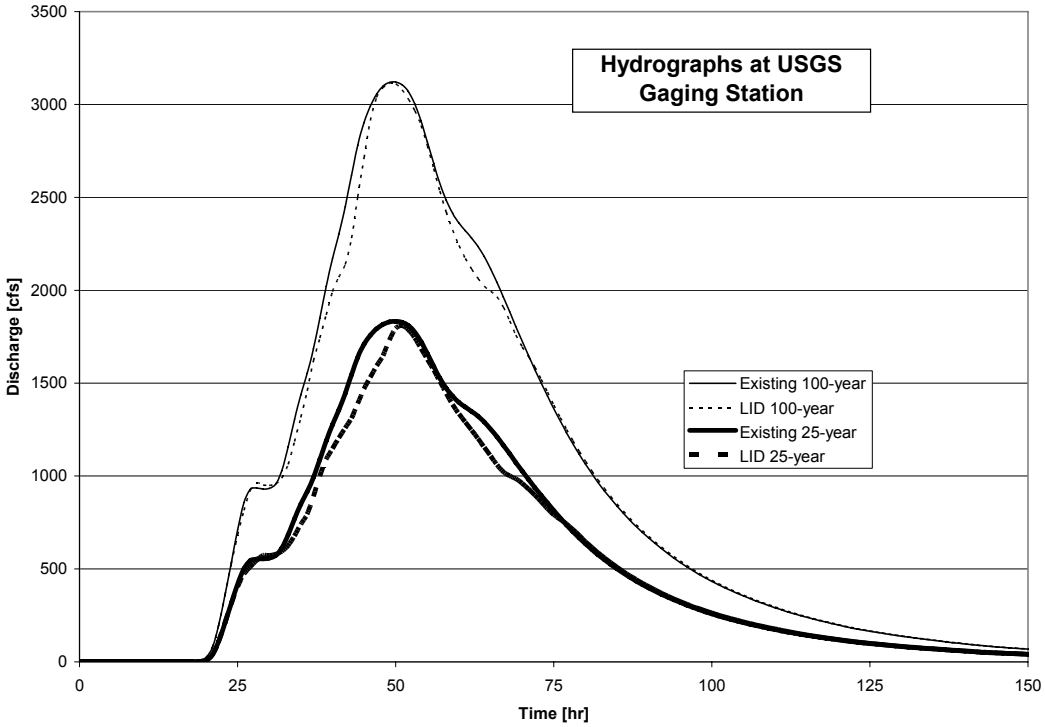

Figure 10 ● 25- and 100-Year Flood Hydrographs at USGS Gaging Station

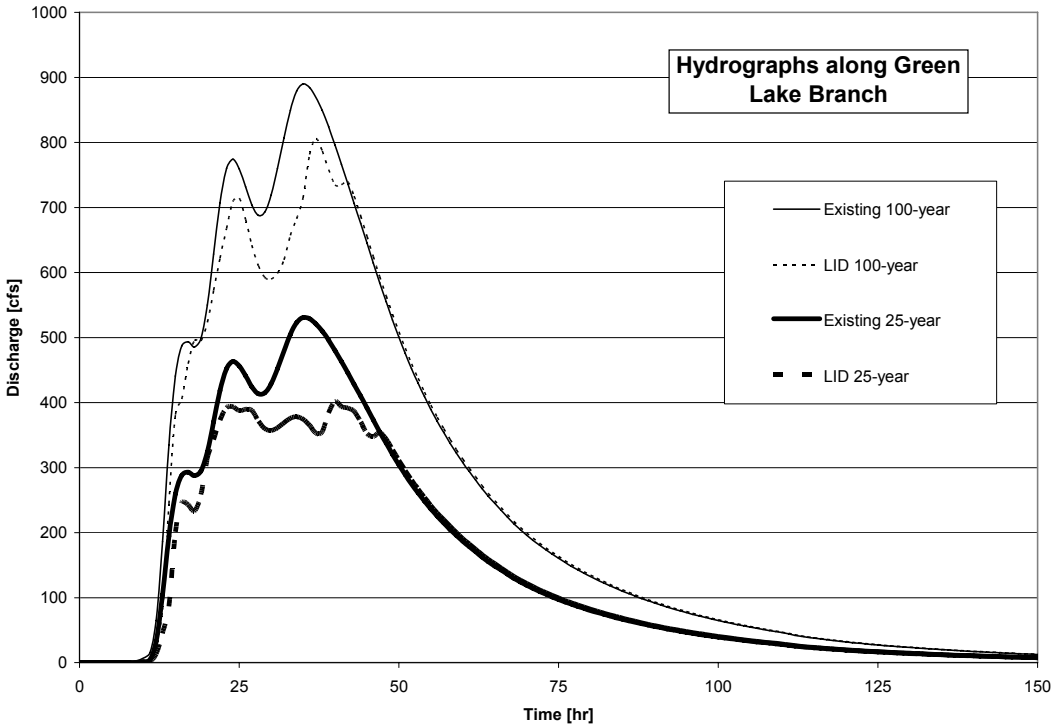

Figure 11 ● 25- and 100-Year Flood Hydrographs Along Green Lake Branch at 140th Avenue

Table 1 - Sub-Watershed Parameters

Sub-Basin Name	Area [mi^2]	CN	Pond Area [mi^2]	Time of Concentration [hr]	Storage Coefficient [hr]
BS01	19.97	76.40	1.35	10.41	18
GL01	5.29	75.66	0.98	10.96	24
GL02	3.35	78.08	0.78	11.45	30
GL03	3.40	76.03	0.44	7.44	15
GL04	1.25	75.53	0.14	3.37	6
GL05	0.89	82.34	0.03	3.30	4.8
GL06	2.87	77.40	0.17	5.29	8.7
GL07	1.72	76.84	0.35	16.44	37
GL08	2.10	74.78	0.21	5.25	9
GL09	2.58	77.28	0.26	7.25	14
GL10	2.68	76.59	0.29	5.19	9
GL11	1.59	75.02	0.19	17.74	34
LR01	13.37	74.96	1.24	17.71	35
MC01	12.05	75.04	2.30	10.89	24.5
MC02	3.97	79.40	0.57	8.93	18.7
MC03	7.11	76.06	0.93	7.75	15.3
MC04	1.68	79.80	0.08	2.62	3.8
MC05	1.62	80.41	0.04	6.10	8
MR01	0.38	73.05	0.06	1.77	2.5
MR02	1.28	73.99	0.11	3.48	5.5
MR03	1.15	76.66	0.21	2.69	5
MR04	3.31	76.86	0.35	11.18	23
MR05	1.22	68.56	0.16	2.44	3.5
MR06	2.69	81.28	0.08	5.15	7.5
MR07	0.91	80.02	0.14	4.77	9
MR08	3.89	79.51	0.30	14.37	27
MR09	3.27	77.70	0.15	9.21	15
UR01	0.76	74.63	0.16	6.04	12
UR02	6.95	71.60	1.15	19.60	35
UR03	1.06	75.13	0.16	3.18	5.5
UR04	5.95	67.54	1.44	7.01	14
UR05	4.51	72.26	0.60	9.09	18
Total	124.82	--	15.41	--	--

Table 2 - Stream Reach Lag Times

Stream Reach Name	Lag Time [min]
RGL08	215
RGL09	319
RGL11A	546
RGL11B	190
RLR01	770
RMC02	482
RMC03	566
RMC05	135
RMR04	534
RMR06	227
RMR07	290
RMR08A	133
RMR08B	495
RMR09	382
RUR02	208
RUR05A	115
RUR05B	39
RUR05C	258

Table 3 - Developed Model Parameters

Sub-Basin Name	Percent Recently Developed	Percent Developing	Undeveloped		Recently Developed		Developing	
			A [mi^2]	CN	A [mi^2]	CN	A [mi^2]	CN
BS01	6%	4%	19.97	76.40				
GL01	3%	1%	5.29	75.66				
GL02	12%	34%	1.55	78.40	0.39	75.62	1.41	88.00
GL03	8%	28%	2.23	76.03			1.18	88.00
GL04	7%	34%	0.72	75.53			0.52	88.00
GL05	23%	54%	0.09	82.14	0.20	83.02	0.60	91.00
GL06	6%	17%	2.25	77.40			0.62	88.00
GL07	10%	52%	0.42	76.54	0.18	79.42	1.12	88.00
GL08	11%	29%	1.11	74.73	0.24	75.23	0.75	88.00
GL09	13%	42%	0.89	76.72	0.34	80.95	1.34	88.00
GL10	5%	4%	2.68	76.59				
GL11	6%	60%	0.41	75.02			1.18	88.00
LR01	6%	5%	13.37	74.96				
MC01	6%	4%	12.05	75.04				
MC02	6%	2%	3.97	79.40				
MC03	9%	2%	7.11	76.06				
MC04	12%	32%	0.81	79.73	0.21	80.26	0.66	91.00
MC05	2%	1%	1.62	80.41				
MR01	0%	61%	0.09	73.05			0.29	88.00
MR02	0%	49%	0.50	73.99			0.78	88.00
MR03	0%	34%	0.67	76.66			0.49	88.00
MR04	5%	0%	3.31	76.86				
MR05	12%	26%	0.68	68.08	0.14	72.19	0.39	88.00
MR06	2%	0%	2.69	81.28				
MR07	2%	0%	0.91	80.02				
MR08	5%	1%	3.89	79.51				
MR09	7%	7%	3.27	77.70				
UR01	5%	19%	0.58	74.63			0.18	88.00
UR02	7%	0%	6.95	71.60				
UR03	14%	32%	0.49	75.83	0.15	70.73	0.43	88.00
UR04	12%	4%	5.21	67.90	0.73	65.00		
UR05	0%	46%	1.92	72.26			2.58	88.00
Total	--	--	107.72	--	2.58	--	14.52	--

Table 4 - Detention Pond Parameters

Parent Sub-Watershed Name	Developing Sub-Watershed Area [mi^2]	CN	0.05 cfs per Impervious Acre	Orifice Area [ft]	Pond Area [ac]	Discharge [cfs]
GL02	1.41	88	32.5	none needed		28.93
GL03	1.18	88	27.1	3.25	6.69	27.08
GL04	0.52	88	12.1	1.45	6.50	12.08
GL05	0.60	91	13.8	1.66	10.09	13.91
GL06	0.62	88	14.4	1.72	6.27	14.37
GL07	1.12	88	25.7	none needed		19.46
GL08	0.75	88	17.4	2.08	7.31	17.35
GL09	1.34	88	31.0	3.71	8.16	30.96
GL11	1.18	88	27.2	none needed		21.62
MC04	0.66	91	15.2	1.82	11.69	15.23
MR01	0.29	88	6.6	0.79	4.73	6.55
MR02	0.78	88	17.9	2.15	9.88	17.92
MR03	0.49	88	11.2	1.34	6.58	11.21
MR05	0.39	88	9.0	1.08	5.75	9.04
UR01	0.18	88	4.2	0.51	1.85	4.22
UR03	0.43	88	9.8	1.17	5.63	9.82
UR05	2.58	88	59.5	7.14	9.52	59.54

Table 5 - Design Rainfall Depths

Hydrologic Soil Group	Curve Number for Woods in Good Condition	1.5 Times the Initial Abstraction [in]	Limited by 1-Year, 24-Hour Rainfall [in]	Limited by 100-Year, 24-Hour Rainfall [in]
A	25	9.00	9.00	6.15
B	55	2.45	2.45	2.45
C	70	1.29	1.95	1.95
D	77	0.90	1.95	1.95

Table 6 - Retention Volumes for Developing Watersheds

Sub-Watershed Name	Developing Sub-Watershed Area [mi^2]	Hydrologic Soil Group	Developed Curve Number	Curve Number for Woods in Good Condition	Design Precipitation Depth [in]	Retention Volume for Runoff Control [ac-ft]	Retention Volume for Discharge Control * [ac-ft]
GL02	1.41	B	78	55	2.45	52	49
GL03	1.18	B	78	55	2.45	43	41
GL04	0.52	B	78	55	2.45	19	18
GL05	0.60	C	85	70	1.95	17	16
GL06	0.62	B	78	55	2.45	23	22
GL07	1.12	B	78	55	2.45	41	39
GL08	0.75	B	78	55	2.45	27	26
GL09	1.34	B	78	55	2.45	49	47
GL11	1.18	B	78	55	2.45	43	41
MC04	0.66	C	85	70	1.95	19	18
MR01	0.29	B	78	55	2.45	10	10
MR02	0.78	B	78	55	2.45	28	27
MR03	0.49	B	78	55	2.45	18	17
MR05	0.39	B	78	55	2.45	14	14
UR01	0.18	B	78	55	2.45	7	6
UR03	0.43	B	78	55	2.45	16	15
UR05	2.58	B	78	55	2.45	94	90

*Prince George's County, Maryland. 2000. *Low-Impact Development Hydrologic Analysis.* Department of Environmental Resources, Prince George's County, Maryland. Appendix B.

Table 7 - Work Index Results

Case	Work Index Ratio (future/existing)	
	1-Year Storm Event	2-Year Storm Event
Full development with no stream bank protection detention	1.26	1.17
Full development with 0.05 cfs per impervious acre detention	1.32	1.21
Full development with LID-based retention	0.85	0.86

Appendix 6a

Watershed Survey Data Sheet

Site ID# (reach.twp.sct.site) _____

Rabbit River Watershed

Picture # _____

Date _____

Investigator (s) _____

Waterbody Name _____

Waterbody Reach _____

County _____ **Township** _____ **Section #** _____ **Qtr** _____

GPS (in decimal degrees format) **Lat:** _____ **Long:** _____

Pollutant Source (choose only one, then complete that section)

1. Debris/Trash/Obstructions **2. Stream Crossing** **3. Gully Erosion**

4. Livestock Access **5. Non-point Ag. Source** **6. Tile Outlet**

7. Streambank Erosion **8. Construction** **9. Urban/Residential (includes Yard Waste)**

10. Rill Erosion **11. Other:** _____

Current precipitation	None	Light	Moderate	Heavy		
Days since last rain	1 or less	2	3 or more	**How much?** _____	inches	
Water Color	None	Clear	Green	Cloudy/Milky	Very Muddy	Black
Water Odor	None	Musty	Rotten Eggs	Chemical	Oil	Sewage
Aquatic Vegetation	None	slight	moderate	extensive		
Algae	None	microscopic	filamentous	mat forming		
Stream flow type	Dry	Stagnant	Slow Flow	Moderate	Rapid Flow	
Stream bottom substrate	Clay	Sand	Gravel	Cobble	Bedrock	Organic
Size:		Smaller than ladybug	Ladybug to tennis ball	Tennis ball to basketball		

Average Stream Wetted Width _____ **feet**

Average Stream Depth _____ **feet**

Streambank Height _____ **feet**

Highest Visible Water Mark (above water level) _____ **feet**

Riparian Habitat (facing u/s)	**Left Bank**	Trees	Shrubs	Herbaceous	Grass	Bare	
	Right Bank	Trees	Shrubs	Herbaceous	Grass	Bare	
	Other (Left Bank)	_____					
	Other (Right Bank)	_____					
Buffer/Filter Strip Width	**Left Bank**	<25 feet	25-50 feet	**Right Bank**	<25 feet	25-50 feet	
		50-100 feet	>100 feet		50-100 feet	>100 feet	
Land Use (facing u/s)	**Left Bank**	Woodland	Wetland	Idle	Agricultural	Res/Comm	Roadway
	Right Bank	Woodland	Wetland	Idle	Agricultural	Res/Comm	Roadway

Watershed Survey Data Sheet **SITE ID#** _____

Rabbit River Watershed

SECTION 1. DEBRIS/TRASH/OBSTRUCTIONS

Describe debris/trash on page 4. Include major obstruction types/ numbers.

Volume of trash/debris in stream	____ft. L x ____ft. W x ____ft. H		**cubic ft**	
Amount of Trash/Debris	Slight	Moderate	Large	Extensive
Is the obstruction diverting flow into the streambank?			Y / N	
Could the obstruction cause an impairment to navigation?			Y / N	

SECTION 2. STREAM CROSSING

Type of Crossing	Bridge	Single Culvert	Double Culvert	Box	Other: _____
Construction material	Concrete	Galvanized	Plastic		Other: _____
Condition	Good	Fair	Poor		
If obstructed, how much?	partial	half	full		
Road Surface	Paved	Gravel	Unimproved		
Erosion Location	Streambank (L/R)	Embankment	Culvert outlet	Shoulder/Ditch	
Extent of Erosion	Minor	Moderate	Severe		
Average Erosion Width	_____ **feet**		(Top width + Bottom width)/2		
Erosion Depth	_____ **feet**				
Erosion Length	_____ **feet**				
Years present	_____ **years**				

SECTION 3. GULLY EROSION

Location	Left Bank	Right Bank	
Cause	Plowing to streambank (no buffer)		Conventional tillage
Average Erosion Width	_____ **feet**		(Top width + Bottom width)/2
Erosion Depth	_____ **feet**		
Erosion Length	_____ **feet**		
Years present	_____ **years**		

SECTION 4. LIVESTOCK ACCESS

Location	Left Bank	Right Bank		
Is erosion active?	Y / N			
Vegetation cover	Bare	Sparse vegetation		Stable vegetation
Average Erosion Width	_____ **feet**		(Top width + Bottom width)/2	
Erosion Depth	_____ **feet**			
Erosion Length	_____ **feet**			
Length of Needed Fencing	_____ **feet**			
Years present	_____ **years**			

SECTION 5. NONPOINT AGRICULTURE SOURCES (MANURE)

Location	Left Bank	Right Bank			
Cropland Erosion/Runoff	Manure Spreading				
Manure in Stream	None		Some Evident		Extensive Amount
Manure Storage Structure	Y / N	**How far is the feedlot from top of streambank?**			_____ **feet**
Animal Operation Type	Dairy	Hog	Beef	Other	None

Watershed Survey Data Sheet **SITE ID#** _____

Rabbit River Watershed

SECTION 6. TILE OUTLETS - EROSION AND DISCHARGE

Location of outlet	Left Bank	Right Bank				
Erosion type, if applicable	plunge pool	gully	outlet failure	other	_____	
Pipe diameter	_____ **inches**					
Pipe Material	Plastic	Clay	Metal	Concrete	Other	_____
Height above Stream Bottom	_____ **inches**					
Discharge Color	Clear	Green	Cloudy/Milky	Very Muddy	Black	
Discharge Odor	None	Musty	Ammonia/eggs	Chemical/oil	Sewage	
Erosion Length	_____ **feet**					
Erosion Height	_____ **feet**					
Erosion Depth	_____ **feet**					
Years Present	_____ **years**					

SECTION 7. STREAMBANK EROSION

Location	Left Bank	Right Bank			
Length of Erosion	_____ **feet**				
Height of Erosion	_____ **feet**				
Years Present	_____ **years**				
Severity of Erosion	Some Bare Bank	Mostly Bare Bank	Bare bank w/ Rills		Undercut/Washout
Location of Erosion	Toe	High Water Mark	Top of Bank		Entire Bank

SECTION 8. CONSTRUCTION

Location	Left Bank	Right Bank	_____ **acres**			
Erosion	Y / N					
Are Control Measures being used?	Y / N					
Type of Control Measures	silt fence	filter barrier	mulch	sediment basin	check dams	
	other:	_____				
Site Slope	slight	moderate	steep			

SECTION 9. URBAN / RESIDENTIAL (Includes Yard Waste)

Location	Left Bank	Right Bank				
Source:	**Septic seepage**					
Water odor	None	Musty	Ammonia/eggs	Chemical/oil	Sewage	
Water color	None	Clear	Green	Cloudy/Milky	Very Muddy	Black
Source:	**Discharge**					
Discharge Water Quality	None	oil sheen	bacterial	foamy	sediment	other
Source:	**Mows to streambank**					
Source:	**Yard waste dumping**					

Yard Waste Pile _____ft. L x _____ft. W x _____ft. H

SECTION 10. Rill Erosion

Is the field being tilled?	Y / N	**Erosion Severity?**	Minor	Moderate	Severe
Cause	Plowing to streambank (no buffer)	Conventional tillage			
Crop type	Soy	Edible Beans	Corn	Other _____	
Area	_____ acres				

SECTION 11: OTHER

Location	Left Bank	Right Bank
Site Description	_____	
	_____	

Use reverse side to write comments.

Watershed Survey Data Sheet
Rabbit River Watershed

SITE ID# _____

Additional Comments

Sketch of site

Appendix 6b

NPS Inventory Results - Non-point Agricultural Source

SITE_ID	POLLUTANT SOURCE	DATE	INVEST	NAME	COUNTY	TWP	SEC	QTR1	LAT	LONG	COMMENTS
	Non-point Ag Source	6/1/1996		Little Rabbit River	Allegan	Dorr	7				
	Non-point Ag Source	6/1/1996		Little Rabbit River	Allegan	Dorr	8				
	Non-point Ag Source	6/1/1996		Little Rabbit River	Allegan	Salem	9				
	Non-point Ag Source	6/1/1996		Little Rabbit River	Allegan	Dorr	11				
	Non-point Ag Source	6/1/1996		Little Rabbit River	Allegan	Salem	12				
	Non-point Ag Source	6/1/1996		Little Rabbit River	Allegan	Dorr	14				
	Non-point Ag Source	6/1/1996		Little Rabbit River	Allegan	Dorr	16				
	Non-point Ag Source	6/1/1996		Little Rabbit River	Allegan	Dorr	17				
	Non-point Ag Source	6/1/1996		Little Rabbit River	Allegan	Salem	20				
	Non-point Ag Source	6/1/1996		Little Rabbit River	Allegan	Dorr	26				
BSDAT0202	Non-point Ag Source	1/1/2000		Bear Swamp Drain	Allegan	Allegan	2				
BSDHT1902	Non-point Ag Source	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	19				
BSDHT2201	Non-point Ag Source	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	22				
BSDHT2302	Non-point Ag Source	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	23				
BSDHT2403	Non-point Ag Source	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	24				
BSDHT2904	Non-point Ag Source	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	29				
BSDHT3103	Non-point Ag Source	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	31				
BSDMT1502	Non-point Ag Source	1/1/2000		Bear Swamp Drain	Allegan	Monterey	15				
BSDMT2502	Non-point Ag Source	1/1/2000		Bear Swamp Drain	Allegan	Monterey	25				
GLSLT0402	Non-point Ag Source	1/1/2000		Green Lake Stream	Allegan	Leighton	4				
GLSLT0605	Non-point Ag Source	1/1/2000		Green Lake Stream	Allegan	Leighton	6				
GLSLT0702	Non-point Ag Source	1/1/2000		Green Lake Stream	Allegan	Leighton	7				
GLSLT0802	Non-point Ag Source	1/1/2000		Green Lake Stream	Allegan	Leighton	8				
GLSLT0902	Non-point Ag Source	1/1/2000		Green Lake Stream	Allegan	Leighton	9				
GLSLT2602	Non-point Ag Source	1/1/2000		Green Lake Stream	Allegan	Leighton	26				
GLSLT2904	Non-point Ag Source	1/1/2000		Green Lake Stream	Allegan	Leighton	29				
MLCMT0502	Non-point Ag Source	1/1/2000		Miller Creek	Allegan	Martin	5				
MLCMT0802	Non-point Ag Source	1/1/2000		Miller Creek	Allegan	Martin	8				
MLCWT1204	Non-point Ag Source	1/1/2000		Miller Creek	Allegan	Watson	12				
URRWT0302	Non-point Ag Source	1/1/2000		Upper Rabbit River	Allegan	Wayland	3				
URRWT0802	Non-point Ag Source	1/1/2000		Upper Rabbit River	Allegan	Wayland	8				
URRWT1803	Non-point Ag Source	1/1/2000		Upper Rabbit River	Allegan	Wayland	18				
LRRDT0706	Non-point Ag Source	3/1/2000		Little Rabbit River	Allegan	Dorr	7				
LRRDT0805	Non-point Ag Source	3/1/2000		Little Rabbit River	Allegan	Dorr	8				
LRRDT1102	Non-point Ag Source	3/1/2000		Little Rabbit River	Allegan	Dorr	11				
LRRDT1403	Non-point Ag Source	3/1/2000		Little Rabbit River	Allegan	Dorr	14				
LRRDT1606	Non-point Ag Source	3/1/2000		Little Rabbit River	Allegan	Dorr	16				
LRRDT1705	Non-point Ag Source	3/1/2000		Little Rabbit River	Allegan	Dorr	17				
LRRDT2604	Non-point Ag Source	3/1/2000		Little Rabbit River	Allegan	Dorr	26				
LRRST0903	Non-point Ag Source	3/1/2000		Little Rabbit River	Allegan	Salem	9				
LRRST1204	Non-point Ag Source	3/1/2000		Little Rabbit River	Allegan	Salem	12				
LRRST2002	Non-point Ag Source	3/1/2000		Little Rabbit River	Allegan	Salem	20				

NPS Inventory Results - Tile Outlet

SITE_ID	POLLUTANT SOURCE	DATE	INVEST	NAME	COUNTY	TWP	SEC	QTR1	LAT	LONG	COMMENTS
204+00	Tile Outlet	11/2/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	8	SE	N 42.65973	W 85.74705	
204+00	Tile Outlet	11/2/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.65973	-85.74705	
Blk.Jam.26.011	Tile Outlet	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	26		42.78946	-85.81551	Tile Outlet Failure & Erosion along Right Bank
Blk.Sal.6.002	Tile Outlet	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Salem	6		42.75144	-85.88207	8" & 24" CMP along Left Bank Require Stabilized Outlet, 24" CMP along Right Bank = Ok
Blk.Sal.7.003	Tile Outlet	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Salem	7		42.73718	-85.89318	6" PVC & 12" DIP along Left Bank, Minor Erosion (Requires Outlet Stabilization)

NPS Inventory Results - Urban/Residential

SITE_ID	POLLUTANT SOURCE	DATE	INVEST	NAME	COUNTY	TWP	SEC	QTR1	LAT	LONG	COMMENTS
	Urban/Residential	6/1/1996		Byron Dorr ICD	Kent	Byron	33				
BSDAT1201	Urban/Residential	1/1/2000		Bear Swamp Drain	Allegan	Allegan	12				
BSDHT2004	Urban/Residential	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	20				
GLSLT0301	Urban/Residential	1/1/2000		Green Lake Stream	Allegan	Leighton	3				
GLSLT0403	Urban/Residential	1/1/2000		Green Lake Stream	Allegan	Leighton	4				
GLSLT0404	Urban/Residential	1/1/2000		Green Lake Stream	Allegan	Leighton	4				
GLSLT0606	Urban/Residential	1/1/2000		Green Lake Stream	Allegan	Leighton	6				
GLSLT0703	Urban/Residential	1/1/2000		Green Lake Stream	Allegan	Leighton	7				
GLSLT1102	Urban/Residential	1/1/2000		Green Lake Stream	Allegan	Leighton	11				
GLSLT1902	Urban/Residential	1/1/2000		Green Lake Stream	Allegan	Leighton	19				
GLSLT2603	Urban/Residential	1/1/2000		Green Lake Stream	Allegan	Leighton	26				
URRWT0403	Urban/Residential	1/1/2000		Upper Rabbit River	Allegan	Wayland	4				
URRWT0501	Urban/Residential	1/1/2000		Upper Rabbit River	Allegan	Wayland	5				
URRWT1901	Urban/Residential	1/1/2000		Upper Rabbit River	Allegan	Wayland	19				
URRWT2101	Urban/Residential	1/1/2000		Upper Rabbit River	Allegan	Wayland	21				
URRWT2801	Urban/Residential	1/1/2000		Upper Rabbit River	Allegan	Wayland	28				
URRWT3001	Urban/Residential	1/1/2000		Upper Rabbit River	Allegan	Wayland	30				
LRRBT3303	Urban/Residential	3/1/2000		Byron Dorr ICD	Kent	Byron	33				
MILMNT0604	Urban/Residential	10/19/2007	AM/KJV/SFM	Miller Creek	Allegan	Monterey	6	NW	N. 42.67827	W. 85.89602	
MILMNT0604	Urban/Residential	10/19/2007	AM/KJV/SFM	Miller Creek					42.67827	-85.89602	
STA 10+00 A	Urban/Residential	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins	17	SW	N. 42.63914	W 85.75849	
STA 10+00 A	Urban/Residential	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins			42.63914	-85.75849	
STA 302+00	Urban/Residential	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins	5	SW	N. 42.67352	W. 85.75654	
STA 302+00	Urban/Residential	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins			42.67352	-85.75654	
STA 307 +00 B	Urban/Residential	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins	5	SW	N. 42.67401	W. 85.75868	
STA 307 +00 B	Urban/Residential	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins			42.67401	-85.75868	
BKC HT 15 01	Urban/Residential	10/31/2007	LBN/SFM	Buskirk Creek	Allegan	Hopkins	15	NE	N. 42.64876	W 085.71190	
BKCHT1501	Urban/Residential	10/31/2007	LBN/SFM	Buskirk Creek					42.64876	-85.71190	

NPS Inventory Results - Rill & Gully Erosion

SITE_ID	POLLUTANT SOURCE	DATE	INVEST	NAME	COUNTY	TWP	SEC	QTR1	LAT	LONG	COMMENTS
	Gully Erosion	6/1/1996		Little Rabbit River	Allegan	Salem	1				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	1				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Salem	1				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Salem	2				
	Gully Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	3				
	Gully Erosion	6/1/1996		Little Rabbit River	Allegan	Salem	3				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	3				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Salem	3				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	4				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	5				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	6				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Leighton	7				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	7				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	8				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	9				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Salem	9				
	Gully Erosion	6/1/1996		Little Rabbit River	Allegan	Salem	10				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	10				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Salem	10				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	11				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Salem	11				
	Gully Erosion	6/1/1996		Little Rabbit River	Allegan	Salem	12				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	12				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Salem	12				
	Gully Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	13				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	13				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Salem	13				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	14				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Salem	14				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	15				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Salem	15				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	16				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Salem	16				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	17				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Salem	17				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	18				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	19				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Salem	20				
	Rill Erosion	6/1/1996		Byron Dorr ICD	Kent	Byron	21				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	21				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	22				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	23				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Salem	23				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Salem	24				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	26				
	Rill Erosion	6/1/1996		Byron Dorr ICD	Kent	Byron	27				
	Rill Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	27				
	Rill Erosion	6/1/1996		Byron Dorr ICD	Kent	Byron	28				
	Rill Erosion	6/1/1996		Byron Dorr ICD	Kent	Byron	32				
	Rill Erosion	6/1/1996		Byron Dorr ICD	Kent	Byron	33				
	Rill Erosion	6/1/1996		Byron Dorr ICD	Kent	Byron	34				
BSDAT1002	Gully Erosion	1/1/2000		Bear Swamp Drain	Allegan	Allegan	10				
BSDHT2402	Gully Erosion	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	24				
BSDHT2602	Gully Erosion	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	26				
BSDHT3102	Gully Erosion	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	31				
BSDHT3401	Gully Erosion	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	34				
GLSLT0602	Gully Erosion	1/1/2000		Green Lake Stream	Allegan	Leighton	6				
GLSLT1602	Rill Erosion	1/1/2000		Green Lake Stream	Allegan	Leighton	16				
GLSLT1603	Gully Erosion	1/1/2000		Green Lake Stream	Allegan	Leighton	16				
GLSLT1701	Rill Erosion	1/1/2000		Green Lake Stream	Allegan	Leighton	17				
GLSLT2002	Gully Erosion	1/1/2000		Green Lake Stream	Allegan	Leighton	20				
GLSLT2102	Rill Erosion	1/1/2000		Green Lake Stream	Allegan	Leighton	21				
GLSLT2103	Gully Erosion	1/1/2000		Green Lake Stream	Allegan	Leighton	21				
GLSLT3102	Gully Erosion	1/1/2000		Green Lake Stream	Allegan	Leighton	31				
GLSLT3202	Gully Erosion	1/1/2000		Green Lake Stream	Allegan	Leighton	32				
GLSLT3502	Rill Erosion	1/1/2000		Green Lake Stream	Allegan	Leighton	35				
GLSLT3602	Gully Erosion	1/1/2000		Green Lake Stream	Allegan	Leighton	36				
MLCMT0501	Gully Erosion	1/1/2000		Miller Creek	Allegan	Martin	5				
MLCMT0702	Gully Erosion	1/1/2000		Miller Creek	Allegan	Martin	7				
MLCMT0801	Gully Erosion	1/1/2000		Miller Creek	Allegan	Martin	8				
MLCWT1201	Gully Erosion	1/1/2000		Miller Creek	Allegan	Watson	12				
URRWT0402	Gully Erosion	1/1/2000		Upper Rabbit River	Allegan	Wayland	4				
URRWT0702	Gully Erosion	1/1/2000		Upper Rabbit River	Allegan	Wayland	7				

URRWT1802	Gully Erosion	1/1/2000		Upper Rabbit River	Allegan	Wayland	18				
URRWT3101	Gully Erosion	1/1/2000		Upper Rabbit River	Allegan	Wayland	31				
LRRBT2101	Rill Erosion	3/1/2000		Byron Dorr ICD	Kent	Byron	21				
LRRBT2701	Rill Erosion	3/1/2000		Byron Dorr ICD	Kent	Byron	27				
LRRBT2801	Rill Erosion	3/1/2000		Byron Dorr ICD	Kent	Byron	28				
LRRBT3201	Rill Erosion	3/1/2000		Byron Dorr ICD	Kent	Byron	32				
LRRBT3301	Rill Erosion	3/1/2000		Byron Dorr ICD	Kent	Byron	33				
LRRBT3401	Rill Erosion	3/1/2000		Byron Dorr ICD	Kent	Byron	34				
LRRDT0101	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	1				
LRRDT0301	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	3				
LRRDT0303	Gully Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	3				
LRRDT0401	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	4				
LRRDT0501	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	5				
LRRDT0601	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	6				
LRRDT0701	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	7				
LRRDT0801	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	8				
LRRDT0901	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	9				
LRRDT1001	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	10				
LRRDT1101	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	11				
LRRDT1201	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	12				
LRRDT1301	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	13				
LRRDT1304	Gully Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	13				
LRRDT1401	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	14				
LRRDT1501	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	15				
LRRDT1601	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	16				
LRRDT1701	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	17				
LRRDT1801	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	18				
LRRDT1901	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	19				
LRRDT2101	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	21				
LRRDT2201	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	22				
LRRDT2301	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	23				
LRRDT2601	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	26				
LRRDT2701	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	27				
LRRLT0701	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Leighton	7				
LRRST0101	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Salem	1				
LRRST0103	Gully Erosion	3/1/2000		Little Rabbit River	Allegan	Salem	1				
LRRST0201	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Salem	2				
LRRST0301	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Salem	3				
LRRST0303	Gully Erosion	3/1/2000		Little Rabbit River	Allegan	Salem	3				
LRRST0901	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Salem	9				
LRRST1001	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Salem	10				
LRRST1004	Gully Erosion	3/1/2000		Little Rabbit River	Allegan	Salem	10				
LRRST1101	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Salem	11				
LRRST1201	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Salem	12				
LRRST1205	Gully Erosion	3/1/2000		Little Rabbit River	Allegan	Salem	12				
LRRST1301	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Salem	13				
LRRST1401	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Salem	14				
LRRST1501	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Salem	15				
LRRST1601	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Salem	16				
LRRST1701	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Salem	17				
LRRST2001	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Salem	20				
LRRST2301	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Salem	23				
LRRST2401	Rill Erosion	3/1/2000		Little Rabbit River	Allegan	Salem	24				
MILMNT0605	Gully Erosion	10/19/2007	AM/KJV/SFM	Miller Creek	Allegan	Monterey	6	NW	N. 42.67716	w. 85.89497	
MILMNT0605	Gully Erosion	10/19/2007	AM/KJV/SFM	Miller Creek					42.67716	-85.89497	
STA 278+00 B	Gully Erosion	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins	5	SW	N. 4267041	W. 85.75130	
STA 278+00 B	Gully Erosion	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins			42.67041	-85.75130	
225+00	Gully Erosion	11/1/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	8	NE	N 42.66361	W 85.74438	
251+00	Gully Erosion	11/1/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	8	NE	N 42.66748	W 85.74895	
258+00	Gully Erosion	11/1/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	5	SE	N 42.66894	W 85.74809	
263+00	Gully Erosion	11/1/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	5	SE	N 42.66914	W 85.74925	
225+00	Gully Erosion	11/1/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.66361	-85.74438	
251+00	Gully Erosion	11/1/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.66748	-85.74895	
258+00	Gully Erosion	11/1/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.66894	-85.74809	
263+00	Gully Erosion	11/1/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.66914	-85.74925	
204+00	Gully Erosion	11/2/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	8	SE	N 42.65973	W 85.74705	
204+00	Gully Erosion	11/2/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.65973	-85.74705	
Blk.Byr.31.002	Gully Erosion	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Kent	Byron	31		42.77857	-85.76487	~ 20 LF of Minor Gully Erosion along Right Bank (~ 1' Width, 2' Depth)
Blk.Jam.25.006	Gully Erosion	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	25		42.79066	-85.79508	~ 30 LF Gully Erosion along Right Bank (~ 2'-4' Width, 3' Depth)
Blk.Jam.25.008	Gully Erosion	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	25		NA	NA	~ 30 LF Gully Erosion along Right Bank (~ 2' Width, 2' Depth), DS of No. 15
Blk.Jam.25.011	Gully Erosion	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	25		42.79032	-85.79845	~ 30 LF Minor Gully Erosion along Left Bank (~ 2' Width, 3' Depth)
Blk.Jam.26.004	Gully Erosion	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	26		NA	NA	Minor Gully Erosion, ~ 300' DS of No. 27
Blk.Jam.26.012	Gully Erosion	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	26		42.78900	-85.81599	Gully Erosion along Left Bank, Partially Stabilized w/ Broken Concrete
Blk.Sal.5.003	Gully Erosion	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Salem	5		42.75682	-85.88312	~ 50 LF of Gully Erosion along Left Bank (~ 3' Width, 3' Depth)
Blk.Sal.6.008	Gully Erosion	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Salem	6		42.73959	-85.89347	~ 50 LF of Gully Erosion along Right Bank (~ 3-10' Width, 3' Depth)
Blk.Sal.7.004	Gully Erosion	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Salem	7		42.73615	-85.89311	~ 40 LF of Gully Erosion along Left Bank (~ 4' Width, 3' Depth)
Blk.Sal.7.006	Gully Erosion	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Salem	7		42.73516	-85.89299	> 50 LF of Gully Erosion along Left Bank (~ 5' Width, 3-4' Depth)

NPS Inventory Results - Debris, Trash, and Obstructions

SITE_ID	POLLUTANT SOURCE	DATE	INVEST	NAME	COUNTY	TWP	SEC	QTR1	LAT	LONG	COMMENTS
BDICD.10	Debris/Trash/Obstruct	6/27/2007	DF2, BS - ACDC	Byron Dorr ICD	Allegan	Dorr	4		42°45'56.21" N	85°44'09.08" W	Minor Log Jam - West Bank
BDICD.12	Debris/Trash/Obstruct	6/27/2007	DF2, BS - ACDC	Byron Dorr ICD	Allegan	Dorr	4		42°45'50.08" N	85°44'11.28" W	Minor Log Jam ~ 100' US
BDICD.14	Debris/Trash/Obstruct	6/27/2007	DF2, BS - ACDC	Byron Dorr ICD	Allegan	Dorr	4		42°45'41.52" N	85°44'13.87" W	Minor Log Jam ~ 100' US
BDICD.16	Debris/Trash/Obstruct	6/27/2007	DF2, BS - ACDC	Byron Dorr ICD	Allegan	Dorr	4		42°45'33.78" N	85°44'14.71" W	Minor Log Jam
BDICD.18	Debris/Trash/Obstruct	6/27/2007	DF2, BS - ACDC	Byron Dorr ICD	Allegan	Dorr	4		42°45'31.35" N	85°44'14.70" W	Log Jam
BDICD.21	Debris/Trash/Obstruct	6/27/2007	DF2, BS - ACDC	Byron Dorr ICD	Allegan	Dorr	9		42°45'57.54" N	85°44'27.58" W	Minor Log Jam, Typical Stable Channel = Good
BDICD.23	Debris/Trash/Obstruct	6/27/2007	DF2, BS - ACDC	Byron Dorr ICD	Allegan	Dorr	9		42°44'51.62" N	85°44'28.69" W	Leaning Poplar Tree near Power Line - Requires Removal by Contractor
BDICD.32	Debris/Trash/Obstruct	6/27/2007	DF2, BS - ACDC	Little Rabbit River	Allegan	Dorr	18		42°43'56.73" N	85°46'00.40" W	Minor Log Jam, Fallen Tree (South Bank) and Dead Twin Tree
BDICD.34	Debris/Trash/Obstruct	6/27/2007	DF2, BS - ACDC	Little Rabbit River	Allegan	Dorr	18		42°43'56.64" N	85°46'02.93" W	Three Log Jams, Minor Bank Erosion, Cut Leaning Trees and Use as Revetments
BDICD.36	Debris/Trash/Obstruct	6/27/2007	DF2, BS - ACDC	Little Rabbit River	Allegan	Dorr	18		42°43'56.51" N	85°46'05.57" W	2 Log Jams DS of Bank Erosion
BDICD.38	Debris/Trash/Obstruct	6/27/2007	DF2, BS - ACDC	Little Rabbit River	Allegan	Dorr	18		42°43'56.51" N	85°46'07.82" W	Log Jam
BDICD.40	Debris/Trash/Obstruct	6/27/2007	DF2, BS - ACDC	Little Rabbit River	Allegan	Dorr	18		42°43'56.51" N	85°46'11.35" W	3 Minor Log Jams w/ Minor Erosion along North Bank
BDICD.41	Debris/Trash/Obstruct	6/27/2007	DF2, BS - ACDC	Little Rabbit River	Allegan	Dorr	18		42°43'56.51" N	85°46'13.36" W	2 Log Jams and 1 Leaning Tree
BDICD.43	Debris/Trash/Obstruct	6/27/2007	DF2, BS - ACDC	Little Rabbit River	Allegan	Dorr	18		42°44'01.22" N	85°46'20.98" W	Log Jam
BDICD.45	Debris/Trash/Obstruct	6/27/2007	DF2, BS - ACDC	Little Rabbit River	Allegan	Dorr	18		42°44'03.16" N	85°46'25.88" W	Log Jam ~ 100' DS of Coordinates, Leaning Tree ~ 300' DS of Coordinates
BDICD.46	Debris/Trash/Obstruct	6/27/2007	DF2, BS - ACDC	Little Rabbit River	Allegan	Dorr	18		42°44'03.94" N	85°46'31.18" W	Log Jam w/ Several Leaning Trees in Vicinity
BDICD.47	Debris/Trash/Obstruct	6/27/2007	DF2, BS - ACDC	Little Rabbit River	Allegan	Dorr	18		42°44'03.76" N	85°46'34.89" W	Fallen Tree
BDICD.48	Debris/Trash/Obstruct	6/27/2007	DF2, BS - ACDC	Little Rabbit River	Allegan	Dorr	18		42°43'59.41" N	85°46'40.61" W	3 Log Jams
BDICD.49	Debris/Trash/Obstruct	6/27/2007	DF2, BS - ACDC	Little Rabbit River	Allegan	Dorr	18		42°43'56.65" N	85°46'44.47" W	Log Jam
BDICD.51	Debris/Trash/Obstruct	6/27/2007	DF2, BS - ACDC	Little Rabbit River	Allegan	Salem	13		42°43'56.20" N	85°46'58.40" W	Log Jam, Remove Branches from Tree Revetment which Protrude into the Channel.
BDICD.52	Debris/Trash/Obstruct	6/27/2007	DF2, BS - ACDC	Little Rabbit River	Allegan	Salem	13		42°43'53.44" N	85°47'06.35" W	Log Jam
BDICD.53	Debris/Trash/Obstruct	6/27/2007	DF2, BS - ACDC	Little Rabbit River	Allegan	Salem	13		42°43'53.87" N	85°47'19.75" W	Log Jam, Remove Branches from Tree Revetment which Protrude into the Channel.
BDICD.54	Debris/Trash/Obstruct	6/27/2007	DF2, BS - ACDC	Little Rabbit River	Allegan	Salem	13		42°43'55.29" N	85°47'52.93" W	Major Log Jam, Meyerdiak Property near Irrigation Pump - May Require Contractor
BDICD.3	Debris/Trash/Obstruct	6/29/2007	DF2, AS - WCR	Byron Dorr ICD	Kent	Byron	33		42°46'33.63" N	85°43'44.77" W	Typical Channel
BDICD.4	Debris/Trash/Obstruct	6/29/2007	DF2, AS - WCR	Byron Dorr ICD	Kent	Byron	33		42°46'23.20" N	85°43'51.23" W	Typical Log Jam
BDICD.5	Debris/Trash/Obstruct	6/29/2007	DF2, AS - WCR	Byron Dorr ICD	Kent	Byron	33		42°46'17.69" N	85°43'53.62" W	Typical Channel - Thick Brush & Log Jams
BDICD.56	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	14		42°43'53.26" N	85°48'04.48" W	Log Jam ~ 350' DS of 26th Street Bridge
BDICD.57	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	14		42°43'53.60" N	85°48'16.28" W	Move Tree Revetments toward Bank, Trim Branches which Extend into Channel
BDICD.58	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	14		42°43'56.26" N	85°48'23.00" W	Fallen Tree
BDICD.59	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	14		42°43'59.73" N	85°48'26.07" W	Several Log Jams, Woody Debris & Leaning Trees
BDICD.6	Debris/Trash/Obstruct	6/29/2007	DF2, AS - WCR	Byron Dorr ICD	Kent	Byron	33		NA	NA	Fallen Tree / Log Jam ~ 100' US of 108th Avenue
BDICD.61	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	14		42°44'05.79" N	85°48'28.85" W	Fallen Tree & Log Jam
BDICD.63	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	14		42°44'07.78" N	85°48'31.88" W	Major Log Jam, Trim Tree Revetment Branches which Extend into Channel
BDICD.64	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	14		42°44'07.92" N	85°48'35.75" W	Trim Tree Revetment Branches which Extend into Channel
BDICD.65	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	14		42°44'08.40" N	85°48'42.15" W	Trim Tree Revetment Branches which Extend into Channel
BDICD.68	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	14		42°44'07.90" N	85°48'59.28" W	Log Jam
BDICD.69	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	14		42°44'03.47" N	85°49'13.72" W	Log Jam at Irrigation Pipe
BDICD.72	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	15		42°43'51.88" N	85°49'33.51" W	Fallen Tree & Log Jam
BDICD.73	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	15		42°43'46.48" N	85°49'44.77" W	Trim Tree Revetment Branches which Extend into Channel
BDICD.76	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	15		42°43'28.89" N	85°50'13.66" W	Fallen Tree ~ 300' US of 142nd Avenue
BDICD.78	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	22		42°43'25.29" N	85°50'17.82" W	Log Jam
BDICD.79	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	22		42°43'22.41" N	85°50'21.26" W	Log Jam
BDICD.81	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	21		42°43'21.43" N	85°50'24.63" W	Log Jam ~ 200' DS of 30th Street
BDICD.82	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	21		42°43'21.25" N	85°50'24.95" W	Log Jams
BDICD.83	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	21		42°43'21.25" N	85°50'24.95" W	~ 5 Log Jams (Mostly Minor)
BDICD.84	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	21		42°43'14.39" N	85°50'42.32" W	Trim Tree Revetment Branches which Extend into Channel
BDICD.86	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	21		42°43'14.39" N	85°50'42.32" W	Log Jam
BDICD.87	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	21		42°43'08.90" N	85°50'41.35" W	Log Jam
BDICD.88	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	21		42°43'01.05" N	85°50'45.15" W	~ 3 Fallen Trees
BDICD.89	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	21		42°43'00.56" N	85°50'46.17" W	~ 2 Fallen Trees
BDICD.90	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	21		42°42'54.56" N	85°50'52.70" W	Log Jam - Tree Revetment Failure, Well Connected Floodplain
BDICD.91	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	21		42°42'51.74" N	85°50'57.84" W	Remove Tree Revetments, Stable Banks with Well Connected Floodplain
BDICD.92	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	21		42°42'49.70" N	85°51'00.78" W	Log Jam - Tree Revetment Failure
BDICD.93	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	21		42°42'47.50" N	85°51'05.05" W	Log Jam
BDICD.94	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	21		42°42'49.33" N	85°51'05.90" W	Major Log Jam
BDICD.95	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	21		42°42'46.20" N	85°51'07.83" W	Log Jam
BDICD.97	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	21		42°42'43.52" N	85°51'18.26" W	Log Jam
BDICD.98	Debris/Trash/Obstruct	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	21		42°42'38.75" N	85°51'29.25" W	Log Jam
GLS.10	Debris/Trash/Obstruct	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	19		42.425850 N	85°39'03.40" W	Fallen 24" Tree, Well Connected Floodplain
GLS.12	Debris/Trash/Obstruct	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	19		42.425434 N	85°39'06.65" W	Log jam ~ 100' DS
GLS.13	Debris/Trash/Obstruct	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	19		42.425276 N	85°39'08.40" W	Fallen 12" Tree, Tree Revetment Maintenance
GLS.17	Debris/Trash/Obstruct	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	19		42.424242 N	85°39'17.87" W	Major Log Jam
GLS.18	Debris/Trash/Obstruct	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	19		42.423675 N	85°39'16.90" W	Log Jam ~ 100' US of 140th Avenue Crossing
GLS.24	Debris/Trash/Obstruct	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	30		42.422534 N	85°39'25.33" W	Minor Log Jam
GLS.25	Debris/Trash/Obstruct	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	30		42.422424 N	85°39'25.93" W	Major Log Jam
GLS.33	Debris/Trash/Obstruct	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	30		42.420925 N	85°39'30.80" W	Begin Log Jams
GLS.35	Debris/Trash/Obstruct	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	30		42.420817 N	85°39'28.26" W	End Log Jams, Several Major Log Jams
GLS.37	Debris/Trash/Obstruct	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	30		42.420212 N	85°39'24.41" W	Log Jam & Fence Across Drain US of RR Crossing
GLS.4	Debris/Trash/Obstruct	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	19		42.431410 N	85°38'48.51" W	Tree Revetment Maintenance
GLS.48	Debris/Trash/Obstruct	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	31		42.413112 N	85°39'23.43" W	Minor Log Jam
GLS.5	Debris/Trash/Obstruct	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	19		42.431360 N	85°38'49.60" W	Minor Log Jam
GLS.6	Debris/Trash/Obstruct	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	19		42.430795 N	85°38'51.92" W	Minor Log Jam
GLS.7	Debris/Trash/Obstruct	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	19		42.430290 N	85°38'57.13" W	Fallen 18"-24" Tree
GLS.9	Debris/Trash/Obstruct	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	19		42.430285 N	85°38'57.10" W	Minor Log Jam
MILMNT0601	Debris/Trash/Obstruct	10/19/2007	AM/KJV/SFM	Miller Creek	Allegan	Monterey	6	NW	N. 42.68034	W. 85.89670	Large cement bridge in stream
MILMNT0601	Debris/Trash/Obstruct	10/19/2007	AM/KJV/SFM	Miller Creek					42.68034	-85.89670	Large cement bridge in stream
MILMNT0602	Debris/Trash/Obstruct	10/19/2007	AM/KJV/SFM	Miller Creek					42.68010	-85.89662	Large cement bridge in stream

MILMNT0602	Debris/Trash/Obstruct	10/19/2007	AM/KJV/SFM	Miller Creek	Allegan	Monterey	6	NW	N. 42.68010	W. 85.89662	Large cement bridge in stream
MLMNT0606	Debris/Trash/Obstruct	10/19/2007	AM/KJV/SFM	Miller Creek	Allegan	Monterey	6	NW	N. 42.67711	W. 85.89475	
MLMNT0606	Debris/Trash/Obstruct	10/19/2007	AM/KJV/SFM	Miller Creek					42.67711	-85.89475	
MLMNT0607	Debris/Trash/Obstruct	10/19/2007	AM/KJV/SFM	Miller Creek	Allegan	Monterey	6	NW	N. 42.67407	W. 85.89097	
MLMNT0607	Debris/Trash/Obstruct	10/19/2007	AM/KJV/SFM	Miller Creek					42.67407	-85.89097	
STA 278+00 A	Debris/Trash/Obstruct	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins	5	SW	N 42.67041	W. 85.75130	
STA 278+00 A	Debris/Trash/Obstruct	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins			42.67041	-85.75130	
STA 297+00	Debris/Trash/Obstruct	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins	5	SW	N. 42.67297	W. 85.75673	
STA 297+00	Debris/Trash/Obstruct	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins			42.67297	-85.75673	
BKC HT 14 01	Debris/Trash/Obstruct	10/31/2007	LBN/SFM	Buskirk Creek	Allegan	Hopkins	14	NW	N. 42.64563	W 085.70231	
BKC HT 14 04	Debris/Trash/Obstruct	10/31/2007	LBN/SFM	Buskirk Creek	Allegan	Hopkins	15	NE	N. 42.64586	W 085. 70435	
BKC HT 15 02	Debris/Trash/Obstruct	10/31/2007	LBN/SFM	Buskirk Creek	Allegan	Hopkins	15	NE	N. 42.6469	W 085.70565	
BKC HT 15 05	Debris/Trash/Obstruct	10/31/2007	LBN/SFM	Buskirk Creek	Allegan	Hopkins	15	NE	N. 42.64604	W 085. 70381	
BKC HT 15 06	Debris/Trash/Obstruct	10/31/2007	LBN/SFM	Buskirk Creek	Allegan	Hopkins	15	NE	N. 42.64604	W 085.70305	
BKCHT1401	Debris/Trash/Obstruct	10/31/2007	LBN/SFM	Buskirk Creek					42.64563	-85.70231	
BKCHT1404	Debris/Trash/Obstruct	10/31/2007	LBN/SFM	Buskirk Creek					42.64586	-85.70435	
BKCHT1502	Debris/Trash/Obstruct	10/31/2007	LBN/SFM	Buskirk Creek					42.64690	-85.70565	
BKCHT1505	Debris/Trash/Obstruct	10/31/2007	LBN/SFM	Buskirk Creek					42.64604	-85.70381	
BKCHT1506	Debris/Trash/Obstruct	10/31/2007	LBN/SFM	Buskirk Creek					42.64604	-85.70305	
202+00	Debris/Trash/Obstruct	11/1/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	8	NE	N 42.66090	W 85.74619	
225+00	Debris/Trash/Obstruct	11/1/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	8	NE	N 42.66361	W 85.74438	
234+00	Debris/Trash/Obstruct	11/1/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	8	NE	N 42.66430	W 85.74733	
264+00	Debris/Trash/Obstruct	11/1/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	5	SW	N 42.66914	W 85.74977	
202+00	Debris/Trash/Obstruct	11/1/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.66090	-85.74619	
225+00	Debris/Trash/Obstruct	11/1/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.66361	-85.74438	
234+00	Debris/Trash/Obstruct	11/1/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.66430	-85.74733	
264+00	Debris/Trash/Obstruct	11/1/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.66914	-85.74977	
184+00	Debris/Trash/Obstruct	11/2/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	8	SE	N 42.65789	W 85.74662	
185+00	Debris/Trash/Obstruct	11/2/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	8	SE	N 42.65837	W 85.74608	
194+00	Debris/Trash/Obstruct	11/2/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	8	SE	N 42.658373	W 85.74432	
201+00	Debris/Trash/Obstruct	11/2/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	8	SE	N 42.65949	W 85.74604	LOG JAM
204+00	Debris/Trash/Obstruct	11/2/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	8	SE	N 42.65973	W 85.74705	
184+00	Debris/Trash/Obstruct	11/2/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.65789	-85.74662	
185+00	Debris/Trash/Obstruct	11/2/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.65837	-85.74608	
194+00	Debris/Trash/Obstruct	11/2/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.65837	-85.74432	
201+00	Debris/Trash/Obstruct	11/2/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.65949	-85.74604	LOG JAM
204+00	Debris/Trash/Obstruct	11/2/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.65973	-85.74705	
122+00	Debris/Trash/Obstruct	11/5/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	17	NE	N 42.65184	W 85.75072	
122+00	Debris/Trash/Obstruct	11/5/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.65184	-85.75072	
Blk.Byr.32.001	Debris/Trash/Obstruct	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Kent	Byron	32		42.77862	-85.76214	Minor Debris/Trash/Obstruct, US of Wilson Ave.
Blk.Jam.25.002	Debris/Trash/Obstruct	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	25		42.79289	-85.78814	Minor Debris/Trash/Obstruct
Blk.Jam.25.003	Debris/Trash/Obstruct	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	25		42.79305	-85.78967	Minor Debris/Trash/Obstruct / Fallen Tree
Blk.Jam.25.007	Debris/Trash/Obstruct	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	25		42.79066	-85.79508	Minor Debris/Trash/Obstruct
Blk.Jam.25.009	Debris/Trash/Obstruct	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	25		NA	NA	Minor Debris/Trash/Obstruct, Typ. DS of Point No. 15
Blk.Jam.25.012	Debris/Trash/Obstruct	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	25		42.79032	-85.79845	Minor Debris/Trash/Obstruct
Blk.Jam.25.013	Debris/Trash/Obstruct	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	25		42.78995	-85.79844	Minor Debris/Trash/Obstruct / Minor Erosion at Toe of Bank
Blk.Jam.25.015	Debris/Trash/Obstruct	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	25		NA	NA	Debris/Trash/Obstruct, ~ 300' DS of No. 22
Blk.Jam.25.016	Debris/Trash/Obstruct	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	25		42.79073	-85.80298	Minor Debris/Trash/Obstruct, US of 8th Ave.
Blk.Jam.26.005	Debris/Trash/Obstruct	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	26		NA	NA	Minor Debris/Trash/Obstruct / Vegetation Buildup in Drain, ~ 400' DS of No. 27
Blk.Jam.26.006	Debris/Trash/Obstruct	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	26		NA	NA	Debris/Trash/Obstruct, ~ 1,500' DS of No. 27 (~ Sta. 185+00)
Blk.Jam.26.009	Debris/Trash/Obstruct	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	26		42.78695	-85.81131	Fence Across Drain
Blk.Jam.34.003	Debris/Trash/Obstruct	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	34		42.77460	-85.83467	Minor Debris/Trash/Obstruct
Blk.Jam.34.006	Debris/Trash/Obstruct	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	34		42.77439	-85.83871	Fallen ~ 30" Tree
Blk.Jam.34.007	Debris/Trash/Obstruct	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	34		42.77441	-85.84096	Minor Debris/Trash/Obstruct / Highly Sinuous Stream Pattern, Well Connected Floodplain, Thick Veg.
Blk.Jam.32.005	Debris/Trash/Obstruct	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Ottawa	Jamestown	32		42.77038	-85.87387	Debris/Trash/Obstruct / Typ. Channel - Stable, ~ 3' High Banks
Blk.Jam.32.007	Debris/Trash/Obstruct	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Ottawa	Jamestown	32		42.76071	-85.87799	Debris Pile along Right Bank (Remove) / Typ. Channel - Stable, Thick Veg.
Blk.Jam.33.002	Debris/Trash/Obstruct	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Ottawa	Jamestown	33		42.77332	-85.84171	Minor Debris/Trash/Obstructs DS of 24th Ave.
Blk.Jam.33.004	Debris/Trash/Obstruct	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Ottawa	Jamestown	33		42.77303	-85.84261	Debris/Trash/Obstruct
Blk.Jam.33.006	Debris/Trash/Obstruct	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Ottawa	Jamestown	33		42.77239	-85.84656	Debris/Trash/Obstruct
Blk.Jam.33.008	Debris/Trash/Obstruct	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Ottawa	Jamestown	33		42.77145	-85.84712	Minor Debris/Trash/Obstruct
Blk.Jam.33.011	Debris/Trash/Obstruct	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Ottawa	Jamestown	33		42.7707	-85.85452	Minor Debris/Trash/Obstruct
Blk.Jam.33.012	Debris/Trash/Obstruct	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Ottawa	Jamestown	33		42.77116	-85.85596	Steel I-Beam Bridge Washout (Remove)
Blk.Jam.33.014	Debris/Trash/Obstruct	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Ottawa	Jamestown	33		42.7709	-85.85791	Major Debris/Trash/Obstruct / Debris/Trash/Obstructs
Blk.Jam.33.015	Debris/Trash/Obstruct	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Ottawa	Jamestown	33		42.77125	-85.85814	2 Fallen 24" Trees
Blk.Sal.6.004	Debris/Trash/Obstruct	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Salem	6		42.74729	-85.88415	Major Debris/Trash/Obstruct (Remove Leaning 30" Tree)
Blk.Sal.6.007	Debris/Trash/Obstruct	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Salem	6		42.74053	-85.8931	Minor Debris/Trash/Obstruct
Blk.Sal.6.009	Debris/Trash/Obstruct	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Salem	6		42.73959	-85.89347	Minor Debris/Trash/Obstruct
Blk.Ove.13.002	Debris/Trash/Obstruct	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Overisal	13		42.724	-85.91429	Fallen Tree / Typ. DS Channel - Lack of Buffer, Fairly Stable Channel Banks
Blk.Ove.24.002	Debris/Trash/Obstruct	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Overisal	24		42.71668	-85.91707	Minor Debris/Trash/Obstruct / Typ. Channel, Well Connected Floodplain, Fairly Stable Channel Banks
Blk.Ove.24.003	Debris/Trash/Obstruct	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Overisal	24		42.71538	-85.91312	Debris/Trash/Obstruct
Blk.Ove.24.005	Debris/Trash/Obstruct	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Overisal	24		NA	NA	Debris/Trash/Obstruct, DS of No. 120
Blk.Ove.24.006	Debris/Trash/Obstruct	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Overisal	24		42.71501	-85.90767	Abandoned Wooden Footbridge (Remove)
Blk.Ove.25.001	Debris/Trash/Obstruct	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Overisal	25		42.70949	-85.89849	Minor Debris/Trash/Obstruct / Typ. Channel, Well Connected Floodplain, Fairly Stable Channel Banks
Blk.Ove.25.002	Debris/Trash/Obstruct	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Overisal	25		42.7081	-85.89975	Minor Debris/Trash/Obstruct / Minor Erosion at Toe of Bank
Blk.Ove.25.003	Debris/Trash/Obstruct	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Overisal	25		42.70659	-85.90161	Minor Debris/Trash/Obstruct
Blk.Ove.25.004	Debris/Trash/Obstruct	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Overisal	25		42.7049	-85.8993	Debris/Trash/Obstruct
Blk.Ove.25.005	Debris/Trash/Obstruct	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Overisal	25		42.70447	-85.89951	Debris/Trash/Obstruct / Minor Sediment Buildup in Center of Channel
Blk.Sal.18.004	Debris/Trash/Obstruct	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Salem	18		42.72466	-85.90418	Irrigation Pump Intake, May Catch Debris and Cause Debris/Trash/Obstruct to Flow
Blk.Sal.7.002	Debris/Trash/Obstruct	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Salem	7		42.73718	-85.89318	Minor Debris/Trash/Obstruct
RRDO31 52 08	Debris/Trash/Obstruct	5/2/2008	SFM	Rabbit River	Allegan	Dorr	31	SE	N. 42.6815	W. 85.76503	

NPS Inventory Results - Livestock Access

SITE_ID	POLLUTANT SOURCE	DATE	INVEST	NAME	COUNTY	TWP	SEC	QTR1	LAT	LONG	COMMENTS
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Salem	2				
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Salem	2				
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Salem	2				
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Dorr	7				
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Dorr	7				
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Dorr	7				
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Dorr	8				
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Salem	10				
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Salem	11				
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Dorr	12				
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Dorr	12				
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Salem	12				
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Dorr	13				
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Dorr	13				
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Salem	14				
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Dorr	16				
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Dorr	16				
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Dorr	17				
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Dorr	18				
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Dorr	18				
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Dorr	21				
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Dorr	21				
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Dorr	22				
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Dorr	22				
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Dorr	23				
	Livestock Access	6/1/1996		Little Rabbit River	Allegan	Dorr	26				
BSDAT0102	Livestock Access	1/1/2000		Bear Swamp Drain	Allegan	Allegan	1				
BSDAT0103	Livestock Access	1/1/2000		Bear Swamp Drain	Allegan	Allegan	1				
BSDHT2002	Livestock Access	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	20				
BSDHT2003	Livestock Access	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	20				
BSDHT2502	Livestock Access	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	25				
BSDHT2503	Livestock Access	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	25				
BSDHT2802	Livestock Access	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	28				
BSDHT2803	Livestock Access	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	28				
BSDHT2902	Livestock Access	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	29				
BSDHT2903	Livestock Access	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	29				
GLSLT0603	Livestock Access	1/1/2000		Green Lake Stream	Allegan	Leighton	6				
GLSLT0604	Livestock Access	1/1/2000		Green Lake Stream	Allegan	Leighton	6				
GLSLT1801	Livestock Access	1/1/2000		Green Lake Stream	Allegan	Leighton	18				
GLSLT1802	Livestock Access	1/1/2000		Green Lake Stream	Allegan	Leighton	18				
GLSLT2003	Livestock Access	1/1/2000		Green Lake Stream	Allegan	Leighton	20				
GLSLT2004	Livestock Access	1/1/2000		Green Lake Stream	Allegan	Leighton	20				
GLSLT2202	Livestock Access	1/1/2000		Green Lake Stream	Allegan	Leighton	22				
GLSLT2203	Livestock Access	1/1/2000		Green Lake Stream	Allegan	Leighton	22				
GLSLT2902	Livestock Access	1/1/2000		Green Lake Stream	Allegan	Leighton	29				
GLSLT2903	Livestock Access	1/1/2000		Green Lake Stream	Allegan	Leighton	29				
GLSLT3001	Livestock Access	1/1/2000		Green Lake Stream	Allegan	Leighton	30				
GLSLT3302	Livestock Access	1/1/2000		Green Lake Stream	Allegan	Leighton	33				
GLSLT3303	Livestock Access	1/1/2000		Green Lake Stream	Allegan	Leighton	33				
GLSLT3402	Livestock Access	1/1/2000		Green Lake Stream	Allegan	Leighton	34				
MLCWT0301	Livestock Access	1/1/2000		Miller Creek	Allegan	Watson	3				
MLCWT1202	Livestock Access	1/1/2000		Miller Creek	Allegan	Watson	12				
MLCWT1203	Livestock Access	1/1/2000		Miller Creek	Allegan	Watson	12				
URRWT0901	Livestock Access	1/1/2000		Upper Rabbit River	Allegan	Wayland	9				
URRWT0902	Livestock Access	1/1/2000		Upper Rabbit River	Allegan	Wayland	9				
URRWT1002	Livestock Access	1/1/2000		Upper Rabbit River	Allegan	Wayland	10				
LRRDT0702	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Dorr	7				
LRRDT0703	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Dorr	7				
LRRDT0704	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Dorr	7				
LRRDT0802	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Dorr	8				
LRRDT1202	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Dorr	12				
LRRDT1203	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Dorr	12				
LRRDT1302	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Dorr	13				

LRRDT1303	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Dorr	13			
LRRDT1602	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Dorr	16			
LRRDT1603	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Dorr	16			
LRRDT1702	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Dorr	17			
LRRDT1802	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Dorr	18			
LRRDT1803	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Dorr	18			
LRRDT2102	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Dorr	21			
LRRDT2103	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Dorr	21			
LRRDT2202	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Dorr	22			
LRRDT2203	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Dorr	22			
LRRDT2302	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Dorr	23			
LRRDT2602	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Dorr	26			
LRRST0202	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Salem	2			
LRRST0203	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Salem	2			
LRRST0204	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Salem	2			
LRRST1002	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Salem	10			
LRRST1102	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Salem	11			
LRRST1202	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Salem	12			
LRRST1402	Livestock Access	3/1/2000		Little Rabbit River	Allegan	Salem	14			
BDICD.70	Livestock Access	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	15	42°44'00.16" N	85°49'16.52" W	Begin Unlimited Access, Devoid of Veg., Severe Bank Erosion along Outside Bends
BDICD.71	Livestock Access	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	15	42°43'52.40" N	85°49'31.62" W	End Unlimited Access, Devoid of Veg., Severe Bank Erosion along Outside Bends
BDICD.74	Livestock Access	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	15	42°43'42.00" N	85°49'54.90" W	Begin Unlimited Access, Bank Erosion from Livestock
BDICD.75	Livestock Access	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	15	42°43'28.89" N	85°50'13.66" W	End Unlimited Access, Bank Erosion from Livestock
GLS.28	Livestock Access	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	30	42.442288 N	85°39'30.03" W	Uncontrolled Access, Trampled Banks, 4'-5' High Bank Erosion
GLS.30	Livestock Access	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	30	42.421900 N	85°39'28.28" W	Uncontrolled Access, Streambank Erosion, Fence Across Drain
GLS.31	Livestock Access	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	30	42.421380 N	85°39'13.80" W	Typical Uncontrolled Access, Property Owner Dislikes Tree Revetments - Snag Cattle
GLS.34	Livestock Access	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	30	42.420925 N	85°39'30.80" W	Uncontrolled Access, ~ 100 LF of 4'-5' High Bank Erosion (West Bank)
GLS.36	Livestock Access	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	30	42.420212 N	85°39'24.41" W	Uncontrolled Access, 1'-2' High Bank Erosion at Toe of Slope
GLS.50	Livestock Access	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	31	42.412485 N	85°39'26.81" W	Uncontrolled Access, 50 LF of 4' High Bank Erosion
Near 130th	Livestock Access	7/7/2007		Rabbit River	Allegan	Hopkins				From Aerial Photo & Methods for completing warsss rrissc
Blk.Jam.26.003	Livestock Access	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	26	42.78977	-85.80336	Uncontrolled Livestock Access, Bank Erosion
Blk.Jam.26.007	Livestock Access	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	26	NA	NA	Uncontrolled Livestock Access, Bank Erosion, Begins near Sta. 195+00
Blk.Jam.26.010	Livestock Access	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	26	NA	NA	Uncontrolled Livestock Access, Typ. Bank Erosion along Outside Channel Bends
Blk.Jam.26.013	Livestock Access	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	26	NA	NA	Uncontrolled Livestock Access Ends ~ Sta. 218+00
Blk.Ove.24.008	Livestock Access	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Overisal	24	NA	NA	Uncontrolled Livestock Access, Bank Erosion, ~ Sta. 785+00 to 140th Ave. (Sta. 792+50)

NPS Inventory Results - Streambank Erosion

SITE_ID	POLLUTANT SOURCE	DATE	INVEST	NAME	COUNTY	TWP	SEC	QTR1	LAT	LONG	COMMENTS
	Streambank Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	4				
	Streambank Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	8				
	Streambank Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	9				
	Streambank Erosion	6/1/1996		Little Rabbit River	Allegan	Salem	13				
	Streambank Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	16				
	Streambank Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	17				
	Streambank Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	18				
	Streambank Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	21				
	Streambank Erosion	6/1/1996		Little Rabbit River	Allegan	Dorr	23				
BSDHT2703	Streambank Erosion	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	27				
BSDMT1302	Streambank Erosion	1/1/2000		Bear Swamp Drain	Allegan	Monterey	13				
BSDMT3602	Streambank Erosion	1/1/2000		Bear Swamp Drain	Allegan	Monterey	36				
URRWT1003	Streambank Erosion	1/1/2000		Upper Rabbit River	Allegan	Wayland	10				
LRRDT0403	Streambank Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	4				
LRRDT0803	Streambank Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	8				
LRRDT0902	Streambank Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	9				
LRRDT1604	Streambank Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	16				
LRRDT1703	Streambank Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	17				
LRRDT1804	Streambank Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	18				
LRRDT2104	Streambank Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	21				
LRRDT2303	Streambank Erosion	3/1/2000		Little Rabbit River	Allegan	Dorr	23				
LRRST1302	Streambank Erosion	3/1/2000		Little Rabbit River	Allegan	Salem	13				
BDICD.17	Streambank Erosion	6/27/2007	DF2, BS - ACDC	Byron Dorr ICD	Allegan	Dorr	4		42°45'33.78" N	85°44'14.71" W	~ 50 LF of Minor Erosion along Upper East Bank, Fairly Stable Toe, < 10' High Bank
BDICD.19	Streambank Erosion	6/27/2007	DF2, BS - ACDC	Byron Dorr ICD	Allegan	Dorr	4		42°45'31.35" N	85°44'14.70" W	~ 20 LF of Minor Erosion along Upper East Bank, Fairly Stable Toe, < 10' High Bank
BDICD.22	Streambank Erosion	6/27/2007	DF2, BS - ACDC	Byron Dorr ICD	Allegan	Dorr	9		42°44'51.62" N	85°44'28.69" W	~ 50 LF of Severe Erosion along 10' High East Bank - Requires Riprap by Contractor
BDICD.28	Streambank Erosion	6/27/2007	DF2, BS - ACDC	Byron Dorr ICD	Allegan	Dorr	17		42°44'04.86" N	85°45'21.07" W	~ 100 LF of Mild Erosion along 5' High East Bank
BDICD.29	Streambank Erosion	6/27/2007	DF2, BS - ACDC	Byron Dorr ICD	Allegan	Dorr	17		42°43'57.02" N	85°45'42.19" W	~ 50 LF of Mild Erosion along 5' High Bank, ~ 300' US of 22nd Street Bridge
BDICD.35	Streambank Erosion	6/27/2007	DF2, BS - ACDC	Little Rabbit River	Allegan	Dorr	18		42°43'56.51" N	85°46'05.57" W	~ 50 LF of Mild Erosion along 8' High Bank
BDICD.37	Streambank Erosion	6/27/2007	DF2, BS - ACDC	Little Rabbit River	Allegan	Dorr	18		42°43'56.51" N	85°46'07.82" W	~ 100 LF of Mild Erosion along 10' High South Bank, Clay Bank w/ Sand Layer at Toe
BDICD.39	Streambank Erosion	6/27/2007	DF2, BS - ACDC	Little Rabbit River	Allegan	Dorr	18		42°44'03.16" N	85°46'25.88" W	Minor Bank Erosion along Outside Channel Bends
BDICD.44	Streambank Erosion	6/27/2007	DF2, BS - ACDC	Little Rabbit River	Allegan	Dorr	18		42°44'03.16" N	85°46'25.88" W	Minor Bank Erosion along Outside Channel Bends
BDICD.60	Streambank Erosion	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	14		42°43'59.73" N	85°48'26.07" W	~ 100 LF of 5' to 8' High Erosion along North Bank (Outside Bend)
BDICD.62	Streambank Erosion	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	14		42°44'05.79" N	85°48'28.85" W	Bank Erosion along Outer Bend
BDICD.85	Streambank Erosion	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	21		42°43'14.39" N	85°50'42.32" W	~ 30 LF of Severe Bank Erosion, ~ 20' High Bank
GLS.11	Streambank Erosion	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	19		42.425434 N	85°39'06.65" W	75 LF of 3' High Bank Erosion along Outside Bend
GLS.14	Streambank Erosion	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	19		42.425212 N	85°39'09.95" W	3' High Bank Erosion along Outside Bends, Typical Mowed Yard
GLS.15	Streambank Erosion	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	19		42.425070 N	85°39'10.78" W	Wood Footbridge & 4' High Bank Erosion ~ 50' DS
GLS.20	Streambank Erosion	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	30		42.423387 N	85°39'21.00" W	50 LF of 3' High Mild Bank Erosion on West Bank
GLS.21	Streambank Erosion	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	30		42.423065 N	85°39'23.38" W	24" Fallen Tree
GLS.23	Streambank Erosion	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	30		42.423041 N	85°39'25.45" W	100 LF of 10' High Bank Erosion
GLS.27	Streambank Erosion	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	30		42.422367 N	85°39'28.01" W	50 LF of 5' High Bank Erosion & Fence Across Drain ~ 50' DS of RR X-ing
GLS.3	Streambank Erosion	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	19		42.431954 N	85°38'41.03" W	50 LF of Bank Erosion, 5' High Bank, Clay Soils
GLS.32	Streambank Erosion	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	30		42.421120 N	85°39'30.30" W	Typical < 3' High Bank Erosion along Outside Bend
GLS.39	Streambank Erosion	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	30		42.415979 N	85°39'23.42" W	75 LF & 50 LF of 4' High Bank Erosion
GLS.40	Streambank Erosion	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	30		42.415420 N	85°39'22.65" W	50 LF of 4' High Bank Erosion
GLS.42	Streambank Erosion	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	31		42.413095 N	85°39'18.45" W	Bank Erosion along Outside Channel Bends between 138th Ave. & RR Crossing
GLS.44	Streambank Erosion	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	31		42.413095 N	85°39'18.45" W	100 LF of 4' High Bank Erosion DS of RR Crossing (High Near Bank Stress)
GLS.45	Streambank Erosion	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	31		42.413130 N	85°39'21.04" W	75 LF of 4' High Bank Erosion
GLS.46	Streambank Erosion	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	31		42.413000 N	85°39'21.18" W	150 LF of 4' High Bank Erosion, Erosion along Outside Channel Bends (Typical)
GLS.47	Streambank Erosion	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	31		42.413112 N	85°39'23.43" W	200 LF of Severe Erosion along 15' High West Bank
GLS.49	Streambank Erosion	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	31		42.412729 N	85°39'27.00" W	100 LF of 5' to 10' High Bank Erosion, DS Uncontrolled Access
GLS.51	Streambank Erosion	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	31		42.412079 N	85°39'27.20" W	100 LF of 3' High Bank Erosion, Uncontrolled Access
GLS.8	Streambank Erosion	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	19		42.430285 N	85°38'57.10" W	Typical 1'-2' High Bank Erosion at Toe of Slope along Outside Bend
STA 10+00 B	Streambank Erosion	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins	17	SW	N. 42.63914	W 85.75849	
STA 10+00 B	Streambank Erosion	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins			42.63914	-85.75849	
STA 127+00	Streambank Erosion	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins	17	NE	N. 42.65155	W 85.74919	
STA 127+00	Streambank Erosion	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins			42.65155	-85.74919	
STA 275+00	Streambank Erosion	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins	5	SW	N. 42.66945	W 85.75118	
STA 275+00	Streambank Erosion	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins			42.66945	-85.75118	
STA 276+00	Streambank Erosion	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins	5	SW	?	?	
STA 276+00	Streambank Erosion	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins					
STA 278+00 C	Streambank Erosion	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins	5	SW	N 42.67041	W. 85.75130	

STA 278+00 C	Streambank Erosion	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins			42.67041	-85.75130		
STA 280+00	Streambank Erosion	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins	5	SW	N. 42.67044	W. 85.75156	Log Jam	
STA 280+00	Streambank Erosion	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins			42.67044	-85.75156	Log Jam	
STA 295+00	Streambank Erosion	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins	5	SW	N. 42.67238	W. 85.75645	Bank erosion caused by log jam	
STA 295+00	Streambank Erosion	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins			42.67238	-85.75645	Bank erosion caused by log jam	
STA 305+00	Streambank Erosion	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins	5	SW	N. 42.67340	W. 85.75816		
STA 305+00	Streambank Erosion	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins			42.67340	-85.75816		
STA 307+00 A	Streambank Erosion	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins	5	SW	N. 42.67401	W. 85.75868	Rip-rap placed at site	
STA 307+00 A	Streambank Erosion	10/24/2007	KJV	Bear Swamp Drain RRE	Allegan	Hopkins			42.67401	-85.75868	Rip-rap placed at site	
81+00	Streambank Erosion	10/31/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS						
81+00	Streambank Erosion	10/31/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins						
212+00	Streambank Erosion	11/1/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	8	NE	N 42.66147	W 85.74519		
225+00	Streambank Erosion	11/1/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	8	NE	N 42.66361	W 85.74438		
244+00	Streambank Erosion	11/1/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	8	NE	N 42.66628	W 85.74820		
258+00	Streambank Erosion	11/1/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	5	SE	N 42.66894	W 85.74809		
263+00	Streambank Erosion	11/1/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	5	SE	N 42.66914	W 85.74925		
269+00	Streambank Erosion	11/1/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	5	SW	N 42.66848	W 85.75118		
272+00	Streambank Erosion	11/1/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	5	SW	N 42.66872	W 85.75174		
212+00	Streambank Erosion	11/1/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.66147	-85.74519		
225+00	Streambank Erosion	11/1/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.66361	-85.74438		
244+00	Streambank Erosion	11/1/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.66628	-85.74820		
258+00	Streambank Erosion	11/1/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.66894	-85.74809		
263+00	Streambank Erosion	11/1/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.66914	-85.74925		
269+00	Streambank Erosion	11/1/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.66848	-85.75118		
272+00	Streambank Erosion	11/1/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.66872	-85.75174		
147+00	Streambank Erosion	11/2/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	8	SE	N 42.65370	W 85.74775		
177+00	Streambank Erosion	11/2/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	8	SE	N 42.65734	W 85.74480		
184+00	Streambank Erosion	11/2/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	8	SE	N 42.65789	W 85.74662		
185+00	Streambank Erosion	11/2/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	8	SE	N 42.65837	W 85.74608		
194+00	Streambank Erosion	11/2/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	8	SE	N 42.658373	W 85.74432		
204+00	Streambank Erosion	11/2/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	8	SE	N 42.65973	W 85.74705		
147+00	Streambank Erosion	11/2/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.65370	-85.74775		
177+00	Streambank Erosion	11/2/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.65734	-85.74480		
184+00	Streambank Erosion	11/2/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.65789	-85.74662		
185+00	Streambank Erosion	11/2/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.65837	-85.74608		
194+00	Streambank Erosion	11/2/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.65837	-85.74432		
204+00	Streambank Erosion	11/2/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.65973	-85.74705		
105+00	Streambank Erosion	11/5/2007	KJV	BEAR SWAMP DRAIN, RABBIT RIVER EXTENSION	ALLEGAN	HOPKINS	17	NW	N 42.65007	W 85.75320		
105+00	Streambank Erosion	11/5/2007	KJV	Bear Swamp Drain, Rabbit River Extens	Allegan	Hopkins			42.65007	-85.75320		
Blk.Byr.30.002	Streambank Erosion	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Kent	Byron	30		42.79018	-85.78053	~ 50 LF of Erosion along 8' High Right Bank	
Blk.Jam.25.010	Streambank Erosion	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	25		NA	NA	Areas of Minor Erosion along Toe of Bank (< 4' High), DS of No. 15	
Blk.Jam.25.014	Streambank Erosion	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	25		42.79001	-85.80017	~ 50 LF of Erosion along 8' High Right Bank	
Blk.Jam.26.014	Streambank Erosion	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	26		42.78880	-85.81800	~ 100 LF of Erosion along 3' High Right Bank	
Blk.Jam.26.016	Streambank Erosion	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	26		42.78866	-85.81804	Typ. Bank Erosion along Outside Channel Bends	
Blk.Jam.27.004	Streambank Erosion	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	27		NA	NA	Erosion along Left Bank (Adams St.) near Sta. 257+00	
Blk.Jam.34.002	Streambank Erosion	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	34		42.77461	-85.83431	~ 50 LF of Erosion along 20' High Left Bank near Sta. 290+00	
Blk.Jam.34.004	Streambank Erosion	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	34		42.77502	-85.83657	Erosion along Toe of Right Bank, Channel against Valley Wall	
Blk.Jam.34.005	Streambank Erosion	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	34		42.77439	-85.83871	~ 100 LF of Erosion along 15' Toe of Right Bank, Channel against Valley Wall	
Blk.Jam.34.009	Streambank Erosion	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	34		NA	NA	Highly Sinuous Stream Pattern, Erosion along ~ 3' High Banks	
Blk.Jam.32.002	Streambank Erosion	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Ottawa	Jamestown	32		42.77183	-85.86142	Typ. Erosion along Outside Bend of ~ 6' High Banks, DS of 32nd Ave.	
Blk.Jam.32.003	Streambank Erosion	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Ottawa	Jamestown	32		NA	NA	Typ. Minor Erosion along Outside Bend of ~ 3' High Banks, between 32nd Ave. & Mud Lake	
Blk.Jam.32.004	Streambank Erosion	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Ottawa	Jamestown	32		42.77081	-85.87181	Minor Erosion along Toe of Bank, DS of Grade Control Structure	
Blk.Jam.33.003	Streambank Erosion	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Ottawa	Jamestown	33		42.77303	-85.84261	Typ. Minor Erosion along Outside Bend of ~ 5' High Banks, DS of 24th Ave.	
Blk.Jam.33.005	Streambank Erosion	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Ottawa	Jamestown	33		42.77276	-85.84499	~ 50 LF of Erosion along 5' High Right Bank (Remove Leaning Trees)	
Blk.Jam.33.007	Streambank Erosion	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Ottawa	Jamestown	33		42.77239	-85.84656	Typ. Minor Erosion along Outside Bend of ~ 5' High Banks, DS of 24th Ave.	
Blk.Jam.33.009	Streambank Erosion	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Ottawa	Jamestown	33		42.77145	-85.84712	Highly Sinuous Stream Pattern, Typ. Erosion along Outside Bend of ~ 5' High Banks	
Blk.Jam.33.010	Streambank Erosion	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Ottawa	Jamestown	33		42.7707	-85.85452	Typ. Erosion along Outside Bend of ~ 6' High Banks	
Blk.Jam.33.013	Streambank Erosion	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Ottawa	Jamestown	33		42.77087	-85.85646	~ 50 LF of Erosion along ~ 6' High Left Bank, DS Re-Aligned Channel w/ Bank Erosion	
Blk.Jam.33.016	Streambank Erosion	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Ottawa	Jamestown	33		42.77125	-85.85814	~ 75 LF of Erosion along ~ 10' High Left Bank	
Blk.Ove.24.004	Streambank Erosion	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Overisal	24		42.71514	-85.91197	~ 75 LF of Erosion along US 4' High Right Bank, ~ 75 LF of Erosion along DS 4' High Left Bank	
Blk.Sal.18.003	Streambank Erosion	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Salem	18		NA	NA	Typ. Erosion DS of No. 112 (Potential Channel Re-alignment from ~ Sta. 667+50 to 671+00)	
Blk.Sal.7.005	Streambank Erosion	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Salem	7		NA	NA	~ 50 LF of Erosion along 8' High Right Bank, ~ 300' DS of No. 101	
Blk.Sal.7.007	Streambank Erosion	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Salem	7		42.73447	-85.89273	Begin - Typ. Erosion along Outside Bend of 4'-8' High Banks / (Remove Leaning Trees)	
Blk.Sal.7.008	Streambank Erosion	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Salem	7		42.73441	-85.89292	End - Typ. Erosion along Outside Bend of 4'-8' High Banks	
PIG SAT 34 01	Streambank Erosion	2/25/2008	SFM	Pigeon Creek	Allegan	Salem	34	SW	N. 42.688838	W. 85.741445		

SITE_ID	POLLUTANT SOURCE	DATE	INVEST	NAME	COUNTY	TWP	SEC	QTR1	LAT	LONG	COMMENTS
BSDAT0104	Stream Crossing	1/1/2000		Bear Swamp Drain	Allegan	Allegan	1				
BSDAT1102	Stream Crossing	1/1/2000		Bear Swamp Drain	Allegan	Allegan	11				
BSDHT1903	Stream Crossing	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	19				
BSDHT2303	Stream Crossing	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	23				
BSDHT2702	Stream Crossing	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	27				
BSDHT2905	Stream Crossing	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	29				
BSDHT3002	Stream Crossing	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	30				
BSDHT3104	Stream Crossing	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	31				
BSDHT3502	Stream Crossing	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	35				
BSDHT3602	Stream Crossing	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	36				
GLSLT1002	Stream Crossing	1/1/2000		Green Lake Stream	Allegan	Leighton	10				
GLSLT1103	Stream Crossing	1/1/2000		Green Lake Stream	Allegan	Leighton	11				
GLSLT1401	Stream Crossing	1/1/2000		Green Lake Stream	Allegan	Leighton	14				
GLSLT1604	Stream Crossing	1/1/2000		Green Lake Stream	Allegan	Leighton	16				
GLSLT1702	Stream Crossing	1/1/2000		Green Lake Stream	Allegan	Leighton	17				
GLSLT1803	Stream Crossing	1/1/2000		Green Lake Stream	Allegan	Leighton	18				
GLSLT2702	Stream Crossing	1/1/2000		Green Lake Stream	Allegan	Leighton	27				
GLSLT2905	Stream Crossing	1/1/2000		Green Lake Stream	Allegan	Leighton	29				
GLSLT3403	Stream Crossing	1/1/2000		Green Lake Stream	Allegan	Leighton	34				
URRWT1601	Stream Crossing	1/1/2000		Upper Rabbit River	Allegan	Wayland	16				
URRWT2001	Stream Crossing	1/1/2000		Upper Rabbit River	Allegan	Wayland	20				
BDICD.11	Stream Crossing	6/27/2007	DF2, BS - ACDC	Byron Dorr ICD	Allegan	Dorr	4		42°45'53.72" N	85°44'10.25" W	Old Truss Bridge
BDICD.13	Stream Crossing	6/27/2007	DF2, BS - ACDC	Byron Dorr ICD	Allegan	Dorr	4		42°45'46.78" N	85°44'11.37" W	Footbridge
BDICD.15	Stream Crossing	6/27/2007	DF2, BS - ACDC	Byron Dorr ICD	Allegan	Dorr	4		42°45'41.52" N	85°44'13.87" W	Timber Bridge - Farm Crossing, Tile Outlet ~ 100' DS w/ No Erosion
BDICD.20	Stream Crossing	6/27/2007	DF2, BS - ACDC	Byron Dorr ICD	Allegan	Dorr	9		42°45'15.53" N	85°44'14.23" W	146th Ave. Twin CSP Culverts, Thick Brush / Willows US, Minor DS Erosion
BDICD.25	Stream Crossing	6/27/2007	DF2, BS - ACDC	Byron Dorr ICD	Allegan	Dorr	8		42°44'27.00" N	85°45'06.49" W	21st Street, Twin 12'10"x8'4" Steel Arch Pipe = Good, Ineffective Sediment Basin
BDICD.26	Stream Crossing	6/27/2007	DF2, BS - ACDC	Byron Dorr ICD	Allegan	Dorr	8		42°44'23.32" N	85°45'11.49" W	144th Avenue, Twin 12'10"x8'4" Steel Arch Pipe = Good, Ineffective Sediment Basin
BDICD.30	Stream Crossing	6/27/2007	DF2, BS - ACDC	Little Rabbit River	Allegan	Dorr	18		42°43'57.02" N	85°45'42.19" W	22nd Street Bridge (Photo Looking DS toward Bridge), Ineffective Sediment Basin
BDICD.42	Stream Crossing	6/27/2007	DF2, BS - ACDC	Little Rabbit River	Allegan	Dorr	18		42°44'01.06" N	85°46'17.88" W	23rd Street Bridge = Good
BDICD.50	Stream Crossing	6/27/2007	DF2, BS - ACDC	Little Rabbit River	Allegan	Dorr	18		42°43'56.79" N	85°46'54.40" W	24th Street Bridge = OK
BDICD.55	Stream Crossing	6/27/2007	DF2, BS - ACDC	Little Rabbit River	Allegan	Salem	13		42°43'53.26" N	85°48'04.48" W	26th Street Bridge = OK
BDICD.7	Stream Crossing	6/27/2007	DF2, BS - ACDC	Byron Dorr ICD	Allegan	Dorr	4		NA	NA	108th Ave. Twin CSP Culverts - Poor Upstream Alignment, Sediment at West Culvert
BDICD.1	Stream Crossing	6/29/2007	DF2, AS - WCR	Byron Dorr ICD	Kent	Byron	33		42°46'58.56" N	85°43'17.69" W	100th Street Culvert
BDICD.100	Stream Crossing	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	29		42°42'36.21" N	85°51'47.83" W	140th Avenue Bridge
BDICD.2	Stream Crossing	6/29/2007	DF2, AS - WCR	Byron Dorr ICD	Kent	Byron	33		42°46'51.35" N	85°43'22.00" W	18th Street Culvert
BDICD.66	Stream Crossing	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	14		42°44'08.49" N	85°48'43.85" W	Private Footbridge with Pier which obstructs Channel Flow
BDICD.77	Stream Crossing	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	22		42°43'28.89" N	85°50'13.66" W	142nd Avenue Bridge
BDICD.80	Stream Crossing	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	21		42°43'21.43" N	85°50'24.63" W	30th Street Bridge, DS Pump Station w/ Sheet Piling
BDICD.96	Stream Crossing	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	21		42°42'44.81" N	85°51'10.22" W	Remove Damaged Wooden Footbridge
BDICD.99	Stream Crossing	6/29/2007	DF2, BS, AS	Little Rabbit River	Allegan	Salem	20		42°42'38.80" N	85°51'34.50" W	32nd Street Bridge, US Fallen Log, DS = Excellent
GLS.1	Stream Crossing	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	19		42.432945 N	85°38'38.50" W	142nd Crossing
GLS.16	Stream Crossing	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	19		42.424870 N	85°39'12.58" W	11th (Division) Street Crossing
GLS.19	Stream Crossing	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	30		42.423675 N	85°39'16.90" W	140th Avenue Crossing
GLS.22	Stream Crossing	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	30		42.423090 N	85°39'24.13" W	Snowmobile X-ing
GLS.26	Stream Crossing	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	30		42.422367 N	85°39'28.01" W	RR Crossing
GLS.38	Stream Crossing	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	30		42.420212 N	85°39'24.41" W	RR Crossing
GLS.41	Stream Crossing	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	30		42.414430 N	85°39'20.35" W	138th Avenue Crossing, East Culvert Filled with Sediment - Requires Cleanout
GLS.43	Stream Crossing	7/6/2007	DF2, BS, AS	Green Lake Stream Ext. of the McConnell Drain	Allegan	Leighton	31		42.413095 N	85°39'18.45" W	RR Crossing
Blk.Byr.30.001	Stream Crossing	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Kent	Byron	30		NA	NA	100th St. Culvert
Blk.Byr.31.001	Stream Crossing	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Kent	Byron	31		42.77862	-85.76214	Wilson Ave. Culvert, Thick Vegetation (Willows) DS
Blk.Byr.31.003	Stream Crossing	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Kent	Byron	31		42.77857	-85.76487	Old Iron, Circular Culvert ~ Sta. 17+00
Blk.Jam.25.001	Stream Crossing	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	25		42.79196	-85.78283	Kenowa Ave. 9.5' x 7' CSPA Culvert, DS Muck Farmer wants Drain Cleanout
Blk.Jam.25.004	Stream Crossing	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	25		42.79334	-85.79181	Abandoned Bridge, Center Pier is Obstructing Flow & Catching Debris (Remove)
Blk.Jam.25.005	Stream Crossing	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	25		42.79309	-85.79407	Clear Span, Steel Girder Bridge w/ Wooden Deck
Blk.Jam.26.001	Stream Crossing	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	26		42.79073	-85.80298	8th Ave. Twin 96" CSP Culverts
Blk.Jam.26.002	Stream Crossing	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	26		NA	NA	Woodridge St. Twin 96" CSP Culverts / DS Fence / Minor Gully Erosion along Right Bank
Blk.Jam.26.008	Stream Crossing	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	26		NA	NA	Rock Ford Crossing near Sta. 202+00 (OK Condition)
Blk.Jam.26.015	Stream Crossing	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	26		NA	NA	Rock Ford Crossing, DS of No. 78 (Requires Stabilization)
Blk.Jam.27.001	Stream Crossing	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	27		42.78814	-85.82204	16th Ave. CSP Culvert
Blk.Jam.27.002	Stream Crossing	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	27		NA	NA	Private, Clear Span Bridge near Sta. 242+00
Blk.Jam.27.003	Stream Crossing	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	27		NA	NA	Stream Crossing near Sta. 255+00
Blk.Jam.33.001	Stream Crossing	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	33		42.77332	-85.84171	24th Ave. Twin Culverts, Poor US Alignment, Northernmost 1/2 Full of Sediment
Blk.Jam.34.001	Stream Crossing	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	34		NA	NA	Adams St. Crossing

Blk.Jam.34.008	Stream Crossing	12/3/2007	DF2, KH - MDA	Black Creek of Jamestown ICD	Ottawa	Jamestown	34		NA	NA	Private Clear Span Bridge near Sta. 328+00
Blk.Jam.32.001	Stream Crossing	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Ottawa	Jamestown	32		42.77183	-85.86142	32nd Ave. Bridge
Blk.Jam.32.006	Stream Crossing	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Ottawa	Jamestown	32		42.76236	-85.87807	Clear Span Bridge
Blk.Sal.5.001	Stream Crossing	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Salem	5		42.76041	-85.88042	34th St. 20' x 12' CSPA
Blk.Sal.5.002	Stream Crossing	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Salem	5		42.73873	-85.89335	Clear Span Bridge
Blk.Sal.6.001	Stream Crossing	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Salem	6		42.75315	-85.88132	146th Ave. 19.3' x 12.3 CSPA
Blk.Sal.6.003	Stream Crossing	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Salem	6		42.74726	-85.88419	Wooden Bridge, Center Pier may Cause Debris/Trash/Obstructs / Typ. Channel - Fairly Stable, Thick Veg.
Blk.Sal.6.005	Stream Crossing	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Salem	6		42.74726	-85.88519	Clear Span Bridge, Steel Sign Truss with Wooden Deck
Blk.Sal.6.006	Stream Crossing	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Salem	6		NA	NA	Clear Span Bridge near Sta. 590+00, Poor Alignment, Erosion along Left Bank, Minor Debris/Trash/Obstruct
Blk.Sal.7.001	Stream Crossing	12/10/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Salem	7		42.73868	-85.89331	144th Ave. 19' x 12.5' CSPA
Blk.Ove.13.001	Stream Crossing	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Overisal	13		42.72406	-85.91437	142nd Ave. Twin 13.8' x 9.7' CSPA (Remove Upstream Debris & Debris/Trash/Obstructs)
Blk.Ove.24.001	Stream Crossing	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Overisal	24		42.72164	-85.91822	141st Ave. Twin 15' x 10' CSPA,
Blk.Ove.24.007	Stream Crossing	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Overisal	24		42.71228	-85.90382	Clear Span, Steel Girder Bridge
Blk.Ove.24.009	Stream Crossing	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Overisal	24		42.71151	-85.8994	Clear Span, Semi Trailer Bottom Steel Frame
Blk.Ove.25.006	Stream Crossing	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Overisal	25		42.70247	-85.90066	139th Ave. Abandoned Steel Truss Bridge, Road Closed
Blk.Sal.18.001	Stream Crossing	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Salem	18		42.728	-85.90019	36th St. Twin 13.5' x 10.7' CSPA / No Buffer along US Steep Right Bank
Blk.Sal.18.002	Stream Crossing	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Salem	18		42.72628	-85.90226	Clear Span, Steel Girder Bridge
Blk.Sal.30.001	Stream Crossing	12/12/2007	DF2, BS - ACDC	Black Creek of Jamestown ICD	Allegan	Salem	30		42.71144	-85.89893	140th Ave. 16.5' x 10' CSPA, East Culvert 1/3 Full of Sediment

SITE_ID	POLLUTANT SOURCE	DATE	INVEST	NAME	COUNTY	TWP	SEC	QTR1	LAT	LONG	COMMENTS
	Other	6/1/1996		Little Rabbit River	Allegan	Salem	1				
	Other	6/1/1996		Little Rabbit River	Allegan	Dorr	3				
	Other	6/1/1996		Little Rabbit River	Allegan	Salem	3				
	Other	6/1/1996		Little Rabbit River	Allegan	Dorr	4				
	Other	6/1/1996		Little Rabbit River	Allegan	Dorr	5				
	Other	6/1/1996		Little Rabbit River	Allegan	Dorr	6				
	Other	6/1/1996		Little Rabbit River	Allegan	Dorr	7				
	Other	6/1/1996		Little Rabbit River	Allegan	Dorr	8				
	Other	6/1/1996		Little Rabbit River	Allegan	Dorr	9				
	Other	6/1/1996		Little Rabbit River	Allegan	Salem	9				
	Other	6/1/1996		Little Rabbit River	Allegan	Dorr	10				
	Other	6/1/1996		Little Rabbit River	Allegan	Salem	10				
	Other	6/1/1996		Little Rabbit River	Allegan	Salem	11				
	Other	6/1/1996		Little Rabbit River	Allegan	Dorr	12				
	Other	6/1/1996		Little Rabbit River	Allegan	Salem	12				
	Other	6/1/1996		Little Rabbit River	Allegan	Salem	13				
	Other	6/1/1996		Little Rabbit River	Allegan	Dorr	14				
	Other	6/1/1996		Little Rabbit River	Allegan	Salem	14				
	Other	6/1/1996		Little Rabbit River	Allegan	Dorr	15				
	Other	6/1/1996		Little Rabbit River	Allegan	Dorr	16				
	Other	6/1/1996		Little Rabbit River	Allegan	Salem	16				
	Other	6/1/1996		Little Rabbit River	Allegan	Dorr	17				
	Other	6/1/1996		Little Rabbit River	Allegan	Salem	17				
	Other	6/1/1996		Little Rabbit River	Allegan	Dorr	18				
	Other	6/1/1996		Little Rabbit River	Allegan	Dorr	19				
	Other	6/1/1996		Byron Dorr ICD	Kent	Byron	21				
	Other	6/1/1996		Little Rabbit River	Allegan	Dorr	21				
	Other	6/1/1996		Little Rabbit River	Allegan	Dorr	22				
	Other	6/1/1996		Little Rabbit River	Allegan	Salem	23				
	Other	6/1/1996		Little Rabbit River	Allegan	Salem	24				
	Other	6/1/1996		Little Rabbit River	Allegan	Dorr	26				
	Other	6/1/1996		Byron Dorr ICD	Kent	Byron	27				
	Other	6/1/1996		Byron Dorr ICD	Kent	Byron	28				
	Other	6/1/1996		Byron Dorr ICD	Kent	Byron	33				
	Other	6/1/1996		Byron Dorr ICD	Kent	Byron	34				
BSDAT0101	Other	1/1/2000		Bear Swamp Drain	Allegan	Allegan	1				
BSDAT0201	Other	1/1/2000		Bear Swamp Drain	Allegan	Allegan	2				
BSDAT1001	Other	1/1/2000		Bear Swamp Drain	Allegan	Allegan	10				
BSDAT1101	Other	1/1/2000		Bear Swamp Drain	Allegan	Allegan	11				
BSDHT1901	Other	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	19				
BSDHT2001	Other	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	20				
BSDHT2301	Other	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	23				
BSDHT2401	Other	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	24				
BSDHT2501	Other	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	25				
BSDHT2601	Other	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	26				
BSDHT2701	Other	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	27				
BSDHT2801	Other	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	28				
BSDHT2901	Other	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	29				
BSDHT3001	Other	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	30				
BSDHT3101	Other	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	31				
BSDHT3201	Other	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	32				
BSDHT3501	Other	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	35				
BSDHT3601	Other	1/1/2000		Bear Swamp Drain/Miller Creek	Allegan	Hopkins	36				
BSDMT1301	Other	1/1/2000		Bear Swamp Drain	Allegan	Monterey	13				
BSDMT1401	Other	1/1/2000		Bear Swamp Drain	Allegan	Monterey	14				
BSDMT1501	Other	1/1/2000		Bear Swamp Drain	Allegan	Monterey	15				
BSDMT1601	Other	1/1/2000		Bear Swamp Drain	Allegan	Monterey	16				
BSDMT2101	Other	1/1/2000		Bear Swamp Drain	Allegan	Monterey	21				
BSDMT2201	Other	1/1/2000		Bear Swamp Drain	Allegan	Monterey	22				
BSDMT2401	Other	1/1/2000		Bear Swamp Drain	Allegan	Monterey	24				
BSDMT2501	Other	1/1/2000		Bear Swamp Drain	Allegan	Monterey	25				
BSDMT3501	Other	1/1/2000		Bear Swamp Drain	Allegan	Monterey	35				
BSDMT3601	Other	1/1/2000		Bear Swamp Drain	Allegan	Monterey	36				
GLSLT0401	Other	1/1/2000		Green Lake Stream	Allegan	Leighton	4				
GLSLT0601	Other	1/1/2000		Green Lake Stream	Allegan	Leighton	6				
GLSLT0701	Other	1/1/2000		Green Lake Stream	Allegan	Leighton	7				
GLSLT0801	Other	1/1/2000		Green Lake Stream	Allegan	Leighton	8				
GLSLT0901	Other	1/1/2000		Green Lake Stream	Allegan	Leighton	9				
GLSLT1001	Other	1/1/2000		Green Lake Stream	Allegan	Leighton	10				
GLSLT1101	Other	1/1/2000		Green Lake Stream	Allegan	Leighton	11				
GLSLT1501	Other	1/1/2000		Green Lake Stream	Allegan	Leighton	15				
GLSLT1601	Other	1/1/2000		Green Lake Stream	Allegan	Leighton	16				
GLSLT1901	Other	1/1/2000		Green Lake Stream	Allegan	Leighton	19				

GLSLT2001	Other	1/1/2000		Green Lake Stream	Allegan	Leighton	20				
GLSLT2101	Other	1/1/2000		Green Lake Stream	Allegan	Leighton	21				
GLSLT2201	Other	1/1/2000		Green Lake Stream	Allegan	Leighton	22				
GLSLT2501	Other	1/1/2000		Green Lake Stream	Allegan	Leighton	25				
GLSLT2601	Other	1/1/2000		Green Lake Stream	Allegan	Leighton	26				
GLSLT2701	Other	1/1/2000		Green Lake Stream	Allegan	Leighton	27				
GLSLT2801	Other	1/1/2000		Green Lake Stream	Allegan	Leighton	28				
GLSLT2901	Other	1/1/2000		Green Lake Stream	Allegan	Leighton	29				
GLSLT3101	Other	1/1/2000		Green Lake Stream	Allegan	Leighton	31				
GLSLT3201	Other	1/1/2000		Green Lake Stream	Allegan	Leighton	32				
GLSLT3301	Other	1/1/2000		Green Lake Stream	Allegan	Leighton	33				
GLSLT3401	Other	1/1/2000		Green Lake Stream	Allegan	Leighton	34				
GLSLT3501	Other	1/1/2000		Green Lake Stream	Allegan	Leighton	35				
GLSLT3601	Other	1/1/2000		Green Lake Stream	Allegan	Leighton	36				
MLCMT0701	Other	1/1/2000		Miller Creek	Allegan	Martin	7				
MLCWT0101	Other	1/1/2000		Miller Creek	Allegan	Watson	1				
MLCWT0601	Other	1/1/2000		Miller Creek	Allegan	Watson	6				
MLCWT1101	Other	1/1/2000		Miller Creek	Allegan	Watson	11				
URRWT0301	Other	1/1/2000		Upper Rabbit River	Allegan	Wayland	3				
URRWT0401	Other	1/1/2000		Upper Rabbit River	Allegan	Wayland	4				
URRWT0701	Other	1/1/2000		Upper Rabbit River	Allegan	Wayland	7				
URRWT0801	Other	1/1/2000		Upper Rabbit River	Allegan	Wayland	8				
URRWT1001	Other	1/1/2000		Upper Rabbit River	Allegan	Wayland	10				
URRWT1401	Other	1/1/2000		Upper Rabbit River	Allegan	Wayland	14				
URRWT1501	Other	1/1/2000		Upper Rabbit River	Allegan	Wayland	15				
URRWT1801	Other	1/1/2000		Upper Rabbit River	Allegan	Wayland	18				
LRRBT2102	Other	3/1/2000		Byron Dorr ICD	Kent	Byron	21				
LRRBT2702	Other	3/1/2000		Byron Dorr ICD	Kent	Byron	27				
LRRBT2802	Other	3/1/2000		Byron Dorr ICD	Kent	Byron	28				
LRRBT3302	Other	3/1/2000		Byron Dorr ICD	Kent	Byron	33				
LRRBT3402	Other	3/1/2000		Byron Dorr ICD	Kent	Byron	34				
LRRDT0302	Other	3/1/2000		Little Rabbit River	Allegan	Dorr	3				
LRRDT0402	Other	3/1/2000		Little Rabbit River	Allegan	Dorr	4				
LRRDT0502	Other	3/1/2000		Little Rabbit River	Allegan	Dorr	5				
LRRDT0602	Other	3/1/2000		Little Rabbit River	Allegan	Dorr	6				
LRRDT0705	Other	3/1/2000		Little Rabbit River	Allegan	Dorr	7				
LRRDT0804	Other	3/1/2000		Little Rabbit River	Allegan	Dorr	8				
LRRDT0903	Other	3/1/2000		Little Rabbit River	Allegan	Dorr	9				
LRRDT1002	Other	3/1/2000		Little Rabbit River	Allegan	Dorr	10				
LRRDT1204	Other	3/1/2000		Little Rabbit River	Allegan	Dorr	12				
LRRDT1402	Other	3/1/2000		Little Rabbit River	Allegan	Dorr	14				
LRRDT1502	Other	3/1/2000		Little Rabbit River	Allegan	Dorr	15				
LRRDT1605	Other	3/1/2000		Little Rabbit River	Allegan	Dorr	16				
LRRDT1704	Other	3/1/2000		Little Rabbit River	Allegan	Dorr	17				
LRRDT1805	Other	3/1/2000		Little Rabbit River	Allegan	Dorr	18				
LRRDT1902	Other	3/1/2000		Little Rabbit River	Allegan	Dorr	19				
LRRDT2105	Other	3/1/2000		Little Rabbit River	Allegan	Dorr	21				
LRRDT2204	Other	3/1/2000		Little Rabbit River	Allegan	Dorr	22				
LRRDT2603	Other	3/1/2000		Little Rabbit River	Allegan	Dorr	26				
LRRST0102	Other	3/1/2000		Little Rabbit River	Allegan	Salem	1				
LRRST0302	Other	3/1/2000		Little Rabbit River	Allegan	Salem	3				
LRRST0902	Other	3/1/2000		Little Rabbit River	Allegan	Salem	9				
LRRST1003	Other	3/1/2000		Little Rabbit River	Allegan	Salem	10				
LRRST1103	Other	3/1/2000		Little Rabbit River	Allegan	Salem	11				
LRRST1203	Other	3/1/2000		Little Rabbit River	Allegan	Salem	12				
LRRST1303	Other	3/1/2000		Little Rabbit River	Allegan	Salem	13				
LRRST1403	Other	3/1/2000		Little Rabbit River	Allegan	Salem	14				
LRRST1602	Other	3/1/2000		Little Rabbit River	Allegan	Salem	16				
LRRST1702	Other	3/1/2000		Little Rabbit River	Allegan	Salem	17				
LRRST2302	Other	3/1/2000		Little Rabbit River	Allegan	Salem	23				
LRRST2402	Other	3/1/2000		Little Rabbit River	Allegan	Salem	24				
MILMNT0603	Other	10/19/2007	AM/KJV/SFM	Miller Creek	Allegan	Monterey	6	NW	N. 42.67827	W. 85.89602	ATV crossing, lawn to creek 150yrds in length
MILMNT0603	Other	10/19/2007	AM/KJV/SFM	Miller Creek					42.67827	-85.89602	ATV crossing, lawn to creek 150yrds in length
BKC HT 14 02	Other	10/31/2007	LBN/SFM	Buskirk Creek	Allegan	Hopkins	14	NE	N. 42.64679	W 085.68829	
BKC HT 14 03	Other	10/31/2007	LBN/SFM	Buskirk Creek	Allegan	Hopkins	14	NE	N. 42.64696	W 085.68514	
BKC HT 15 03	Other	10/31/2007	LBN/SFM	Buskirk Creek	Allegan	Hopkins	15	NE	N. 42.64632	W 085. 70498	
BKCHT1402	Other	10/31/2007	LBN/SFM	Buskirk Creek					42.64679	-85.68829	
BKCHT1403	Other	10/31/2007	LBN/SFM	Buskirk Creek					42.64696	-85.68514	
BKCHT1503	Other	10/31/2007	LBN/SFM	Buskirk Creek					42.64632	-85.70498	Other (no buffer z
BER HPT 19 01	Other	2/25/2008	SFM	Bear Swamp Drain	Allegan	Hopkins	19	SE	N. 42.624040	W. 85.762404	Hopkins Village grain elevator. No buffer from driveway to stream. Possible heavy runoff mixed with gasoline, fertilizers, grain, etc. during rain events

Appendix 7

Appendix C - Assessment units not supporting designated uses (i.e. assessment units placed in Categories 4 or 5). This list is organized by 8, 10, and 12 digit HUCs. For Category 4a the TMDL completion date is provided. For Category 4b the expected to attain by date is provided. For Category 4c the 'Pollutant ?' field is blank. For Category 5 the TMDL schedule date is provided.

10 Digit HUC: 0405000308 Rabbit River

12 Digit HUC: 040500030801 Green Lake Creek

AUID: 040500030801-01 Rivers/Streams in HUC 040500030801 RIVER 20.9425 MILES
Includes: GREEN LAKE CREEK

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Fish Consumption	Not Supporting	PCB in Fish Tissue	Y	2014		
Fish Consumption	Not Supporting	PCB in Water Column	Y	2014		

AUID: 040500030801-02 Rivers/Streams in HUC 040500030801 RIVER 2.226875 MILES
Includes Miscellaneous Waters within HUC

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Other Indigenous Aquatic Life and Wildlife	Not Supporting	Other anthropogenic substrate alterations				
Other Indigenous Aquatic Life and Wildlife	Not Supporting	Other flow regime alterations				
Fish Consumption	Not Supporting	PCB in Fish Tissue	Y	2014		
Fish Consumption	Not Supporting	PCB in Water Column	Y	2014		

12 Digit HUC: 040500030802 Fales Drain-Rabbit River

AUID: 040500030802-01 Rivers/Streams in HUC 040500030802 RIVER 43.01625 MILES
Includes: Rabbit River

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Other Indigenous Aquatic Life and Wildlife	Not Supporting	Other anthropogenic substrate alterations				
Other Indigenous Aquatic Life and Wildlife	Not Supporting	Other flow regime alterations				
Fish Consumption	Not Supporting	PCB in Fish Tissue	Y	2014		
Fish Consumption	Not Supporting	PCB in Water Column	Y	2014		

12 Digit HUC: 040500030803 Miller Creek

AUID: 040500030803-01 SELKIRK LAKE FRESHWATER LAKE 86.9792 ACRES
Vicinity of Shelbyville

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Fish Consumption	Not Supporting	Mercury in Fish Tissue	Y	2011		

AUID: 040500030803-02 Rivers/Streams in HUC 040500030803 RIVER 27.08375 MILES
Includes: Miller Creek

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Fish Consumption	Not Supporting	PCB in Fish Tissue	Y	2014		
Fish Consumption	Not Supporting	PCB in Water Column	Y	2014		

AUID: 040500030803-04 Rivers/Streams in HUC 040500030803 RIVER 5.165 MILES
Includes: Miller Creek

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Fish Consumption	Not Supporting	PCB in Fish Tissue	Y	2014		
Fish Consumption	Not Supporting	PCB in Water Column	Y	2014		

12 Digit HUC: 040500030804 Bear Creek

AUID: 040500030804-01 Rivers/Streams in HUC 040500030804 RIVER 25.75625 MILES
Includes: Bear Creek

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Fish Consumption	Not Supporting	PCB in Fish Tissue	Y	2014		
Fish Consumption	Not Supporting	PCB in Water Column	Y	2014		

12 Digit HUC: 040500030805 Buskirk Creek-Rabbit River

AUID: 040500030805-01 Rivers/Streams in HUC 040500030805 RIVER 9.16125 MILES
Includes: Rabbit River

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Fish Consumption	Not Supporting	PCB in Fish Tissue	Y	2014		
Fish Consumption	Not Supporting	PCB in Water Column	Y	2014		

AUID: 040500030805-02 Rivers/Streams in HUC 040500030805 RIVER 7.288125 MILES
Includes: Buskirk Creek

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Fish Consumption	Not Supporting	PCB in Fish Tissue	Y	2014		
Fish Consumption	Not Supporting	PCB in Water Column	Y	2014		

AUID: 040500030805-03 Rivers/Streams in HUC 040500030805 RIVER 13.38 MILES
Includes: Rabbit River

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Fish Consumption	Not Supporting	PCB in Fish Tissue	Y	2014		
Fish Consumption	Not Supporting	PCB in Water Column	Y	2014		

12 Digit HUC: 040500030806 Headwaters Little Rabbit River

AUID: 040500030806-01 Rivers/Streams in HUC 040500030806 RIVER 1.43875 MILES
Includes: Red Run

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Fish Consumption	Not Supporting	PCB in Fish Tissue	Y	2014		
Fish Consumption	Not Supporting	PCB in Water Column	Y	2014		

AUID: 040500030806-02 Rivers/Streams in HUC 040500030806 RIVER 17.75125 MILES
Includes: Red Run

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Warm Water Fishery	Not Supporting	Oxygen, Dissolved	Y			2018
Other Indigenous Aquatic Life and Wildlife	Not Supporting	Sedimentation/Siltation	Y			2018
Fish Consumption	Not Supporting	PCB in Fish Tissue	Y	2014		
Fish Consumption	Not Supporting	PCB in Water Column	Y	2014		

AUID: 040500030806-03 Rivers/Streams in HUC 040500030806 RIVER 18.625 MILES
Includes Miscellaneous Waters within HUC

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Fish Consumption	Not Supporting	PCB in Fish Tissue	Y	2014		
Fish Consumption	Not Supporting	PCB in Water Column	Y	2014		

12 Digit HUC: 040500030807 Little Rabbit River

AUID: 040500030807-01 Rivers/Streams in HUC 040500030807 RIVER 29.995625 MILES
Includes: Little Rabbit River

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Fish Consumption	Not Supporting	PCB in Fish Tissue	Y	2014		
Fish Consumption	Not Supporting	PCB in Water Column	Y	2014		

12 Digit HUC: 040500030808 Pigeon Creek-Rabbit River

AUID: 040500030808-01 Rivers/Streams in HUC 040500030808 RIVER 12.598125 MILES
Includes: Rabbit River

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Fish Consumption	Not Supporting	PCB in Fish Tissue	Y	2014		
Fish Consumption	Not Supporting	PCB in Water Column	Y	2014		

AUID: 040500030808-02 Rivers/Streams in HUC 040500030808 RIVER 28.378125 MILES
Includes: Pigeon Creek

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Fish Consumption	Not Supporting	PCB in Fish Tissue	Y	2014		
Fish Consumption	Not Supporting	PCB in Water Column	Y	2014		

12 Digit HUC: 040500030809 Black Creek

AUID: 040500030809-01 Rivers/Streams in HUC 040500030809 RIVER 41.833125 MILES
Includes: Black Creek

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Other Indigenous Aquatic Life and Wildlife	Not Supporting	Other anthropogenic substrate alterations				
Other Indigenous Aquatic Life and Wildlife	Not Supporting	Other flow regime alterations				
Fish Consumption	Not Supporting	PCB in Fish Tissue	Y	2014		
Fish Consumption	Not Supporting	PCB in Water Column	Y	2014		

12 Digit HUC: 040500030810 Silver Creek-Rabbit River

AUID: 040500030810-01 Rivers/Streams in HUC 040500030810 RIVER 7.786875 MILES
Includes: Rabbit River

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Fish Consumption	Not Supporting	PCB in Fish Tissue	Y	2014		
Fish Consumption	Not Supporting	PCB in Water Column	Y	2014		

AUID: 040500030810-02 Rivers/Streams in HUC 040500030810 RIVER 2.730625 MILES
Includes Miscellaneous Waters within HUC

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Fish Consumption	Not Supporting	PCB in Fish Tissue	Y	2014		
Fish Consumption	Not Supporting	PCB in Water Column	Y	2014		

AUID: 040500030810-03 Rivers/Streams in HUC 040500030810 RIVER 4.376875 MILES
Includes: Miller Creek

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Fish Consumption	Not Supporting	PCB in Fish Tissue	Y	2014		
Fish Consumption	Not Supporting	PCB in Water Column	Y	2014		

AUID: 040500030810-04 Rivers/Streams in HUC 040500030810 RIVER 7.2725 MILES
Includes Miscellaneous Waters within HUC

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Fish Consumption	Not Supporting	PCB in Fish Tissue	Y	2014		
Fish Consumption	Not Supporting	PCB in Water Column	Y	2014		

12 Digit HUC: 040500030811 Rabbit River

AUID: 040500030811-01 Rivers/Streams in HUC 040500030811 RIVER 15.13 MILES
Includes: Rabbit River

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Fish Consumption	Not Supporting	PCB in Fish Tissue	Y	2014		
Fish Consumption	Not Supporting	PCB in Water Column	Y	2014		

AUID: 040500030811-02 Rivers/Streams in HUC 040500030811 RIVER 14.335625 MILES
Includes Miscellaneous Waters within HUC

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Other Indigenous Aquatic Life and Wildlife	Not Supporting	Other anthropogenic substrate alterations				
Other Indigenous Aquatic Life and Wildlife	Not Supporting	Other flow regime alterations				
Fish Consumption	Not Supporting	PCB in Fish Tissue	Y	2014		
Fish Consumption	Not Supporting	PCB in Water Column	Y	2014		

AUID: 040500030811-03 HAMILTON IMPOUNDMENT (RABBIT RIVER) RESERVOIR 29.1578 ACRES
Vicinity of Hamilton at M-40.

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Fish Consumption	Not Supporting	PCB in Fish Tissue	Y	2010		

AUID: 040500030811-04 Rivers/Streams in HUC 040500030811 RIVER 15.275 MILES
Includes Miscellaneous Waters within HUC

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Fish Consumption	Not Supporting	PCB in Fish Tissue	Y	2014		
Fish Consumption	Not Supporting	PCB in Water Column	Y	2014		

AUID: 040500030811-05 Rivers/Streams in HUC 040500030811 RIVER 5.890625 MILES
Includes: Rabbit River

Designated Use	Use Support	Cause	Pollutant?	TMDL Schedule	TMDL Completion	Expected to Attain
Fish Consumption	Not Supporting	PCB in Fish Tissue	Y	2014		
Fish Consumption	Not Supporting	PCB in Water Column	Y	2014		

Appendix 8

Project Title: Rabbit River Watershed Management Plan
Job Number: G06302
Engineer: KJV
Date: 12/3/2008

Template Title: Rabbit River Watershed – NPS Site Assumptions & Methodology

Rill and Gully Erosion

Methodology:

- Sediment Loading caused by Rill and Gully Erosion was calculated using the **Gully Erosion Equation (GEE)** found on page 10 of the *MDEQ – Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual*.
- **Gully Erosion Equation (GEE)** = $\frac{\text{Avg. Width (ft) x Depth (ft) x Length (ft) x Soil Weight (tons/ft}^3\text{)}}{\text{Number of Years}}$
  - Avg. Width = Average Width of Gully Erosion
  - Depth = Depth of Gully Erosion
  - Length = Length of Gully Erosion
  - Soil Weight = Dry Density of Soil
  - Number of Years = Amount of Time that Gully Erosion took to Form.

Assumptions:

- The **Gully Erosion Equation (GEE)** assumes 100% delivery of eroded soils to the stream.
- Volume (Avg. Width x Depth x Length) of Rill and Gully Erosion was obtained from Table 4.4 – *Recommendation and Cost Estimates for Rill and Gully Erosion* of the Rabbit River Watershed Management Plan.
- Soil Weights were based on the majority of soils in the subwatershed and Exhibits 1 & 2 of the Pollutants Controlled Calculation and Documentation for Section 319 Watershed Training Manual**.**

Subwatershed	**Soil Type**	**Soil Weight (tons/ft^3)**
Black Creek	Loams	0.045
Middle Rabbit River West	Sandy Loam	0.0525
Little Rabbit River	Loamy Sand	0.055
Red Run Drain	Loamy Sand	0.055
Green Lake Creek	Loamy Sand	0.055

- Number of Years was assumed, based on the Volume of Rill and Gully Erosion. (< 10 ft^3 = 1 Year, 10 ft^3 - 50 ft^3 = 3 Years, 51 ft^3 – 100 ft^3 = 7 Years, > 100 ft^3 = 10 Years)**.**

Livestock Access Erosion

Methodology:

- Sediment Loading caused by Livestock Access Erosion was calculated using the **Channel Erosion Equation (CEE)** found on page 15 of the *MDEQ – Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual*.
- **Channel Erosion Equation (CEE)** = Length (ft) x Height (ft) x LRR (ft/yr) x Soil Weight (tons/ft^3)
  - Length = Length of Eroding Bank
  - Height = Height of Eroding Bank
  - Lateral Recession Rate (LRR) = Thickness of soil eroded from a bank surface (perpendicular to the face) in an average year.
  - Soil Weight = Dry Density of Soil

Assumptions:

- The **Channel Erosion Equation (CEE)** assumes 100% delivery of eroded soils to the stream.
- Length of Livestock Access Erosion was based upon NPS Field Data. (Estimated lengths)
- Height of Livestock Access Erosion was based upon NPS Field Data. (<3 ft = 2 ft, 3 ft = 3 ft, 3-6 ft = 5 ft, >6 ft = 10 ft)
- The Lateral Recession Rate was based upon the NPS Field Data and the Severity of the Livestock Access Erosion. ("Slight" = 0.05 ft/yr, "Moderate" = 0.2 ft/yr, "Severe" = 0.5 ft/yr)
- Soil Weights were based on the majority of soils in the subwatershed and Exhibits 1 & 2 of the Pollutants Controlled Calculation and Documentation for Section 319 Watershed Training Manual**.**

Subwatershed	Soil Type	Soil Weight (tons/ft^3)
Black Creek	Loams	0.045
Middle Rabbit River West	Sandy Loam	0.0525
Little Rabbit River	Loamy Sand	0.055
Red Run Drain	Loamy Sand	0.055
Green Lake Creek	Loamy Sand	0.055

Tile Outlet Erosion

Methodology:

- Sediment Loading caused by Tile Outlet Erosion was calculated using the **Channel Erosion Equation (CEE)** found on page 15 of the *MDEQ – Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual*.
- **Channel Erosion Equation (CEE)** = Length (ft) x Height (ft) x LRR (ft/yr) x Soil Weight (tons/ft^3)
  - Length = Length of Eroding Bank
  - Height = Height of Eroding Bank
  - Lateral Recession Rate (LRR) = Thickness of soil eroded from a bank surface (perpendicular to the face) in an average year.
  - Soil Weight = Dry Density of Soil

Assumptions:

- The **Channel Erosion Equation (CEE)** assumes 100% delivery of eroded soils to the stream.
- Area (Length x Height) of Tile Outlet Erosion was obtained from Table 4.6 – *Recommendation and Cost Estimates for Tile Outlets* of the Rabbit River Watershed Management Plan.
- The Lateral Recession Rate was based upon the NPS Field Data and the Severity of the Livestock Access Erosion. ("Slight" = 0.05 ft/yr, "Moderate" = 0.2 ft/yr, "Severe" = 0.5 ft/yr)
- Soil Weights were based on the majority of soils in the subwatershed and Exhibits 1 & 2 of the Pollutants Controlled Calculation and Documentation for Section 319 Watershed Training Manual**.**

Subwatershed	Soil Type	Soil Weight (tons/ft^3)
Black Creek	Loams	0.045
Middle Rabbit River West	Sandy Loam	0.0525
Little Rabbit River	Loamy Sand	0.055
Red Run Drain	Loamy Sand	0.055
Green Lake Creek	Loamy Sand	0.055

Streambank Erosion

Methodology:

- Sediment Loading caused by Streambank Erosion was calculated using the **Channel Erosion Equation (CEE)** found on page 15 of the *MDEQ – Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual*.
- **Channel Erosion Equation (CEE)** = Length (ft) x Height (ft) x LRR (ft/yr) x Soil Weight (tons/ft^3)
  - Length = Length of Eroding Bank
  - Height = Height of Eroding Bank
  - Lateral Recession Rate (LRR) = Thickness of soil eroded from a bank surface (perpendicular to the face) in an average year.
  - Soil Weight = Dry Density of Soil

Assumptions:

- The **Channel Erosion Equation (CEE)** assumes 100% delivery of eroded soils to the stream.
- Area (Length x Height) of Tile Outlet Erosion was obtained from Table 4.3 – *Recommendation and Cost Estimates for Streambank Erosion* of the Rabbit River Watershed Management Plan.
- The Lateral Recession Rate was based upon the NPS Field Data and the Severity of the Livestock Access Erosion. ("Slight" = 0.05 ft/yr, "Moderate" = 0.2 ft/yr, "Severe" = 0.5 ft/yr)
- Soil Weights were based on the majority of soils in the subwatershed and Exhibits 1 & 2 of the Pollutants Controlled Calculation and Documentation for Section 319 Watershed Training Manual**.**

Subwatershed	**Soil Type**	**Soil Weight (tons/ft^3)**
Black Creek	Loams	0.045
Middle Rabbit River West	Sandy Loam	0.0525
Little Rabbit River	Loamy Sand	0.055
Red Run Drain	Loamy Sand	0.055
Green Lake Creek	Loamy Sand	0.055

Appendix 9

ROAD / STREAM CROSSING EROSION

Site ID	Waterbody	Subwatershed	COMMENTS
Blk.Jam.25.001	Black Creek of Jamestown ICD	Black Creek	Kenowa Ave. 9.5' x 7' CSPA Culvert, DS Muck Farmer wants Drain Cleanout
Blk.Jam.25.004	Black Creek of Jamestown ICD	Black Creek	Abandoned Bridge, Center Pier is Obstructing Flow & Catching Debris (Remove)
Blk.Jam.26.015	Black Creek of Jamestown ICD	Black Creek	Rock Ford Crossing, DS of No. 78 (Requires Stabilization)
Blk.Jam.34.008	Black Creek of Jamestown ICD	Black Creek	Private Clear Span Bridge near Sta. 328+00
Blk.Jam.33.001	Black Creek of Jamestown ICD	Black Creek	24th Ave. Twin Culverts, Poor US Alignment, Northernmost 1/2 Full of Sediment
Blk.Sal.6.006	Black Creek of Jamestown ICD	Black Creek	Clear Span Bridge near Sta. 590+00, Poor Alignment, Erosion along Left Bank, Minor Debris/Trash/Obstruct
Blk.Ove.13.001	Black Creek of Jamestown ICD	Black Creek	142nd Ave. Twin 13.8' x 9.7' CSPA (Remove Upstream Debris & Debris/Trash/Obstructs)
Blk.Sal.30.001	Black Creek of Jamestown ICD	Black Creek	140th Ave. 16.5' x 10' CSPA, East Culvert 1/3 Full of Sediment
BDICD.20	Byron Dorr ICD	Red Run Drain	146th Ave. Twin CSP Culverts, Thick Brush / Willows US, Minor DS Erosion
BDICD.7	Byron Dorr ICD	Red Run Drain	108th Ave. Twin CSP Culverts - Poor Upstream Alignment, Sediment at West Culvert
BDICD.50	Little Rabbit River	Little Rabbit River	24th Street Bridge = OK
BDICD.55	Little Rabbit River	Little Rabbit River	26th Street Bridge = OK
BDICD.66	Little Rabbit River	Little Rabbit River	Private Footbridge with Pier which obstructs Channel Flow
BDICD.80	Little Rabbit River	Little Rabbit River	30th Street Bridge, DS Pump Station w/ Sheet Piling
BDICD.96	Little Rabbit River	Little Rabbit River	Remove Damaged Wooden Footbridge
GLS.22	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	Snowmobile X-ing
GLS.16	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	11th (Division) Street Crossing
GLS.26	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	RR Crossing
GLS.41	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	138th Avenue Crossing, East Culvert Filled with Sediment - Requires Cleanout
GLS.43	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	RR Crossing
BSDAT0104	Bear Swamp Drain	Bear Creek	
BSDAT1102	Bear Swamp Drain	Bear Creek	
BSDHT1903	Bear Swamp Drain/Miller Creek		
BSDHT2303	Bear Swamp Drain/Miller Creek		
BSDHT2702	Bear Swamp Drain/Miller Creek		
BSDHT2905	Bear Swamp Drain/Miller Creek		
BSDHT3002	Bear Swamp Drain/Miller Creek		
BSDHT3104	Bear Swamp Drain/Miller Creek		
BSDHT3502	Bear Swamp Drain/Miller Creek		
BSDHT3602	Bear Swamp Drain/Miller Creek		
GLSLT1002	Green Lake Stream	Green Lake Creek	
GLSLT1103	Green Lake Stream	Green Lake Creek	
GLSLT1401	Green Lake Stream	Green Lake Creek	
GLSLT1604	Green Lake Stream	Green Lake Creek	
GLSLT1702	Green Lake Stream	Green Lake Creek	
GLSLT1803	Green Lake Stream	Green Lake Creek	
GLSLT2702	Green Lake Stream	Green Lake Creek	
GLSLT2905	Green Lake Stream	Green Lake Creek	
GLSLT3403	Green Lake Stream	Green Lake Creek	
URRWT1601	Upper Rabbit River	Upper Rabbit River	
URRWT2001	Upper Rabbit River	Upper Rabbit River	

Lack of Riparian Buffer

Site ID	Waterbody	Subwatershed	Location	Description
BKC HT 14 02	Buskirk Creek	Buskirk Creek	Left/b Right/b	<25 No Buffer, needs wider buffer on AG field
BKC HT 14 03	Buskirk Creek	Buskirk Creek	Left/b Right/b	<25 No Buffer, needs wider buffer on AG field
BER HPT 19 01	Bear Swamp Drain	Middle Rabbit River West	Left/right banks	Grain elevator/Fertilizer storage. Hopkins
BKC HT 15 03	Buskirk Creek	Buskirk Creek	Left/b Right/b	No Buffer, needs wider buffer on AG field
MILMNT0603	Miller Creek	Silver Creek	Left bank	Recreational crossing; lawn to creek 150yrds in length
BSDAT0101	Bear Swamp Drain	Bear Creek		
BSDAT0201	Bear Swamp Drain	Bear Creek		
BSDAT1001	Bear Swamp Drain	Bear Creek		
BSDAT1101	Bear Swamp Drain/Miller Creek			
BSDHT1901	Bear Swamp Drain/Miller Creek			
BSDHT2001	Bear Swamp Drain/Miller Creek			
BSDHT2301	Bear Swamp Drain/Miller Creek			
BSDHT2401	Bear Swamp Drain/Miller Creek			
BSDHT2501	Bear Swamp Drain/Miller Creek			
BSDHT2601	Bear Swamp Drain/Miller Creek			
BSDHT2701	Bear Swamp Drain/Miller Creek			
BSDHT2801	Bear Swamp Drain/Miller Creek			
BSDHT2901	Bear Swamp Drain/Miller Creek			
BSDHT3001	Bear Swamp Drain/Miller Creek			
BSDHT3101	Bear Swamp Drain/Miller Creek			
BSDHT3201	Bear Swamp Drain/Miller Creek			
BSDHT3501	Bear Swamp Drain/Miller Creek			
BSDHT3601	Bear Swamp Drain	Bear Creek		
BSDMT1301	Bear Swamp Drain	Bear Creek		
BSDMT1401	Bear Swamp Drain	Bear Creek		
BSDMT1501	Bear Swamp Drain	Bear Creek		
BSDMT1601	Bear Swamp Drain	Bear Creek		
BSDMT2101	Bear Swamp Drain	Bear Creek		
BSDMT2201	Bear Swamp Drain	Bear Creek		
BSDMT2401	Bear Swamp Drain	Bear Creek		
BSDMT2501	Bear Swamp Drain	Bear Creek		
BSDMT3501	Bear Swamp Drain	Bear Creek		
BSDMT3601	Green Lake Stream	Green Lake Creek		
GLSLT0401	Green Lake Stream	Green Lake Creek		
GLSLT0601	Green Lake Stream	Green Lake Creek		
GLSLT0701	Green Lake Stream	Green Lake Creek		
GLSLT0801	Green Lake Stream	Green Lake Creek		
GLSLT0901	Green Lake Stream	Green Lake Creek		
GLSLT1001	Green Lake Stream	Green Lake Creek		
GLSLT1101	Green Lake Stream	Green Lake Creek		
GLSLT1501	Green Lake Stream	Green Lake Creek		
GLSLT1601	Green Lake Stream	Green Lake Creek		
GLSLT1901	Green Lake Stream	Green Lake Creek		
GLSLT2001	Green Lake Stream	Green Lake Creek		
GLSLT2101	Green Lake Stream	Green Lake Creek		
GLSLT2201	Green Lake Stream	Green Lake Creek		
GLSLT2501	Green Lake Stream	Green Lake Creek		
GLSLT2601	Green Lake Stream	Green Lake Creek		
GLSLT2701	Green Lake Stream	Green Lake Creek		
GLSLT2801	Green Lake Stream	Green Lake Creek		
GLSLT2901	Green Lake Stream	Green Lake Creek		
GLSLT3101	Green Lake Stream	Green Lake Creek		
GLSLT3201	Green Lake Stream	Green Lake Creek		
GLSLT3301	Green Lake Stream	Green Lake Creek		
GLSLT3401	Green Lake Stream	Green Lake Creek		
GLSLT3501	Green Lake Stream	Green Lake Creek		
GLSLT3601	Byron Dorr ICD	Red Run Drain		
LRRBT2102	Byron Dorr ICD	Red Run Drain		
LRRBT2702	Byron Dorr ICD	Red Run Drain		
LRRBT2802	Byron Dorr ICD	Red Run Drain		
LRRBT3302	Byron Dorr ICD	Red Run Drain		
LRRBT3402	Little Rabbit River	Little Rabbit River		
LRRDT0302	Little Rabbit River	Little Rabbit River		
LRRDT0402	Little Rabbit River	Little Rabbit River		
LRRDT0502	Little Rabbit River	Little Rabbit River		
LRRDT0602	Little Rabbit River	Little Rabbit River		
LRRDT0705	Little Rabbit River	Little Rabbit River		
LRRDT0804	Little Rabbit River	Little Rabbit River		
LRRDT0903	Little Rabbit River	Little Rabbit River		

Site ID	Waterbody	Subwatershed
LRRDT1002	Little Rabbit River	Little Rabbit River
LRRDT1204	Little Rabbit River	Little Rabbit River
LRRDT1402	Little Rabbit River	Little Rabbit River
LRRDT1502	Little Rabbit River	Little Rabbit River
LRRDT1605	Little Rabbit River	Little Rabbit River
LRRDT1704	Little Rabbit River	Little Rabbit River
LRRDT1805	Little Rabbit River	Little Rabbit River
LRRDT1902	Little Rabbit River	Little Rabbit River
LRRDT2105	Little Rabbit River	Little Rabbit River
LRRDT2204	Little Rabbit River	Little Rabbit River
LRRDT2603	Little Rabbit River	Little Rabbit River
LRRST0102	Little Rabbit River	Little Rabbit River
LRRST0302	Little Rabbit River	Little Rabbit River
LRRST0902	Little Rabbit River	Little Rabbit River
LRRST1003	Little Rabbit River	Little Rabbit River
LRRST1103	Little Rabbit River	Little Rabbit River
LRRST1203	Little Rabbit River	Little Rabbit River
LRRST1303	Little Rabbit River	Little Rabbit River
LRRST1403	Little Rabbit River	Little Rabbit River
LRRST1602	Little Rabbit River	Little Rabbit River
LRRST1702	Little Rabbit River	Little Rabbit River
LRRST2302	Little Rabbit River	Little Rabbit River
LRRST2402	Miller Creek	Miller Creek
MLCMT0701	Miller Creek	Miller Creek
MLCWT0101	Miller Creek	Miller Creek
MLCWT0601	Miller Creek	Miller Creek
MLCWT1101	Upper Rabbit River	Upper Rabbit River
URRWT0301	Upper Rabbit River	Upper Rabbit River
URRWT0401	Upper Rabbit River	Upper Rabbit River
URRWT0701	Upper Rabbit River	Upper Rabbit River
URRWT0801	Upper Rabbit River	Upper Rabbit River
URRWT1001	Upper Rabbit River	Upper Rabbit River
URRWT1401	Upper Rabbit River	Upper Rabbit River
URRWT1501	Upper Rabbit River	Upper Rabbit River
URRWT1801	Byron Dorr ICD	Red Run Drain
	Byron Dorr ICD	Red Run Drain
	Byron Dorr ICD	Red Run Drain
	Byron Dorr ICD	Red Run Drain
	Byron Dorr ICD	Red Run Drain
	Little Rabbit River	Little Rabbit River
	Little Rabbit River	Little Rabbit River
	Little Rabbit River	Little Rabbit River
	Little Rabbit River	Little Rabbit River
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	Little Rabbit River	Little Rabbit River

STREAMBANK EROSION

Site ID	Waterbody	Subwatershed	Streambank Erosion Length (ft)	Streambank Erosion Height (ft)	Erosion Severity	Erosion Area (ft^2)	Lateral Recession Rate (ft/yr)	Soil Weight ($tons/ft^3$)	Sediment Reduction (tons/yr)	
STA 10+00 B	Bear Swamp Drain RRE	Middle Rabbit River West	165	2	MOSTLY BARE BANK	330	0.20	0.0525	3.47	
STA 127+00	Bear Swamp Drain RRE	Middle Rabbit River West	300	5	SOME BARE BANK	1,500	0.05	0.0525	3.94	
STA 275+00	Bear Swamp Drain RRE	Middle Rabbit River West	100	2	MOSTLY BARE BANK	200	0.20	0.0525	2.10	
STA 276+00	Bear Swamp Drain RRE	Middle Rabbit River West	100	10	WASHOUT	1,000	0.50	0.0525	26.25	
STA 278+00 C	Bear Swamp Drain RRE	Middle Rabbit River West				0	0.35	0.0525	0.00	
STA 280+00	Bear Swamp Drain RRE	Middle Rabbit River West	20	1	WASHOUT	20	0.50	0.0525	0.53	Log Jam
STA 295+00	Bear Swamp Drain RRE	Middle Rabbit River West	10	5	MOSTLY BARE BANK	50	0.20	0.0525	0.53	Bank erosion caused by log jam
STA 305+00	Bear Swamp Drain RRE	Middle Rabbit River West	200	5	SOME BARE BANK	1,000	0.05	0.0525	2.63	
STA 307+00 A	Bear Swamp Drain RRE	Middle Rabbit River West	135	2	SOME BARE BANK	270	0.05	0.0525	0.71	Rip-rap placed at site
PIG SAT 34 01	Pigeon Creek	Middle Rabbit River West	2000	12	WASHOUT	24,000	0.50	0.0525	630.00	
147+00	Bear Swamp Drain RRE	Middle Rabbit River West	300	3	SOME BARE BANK	900	0.05	0.0525	2.36	
177+00	Bear Swamp Drain RRE	Middle Rabbit River West	100	2	MOSTLY BARE BANK	200	0.20	0.0525	2.10	
184+00	Bear Swamp Drain RRE	Middle Rabbit River West	50	1	SOME BARE BANK	50	0.05	0.0525	0.13	
185+00	Bear Swamp Drain RRE	Middle Rabbit River West	50	1	MOSTLY BARE BANK	50	0.20	0.0525	0.53	
194+00	Bear Swamp Drain RRE	Middle Rabbit River West	200	1	UNDERCUT/WASHOUT	200	0.35	0.0525	3.68	
204+00	Bear Swamp Drain RRE	Middle Rabbit River West	50	2	SOME BARE BANK	100	0.05	0.0525	0.26	
212+00	Bear Swamp Drain RRE	Middle Rabbit River West	200	1	MOSTLY BARE BANK	200	0.20	0.0525	2.10	
225+00	Bear Swamp Drain RRE	Middle Rabbit River West	200	1	UNDERCUT/WASHOUT	200	0.35	0.0525	3.68	
244+00	Bear Swamp Drain RRE	Middle Rabbit River West	50	3	MOSTLY BARE BANK	150	0.20	0.0525	1.58	
258+00	Bear Swamp Drain RRE	Middle Rabbit River West	200	3	MOSTLY BARE BANK	600	0.20	0.0525	6.30	
263+00	Bear Swamp Drain RRE	Middle Rabbit River West	100	2	MOSTLY BARE BANK	200	0.20	0.0525	2.10	
269+00	Bear Swamp Drain RRE	Middle Rabbit River West	300	2	MOSTLY BARE BANK	600	0.20	0.0525	6.30	
272+00	Bear Swamp Drain RRE	Middle Rabbit River West	200	5	UNDERCUT/WASHOUT	1,000	0.35	0.0525	18.38	
105+00	Bear Swamp Drain RRE	Middle Rabbit River West	200	2	MOSTLY BARE BANK	400	0.20	0.0525	4.20	
81+00	Bear Swamp Drain RRE	Middle Rabbit River West			RIGHT BANK		0.35	0.0525	0.00	
Blk.Byr.30.002	Black Creek of Jamestown ICD	Black Creek	50	8	MOSTLY BARE BANK	400	0.20	0.045	3.60	~ 50 LF of Erosion along 8' High Right Bank
Blk.Jam.25.010	Black Creek of Jamestown ICD	Black Creek	50	4	SOME BARE BANK	200	0.05	0.045	0.45	Areas of Minor Erosion along Toe of Bank (< 4' High), DS of No. 15
Blk.Jam.25.014	Black Creek of Jamestown ICD	Black Creek	50	8	MOSTLY BARE BANK	400	0.20	0.045	3.60	~ 50 LF of Erosion along 8' High Right Bank
Blk.Jam.26.014	Black Creek of Jamestown ICD	Black Creek	100	3	SOME BARE BANK	300	0.05	0.045	0.68	~ 100 LF of Erosion along 3' High Right Bank
Blk.Jam.26.016	Black Creek of Jamestown ICD	Black Creek	50	3	SOME BARE BANK	150	0.05	0.045	0.34	Typ. Bank Erosion along Outside Channel Bends
Blk.Jam.27.004	Black Creek of Jamestown ICD	Black Creek	50	3	MOSTLY BARE BANK	150	0.20	0.045	1.35	Erosion along Left Bank (Adams St.) near Sta. 257+00
Blk.Jam.34.002	Black Creek of Jamestown ICD	Black Creek	50	20	MOSTLY BARE BANK	1,000	0.20	0.045	9.00	~ 50 LF of Erosion along 20' High Left Bank near Sta. 290+00
Blk.Jam.34.004	Black Creek of Jamestown ICD	Black Creek	50	3	SOME BARE BANK	150	0.05	0.045	0.34	Erosion along Toe of Right Bank, Channel against Valley Wall
Blk.Jam.34.005	Black Creek of Jamestown ICD	Black Creek	100	3	SOME BARE BANK	300	0.05	0.045	0.68	~ 100 LF of Erosion along 15' Toe of Right Bank, Channel against Valley Wall
Blk.Jam.34.009	Black Creek of Jamestown ICD	Black Creek	50	3	SOME BARE BANK	150	0.05	0.045	0.34	Highly Sinuous Stream Pattern, Erosion along ~ 3' High Banks
Blk.Jam.33.003	Black Creek of Jamestown ICD	Black Creek	50	5	MOSTLY BARE BANK	250	0.20	0.045	2.25	Typ. Minor Erosion along Outside Bend of ~ 5' High Banks, DS of 24th Ave.
Blk.Jam.33.005	Black Creek of Jamestown ICD	Black Creek	50	5	MOSTLY BARE BANK	250	0.20	0.045	2.25	~ 50 LF of Erosion along 5' High Right Bank (Remove Leaning Trees)
Blk.Jam.33.007	Black Creek of Jamestown ICD	Black Creek	50	5	MOSTLY BARE BANK	250	0.20	0.045	2.25	Typ. Minor Erosion along Outside Bend of ~ 5' High Banks, DS of 24th Ave.
Blk.Jam.33.009	Black Creek of Jamestown ICD	Black Creek	50	5	MOSTLY BARE BANK	250	0.20	0.045	2.25	Highly Sinuous Stream Pattern, Typ. Erosion along Outside Bend of ~ 5' High Banks
Blk.Jam.33.010	Black Creek of Jamestown ICD	Black Creek	50	6	MOSTLY BARE BANK	300	0.20	0.045	2.70	Typ. Erosion along Outside Bend of ~ 6' High Banks
Blk.Jam.33.013	Black Creek of Jamestown ICD	Black Creek	50	6	MOSTLY BARE BANK	300	0.20	0.045	2.70	~ 50 LF of Erosion along ~ 6' High Left Bank, DS Re-Aligned Channel w/ Bank Erosion
Blk.Jam.33.016	Black Creek of Jamestown ICD	Black Creek	75	10	MOSTLY BARE BANK	750	0.20	0.045	6.75	~ 75 LF of Erosion along ~ 10' High Left Bank
Blk.Jam.32.002	Black Creek of Jamestown ICD	Black Creek	50	6	MOSTLY BARE BANK	300	0.20	0.045	2.70	Typ. Erosion along Outside Bend of ~ 6' High Banks, DS of 32nd Ave.
Blk.Jam.32.003	Black Creek of Jamestown ICD	Black Creek	50	3	SOME BARE BANK	150	0.05	0.045	0.34	Typ. Minor Erosion along Outside Bend of ~ 3' High Banks, between 32nd Ave. & Mud Lake
Blk.Jam.32.004	Black Creek of Jamestown ICD	Black Creek	50	3	SOME BARE BANK	150	0.05	0.045	0.34	Minor Erosion along Toe of Bank, DS of Grade Control Structure
Blk.Sal.7.005	Black Creek of Jamestown ICD	Black Creek	50	8	MOSTLY BARE BANK	400	0.20	0.045	3.60	~ 50 LF of Erosion along 8' High Right Bank, ~ 300' DS of No. 101
Blk.Sal.7.007	Black Creek of Jamestown ICD	Black Creek	50	6	MOSTLY BARE BANK	300	0.20	0.045	2.70	Begin - Typ. Erosion along Outside Bend of 4'-8' High Banks / (Remove Leaning Trees)
Blk.Sal.7.008	Black Creek of Jamestown ICD	Black Creek	50	6	MOSTLY BARE BANK	300	0.20	0.045	2.70	End - Typ. Erosion along Outside Bend of 4'-8' High Banks
Blk.Sal.18.003	Black Creek of Jamestown ICD	Black Creek	50	3	SOME BARE BANK	150	0.05	0.045	0.34	Typ. Erosion DS of No. 112 (Potential Channel Re-alignment from ~ Sta. 667+50 to 671+00)
Blk.Ove.24.004	Black Creek of Jamestown ICD	Black Creek	150	4	MOSTLY BARE BANK	600	0.20	0.045	5.40	~ 75 LF of Erosion along US 4' High Right Bank, ~ 75 LF of Erosion along DS 4' High Left Bank

LIVESTOCK ACCESS

Site ID	Waterbody	Subwatershed	Erosion Extent	Erosion Length (ft)	Erosion Height (ft)	Lateral Recession Rate (ft/yr)	Soil Weight (tons/ft^3)	Sediment Reduction (tons/yr)	COMMENTS
Blk.Jam.26.003	Black Creek of Jamestown ICD	Black Creek	MODERATE	100	5	0.20	0.045	4.50	Uncontrolled Livestock Access, Bank Erosion
Blk.Jam.26.007	Black Creek of Jamestown ICD	Black Creek	MODERATE	600	5	0.20	0.045	27.00	Uncontrolled Livestock Access, Bank Erosion, Begins near Sta. 195+00
Blk.Jam.26.010	Black Creek of Jamestown ICD	Black Creek	MODERATE	1150	5	0.20	0.045	51.75	Uncontrolled Livestock Access, Typ. Bank Erosion along Outside Channel Bends
Blk.Jam.26.013	Black Creek of Jamestown ICD	Black Creek	MODERATE	550	5	0.20	0.045	24.75	Uncontrolled Livestock Access Ends ~ Sta. 218+00
Blk.Ove.24.008	Black Creek of Jamestown ICD	Black Creek	MODERATE	750	3	0.20	0.045	20.25	Uncontrolled Livestock Access, Bank Erosion, ~ Sta. 785+00 to 140th Ave. (Sta. 792+50)
BDICD.70	Little Rabbit River	Little Rabbit River	SEVERE	75	5	0.50	0.055	10.31	Begin Unlimited Access, Devoid of Veg., Severe Bank Erosion along Outside Bends
BDICD.71	Little Rabbit River	Little Rabbit River	SEVERE	75	5	0.50	0.055	10.31	End Unlimited Access, Devoid of Veg., Severe Bank Erosion along Outside Bends
BDICD.74	Little Rabbit River	Little Rabbit River	MODERATE	85	3	0.20	0.055	2.81	Begin Unlimited Access, Bank Erosion from Livestock
BDICD.75	Little Rabbit River	Little Rabbit River	MODERATE	85	3	0.20	0.055	2.81	End Unlimited Access, Bank Erosion from Livestock
Near 130th	Rabbit River	Middle Rabbit River East	SEVERE	1320	3	0.5	0.0525	103.95	Uncontroled livestock access, measured from ariel photo
GLS.28	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	MODERATE	500	5	0.2	0.055	27.50	Uncontrolled Access, Trampled Banks, 4'-5' High Bank Erosion
GLS.30	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	MODERATE	500	5	0.2	0.055	27.50	Uncontrolled Access, Streambank Erosion, Fence Across Drain
GLS.31	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	MODERATE	500	5	0.2	0.055	27.50	Typical Uncontrolled Access, Property Owner Dislikes Tree Revetments - Snag Cattle
GLS.34	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	MODERATE	100	5	0.2	0.055	5.50	Uncontrolled Access, ~ 100 LF of 4'-5' High Bank Erosion (West Bank)
GLS.36	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	SEVERE	50	2	0.5	0.055	2.75	Uncontrolled Access, 1'-2' High Bank Erosion at Toe of Slope
GLS.49	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	MODERATE	100	10	0.2	0.055	11.00	100 LF of 5' to 10' High Bank Erosion, DS Uncontrolled Access
GLS.50	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	MODERATE	50	5	0.2	0.055	2.75	Uncontrolled Access, 50 LF of 4' High Bank Erosion
GLS.51	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	MODERATE	100	3	0.2	0.055	3.30	100 LF of 3' High Bank Erosion, Uncontrolled Access
BSDAT0102	Bear Swamp Drain	Bear Creek							
BSDAT0103	Bear Swamp Drain	Bear Creek							
BSDHT2002	Bear Swamp Drain/Miller Creek								
BSDHT2003	Bear Swamp Drain/Miller Creek								
BSDHT2502	Bear Swamp Drain/Miller Creek								
BSDHT2503	Bear Swamp Drain/Miller Creek								
BSDHT2802	Bear Swamp Drain/Miller Creek								
BSDHT2803	Bear Swamp Drain/Miller Creek								
BSDHT2902	Bear Swamp Drain/Miller Creek								
BSDHT2903	Bear Swamp Drain/Miller Creek								
GLSLT0603	Green Lake Stream	Green Lake Creek							
GLSLT0604	Green Lake Stream	Green Lake Creek							
GLSLT1801	Green Lake Stream	Green Lake Creek							
GLSLT1802	Green Lake Stream	Green Lake Creek							
GLSLT2003	Green Lake Stream	Green Lake Creek							
GLSLT2004	Green Lake Stream	Green Lake Creek							
GLSLT2202	Green Lake Stream	Green Lake Creek							
GLSLT2203	Green Lake Stream	Green Lake Creek							
GLSLT2902	Green Lake Stream	Green Lake Creek							
GLSLT2903	Green Lake Stream	Green Lake Creek							
GLSLT3001	Green Lake Stream	Green Lake Creek							
GLSLT3302	Green Lake Stream	Green Lake Creek							
GLSLT3303	Green Lake Stream	Green Lake Creek							
GLSLT3402	Green Lake Stream	Green Lake Creek							
LRRDT0702	Little Rabbit River	Little Rabbit River							
LRRDT0703	Little Rabbit River	Little Rabbit River							
LRRDT0704	Little Rabbit River	Little Rabbit River							
LRRDT0802	Little Rabbit River	Little Rabbit River							
LRRDT1202	Little Rabbit River	Little Rabbit River							
LRRDT1203	Little Rabbit River	Little Rabbit River							
LRRDT1302	Little Rabbit River	Little Rabbit River							
LRRDT1303	Little Rabbit River	Little Rabbit River							

DEBRIS TRASH

Site ID	Waterbody	Subwatershed	Description of Debris	Debris Extent
BKC HT 15 02	Buskirk Creek	Buskirk Creek		MODERATE
BKC HT 14 04	Buskirk Creek	Buskirk Creek		MODERATE
BKC HT 15 05	Buskirk Creek	Buskirk Creek		LARGE
BKC HT 15 06	Buskirk Creek	Buskirk Creek		MODERATE
BKC HT 14 01	Buskirk Creek	Buskirk Creek		
STA 278+00 A	Bear Swamp Drain RRE	Middle Rabbit River West		SLIGHT
STA 297+00	Bear Swamp Drain RRE	Middle Rabbit River West		SLIGHT
MILMNT0601	Miller Creek	Silver Creek	Large cement bridge in stream	LARGE
MILMNT0602	Miller Creek	Silver Creek	Large cement bridge in stream	EXTENSIVE
MLMNT0606	Miller Creek	Silver Creek		MODERATE
MLMNT0607	Miller Creek	Silver Creek		MODERATE
RRDO31 52 08	Rabbit River	Silver Creek	200+ tires	LARGE
184+00	BEAR SWAMP DRAIN, RRE	Middle Rabbit River West		MODERATE
185+00	BEAR SWAMP DRAIN, RRE	Middle Rabbit River West		MODERATE
194+00	BEAR SWAMP DRAIN, RRE	Middle Rabbit River West		LARGE
201+00	BEAR SWAMP DRAIN, RRE	Middle Rabbit River West	LOG JAM	MODERATE
202+00	BEAR SWAMP DRAIN, RRE	Middle Rabbit River West		MODERATE
204+00	BEAR SWAMP DRAIN, RRE	Middle Rabbit River West		LARGE
225+00	BEAR SWAMP DRAIN, RRE	Middle Rabbit River West		LARGE
234+00	BEAR SWAMP DRAIN, RRE	Middle Rabbit River West		LARGE
264+00	BEAR SWAMP DRAIN, RRE	Middle Rabbit River West		SLIGHT
122+00	BEAR SWAMP DRAIN, RRE	Middle Rabbit River West		SLIGHT
Blk.Byr.32.001	Black Creek of Jamestown ICD	Black Creek	Minor Debris/Trash/Obstruct, US of Wilson Ave.	SLIGHT
Blk.Jam.25.002	Black Creek of Jamestown ICD	Black Creek	Minor Debris/Trash/Obstruct	SLIGHT
Blk.Jam.25.003	Black Creek of Jamestown ICD	Black Creek	Minor Debris/Trash/Obstruct / Fallen Tree	SLIGHT
Blk.Jam.25.007	Black Creek of Jamestown ICD	Black Creek	Minor Debris/Trash/Obstruct	SLIGHT
Blk.Jam.25.009	Black Creek of Jamestown ICD	Black Creek	Minor Debris/Trash/Obstruct, Typ. DS of Point No. 15	SLIGHT
Blk.Jam.25.012	Black Creek of Jamestown ICD	Black Creek	Minor Debris/Trash/Obstruct	SLIGHT
Blk.Jam.25.013	Black Creek of Jamestown ICD	Black Creek	Minor Debris/Trash/Obstruct / Minor Erosion at Toe of Bank	SLIGHT
Blk.Jam.25.015	Black Creek of Jamestown ICD	Black Creek	Debris/Trash/Obstruct, ~ 300' DS of No. 22	MODERATE
Blk.Jam.25.016	Black Creek of Jamestown ICD	Black Creek	Minor Debris/Trash/Obstruct, US of 8th Ave.	SLIGHT
Blk.Jam.26.005	Black Creek of Jamestown ICD	Black Creek	Minor Debris/Trash/Obstruct / Vegetation Buildup in Drain, ~ 400' DS of No. 27	SLIGHT
Blk.Jam.26.006	Black Creek of Jamestown ICD	Black Creek	Debris/Trash/Obstruct, ~ 1,500' DS of No. 27 (~ Sta. 185+00)	MODERATE
Blk.Jam.26.009	Black Creek of Jamestown ICD	Black Creek	Fence Across Drain	MODERATE
Blk.Jam.34.003	Black Creek of Jamestown ICD	Black Creek	Minor Debris/Trash/Obstruct	SLIGHT
Blk.Jam.34.006	Black Creek of Jamestown ICD	Black Creek	Fallen ~ 30" Tree	LARGE
Blk.Jam.34.007	Black Creek of Jamestown ICD	Black Creek	Minor Debris/Trash/Obstruct / Highly Sinuous Stream Pattern, Well Connected Floodplain, Thick Veg.	SLIGHT
Blk.Jam.33.002	Black Creek of Jamestown ICD	Black Creek	Minor Debris/Trash/Obstructs DS of 24th Ave.	SLIGHT
Blk.Jam.33.004	Black Creek of Jamestown ICD	Black Creek	Debris/Trash/Obstruct	MODERATE
Blk.Jam.33.006	Black Creek of Jamestown ICD	Black Creek	Debris/Trash/Obstruct	MODERATE
Blk.Jam.33.008	Black Creek of Jamestown ICD	Black Creek	Minor Debris/Trash/Obstruct	SLIGHT
Blk.Jam.33.011	Black Creek of Jamestown ICD	Black Creek	Minor Debris/Trash/Obstruct	SLIGHT
Blk.Jam.33.012	Black Creek of Jamestown ICD	Black Creek	Steel I-Beam Bridge Washout (Remove)	LARGE
Blk.Jam.33.014	Black Creek of Jamestown ICD	Black Creek	Major Debris/Trash/Obstruct / Debris/Trash/Obstructs	LARGE
Blk.Jam.33.015	Black Creek of Jamestown ICD	Black Creek	2 Fallen 24" Trees	LARGE
Blk.Jam.32.005	Black Creek of Jamestown ICD	Black Creek	Debris/Trash/Obstruct / Typ. Channel - Stable, ~ 3' High Banks	MODERATE
Blk.Jam.32.007	Black Creek of Jamestown ICD	Black Creek	Debris Pile along Right Bank (Remove) / Typ. Channel - Stable, Thick Veg.	MODERATE
Blk.Sal.6.004	Black Creek of Jamestown ICD	Black Creek	Major Debris/Trash/Obstruct (Remove Leaning 30" Tree)	LARGE
Blk.Sal.6.007	Black Creek of Jamestown ICD	Black Creek	Minor Debris/Trash/Obstruct	SLIGHT
Blk.Sal.6.009	Black Creek of Jamestown ICD	Black Creek	Minor Debris/Trash/Obstruct	SLIGHT
Blk.Sal.7.002	Black Creek of Jamestown ICD	Black Creek	Minor Debris/Trash/Obstruct	SLIGHT
Blk.Sal.18.004	Black Creek of Jamestown ICD	Black Creek	Irrigation Pump Intake, May Catch Debris and Cause Debris/Trash/Obstruct to Flow	LARGE
Blk.Ove.13.002	Black Creek of Jamestown ICD	Black Creek	Fallen Tree / Typ. DS Channel - Lack of Buffer, Fairly Stable Channel Banks	LARGE
Blk.Ove.24.002	Black Creek of Jamestown ICD	Black Creek	Minor Debris/Trash/Obstruct / Typ. Channel, Well Connected Floodplain, Fairly Stable Channel Banks	SLIGHT
Blk.Ove.24.003	Black Creek of Jamestown ICD	Black Creek	Debris/Trash/Obstruct	MODERATE
Blk.Ove.24.005	Black Creek of Jamestown ICD	Black Creek	Debris/Trash/Obstruct, DS of No. 120	MODERATE
Blk.Ove.24.006	Black Creek of Jamestown ICD	Black Creek	Abandoned Wooden Footbridge (Remove)	LARGE
Blk.Ove.25.001	Black Creek of Jamestown ICD	Black Creek	Minor Debris/Trash/Obstruct / Typ. Channel, Well Connected Floodplain, Fairly Stable Channel Banks	SLIGHT
Blk.Ove.25.002	Black Creek of Jamestown ICD	Black Creek	Minor Debris/Trash/Obstruct / Minor Erosion at Toe of Bank	SLIGHT
Blk.Ove.25.003	Black Creek of Jamestown ICD	Black Creek	Minor Debris/Trash/Obstruct	SLIGHT
Blk.Ove.25.004	Black Creek of Jamestown ICD	Black Creek	Debris/Trash/Obstruct	MODERATE
Blk.Ove.25.005	Black Creek of Jamestown ICD	Black Creek	Debris/Trash/Obstruct / Minor Sediment Buildup in Center of Channel	SLIGHT
BDICD.10	Byron Door ICD	Red Run Drain	Minor Log Jam - West Bank	LARGE
BDICD.12	Byron Door ICD	Red Run Drain	Minor Log Jam ~ 100' US	LARGE
BDICD.14	Byron Door ICD	Red Run Drain	Minor Log Jam ~ 100' US	LARGE
BDICD.16	Byron Door ICD	Red Run Drain	Minor Log Jam	LARGE
BDICD.18	Byron Door ICD	Red Run Drain	Log Jam	MODERATE

BDICD.21	Byron Door ICD	Red Run Drain	Minor Log Jam, Typical Stable Channel = Good	SLIGHT
BDICD.23	Byron Door ICD	Red Run Drain	Leaning Poplar Tree near Power Line - Requires Removal by Contractor	SLIGHT
BDICD.3	Byron Door ICD	Red Run Drain	Typical Channel	MODERATE
BDICD.4	Byron Door ICD	Red Run Drain	Typical Log Jam	MODERATE
BDICD.5	Byron Door ICD	Red Run Drain	Typical Channel - Thick Brush & Log Jams	MODERATE
BDICD.6	Byron Door ICD	Red Run Drain	Fallen Tree / Log Jam ~ 100' US of 108th Avenue	MODERATE
BDICD.32	Little Rabbit River	Little Rabbit River	Minor Log Jam, Fallen Tree (South Bank) and Dead Twin Tree	SLIGHT
BDICD.34	Little Rabbit River	Little Rabbit River	Three Log Jams, Minor Bank Erosion, Cut Leaning Trees and Use as Revetments	MODERATE
BDICD.36	Little Rabbit River	Little Rabbit River	2 Log Jams DS of Bank Erosion	MODERATE
BDICD.38	Little Rabbit River	Little Rabbit River	Log Jam	MODERATE
BDICD.40	Little Rabbit River	Little Rabbit River	3 Minor Log Jams w/ Minor Erosion along North Bank	SLIGHT
BDICD.41	Little Rabbit River	Little Rabbit River	2 Log Jams and 1 Leaning Tree	MODERATE
BDICD.43	Little Rabbit River	Little Rabbit River	Log Jam	MODERATE
BDICD.45	Little Rabbit River	Little Rabbit River	Log Jam ~ 100' DS of Coordinates, Leaning Tree ~ 300' DS of Coordinates	MODERATE
BDICD.46	Little Rabbit River	Little Rabbit River	Log Jam w/ Several Leaning Trees in Vicinity	MODERATE
BDICD.47	Little Rabbit River	Little Rabbit River	Fallen Tree	SLIGHT
BDICD.48	Little Rabbit River	Little Rabbit River	3 Log Jams	MODERATE
BDICD.49	Little Rabbit River	Little Rabbit River	Log Jam	MODERATE
BDICD.51	Little Rabbit River	Little Rabbit River	Log Jam, Remove Branches from Tree Revetment which Protrude into the Channel.	MODERATE
BDICD.52	Little Rabbit River	Little Rabbit River	Log Jam	MODERATE
BDICD.53	Little Rabbit River	Little Rabbit River	Log Jam, Remove Branches from Tree Revetment which Protrude into the Channel.	MODERATE
BDICD.54	Little Rabbit River	Little Rabbit River	Major Log Jam, Meyerdiak Property near Irrigation Pump - May Require Contractor	LARGE
BDICD.56	Little Rabbit River	Little Rabbit River	Log Jam ~ 350' DS of 26th Street Bridge	MODERATE
BDICD.57	Little Rabbit River	Little Rabbit River	Move Tree Revetments toward Bank, Trim Branches which Extend into Channel	SLIGHT
BDICD.58	Little Rabbit River	Little Rabbit River	Fallen Tree	SLIGHT
BDICD.59	Little Rabbit River	Little Rabbit River	Several Log Jams, Woody Debris & Leaning Trees	MODERATE
BDICD.61	Little Rabbit River	Little Rabbit River	Fallen Tree & Log Jam	MODERATE
BDICD.63	Little Rabbit River	Little Rabbit River	Major Log Jam, Trim Tree Revetment Branches which Extend into Channel	LARGE
BDICD.64	Little Rabbit River	Little Rabbit River	Trim Tree Revetment Branches which Extend into Channel	SLIGHT
BDICD.65	Little Rabbit River	Little Rabbit River	Trim Tree Revetment Branches which Extend into Channel	SLIGHT
BDICD.68	Little Rabbit River	Little Rabbit River	Log Jam	MODERATE
BDICD.69	Little Rabbit River	Little Rabbit River	Log Jam at Irrigation Pipe	MODERATE
BDICD.72	Little Rabbit River	Little Rabbit River	Fallen Tree & Log Jam	MODERATE
BDICD.73	Little Rabbit River	Little Rabbit River	Trim Tree Revetment Branches which Extend into Channel	SLIGHT
BDICD.76	Little Rabbit River	Little Rabbit River	Fallen Tree ~ 300' US of 142nd Avenue	SLIGHT
BDICD.78	Little Rabbit River	Little Rabbit River	Log Jam	MODERATE
BDICD.79	Little Rabbit River	Little Rabbit River	Log Jam	MODERATE
BDICD.81	Little Rabbit River	Little Rabbit River	Log Jam ~ 200' DS of 30th Street	MODERATE
BDICD.82	Little Rabbit River	Little Rabbit River	Log Jams	MODERATE
BDICD.83	Little Rabbit River	Little Rabbit River	~ 5 Log Jams (Mostly Minor)	SLIGHT
BDICD.84	Little Rabbit River	Little Rabbit River	Trim Tree Revetment Branches which Extend into Channel	SLIGHT
BDICD.86	Little Rabbit River	Little Rabbit River	Log Jam	MODERATE
BDICD.87	Little Rabbit River	Little Rabbit River	Log Jam	MODERATE
BDICD.88	Little Rabbit River	Little Rabbit River	~ 3 Fallen Trees	SLIGHT
BDICD.89	Little Rabbit River	Little Rabbit River	~ 2 Fallen Trees	SLIGHT
BDICD.90	Little Rabbit River	Little Rabbit River	Log Jam - Tree Revetment Failure, Well Connected Floodplain	MODERATE
BDICD.91	Little Rabbit River	Little Rabbit River	Remove Tree Revetments, Stable Banks with Well Connected Floodplain	MODERATE
BDICD.92	Little Rabbit River	Little Rabbit River	Log Jam - Tree Revetment Failure	MODERATE
BDICD.93	Little Rabbit River	Little Rabbit River	Log Jam	MODERATE
BDICD.94	Little Rabbit River	Little Rabbit River	Major Log Jam	LARGE
BDICD.95	Little Rabbit River	Little Rabbit River	Log Jam	MODERATE
BDICD.97	Little Rabbit River	Little Rabbit River	Log Jam	MODERATE
BDICD.98	Little Rabbit River	Little Rabbit River	Log Jam	MODERATE
GLS.10	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	Fallen 24" Tree, Well Connected Floodplain	SLIGHT
GLS.12	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	Log jam ~ 100' DS	MODERATE
GLS.13	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	Fallen 12" Tree, Tree Revetment Maintenance	SLIGHT
GLS.17	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	Major Log Jam	LARGE
GLS.18	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	Log Jam ~ 100' US of 140th Avenue Crossing	MODERATE
GLS.24	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	Minor Log Jam	SLIGHT
GLS.25	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	Major Log Jam	LARGE
GLS.33	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	Begin Log Jams	LARGE
GLS.35	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	End Log Jams, Several Major Log Jams	LARGE
GLS.37	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	Log Jam & Fence Across Drain US of RR Crossing	MODERATE
GLS.4	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	Tree Revetment Maintenance	SLIGHT
GLS.48	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	Minor Log Jam	SLIGHT
GLS.5	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	Minor Log Jam	SLIGHT
GLS.6	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	Minor Log Jam	SLIGHT
GLS.7	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	Fallen 18"-24" Tree	SLIGHT
GLS.9	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	Minor Log Jam	SLIGHT
GLS.21	Green Lake Stream Ext. of the McConnell Drain	Green Lake Creek	24" Fallen Tree	SLIGHT

RILL AND GULLY EROSION

Site ID	Waterbody	Subwatershed	Rill & Gully Length (ft)	Rill & Gully Depth (ft)	Rill & Gully Width (ft)	Rill & Gully surface area (ft^2)	Rill & Gully Volume (ft^3)	Soil Weight ($tons/ft^3$)	Number of Years	Annual Sediment (tons/yr)	EXT_3	COMMENTS
MILMNT0605	Miller Creek	Silver Creek	20	2	15	300	600	0.0525	10	3.15	Field gully erosion	
STA 278+00 B	Bear Swamp Drain RRE	Middle Rabbit River West	30	10	10	300	3,000	0.0525	10	15.75	Conventional tillage	
204+00	BEAR SWAMP DRAIN, RRE	Middle Rabbit River West	30	10	20	600	6,000	0.0525	10	31.50	CONVENTIONAL TILLAGE	
225+00	BEAR SWAMP DRAIN, RRE	Middle Rabbit River West	20	3	5	100	300	0.0525	10	1.58	CONVENTIONAL TILLAGE	
251+00	BEAR SWAMP DRAIN, RRE	Middle Rabbit River West	100	2	8	800	1,600	0.0525	10	8.40	CONVENTIONAL TILLAGE	
258+00	BEAR SWAMP DRAIN, RRE	Middle Rabbit River West	50	10	10	500	5,000	0.0525	10	26.25	CONVENTIONAL TILLAGE	
263+00	BEAR SWAMP DRAIN, RRE	Middle Rabbit River West	15	2	5	75	150	0.0525	7	1.13	CONVENTIONAL TILLAGE	
Blk.Byr.31.002	Black Creek of Jamestown ICD	Black Creek	20	2	1	20	40	0.045	3	0.60		~ 20 LF of Minor Gully Erosion along Right Bank (~ 1' Width, 2' Depth)
Blk.Jam.25.006	Black Creek of Jamestown ICD	Black Creek	30	3	3	90	270	0.045	10	1.22		~ 30 LF Gully Erosion along Right Bank (~ 2'-4' Width, 3' Depth)
Blk.Jam.25.008	Black Creek of Jamestown ICD	Black Creek	30	2	2	60	120	0.045	10	0.54		~ 30 LF Gully Erosion along Right Bank (~ 2' Width, 2' Depth), DS of No. 15
Blk.Jam.25.011	Black Creek of Jamestown ICD	Black Creek	30	3	2	60	180	0.045	10	0.81		~ 30 LF Minor Gully Erosion along Left Bank (~ 2' Width, 3' Depth)
Blk.Jam.26.004	Black Creek of Jamestown ICD	Black Creek	30	2	2	60	120	0.045	10	0.54		Minor Gully Erosion, ~ 300' DS of No. 27
Blk.Jam.26.012	Black Creek of Jamestown ICD	Black Creek	30	2	2	60	120	0.045	10	0.54		Gully Erosion along Left Bank, Partially Stabilized w/ Broken Concrete
Blk.Sal.5.003	Black Creek of Jamestown ICD	Black Creek	50	3	3	150	450	0.045	10	2.03		~ 50 LF of Gully Erosion along Left Bank (~ 3' Width, 3' Depth)
Blk.Sal.6.008	Black Creek of Jamestown ICD	Black Creek	50	3	7	350	1,050	0.045	10	4.73		~ 50 LF of Gully Erosion along Right Bank (~ 3-10' Width, 3' Depth)
Blk.Sal.7.004	Black Creek of Jamestown ICD	Black Creek	40	3	4	160	480	0.045	10	2.16		~ 40 LF of Gully Erosion along Left Bank (~ 4' Width, 3' Depth)
Blk.Sal.7.006	Black Creek of Jamestown ICD	Black Creek	50	4	5	250	1,000	0.045	10	4.50		> 50 LF of Gully Erosion along Left Bank (~ 5' Width, 3-4' Depth)
BSDAT1002	Bear Swamp Drain	Bear Creek										
BSDHT2402	Bear Swamp Drain/Miller Creek											
BSDHT2602	Bear Swamp Drain/Miller Creek											
BSDHT3102	Bear Swamp Drain/Miller Creek											
BSDHT3401	Bear Swamp Drain/Miller Creek											
GLSLT0602	Green Lake Stream	Green Lake creek										
GLSLT1603	Green Lake Stream	Green Lake creek										
GLSLT2002	Green Lake Stream	Green Lake creek										
GLSLT2103	Green Lake Stream	Green Lake creek										
GLSLT3102	Green Lake Stream	Green Lake creek										
GLSLT3202	Green Lake Stream	Green Lake creek										
GLSLT3602	Green Lake Stream	Green Lake creek										
LRRDT0303	Little Rabbit River	Little Rabbit River										
LRRDT1304	Little Rabbit River	Little Rabbit River										
LRRST0103	Little Rabbit River	Little Rabbit River										
LRRST0303	Little Rabbit River	Little Rabbit River										
LRRST1004	Little Rabbit River	Little Rabbit River										
LRRST1205	Little Rabbit River	Little Rabbit River										
MLCMT0501	Miller Creek	Miller Creek										
MLCMT0702	Miller Creek	Miller Creek										
MLCMT0801	Miller Creek	Miller Creek										
MLCWT1201	Miller Creek	Miller Creek										
URRWT0402	Upper Rabbit River	Upper Rabbit River										
URRWT0702	Upper Rabbit River	Upper Rabbit River										
URRWT1802	Upper Rabbit River	Upper Rabbit River										
URRWT3101	Upper Rabbit River	Upper Rabbit River										
	Little Rabbit River	Little Rabbit River										
	Little Rabbit River	Little Rabbit River										
	Little Rabbit River	Little Rabbit River										
	Little Rabbit River	Little Rabbit River										
	Little Rabbit River	Little Rabbit River										
	Little Rabbit River	Little Rabbit River										
GLSLT1602	Green Lake Stream	Green Lake creek										
GLSLT1701	Green Lake Stream	Green Lake creek										
GLSLT2102	Green Lake Stream	Green Lake creek										
GLSLT3502	Green Lake Stream	Green Lake creek										
LRRBT2101	Byron Dorr ICD	Red Run Drain										
LRRBT2701	Byron Dorr ICD	Red Run Drain										
LRRBT2801	Byron Dorr ICD	Red Run Drain										
LRRBT3201	Byron Dorr ICD	Red Run Drain										
LRRBT3301	Byron Dorr ICD	Red Run Drain										
LRRBT3401	Byron Dorr ICD	Red Run Drain										
LRRDT0101	Little Rabbit River	Little Rabbit River										
LRRDT0301	Little Rabbit River	Little Rabbit River										
LRRDT0401	Little Rabbit River	Little Rabbit River										
LRRDT0501	Little Rabbit River	Little Rabbit River										
LRRDT0601	Little Rabbit River	Little Rabbit River										
LRRDT0701	Little Rabbit River	Little Rabbit River										
LRRDT0801	Little Rabbit River	Little Rabbit River										
LRRDT0901	Little Rabbit River	Little Rabbit River										
LRRDT1001	Little Rabbit River	Little Rabbit River										
LRRDT1101	Little Rabbit River	Little Rabbit River										
LRRDT1201	Little Rabbit River	Little Rabbit River										
LRRDT1301	Little Rabbit River	Little Rabbit River										
LRRDT1401	Little Rabbit River	Little Rabbit River										

URBAN RESIDENTIAL

Site ID	Waterbody	Subwatershed	Location	Description	Extent
BKC HT 15 01	Buskirk Creek	Buskirk Creek	Right	Lawn/No buffer	
STA 10+00 A	Bear Swamp Drain RRE	Middle Rabbit River West	Right	Mows to bank	200 yards
STA 302+00	Bear Swamp Drain RRE	Middle Rabbit River West	Left bank	Mows to bank	
STA 307 +00 B	Bear Swamp Drain RRE	Middle Rabbit River West	Right bank	Mows to streambank	100 yards
MILMNT0604	Miller Creek	Silver Creek	Left bank	Mows to streambank	
BSDAT1201	Bear Swamp Drain	Bear Creek			
BSDHT2004	Bear Swamp Drain/Miller Creek				
GLSLT0301	Green Lake Stream	Green Lake Creek			
GLSLT0403	Green Lake Stream	Green Lake Creek			
GLSLT0404	Green Lake Stream	Green Lake Creek			
GLSLT0606	Green Lake Stream	Green Lake Creek			
GLSLT0703	Green Lake Stream	Green Lake Creek			
GLSLT1102	Green Lake Stream	Green Lake Creek			
GLSLT1902	Green Lake Stream	Green Lake Creek			
GLSLT2603	Green Lake Stream	Green Lake Creek			
LRRBT3303	Byron Dorr ICD	Red Run Drain			
URRWT0403	Upper Rabbit River	Upper Rabbit River			
URRWT0501	Upper Rabbit River	Upper Rabbit River			
URRWT1901	Upper Rabbit River	Upper Rabbit River			
URRWT2101	Upper Rabbit River	Upper Rabbit River			
URRWT2801	Upper Rabbit River	Upper Rabbit River			
URRWT3001	Upper Rabbit River	Upper Rabbit River			
	Byron Dorr ICD	Red Run Drain			

TILE OUTLET EROSION

Site ID	Waterbody	Subwatershed	Diameter	Tile Outlet Height	EROS LENGTH_6	EROS HEIGHT_6	Erosion Area (ft^2)	Lateral Recession Rate (ft/yr)	Soil Weight (tons/ft^3)	Sediment Reduction (tons/yr)	COMMENTS
204+00	BEAR SWAMP DRAIN,RRE	Middle Rabbit River West	4	15 FEET	30	15	450	0.5	0.0525	11.81	
Blk.Jam.26.011	Black Creek of Jamestown ICD	Black Creek	8	12"-36"			12	0.2	0.045	0.11	Tile Outlet Failure & Erosion along Right Bank
Blk.Sal.6.002	Black Creek of Jamestown ICD	Black Creek	8, 24	12"-36"			24	0.2	0.045	0.22	8" & 24" CMP along Left Bank Require Stabilized Outlet, 24" CMP along Right Bank = Ok
Blk.Sal.7.003	Black Creek of Jamestown ICD	Black Creek	6, 12	12"-36"			24	0.2	0.045	0.22	6" PVC & 12" DIP along Left Bank, Minor Erosion (Requires Outlet Stabilization)
									Total:	12.35	

Non-Point Ag Source

Site ID	Waterbody	Subwatershed	Location	Description	Extent
BSDAT0202	Bear Swamp Drain	Bear Creek	Right	Lawn/No buffer	
BSDHT1902	Bear Swamp Drain/Miller Creek		Right	Mows to bank	200 yards
BSDHT2201	Bear Swamp Drain/Miller Creek		Left bank	Mows to bank	
BSDHT2302	Bear Swamp Drain/Miller Creek		Right bank	Mows to streambank	100 yards
BSDHT2403	Bear Swamp Drain/Miller Creek		Left bank	Mows to streambank	
BSDHT2904	Bear Swamp Drain/Miller Creek				
BSDHT3103	Bear Swamp Drain/Miller Creek				
BSDMT1502	Bear Swamp Drain	Bear Creek			
BSDMT2502	Bear Swamp Drain	Bear Creek			
GLSLT0402	Green Lake Stream	Green Lake Creek			
GLSLT0605	Green Lake Stream	Green Lake Creek			
GLSLT0702	Green Lake Stream	Green Lake Creek			
GLSLT0802	Green Lake Stream	Green Lake Creek			
GLSLT0902	Green Lake Stream	Green Lake Creek			
GLSLT2602	Green Lake Stream	Green Lake Creek			
GLSLT2904	Green Lake Stream	Green Lake Creek			
LRRDT0706	Little Rabbit River	Little Rabbit River			
LRRDT0805	Little Rabbit River	Little Rabbit River			
LRRDT1102	Little Rabbit River	Little Rabbit River			
LRRDT1403	Little Rabbit River	Little Rabbit River			
LRRDT1606	Little Rabbit River	Little Rabbit River			
LRRDT1705	Little Rabbit River	Little Rabbit River			
LRRDT2604	Little Rabbit River	Little Rabbit River			
LRRST0903	Little Rabbit River	Little Rabbit River			
LRRST1204	Little Rabbit River	Little Rabbit River			
LRRST2002	Little Rabbit River	Little Rabbit River			
MLCMT0502	Miller Creek	Miller Creek			
MLCMT0802	Miller Creek	Miller Creek			
MLCWT1204	Miller Creek	Miller Creek			
URRWT0302	Upper Rabbit River	Upper Rabbit River			
URRWT0802	Upper Rabbit River	Upper Rabbit River			
URRWT1803	Upper Rabbit River	Upper Rabbit River			
	Little Rabbit River	Little Rabbit River			
	Little Rabbit River	Little Rabbit River			
	Little Rabbit River	Little Rabbit River			
	Little Rabbit River	Little Rabbit River			
	Little Rabbit River	Little Rabbit River			
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Appendix 10

Appendix 10 - Structural and Vegetative Best Management Practices

Best Management Practice	Description	Pollutant Addressed	Pollutant Removal Efficiency	Potential Sources of Pollutants	Additional BMPs to Complete Treatment Train	Expected Life Span	Maintenance Requirements	Training Requirements	Applicability to Site	Environmental Concerns	Hydrologic Effects to Consider	Installation Costs	Operation and Maintenance Costs	Special Considerations	Communities Using BMP	MDEQ/NRCS Link
Pretreatment (e.g., sediment traps, drainage channels, water quality inlets)																
Catch basin inlet devices	Devices that are inserted into the storm drain inlets to filter or absorb sediment, pollutants, and sometimes oil and grease. The capture of hydrocarbons can be enhanced with the use of absorbents.	Solids, sediments	Moderate to high; 70% of total suspended solids (5); <20% of total phosphorous. Assume same as Hydrodynamic Separators.	Storm water runoff	Catch basin cleaning program	2 - 5 years	High; Remove and dispose of sediment, trash and debris, and change filters as needed (approximately every 6 months)	Low/moderate	Needs less than 5 acres of drainage area	Proper disposal of sediment		$50 - 1,500 (5)	$300/Catch Basin/year (5)	Useful for retrofit	MDOT	
Permanent Sediment Basin (including forebays)	Man-made depression in the ground where runoff water is collected and stored to allow suspended solids to settle out. May have inlet and outlet structures to regulate flow.	Sediments, solids	Moderate to high; 50% of Total Suspended Solids(4); <20% of Total Phosphorous (4)	Storm water runoff	Detention/Infiltration	50+ years	Moderate; Remove and dispose of sediment, trash and debris, and repair erosion.	Low	Use for large drainage areas (≥ 1 acre), at storm sewer outfalls, may be included with detention pond, and to collect overland flow.			Low; Capital Cost: $0.60/cft of storage volume excluding land purchase. (1)	7% of capital cost/year. (1)	Not always aesthetically pleasing		http://www.deq.state.mi.us/documents/deq-swq-nps-sb.pdf
Combination curb with water spreader and vegetated swale	Curb with cut outs. Storm water is directed off the street at the cut out areas (not spillways).	Sediments, water volumes	High; 80% of total suspended solids. 50% of total phosphorous.	Storm water runoff	Vegetated swale, detention pond	30+ years (6)	Moderate; Remove and dispose of sediment, trash and debris, and repair erosion.	Low			Capacity must be equal to swale or channel	Moderate	Low	Need to stabilize cut out sections behind curb to prohibit soil erosion. Requires a vegetated swale behind the curb. Street sweeping.		
Check dams, Grade control structures (NRCS practice 410)	Stones, sandbags, or gravel generally used to stabilize grades in natural or artificial channels by carrying runoff from one grade to another. Designed to prevent banks from slumping, reduce runoff velocity, and prevent channel erosion from an excessive grade.	Sediment and attached pollutants, hydrologic flow	High (classic gully erosion) (12) Moderate (streambank erosion) (12) Low (runoff/ flooding) (12)	Streambank erosion, soil erosion, storm water runoff	Buffer/filter strips, grassed waterway, diversion, critical area planting	20+ years	Low. Periodic inspections. Repair/replace failing structures. Address any vegetation and erosion plems.	Moderate. Design and installation should be done by a registered professional engineer	Widely applicable to erosive areas with an excessive grade. Place in drainage channel.	Concentrated flows may cause erosion downstream - discharge point should be investigated.	Cause backwater effect; slows down water velocities; capacity equal to channel	Low to moderate. $4,650/structure or $800/vegeted chute (9) - EQIP, WHIP	Low. $60 structure (9)	Use native grasses when planting filter strip. Easements or permits may need to be obtained.		http://www.deq.state.mi.us/documents/deq-swq-nps-cd.pdf
Hydrodynamic Separator Units (Continuous Deflective Separation (CDS) Units, Stormceptors, Vortechnics, Downstream Defender)	Precast, flow-through, underground units that capture sediments, debris, and oils (in some units). The capture of oils can be enhanced with the use of absorbents. (CDS, Vortechs, Downstream Defender, Stormceptor)	Sediment, solids	Effective; 60% TSS Removal (1); <20% of total phosphorous (4)	Storm sewer system	Street sweeping, stream protection practices	50+	Moderate; Remove and dispose of sediment, trash and debris	Minimum	Use for small drainage areas (≤ 1 acre) with high pollutant loads, in line with storm sewer system, and to collect overland flow	Proper disposal of sediment	Catches first flush. High flows by-pass unit through pipe system	High. $15,000 per acre of impervious (2); 6,000/cfs capacity	$500 practice (2); $1,000/year (3)	Placed upstream of storm sewer discharge. Unit is below grade. Need to allow access for cleaning the chambers.		http://www.deq.state.mi.us/documents/deq-swq-nps-ogs.pdf

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Detention/Retention (e.g., extended detention basin)																
Ponded Type Detention Basin (wet pond)	Small, man-made basin to maintain a permanent pool of water with emergent wetland vegetation around the bank. Designed to capture and remove particulate matter, nonsoluble metals, organic matter and nutrients through settling. It generally has inlet and outlet structures to regulate flow.	Sediment; nutrients; hydrologic flow	Moderate; 80% of total suspended solids (4) 50% of total phosphorous (4). Of the detention/ retention basins, this practice may be the most effective in removing pollutants.	Storm water runoff	Sediment forebay or other form of pretreatment, riprap, sediment basin, filter	50+ years (1,6)	Low; remove and dispose of sediment, trash and debris; repair erosion; and plant replacement vegetation as needed.	Low; design and installation should be done by a professional	Use for large drainage areas (≥ 10 acre), at storm sewer outfalls, and to collect overland flow. Ponds generally will not work in soils with high infiltration rates.	Possible downstream warming; low bacteria removal; West Nile Virus (aerator can remove threat of West Nile Virus)	Provides full control of peak discharges for large design storms.	Low to moderate; $1/cft of storage volume, excluding land purchase (1)	5% of capital cost/year. (1)	Need available land area, can include sediment forebay, requires more planning, maintenance and land to construct.		http://www.deq.state.mi.us/documents/deq-swq-nps-wdb.pdf
Dry Detention Basin	Small, man-made basin designed to capture and remove particulate matter. It generally has inlet and outlet structures to regulate flow, but is dry for most of the year.	Sediment; hydrologic flow	Moderate; 80% of total suspended solids (4) 50% of total phosphorous (4)	Storm water runoff	Sediment forebay or other form of pretreatment	50+ years	Low; remove and dispose of sediment, trash and debris; repair erosion.	Minimum	Needs land that will allow inlet at a higher elevation than outlet	Low bacteria and nutrient removal. If vegetation is not maintained, erosion and resuspension will occur.	Reduced peak flows and no standing water	Low to moderate	Low to moderate	Basin grading very important to prevent pools of standing water.	MDOT	
Extended Detention Basin	Extended detention basins are designed to receive and detain storm water runoff for a prolonged period of time, typically up to 48 hours. Benefits include: receives and detains storm water runoff, minimizes downstream erosion, reduces flooding, and provides enhanced pollutant removal.	Sediment and attached pollutants, nonsoluble metals, nutrients, hydrologic flow	Moderate to high	Storm water runoff	Riprap, grassed waterways, sediment basins		Moderate to high	Mow buffer/filter strip, remove debris and inspect basin regularly during wet weather, and remove sediment from basin every 5-10 years.	Depends on infiltration rates and soil permeability	Can significantly warm the water in the marsh area over a short period of time	Designed to receive and detain storm water runoff for a prolonged period of time. Outlet device regulates the flow from the basin.			Determine site location of BMP through a hydrologic analysis. Designed as either single stage or two-stage. Need spill response plan.		http://www.deq.state.mi.us/documents/deq-swq-nps-edb.pdf
Parking lot storage	Storage of storm water on parking lots is used primarily to reduce the peak discharge of storm water from the surrounding area during moderate storms. Will reduce peak runoff from small sites and provide some flood storage. This helps reduce stream bank erosion and flooding.	Sediment and attached pollutants, hydrologic flow		Storm water runoff, soil erosion	Grassed waterway, porous or modular pavement, infiltration trench, buffer/filter strip, street sweeping		Low to moderate - sweep and clear debris from the parking lot after storms. Regularly inspect and clean the release drain.	Design and installation should be done by a professional	This BMP will work best in areas that do not have a steep slope. Parking lot slope should be 1% or less.	Because detention time is small, only some large solids will settle. Solids must be removed often to prevent resuspension.	Reduces peak runoff from small sites, provides some flood storage, and reduces flooding.			A spill response plan must be developed. BMP is most effective when used with other BMPs that allow for infiltration or sediment trapping.		http://www.deq.state.mi.us/documents/deq-swq-nps-pls.pdf
Water and Sediment Control Basin (638)	An earth embankment or a combination ridge and channel generally constructed across the slope and minor watercourses to form a sediment trap and water detention basin. Improves water quality by trapping sediment on uplands and reducing gully erosion. Grass cover may provide wildlife habitat. Dissolved substances, such as nitrates, may be removed from discharge to downstream areas because of the increased infiltration.	Sediment and attached pollutants, nutrients, hydrologic flow	High (gully erosion) (12) Moderate (runoff/ flooding) (12) Low (streambank erosion) (12)	Soil erosion, agricultural runoff	Nutrient management, terraces, grassed waterways, contouring, conservation cropping system, conservation tillage, and crop residue management	10 years (9)	Reseed and fertilize as needed. Check basins after large storm events and make necessary repairs.	USDA Natural Resources Conservation Service (NRCS) available for assistance	Widely applicable.	Over application of fertilizer possible.	Traps storm water runoff and prevents it from reaching lowlands. Moderate decrease in runoff/flooding. Slight increase in excess subsurface water. (12)	$2,100 - 3,150/basin (11)	5% of original cost per unit (11)	Basin must be large enough to control the runoff from a 10-year storm without overtopping.		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/638.pdf

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Regional Detention	Large, man-made basin designed to capture and remove particulate matter. It generally has inlet and outlet structures to regulate flow from large drainage areas.	Sediment; nutrients; hydrologic flow	Moderate	Storm water runoff	Sediment forebay or other form of pretreatment	50+ years	Low; remove and dispose of sediment, trash and debris; repair erosion.	Minimum	Use for large drainage areas (≥ 1 acre), at storm sewer outfalls, and to collect overland flow.	Possible downstream warming; low bacteria removal; West Nile Virus	Reduced peak flows, storage	Moderate	Low to Moderate	Need available land area, can include sediment forebay.		
Vegetated Treatment (e.g., constructed wetland, grassed swale)																
Constructed Wetland	Excavated basin with irregular perimeters and undulating bottom contours into which wetland vegetation is placed to enhance pollutant removal from storm water runoff.	Sediment, nutrients, bacteria	Moderate to high depending on season; 80% of total suspended solids (4) 50% of total phosphorous (4)	Storm water runoff	Sediment forebay or other form of pretreatment	50+ years (1)	High; remove and dispose of sediment, trash and debris; repair erosion.	Moderate to High	Significant land use requirement; needs appropriate soils, slope, and hydrology	Potential for nutrient release in winter months	Slows flow and reduces peak flow	Moderate to High; $500 - $1000 excluding purchase of land (3)	2% of capital cost/year (1)	2% of drainage area needs to be wetland for efficient pollutant removal. Harvesting may be necessary if plants are taking up large amounts of toxics. Needs supplement water to maintain water level.		http://www.deq.state.mi.us/documents/deq-swq-nps-conw.pdf
Restored Wetland (NRCS practice 657)	Rehabilitation of a drained or degraded wetland where hydrology and the vegetative community are returned to their natural condition to the extent practicable. Provides natural pollution control by removing pollutants, filtering and collecting sediment, reducing both soil erosion and downstream flooding, and recharging groundwater supplies.	Sediment and attached pollutants, nutrients, hydrologic flow, bacteria, chemicals	Moderate to high (depending on season); 80% of total suspended solids from sheet, rill, wind, or ephemeral gully erosion (4) 50% of total phosphorous (4).	Storm water runoff, soil erosion	Sediment forebay or other form of pretreatment. In agricultural areas cattle exclusion fencing, buffer/filter strip, grassed waterway	50+ years (1)	High; remove and dispose of sediment, trash and debris, and repair eroded areas.	Moderate to High Design and installation should be done by a professional	Site must have previously been a wetland	Can increase water temperature. Potential for nutrient release in winter months	Stores storm water and may reduce downstream runoff and flooding. Slows flow and reduces peak flow.	Low: $200 cost to landowner if wildlife organization involved. Break tile and build berm. $2,350/acre (scwmp)	3% of original cost (11)	Many wetlands release water slowly into the ground which recharges groundwater supplies. One acre of wetland can store up to 1.5 million gallons of floodwater (enough to fill 30 Olympic size swimming pools) (EPA, 2002)		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/657.pdf
Rain Gardens and other "Landscaping for Water Quality" techniques	Small, vegetated depressions used to promote infiltration and evapo-transpiration of storm water runoff. A rain garden combines shrubs, grasses, and flowering perennials in depressions that allow water to pool for only a few days after a rain. Landscaping for water quality involves planting native gardens in place of turf grass using native grasses, sedges, and wildflowers. Protects water quality, captures rainwater, reduces flooding, eases soil erosion, increases infiltration, and requires less fertilizer and water to thrive.	Sediment and attached pollutants, nutrients, thermal pollution, solids, chemicals, oils, salt, hydrologic flow	High; 75% - 90% of total suspended solids. (3) (8) 75% of total phosphorous. (8)	Storm water runoff, fertilizers	Mulching	Assume 25 years, based on rain gardens installed in the early 1990s in Prince George County, MD which are still functioning. Depends on plant types and owner maintenance.	Low to Medium; remove and dispose of sediment, trash, and debris, repair erosion, re-vegetate, and weed, water, and mulch, annually. Soil replacement and additional preparation are sometimes needed for success. A mulch of shredded hardwood is an integral part of the rain garden to keep the soil moist and ready to soak up rain, and low maintenance.	Moderate, initial work to establish plant community. Aesthetic maintenance after initial establishment of rain garden. Center for Environmental Study, Master Gardeners Program, West Michigan Environmental Action Council available for assistance.	Site specific, depends on soils. Use for drainage areas ≤ 5 acres (8), at storm sewer outfalls, and to collect overland flow. Highly suitable for residential areas, not on steep slopes	Introduction of exotic/invasive plant species possible. Landowner may treat vegetation with herbicides or pesticides which could be carried via runoff to surface waters.	Will reduce the velocity of storm water runoff and increase infiltration	$1,075 - $12,355/ rain garden (dependent on surrounding land use)	Low. Assume $100/year; similar to yearly landscaping maintenance	Use native plant species. Soils adequate for infiltration are required. Cold climates may reduce evapotranspiration and infiltrative capacity. Practice not suitable for slopes greater than 20% (1). Pretreatment (sediment basin) needed in high sediment load areas. Not used in wellhead protection areas.		

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Best Management Practice	Description	Pollutant Addressed	Pollutant Removal Efficiency	Potential Sources of Pollutants	Additional BMPs to Complete Treatment Train	Expected Life Span	Maintenance Requirements	Training Requirements	Applicability to Site	Environmental Concerns	Hydrologic Effects to Consider	Installation Costs	Operation and Maintenance Costs	Special Considerations	Communities Using BMP	MDEQ/NRCS Link
Vegetated Buffers or Filter Strips (NRCS Practice 393)	A buffer/filter strip is a vegetated area adjacent to a water body. The buffer/filter area may be natural, undeveloped land where the existing vegetation is left intact, or it may be land planted with vegetation. Practice protects water bodies from pollutants such as sediment, nutrients and organic matter, prevents erosion, provides shade, leaf litter, and woody debris. Buffer/filter strips often provide several benefits to wildlife, such as travel corridors, nesting sites and food sources.	Sediment and attached pollutants, nutrients, thermal pollution	High to Moderate (streambank erosion) (12) Insignificant (runoff/ flooding) (12)	Runoff from parking lots, roof tops, and outflow from ponds, soil erosion, agricultural runoff	Conservation tillage in agricultural areas	10-20 years (9)	Low. Perform periodic inspections to identify concentrated flows and to verify that vegetative cover is maintaining its effectiveness. Address stream bank erosion if identified. Damaged areas should be repaired.	Low. NRCS available for assistance	Widely applicable		Will reduce the velocity of storm water runoff and increase infiltration.	Low. $350/acre (10). $250/ herbaceous acre (11) – Conservation Reserve Program (CRP), Environmental Quality Management Program (EQIP)	Low. $10/acre (9)	Several researchers have measured >90% reductions in sediment and nitrate concentrations; buffer/filter strips do a reasonably good job of removing phosphorus attached to sediment, but are relatively ineffective in removing dissolved phosphorus (Gilliam, 1994).		http://www.deq.state.mi.us/documents/deq-swq-nps-bfs.pdf ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/393.pdf
Forested or Wooded Riparian Buffer (NRCS practice 390)	Forested or wooded areas adjacent to stream	Sediment and attached pollutants, nutrients, thermal pollution	High (sheet, rill, wind, streambank, soil mass movement, road bank/ construction erosion; organics, fertilizers, pesticides, runoff/ flooding) (12)	Runoff from parking lots, roof tops, and outflow from ponds, soil erosion, storm water runoff	Filter strip	15 years (9)	Low. Perform periodic inspections to identify concentrated flows and to verify that vegetative cover is maintaining its effectiveness. Address stream bank erosion if identified. Damaged areas should be repaired.	Moderate to High. NRCS/Michigan Department of Agriculture (MDA) available for assistance	Widely applicable	Poor or lack of maintenance may cause increased erosion if trees fall into stream	Trees in the floodplain may catch debris and impede flow.	Low. $475/forrested acre (11) - CRP, EQIP	1% of original cost (11)	Keep south and west sides of streams wooded to provide shade. Several researchers have measured >90% reductions in sediment and nitrate concentrations; buffer/filter strips do a reasonably good job of removing phosphorus attached to sediment, but are relatively ineffective in removing dissolved phosphorus (Gilliam, 1994).		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/390.pdf
Two-stage channel design	A practical procedure that can be used to correctly size the stream channel and minimum bench widths for stable, effective discharge in agricultural drainage ditches. The bench of a two-stage ditch acts as a floodplain within the ditch to dissipate energy, reduces the erosive potential of high flow volumes, and reduces the shear stress on the bank toe. Two-stage ditches will have improved conveyance capacity, will be more self sustaining, will create and maintain better habitat, and will improve water quality.	Sediment, hydrologic flow		Agricultural runoff	Filter/buffer strips		May require less maintenance then conventional ditches.	The Nature Conservancy has information available for assistance.	Widely applicable.		Two-stage ditches have improved conveyance capacity compared to conventional ditches and enhance drainage	In comparison to conventional ditches, additional costs are related to increased width and more initial earthwork.	May result in less annual Operation & Maintenance (O&M) costs then conventional ditches.	Evidence and theory both suggest that ditches prone to filling with accumulated sediment may require less frequent "dipping out" if constructed in a two-stage form.		

Appendix 10 - Structural and Vegetative Best Management Practices

Best Management Practice	Description	Pollutant Addressed	Pollutant Removal Efficiency	Potential Sources of Pollutants	Additional BMPs to Complete Treatment Train	Expected Life Span	Maintenance Requirements	Training Requirements	Applicability to Site	Environmental Concerns	Hydrologic Effects to Consider	Installation Costs	Operation and Maintenance Costs	Special Considerations	Communities Using BMP	MDEQ/NRCS Link
Infiltration (e.g., infiltration basin)																
Infiltration Trench	An excavated trench (3 - 12 feet deep), backfilled with stone aggregate, and lined with filter fabric. Infiltration trenches remove fine sediment and the pollutants associated with them.	Nutrients, sediment, metals, hydrologic flow (soluble pollutants - dependent on holding time)	High; 100% of total suspended solids (4); 60% of total phosphorous.	Storm water runoff	Sediment basin, buffer/filter strips, oil/grit separators	Short; 10 years or less (1)	Low to Moderate - Annual; Remove and dispose of sediment, trash and debris. Eroding or barren areas must be re-vegetated.	Moderate. Design and installation should be done by a professional	Site specific; depends on soils. Soil infiltration rates must be greater than 0.52 inches per hour, with clay content less than 30%.	If storm water runoff contains high amounts of soluble contaminants, groundwater contamination can occur.	Provides full control of peak discharges for small sites, provides groundwater recharge, may augment base stream flow, and allow infiltration.	Moderate; average $8/cubic feet of storage (1)	9% of capital cost (1)	Avoid areas with potential hazardous material contamination. Soils with high infiltration rates required. Cold climates may hinder infiltrative capacity, fines will clog pore space in soil, and practice is not suitable for steep slopes. Use as part of a "treatment train," where soluble organic substances, oils, and coarse sediment are removed prior to storm water entering the trench. A very high failure rate occurs with infiltration trenches if they are not maintained.	MDOT	http://www.deq.state.mi.us/documents/deq-nps-it.pdf
Infiltration Pond	Water impoundment over permeable soils which receives storm water runoff and contains it until it infiltrates the soils.	Nutrients, sediment, metals	High	Storm water runoff	Sediment forebay or other form of pretreatment	25+ years	Annual	Moderate	Site specific depends on soils	Potential to contaminate groundwater	May recharge groundwater	Moderate	Moderate	Avoid areas with potential hazardous material contamination	MDOT	http://www.deq.state.mi.us/documents/deq-swq-nps-ib.pdf
Porous or Modular Pavement	Permeable asphalt or interlocking paving blocks providing infiltration. When the brick or concrete is laid on a permeable base, water will be allowed to infiltrate. Benefits include: removal of fine particulates and soluble pollutants; attenuation of peak flows; reduction in the volume of runoff; reduction in soil erosion; and groundwater recharge.	Nutrients, sediment, metals, hydrologic flow	High; 95% TSS removal rate (2)	Storm water runoff	Vacuum sweeping, subsurface drains, extended detention basin, infiltration basin.	10+ years	Moderate; Bi annual sweeping required. Periodically inspect, especially after large storms. If severe clogging occurs, may have to replace filtering material.	Low. Design and installation should be done by a professional	This practice should only be used on sites with soils which are well or moderately well drained. Must use special materials for high traffic areas	Potential risk to groundwater due to oils, greases, and other substances that may leak onto the pavement and leach into the ground.	Provides soil infiltration, attenuation of peak flows, reduction in the volume of runoff leaving the site and entering storm sewers, and groundwater recharge.	Moderate	Low to Moderate	Pretreatment of storm water is recommended where oil and grease or other potential groundwater contaminants are expected. Avoid areas with potential hazardous material contamination	MDOT	http://www.deq.state.mi.us/documents/deq-swq-nps-pap.pdf

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Filtration (e.g., sand filters)																
Vegetated Swale or Bio-filtration	A broad, shallow channel consisting of dense vegetation and designed to accommodate concentrated flows without erosion.	Sediment	High; 75% - 80% of total suspended solids (2)(4); 50% of total phosphorous (4)	Storm water runoff	Native vegetation	20-50 years	Moderate; remove and dispose of sediment, trash and debris, and repair erosion.	Moderate	Highly applicable to residential areas, not suited to steep slopes	Potential to contaminate groundwater	Slows flow	Low; $0.50/square foot of swale (7)	$0.03/square foot/year. (7)	Does not require a large land area. Should not be used in steep areas or well head areas. Soils adequate for infiltration required to discourage ponding on slopes less than 2%.	MDOT	
Sand Filters	Area designed to hold and treat the first half inch of runoff discharging from an adjacent impervious area.	Sediment, bacteria, nutrients, metals	Moderate; 83% TSS removal rate (2)	Storm water runoff		Yet to be determined	Moderate to High depending on amount of sediment	Moderate	Suitable for individual developments; requires less land and can be placed underground.	Will not filter soluble nutrients and toxics		Low to moderate	5% of initial construction costs (1)	BMP performance is still experimental		
Agricultural BMPs																
Cattle Exclusion (NRCS practices: Use Exclusion (472), Fence (382))	Fencing to exclude cattle from waterbodies and protect streambanks. Fencing prevents cattle from trampling banks, destroying vegetation, depositing waste in the stream, and stirring up sediment in the streambed.	Sediment and attached pollutants, nutrients, pathogens	Moderate to High (12)	Livestock access, animal manure	Buffer/filter strip, alternative water sources for livestock, planned grazing system, stream crossing and livestock access	10 years (use exclusion) (15) 20 years (fence) (9)	Repair fence as needed. Remove off-stream watering systems in the winter, if needed.	NRCS available for assistance	Widely applicable	Increased grazing in confined areas may reduce vegetative cover	Fencing in floodplain may catch debris and restrict flow	$1.90/ft of fence (9) - EQIP (use exclusion) Wildlife Habitat Incentive Program (WHIP) (fence)	$0.05/ft of fence (9)	Additional BMPs (e.g. Buffer/Filter Strips) are needed to prevent animal waste runoff from entering the stream.		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/472.pdf ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/382.pdf
Agricultural Waste Storage Facility (313)	A waste storage impoundment that protects water bodies from manure runoff by storing manure until conditions are appropriate for field application. Several options exist including an earthen storage pond, above or below ground tank, pit underneath a confinement facility, or a sheltered concrete slab area. Allows for field application when conditions are right. Field application cuts fertilizer costs and reduces nutrient losses.	Nutrients, pathogens	Moderate (organics (12), fertilizers (12), and polluted storm water runoff)	Animal manure	Cattle exclusion fencing, roof runoff management, diversion, Comprehensive Nutrient Management Plan (CNMP)	15 years (15)	Inspect storage structures for leaks or seepage periodically and make necessary repairs. Repair any damaged fences immediately. Empty storage structure twice a year.	NRCS available for assistance	Widely applicable	Leaks or seepage of the structure could add nutrients and bacteria to downstream water bodies via runoff. However, if building is according to specifications this would not occur.		Approximately $10,000 - 250,000 (14) - (12) - EQIP	$250 - 1,000 maximum (14)	Storage period should be 6 months unless winter applied risk index is completed		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/313.pdf

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Alternative Water Sources (Watering Facility (614), Water Well (642))	A readily available source of clean drinking water for cattle located away from water bodies. Reduces the direct deposition of cattle waste into water bodies by changing animal behavior through providing alternate drinking water.	Sediment and attached pollutants, nutrients, pathogens		Livestock access, animal manure	Cattle exclusion fencing, buffer/filter strip, planned grazing system, stream crossing and livestock access	10 years / watering facility (15) 20 years / water well (15)	Watering facility: check for materials in the trough which may restrict the inflow or outflow system; check for leaks and repair immediately; check the automatic water level device to insure proper operation. Water well: create a maintenance plan including a log of identified problems, corrective actions taken, etc.	NRCS available for assistance	Widely applicable	Depending on the structure, it may not protect watercourse if contiguous with it	Diversion of water	$1,050 / water facility (11) - EQIP	2% original cost (watering facility) (11) 1% original cost (water well) (11)	Areas adjacent to source that will be trampled by livestock should be graveled, paved, or otherwise treated to provide firm footing and reduce erosion.		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/614.pdf ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/642.pdf
Cover Crop (340)	A crop of close-growing, grasses, legumes, or small grain grown primarily for seasonal protection and soil improvement. It usually is grown for 1 year or less, except where there is permanent cover as in orchards. Temporarily protects ground from wind / water erosion, adds organic matter to the soil, recycles or holds nutrients, improves soil tilth, reduces weed competition, retained soil moisture by acting as a mulch, and fixes atmospheric nitrogen (legumes).	Sediment and attached pollutants, nutrients, chemicals (pesticide), hydrologic flow, chloride (salt)	High (sheet, rill, wind, gully irrigation induced erosion, runoff/ flooding) (12) Moderate (salts, organics, fertilizers, pesticides) (12)	Soil erosion, agricultural runoff	Pest management, nutrient management, conservation crop rotation, crop residue management	1 year (9)	Plant cover crop annually, kill cover crop in the spring, restrict grazing if necessary	NRCS available for assistance	Widely applicable. Consider soil type, slopes, etc.	Requires pest management (IPM) to ensure that pesticide use is appropriate	Significant decrease in runoff/ flooding, moderate reduction in excess subsurface water	$30/acre (9) - EQIP	$0/acre (9)	Can be used for livestock feed or left alone to build soil organic matter.		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/340.pdf
Windbreak/Shelterbelt Establishment (380)	Rows of trees and shrubs that protect areas from wind and provide food and cover for wildlife. Reduces wind erosion, conserves energy, provides food and cover for wildlife, and beautifies a farmstead.	Sediment and attached pollutants	High (wind erosion only) (12)	Soil erosion	Cattle exclusion fencing	15 years (9)	Control competing vegetation, inspect regularly	NRCS available for assistance	Widely applicable	Over application of herbicides or pesticides possible	Will reduce storm water runoff and increase infiltration	$150 - 1,000 seedlings (13) - EQIP, WHIP	10% of original cost (11)	Consider if the mature windbreak will cast a shadow over the driveway or nearby road, prolonging icy conditions.		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/380.pdf
Conservation Cover (327)	Establishing and maintaining perennial vegetative cover to protect soil and water resource on land retired from agricultural production. Reduces erosion and increases soil tilth due to perennial cover establishment of species adapted to site. Improves water quality when nutrients and sediments are retained on the field. Reduces weed sources. Wildlife food, cover, and water needs will be met.	Sediment and attached pollutants, hydrologic flow, nutrients	High (sheet, rill, wind, gully erosion; runoff/ flooding) Moderate (streambank erosion) (12)	Soil erosion, agricultural runoff	Upland wildlife habitat management, wildlife food plot, tree/shrub establishment	10 years (15)	If necessary, mow during the establishment period to reduce competition from annual weeds. Annual mowing of the conservation cover stand for general weed control is not recommended. Control noxious weeds.	NRCS available for assistance	Widely applicable	Over application of herbicides or pesticides possible	Significant decrease in runoff/ flooding, moderate reduction in excess subsurface water	$260 - 460/acre (9) - CRP, EQIP	$35/acre (9)	Use of fertilizers, pesticides and other chemicals should not compromise the intended purpose. Maintenance practices and activities should not disturb cover during the primary nesting period for grassland species in each state.		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/327.pdf

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Pasture and Hayland Planting (512)	Planting grass and legumes to reduce soil erosion and improve production in a low-producing pasture, hayfield, or eroding crop field. Reduces soil erosion by wind and/or water, extends length of the grazing season, provides cover and habitat for wildlife, protects water quality by filtering runoff and increasing filtration, and adds organic matter to the soil	Sediment and attached pollutants, nutrients, chemicals (pesticides), hydrologic flow	High (sheet, rill, wind ephemeral gully, irrigation inducted erosion; fertilizers, pesticides, runoff/ flooding) (12)	Soil erosion, agricultural runoff	Nutrient management, pest management, prescribed grazing	10 years (9)	Mow weeds, apply fertilizer and herbicide as needed	NRCS available for assistance	Widely applicable. Consider soil type	Over application of herbicides or pesticides possible	Significant decrease in runoff/ flooding and excess subsurface water	$75/acre (11) - EQIP, CRP	5% of original cost per unit (11)	Do not mix warm and cool season grasses in the same pasture. Choose species that will help reduce the use of pesticides and herbicides.		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/512.pdf
Critical Area Planting (342)	Establishing permanent vegetation on sites that have or are expected to have high erosion rates, and on sites that have physical, chemical or biological conditions that prevent the establishment of vegetation with normal practices. Stabilizes areas with existing or expected high rates of soil erosion by water and wind. Restores degraded sites that cannot be stabilized through normal methods.	Sediment and attached pollutants, salts	High (sheet, rill, wind, gully, streambank, soil mass movement, road bank/constructi on erosion) (12) Moderate (salts) (12)	Soil erosion, agricultural runoff	Diversions, riprap, grade stabilization structures, filter/buffer strips, subsurface drains, grassed waterways, nutrient management	10 years (9)	Periodic burning (if needed), prohibit grazing until year 2, prevent overgrazing, inspect after severe storms	NRCS available for assistance	Widely applicable. Consider soil type, slopes, etc. Apply on any area which is difficult to stabilize.	Use of non-native or invasive species is not recommended. Use by recreational users may degrade area.	Will reduce the velocity of storm water runoff and increase infiltration.	$460 - $815/acre (2001 and 2004) EQIP, WHIP, WRP	1 % of original cost per unit (11)	Use native plants with low long term maintenance requirements. Soil tests should be done to determine the nutrient and pH content of the soil.		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/342.pdf
Grassed Waterway (412)	The establishment and shaping of grass in a natural drainage way to prevent gullies from forming. Vegetation filters runoff and provides cover for wildlife.	Sediment and attached pollutants, hydrologic flow	High (ephemeral gully erosion) (12) Low (reduction in classic gully erosion, runoff/ flooding) (12)	Soil erosion, agricultural runoff	Grade stabilization structure	10 years (9)	Yearly re-grading, reseeding, and inspection of subsurface drain and related outfall may be needed. Fertilize as needed and mow periodically.	Design and installation should be done by a professional. NRCS available for assistance.	Widely applicable	Better conveyance enhances storm water runoff velocities and possible contamination to surface waters	Drainage way directs runoff to an outlet	$800/acre (without tile) (9) $4,500/acre (with tile) (9) CRP, EQIP	$105/acre (9)	A nurse crop, temporary cover or mulching may be necessary until permanent cover is established. Avoid planting end rows along the waterway.		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/412.pdf
Diversion (362)	Earthen embankment that directs runoff water from a specific area. Reduces soil erosion on lowlands. Vegetation filters runoff water and provides cover. Allows better crop growth on bottomland soils.	Sediment, nutrients, chemicals (pesticide), hydrologic flow	High (ephemeral gully erosion, runoff/ flooding) (12) Moderate (classic gully, soil mass movement, road bank/constructi on erosion) (12) Low (sheet, rill, streambank erosion, organics, fertilizers, pesticides) (12)	Soil erosion, agricultural runoff	Sediment basin or stabilized outlet, buffer/filter strip, nutrient management	10 years (9)	Clear outlet of debris, maintain vegetative cover on ridge, ridge repair, fertilize as needed	Design and installation should be done by a professional	Widely applicable. Do not build in high sediment producing areas unless other conservatio n measures are installed.	Over application of fertilizer possible	Catches storm water runoff and prevents it from reaching lowlands, reducing runoff velocity and increasing infiltration	$5.00/ft (9) - EQIP	$0.26/ft (9)	Important as Soil Erosion and Sediment Control (SESC) in developing sites. Each diversion must have an outlet.		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/362.pdf

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Other BMPs																
Abandoned Well Closures (Well decommissioning (351))	Well decommissioning seals an abandoned well. Abandoned wells are wells which are no longer in use or are in such disrepair that groundwater can no longer be obtained from them. Benefits include: a) Reduces the risk of groundwater contamination, b) Eliminates the risk of injury, c) Avoids liability under the Michigan Polluter Pay Law	Sediment and attached pollutants, chemicals, nutrients, chloride (salt), pathogens, hydrocarbons	High (13)	Agricultural runoff, hazardous waste spills	Stand alone practice	20 years (9)		High: professional required. A drilled, deep bedrock and artesian well should be closed by a licensed well driller. Farm*A*Syst available for assistance.	Widely applicable.	Groundwater contamination may already be present.	Will prevent surface water from reaching the groundwater supply via the abandoned well.	$50 - $500/closure - Michigan groundwater stewardship program, MDA, EQIP	Low (14)	Filling a well with rocks/gravel will not reduce the groundwater contamination risk. Technical assistance is required to properly close an abandoned well.		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/351.pdf
Streambank and Shoreline Protection (580)	Treatment(s) used to stabilize and protect banks of streams or constructed channels, and shorelines of lakes, reservoirs, or estuaries, such as bioengineering, rip rap, geotextile materials, and vegetative techniques.	Sediment and attached pollutants	High (streambank erosion, soil mass movement) (12)	Soil erosion	Livestock exclusion, prescribed grazing, buffer/filter strips, diversions, or additional sediment control measures.	20 years (9)	Site inspections conducted to ensure the stream bank structures are staying in place within the first few months of installation and following storm events.	Consult the MDEQ (Water Division or Land Division), local Conservation District, NRCS, or other agencies or consultants.	Widely applicable: site-specific practices will depend on soil type, slope of the bank, river gradient, flow, and uses of the watercourse.		Maintains the capacity of the stream channel.	EQIP: 50% cost share (15)	10% of original cost (11)	Since each reach of a watercourse is unique, stream bank protection techniques must be selected on a site-by-site basis; the specifications for each technique differ. Utilize vegetative species that are native and/or compatible with local ecosystems.		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/580.pdf
Dam Removal	Releases made from dams commonly cause a decrease in summer temperatures and an increase in winter temperatures downstream. Dam removal benefits fish by: (a) removing obstructions to upstream and downstream migration; (b) restoring natural riverine habitat; (c) restoring natural seasonal flow variations; (d) eliminating siltation of spawning and feeding habitat above the dam; (e) allowing debris, small rocks and nutrients to pass below the dam, creating healthy habitat; (f) eliminating unnatural temperature variations below the dam; and (g) removing turbines that kill fish.	Thermal pollution		Dam	Will depend on the effects of dam removal. Streambank stabilization may be necessary.	Permanent		Design and removal should be done by a professional	Widely applicable to unsafe dams and dams that no longer serve a purpose.	Recent studies show removal of small dams can have limited negative environmental impacts while restoring stream functions. Negative impacts include elevated sediment loads in addition to transformed channel morphology and hydrology. Dam removal may also wreak havoc on already highly disturbed ecosystems. Reservoirs that store high levels of contaminants may release them following dam removal, creating a contaminant plume.	Dam removal will restore natural stream flow and natural seasonal flow variations.	A number of studies (River Alliance of Wisconsin 2003, American Rivers 2003) have found removal costs to be up to 1/3 to 1/5 the cost of repair, especially when the benefits of the dam are minor. Funding sources include: private or community foundation funding, environmental grants, and state or federal assistance programs.	None	Many aging dams are no longer economically practical or cost effective to operate. Similarly, dam operation and maintenance costs tend to increase as a dam ages. These increased costs, combined with the potentially lower revenue, allow for removal to become the most cost effective alternative for the dam owner.		

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Stabilized Outlets	Outlets are areas which receive discharge water. Stabilized outlets are outlets which reduce the velocity of discharge water to non-erosive velocities. Stabilized outlets help reduce erosion in the area where water is released. Some outlets may also provide treatment of various types of pollutants. Types of outlets include: conveyance outlets (grassed waterway, stone filters, stormwater conveyance channel); water storage outlets (sediment basin, infiltration basin, detention/retention basin, oil/grit separators, Wet ponds and wetlands); conduits; and outlet protection.	Sediment and attached pollutants, hydrologic flow	Dependent on type of outlet used.	Storm water runoff, streambank erosion	Riprap, if needed	Dependent on type of outlet used.	Requires regular maintenance.	Stabilized outlets should be designed by a registered professional engineer.	Widely applicable.	If outlets are not maintained, excessive sediment may be introduced to surface waters downstream.	Stabilized outlets will reduce the velocity of discharge water to non-erosive levels.	Dependent on type of outlet used.	Dependent on type of outlet used.	If the outlet is a county or intercounty drain, permission to discharge must be obtained from the		http://www.deq.state.mi.us/documents/deq-swq-nps-so.pdf
Emergency Spill Kit	Kit materials capture oil, gasoline, and diesel spills on water.	Hydrocarbons		Boat spill					Applicable to lakes							
Pond Construction and Management (378)	A water impoundment made by constructing an embankment or by excavating a pit or dugout. Excavated ponds are made for conditions which require a small supply of water such as a golf course hazard. Embankment ponds hold larger volumes of water. Ponds can be used for storm water management and to attract wildlife. Properly designed and maintained embankment ponds provide a safe, reliable means of water supply, and may become the settling area for sediment and contaminants in the drainage area. If water quantity is more critical than quality, runoff can be used to maintain higher pond levels of an excavated pond.	Sediment and attached pollutants, chemicals, nutrients, flooding	Low (gully erosion, streambank erosion, flooding) None (sheet and rill erosion) N/A (chemicals, nutrients)	Storm water runoff	Slope/Shoreline Stabilization, Seeding, Mulching, Sodding, Pond Sealing or Lining	20 years (2004)	Moderate to High	Design and installation should be done by a professional	Depends on soil suitability. Build ponds in areas where the water supply is adequate for the intended use.	Purple loosestrife (Lythrum salicaria) is an undesirable, exotic perennial which often becomes established in disturbed sites.	Ponds can be used for storm water management.		1% of original cost per unit (2001)	For excavated ponds, consider drainage characteristics, including depth to the water table. For embankment ponds, consider upstream drainage characteristics and how the pond will affect downstream flows, temperatures, etc.		
Composting Facility (317)	A facility for the biological stabilization of waste organic material. The purposed is to treat waste organic material biologically by producing a humus-like material that can be recycled as a soil amendment and fertilizer substitute or otherwise utilized in compliance with all laws, rules, and regulations. Keeps organic debris out of surface waters and away from floodplains, which helps prevent the depletion of oxygen in surface waters.	Nutrients, low dissolved oxygen (DO)		Upland source (yard trimmings and kitchen waste)	N/A	15 years / composting facility (2004)	Composting requires proper aeration, watering and mixing in order to result in a useable end product. Product can be sold, delivered, and applied.	Design and installation should be done by a professional	Widely applicable to dense residential or riparian sites. Soils, topography and climate will all affect the types of composting options available.	Waste needs to be composted and correctly applied as fertilizer. Runoff from compost application may contaminate surface waters.	N/A	$37,000/ composting facility (2004)	Annual Maintenance $370/ year composting facility (2004)	As of March 27, 1993, yard waste collected or generated in Michigan on public property is banned from land fills and incinerators.		

Appendix 10 - Structural and Vegetative Best Management Practices

Best Management Practice	Description	Pollutant Addressed	Pollutant Removal Efficiency	Potential Sources of Pollutants	Additional BMPs to Complete Treatment Train	Expected Life Span	Maintenance Requirements	Training Requirements	Applicability to Site	Environmental Concerns	Hydrologic Effects to Consider	Installation Costs	Operation and Maintenance Costs	Special Considerations	Communities Using BMP	MDEQ/NRCS Link
Mulching (484)	The process of placing a uniform layer of straw, wood fiber, wood chips or other acceptable materials over a seeded or landscaped area. Helps keep soil particles and their associated attached chemicals (e.g. phosphorus and pesticides) from entering surface waters. Will suppress weed growth and provide a moist area for vegetative growth.	Sediment and attached pollutants	Low to Moderate	Soil erosion	Seeding, soil management, fertilizer management, grading practices, diversions (if needed).	1 year (2004)	Low: inspect mulched areas following storm events to ensure mulch has stayed in place.	Low	Widely applicable	None known.	Seeded area will eventually reduce the velocity and increase infiltration of storm water runoff.	$3.00/acre (2001)	Annual maintenance 100% of original cost per unit (2001)	Mulch should be applied immediately after seeding has occurred. Anchoring of the mulch should be done immediately after the mulch is applied.		
Riprap	A permanent cover of rock used to stabilize stream banks, provide in-stream channel stability, and provide a stabilized outlet below concentrated flows. The use of riprap protects stream banks and discharge channels from higher erosive flow velocities and decreases sediment input to a watercourse.	Sediment and attached pollutants	High	Soil erosion, agricultural runoff	Filters. (Riprap is often used in making stabilized outlets, in stream bank stabilization, etc.)	10 + years (SV)	Low: Periodically inspect underlying fabric, adjust and add riprap as needed.	Low: consult technical resources	Widely applicable: riprap is most often used in stream banks, on slopes, and at outlets.	Potential to cause additional erosion downstream.	Reduces down cutting and lateral cutting of erosive flow velocities. Typically not a significant velocity reducer.	$70/square yard (2003b) Including geotextile		MDEQ permit may be required if placed in waters of the state. Explore downstream impacts.		

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Appendix 10 - Managerial Best Management Practices

Best Managerial Practices	Description	Benefit	Pollutant Addressed	Potential Sources of Pollutants	Environmental Impacts and Special Concerns	Comparative Costs	Communities Using BMP	MDEQ/NRCS Link
Agricultural								
Crop Residue Management (329A-C, 344), includes no till, mulch till, ridge till, and seasonal	Leaving last year's crop residue on the surface before and during planting operations, providing soil cover at a critical time of the year. The residue is left on the surface by reducing tillage operations and turning the soil less. Pieces of crop residue shield soil particles from rain and wind until plants can produce a protective canopy.	Ground cover prevents soil erosion and protects water quality. Residue improves soil tilth and adds organic matter to the soil as it decomposes. Fewer trips and less tillage reduce soil compaction.	Sediment and attached pollutants	Agricultural runoff, soil erosion	Consider if crop will produce enough residue. Planning for residue cover should begin at harvest. Time, energy, and labor savings are possible with fewer tillage trips. Equipment for specialized tillage techniques needed. Additional chemical treatments may be necessary to control pests. Assistance available from USDA office or Conservation District. No local government controls in place. Crop reside reduces the velocity of storm water runoff and improves infiltration	$28-36/acre (includes no-till and strip till, ridge till) (11). Maintenance costs are 100% of original cost (11). Environmental Quality Incentive Program (EQIP) (for mulch till, ridge till, and seasonal residue management). Equipment rental or purchase $40+ per acre. Consider costs for pest control.		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/329a.pdf ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/329b.pdf ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/329c.pdf ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/344.pdf
Conservation Crop Rotation (328)	A sequence of crops designed to provide adequate organic residue for maintenance or improvement of soil tilth and fertility. Other BMPs to use include nutrient and pest management, buffer/filter strips, cover crops	Reduces sheet, rill, and wind erosion Maintains or improve soil organic matter content Manages the balance of plant nutrients Improves water use efficiency Manages saline seeps Manages plant pests (weeds, insects, and diseases) Provides food and cover for wildlife Reduces fertilizer needs and may reduce pesticide needs	Sediment and attached pollutants	Soil erosion, agricultural runoff	Rotations that include grains, such as corn, or meadow provide better erosion control. Where excess plant nutrients or soil contaminants are a concern, utilizing deep rooted crops or cover crops in the rotation can help recover or remove the nutrient or contaminant from the soil profile. Over application of fertilizer or pesticide is possible. Plants will reduce the velocity of storm water runoff and increase infiltration.	$4.00/acre (11) - EQIP		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/328.pdf
Planned Grazing System	Pasture is divided into two or more pastures or paddocks with fencing. Cattle are moved from paddock to paddock based on forage availability and livestock nutrition needs. Other BMPs to use include alternative water source, cattle exclusions, nutrient management, and soil testing	Improves vegetative cover, reduces erosion, and improves water quality by reducing sediment and nutrient runoff. Rotating also evenly distributes manure and nutrient resources.	Sediment and attached pollutants, nutrients, pathogens	Soil erosion, agricultural runoff	Keep fencing secure. Apply fertilizer and nutrients according to soil tests, mow or hay paddocks if needed and update rotation schedule if needed. Practice is widely applicable. Consider adequacy of the mix of grass and legumes to meet livestock needs. Sediment and nutrient runoff is not eliminated just reduced. This practice will increase harvest efficiently and help ensure adequate forage throughout the grazing season.	EQIP can fund establishment. $25/acre for maintenance (14)		
Irrigation Water Management (449)	Determining and controlling the rate, amount, and timing of irrigation water in a planned and efficient manner. Other BMPs to use include nutrient management, pest management, crop residue management, soil conservation measures	Management of the irrigation system should provide the control needed to minimize losses of water and discharge of sediment and sediment-attached and dissolved substances, such as plant nutrients and herbicides.	Sediment and attached pollutants, nutrients, hydrologic flow	Agricultural runoff	Poor management may allow the loss of dissolved substances from the irrigation system to surface or groundwater. There is an insignificant reduction in runoff/flooding and slight reduction in excess subsurface water. Consider the effects irrigation water has on wetlands, water related wildlife habitats, riparian areas, cultural resources, and recreation opportunities.	EQIP can fund establishment.		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/449.pdf
Contour Strip Cropping (585)	Crop rotation and contouring combined in equal-width strips of corn or soybeans planted on the contour and alternated with strips of oats, grass, or legumes. Other BMPs to use include field border, fertilizer management, grassed waterways.	Meadow slows runoff, increases infiltration, traps sediment and provides surface cover. Ridges formed by contoured rows slow water flow which reduces erosion. May reduce fertilizer costs.	Sediment and attached pollutants, hydrologic flow	Agricultural runoff, soil erosion	Keep strip widths consistent from year to year. Make adjustments in rotation schedule if needed. Over application of fertilizer possible, if used. Will reduce the velocity of storm water runoff and increase infiltration. Strip cropping is not as effective if crop strips become too wide, especially on steep slopes.	$10/acre (9) - EQIP		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/585.pdf

Appendix 10 - Managerial Best Management Practices

Best Managerial Practices	Description	Benefit	Pollutant Addressed	Potential Sources of Pollutants	Environmental Impacts and Special Concerns	Comparative Costs	Communities Using BMP	MDEQ/NRCS Link
Contour Farming (330)	Hillsides are cultivated and planted in rows along the hillside contour, not up and down the hill. Crop row ridges on the contour create hundreds of small berms. Other BMPs to use include field border, grassed waterways, and terraces or strip cropping if needed.	Reduces sheet and rill erosion and transport of sediment and other water-borne contaminants. Ridges built by tilling and planting on the contour, slow water flow and increase infiltration, which reduces erosion by as much as 50% from up and down hill farming.	Sediment and attached pollutants, hydrologic flow	Agricultural runoff, soil erosion	To avoid having to lay out new contour lines every year, establish a narrow permanent strip of grass along each key contour line. All tillage and planting operations should be performed parallel to the key contour line. Contour farming will reduce the velocity of storm water runoff, increase infiltration, moderately decrease runoff/ flooding, and slightly increase excess subsurface water. Contouring is less effective in preventing soil erosion on steeper or longer slopes.	$10/acre (9)		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/330.pdf
Pest Management (595)	Crops are scouted to determine type of pests and the stage of development. The potential damage of the pest is then weighed against the cost of control. Finally, if pest control is economical, all alternatives are evaluated based on cost, results, and environmental impact. Precaution is taken to keep any chemicals from leaving the field by leaching, runoff, or drift. Other BMPs include buffer/filter strips, crop rotation, and erosion control measures.	Treatments tailored for specific pests on identified areas of a field prevent over-treatment of pests. Using fewer chemicals improves water quality.	Chemicals (Pesticide)	Agricultural runoff	Continual scouting to best identify pests and control methods. Keep records to track costs and chemical application. Calibrate spray equipment. Consider which soils on farm are likely to leach pesticides. Consider pest control alternatives.	100% of cost/unit (11) - EQIP		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/595.pdf
Nutrient Management (590) CNMP	Crop nutrient needs are determined after a soil test, setting realistic yield goals, and taking credit for contributions from previous years' crops and manure applications, crop nutrient needs are determined. Nutrients are then applied at the proper time by the proper application method. Nutrient sources include animal manure, sludge, and commercial fertilizers. Other BMPs include manure testing, soil testing, soil conservation measures, waste management system, waste storage facility, and waste utilization.	This practice properly budgets and supplies nutrients for plant production. It also reduces the potential for nutrients to infiltrate into water supplies by preventing over application. Correct manure and sludge application on all fields can improve soil tilth and organic matter. It is very applicable on Concentrated Animal Feeding Operations (CAFOs).	Nutrients	Agricultural runoff, over application of fertilizers.	Maintenance requirements: - Perform a periodic plan review to determine necessary adjustments - Protect nutrient storage facilities from weather and accidental leakage/spillage - Calibrate application equipment and document application rates - Spread wastes away from waterbodies on an adequate land base and incorporate ASAP - Analyze manure and other organic waste for nutrient content before field application and determine appropriate application rate - Test soils once every three years according to Extension recommendations - Establish a winter cover crop if nitrogen leaching is possible due to poor crop yield * Consider the Michigan Agriculture Environmental Assurance Program (MAEAP). The CNMP must be developed by a trained technical person (service provided by NRCS or Conservation District). Consider potential groundwater contamination - proximity to waterbodies critical.	$5/acre (9) - EQIP (Costs associated with waste water collection, soil testing, integrated crop management are low but have a high start up.)		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/590.pdf

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Best Managerial Practices	Description	Benefit	Pollutant Addressed	Potential Sources of Pollutants	Environmental Impacts and Special Concerns	Comparative Costs	Communities Using BMP	MDEQ/NRCS Link
Organic Farming Practices	Organic farming differs from other farming systems in a number of ways. It favors renewable resources and recycling, returning to the soil the nutrients found in waste products. Where livestock is concerned, meat and poultry production is regulated with particular concern for animal welfare and by using natural foodstuffs. Organic farming respects the environment's own systems for controlling pests and disease in crops and livestock. Organic farmers use a range of techniques that help sustain ecosystems and reduce pollution. Other BMPs include filter/buffer strips, crop rotation, organic manuring, composting, limited chemical intervention, conservation of wildlife and natural habitats, management of livestock, recycling of organic materials.	Organic farming conserves biodiversity, provides a wide range of habitats, saves energy, improves soil fertility, and protects groundwater and surface waters from nitrates, phosphates, and pesticides. Organic food is grown without using any synthetic pesticides, herbicides, insecticides, fungicides, fertilizers, or hormones.	Nutrients, chemicals (pesticides)	Agricultural runoff	Organic farming methods are usually more labor intensive than conventional farming, so the cost of organic farming will usually be more.	EQIP funds supporting practices such as cover crops, conservation crop rotation, nutrient management, pest management.		
Soil Testing of Cropland	For proper management, a soil test for available nutrients should be made every 3-5 years. Use Integrated Crop Management (ICM)	Testing will help prevent over application of nutrients from fertilizers, manures and other sources.	Nutrients	Agricultural runoff.	Soil should be tested to determine nutrient levels. Care should be taken to not add nutrients already present in adequate levels. Soil testing should be undertaken by lab or local Michigan State University Extension (MSUE) office. Proper collection of a soil sample is important. Accuracy of analysis depends on the collection of a representative soil sample.	Costs associated with Integrated Crop Management (ICM). Typically a yearly expense. Low cost technique of monitoring soil. EQIP		
Agriculture Incentive Programs	Farm Bill programs that offer a rental payment to landowners that agree to take environmentally sensitive areas out of production. Continuous sign-ups for these programs are available to riparian and wetland areas. Rental rates are set by county boards.	Creates incentive for landowners to conserve riparian buffers, wetlands, and wildlife habitats.	Sediment, nutrients, hydrologic flow, pathogens, chemicals (pesticides)	Agricultural runoff	Property enrolled in Farm Bill programs are not protected in perpetuity. Fertilizer cannot be applied to areas under contract. In some cases, land values or crop yields may discourage landowners to use these incentive programs.	In some counties soil rental rates can be very high.		http://www.nrcs.usda.gov/programs
Zoning Ordinances/Land Use Policies								
Stronger County and State Regulatory Oversight of Over Application and Misapplication of Septage	Stronger regulatory oversight can ensure that septage is applied correctly and limited to those areas where it is appropriate. Septic system alternatives should be encouraged where such alternatives prove economical and technically sufficient in order to protect public health and the environment.	Stronger regulatory oversight will reduce the over application and misapplication of septage and help prevent nutrients and *E.coli* from entering waterbodies.	Nutrients, *E. coli*	Agricultural runoff	If existing and future regulations are not enforced, they will be useless in preventing over application and misapplication of septage			
Development/Enforcement of Storm Water Ordinance	An ordinance can provide for the regulation and control of storm water runoff; provide for storm water permits and the procedures and standards for the issuance; provide regulations for the inspection, sampling and monitoring of storm water and other discharges; establish performance and design standards for storm water management in specified zones of the township/municipality; and provide penalties for the violations of the ordinance.	Storm water runoff rates and volumes are controlled in order to protect floodways. Controls soil erosion and sedimentation; minimizes deterioration of existing watercourses, culverts, bridges, etc.; and encourages groundwater recharge.	Sediment and attached pollutants, hydrologic flow	Storm water runoff	Establishing storm water management control will minimize storm water runoff rates and volumes from identified new land development and encourage groundwater recharge. Proposed Model Storm Water Ordinance for Kent County recommends the following release rates: 0.05 cfs/acre for a 2-year storm event for Zone A; 0.13 cfs/acre per Kent County Drain Commission rules for Zone B	$8,000/ordinance development (Grand Valley Community Survey)		
Development/Enforcement of Stream Buffer Ordinance	Ordinance protects a given area of buffer adjacent to stream systems. Protected buffers can provide numerous environmental protection and resource management benefits.	Moderate to high. Reduces the risk of sediment and contaminants entering the stream. Provides long term solution to water quality concerns.	Sediment and attached pollutants, nutrients, thermal pollution	Storm water runoff from impervious surfaces (e.g. parking lots and roof tops) and outflow from ponds.	Lack of maintenance can increase erosion if trees fall into streams. At a minimum, keep south and west sides of streams wooded to provide shade. Trees in floodway can impede flow.	$8,000/ordinance development (Grand Valley Community Survey)		

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Best Managerial Practices	Description	Benefit	Pollutant Addressed	Potential Sources of Pollutants	Environmental Impacts and Special Concerns	Comparative Costs	Communities Using BMP	MDEQ/NRCS Link
Development/Enforcement of Wetland Ordinance	Ordinance promotes a policy to avoid or minimize damage to wetlands and coordinate the planning and zoning process with federal and state wetland programs.	Wetland benefits are preserved. Wetlands provide natural pollution control by removing pollutants, filtering and collecting sediment, reducing both soil erosion and downstream flooding, and recharging groundwater supplies.	Sediment and attached pollutants, hydrologic flow, nutrients, pathogens, chemicals (pesticides), salts	Storm water runoff	Part 303, section 324.30307 authorizes local units of government to adopt and administer their own wetland regulations that address wetlands not protected by the state, provided they are at least as restrictive as state regulations. The DEQ must be notified if a community adopts a wetland ordinance, but it has no review or approval authority.	$8,000/ordinance development (Grand Valley Community Survey)		
Green Space Protection Ordinance	Ordinance preserves environmentally sensitive and open areas. Can also use filter strips and tree planting to enhance protection.	High if properly executed. Provides protection of natural pollutant removal methods.	Thermal pollution, sediment, nutrients, hydrologic flow	Construction zones, developed parcels, agricultural land		$3/sq. ft. Land acquisition and management costs depend on site. Affected property may double as park/open space usage with related costs.		
Low Impact Design Practices	Land use planning to incorporate practices onsite. Examples include: bioretention, dry wells, filter strips, vegetated buffers, grass swales, rain barrels, cisterns, infiltration trenches. Involves careful site planning to reduce the impact to water resources by eliminating impervious surfaces and protecting infiltration areas.	Numerous water quality benefits. Long term solution to concerns.	Thermal pollution, solids, sediments, nutrients, metals	Rainfall, runoff, solar, fertilizers				http://www.lid-stormwater.net/
Illicit Discharge Ordinance (MDOT)	Program to seek out and prohibit illicit discharges and connections to municipal separate storm sewers	High if properly executed. Eliminate hazardous and harmful discharges	Hazardous wastes	Industrial, residential, commercial		$2/ac (assuming 1 system monitored every 5 sq. miles). Maintenance program. $0.83/acre/year, $50/ac/yr (with TV inspection)	MDOT	
Pet Waste Disposal Ordinance	Ordinance to require pet owners to clean up after their pets. Can be enhanced by installing signs and pet waste collection facilities in high traffic areas	Moderate	Nutrients, bacteria	Animals, dogs or other household pets				
Development/Enforcement of Septic System Ordinance	Ordinance abates water pollution caused by failing onsite sewage disposal systems, minimizes infiltration of seepage from systems into the storm water drainage system, and establishes penalties for its violation.	Ordinance can be used to enforce regular maintenance of disposal systems, which will minimize threats to public health and combat the degradation of surface and subsurface waters.	Bacteria	Septic systems	Lack of ordinance enforcement (regular inspection) can introduce pollution into groundwater reserves.	$8,000/ordinance development (Grand Valley Community Survey)		
Development/Enforcement of Yard and Kitchen Waste Ordinance	Ordinance prohibits the disposal of yard and kitchen waste on streambanks and outlines acceptable disposal methods, such as composting or disposal at a permitted disposal facility.	Proper disposal of yard and kitchen waste ensures that nutrients from these materials are not released into surface and groundwater supplies.	Nutrients	Upland source (yard/kitchen waste)	If yard and kitchen waste are composted on landowner's premises, nutrient runoff should not reach nearby surface water bodies.	$8,000/ordinance development (Grand Valley Community Survey)		
Development/Enforcement of Watercraft Control Ordinance	Ordinance prohibits the operator of a recreational watercraft to exceed a "slow - no wake" speed when within x feet of the shoreline.	Enforcing "no wake" zones will reduce streambank erosion.	Sediment and attached pollutants	Recreational watercraft	Issues concerning trespass, disorderly conduct, or damage caused to private property by the wake of vessels are not valid safety considerations for establishing a local ordinance.	$8,000/ordinance development (Grand Valley Community Survey)		
Public Access Ordinance	Ordinance controls access to a designated waterbody by limiting hours of access, number of users, etc.	By controlling public access to a waterbody, sediment pollution is reduced.	Sediment and attached pollutants	Public access, boat wakes	Consider using porous/ modular pavement at boat launches locations.	$8,000/ordinance development (Grand Valley Community Survey)		
Development/Enforcement of Fertilizer Ordinance	Ordinance prohibits the use of fertilizers containing more than 1% by weight of anhydric phosphoric acid.	Moderate; other sources of phosphorus may be present in the watershed.	Phosphorus	Fertilizers	Sources of low phosphorus fertilizers are few.	$8,000/ordinance development (Grand Valley Community Survey)		
RECYCLING/COMPOSTING								
Household Hazardous Waste Management	Proper buying, using, storing and disposal of Hazardous materials such as automotive waste, household cleaners and paint.	Moderate: eliminates disincentives and discourages illegal dumping of products into storm sewers and onto the ground	Hazardous wastes	Residents: Used oil, paints, cleaning products, etc.	Proper credentials needed for management. Typically consultant based.	Recycling station expenses.		http://www.deq.state.mi.us/documents/deq-swq-nps-hhhw.pdf

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Best Managerial Practices	Description	Benefit	Pollutant Addressed	Potential Sources of Pollutants	Environmental Impacts and Special Concerns	Comparative Costs	Communities Using BMP	MDEQ/NRCS Link
Composting	Converting plant debris, grass, leaves, pruned branches, etc. to compost. Use with lawn maintenance, pesticide and fertilizer management, and diversions (if needed)	Keeping organic debris out of surface waters and away from floodplains. Will help prevent the depletion of oxygen in surface waters. Widely applicable to dense residential or riparian sites.	Nutrients, chemicals, and pesticides, low dissolved oxygen, trash and debris	neighborhoods, agricultural areas, yard, and kitchen waste	Compost piles placed near floodplains will contribute to the depletion of oxygen in surface waters. Composting requires proper aeration, watering, and mixing in order to result in a useable end-product. Soils, topography and climate will all affect the types of composting options available.	Recycling vs. garbage hauler costs. Establishment of large scale facility $190,000, land dependant. $70,000 annual maintenance.		
Yard Waste Collection and Disposal Program	Municipalities collect yard waste for compost.	Widely applicable to dense residential or riparian sites	Nutrients and organic sediment, trash and debris	Yard waste and leaf litter	Waste needs to be composted and correctly applied as fertilizer. Need large collection facility for compost operations.	Low		
Recycling Program (MDOT)	Collection of recyclable materials either by curb-side pick up or at drop off centers	Reduction in potential clogging and harmful discharge	Trash, used construction material reuse	Highways, travelers, vehicle debris	Some materials may require more energy to collect and recycle than using new products. However, recycling programs do build awareness	$200,000/year. $1.15/person/yr.		
Used Oil Recycling Program (MDOT)	Central collection facilities that allow residents to drop off used motor oil. Can be operated by local governments or businesses that recycle oil.	Reduces risk of surface water and groundwater contamination	Used oil and other transportation fluids reuse, hydrocarbons, metals, nutrients	Vehicle maintenance facilities. Vehicles or other equipment requiring lubrication.	Oil may easily become contaminated during collection making it a hazardous waste.	$79 - $179 recovery charge. Administrative costs to organize. Minimal personnel cost to collect and temporarily store oil. Opportunity to be paid by private business for waste material	MDOT	
Turf Management								
Pesticide Management for Turf Grass and Ornamentals	Use of all available strategies (resistant turf, cultural controls, biological controls, mechanical controls and pesticides) to manage pests so that an acceptable yield and quality can be achieved economically with the least disruption to the environment. Used with lawn maintenance, fertilizer management, and soil management.	Moderate to High	Harmful chemicals, pesticides, insecticides	Landscaping, storm water runoff	Must have proper training and credentials to commercially apply pesticides and manage turf.	Pesticide management should reduce application rates and related costs.		http://www.deq.state.mi.us/documents/deq-swq-nps-pm.pdf
Lawn Maintenance	Includes mowing, irrigating, pesticide and fertilizer management, soil management and the disposal of organic debris such as lawn clippings and leaves.		Phosphorus, nutrients, and sediments	Landscaping, storm water runoff	Consider minimizing lawn with more native species	Lawn alternatives may reduce mowing but still require regular maintenance of weed control and pest management.		http://www.deq.state.mi.us/documents/deq-swq-nps-lm.pdf
Fertilizer Management	Includes the proper selection, use, application, storage and disposal of fertilizers. Used with pesticide management, lawn maintenance, and nutrient management	Moderate	Nutrients	Landscaping, storm water runoff	Consider consulting professional, such as Michigan State University Extension (MSUE)	Material cost reduction may conflict with traditional aesthetic values. Fertilizer management should reduce chemical costs but may impact maintenance and watering.		http://www.deq.state.mi.us/documents/deq-swq-nps-fm.pdf
Soil Testing of Lawns and Gardens			Nutrients	Lawn and garden fertilizer	Testing should be done at qualified lab	Typically yearly testing required, contact local MSUE office. Test results may result in operations and maintenance costs. Low cost tool in management of lawns and gardens. $9.50 per test.		
Operations and Maintenance								
Operation and Maintenance Programs			Sediment, hydrocarbons, metals, nutrients	Erosion of road footprint and related infrastructure, leaking equipment, etc.		Labor intensive. Equipment required.	MDOT	
BMP Inspection and Maintenance Plan for Roads (MDOT)		A regular inspection and maintenance program will maintain the effectiveness and structural integrity of the BMPs.	Sediment, hydrocarbons, metals, nutrients, etc.	Road related sediments/pollutants	Materials needed for emergency structural repairs may not be easily obtainable and may require stockpiling (MDOT). Should be designed and implemented by trained professional.	$150-$9,000 depending on the BMP. Specialized BMP installation involves planning, design, construction and maintenance costs.	MDOT	
Material Management Plan (MDOT)	Identified hazardous and non-hazardous materials in the facility. Assures that all containers have labels. Identifies hazardous chemicals that require special handling, storage, and disposal.		Chemicals and other potentially hazardous materials.	Varies depending on type of material usage at specific facilities. Oil, salt, degreasers, solvents, antifreeze, etc. Industrial sites where chemicals are used.	Extensive training typically required to prepare and administer plan.	Plan preparation and updates. Inspections mandated. Plan development typically needs consultant or knowledgeable employee. Operation typically employee dependant.	MDOT	

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Best Managerial Practices	Description	Benefit	Pollutant Addressed	Potential Sources of Pollutants	Environmental Impacts and Special Concerns	Comparative Costs	Communities Using BMP	MDEQ/NRCS Link
Clean and Maintain Storm Drain Channels (MDOT)		Prevent erosion in channels. Improve capacity by removing sediment. Remove debris toxic to wildlife.	Sediment, trash, woody debris	Development, natural erosion, vehicle remnants, road winter safety operations.	Should be implemented by trained professional.	$21/acre/year, $45-60 per acre (rural). Channels are less expense to construct and easier to maintain than enclosed systems.	MDOT	
Clean and Maintain Storm Inlets and Catch Basins (MDOT)	Catch basins are periodically inspected and cleaned out using a vacuum truck.	Moderate; reduces pollutant slugs during the first flush, prevents downstream clogging, and restores sediment trapping capacity of the catch basin.	Solids, sediments, metals, oils	Storm water runoff, automobiles	Requires continual maintenance every 1 - 3 years. General fund, KCRC road maintenance budget - $250,000	Moderate to High; Total annual cost per catch basin = ($8/catch basin) + ($40/catch basin) = $48/catch basin. (Grand Rapids (GR) BMP Study). $21/acre/year maintenance.		
Annual Road/Stream Crossing Inspections	Inspections of stream crossings for evidence of erosion, debris, etc.	Moderate	Sediment	Erosion of streambank		Moderate; regular inspection can prevent major expenditures for potential major points of erosion		
Municipal Operations								
Snow and Ice Control Operations	Removal of snow and ice from roadways, utilizing plows, salt, and sand.		Salts	Snow melt runoff	Moderate, all KCRC equipment operators are trained. Training of road maintenance crew required.	KCRC winter maintenance budget - $3.5 million. Maintenance costs $1,000/lane/mile, dependant on severity of winter.		
Calibrated Salt Delivery		Low	Salts	Over application of salt	Calibration does not guarantee efficient application of road salt. Annual training and calibration necessary.	Low upfront cost. Long term equipment maintenance vs. reduced salt. Equipment costs $1,500 per truck, minimal additional cost.		
Pre-wet Road Salt Application		High if also used with environmentally friendly alternatives to salt	Salts	Road salt		Low to Moderate; $25/lane/mile, equipment maintenance costs - $5,000 per truck.		
Snow Removal Storage on Grassy Areas		Low	Sediment, metals, hydrocarbons, salt	Snow melt runoff	Snow storage may damage vegetation and possibly cause soil erosion. Piled snow melts at a slower rate. Need Right of Way (ROW) for snow removal. Need large grassed area adjacent to buildings and parking areas and properly spaced from waterbody.	Dependant on amount of trucking, distance to site, etc. Cleanup after melt		
Minimizing Effects from Road Deicing (MDOT)			Salts & chemicals	Maintaining agency, Snow melt runoff, spring rains		Varies	MDOT	
Street Sweeping	The use of specialized equipment to remove litter, loose gravel, soil, vehicle debris and pollutants, dust, de-icing chemicals, and industrial debris from road surfaces. There are generally 2 types of sweepers: mechanical broom street sweepers and vacuum-type street sweepers.	Moderate; 60% TSS removal rate. Reduction in potential clogging of storm drains. Some oil and grease control (MDOT). When done regularly, can remove 50 - 90% of street pollutants (1), makes road surfaces less slippery in light rains, improves aesthetics by removing litter, and controls pollutants.	Sediment, metals, hydrocarbons	Atmosphere, construction, vehicles	Sweeping may wash sediments into catch basins if wash is not vacuumed. Disposal of collected materials must be handled by the governing agency (MDEQ, Public Health, Transportation). Sweeping schedules and timing critical - sweep after snow melt and before spring rains. Vehicle maintenance required.	KCRC Road maintenance budget - $300,000/yr. Ottawa County: Mechanical - $119.40/curb mile. Vacuum Assisted - $87.95/curb mile (GR BMP Study)	MDOT	http://www.deq.state.mi.us/documents/deq-swq-nps-sw.pdf
Emergency Spill Response and Prevention Plan	Plans detail emergency procedures to respond to a release of hazardous materials. Also plans that describe procedures for proper handling and storage of chemical materials.	Low to High, depending on preparedness. Can be highly effective at reducing the risk of surface and ground water contamination	Hazardous wastes	Equipment, poor training, accidents, Industrial, commercial, residential, and transportation related spills, chemical storage areas	Speed and containment are critical. Requires a well-planned and clearly defined plan, updated regularly. May require training, protective gear, containment and retrieval knowledge. Equipment must be readily available. (MDOT)	Management plan preparation with upgrades. Cost of simulations. In public sector, typically subcontracted to private contractor	MDOT	
SESC Plans	Plans that specifies the actions that will be taken on a construction site to minimize erosion and sedimentation	High if properly executed. Reduce erosion and sedimentation during construction project. Increased removal using Floc Logs through construction.	Sediment	Unvegetated areas, land development	State training, SESC and/or certified operator.	Act 91 mandated, ongoing local administrative costs. Fee based to landowner option.		
Dust Control (MDEQ)	Using measures such as watering, fencing, mulching and vegetation to prevent soil and attached pollutants from leaving a site and/or entering nearby waterways.	High if properly executed.	Sediment	Lack of vegetation typically associated with dirt or gravel roads	Salt and other potential pollutants are used in the dust control mixture. Rural, urbanizing, and transportation sites subject to wind erosion. Air pollution issue if neglected.	$100 to $500 per treatment. Employee administrative expense. Maintenance of water truck (minimal) - Roads 50-55 cents/gal, 1,500 gal/mile for a single pass		http://www.deq.state.mi.us/documents/deq-swq-nps-dc.pdf
Urban Forestry	Management of woods and trees in an urban setting.	Moderate to high. Increases greenspace, reduces storm water runoff and thermal pollution. Long term solution to concerns.	Thermal pollution, solids, sediments	Rainfall, Solar	Woody debris and detritus may require annual maintenance. May eliminate original line of sight			

Appendix 10 - Managerial Best Management Practices

Best Managerial Practices	Description	Benefit	Pollutant Addressed	Potential Sources of Pollutants	Environmental Impacts and Special Concerns	Comparative Costs	Communities Using BMP	MDEQ/NRCS Link
Other								
Invasive Plant Species Management	Invasive plant species are controlled using appropriate and effective removal methods for particular species.	Population and spread of invasive plant species is reduced or eliminated.	Invasive plant species	Accidental/purposeful introduction, natural dispersion	Invasive alien plants thrive in disturbed sites. Native plant communities fragmented by human disturbance are most vulnerable to invasion, but the most invasive species can infest even intact ecosystems. Invasive alien plants are free of natural controls such as insects and diseases that keep them in balance in their native habitats. Invasive species can also significantly reduce forest regeneration.			
Woody Debris Management								
Goose Management								
Information and Education								
Public Education Program (MDOT)		Can reduce improper disposal of hazardous waste	Potentially all			$200,000/year		
Grounds Maintenance Training		Moderate	Nutrients and organic sediment	Leaf litter, grass clippings, fertilizer, and pesticides		Low		
Employee Training (MDOT)		Low cost and easy to implement storm water management BMPs	Potentially all				MDOT	
Storm Drain Stenciling	Painting Storm Drain Inlets with "No Dumping" signs and symbols.	Moderate; Educates the general public that the storm drain discharges into a natural waterbody. Can tie into hazardous waste collection, yard waste collection	Hazardous waste and nutrients	Household hazardous waste, motor oil, pet waste and yard waste	Volunteers need to take care with paint around storm drains. Permanent castings or decals may be more effective. Public education campaign is also needed for effective reduction in illegal dumping. Short term effectiveness.	$0.45/inch - Mylar stencils $5-$6 each - ceramic tiles $100 or more - metal stencils	MDOT	

1. Fishbeck, Thompson, Carr & Huber, Inc. Evaluation of Best Management Practices for MDOT. 2002.
2. Bannerman, Roger T., Wisconsin Department of Natural Resources. Source Area and Regional Storm Water Treatment Practices: Options for Achieving Phase II Retrofit Requirements in Wisconsin. 2002.
3. Michigan Department of Environmental Quality. Guidebook of Best Management Practices for Michigan.1996.
4. Environmental Protection Agency (EPA). National Pollutant Removal Performance Database. June 2000.
5. Personal Communication with Hydro-Compliance Management, Inc. staff. 2004.
6. Gruenwald, Paul E. Governmental Accounting Focus, Estimating Useful Lives for Capital Assets. May 2002.
7. Rouge River National Wet Weather Demonstration Project. Planning and Cost Estimating Criteria for Best Management Practices. April, 2001. TR-NPS25.00.
8. Rain Gardens of West Michigan. Beautiful Solutions for Water Pollution. [Online] 2003. Available at http://www.raingardens.org/Index.php.
9. USDA - Natural Resources Conservation Service. Field Office Technical Guide, Section 1 Cost Information (draft). 2004.
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11. USDA - Natural Resources Conservation Service. Sample County Practice and Maintenance Costs. 2001.
12. USDA - Natural Resources Conservation Service. Conservation Practice Physical Effect Worksheet[s]. 2004.
13. Personal Communication with Technical Committee of the Lower Grand River Watershed Project. 2004.
14. Personal Communication with District Conservationist of the NRCS Grand Rapids Service Center. 2004.
15. USDA - Natural Resources Conservation Service. FY04 Michigan EQIP Statewide Eligible Practice List, Land Management Practices (Incentive Payments). 2004.

Appendix 11

CONSERVATION EASEMENT
(Provided by Land Conservancy of West Michigan)

DATE: **(INSERT DATE)**

DONOR/OWNER: **(INSERT DONOR'S NAME, MARITAL STATUS AND ADDRESS)**

DONEE/CONSERVANCY: Land Conservancy of West Michigan
1345 Monroe Avenue NW, Suite 324
Grand Rapids, MI 49505

For purposes of this Conservation Easement, the Donor, who is the current Owner, and all subsequent Owners of the subject Property, will be referred to as the "Owner" throughout this Conservation Easement. The Donee will be referred to as the "Conservancy" throughout this Conservation Easement.

PROPERTY: (INSERT COMPLETE LEGAL DESCRIPTION)

CONVEYANCE: The Owner conveys and warrants to the Conservancy a perpetual Conservation Easement over the Property. The scope of this Conservation Easement is set forth in this agreement. This conveyance is a gift from the Donor to the Conservancy. Accordingly, this is exempt from Transfer Tax pursuant to MCL 207.505(a) and 207.526(a).

THE OWNER AND THE CONSERVANCY AGREE TO THE FOLLOWING:

1. PURPOSES OF THIS CONSERVATION EASEMENT AND COMMITMENTS OF THE DONOR/OWNER AND THE CONSERVANCY.

   A. This Conservation Easement ensures that the Property will be perpetually preserved in its predominantly natural, scenic, historic, agricultural, forested, and open space **(DELETE THOSE THAT DO NOT APPLY)** condition. The Purposes of this Conservation Easement are to protect the Property's natural resource and watershed values; to maintain and enhance biodiversity; to retain

quality habitat for native plants and animals, and to maintain and enhance the natural features of the Property. Any uses of the Property that may impair or interfere with the Conservation Values are expressly prohibited.

B. The Donor is the Owner of the Property and is committed to preserving the Conservation Values of the Property. The Owner agrees to confine use of the Property to activities consistent with the Purposes of this Easement and the preservation of the Conservation Values.

C. The Conservancy is a qualified Recipient of this Conservation Easement, is committed to preserving the Conservation Values of the Property, and is committed to upholding the terms of this Conservation Easement. The Conservancy protects natural habitats of fish, wildlife, plants, and the ecosystems that support them. The Conservancy also preserves open spaces, including farms and forests, where such preservation is for the scenic enjoyment of the general public or pursuant to clearly delineated governmental conservation policies and where it will yield a significant public benefit.

2. CONSERVATION VALUES. The Property possesses natural, scenic, historic, open space, scientific, biological, and ecological values **(DELETE THOSE THAT DO NOT APPLY)** of prominent importance to the Owner, the Conservancy, and the public. These values are referred to as the "Conservation Values" in this Easement. The Conservation Values include the following:

(NOTE TO DRAFTER: It is critically important to include all of the Conservation Values that are specific to the Property. Include the following values that pertain; add additional specific values; include local policy statements, goals, and laws; delete those Conservation Values that do not apply; delete any legislation that does not apply. The headings are meant to stimulate ideas for listing Conservation Values and may be deleted).

OPEN SPACE and SCENIC:

A. A scenic landscape and natural character that would be impaired by modification of the Property.

B. A scenic panorama visible to the public from publicly accessible sites that would be adversely affected by modifications of the natural habitat.

C. Relief from urban closeness.

D. Prominent visibility to the public from **(INSERT)**, and, which will enhance tourism if preserved in its natural state.

E. Biological integrity of other land in the vicinity has been modified by intense urbanization, and the trend is expected to continue.

F. There is a reasonable possibility that the Conservancy may acquire other valuable property rights on nearby or adjacent properties to expand the Conservation Values preserved by this Conservation Easement.

PUBLIC POLICY:

G. The State of Michigan has recognized the importance of protecting our natural resources as delineated in the 1963 Michigan Constitution, Article IV, Section 52, "The conservation and development of the natural resources of the state are hereby declared to be of paramount public concern in the interest of the health, safety, and general welfare of the people. The legislature shall provide for the protection of the air, water, and other natural resources of the state from pollution, impairment, and destruction."

H. The Property is preserved pursuant to a clearly delineated federal, state, or local conservation policy and yields a significant public benefit. The following legislation, regulations, and policy statements establish relevant public policy: **(For a more extensive list of relevant laws, see the *Collection of Conservation, Preservation, and Environmental Laws and Summaries* compiled by the Little Traverse Conservancy in April 2000 and provided to each land conservancy in Michigan.)**

- Conservation and Historic Preservation Easement, Sub part 11 of Part 21 of the Michigan Natural Resources and Environmental Protection Act - MCL §§ 324.2140 *et seq*.;

- Biological Diversity Conservation, Part 355 of the Michigan Natural Resources and Environmental Protection Act – MCL §§ 324.35501 *et seq;* (Legislative Findings § 324.35502);

- Sand Dune Protection and Management, Part 353 of the Michigan Natural Resources and Environmental Protection Act, MCL §§ 324.35301 *et seq*.; (Legislative Findings MCL § 324.35302);

- Wetland Protection, Part 303 of the Michigan Natural Resources and Environmental Act - MCL §§ 324.30301 *et seq*.; (Legislative Findings MCL § 324.30302);

- Water Pollution Control Act of 1972, 33 USC §§ 1251 - 1387 (§1251 Goals & Policy; § 1344 Wetlands permitting, aka "Section 404" Clean Water Act.);

- Coastal Zone Management Act, 16 USC §§ 1451 *et seq*.; (§§ 1451, 1452 Congressional Findings and Policy.);

- Shorelands Protection and Management, Part 323 of the Michigan Natural Resources and Environmental Protection Act - MCL §§ 324.32301 *et seq*.;

- Inland Lakes and Streams, Part 301 of the Michigan Natural Resources and Environmental Protection Act - MCL §§ 324.30101 *et seq.*;

- Great Lakes Submerged Lands, Part 325 of the Michigan Natural Resources and Environmental Protection Act - MCL §§ 324.32501 *et seq*.;

- Farmland and Open Space Preservation, Part 361 of the Michigan Natural Resources and Environmental Protection Act - MCL §§ 324.36101 *et seq*.;

- Soil Conservation, Erosion, and Sedimentation Control, Parts 91 & 93 of the Michigan Natural Resources and Environmental Protection Act – MCL §§ 324.9101 *et seq;* 324.9301 *et seq*; (Legislative Policy § 324.9302);

I. The **(INSERT)** governmental agency has endorsed the proposed scenic view of the Property under a landscape inventory, pursuant to a review process.

J. The **(INSERT)** office has recognized the importance of the Property as an ecological and scenic resource, by designating this and other land as **(INSERT)**.

K. The Township / County of **(INSERT)** has designated this area as **(INSERT)** in its Comprehensive Plan dated **(INSERT)**.

L. **(Insert local policy statements which apply).**

WILDLIFE VALUES:

M. The Property is home to many species of wildlife, including: **(INSERT)**.

N. The Property provides vital corridor wetlands and upland wildlife habitats that serve as a connection for wildlife movement and create a natural "greenway" **(INSERT AREA)**.

O. The Property is noteworthy for the **(INSERT)**.

ECOLOGICAL / HABITAT:

P. The Property contains significant natural habitat in which fish, wildlife, plants, or the ecosystems that support them, thrive in a natural state.

Q. Wetlands, as described in Wetland Protection, Part 303 of the Michigan Natural

Resources and Environmental Code MCL 324.30301 et seq., identified as important natural resources for the people of the State of Michigan, are present on the Property.

R. Habitat for rare, endangered, or threatened species of animal, fish, plants, or fungi, including: **(INSERT SPECIES)**. **(INSERT if threatened or endangered and if in the State of Michigan or federal)** are supported on the Property.

S. The Property contains natural areas that represent high quality examples of terrestrial or aquatic communities **(INSERT)**.

T. The Property contains sustainable habitat for biodiverse vegetation, birds, fish, and terrestrial animals.

U. A diversity of plant and animal life are found on the Property in an unusually broad range of habitats for a property of its size.

V. The Property is characteristic of **(INSERT)**. Its dominant vegetation is **(INSERT)** interspersed with **(INSERT other habitats, streams, important natural features)**. These plant communities are in a relatively natural and undisturbed condition and support the full range of wildlife species found in these habitat types.

W. The Property contains natural wetland areas that provide habitat for aquatic invertebrates, reptiles, amphibians, and aquatic and/or emergent vegetation.

X. Valued native forest land exists on the Property, which includes diverse native species, trees of many age classes and structural diversity, including a multi-story canopy, standing dead trees and downed logs.

WATERSHED PROTECTION:

Y. The Property provides important natural land within the watershed of **(INSERT)**. Protection of the Property in its natural and open space condition helps to ensure the quality and quantity of water resources for the **(INSERT)** area.

Z. The Property includes the **(INSERT)** feet of frontage on the **(INSERT)(river, stream, lake).**

AA. The Property has a significant amount of undeveloped frontage on the banks/shore of **(INSERT)**, which is a State designated Natural River (designated as a Wilderness River, Wild and Scenic River, or Country-Scenic River) under the Natural Rivers Section (Part 305) of the Michigan's Natural Resources Environmental Protection Act, MCL §§ 324.30501-30515 *et seq*., **(OR)** a State

designated “Blue Ribbon Trout Stream” considered by the Department of Natural Resources to be one of the “Top Ten” trout streams in Michigan.

BB. Sections of the property are situated on hillsides with slopes greater than 20% that are adjacent to or in close proximity to **(INSERT BODY OF WATER OR STREAM)** and the vegetated slopes would be highly susceptible to erosion damage and accelerated stormwater runoff that could adversely affect water quality if the trees or other vegetation were removed.

ADJACENT TO PROTECTED LANDS:

CC. The Property lies in close proximity to the following conserved properties that similarly preserve the existing natural habitat: **(INSERT)**.

DD. This Easement protects a natural area which contributes to the ecological viability of a local, state, or national park, nature preserve, wildlife refuge, wilderness area, or similar conservation area.

EE. Preservation of the Property enables the Owner to integrate the Conservation values with other neighboring lands.

FARMLAND:

FF. The Property consists entirely of “prime farmland” and “farmland of local importance” as classified by the U.S. Department of Agriculture and the Natural Resources Conservation Service.

GG. The Property has a long history of productive farming and contains significant areas with soil classifications designated as **(INSERT)**.

HH. The Property is located within **(INSERT)** Township, a community with an agriculture-based economy in an area presently experiencing rapid development, including the subdivision of prime farmland.

3. BASELINE DOCUMENTATION. Specific Conservation Values of the Property have been documented in a natural resource inventory signed by the Owner and the Conservancy. This “Baseline Documentation Report” consists of maps, a depiction of all existing human-made modifications, prominent vegetation, identification of flora and fauna, land use history, distinct natural features, and photographs. The parties acknowledge that this natural resources inventory, the Baseline Documentation Report, is an accurate representation of the Property at the time of this donation.

4. PROHIBITED ACTIONS. Any activity on, or use of, the Property that is inconsistent with the Purposes of this Conservation Easement or that is detrimental to the Conservation Values is expressly prohibited. By way of example, but not by way of

limitation, the following activities and uses are explicitly prohibited:

A. **Division.** Any division or subdivision of the Property is prohibited.

B. **Commercial Activities.** Any commercial activity on the Property is prohibited. *De minimis* commercial recreational activity is, however, permitted.

(Optional language) except as associated with permitted activities (such as agriculture, timber management, home business) as specified in Paragraph **(insert)** below.

C. **Industrial Activities.** Any industrial activity on the Property is prohibited.

D. (Optional) **Construction.** The placement or construction of any human-made modification such as, but not limited to, structures, buildings, fences, roads, and parking lots is prohibited except as provided for under Paragraph **(insert)**.

E. **Cutting Vegetation.** Any cutting of trees or vegetation, including pruning or trimming, is prohibited, except for the cutting or removal of trees or vegetation that pose a threat to human life or property and as provided for under Paragraph **(insert)**.

F. **Land Surface Alteration.** Any mining or alteration of the surface of the land is prohibited, including the mining or extraction of any substance that must be quarried or removed by methods that will consume or deplete the surface estate, including, but not limited to, the removal of topsoil, sand, gravel, rock, and peat. In addition, exploring for, developing, and extracting oil, gas, hydrocarbons, or petroleum products are all prohibited activities.

G. **Dumping.** Waste and unsightly or offensive material is not allowed and may not be accumulated on the Property.

H. **Water Courses.** Natural water courses, lakes, wetlands, or other bodies of water may not be altered.

I. (Optional) **Off-Road Recreational Vehicles.** Motorized off-road vehicles such as, but not limited to, snowmobiles, dune buggies, all-terrain vehicles, and motorcycles may not be operated off of designated roads on the Property except those vehicles, such as tractors, trucks, and other 4-wheel vehicles, that may be used in **(insert)** areas expressly for activities described in Paragraph **(insert)** .

J. (Optional) **Agriculture.** Any agricultural activity on the property is prohibited except **(insert)** as provided for under Paragraph **(insert)**. Agricultural activity is

defined as the planting and harvesting of crops, nursery stock, and trees.

K. (Optional) **Animals**. The raising or housing of livestock, poultry or horses, the commercial kenneling of animals or conducting commercial aquaculture on the Property is prohibited, except **(insert)** as provided for under Paragraph **(insert)** .

L. **Signs and Billboards.** Billboards are prohibited. Signs are prohibited, except the following signs may be displayed for the following purposes:

- To disclose the name and address of the Property or the owner's name.
- To disclose that the area is protected by a conservation easement.
- To state that trespassers or any unauthorized entry or use is prohibited.
- To advertise the Property for sale.
- To identify and interpret trails and natural features.
- To warn of the presence of dogs or other animals.

5. PERMITTED USES. The Owner retains all ownership rights that are not expressly restricted by this Conservation Easement. In particular, the following rights are reserved:

A. **Right to Convey.** The Owner retains the right to sell, mortgage, bequeath, or donate the Property. Any conveyance will remain subject to the terms of the Conservation Easement and the subsequent Owner will be bound by all obligations in this agreement.

B. (Optional) **Right to Maintain and Replace Existing Structures.** The Owner retains the right to maintain, renovate, and replace the existing structures, driveway, and parking area, in the Building Envelope described below and as noted in the Baseline Documentation Report, in substantially the same location, size, and character. Any renovation or replacement may not substantially alter the character or function of the structure.

The following structures may be maintained, replaced, or renovated in the Building Envelope indicated in the Baseline Documentation Map:

1. _____

2. _____

Prior to beginning any renovation or replacement of the existing structures, the Owner will provide a written plan to the Conservancy for the Conservancy's review and approval under the provisions of Paragraph 8. Such approval shall not be unreasonably withheld.

C. (Optional) **Right to Add Designated Structures or Uses.** The Owner retains the right to add the following structures, modifications, or uses on the following legally described portion of the Property **(NOTE TO DRAFTER: Insert legal description of building envelope).**

The following structures may be added in the Building Envelope indicated in the Baseline Documentation Map:

1. _____

2. _____

Prior to adding of any new structures, the Owner will provide a written plan to the Conservancy for the Conservancy's review and approval under the provisions of Paragraph 8. Such approval shall not be unreasonably withheld.

D. (Optional) **Right to Maintain Natural Areas.** Cutting down or otherwise destroying or removing trees or other vegetation whether living or dead is prohibited in areas designated as Natural Areas on the Baseline Documentation Map except to remove dangerous trees, reduce a natural threat of infestation posed by diseased vegetation, or control invasive non-native plant species that endanger the health of native species.

E. (Optional) **Right to Maintain Trails.** The Owner retains the right to maintain existing foot trails and existing unpaved two-tracks throughout the Property provided that the maintenance activity does not substantially alter the landscape or adversely affect the Conservation Values of the Property.

F. (Optional) **Right to Manage Lawn and Garden.** In areas designated as the Building Envelope on the Baseline Documentation Map, the Owner retains the right to remove, trim, and otherwise manage lawn and gardens; and to grow and harvest fruits, nuts, and vegetables.

G. (Optional) **Right to Maintain Agricultural Operations.** The Owner retains the right to maintain agricultural operations uses on the Property. Agricultural use is permitted in areas designated as Agriculture on Baseline Documentation Map and is defined as the planting and harvesting of crops, nursery stock, and trees for silviculture, and, the raising and housing of livestock. Agricultural management operations shall employ generally accepted agricultural management practices as defined and recommended in the Michigan Right-to-Farm Act, Public Act 93 of 1981, as amended, MCL 286.472, 286.473, and 286.474, so as to minimize soil erosion and other damaging occurrences. There shall be no commercial confinement facilities for livestock, swine, or poultry on the Property, including, but not limited to, confinement buildings or confined feeding lots.

Agricultural operations shall be permitted pursuant to a certified Conservation Plan, completed by a Natural Resource Conservation Service - United States Department of Agriculture (USDA) representative, which, including future revisions of the Conservation Plan, shall be submitted to the Conservancy for review and approval. Such approval shall not be unreasonably withheld. The Conservation Plan shall satisfy all of the following conditions: **(NOTE TO DRAFTER: define the conditions appropriate for the Property)**

H. (Optional) **Right to Remove Trees in Managed Woodland Areas.** The Owner retains the right to conduct the following forestry activities on the Property in areas designated as Managed Woodland Area or Managed Open Space on the Baseline Documentation Map **(NOTE TO DRAFTER: add appropriate forestry guidelines)**

6. RIGHTS OF THE CONSERVANCY. The Owner confers the following rights upon the Conservancy to perpetually maintain the Conservation Values of the Property:

A. **Right to Enter.** The Conservancy has the right to enter the Property at reasonable times to monitor the Conservation Easement Property. Furthermore, the Conservancy has the right to enter the Property at reasonable times to enforce compliance with, or otherwise exercise its rights under, this Conservation Easement. The Conservancy may not, however, unreasonably interfere with the Owner's use and quiet enjoyment of the Property. The Conservancy has no right to permit others to enter the Property. The general public is not granted access to the Property under this Conservation Easement.

B. **Right to Preserve.** The Conservancy has the right to prevent any activity on or use of the Property that is inconsistent with the Purposes of this Conservation Easement or detrimental to the Conservation Values of the Property.

C. **Right to Require Restoration.** The Conservancy has the right to require the Owner to restore the areas or features of the Property that are damaged by any activity inconsistent with this Conservation Easement.

D. **Signs.** The Conservancy has the right to place signs on the Property that identify the land as protected by this Conservation Easement. The number and location of any signs are subject to the Owner's approval.

7. CONSERVANCY'S REMEDIES. This section addresses cumulative remedies of the Conservancy and limitations on these remedies.

A. **Delay in Enforcement.** A delay in enforcement shall not be construed as a

waiver of the Conservancy's right to eventually enforce the terms of this Conservation Easement.

B. **Acts Beyond Owner's Control.** The Conservancy may not bring an action against the Owner for modifications to the Property resulting from causes beyond the Owners' control, including, but not limited to, unauthorized actions by third parties, natural disasters such as unintentional fires, floods, storms, natural earth movement, or even an Owner's well-intentioned action in response to an emergency resulting in changes to the Property. The Owner has no responsibility under this Conservation Easement for such unintended modifications.

C. **Notice and Demand.** If the Conservancy determines that the Owner is in violation of this Conservation Easement, or that a violation is threatened, the Conservancy shall provide written notice to the Owner. The written notice will identify the violation and request corrective action to cure the violation and, where the Property has been injured, to restore the Property.

However, if at any time the Conservancy determines, at its sole discretion, that the violation constitutes immediate and irreparable harm, no written notice is required. The Conservancy may then immediately pursue its remedies to prevent or limit harm to the Conservation Values of the Property.

If the Conservancy determines that this Conservation Easement is, or is expected to be, violated, and the Conservancy's good-faith and reasonable efforts to notify the Owner are unsuccessful, the Conservancy may pursue its lawful remedies to mitigate or prevent harm to the Conservation Values without prior notice and without awaiting the Owner's opportunity to cure. The Owner agrees to reimburse all actual costs, including attorney fees, associated with this effort.

D. **Failure to Act.** If, within 28 days after written notice, the Owner does not implement corrective measures requested by the Conservancy, the Conservancy may bring an action in law or in equity to enforce the terms of the Conservation Easement. In the case of immediate or irreparable harm, or if an Owner is unable to be notified, the Conservancy may invoke these same remedies without notification and/or awaiting the expiration of the 28-day period.

The Conservancy is entitled to enjoin the violation through temporary or permanent injunctive relief and to seek specific performance, declaratory relief, restitution, reimbursement of expenses, and/or an order compelling the Owner to restore the Property. If the court determines that the Owner has failed to comply with this Conservation Easement, the Owner shall also reimburse the Conservancy for all actual litigation costs and actual attorney's fees, and all costs of corrective action or Property restoration incurred by the Conservancy.

E. **Unreasonable Litigation**. If the Conservancy initiates litigation against the Owner to enforce this Conservation Easement, and if the court determines that the litigation was initiated without reasonable cause or in bad faith, then the court may require the Conservancy to reimburse the Owner's reasonable costs and reasonable attorney's fees in defending the action.

F. **Actual or Threatened Non-Compliance.** The Conservancy's rights under this Section, Conservancy Remedies, apply equally in the event of either actual or threatened violations of the terms of this Easement. The Owner agrees that the Conservancy's claim for money damages for any violation of the terms of this Easement is inadequate. The Conservancy shall also be entitled to affirmative and prohibitive injunctive relief and specific performance, both prohibitive and mandatory. The Conservancy's claim for injunctive relief or specific performance for a violation of this Conservation Easement shall not require proof of actual damages to the Conservation Values.

G. **Cumulative Remedies.** The preceding remedies of the Conservancy are cumulative. Any, or all, of the remedies may be invoked by the Conservancy if there is an actual or threatened violation of this Conservation Easement.

8. NOTIFICATION PROVISION. The Conservancy is entitled to 60 Days written notice whenever its approval is required under this Conservation Easement. If the Conservancy fails to respond within 60 Days after it receives the written request, then its approval shall be deemed given. This implied approval shall not extend to any activity contrary to this Conservation Easement or impairing a Conservation Value. The Conservancy's approval shall continue for three years. If the approved activity is not completed within three years after the approval date, then the Owner must re-submit the written application to the Conservancy.

9. CONSERVATION EASEMENT REQUIREMENTS UNDER MICHIGAN LAW AND UNITED STATES TREASURY REGULATIONS.

A. This Conservation Easement is created pursuant to the Conservation and Historic Preservation Easement, Sub part 11 of Part 21 of the Michigan Natural Resources and Environmental Protection Act (NREPA) - MCL §§ 324.2140 *et seq*.

B. This Conservation Easement is established for conservation purposes pursuant to the Internal Revenue Code, as amended at Title 26, U.S.C.A., Section 170(h)(1)-(6) and Sections 2031(c), 2055, and 2522, and under Treasury Regulations at Title 26 C.F.R. § 1.170A-14 *et seq*, as amended.

C. The Conservancy is qualified to hold conservation easements pursuant to these

statutes. It is a publicly funded, non-profit 501(c)(3) organization.

10. OWNERSHIP COSTS AND LIABILITIES. In accepting this Conservation Easement, the Conservancy shall have no liability or other obligation for costs, liabilities, taxes or insurance of any kind related to the Property. The Conservancy, its members, directors, officers, employees and agents have no liability arising from injury or death to any person or physical damage to any property on the Property. The Owner agrees to defend the Conservancy against such claims and to indemnify the Conservancy against all costs and liabilities relating to such claims during the tenure of ownership of the Property. Subsequent owners of the Property will similarly defend and indemnify the Conservancy for any claims arising during the tenure of their ownership. Notwithstanding the foregoing, the Conservancy shall indemnify and hold harmless the Owner from any claims for injury or death of any person or property incurred in connection with or arising out of the Conservancy's use of the Property described in Paragraphs 6A and 6D above.

11. HAZARDOUS MATERIALS. The Owner warrants that Owner has no knowledge of a release of hazardous substances or hazardous wastes on the Property. The Owner agrees to protect and defend the Conservancy against any claims of hazardous materials contamination on the Property.

12. CESSATION OF EXISTENCE. If the Conservancy shall cease to exist or if it fails to be a "qualified organization" for purposes of Internal Revenue Code Section 170(h)(3), or if the Conservancy is no longer authorized to acquire and hold conservation easements, then this Conservation Easement shall become vested in another entity. This entity shall be a "qualified organization" for purposes of Internal Revenue Code Section 170(h)(3). The Conservancy's rights and responsibilities shall be assigned to an entity having similar conservation purposes to which such right may be awarded under the *cy pres* doctrine.

13. TERMINATION. This Conservation Easement may be extinguished only by an unexpected change in condition which causes it to be impossible to fulfill the Conservation Easement's purposes, or by exercise of eminent domain.

    A. **Unexpected Change in Conditions.** If subsequent circumstances render the Purposes of this Conservation Easement impossible to fulfill, then this Conservation Easement may be partially or entirely terminated only by judicial proceedings. The Conservancy will then be entitled to compensation in accordance with the provisions of IRC Treasury Regulations Section 1.170A-14(g)(6)(ii)in effect on the date of this Conservation Easement.

    B. **Eminent Domain.** If the Property is taken, in whole or in part, by power of eminent domain, then the Conservancy will be entitled to compensation by the method as is set forth in IRC Treasury Regulations Section 1.170A-14(g)(6)(ii) in effect on the date of this Conservation Easement.

14. LIBERAL CONSTRUCTION. This Conservation Easement shall be liberally construed in favor of maintaining the Conservation Values of the Property and in accordance with the Conservation and Historic Preservation Easement, Sub part 11 of Part 21 of the Michigan Natural Resources and Environmental Code MCL 324.2140 *et seq.*

15. NOTICES. For purposes of this Conservation Easement, required written notices shall be provided by either party to the other party by personal delivery or by First Class mail to the most recent address of record. If a new party succeeds either party or either party changes its address, the new address information shall be provided in writing to the other party as soon as practicable by personal delivery or First Class mail. Service will be complete upon personal delivery or upon depositing the properly addressed notice with the U.S. Postal Service with sufficient postage prepaid.

16. SEVERABILITY. If any portion of this Conservation Easement is determined to be invalid, the remaining provisions will remain in force.

17. SUCCESSORS. This Conservation Easement is binding upon, and inures to the benefit of, the Donor/Owner's and the Conservancy's successors in interest. All subsequent Owners of the Property are bound to all provisions of this Conservation Easement to the same extent as the Donor.

18. TERMINATION OF RIGHTS AND OBLIGATIONS. A party's future rights and obligations under this Conservation Easement terminate upon transfer of that party's interest in the Property. Liability for acts or omissions occurring prior to transfer will survive the transfer.

19. MICHIGAN LAW. This Conservation Easement will be construed in accordance with Michigan Law.

20. ENTIRE AGREEMENT. This Conservation Easement sets forth the entire agreement of the parties. It is intended to supersede all prior discussions or understandings.

OWNER:

_____

_____

STATE OF MICHIGAN)
)
COUNTY OF _____)

Acknowledged before me on this _____ of _____, of 2006, by **(Insert)** , husband and wife.

Notary Public
_____ County, Michigan
My commission expires:

LAND CONSERVANCY OF WEST MICHIGAN:

_____
April Scholtz
It's: Land Protection Director

STATE OF MICHIGAN)
)
COUNTY OF _____)

Acknowledged before me on this _____ of _____ , of 2006, by April Scholtz, known to me to be the Land Protection Director of the Land Conservancy of West Michigan.

Notary Public
_____ County, Michigan
My commission expires:

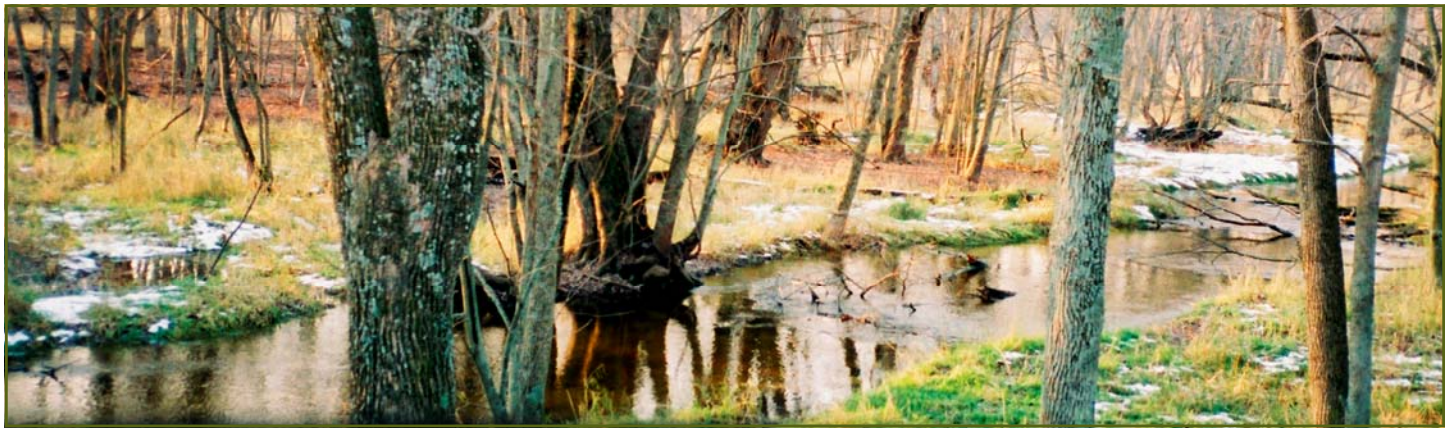
AFTER RECORDING SEND TO:
Pete DeBoer
Land Protection Specialist
Land Conservancy of West Michigan
1345 Monroe Ave. NW
Ste. 324
Grand Rapids, MI 49505

SEND TAX BILL TO:
Insert Owner

PREPARED BY:
Pete DeBoer
Land Protection Specialist
Land Conservancy of West Michigan
1345 Monroe Ave. NW
Ste. 324
Grand Rapids, MI 49505

Conservation Easements

A conservation tool for landowners who want to protect the natural features of their property and retain private ownership.



A conservation easement made it possible for the Reed Family to protect nearly 200 acres in Mason County. *Photo: Todd Reed*

What is a Conservation Easement?

For landowners who want to conserve their land and yet keep it in private ownership and use, a conservation easement may be the best solution. A conservation easement is a legal agreement between a landowner and the Land Conservancy that limits a property's uses and development in order to conserve its natural, agricultural, or scenic values.

This voluntary agreement between a landowner and the Land Conservancy is permanent and applies to all future owners, whether they inherit or purchase the property. The land stays in private ownership and the conservation easement simply gives the Land Conservancy the right to ensure that the natural characteristics of the land are protected.

Land preserved with a conservation easement benefits the public by conserving natural habitats and scenic views. To encourage the donation of these easements, federal and state tax incentives were created for qualified conservation easement donations.

Creating a conservation easement does not mean that the land is opened up to the public. Most easement donors want to maintain their privacy and therefore do not allow public access to their property. If the easement donor or a future landowner wants to permit full or limited access by the public, they may do so, but it is not required.

Conserving Land by Limiting Uses

Conservation easements preserve natural and agricultural land by limiting future uses that could destroy or degrade these resources. Each conservation easement is written to reflect the unique characteristics of a property and the resources that are to be protected, as well as the landowner's current uses and goals for the property.

Most conservation easements limit future residential development and land division because both have a significant impact on natural habitats. Other development activities that would significantly alter the landscape and habitats, such as road building and mining, are also limited. Frequently, conservation easements include a residential area that is largely free of restrictions and allow farming and habitat management activities to continue.

The Land Conservancy does not restrict hunting with a conservation easement, but the number of blinds and bait piles may be limited. Conservation easements may be designed to cover all or only a portion of a property.

Is a Conservation Easement Right for Your Land?

Please contact the Land Conservancy of West Michigan's land protection staff at 616-451-9476 or email lcwm@naturenearby.org and we will help you determine the best conservation option for your land.

Land Conservancy of West Michigan • 1345 Monroe Ave. NW, Ste. 324 • Grand Rapids, MI 49505
Ph: 616-451-9476 • lcwm@naturenearby.org • www.naturenearby.org

Protecting Private Property Rights

Some landowners are concerned that if they create a conservation easement they are turning over all their rights to manage and use the property to the Land Conservancy. This is not true. In fact, all that is transferred to the Land Conservancy is the right to enforce the restrictions stated in the conservation easement.

The Land Conservancy annually monitors the property to make sure that the terms of the easement are being followed, but it has no other management responsibilities and exercises no direct control over unrestricted activities on the land.

Similarly, the Land Conservancy has only a limited right to enter the property – to meet the monitoring requirements and to prevent a violation of the easement's terms. It is the Land Conservancy's policy to make every effort to get permission from the landowner before entering the property.

Jeff and Anya Byam (pictured above) created a conservation easement to protect their 30 acres in Muskegon County. "It is very fulfilling and reassuring to know that this piece of land will be there for people to enjoy and wildlife to survive on for generations to come," explains Jeff.

A Long-Term Commitment to Conservation

The conservation easements held by the Land Conservancy are "perpetual" – they last forever. If the Land Conservancy discovers a problem and believes the terms of the easement are not being followed, the Land Conservancy will take whatever steps are necessary to uphold the terms of the easement.

Although the Land Conservancy has a right to take legal action against violators, it is our policy to make every effort to first work cooperatively with the landowner to fully understand the nature of the problem, to stop any further destruction of the protected resources, to have damaged resources restored, and to ensure that the problem doesn't continue in the future.

Property that Qualifies for a Conservation Easement

To qualify for federal and state tax incentives a conservation easement donation must be voluntarily created by the landowner, it must be given to a qualified charitable organization such as the Land Conservancy of West Michigan, and the easement must be of significant conservation value as defined by the federal government. Easements that meet this "conservation purposes" test will do one or more of the following:

- protect natural habitat for wildlife,
- preserve open space that contributes to the goals of a government program,
- preserve recognized scenic views for the public,
- preserve important farmland or forestland,
- or preserve public land for outdoor recreation and education.

If other parties hold a legal interest in the property that would affect the permanence of the easement or the resources that are being protected, such as mortgages and surface mineral rights, these interests must be subordinated to the conservation easement. Finally, the conservation easement must be perpetual, or permanent.

The Land Conservancy prefers conservation easements that preserve at least 10 acres in urban areas and 30 acres in rural areas. Smaller parcels may be considered if they are adjacent to other conserved lands, if they contribute to one of the Land Conservancy's priority protection goals, or if they have significant ecological features.

Currently, the Land Conservancy places a priority on preserving natural habitats with relatively little man-made disturbance – properties that help us meet our goal of "keeping nature nearby". At the invitation of the landowner, Land Conservancy staff will evaluate a property to determine whether it meets the Land Conservancy's criteria.

Making "Cents" of Conservation Easements

Financial Benefits of Creating a Conservation Easement

There has never been a better time to donate a conservation easement. In 2006 there were significant changes in both the federal and state tax incentives for conservation easement donations. These changes allow many modest-income landowners to benefit much more from the donation of a conservation easement. **These expanded federal tax benefits were renewed for another two years (for 2008 and 2009) as part of the 2008 Farm Bill.**

Federal Income Tax Benefits

The expanded federal law did three key things for conservation easement donors:

- First, it raised the maximum annual deduction for an easement donation to 50% of a landowner's adjusted gross income instead of the 30% maximum allowed previously.
- Second, the number of years that a donor can "carry forward" any unused portion of the donation increased to 15 successive years, instead of the 5 additional years allowed previously.
- Third, it allowed qualified farmers, ranchers, or forest landowners who derive a majority of their income from these sources to deduct the value of the conservation easement against 100% of their income.

These expanded tax benefits apply to all qualified conservation easements that are donated in 2008 and 2009. Land conservation groups will undoubtedly be seeking legislation to make these increased benefits permanent.

The protection of important wildlife habitat is just one of the many benefits of creating a conservation easement. *Photo: Jim Reminga.*

Determining the Value of a Conservation Easement for Federal Tax Purposes

An independent appraisal done to IRS standards determines the value of a conservation easement for a donor's tax deduction purposes. The Land Conservancy can provide a list of appraisers in the area that meet IRS qualifications and who have experience in easement appraisals. We can also provide necessary information to other qualified appraisers who haven't previously worked on an easement.

To value a conservation easement, the appraiser must first determine the "before" value of the property – its unrestricted fair market value. Then the appraiser will determine the "after" value of the easement property – how its value is affected by the restrictions imposed by the conservation easement agreement. The difference between these two values is the value of the conservation easement. (See example on last page.)

If valuable development rights are restricted, such as upland residential sites in desirable areas with good access to roads and utilities, the donation value of a conservation easement may be much greater than if the conservation easement only places limits on land that is not easily developed, such as wetlands and steep dunes.

Reed Family Conservation Easement

For many years the Reed family has carefully managed their hunting property on the Pere Marquette River to improve the quality of the wildlife habitat. In addition to hunting the property, they value the land as a place for family gatherings, where kids can learn through outdoor adventures, and where the talented photographers in their family can practice their art.

When they learned about conservation easements they could see that it was a way to ensure that their land would never be turned into a riverside subdivision and that it would make it much easier for their heirs to keep the land in the family.

The Reed's conservation easement allows them to continue wildlife habitat enhancement projects, to lease agricultural fields to neighbors, and to allow future generations to place another cottage along the mile-long stretch of river that they own. The majority of the property will remain free of development, helping to preserve the natural Pere Marquette River corridor and home to a great diversity of wildlife.

Making "Cents" of Conservation Easements

State Property Tax Benefits

Unlike the federal law, Michigan's new tax incentive for conservation easements is not temporary. Michigan Public Act 446, passed in December 2006, caps property tax reassessments for land restricted by a qualified conservation easement. Under current law, the taxable value of a property may not increase from one year to the next by more than 5% or the increase in the consumer price index, whichever is lower, until there is a transfer of ownership.

This means that the assessed value of land that has been held for several years by an owner is often far less than its fair market value. When the land passes to heirs or is sold it is reassessed and taxes can increase substantially. This "pop-up tax" can be a huge burden on families who want to keep natural and agricultural land in the family without being forced to sell or develop some of it to pay the taxes.

The new state bill eliminates the pop-up tax on conservation easement land so that when the land passes to heirs or is sold to a new owner the property's assessed value will continue to increase only at the rate of inflation, and at no more than 5% annually. This new cap applies only to the land – any buildings on the property remain subject to the pop-up tax when ownership is transferred.

Unfortunately, creating a conservation easement in Michigan does not necessarily mean that property taxes will be reduced even though an independent appraisal may demonstrate a reduction in the property's value. Assessors were directed by the Tax Tribunal and the Department of Treasury to "consider" the reduction in a property's value caused by a conservation easement when establishing its assessed value, but they are not required to lower property taxes. The owner of the property will have to apply to his or her local township in order to request a reduction in property taxes.

Estate Tax Benefits and Donating an Easement though a Will

Conservation easements may reduce a landowner's estate tax if the donation of the easement reduces the value of the property. It is possible for a landowner to donate an easement through a will, or the heirs may create an easement after a landowner's death. The value of the easement may then be deducted from the taxable estate.

The Taxpayer Relief Act of 1997 greatly increased the estate tax benefits of a conservation easement. The law allows the exclusion for estate tax considerations of 40% of the value of land subject to a conservation easement, up to $500,000 per estate. This exclusion is in addition to the appraised value of the conservation easement.

It is always a good idea to contact the Land Conservancy prior to donating a conservation easement through a will. This will ensure that the Land Conservancy can accept the proposed conservation easement and that it will be possible to achieve the landowner's goals.

Please Consult Your Financial Advisor! If you are considering donating a conservation easement you should be aware that your actual tax savings would be a function of your income tax bracket and whether or not you have other charitable deductions. ***To determine how a conservation easement donation would affect your taxes you need to consult your own professional tax and/or legal advisor. The Land Conservancy does not claim to give legal or tax advice about the consequences of a particular conservation easement donation.***

Making "Cents" of Conservation Easements

Costs to Create a Conservation Easement

Appraisals: A landowner seeking a federal income tax deduction for the donation of a conservation easement will be required to provide a qualified appraisal if the value of the deduction is greater than $5,000. The IRS requires a specific kind of appraisal that uses a "before and after" evaluation method and a full discussion of all comparables and adjustments. At this time, we are seeing prices for this kind of appraisal ranging between $3,500 and $10,000, depending on the size and complexity of the easement and the property. Some of this cost may be deductible as a tax planning expense.

Title Work: The Land Conservancy requires a review of the property's title for all conservation easement properties. Title work generally costs about $150. In rare cases, more costly title insurance may be necessary.

Survey: The Land Conservancy requires that the boundaries of a conservation easement property can be located by representatives of the Land Conservancy responsible for easement monitoring. A survey isn't required if the boundaries are readily found.

Tax and Legal Advice: The Land Conservancy of West Michigan cannot represent the landowner's interests in legal or tax matters. We strongly encourage landowners to get professional advice in these areas.

Conservation Easement Stewardship Fund: In accepting a conservation easement, the Land Conservancy makes a commitment to do whatever is necessary to uphold the terms of the easement. To ensure that the organization can fulfill its responsibility to legally defend a conservation easement or to repair the damage caused by a violation, the Conservancy created the Easement Stewardship Fund.

All easement donors are asked to consider making a financial contribution to the Conservancy's Easement Stewardship Fund. The Land Conservancy uses an easement endowment "calculator" or worksheet to help determine how much it will cost the organization to hold the conservation easement, over time. The property's size, location, and the number of reserved rights in the conservation easement factor into the recommended endowment contribution.

Most landowners see that their conservation goals are more likely to be sustained if they can contribute to the easement's future protection. Contributions to the Fund can be made through a one-time donation, over a number of years, or through a will or estate.

Although there are costs associated with the creation of conservation easements, there are many potential financial benefits as well.
Photos (left & above): Jim Reminga

The Nuts and Berries of How Conservation Easements Work

A Conservation Easement Example: The Smiths own and live on a 90-acre property. They have a house and outbuildings, but most of the property is natural and undeveloped, with fields, woods, and wetlands. Without a conservation easement their property would likely become a residential subdivision.

Using the "before and after" method for evaluating a conservation easement, an appraiser determines that the fair market value of their property, unrestricted, is $650,000.

The Smith's conservation easement will prohibit further land division and home construction. An appraiser determines that removing this development potential reduces the value of the property to $330,000. Therefore, the value of their conservation easement is $320,000:

Unrestricted property:	$650,000
Property restricted with easement:	$330,000
Value of Conservation Easement:	$320,000

The Smiths donate the conservation easement to the Land Conservancy of West Michigan (a qualified nonprofit) and deduct the value of the gift the year the gift is made, up to 50% of their adjusted gross income. Any amount of the charitable donation remaining after the first year can be carried forward and deducted against income (within the 50% limit) for 15 additional years.

In this example, assume that the Smiths' adjusted gross income is $80,000 and it remains constant. If they donate a conservation easement valued at $320,000 to the Land Conservancy and they claim no other charitable deductions, they can deduct $40,000 from their income tax the year the gift is made (50% of $80,000) and do the same for the 7 following years until they've used all of the donated easement's value ($40,000 x 8 = $320,000).

The actual tax savings the Smith's would realize as a result of their easement gift is a function of their income tax bracket. In this example, if the Smiths were in the 28% tax bracket the year their gift was made, the conservation easement tax deduction would allow them to apply their tax rate to a $40,000 AGI instead of an $80,000 AGI, resulting in an actual tax savings of $11,200 that first year.

Calculations:	**Old Benefits**	**Expanded Benefits**
Adjusted Gross Income (AGI)	$80,000	$80,000
Value of Conservation Easement	$320,000	$320,000
Annual limit on Charitable Contribution	$24,000	$40,000
Contribution Deduction Year 1-6	$24,000	$40,000
Contribution Deduction Year 7-8	NA	$40,000
Contribution Deduction Year 9-16	NA	-0-
Total Deduction	**$144,000**	**$320,000**
Actual Tax Savings (28% tax bracket)	**$40,320**	**$89,600**

Additional Tax Savings Under New Law = $49,280

Upper Rabbit River Watershed Project
Model Ordinances:

Developed for:

Dorr Township
Salem Township
Hopkins Township
Monterey Township
Leighton Township
Wayland Township
City of Wayland

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(a.) Intent. The (community) recognizes that stormwater runoff has been traditionally treated as a by-product of development to be disposed of as quickly and efficiently as possible. The result has often been increased flooding, degradation of water quality, soil erosion and sedimentation, and a failure to capitalize on the benefit of creative stormwater management. It is also recognized that certain community development standards may contribute to decreased pervious surface and increased stormwater runoff.

(a.) Intent. The (community) recognizes that, due to the specific requirements of any given development, application of adopted public road design standards may result in development with excessive paving and grading, increased stormwater runoff, and loss of vegetation. It is also the intent of this Ordinance to recognize that stormwater runoff has been traditionally treated as a by-product of development to be disposed of as quickly and efficiently as possible. The result has often been increased flooding, degradation of water quality, soil erosion and sedimentation, and a failure to capitalize on the benefit of creative stormwater management. However, unobstructed, safe, and continuous vehicle access to lots is necessary to promote and protect the public health, safety, and welfare to ensure that public services can safely enter and exit private property at all times.

(a.) Intent. It is the intent of the (community) in adopting this article to significantly reduce hazards to persons and damage to property as a result of flood conditions in the (community); to comply with the provisions and requirements of the National Flood Insurance Program; to protect human life, health and property from dangerous and damaging effects of flood conditions; to minimize public expenditures for flood control projects, rescue and relief efforts in the aftermath of flooding, repair of flood damage public facilities and utilities, and the redevelopment of flood damaged homes, neighborhoods, commercial and industrial areas; to maintain stable development patterns not subject to the blighting influence of flood damage; to designate floodplains and institute floodplain development regulations and general development standards; to establish regulations concerning the same; and to provide for the administration of this article and to provide penalties for violation.

Post Construction Runoff Ordinance (Site-plan review)PG>19

(a). Intent The purpose of this ordinance is to establish minimum stormwater management requirements and controls to protect and safeguard the general health, safety, and welfare of the public residing in watersheds within this jurisdiction.

Lake/Funnel Access Ordinance PG>57

(a). Intent: To add provisions pertaining to the regulation of the number of users and types of uses of lake frontage. To preserve the qualities of the waters, minimize conflicting land uses, promote safety and help preserve the quality of recreational use of lands and waters within the township.

Stormwater Management/Impervious Surface Mitigation Standards

The following is sample language relative to stormwater management that may be adopted as part of either the Zoning Ordinance or community design standards. Most communities have adopted standards that limit the rate of runoff from sites, but do little to encourage either creative means of managing stormwater on-site or reducing the amount of impervious surface. Frequently, local ordinances contain provisions that result in significant amounts of impervious surface from streets, sidewalks, and parking lots and do not promote environmentally compatible design. Single purpose solutions are proposed that may efficiently remove stormwater but do not promote infiltration, improve water quality, or enhance integrated stormwater management as an integral component of aesthetic site design.

Section _____. Stormwater Management/Impervious Surface Mitigation

(a.) Purpose. The (community) recognizes that stormwater runoff has been traditionally treated as a by-product of development to be disposed of as quickly and efficiently as possible. The result has often been increased flooding, degradation of water quality, soil erosion and sedimentation, and a failure to capitalize on the benefit of creative stormwater management. It is also recognized that certain community development standards may contribute to decreased pervious surface and increased stormwater runoff.

It is the intent of this Ordinance to encourage the use of Best Management Practices (BMPs) which are structural, vegetative, or managerial practices designed to treat, prevent, or reduce degradation of water quality due to stormwater runoff. All development projects subject to review under the requirements of this Ordinance shall be designed, constructed, and maintained using BMPs to prevent flooding, protect water quality, reduce soil erosion, maintain and improve wildlife habitat, and contribute to the aesthetic values of the project. The particular facilities and measures required on-site shall reflect and incorporate existing grade, natural features, wetlands, and watercourses on the site, to the maximum extent feasible.

(b.) Stormwater Drainage/Erosion Control. All stormwater drainage and erosion control plans shall meet the standards adopted by the (community) for design and construction and shall, to the maximum extent feasible, utilize nonstructural control techniques, including but not limited to:

(1) limitation of land disturbance and grading;

(2) maintenance of vegetated buffers and natural vegetation;

(3) minimization of impervious surfaces;

(4) use of terraces, contoured landscapes, runoff spreaders, grass or rock-lined swales;

(5) use of infiltration devices;

(c.) General Standards.
(1) Stormwater management systems shall be designed to prevent flooding and the degradation of water quality related to stormwater runoff and soil erosion from proposed development.

(2) All properties which are subject to this ordinance shall provide for on-site storage of stormwater. Facilities shall be designed to provide a volume of storage and discharge rate which meets the County Drain Commissioner's standards or the standards of (community), whichever are stricter.

(3) Priority shall be placed on site design that maintains natural drainage patterns and watercourses. Alterations to natural drainage patterns shall not create flooding or degradation in water quality for adjacent or downstream property owners.

(4) The use of swales and buffer strips vegetated with native materials is encouraged as a method of stormwater conveyance so as to decrease runoff velocity, allow for biofiltration, allow suspended sediment particles to settle, and to remove pollutants.

(5) Drainage systems shall be designed to be visually attractive. The integration of stormwater conveyance systems and retention and detention ponds in the overall landscape concept is recommended. Ponds with a naturally contoured, rather than square or rectangular design and appearance shall be encouraged.

(d.) Use of Wetlands. Wetlands may be used for stormwater management if all the following conditions are met:
(1) Direct discharge of untreated stormwater to a natural wetland is prohibited. All runoff from the development will be pre-treated to remove sediment and other pollutants prior to discharge to a wetland. Such treatment facilities shall be constructed before property grading begins. Stormwater runoff discharged to wetlands must be diffused to non-erosive velocities before it reaches the wetland.

(2) Wildlife, fish, or other beneficial aquatic organisms and their habitat within the wetland will not be impaired

(3) The wetland has sufficient holding capacity for stormwater, based upon

calculations prepared by the proprietor and reviewed and approved by the township engineer.

(4) Adequate on-site erosion control is provided to protect the natural functioning of the wetland.

(5) Adequate private restrictions are established so as to insure that the wetland is not disturbed or impaired in the future relative to the needed storage capacity.

(6) Applicable permits from the Michigan Department of Environmental Quality are obtained.

(e.) Impervious Surface Reduction/Infiltration Enhancement. The (community) recognizes that, due to the specific requirements of any given development, inflexible application of the design standards may result in development in excessive paving and stormwater runoff and a waste of space, which could be left as open space.

Either through procedures prescribed by Ordinance or creative land development techniques permitted by Ordinance, the (community) may permit deviations from requirements allowing for reduction in impervious surfaces whenever it finds that such deviations are more likely to meet the intent and standards of this Ordinance and accommodate the specific characteristics of the use in question.

The (community) may attach conditions to the approval of a deviation that bind such approval to the specific use in question. Measures that reduce impervious surface and increase infiltration may include, but are not limited to, the following:

(1) Streets and Access.
a. Residential streets designed with the minimum required pavement width needed to support travel lanes; on-street parking; and emergency, maintenance, service vehicle access, and function based on traffic volumes.

b. The total length of residential streets reduced by examining alternative street layouts to determine the best option for increasing the number of homes per unit length.

c. Street right-of-way widths designed to reflect the minimum required to accommodate the travel-way, the sidewalk, and vegetated open channels.

d. Minimize the number of street cul-de-sacs and reduce the radius of cul-de-sacs to

the minimum required to accommodate emergency and maintenance vehicles. Alternative turnarounds shall be considered, including the use of mountable curbing and grass shoulders for the occasional event of access by fire trucks and other large commercial trucks. Where cul-de-sacs do exist, provide landscape center islands.

e. Where density, topography, soils, and slope permit, use of vegetated open channels in the street right-of-way to convey and treat stormwater runoff.

f. Use of alternative driveway surfaces and shared driveways that connect two or more uses.

g. Promote more flexible design standards for residential subdivision sidewalks. Where practical, consider locating sidewalks on only one side of the street and providing common walkways linking pedestrian areas.

(2) Parking
a. Base parking requirements on the specific characteristics of the use, and landbank in open space, parking that is required to satisfy Ordinance requirements.
b. Reduce the overall imperviousness associated with parking lots by providing compact car spaces, minimizing stall dimensions, incorporating efficient parking lanes, and using pervious materials in the spillover parking areas where possible.

c. Encourage shared parking between compatible users.

(3) Site Design
a. Relax side yard setbacks and allow narrower frontages to reduce total road length in the community and overall site imperviousness. Relax front set back requirements to minimize driveway lengths and reduce overall lot imperviousness.

b. Direct rooftop runoff to pervious areas such as yards, open channels, or vegetated areas and avoid routing rooftop runoff to the roadway and the stormwater conveyance system.

c. Create a variable width, naturally vegetated buffer system along all drainageways that also encompasses critical environmental features such as the 100-year floodplain, steep slopes, and wetlands.

d. Minimize clearing and grading of woodlands and native vegetation to the minimum amount needed to build lots, allow access, and provide fire protection.

e. Conserve trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native plants.

(f.) Maintenance. Whenever a landowner is required to provide on-site storm water retention and/or surface drainage to wetland, or whenever other protective environmental measures including monitoring devices are required, such measures or facilities shall be provided and maintained at the landowner's expense. The landowner shall provide satisfactory assurance to the Township whether by written agreement or otherwise, that the landowner will bear the responsibility for providing and maintaining such methods or facilities.

Private Road Ordinance

Private roads can be an effective tool to allow reasonable and safe access to properties while avoiding some of the grading, increase in impervious surfaces, and tree removal often associated with public road standards. When coupled with Planned Unit Developments and/or open space development ordinances, private road regulations can be used as an incentive for more creative, environmentally compatible development and serve to aid in more effective stormwater management.

Section. _____. Private Road Regulations

(a.) Intent. The (community) recognizes that, due to the specific requirements of any given development, application of adopted public road design standards may result in development with excessive paving and grading, increased stormwater runoff, and loss of vegetation. It is also the intent of this Ordinance to recognize that stormwater runoff has been traditionally treated as a by-product of development to be disposed of as quickly and efficiently as possible. The result has often been increased flooding, degradation of water quality, soil erosion and sedimentation, and a failure to capitalize on the benefit of creative stormwater management. However, unobstructed, safe, and continuous vehicle access to lots is necessary to promote and protect the public health, safety, and welfare to ensure that public services can safely enter and exit private property at all times.

It is the intent of this Ordinance to permit access to the interior of certain properties within the (community) by private roads that are subject to minimum standards and specifications. These standards and limitations are intended to permit unobstructed, safe, and continuous vehicle access, as well as, encourage road design standards which will result in the reduction of impervious surfaces and the preservation of vegetation, in order to more appropriately manage stormwater. It is further the intent of this Ordinance to ensure that private roads are maintained and repaired by the private property owners, who own and use the road.

The procedures, standards, and specifications hereinafter set forth are determined to

be the minimum procedures, standards, and specifications necessary to meet the intent of this ordinance.
(b.) Definitions.
(1) Easement - The right of an owner of property by reason of such ownership, to use the property of another for purposes of ingress, egress, utilities, drainage, and similar uses. In the context of this Ordinance, private road easements shall be designated for purpose of vehicle ingress and egress.

(2) Private Road - An area of land that is privately owned, provides vehicular access to more than one (1) lot and has not been dedicated to public use other than access by emergency and public safety vehicles, and is maintained by its private owners.

(3) Public Street or Right-of-Way - A public or dedicated right-of-way, which affords the principal means of vehicular access to abutting property and which is under public ownership or control.

(4) Private Road Administrator - An official appointed by the (community) to administer the Private Road Ordinance.

(c.) Permit Application and Review Requirements. Each application for a private road shall be accompanied by completed plans prepared and sealed by civil engineer or land surveyor registered in the State of Michigan, which include the information contained herein. Where the required information is incorporated in the overall site plan of a development, separate road plans shall not be required.

The application and plans for a private road shall include the following information:
(1) The names and addresses of the lot or parcel owners to be served by the private road.

(2) A vicinity map of a minimum scale of one inch equals two thousand feet (1" = 2,000'), showing the location of the private road in the Township, any access roads and cross streets, road names, a scale, and a north arrow.

(3) Existing topography at two (2) foot contour intervals for the portions of the site sufficient to determine drainage from the private road easement to a suitable storm water outlet.

(4) Proposed improvements (including but not limited to, roads, sewers, and ditches) shown in plan and profile indicating all materials, grades, dimensions, and bearings in compliance with the standards set forth in Attachment A. The plans shall also show all existing and proposed grades, the location of all existing and proposed drainage

facilities, the location of existing and/or proposed utilities and structures, other structures, physical or natural conditions existing adjacent to such improvements, and any connections to existing public and private roads.

(5) Soil borings within the proposed route of the road. Tree coverage and wetland areas within one hundred (100) feet of either side of the proposed route.

(6) Location of existing buildings on the lots or parcels being served or intended to be served by the private road, as well as, any existing building or structures in or adjacent to any proposed road easement.

(7) Plans shall show the existing or proposed location of private utilities and easements, such as gas, telephone, and electric.

(8) A complete statement of all the terms and conditions of the proposed road easement, including copies of all agreements or intended agreements regarding the maintenance and improvements of the right-of-way and roadway. Furthermore, said maintenance agreements shall be in such form as to be recordable with the County Register of Deeds and shall specifically address the liability and responsibility of the parties to said agreement to maintain the private road pursuant to the specifications of this article, including, but not limited to, the responsibility of removing snow from said private roads. The recorded statement which runs with the land, shall also inform subsequent purchasers that the road is private and may never be maintained or accepted by the County Road Commission.

(9) Appropriate deed restrictions and/or master deed provisions shall provide for free and clear vehicular access for emergency service vehicles on all private roads.

(d.) Design Standards.
(1) The design and construction of all private roads shall comply with the most currently published American Society of Highway Traffic Officials (ASHTO) standards for the criteria applicable to the private road, subject to the approval of the (community) Engineer (see attachment A). If the private road provides direct access to a county road, approval of the road connection, placement, and design must be approved by the County Road Commission prior to (community) approval.

(2) Notwithstanding any other provisions of the Ordinance, private roads in subdivisions platted prior to the enactment of this Ordinance and private roads or easements that are contained in land divisions approved by the (community) prior to the enactment of this Ordinance, shall continue to meet the specifications approved at the time of application. Upon expansion, reconstruction, or major alteration of an

existing private road, new construction shall comply with the most currently published American Society of Highway Traffic Officials (ASHTO) standards for the criteria applicable to the private road. The (community) Engineer shall determine if this provision is met.

(e.) Inspection. Prior to the initiation of construction, a pre-construction conference will be held with the applicant, (community) Engineer, and Private Road Administrator. Evidence of issuance of County Road Commission and soil erosion control permits shall be provided by the applicant at the time of the meeting.

All required improvements shall be inspected by the (community) Engineer or designated (community) official at various stages of construction. The (community) Engineer or Private Road Administrator shall make a final inspection upon completion of construction and shall report the results of the final inspection to the (community) in writing. The applicant's engineer shall certify to the (community), before the final inspection and report thereon are made, that the required improvements were made in accordance with this article and all approved plans.

The costs of inspection, including compensation of the (community) Engineer or (community) official shall be paid by the applicant prior to the issuance of the certificate of completion. The (community) shall establish and determine the costs of inspection. If the applicant does not directly pay the costs of inspection, the same shall be paid from the deposit established by the (community) and held by the (community), and the balance, if any, shall be returned to the applicant.

(f.) Permit Approval Procedure.
(1) Upon receipt of an application, the Private Road Administrator shall bring the application before the (legislative body) at its next regular meeting. The (legislative body) may refer the application to the Planning Commission and any other appropriate body for review and comment.

(2) The (community) Engineer shall report in writing to the (legislative body) as to whether or not the proposed private road conforms to the standards and specifications of this Ordinance. Said report may include any suggested conditions to be attached to the Permit that, in the Engineer's judgment, are necessary to achieve the intent of this Ordinance.

(3) The (legislative body) shall consider the application, the Engineer's report, and all other relevant information in determining whether to grant the Permit application. If the information submitted by the applicant does not establish that the proposed private road will conform to the standards and specifications of this Ordinance, the

(legislative body) shall not grant the Permit. The (legislative body) shall impose such conditions on the approval of the Permit as it deems necessary to achieve the intent and objectives of this Ordinance, which may include, but need not be limited to, conditions suggested by the Engineer. The breach of any such condition proposed by the (legislative body) shall automatically invalidate the Permit.

(4) As a condition to the granting of any Permit under this Ordinance, the (legislative body) shall require that the applicant deposit with the Private Road Administrator a sum of money, bank letter of credit or certified check, in an amount sufficient to guarantee that the applicant shall perform the terms and conditions of the permit, including the payment of required fees. Upon completion of all improvements required by this Ordinance, any unused portion of the deposit shall be refunded to the applicant.

(5) Upon receipt of the required deposit and predetermined fees and approval, the Private Road Administrator shall issue the Permit pursuant to the terms established by the (legislative body) approving the application.

(6) Only the (legislative body) shall have the authority to approve or deny applications for permits. No other permit issued by any Official or other governmental body or official shall be a substitute for a Permit.

(g.) Variances.
(1) Variances may only be granted by the (community) upon the finding that at least one of the two following conditions have been met:

a. That a variance or exemption is required in order to comply with conflicting County or State laws, rules, or regulations.

b. That there are such special circumstances or conditions affecting said property that strict application of the provisions of this Ordinance would clearly be impractical or unreasonable. This may include topographic, vegetative, or drainage conditions.

(2) In order to grant a variance, the (community) shall also find:

a. That the granting of the variance will not be detrimental to the public welfare or injurious to other property in the area in which said property is situated.

b. That such variance or exemption will not have the effect of nullifying the intent and purpose of this Ordinance, the Master Plan, or the Zoning Ordinance.

(h.) Violations. Any person who violates any provision of this article shall be guilty of a misdemeanor and shall be subject to a fine not exceeding five hundred dollars ($500.00) or by imprisonment not exceeding ninety (90) days, or both such fine and imprisonment. Any access that is used in violation of the terms of this article be and the same is hereby declared to be a nuisance per se, and such use may be abated, restrained, enjoined, and prohibited, upon the commencement of an appropriate action in the court of competent jurisdiction.

(i.) Fees. The (legislative body) shall establish by resolution a fee schedule to defray costs of inspection, plan review, administration, and enforcement of this article.

(j.) Severability. The provisions of this ordinance are severable and any decision by any Court of competent jurisdiction that any provision or clause hereof is invalid shall not affect the validity of the remainder of this ordinance.

(k.) Compliance with Other Statutes, Ordinance Order, or Regulation. Nothing in this Ordinance is intended to permit any practice which is a violation of any statute, ordinance, order or regulation, and no provision contained in this ordinance is intended to impair or abrogate any civil remedy or process whether legal or equitable which might otherwise be available to any person.

(l.) Effective Date. This ordinance was adopted by the (legislative body) at a regular meeting thereof held on the day of and shall become effective thirty days after publication.

Attachment A

Minimum Private Road Standards
As Per the American Society of Highway Traffic Officials (ASHTO)

1. Average Daily Traffic Volumes (ADT) - 9.5 vehicles per day per single family detached dwelling; 8 vehicles per day per each attached dwelling unit.
2. Design Speed - 20 mph
3. Stopping Sight Distance - 125 feet
4. Vertical Alignment - 0.5% minimum, 10.0% maximum
5. Horizontal Alignment - 100 ft. minimum radius
6. Right-of-Way Width - With ditches: 60 feet, 100-ft. diameter at cul-de-sacs; With curb & gutter: 50 feet, 100-ft. diameter at cul-de-sacs
7. Road Width (width of pavement, edge to edge - ADT less than 250: 18 feet ADT over 400: 20 feet

8. Shoulder Width (graded slope) - Shoulders not required with curb & gutter; otherwise: ADT less than 400: 2 feet (each side), ADT over 400: 4 feet (each side)
9. Curb and Gutter - Concrete curb and gutter permitted
10. Cul-de-Sacs - 66-foot diameter minimum
- to edge of pavement (not including shoulders or curb & gutter)
-islands permitted when road is paved
-islands must include curb & gutter
11. Intersection Offsets - Private road intersections shall be directly aligned with other streets or roads, or offset at least 250 feet from a public road or offset at least 125 feet from a private road (measurement from centerline to centerline)
12. Road Surface - Less than 5 houses: 7 inches compacted thickness of 21AA, 22A, or 23A gravel. Five (5) or more houses: 3 inches of bituminous surface, placed in two courses over a 7-inch gravel base of 6-inches of concrete.
13. Sub-Base - Six (6) inches of compacted Class II sand. On-site material may be used if laboratory analysis indicates that it meets specification requirements. Sub-base not required for concrete pavement.
14. Drainage - Ditches: 2'-0" minimum depth from centerline, IV; 3H front and back slopes; 2' bottom width. Culverts/Storm Sewers: Pipe must comply with MDOT Standard Specifications. Provide minimum 2-foot of cover over pipe at road crossings. End sections must be provided at culvert ends.
15. Horizontal Clearance to Obstructions - All trees and other objects must be removed from the roadway to the back slope of the ditch 1' above the ditch bottom.
16. Erosion Control/Restoration - All areas disturbed by construction must be topsoiled, seeded, and mulched. Steep slopes may require sod or riprap. Temporary erosion control measures must be utilized.
17. Private Road Sign - Each private road shall be identified with a sign at each intersection. These signs shall be distinguishable from public street signs.
18. Traffic Control Devices - Provide stop signs and street signs at entrance and interior intersections (comply with MMUTCD Manual). Provide a speed limit sign (5 MHP less than the design speed) following each intersection, located 100' to 200' from the intersection. Provide pedestrian crossing signs at all trail/walkway crossings.
19. County Road Commission Approval - If the private road intersects a County road, a permit for the approach must be obtained from the County Road Commission prior to Township review. A copy of the permit shall be attached with the application.
Source: Hamburg Township Private Road Ordinance as taken from the American Society of Highway Traffic Officials (ASHTO)

Floodplain Management Standards

Floodplain management regulations have been in existence for a number of years, but took on increased significance with the passage of the National Flood Insurance Program. Floodplain regulations are a necessary prerequisite to permit enrolling of proposed owners in the flood insurance program.

The following language represents standards that are designed to prevent loss of life and property by restricting development within floodplain areas.

Section. _____. Floodplain Management Standards

(a.) Intent. It is the intent of the (community) in adopting this article to significantly reduce hazards to persons and damage to property as a result of flood conditions in the (community); to comply with the provisions and requirements of the National Flood Insurance Program; to protect human life, health and property from dangerous and damaging effects of flood conditions; to minimize public expenditures for flood control projects, rescue and relief efforts in the aftermath of flooding, repair of flood damage public facilities and utilities, and the redevelopment of flood damaged homes, neighborhoods, commercial and industrial areas; to maintain stable development patterns not subject to the blighting influence of flood damage; to designate floodplains and institute floodplain development regulations and general development standards; to establish regulations concerning the same; and to provide for the administration of this article and to provide penalties for violation.

(b.) Delineation of the flood hazard area overlay zone.
(1) The flood hazard area zone shall overlay existing zoning districts delineated on the official (community) Zoning Map. The boundaries of the flood hazard area zone shall coincide with the boundaries of the areas indicated as within the limits of the 100-year flood on the Flood Insurance Road Map for (community) dated _____. The Flood Insurance Rate Map is adopted by reference, appended, and declared to be a part of this ordinance. The term flood hazard area as used in this ordinance shall mean the flood hazard area zone.

(2) Disputes as to the location of a flood hazard area zone boundary shall be resolved by the Zoning Board of Appeals.

(3) In addition to other requirements of this ordinance applicable to development in the underlying zoning districts, compliance with the requirements of this Section shall be necessary for all development occurring within the flood hazard area zone. Conflicts between the requirements of this Section and other requirements of this ordinance or any other ordinance shall be resolved in favor of this Section, except

where the conflicting requirement is more stringent and would further the objectives of this Section to a greater extent than the requirements of this Section. In such cases, the more stringent requirement shall be applied.

(c.) Principal and Accessory Uses Permitted.
(1) Within the flood hazard area overlay zone, no land shall be used except for one or more of the following principal uses:

a. Agriculture and pasture land.

b. Parks and recreation facilities, provided no permanent structures are constructed.

c. Swimming beaches, fishing, and boating docks in accord with the provisions of the Inland Lakes and Streams Act of 1972.

d. Required open space or lot area for structural uses that are landward of the overlay zone.

(2) The following accessory structures and uses are permitted, provided they are also permitted in the underlying zoning district.

a. Off-street parking, streets, roads, bridges, outdoor play equipment, sheds and garages, boathouses, boat hoists, utility lines, pump houses, bleachers, bank protection structures, signs, fences, gazebos and similar outdoor equipment and appurtenances, provided each of the following requirements are met:

1. The structure would not cause an increase in water surface elevation, obstruct flow, or reduce the impoundment capacity of the floodplain.

2. All equipment and structures shall be anchored to prevent flotation and lateral movement.

3. Compliance with these requirements is certified by an engineering finding by a registered engineer.

(d.) Filling and Dumping - Dredging and filling and/or dumping or backfilling with any material in any manner is prohibited unless through compensating excavation and shaping of the floodplain, the flow and impoundment capacity of the floodplain will be maintained or improved, and unless all applicable state regulations are met.

(e.) General Standards for Flood Hazard Reduction.

(1) No building or structure shall be erected, converted, or substantially improved or placed, and no land filled or structure used in a flood hazard area unless permission is obtained from the (community). Approval shall not be granted until a permit from the Michigan Department of Environmental Quality under authority of Act 245 of the Public Acts of 1929, as amended by Act 167 of the Public Acts of 1968 has been obtained.

(2) All public utilities and facilities shall be designed, constructed, and located to minimize or eliminate flood damage.

(3) Land shall not be divided in a manner creating parcels or lots which cannot be used in conformance with the requirements of this Section.

(4) Available flood hazard data from federal, state or other sources shall be reasonably utilized in meeting the standards of this section.

(f.) Disclaimer of Liability. The degree of flood protection required by this article is considered reasonable for regulatory purposes and is based upon engineering and scientific methods of study. Larger floods may occur on rare occasions. Flood heights may be increased by man-made or natural causes. Thus, approval of the use of land under this article shall not be considered a guarantee or warranty of safety from flood damage. This article does not imply that areas outside the flood hazard area will be free from flood damage. This article does not create liability on the part of the (community) or any officer or employee thereof for any flood damage that results from reliance on this article, or any administrative decision lawfully made.

(g.) Flood Hazard Area Variances.
(1) Variances from the provisions of Section _____ Floodplain Management shall only be granted by the Zoning Board of Appeals upon a determination of compliance with the general standards for variances contained in this ordinance and each of the following specific standards.

a. A variance shall be granted only upon:

1. a showing of good and sufficient cause;

2. a determination that failure to grant the variance would result in exceptional hardship to the applicant; and

3. a determination that the granting of a variance will not result in a harmful increase in flood heights, additional threats to public safety, extraordinary public expense,

create nuisances, cause fraud on or victimization of the public, or conflict with existing laws or ordinances; and

4. a determination that the granting of a variance will not result in any violations of applicable state or federal laws.

b. The variance granted shall be the minimum necessary, considering the flood hazards, to afford relief to the applicant.

(2) The Zoning Board of Appeals may attach conditions to the granting of a variance to ensure compliance with the standards contained in this ordinance.

(3) Variances may be granted for the reconstruction, rehabilitation, or restoration of structures listed on the National Register of Historic Places or the Michigan Historic Markers listing of historic sites or any other state register of historic places without regard to the requirements of this section governing variances in flood hazard areas.

(h.) Mapping disputes.
(1) Where disputes arise as to the location of the flood hazard area boundary or the limits of the floodway, the Zoning Board of Appeals shall resolve the dispute and establish the boundary location. In all cases, the decision of the Zoning Board of Appeals shall be based upon the most current floodplain studies issued by the Federal Insurance Administration. Where Federal Insurance Administration information is not available, the best available floodplain information shall be utilized.

(2) Where a dispute involves an allegation that the boundary is incorrect as mapped and the Federal Insurance Administration floodplain studies are being questioned, the Zoning Board of Appeals shall modify the boundary of the flood hazard area or the floodway only upon receipt of an official letter of map amendment issued by the Federal Insurance Administration.

(3) All parties to a map dispute may submit technical evidence to the Zoning Board of Appeals.

Post Construction Runoff Ordinance (Site-plan review)

Section 1.General Provisions

1.1. Findings of Fact

It is hereby determined that:

Land development projects and associated increases in impervious cover alter the hydrologic response of local watersheds and increase stormwater runoff rates and volumes, flooding, stream channel erosion, and sediment transport and deposition; This stormwater runoff contributes to increased quantities of water-borne pollutants, and; Stormwater runoff, soil erosion and nonpoint source pollution can be controlled and minimized through the regulation of stormwater runoff from development sites.

Therefore, the (jurisdictional stormwater authority) establishes this set of water quality and quantity policies applicable to all surface waters to provide reasonable guidance for the regulation of stormwater runoff for the purpose of protecting local water resources from degradation. It is determined that the regulation of stormwater runoff discharges from land development projects and other construction activities in order to control and minimize increases in stormwater runoff rates and volumes, soil erosion, stream channel erosion, and nonpoint source pollution associated with stormwater runoff is in the public interest and will prevent threats to public health and safety.

1.2. Purpose

The purpose of this ordinance is to establish minimum stormwater management requirements and controls to protect and safeguard the general health, safety, and welfare of the public residing in watersheds within this jurisdiction. This ordinance seeks to meet that purpose through the following objectives:

(1). minimize increases in stormwater runoff from any development in order to reduce flooding, siltation and streambank erosion and maintain the integrity of stream channels;

(2). minimize increases in nonpoint source pollution caused by stormwater runoff from development which would otherwise degrade local water quality

(3). minimize the total annual volume of surface water runoff which flows from any specific site during and following development to not exceed the pre-development hydrologic regime to the maximum extent practicable.

(4). reduce stormwater runoff rates and volumes, soil erosion and nonpoint source pollution, wherever possible, through stormwater management controls and to ensure that these management controls are properly maintained and pose no threat to public safety.

The above list is a general set of objectives to reduce the impact of stormwater on receiving waters. The local stormwater authority may wish to set some more specific objectives, based on priority water quality and habitat problems (e.g., to reduce phosphorus loads being delivered to recreational lakes, to sustain a class X trout fishery)

1.3. Applicability

This ordinance shall be applicable to all major subdivision or site plan applications, unless eligible for an exemption or granted a waiver by the (jurisdictional stormwater authority) under the specifications of Section 4 of this ordinance. The ordinance also applies to land development activities that are smaller than the minimum applicability criteria if such activities are part of a larger common plan of development that meets the following applicability criteria, even though multiple separate and distinct land development activities may take place at different times on different schedules. In addition, all plans must also be reviewed by local environmental protection officials to ensure that established water quality standards will be maintained during and after development of the site and that post construction runoff levels are consistent with any local and regional watershed plans.

The size of the site development to which post-construction stormwater management runoff control applies varies but many communities opt for a size limit of 5000 square feet or more. For sites less than 5000 square feet, local officials may wish to grant an exemption as long as the amount of impervious cover created does not exceed 1000 square feet.

To prevent the adverse impacts of stormwater runoff, the (jurisdictional stormwater authority) has developed a set of performance standards that must be met at new development sites. These standards apply to any construction activity disturbing or more square feet of land. The following activities may be exempt from these stormwater performance criteria:

1. Any logging and agricultural activity which is consistent with an approved soil conservation plan or a timber management plan prepared or approved by the (agency), as applicable.

2. Additions or modifications to existing single family structures

3. Developments that do not disturb more than square feet of land, provided they are not part of a larger common development plan;

- Repairs to any stormwater treatment practice deemed necessary by the (jurisdictional stormwater authority).

When a site development plan is submitted that qualifies as a redevelopment project as defined in Section 2 of this ordinance, decisions on permitting and on-site stormwater requirements shall be governed by special stormwater sizing criteria found in the current stormwater design manual. This criteria is dependent on the amount of impervious area created by the redevelopment and its impact on water quality. Final authorization of all redevelopment projects will be determined after a review by the (jurisdictional stormwater authority).

There are a number of decisions to be made by local communities when addressing the issue of redevelopment and stormwater treatment. The first is defining exactly what qualifies as redevelopment. The definition in Section 2 is from the current Maryland Stormwater Management regulations, and uses the square foot size of the project and its land use classification to establish the definition of a redevelopment project. The second decision involves to what level of stormwater management standards redevelopment projects will be held. Providing cost effective stormwater treatment at redevelopment sites is often a difficult task, and these projects may be given reduced criteria to meet to allow for site constraints. The State of Maryland currently requires that proposed redevelopment project designs include either at least a 20 percent reduction in existing site impervious area, management of at least 20 % of the water quality volume, or some combination of both.

1.4. Compatibility with Other Permit and Ordinance Requirements

This ordinance is not intended to interfere with, abrogate, or annul any other ordinance, rule or regulation, stature, or other provision of law. The requirements of this ordinance should be considered minimum requirements, and where any provision of this ordinance imposes restrictions different from those imposed by any other ordinance, rule or regulation, or other provision of law, whichever provisions are more restrictive or impose higher protective standards for human health or the environment shall be considered to take precedence.

1.5. Severability

If the provisions of any article, section, subsection, paragraph, subdivision or clause of this ordinance shall be judged invalid by a court of competent jurisdiction, such order of judgment shall not affect or invalidate the remainder of any article, section, subsection, paragraph, subdivision or clause of this ordinance.

1.6. Development of a Stormwater Design Manual

The (jurisdictional stormwater authority) may furnish additional policy, criteria and information including specifications and standards, for the proper implementation of the requirements of this ordinance and may provide such information in the form of a Stormwater Design Manual.

This manual will include a list of acceptable stormwater treatment practices, including the specific design criteria for each stormwater practice. The manual may be updated and expanded from time to time, at the discretion of the local review authority, based on improvements in engineering, science, monitoring and local maintenance experience. Stormwater treatment practices that are designed and constructed in accordance with these design and sizing criteria will be presumed to meet the minimum water quality performance standards.

Local communities will need to select the minimum water quality performance standards (e.g., 80% TSS, 40% P) they will require for stormwater treatment practices and place these in their design manual. The 80% removal goal for total suspended solids (TSS) is a management measure developed by EPA as part of the Coastal Zone Act Reauthorization Amendments of 1990. It was selected by EPA for the following factors: (1) removal of 80% is assumed to control heavy metals, phosphorus, and other pollutants; (2) a number of states including DE, FL, TX, MD, and MA require/recommend TSS removal of 80% or greater for new development; and (3) data show that certain structural controls, when properly designed and maintained, can meet this performance level. Further discussion of water quality standards for stormwater management measures can be found in the CZARA Coastal Zone 6217(g) management measures document entitled "Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters" (US EPA, 1993).

There are a number of good stormwater design manuals available around the country that communities may wish to refer to in creating their own local manual. One such manual is the new Maryland Department of the Environment 2000 Maryland Stormwater Design Manual Volumes I & II. This manual contains innovative criteria for stormwater management, and is available online at www.mde.state.md.us/environment/wma/stormwatermanual/mdswmanual *.*

*Local communities may also wish to consult a new resource available on the Internet called the **Stormwater Managers Resource Center (SMRC)**. This site is dedicated to providing information to stormwater management program managers in Phase II communities to assist in meeting the requirements of the new National Pollutant Discharge Elimination System Phase II regulations. Among the resources available at the website will be a section devoted to supplying guidance on how to build a stormwater manual, including sizing and design criteria. The SMRC website and the manual-builder resources are located at* www.stormwatercenter.net.

Section 2. Definitions:

"Accelerated Erosion" means erosion caused by development activities that exceeds the natural processes by which the surface of the land is worn away by the action of water, wind, or chemical action.

"Applicant" means a property owner or agent of a property owner who has filed an application for a stormwater management permit.

"Building" means any structure, either temporary or permanent, having walls and a roof, designed for the shelter of any person, animal, or property, and occupying more than 100 square feet of area.

"Channel" means a natural or artificial watercourse with a definite bed and banks that conducts continuously or periodically flowing water.

"Dedication" means the deliberate appropriation of property by its owner for general public use.

"**Detention**" means the temporary storage of storm runoff in a stormwater management practice with the goals of controlling peak discharge rates and providing gravity settling of pollutants.

"Detention Facility" means a detention basin or alternative structure designed for the purpose of temporary storage of stream flow or surface runoff and gradual release of stored water at controlled rates.

"Developer" means a person who undertakes land disturbance activities.

"Drainage Easement" means a legal right granted by a landowner to a grantee allowing the use of private land for stormwater management purposes.

"Erosion and Sediment Control Plan" means a plan that is designed to minimize the accelerated erosion and sediment runoff at a site during construction activities.

"Fee in Lieu" means a payment of money in place of meeting all or part of the storm water performance standards required by this ordinance.

"**Hotspot**" means an area where land use or activities generate highly contaminated runoff, with concentrations of pollutants in excess of those typically found in stormwater.

"**Hydrologic Soil Group (HSG)**" means a Natural Resource Conservation Service classification system in which soils are categorized into four runoff potential groups. The groups range from A soils, with high permeability and little runoff production, to D soils, which have low permeability rates and produce much more runoff.

"**Impervious Cover**" means those surfaces that cannot effectively infiltrate rainfall (e.g., building rooftops, pavement, sidewalks, driveways, etc).

"**Industrial Stormwater Permit**" means an National Pollutant Discharge Elimination System permit issued to a commercial industry or group of industries which regulates the pollutant levels associated with industrial stormwater discharges or specifies on-site pollution control strategies.

"**Infiltration**" means the process of percolating stormwater into the subsoil.

"**Infiltration Facility**" means any structure or device designed to infiltrate retained water to the subsurface. These facilities may be above grade or below grade.

"**Jurisdictional Wetland**" means an area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation.

"Land Disturbance Activity" means any activity which changes the volume or peak flow discharge rate of rainfall runoff from the land surface. This may include the grading, digging, cutting, scraping, or excavating of soil, placement of fill materials, paving, construction, substantial removal of vegetation,, or any activity which bares soil or rock or involves the diversion or piping of any natural or man-made watercourse.

"Landowner" means the legal or beneficial owner of land, including those holding the right to purchase or lease the land, or any other person holding proprietary rights in the land.

"**Maintenance Agreement**" means a legally recorded document that acts as a property deed restriction, and which provides for long-term maintenance of storm water management practices.

"**Nonpoint Source Pollution**" means pollution from any source other than from any discernible, confined, and discrete conveyances, and shall include, but not be limited to, pollutants from agricultural, silvicultural, mining, construction, subsurface disposal and urban runoff sources.

"Offset Fee" means a monetary compensation paid to a local government for failure to meet pollutant load reduction targets.

"Off-Site Facility" means a stormwater management measure located outside the subject property boundary described in the permit application for land development activity.

"On-Site Facility" means a stormwater management measure located within the subject property boundary described in the permit application for land development activity.

"Recharge" means the replenishment of underground water reserves.

"**Redevelopment**" means any construction, alteration or improvement exceeding square feet in areas where existing land use is high density commercial, industrial, institutional or multi-family residential.

"Stop Work Order" means an order issued which requires that all construction activity on a site be stopped.

"Storm Water Management" means the use of structural or non-structural practices that are designed to reduce storm water runoff pollutant loads, discharge volumes, and/or peak flow discharge rates.

"Storm Water Retrofit" means a stormwater management practice designed for an existing development site that previously had either no stormwater management practice in place or a practice inadequate to meet the stormwater management requirements of the site.

"**Stormwater Runoff**" means flow on the surface of the ground, resulting from precipitation.

"**Stormwater Treatment Practices (STPs)**" means measures, either structural or nonstructural, that are determined to be the most effective, practical means of preventing or reducing point source or nonpoint source pollution inputs to stormwater runoff and water bodies.

"**Water Quality Volume (WQ_v)**" means the storage needed to capture and treat 90% of the average annual stormwater runoff volume. Numerically **(WQ_v)** will vary as a function of long term rainfall statistical data.

"Watercourse" means a permanent or intermittent stream or other body of water, either natural or man-made, which gathers or carries surface water.

Section 3. Permit Procedures and Requirements

3.1. Permit Required

No land owner or land operator shall receive any of the building, grading or other land development permits required for land disturbance activities without first meeting the requirements of this ordinance prior to commencing the proposed activity.

The intent is to ensure that no activities that disturb the land are issued permits prior to review and approval of the stormwater management plan. Communities may elect to issue a stormwater management permit separate of any other land development permits they require, or, as in this ordinance, to tie the issuing of construction permits to the approval of a final stormwater management plan.

3.2. Application Requirements

Unless specifically excluded by this ordinance, any land owner or operator desiring a permit for a land disturbance activity shall submit to the (jurisdictional stormwater authority) a permit application on a form provided by the (jurisdictional stormwater authority) for that purpose.

Unless otherwise excepted by this ordinance, a permit application must be accompanied by the following in order that the permit application be considered: a stormwater management concept plan; a maintenance agreement; and a non-refundable permit review fee.

The stormwater management plan shall be prepared to meet the requirements of Sec. 5 of this ordinance, the maintenance agreement shall be prepared to meet the requirements of Sec. of this ordinance, and fees shall be those established by the (jurisdictional stormwater authority).

3.3. Application Review Fees

The fee for review of any land development application shall be based on the amount of land to be disturbed at the site, and the fee structure shall be established by the (jurisdictional stormwater authority). All of the monetary contributions shall be credited to an appropriate capital improvements program project, and shall be made prior to the issuance of any building permit for the development.

Local communities can use these review fees to raise funds for staff and resources to further their stormwater management programs.

3.4. Application Procedure

- Applications for land disturbance activity permits must be filed with the (appropriate review agency) on any regular business day.

- A copy of this permit application shall be forwarded to (jurisdictional stormwater authority) for review

- Permit applications shall include the following: two copies of the stormwater management concept plan, two copies of the maintenance agreement, and any required review fees.

- Within business days of the receipt of a complete permit application, including all documents as required by this ordinance, the (jurisdictional stormwater authority) shall inform the applicant whether the application, plan and maintenance agreement are approved or disapproved.

Local officials will need to decide the appropriate time frame for review of an application. This will often be determined by the staff available for permit review and for an inspection of sites undergoing construction.

- If the permit application, stormwater management plan or maintenance agreement are disapproved, the applicant may revise the stormwater management plan or agreement. If additional information is submitted, the (jurisdictional stormwater authority) shall have business days from the date

the additional information is received to inform the applicant that the plan and maintenance agreement are either approved or disapproved.

- If the permit application, final stormwater management plan and maintenance agreement are approved by the (jurisdictional stormwater authority), all appropriate land disturbance activity permits shall be issued.

3.5. Permit Duration

Permits issued under this section shall be valid from the date of issuance through the date the (jurisdictional stormwater authority) notifies the permitholder that all stormwater management practices have passed the final inspection required under permit condition.

Section 4. Waivers to Stormwater Management Requirements

4.1. Waivers for Providing Stormwater Management

Every applicant shall provide for stormwater management, unless they file a written request to waive this requirement. Requests to waive the stormwater management plan requirements shall be submitted to the (jurisdictional stormwater authority) for approval.
The minimum requirements for stormwater management may be waived in whole or in part upon written request of the applicant, provided that at least one of the following conditions applies:

- It can be demonstrated that the proposed development is not likely to impair attainment of the objectives of this ordinance.

2. Alternative minimum requirements for on-site management of stormwater discharges have been established in a stormwater management plan that has been approved by the (jurisdictional stormwater authority) and that is required to be implemented by local ordinance.

- Provisions are made to manage stormwater by an off-site facility. The off-site facility is required to be in place, to be designed and adequately sized to provide a level of stormwater control that is equal to or greater than that which would be afforded by on-site practices and has a legally obligated entity responsible for long-term operation and maintenance of the stormwater practice.

- The (jurisdictional stormwater authority) finds that meeting the minimum on-site management requirements is not feasible due to the natural or existing physical characteristics of a site.
- Non-structural practices are provided that reduce the generation of stormwater from the site, the size and cost of stormwater storage and provide partial removal of many pollutants are to be used at the site. These non-structural practices are explained in detail in the current design manual and the amount of credit available for using such practices shall be determined by the (jurisdictional stormwater authority)

In instances where one of the conditions above applies, the (jurisdictional stormwater authority) may grant a waiver from strict compliance with stormwater management provisions that are not achievable, provided that acceptable mitigation measures are provided. However, to be eligible for a variance, the applicant must demonstrate to the satisfaction of the (jurisdictional stormwater authority) that the immediately downstream waterways will not be subject to:

- Deterioration of existing culverts, bridges, dams, and other structures;
- Deterioration of biological functions or habitat;
- Accelerated streambank or streambed erosion or siltation;
- Increased threat of flood damage to public health, life and property.

Furthermore, where compliance with minimum requirements for stormwater management is waived, the applicant will satisfy the minimum requirements by meeting one of the mitigation measures selected by the jurisdictional stormwater authority. Mitigation measures may include, but are not limited to, the following:

The purchase and donation of privately owned lands, or the grant of an easement to be dedicated for preservation and/or reforestation. These lands should be located adjacent to the stream corridor in order to provide permanent buffer areas to protect water quality and aquatic habitat,

The creation of a stormwater management facility or other drainage improvements on previously developed properties, public or private, that currently lack stormwater management facilities designed and constructed in accordance with the purposes and standards of this ordinance,

Monetary contributions (Fee-in-Lieu) to fund stormwater management related studies including regional wetland delineation studies, stream monitoring studies for water quality and macroinvertebrates, stream flow monitoring, and threatened and endangered species studies.

4.2. Fee in Lieu of Stormwater Management Practices.

Where the (jurisdictional stormwater authority) waives all or part of the minimum stormwater management requirements, or where the waiver is based on the provision of adequate stormwater facilities provided downstream of the proposed development, the applicant shall be required to pay a fee in an amount as determined by the (jurisdictional stormwater authority).

When an applicant obtains a waiver of the required stormwater management, the monetary contribution required shall be in accordance with a fee schedule (unless the developer and the stormwater authority agree on a greater alternate contribution) established by the (jurisdictional stormwater authority), and based on the cubic feet of storage required for stormwater management of the development in question. All of the monetary contributions shall be credited to an appropriate capital improvements program project, and shall be made by the developer prior to the issuance of any building permit for the development.

4.3. Dedication of land

In lieu of a monetary contribution, an applicant may obtain a waiver of the required stormwater management by entering into an agreement with the (jurisdictional stormwater authority) for the granting of an easement or the dedication of land by the applicant, to be used for the construction of an off-site stormwater management facility. The agreement shall be entered into by the applicant and the (jurisdictional stormwater authority) prior to the recording of plats or, if no record plat is required, prior to the issuance of the building permit.

Section 5. General Performance Criteria for Stormwater Management

Unless judged by the (jurisdictional stormwater authority) to be exempt or granted a waiver, the following performance criteria shall be addressed for stormwater management at all sites:

(A). All site designs shall establish stormwater management practices to control the peak flow rates of stormwater discharge associated with specified design storms and reduce the generation of stormwater. These practices should seek to utilize pervious areas for stormwater treatment and to infiltrate stormwater runoff from driveways, sidewalks, rooftops, parking lots, and landscaped areas to the maximum extent practical to provide treatment for both water quality and quantity.

There are several sources of climatological references that can be consulted to find the rainfall depths for the appropriate design storm intervals (1, 10, 25, and 100 year). The NOAA National Climatological Data Center has a "Summary of the Day" database that can provide rainfall numbers for most major cities and airports in the country. Another possible source is the Urban Hydrology for Small Watersheds, TR-55 (Technical Release 55) published by the Engineering Division, United States Natural Resource Conservation Service (formerly known as the Soil Conservation Service) United States Department of Agriculture, June 1986.

(B). All stormwater runoff generated from new development shall not discharge untreated stormwater directly into a jurisdictional wetland or local water body without adequate treatment. Where such discharges are proposed, the impact of the proposal on wetland functional values shall be assessed using a method acceptable to the (jurisdictional stormwater authority). In no case shall the impact on functional values be any less than allowed by the Army Corp of Engineers (ACE) or the (Appropriate State Agency) responsible for natural resources.

(C). Annual groundwater recharge rates shall be maintained, by promoting infiltration through the use of structural and non-structural methods. At a minimum, annual recharge from the post development site shall mimic the annual recharge from pre-development site conditions.

Recharge is a relatively new stormwater criteria, and has been implemented so far in the Massachusetts coastal zone and in Maryland. The recharge criteria requires considerable effort to use existing pervious areas for stormwater treatment and infiltration, which means that it must be considered very early in the site design process when basic decisions about layout and vegetative cover are made.

(D). For new development, structural STPs shall be designed to remove % of the average annual post development total suspended solids load (TSS). It is presumed that a STP complies with this performance standard if it is:

- sized to capture the prescribed water quality volume (WQ_v).
- designed according to the specific performance criteria outlined in the local stormwater design manual,
- constructed properly, and
- maintained regularly.

For post construction stormwater runoff, the ability of stormwater management programs to meet federal guidelines under the NPDES regulations will become increasingly important. A local government seeking to manage runoff to achieve

water quality standards has a number of options for reaching their goal. The options are listed below, from the most typical standard stormwater quality practice to more advanced program options. Each option has an associated level of effort for the management of stormwater, and the likelihood of realizing water quality treatment goals depends on the option a local government selects. Local governments should assess the option they wish to select in light of new Phase II regulations and the current ability of their stormwater management staff to meet more extensive local/state staff review and inspection requirements.

***Option 1**. Require Stormwater Treatment Practices for Stormwater Quality*

Many current stormwater programs simply require that the developer install stormwater treatment practices, but do not specify a target for specific pollutant reduction performance. These programs simply require that a standard volume of stormwater be treated (e.g., a half-inch of runoff). Many of these programs also have generous waiver and exemption provisions, so that as much as 25% of all new development can avoid criteria for water quality. Typically, these programs have no formal maintenance programs. Unless the target removal goals are very low, these communities cannot expect their current programs to eliminate net additional pollutants associated with future development.

***Option 2**. Institute More Rigorous Design Standards for Stormwater Practices.*

A number of communities have improved their stormwater programs by strengthening their design standards for stormwater practices. This has involved narrowing the list of acceptable practices to those with a proven ability to remove particular pollutants, increasing the volume of runoff that is treated by each practice (e.g, treat first 1" of stormwater runoff), clamping down on waivers and exemptions (or requiring a fee-in-lieu), and requiring design features that reduce maintenance problems.

The advantage of this program option is that compliance can be presumed as long as designers follow the design rules. It does require a good stormwater manual and more extensive local/state staff review and training. It can achieve significant reduction for some pollutants, such as sediment and nutrients. The disadvantage of the program option is that current stormwater technology may not be effective enough for some pollutants (e.g., bacteria), or capable of reducing the net additional load for high levels from future development.

***Option 3**. Require On-Site Load Calculation*

A handful of communities have adopted an approach whereby the design engineer must calculate pre- and post- development loads for a particular pollutant, and then design a system of practices to meet a load reduction target, based on STP removal rates. Phosphorus has been used in most cases, and the load reduction target varies. This option results in more directed design geared more specifically to the pollutant of concern.

The on-site load calculation option has several disadvantages. First, designers often utilize STP math tricks to come into compliance (fudging loads, removal efficiencies, etc). Second, technical data to support the program option are limited to just a few parameters, such as phosphorus, nitrogen and sediment. Third, the removal rates for the stormwater practices seldom account for factors where pollutant load removal is compromised, and tend to be optimistic. Lastly, this program option is very intensive in terms of local review and compliance, and requires more staffing to implement.

Option 4. *Load Calculation w/ Stormwater Offset Fee to Provide Retrofits on Existing Development*

In this program option, a community requires the on-site load calculation described in Option 3, but is very conservative in the assumptions it allows on loading and removal efficiency. Consequently, designers at most sites cannot fully comply with the load reduction for the requirement at their site. To fully comply, they must pay an offset fee to the local government which is used to support design and construction of stormwater retrofits at existing development in the watershed. The fee is set at the cost of providing an equivalent amount of pollutant removal elsewhere (dollars/pound).

The advantage of this approach is that it provides a means of financing the stormwater retrofits needed to reduce pollutant loads from existing development. It does require greater local staffing to find, design and build the retrofits which offset the loads from new development. If administered properly, this program option can potentially eliminate the net additional load from new development. Several communities currently provide this option for developers, but it is not clear how much revenue has been collected so far.

(E). To protect stream channels from degradation, a specific channel protection criteria shall be provided as prescribed in the current stormwater manual.

Channel protection is a relatively new criteria, but is increasingly viewed as a critical one due to the mounting evidence that stream channels enlarge in response to watershed development. Studies have found higher bank erosion rates and increased

instream sediment loads for urban streams when compared to the 5-20% estimate for the annual sediment budget attributable to bank erosion in rural streams (Walling and Woodward, 1995; Collins et al., 1997). Research also indicates that channel enlargement can begin at a relatively low level of watershed development, as indicated by the amount of impervious cover. One study estimated that channel erosion rates were three to six times higher in a moderately urbanized watershed (14% impervious cover) than in a comparable rural one, with less than 2% impervious cover (Neller, 1988).

The basic methodology to calculate channel enlargement relies on obtaining historical cross-sectional data from past surveys (often obtained from transportation agencies or public works departments that conducted surveys at the time of road construction or improvement projects) and comparing these with current cross-sectional data obtained from field surveys conducted at the time of the study. The approach also utilizes predictive (i.e., empirical) equations to estimate an ultimate channel enlargement ratio once the channel has enlarged sufficiently to be in balance with its hydrological forces.

Basic Options for Stream Channel Protection

As many as five different design criteria have been suggested to protect downstream channels from erosion. It should be clearly noted that none of these criteria have yet been monitored in the field to demonstrate their effectiveness, and most are based on hydrologic or hydraulic modeling of streams. The five options are:

Two year control *(post development peak discharge rate from two year storm is held to pre development levels). It is very important to note that research studies indicate that this criteria does not protect channels from downstream erosion, and may actually exacerbate erosion since banks are exposed to a longer duration of erosive bankfull and sub-bankfull events. (MaCrae, 1993 and 1996, McCuen and Moglen, 1988). In addition, many communities have provided anecdotal evidence that two year control has failed to protect downstream channels from erosion. This evidence suggests that while the magnitude of the peak discharge is unchanged from pre to post development under two year control, the duration of erosive flows sharply increases. As a result, "effective work" on the channel (sensu Wolman et al, 1964) is shifted to smaller runoff events that range from the half year event up to the 1.5 year runoff event (MacRae, 1993). Consequently, the two year control approach is considered ineffective for stream channel protection, although it remains a useful criterion for prevention of overbank flooding.*

Two year over-control *(post development peak discharge rate to 50% or less of predevelopment level). First proposed by McCuen and Moglen (1988), this design approach recognizes the inherent limitations of two year control. The approach emphasizes "overcontrol" of the two year storm. The most common numerical approach is to control the two year post development discharge rate to the one year predevelopment rate, using the 24 hour storm event. Subsequent analysis by Macrae (1996), however, indicates that this design criteria is still not fully capable of protecting the stream channel from erosion. His modeling suggests that "tail-end" of the post development hydrograph is subject to a considerable duration of effective work".*

24 hour detention of the one year storm event*. This criteria would result in up to 24 hours of detention for runoff generated by a rainfall depth based on annual rainfall for a region. Smaller storms events would also experience some detention, but probably much less than 24 hours. The premise of this criteria is that runoff would be stored and released in such a gradual manner that critical erosive velocities would seldom be exceeded in downstream channels. The required volume needed for 1 year extended detention is significant; it is roughly equivalent to about 90 to 95% of the required volume needed for ten year peak discharge control. Consequently, the need for two year peak discharge management would be eliminated when the 1 year ED is provided, as long as the ten year peak discharge control is achieved.*

Distributed runoff control (DRC): *This criteria has been developed by MaCrae (1993) and involves complex field assessments and modeling to determine the hydraulic stress and erosion potential of bank materials. The criteria states that channel erosion is minimized if the alteration in the transverse distribution of erosion potential about a channel parameter is maintained constant with predevelopment values, over the range of available flows, such that the channel is just able to move the dominant particle size of the bed load. This Canadian method holds promise, but has not been tested extensively in the United States and requires significantly greater data collection and modeling then any of the other methods.*

Bankfull capacity/duration criteria: *This criteria has been advanced by Tapley et al 1996, and states that the post-development, bankfull flow frequency, duration and depth must be controlled to predevelopment values at a designated control point(s) in the channel. The Rule of thumb for selecting control point(s) is to use a 10: 1 ratio of peak discharge from the one year storm for the developed site to the discharge from the stream for the same frequency storm (Tapley et al, 1996). In theory, this criteria should result in a high level of downstream protection. The practical problem is in defining how the criteria is to be interpreted; whether sub-bankfull events (that typically erode the toe of the streambank) should also be considered; and precisely*

where the "bankfull" should be measured. For example, the channel of many streams have been modified in the past by prior land uses and channelization, and may not represent the "true" channel. In other cases, the stormwater outfall discharge laterally to a stream, and it is therefore difficult to assign which flows the developer is actually responsible for controlling.

Pros and Cons of Channel Protection Sizing Criteria.

If two year control and two year overcontrol are deemed inadequate to fully protect channels from erosion, then only three options remain, each of which has some limitations. For example, both the DRC and bankfull capacity sizing criteria options lack widely accepted or universal design methodologies. In each case, local stream cross-section and/or soil measurements are needed, and considerable contention between the designer and the reviewer can be expected on how and where the analysis should be performed. Given the many operational problems currently associated with either option, and the lack of a tested design methodology at present, the two options probably deserve further study, but are not ready for wide application.

This leaves only one remaining option-- the one-year 24 hour detention criteria. It, too, has some limitations:

- *results in unacceptably small diameter orifices for sites less than ten acres in size.*
- *requires a storage volume roughly equivalent to that needed for two year control.*
- *has not been "tested" by continuous simulation modeling to determine if acceptable detention times can be achieved for smaller storms can be achieved (1.0 to 1.5 inches).*
- *is only needed in streams that are susceptible to bank erosion.*

Based on the foregoing, it appears that the best option to provide channel protection (Cp_v) is 12 to 24 hour extended detention of the one-year 24 hour storm event. This Cp_v requirement only applies to sites greater than ten acres in size. Local governments may wish to retain the option of employing the DRC or bankfull capacity/duration criteria as an alternative, should their analytical and design requirements become more simplified and refined in the future

There are some basic exemptions to where the channel protection criteria should be applied (small drainage areas, direct discharge to tidal waters or a lake, flat terrain etc), and communities must decide how and when this criteria will be required.

(F). Stormwater discharges to critical areas with sensitive resources (i.e., cold water fisheries, shellfish beds, swimming beaches, recharge areas, water supply reservoirs) may be subject to additional performance criteria, or may need to utilize or restrict certain stormwater management practices.

(G). Certain industrial sites are required to prepare and implement a stormwater pollution prevention plan, and shall file a notice of intent (NOI) under the provisions of the National Pollutant Discharge Elimination System (NPDES) general permit. The stormwater pollution prevention plan requirement applies to both existing and new industrial sites.

Applicants and local communities may wish to consult the Environmental Protection Agency website at http://www.epa.gov/owm/swm/phase2 for more information on Phase II requirements.

(H). Stormwater discharges from land uses or activities with higher potential pollutant loadings, known as "hotspots", may require the use of specific structural STPs and pollution prevention practices.

(I). Prior to design, applicants are required to consult with the (jurisdictional stormwater authority) to determine if they are subject to additional stormwater design requirements.

(J). The calculations for determining peak flows as found in the Stormwater Design Manual shall be used for sizing all stormwater management practices.

Section 6. Basic Stormwater Management Design Criteria

Rather than place specific stormwater design criteria into an ordinance, it is often preferable to fully detail these requirements in a stormwater design manual. This allows specific design information to change over time as new information or techniques become available without requiring the formal process needed to change ordinance language. The ordinance can then require those submitting any development application to consult the current stormwater design manual for the exact design criteria for the stormwater management practices appropriate for their site.

In the Maryland Stormwater Design Manual, for example, there are a set of specified performance criteria for each stormwater management practice, based on six factors:

- *Site Design Feasibility* -
- *Conveyance Issues* -

- *Pretreatment Requirements* -
- *Treatment/Geometry Conditions*
- *Environmental/Landscaping Standards*
- *Maintenance Needs*

Each community will need to decide the specific design and sizing criteria for the stormwater management practices they allow, and select a storm event frequency(1, 2, 10, 100 year) that they believe will meet their stormwater quality and quantity control requirements.

6.1. Minimum Control Requirements

All stormwater management practices will be designed so that the specific storm frequency storage volumes (e.g., recharge, water quality, channel protection, 10 year, 100 year) as identified in the current stormwater design manual are met, unless the (jurisdictional stormwater authority) grants the applicant a waiver or the applicant is exempt from such requirements.

In addition, if hydrologic or topographic conditions warrant greater control than that provided by the minimum control requirements, the (jurisdictional stormwater authority) reserves the right to impose any and all additional requirements deemed necessary to control the volume, timing, and rate of runoff.

6.2 Site Design Feasibility

Stormwater management practices for a site shall be chosen based on the physical conditions of the site. Among the factors that should be considered:

- Topography
- Maximum Drainage Area
- Depth to Water Table
- Soils
- Slopes
- Terrain
- Head
- Location in relation to environmentally sensitive features or ultra-urban areas

Applicants shall consult the Stormwater Design Manual for guidance on the factors that determine site design feasibility when selecting a stormwater management practice.

6.3. Conveyance Issues

All stormwater management practices shall be designed to convey stormwater to allow for the maximum removal of pollutants and reduction in flow velocities. This shall include, but not be limited to:

- Maximizing of flowpaths from inflow points to outflow points
- Protection of inlet and outfall structures
- Elimination of erosive flow velocities
- Providing of underdrain systems, where applicable

The Stormwater Design Manual shall provide detailed guidance on the requirements for conveyance for each of the approved stormwater management practices.

6.4. Pretreatment Requirements

Every stormwater treatment practice shall have an acceptable form of water quality pretreatment, in accordance with the pretreatment requirements found in the current stormwater design manual. Certain stormwater treatment practices, as specified in the Stormwater Design Manual, are prohibited even with pretreatment in the following circumstances:

A. Stormwater is generated from highly contaminated source areas known as "hotspots"

B. Stormwater is carried in a conveyance system that also carries contaminated, non-stormwater discharges

C. Stormwater is being managed in a designated groundwater recharge area.

D. Certain geologic conditions exist (e.g., karst) that prohibit the proper pretreatment of stormwater

6.5. Treatment/Geometry Conditions

All stormwater management practices shall be designed to capture and treat stormwater runoff according to the specifications outlined in the Stormwater Design Manual. These specifications will designate the water quantity and quality treatment criteria that apply to an approved stormwater management practice.

6.6. Landscaping Plans Required

All stormwater management practices must have a landscaping plan detailing both the vegetation to be in the practice and how and who will manage and maintain this

vegetation. This plan must be prepared by a registered landscape architect or soil conservation district.

6.7. Maintenance Agreements

All stormwater treatment practices shall have an enforceable operation and maintenance agreement to ensure the system functions as designed. This agreement will include any and all maintenance easements required to access and inspect the stormwater treatment practices, and to perform routine maintenance as necessary to ensure proper functioning of the stormwater treatment practice. In addition, a legally binding covenant specifying the parties responsible for the proper maintenance of all stormwater treatment practices shall be secured prior to issuance of any permits for land disturbance activities.

6.8. Non-Structural Stormwater Practices

The use of non-structural stormwater treatment practices is encouraged in order to minimize the reliance on structural practices. Credit in the form of reductions in the amount of stormwater that must be managed can be earned through the use of non-structural practices that reduce the generation of stormwater from the site. These non-structural practices are explained in detail in the current design manual and applicants wishing to obtain credit for use of non-structural practices must ensure that these practices are documented and remain unaltered by subsequent property owners.

Section 7. Requirements for Stormwater Management Plan Approval

7.1. Stormwater Management Plan Required for All Developments.

No application for development will be approved unless it includes a stormwater management plan detailing in concept how runoff and associated water quality impacts resulting from the development will be controlled or managed. This plan must be prepared by an individual approved by the (jurisdictional stormwater authority) and must indicate whether stormwater will be managed on-site or off-site and, if on-site, the general location and type of practices.

The stormwater management plan(s) shall be referred for comment to all other interested agencies, and any comments must be addressed in a final stormwater management plan. This final plan must be signed by a licensed professional engineer (PE), who will verify that the design of all stormwater management practices meet the submittal requirements outlined in the Submittal Checklist found in the

stormwater design manual. No building, grading, or sediment control permit shall be issued until a satisfactory final stormwater management plan, or a waiver thereof, shall have undergone a review and been approved by the (jurisdictional stormwater authority) after determining that the plan or waiver is consistent with the requirements of this ordinance.

One way to handle the submittal requirements for both the concept plan and the final design plan is to place Submittal Checklists in the stormwater design manual and require that they are used for submission of any plan. The benefit of this is that changes in submittal requirements can be made as needed without needing to revisit and alter the original ordinance. Attached are three model checklists that local communities may wish to review for ideas on requirements in their own submittal checklist.

7.2. Stormwater Management Concept Plan Requirements

A stormwater management concept plan shall be required with all permit applications and will include sufficient information (e.g., maps, hydrologic calculations, etc) to evaluate the environmental characteristics of the project site, the potential impacts of all proposed development of the site, both present and future, on the water resources, and the effectiveness and acceptability of the measures proposed for managing stormwater generated at the project site. The intent of this conceptual planning process is to determine the type of stormwater management measures necessary for the proposed project, and ensure adequate planning for management of stormwater runoff from future development. To accomplish this goal the following information shall be included in the concept plan:

- A map (or maps) indicating the location of existing and proposed buildings, roads, parking areas, utilities, structural stormwater management and sediment control facilities. The map(s) will also clearly show proposed land use with tabulation of the percentage of surface area to be adapted to various uses; drainage patterns; locations of utilities, roads and easements; the limits of clearing and grading; A written description of the site plan and justification of proposed changes in natural conditions may also be required.

This project description and site plan requirement includes information normally found in an Erosion and Sediment Control plan. For local governments that do not currently have ESC plan requirements or are looking to upgrade their ESC ordinance language, there is a model Erosion and Sediment Control ordinance located at this website.

- Sufficient engineering analysis to show that the proposed stormwater management measures are capable of controlling runoff from the site in compliance with this ordinance and the specifications of the Stormwater Design Manual.
- A written or graphic inventory of the natural resources at the site and surrounding area as it exists prior to the commencement of the project and a description of the watershed and its relation to the project site. This description should include a discussion of soil conditions, forest cover, topography, wetlands, and other native vegetative areas on the site. Particular attention should be paid to environmentally sensitive features that provide particular opportunities or constraints for development.
- A written description of the required maintenance burden for any proposed stormwater management facility.
- The (jurisdictional stormwater authority) may also require a concept plan to consider the maximum development potential of a site under existing zoning, regardless of whether the applicant presently intends to develop the site to its maximum potential.

For development or redevelopment occurring on a previously developed site, an applicant shall be required to include within the stormwater concept plan measures for controlling existing stormwater runoff discharges from the site in accordance with the standards of this Ordinance to the maximum extent practicable.

7.3. Final Stormwater Management Plan Requirements

After review of the stormwater management concept plan, and modifications to that plan as deemed necessary by the (jurisdictional stormwater authority), a final stormwater management plan must be submitted for approval. The final stormwater management plan, in addition to the information from the concept plan, shall include all of the information required in the Final Stormwater Management Plan checklist found in the Stormwater Design Manual. This includes:

1. Contact Information

The name, address, and telephone number of all persons having a legal interest in the property and the tax reference number and parcel number of the property or properties affected.

2. Topographic Base Map

A 1" = 200' topographic base map of the site which extends a minimum of feet beyond the limits of the proposed development and indicates existing surface water drainage including streams, ponds, culverts, ditches, and wetlands; current land use including all existing structures; locations of utilities, roads, and easements; and significant natural and manmade features not otherwise shown.

3. Calculations

Hydrologic and hydraulic design calculations for the pre-development and post-development conditions for the design storms specified in this ordinance. Such calculations shall include (i) description of the design storm frequency, intensity and duration, (ii) time of concentration, (iii) Soil Curve Numbers or runoff coefficients, (iv) peak runoff rates and total runoff volumes for each watershed area, (v) infiltration rates, where applicable, (vi) culvert capacities, (vii) flow velocities, (viii) data on the increase in rate and volume of runoff for the design storms referenced in the Stormwater Design Manual, and (ix) documentation of sources for all computation methods and field test results.

4. Soils Information

If a stormwater management control measure depends on the hydrologic properties of soils (e.g., infiltration basins), then a soils report shall be submitted. The soils report shall be based on on-site boring logs or soil pit profiles. The number and location of required soil borings or soil sits shall be determined based on what is needed to determine the suitability and distribution of soil types present at the location of the control measure.

5. Maintenance and Repair Plan

The design and planning of all stormwater management facilities shall include detailed maintenance and repair procedures to ensure their continued function. These plans will identify the parts or components of a stormwater management facility that need to be maintained and the equipment and skills or training necessary. Provisions for the periodic review and evaluation of the effectiveness of the maintenance program and the need for revisions or additional maintenance procedures shall be included in the plan.

- Landscaping plan

The applicant must present a detailed plan for management of vegetation at the site after construction is finished, including who will be responsible for the maintenance of vegetation at the site and what practices will be employed to ensure that adequate vegetative cover is preserved. This plan must be prepared by a registered landscape architect or by the soil conservation district.

- Maintenance Easements

The applicant must ensure access to all stormwater treatment practices at the site for the purpose of inspection and repair by securing all the maintenance easements needed on a permanent basis. These easements will be recorded with the plan and will remain in effect even with transfer of title to the property.

- Maintenance Agreement

The applicant must execute an easement and an inspection and maintenance agreement binding on all subsequent owners of land served by na on-site stormwater management measure in accordance with the specifications of this ordinance.

- Erosion and Sediment Control Plans for Construction of Stormwater Management Measures

The applicant must prepare an erosion and sediment control plan for all construction activities related to implementing any on-site stormwater management practices.

- Other Environmental Permits

The applicant shall assure that all other applicable environmental permits have been acquired for the site prior to approval of the final stormwater design plan.

7.4. Performance Bond/Security.

The (jurisdictional stormwater authority) may, at its discretion, require the submittal of a performance security or bond prior to issuance of a permit in order to insure that the stormwater practices are installed by the permit holder as required by the approved stormwater management plan. The amount of the installation performance security shall be the total estimated construction cost of the stormwater management practices approved under the permit, plus 25%. The performance security shall contain forfeiture provisions for failure to complete work specified in the stormwater management plan.

The installation performance security shall be released in full only upon submission of "as built plans" and written certification by a registered professional engineer that the stormwater practice has been installed in accordance with the approved plan and other applicable provisions of this ordinance. The (jurisdictional stormwater authority) will make a final inspection of the stormwater practice to ensure that it is in compliance with the approved plan and the provisions of this ordinance. Provisions for a partial pro-rata release of the performance security based on the completion of various development stages can be done at the discretion of the (jurisdictional stormwater authority).

Some communities elect to also require a maintenance performance security. This bond typically is set at the maintenance costs estimated in the stormwater plan for the period during which the permit holder has maintenance responsibility and is released when the responsibility for practice maintenance is passed on to another party, via an approved maintenance agreement.

Section 8. Construction Inspection

8.1. Notice of Construction Commencement

The applicant must notify the (jurisdictional stormwater authority) in advance before the commencement of construction. Regular inspections of the stormwater management system construction shall be conducted by the staff of the (jurisdictional stormwater authority) or certified by a professional engineer or their designee who has been approved by the jurisdictional stormwater authority. All inspections shall be documented and written reports prepared that contain the following information:

- The date and location of the inspection;
- Whether construction is in compliance with the approved stormwater management plan
- Variations from the approved construction specifications
- Any violations that exist

If any violations are found, the property owner shall be notified in writing of the nature of the violation and the required corrective actions. No added work shall proceed until any violations are corrected and all work previously completed has received approval by the (jurisdictional stormwater authority).

8.2. As Built Plans

All applicants are required to submit actual "as built"plans for any stormwater management practices located on-site after final construction is completed. The plan must show the final design specifications for all stormwater management facilities and must be certified by a professional engineer. A final inspection by the (jurisdictional stormwater authority) is required before the release of any performance securities can occur.

8.3. Landscaping and Stabilization Requirements

Any area of land from which the natural vegetative cover has been either partially or wholly cleared or removed by development activities shall be revegetated within ten (10) days from the substantial completion of such clearing and construction. The following criteria shall apply to revegetation efforts:

Reseeding must be done with an annual or perennial cover crop accompanied by placement of straw mulch or its equivalent of sufficient coverage to control erosion until such time as the cover crop is established over ninety percent (90%) of the seeded area.

Replanting with native woody and herbaceous vegetation must be accompanied by placement of straw mulch or its equivalent of sufficient coverage to control erosion until the plantings are established and are capable of controlling erosion.

Any area of revegetation must exhibit survival of a minimum of seventy-five percent (75%) of the cover crop throughout the year immediately following revegetation. Revegetation must be repeated in successive years until the minimum seventy-five percent (75%) survival for one (1) year is achieved.

In addition to the above requirements, a landscaping plan must be submitted with the final design describing the vegetative stabilization and management techniques to be used at a site after construction is completed. This plan will explain not only how the site will be stabilized after construction, but who will be responsible for the maintenance of vegetation at the site and what practices will be employed to ensure that adequate vegetative cover is preserved. This plan must be prepared by a registered landscape architect or by the soil conservation district, and must be approved prior to receiving a permit.

Section 9. Maintenance and Repair of Stormwater Facilities

A model operation and maintenance ordinance for stormwater facilities is available at this website. This ordinance goes into greater detail on the elements needed to create

an effective stormwater maintenance ordinance. Requirements for inspection are also included in the model.

9.1. Maintenance Easement

Prior to the issuance of any permit that has an stormwater management facility as one of the requirements of the permit, the applicant or owner of the site must execute a maintenance easement agreement that shall be binding on all subsequent owners of land served by the stormwater management facility. The agreement shall provide for access to the facility at reasonable times for periodic inspection by the (jurisdictional stormwater authority), or their contractor or agent, and for regular or special assessments of property owners to ensure that the facility is maintained in proper working condition to meet design standards and any other provisions established by this ordinance. The easement agreement shall be recorded by the (jurisdictional stormwater authority) in the land records.

9.2. Maintenance Covenants

Maintenance of all stormwater management facilities shall be ensured through the creation of a formal maintenance covenant that must be approved by the (jurisdictional stormwater authority) and recorded into the land record prior to final plan approval. As part of the covenant, a schedule shall be developed for when and how often maintenance will occur to ensure proper function of the stormwater management facility. The covenant shall also include plans for periodic inspections to ensure proper performance of the facility between scheduled cleanouts.

The (jurisdictional stormwater authority), in lieu of an maintenance covenant, may accept dedication of any existing or future stormwater management facility for maintenance, provided such facility meets all the requirements of this chapter and includes adequate and perpetual access and sufficient area, by easement or otherwise, for inspection and regular maintenance.

9.3. Requirements for Maintenance Covenants

All stormwater management facilities must undergo, at the minimum, an annual inspection to document maintenance and repair needs and ensure compliance with the requirements of this ordinance and accomplishment of its purposes. These needs may include; removal of silt, litter and other debris from all catch basins, inlets and drainage pipes, grass cutting and vegetation removal, and necessary replacement of landscape vegetation. Any maintenance needs found must be addressed in a timely manner, as determined by the (jurisdictional stormwater authority), and the

inspection and maintenance requirement may be increased as deemed necessary to ensure proper functioning of the stormwater management facility.

9.4. Inspection of Stormwater Facilities

Inspection programs may be established on any reasonable basis, including but not limited to: routine inspections; random inspections; inspections based upon complaints or other notice of possible violations; inspection of drainage basins or areas identified as higher than typical sources of sediment or other contaminants or pollutants; inspections of businesses or industries of a type associated with higher than usual discharges of contaminants or pollutants or with discharges of a type which are more likely than the typical discharge to cause violations of state or federal water or sediment quality standards or the NPDES stormwater permit; and joint inspections with other agencies inspecting under environmental or safety laws. Inspections may include, but are not limited to: reviewing maintenance and repair records; sampling discharges, surface water, groundwater, and material or water in drainage control facilities; and evaluating the condition of drainage control facilities and other stormwater treatment practices.

9.5. Right-of-Entry for Inspection

When any new drainage control facility is installed on private property, or when any new connection is made between private property and a public drainage control system, sanitary sewer or combined sewer, the property owner shall grant to the (jurisdictional stormwater authority) the right to enter the property at reasonable times and in a reasonable manner for the purpose of inspection. This includes the right to enter a property when it has a reasonable basis to believe that a violation of this ordinance is occurring or has occurred, and to enter when necessary for abatement of a public nuisance or correction of a violation of this ordinance.

9.6. Records of Installation and Maintenance Activities.

Parties responsible for the operation and maintenance of a stormwater management facility shall make records of the installation and of all maintenance and repairs, and shall retain the records for at least_years. These records shall be made available to the (jurisdictional stormwater authority) during inspection of the facility and at other reasonable times upon request.

9.7 Failure to Maintain Practices

If a responsible party fails or refuses to meet the requirements of the maintenance covenant, the (jurisdictional stormwater authority), after reasonable notice, may correct a violation of the design standards or maintenance needs by performing all necessary work to place the facility in proper working condition. In the event that the stormwater management facility becomes a danger to public safety or public health, the (jurisdictional stormwater authority) shall notify the party responsible for maintenance of the stormwater management facility in writing. Upon receipt of that notice, the responsible person shall have days to effect maintenance and repair of the facility in an approved manner. After proper notice, the (jurisdictional stormwater authority) may assess the owner(s) of the facility for the cost of repair work and any penalties; and the cost of the work shall be a lien on the property, or prorated against the beneficial users of the property, and may be placed on the tax bill and collected as ordinary taxes by the county.

Section 10. Enforcement and Penalties.

10.1. Violations

Any development activity that is commenced or is conducted contrary to this Ordinance, may be restrained by injunction or otherwise abated in a manner provided by law.

10.2. Notice of Violation.

When the (jurisdictional stormwater authority) determines that an activity is not being carried out in accordance with the requirements of this Ordinance, it shall issue a written notice of violation to the owner of the property. The notice of violation shall contain :

(1) the name and address of the owner or applicant;

(2) the address when available or a description of the building, structure or land upon which the violation is occurring;

(3) a statement specifying the nature of the violation;

(4) a description of the remedial measures necessary to bring the development activity into compliance with this Ordinance and a time schedule for the completion of such remedial action;

(5) a statement of the penalty or penalties that shall or may be assessed against the person to whom the notice of violation is directed;

(6) a statement that the determination of violation may be appealed to the municipality by filing a written notice of appeal within fifteen (15) days of service of notice of violation.

10.3. Stop Work Orders

Persons receiving a notice of violation will be required to halt all construction activities. This "stop work order" will be in effect until the (jurisdictional stormwater authority) confirms that the development activity is in compliance and the violation has been satisfactorily addressed. Failure to address a notice of violation in a timely manner can result in civil, criminal, or monetary penalties in accordance with the enforcement measures authorized in this ordinance.

10.4. Civil and Criminal Penalties

In addition to or as an alternative to any penalty provided herein or by law, any person who violates the provisions of this Ordinance shall be punished by a fine of not less than Dollars ($xx) or by imprisonment for a period not to exceed (xx) days, or both such fine and imprisonment. Such person shall be guilty of a separate offense for each day during which the violation occurs or continues.

10.4. Restoration of lands

Any violator may be required to restore land to its undisturbed condition. In the event that restoration is not undertaken within a reasonable time after notice, the (jurisdictional stormwater authority) may take necessary corrective action, the cost of which shall become a lien upon the property until paid.

10.5. Holds on Occupation Permits

Occupation permits will not be granted until a corrections to all stormwater practices have been made and accepted by the (jurisdictional stormwater authority).

Approved by: _____

Date _____

Example Checklist for Preliminary/Concept

Stormwater Management Plan Preparation and Review

DRAFT

- Applicant information
- Name, legal address, and telephone number
- Common address and legal description of site
- Vicinity map
- Existing and proposed mapping and plans (recommended scale of 1" = 50'.) which illustrate at a minimum:

Existing and proposed topography (minimum of 2-foot contours recommended)

Perennial and intermittent streams

Mapping of predominant soils from USDA soil surveys

Boundaries of existing predominant vegetation and proposed limits of clearing

Location and boundaries of resource protection areas such as wetlands, lakes, ponds, and other setbacks (e.g., stream buffers, drinking water well setbacks, septic setbacks)

Location of existing and proposed roads, buildings, and other structures

Existing and proposed utilities (e.g., water, sewer, gas, electric) and easements

Location of existing and proposed conveyance systems such as grass channels, swales, and storm drains

Flow paths

Location of floodplain/floodway limits and relationship of site to upstream and downstream properties and drainages

Preliminary location and dimensions of proposed channel modifications, such as bridge or culvert crossings

Preliminary location, size, and limits of disturbance of proposed structural stormwater management practices

- Hydrologic and hydraulic analysis including:

Existing condition analysis for runoff rates, volumes, and velocities presented showing methodologies used and supporting calculations

Proposed condition analysis for runoff rates, volumes, and velocities showing the methodologies used and supporting calculations

Preliminary analysis of potential downstream impact/effects of project, where necessary

Preliminary selection and rationale for structural stormwater management practices

Preliminary sizing calculations for structural stormwater management practices including, contributing drainage area, storage, and outlet configuration

- Preliminary landscaping plans for structural stormwater management practices and any site reforestation or revegetation

- Preliminary erosion and sediment control plan that at a minimum meets the requirements outlined in local Erosion and Sediment Control guidelines
- Identification of preliminary waiver requests

Example Checklist for Final

Stormwater Management Plan Preparation and Review

DRAFT

- Applicant information

Name, legal address, and telephone number

- Common address and legal description of site
- Signature and stamp of registered engineer/surveyor and design/owner certification
- Vicinity map
- Existing and proposed mapping and plans (recommended scale of 1" = 50' or greater detail) which illustrate at a minimum:

Existing and proposed topography (minimum of 2-foot contours recommended)

Perennial and intermittent streams

Mapping of predominant soils from USDA soil surveys as well as location of any site-specific borehole investigations that may have been performed.

Boundaries of existing predominant vegetation and proposed limits of clearing

Location and boundaries of resource protection areas such as wetlands, lakes, ponds, and other setbacks (e.g., stream buffers, drinking water well setbacks, septic setbacks)

Location of existing and proposed roads, buildings, and other structures

Location of existing and proposed utilities (e.g., water, sewer, gas, electric) and easements

Location of existing and proposed conveyance systems such as grass channels, swales, and storm drains

Flow paths

Location of floodplain/floodway limits and relationship of site to upstream and downstream properties and drainages

Location and dimensions of proposed channel modifications, such as bridge or culvert crossings

Location, size, maintenance access, and limits of disturbance of proposed structural stormwater Management practices

- Representative cross-section and profile drawings and details of structural stormwater Management practices and conveyances (i.e., storm drains, open channels, swales, etc.) which include:

Existing and proposed structural elevations (e.g., invert of pipes, manholes, etc.)

Design water surface elevations

Structural details of outlet structures, embankments, spillways, stilling basins, grade control structures, conveyance channels, etc.

Logs of borehole investigations that may have been performed along with supporting geotechnical report.

- Hydrologic and hydraulic analysis for all structural components of stormwater system (e.g., storm drains, open channels, swales, Management practices, etc.) for applicable design storms including:

Existing condition analysis for time of concentrations, runoff rates, volumes, velocities, and water surface elevations showing methodologies used and supporting calculations

Proposed condition analysis for time of concentrations, runoff rates, volumes, velocities, water surface elevations, and routing showing the methodologies used and supporting calculations

Final sizing calculations for structural stormwater Management practices including, contributing drainage area, storage, and outlet configuration

Stage-discharge or outlet rating curves and inflow and outflow hydrographs for storage facilities (e.g., stormwater ponds and wetlands)

Final analysis of potential downstream impact/effects of project, where necessary

Dam breach analysis, where necessary

- Final landscaping plans for structural stormwater Management practices and any site reforestation or revegetation
- Structural calculations, where necessary
- Applicable construction specifications
- Erosion and sediment control plan that at a minimum meets the requirements of the local Erosion and Sediment Control Guidelines
- Sequence of construction
- Maintenance plan which will include:

Name, address, and phone number of responsible parties for maintenance.

Description of annual maintenance tasks

Description of applicable easements

Description of funding source

Minimum vegetative cover requirements

Access and safety issues

Testing and disposal of sediments that will likely be necessary

- Evidence of acquisition of all applicable local and non-local permits
- Evidence of acquisition of all necessary legal agreements (e.g., easements, covenants, land trusts)
- Waiver requests
- Review agency should have inspector's checklist identifying potential features to be inspected on site visits

Example Checklist for Incorporation of Better Site Design Techniques in Stormwater Management Plan

DRAFT

- Applicant information

Name, legal address, and telephone number

- Common address and legal description of site
- Vicinity map
- Existing and proposed mapping and plans (recommended scale of 1" = 50'.) which illustrate at a minimum:

Existing and proposed topography (minimum of 2-foot contours recommended)

Perennial and intermittent streams

Mapping of predominant soils from USDA soil surveys as well as location of any site-specific borehole investigations that may have been performed.

Boundaries of existing predominant vegetation and proposed limits of clearing

Location and boundaries of resource protection areas such as wetlands, lakes, ponds, and other setbacks (e.g., stream buffers, drinking water well setbacks, septic setbacks)

Grading plan with location of existing and proposed roads, buildings, and other structures

Location of existing and proposed utilities (e.g., water, sewer, gas, electric) and easements

Location of existing and proposed conveyance systems such as grass channels, swales, and storm drains

Flow paths

Location of floodplain/floodway limits and relationship of site to upstream and downstream properties and drainages

Location and dimensions of proposed channel modifications, such as bridge or culvert crossings

Location, size, maintenance access, and limits of disturbance of proposed structural stormwater management practices

Location of proposed community recreation/open space areas

Landscape plan

- Narrative and supporting calculations describing:

Zoning, acreage, types and amounts of land uses (e.g., parking spaces, density, green areas, building footprint areas, etc.)

Traffic analysis estimating average daily trips for street network and parking requirements

Site impervious area

Reforestation and/or resource conservation protection measures

Comparison of proposed development data with allowable density, land use, etc.

Representative low-impact development techniques (with supporting evidence that technique is compatible with site characteristics) such as on-lot bioretention, tree clearing minimization, minimizing directly connected impervious surfaces, open section roads (also called roadside swales), etc.

Development phasing or implementation sequence

_____ TOWNSHIP
COUNTY OF ALLEGAN, MICHIGAN

ORDINANCE NO. ___
AN ORDINANCE TO AMEND THE ZONING ORDINANCE OF _____ TOWNSHIP

AN ORDINANCE TO AMEND THE "ZONING ORDINANCE" FOR THE TOWNSHIP OF _____ TO ADD PROVISIONS PERTAINING TO THE REGULATION OF THE NUMBER OF USERS AND TYPES OF USES OF LAKE FRONTAGE, TO PRESERVE THE QUALITIES OF THE WATERS, MINIMIZE CONFLICTING LAND USES, PROMOTE SAFETY AND HELP PRESERVE THE QUALITY OF RECREATIONAL USE OF LANDS AND WATERS WITHIN THE TOWNSHIP, BY ADDING A NEW SECTION ESTABLISHING REGULATIONS THAT LIMIT CAMPING ON RESIDENTIAL LOTS AND THE CAMPING AND STORAGE OF CAMPERS AND RECREATION VEHICLES ON VACANT RESIDENTIAL LOTS AND BY CHANGING THE SPECIAL USE PROVISIONS OF THE ZONING ORDINANCE TO ESTABLISH TWO CLASSES OF SPECIAL USES AND TO ESTABLISH A CLASS I SPECIAL USE REVIEW COMMITTEE.

Lake / Riparian Access

Article 1. The _____ Township Zoning Ordinance is hereby amended by adding the following definitions to Chapter III

Boat or watercraft shall mean any vessel as defined in Public Act 451 of the Public Acts of 1994, Public Act 58 of the Public Acts of 1995 and Public Act 102 of the public acts of 1997 as amended.
Single unit boat access site shall mean a facility which extends into or over a lake, or provides dry-docking space, for mooring or docking of boats and watercraft for not more than one, single family residential parcel, lot or unit.

Multi-unit boat access site shall mean a facility which extends into or over a lake, or provides dry-docking space, for mooring or docking of boats and watercraft for use by more than one family (as defined herein), parcel, lot, unit or apartment. A facility for the mooring or docking of a boat or boats owned and operated exclusively by one family (as defined herein), residing in one dwelling unit and which supports the docking or mooring of six or fewer vessels shall not be included within the definition and meaning of *multi-unit boat access site* where the docking or mooring facility is property which is owned exclusively by such family and which is a contiguous part of the property on which the dwelling is situated. Any situation involving multiple or divided ownership and interest in the riparian property or boat access site including but not limited to family trusts, corporations, condominium associations, and co-ops is considered a multi-unit boat access site and shall be subject to the limitations and regulations for such facilities contained herein.

Public access shall mean a multi-boat access site operated by a- governmental entity, including access from a public road authorized expressly or impliedly by a governmental entity.

Article 2. The _____ Township/City Zoning Ordinance is hereby amended by adding the following and shall read in its entirety as follows:

15.147 Sec. 12.17 LAKE / RIPARIAN ACCESS

The following restrictions are intended to limit and regulate the number of users and types of uses of lake frontage in order to preserve the qualities of the waters, minimize conflicting land uses, promote safety and help preserve the quality of recreational use of lands and waters within the Township. For the purpose of this Section (12.17) a lake shall mean any natural or man made body of water having a surface area greater than five acres and over which riparian access has been extended to more than one parcel, lot, unit, or person.

(a) Development Parcels

In all zoning districts, for any new lot supporting a single family dwelling unit or any other form of residential development there shall be at least seventy five (75) feet of water frontage, as measured along the ordinary high water mark of the lake and each lot or parcel shall otherwise meet the minimum dimensional requirements for such lots in the zoning district in which it is located.

(b) Access (Keyhole) Parcels

(1) In any zoning district where there is an existing parcel of record having water frontage of less than seventy five (75) feet, which by intent of the

owner or by its dimensional or physical limitations will not support building development, such parcel or lot may be used or conveyed as a riparian access parcel for not more than one (1) other parcel, lot, unit, or person.

(2) In any zoning district where there is an intent to create and use a new lot, parcel, easement or common area for the purpose of providing riparian rights by deeded access, the new lot, parcel, easement or common area shall have at least seventy five (75) lineal feet of water frontage and a depth of at least 100 feet. The number of parcels, lots, units or persons permitted to have deeded riparian access over the lot, parcel, easement or common area shall be one (1) for the first seventy five (75) feet of water frontage, plus one (1) additional lot, parcel, unit, apartment, or person for each additional seventy five (75) feet of frontage that the access parcel has on the body of water.

(c) In all zoning districts where multiple unit residential development is permitted, any multiple-unit residential development shall have not more than one (1) boat access for each seventy five (75) feet of water frontage, as measured along the normal high water mark of the lake.

(d) In all zoning districts, no lake access, boat ramp, shore station, dock, boat launch or shoreline abutting a lake shall be utilized for commercial, business, outdoor recreational (or entertainment) facilities, institutional, nonresidential or nonagricultural uses or purposes unless such use complies with the requirements of the zoning district in which it is located and is also approved as a special land use.

(e) In addition to the above limitations, no easement, private park, common area, condominium arrangement, lake access device or lot or access property abutting or adjoining a lake shall be used to permit access to the lake for more than one (1) single-family, property, dwelling unit, condominium unit, site condominium unit or apartment unit unless such use is also approved as a special land use.

(f) No new channel or canal shall be created abutting, enlarging or tied into a lake, nor shall existing canals or channels be enlarged. Canals or channels which touch or abut a lake and were lawfully in existence as of the date of enactment of this ordinance may be cleaned and dredged, so long as they are not enlarged beyond their original dimensions.

(g) The restrictions of this Section shall apply to all lots and parcels on or abutting any lake, regardless of whether access to the lake shoreline or waters shall be

by easement, park, common-fee ownership, single-fee ownership, condominium arrangement, license, or lease.

(h) Although the owner of a property with frontage on a lake may permit family members and occasional invitees to use the water frontage, dock and watercraft owned by the owner as incidental to the residential use of the property, the owner shall not permit anyone other than a family member of a person co-owning or residing on the property fronting on the water to moor a watercraft overnight at the dock on the property or in the waters adjacent to the property. Nor shall the owner of such a property enter into an agreement to permit anyone to use the shoreline (or dock thereof) of water unless such person is leasing a residence on the property and is in possession of the entire waterfront property.

(i) The nonconforming use provisions of Chapter XIV of this Zoning Ordinance shall be applicable to this Section except the following shall be permissible notwithstanding the provisions of Chapter XIV of this Zoning Ordinance:

(1) Any lot of record having frontage on a body of water may have one (1) dock even though the lot has less than seventy five (75) feet of frontage on the water. This Section (Section 12.17) shall not be construed to prevent docks, even if docks have not been installed, where recorded vested rights were granted prior to the adoption of this zoning ordinance amendment.

(2) Any easement, park, common area or access property having frontage on a body of water which lawfully exists as of the date of the adoption of this Section (Section 12.17) may have one (1) dock even though it has less than (75) feet of frontage on the water.

(3) If a given property, easement, park, common area or access property has a right to have a dock under this Section (Section 12.17) or Chapter IV, that right to utilize a dock shall continue even if the dock is seasonal in nature, has to be repaired or replaced or is not utilized every year.

Article 3. Amend general provisions by adding a new section establishing regulations that limits of camping on residential lots and the storage of campers and recreation vehicles on vacant residential lots. New Sections 15.448 [Section 12.18] Section 15.449 [Section 12.19] and Section 15.450 [Section 12.20] shall be added in their entirety to read as follows:

15.448 Sec.12.18 INCIDENTAL CAMPING ON OCCUPIED RESIDENTIAL PROPERTIES

Incidental camping or the occupancy or use of tents, motor homes or campers for occasional periods is permitted on occupied residential lots or parcels under the following conditions:

(a) Not more than 4 camping units consisting of any combination of tents, motor homes, travel trailers or campers shall be permitted on the lot or parcel at any given time.

(b) The camping activity shall be limited to the residents of the lot and to guests of the lot owner/residents.

(c) No period of occupancy may exceed 14 consecutive days. Unless the camping unit is owned or licensed by the property owner, the unit shall be removed from the premises after each period of permitted occupancy. Each period of use or permitted occupancy must be separated from the next by at least 14 days.

(d) All tents, campers and motor homes must located in the rear or side yard, behind the line of the principle structure facing any street and at least 20 feet from all property lines.

(e) The camping unit shall not have fixed connections to electricity, water, gas or sanitary sewerage.

(f) The above provisions shall not be construed to permit organized day camps or boarding camps for short visitation, wilderness campgrounds or any form of campground that is open to the public charging daily rates.

15.449 Sec.12.19 CAMPING ON VACANT PROPERITES

(a) Camping On Vacant, Non-Riparian Properties Camping or the occupancy or use of tents, motor homes or campers, or the storage thereof is prohibited on vacant non-riparian lots or parcels of record within the AG, R-1, R-1A, R-2 or R-3 Districts, except under the following circumstances:

(1) The lot is adjacent to a lot or parcel on which there is an occupied dwelling and both lots are under the same ownership or,

(2) The camping, use or storage is located within a campground as permitted and authorized under the provisions of this ordinance or,

(3) On vacant non-riparian parcel or tract in excess of 10 acres in size, camping is permitted under the following provisions except that camping is permitted without interruption during deer hunting seasons established by the State of Michigan for any state wide or special Zone 3 archery or firearm deer hunting season.

(a) Not more than 4 camping units consisting of any combination of tents, motor homes, travel trailers or campers shall be permitted on the lot or parcel at any given time.

(b) The camping activity shall be limited to the owner of the parcel and to guests of the parcel owner, without remittance.

(c) Camping is permitted without interruption during deer hunting seasons established by the State of Michigan for any state-wide or special Zone 3 archery or firearm deer hunting season. During all other times of the year no period of occupancy may exceed 14 consecutive days. Unless the camping unit is owned or licensed by the property owner, the unit shall be removed from the premises after each period of permitted occupancy. Each period of use or permitted occupancy must be separated from the next by at least 14 days.

(d) All tents, campers and motor homes must located behind the line of any nearby structures and at least 20 feet from all property lines.

(e) The camping unit shall not have fixed connections to electricity, water, gas or sanitary sewerage.

(b) <u>Camping On Vacant Lots Having Lake Frontage (Riparian Lands)</u>

It is recognized that certain vacant riparian lots within the township have an intrinsic outdoor recreational quality and character that makes seasonal camping an attractive interim or alternative use for the lot. Care must be taken however, to ensure that any such allowed activity, whether temporary or permanent, would not diminish the character and value of adjacent and nearby traditional single family residential home sites.

Camping on vacant lots having lake frontage may therefore only be authorized as a special use by the Planning Commission. In such cases and if approved by the Planning Commission, the Planning Commission shall limit the number, location, and duration of camping and RV storage activity commensurate with the size and character of the site and the use and character of the surrounding residential lots and area.

In reviewing an application to allow the use of a vacant lot for such use the Planning Commission may not approve an activity that exceeds the limiting standards contained in Section 15.448 [15.18] and shall consider the following in deciding whether to authorize the special use permit:

(1) The number and location of proposed campsites or recreation vehicles on the site.

(2) The size width and depth of the parcel lot or parcel.

(2) Setbacks and screening.

(3) The existence of nearby developed residential dwellings, the distances to adjacent developed home sites.

(4) Accessibility and parking constraints.

(5) Potential impacts on adjoining property values.

(6) The duration of the proposed camping activity.

(7) Whether or not the activity will entail the prolonged storage of recreation vehicles on the site and whether such storage would have a negative impact on adjoining properties.

(8) The existence or non-existence of similar camping or storage activity on nearby non-riparian lots as remitted under Sub-section (a) of this Section.

Article 4 Section 1521 [12B.01] Special Use permits shall be amended in its entirety to read as follows:

1521 SECTION 12B.01 INTENT AND PURPOSE:

The provisions of this Chapter are intended to set forth the procedures and standards that are applicable to certain land uses, structures or activities classified as Special Uses. Due to their unique characteristics relative to other uses, special uses shall not be permitted without review and may warrant restrictions or conditions by reasons of

their uniqueness or the special problems presented by the use in a particular location or in relation to neighboring properties and/or the community as a whole.

Article 5 ***Existing Section 15.523 [12B.03] Contents of Application shall be renumbered Section 15.524 [12B.04], Existing Section 15.524 [12B.04] Procedures For Issuance of Special Use Permit shall be deleted and new Sections 15.522 [12B.02] and 15.522 [12B.03] shall be inserted to read in their entirety as follows:***

15.522 SECTION 12B.02 SPECIAL USE CLASSIFICATIONS/REVIEW AND APPROVAL AUTHORITY:

Within this Section, individual types of special uses are categorized within one of two classes. Class I and Class II, special uses are created for the purpose of grouping individual special uses based upon their degree of potential impacts upon adjacent property and the surrounding community. Provisions applicable to each class as outlined in this Chapter shall govern each class of special use.

(a) Class I Special Uses: A Class I Special Use Review Committee shall be appointed to review and decide all requests for Class I special use permits as applied for under this Chapter. The Committee shall consist of two members of Planning Commission and the Township Zoning Administrator. Two alternate members of the Committee shall be appointed by the Chairperson of the Planning Commission from the remaining membership of the Planning Commission. Said appointments shall be made at the first official meeting of the Planning Commission each year.

The Committee shall select from its members its own chairperson and select a secretary for the purpose of recording minutes and keeping records of its actions. A quorum of two members of the Committee must be present in order to take any formal action on an application submitted for Class I special use permit approval. All meetings of the Committee shall conform to the provisions of the Open Meetings Act being Act 267 of the Michigan Public Acts of 1976 as amended.

Class I Special Uses include:

(1) Home occupations.

(2) **Camping or the occupancy and use of tents, motor homes and campers on vacant waterfront residential lots.**

(b) Class II Special Uses: Class II Special Uses include the following special uses and shall be approved by the Planning Commission.

(1) Amusement enterprises in the C-2 Districts

(2) Sexually oriented businesses in the C-2 District
(3) Keeping of livestock in the R-1A District.
(4) Kennels in the R-1,
(5) Nursing homes, senior citizen housing and similar group housing in the R-3 Zone.
(6) Churches, private and public schools, libraries, museums art galleries, parks, playgrounds, community centers, government service buildings and similar uses when owned by a government agency or non-profit or non-commercial organization.
(7) Any other commercial or industrial use requiring authorization by the Planning Commission as special use n the C-1, C-2 and I-1 Districts as indicated in Sections 9.02, 10.02, and 11.02.
(8) Expansion, restoration and repair of legal non-conforming buildings and structures as indicated under Sections 14.02 and 14.03
(9) Removal and processing of topsoil, sand, gravel and other such minerals, in the AG and R-1 Districts.
(10) Cellular and other Wireless Communications Towers
(11) Multi-unit boat access sites and facilities as defined herein

15.522 SECTION 20.03 PROCEDURES:

An application shall be submitted to the Zoning Administrator on a form for that purpose together with a site plan prepared to the specifications contained in this chapter. Each application shall be accompanied by the payment of a fee or determined by the Township Board. In the event that the allowance of a proposed use requires both a rezoning and a special use permit, the application for rezoning shall be processed in its entirety prior to final action on the special use.

(a) NOTIFICATION OF REQUEST - Upon receipt of an application for a Special Use Permit, notice shall be given that a request for special use approval has been received. The notice shall be published in a newspaper which circulates in the township, and sent by mail or personal delivery to the owners of property for which approval is being considered, to all persons to whom real property is assessed within three hundred (300) feet of the boundary of the property in question, and to the occupants of all structures within three hundred (300) feet. The notice shall be given not less than five (5) or more than fifteen (15) days before the date of the meeting that the application will be considered.

If the name of the occupant is not known, the term "occupant" may be used in making notification. Notification need not be given to more than one (1) occupant of a structure, except that if a structure contains more than one (1)

dwelling unit or spatial area owned or leased by different individuals, partnerships, businesses, or organizations, one (1) occupant of each unit or spatial area shall receive notice. In the case of a single structure containing more than four (4) dwelling units or other distinct spatial areas owned or leased by different individuals, partnerships, businesses, or organizations, notice may be given to the manager or owner of the structure who shall be requested to post the notice at the primary entrance to the structure. The notice shall:

(1) Describe the nature of the special use request;
(2) Indicate the property which is the subject of the special use request;
(3) State when and where the special use request will be considered and the body that will be considering the application;
(4) Indicate when and where written comments will be received concerning the request; and
(5) In the case of a Class I Special Use, the notice shall indicate that a public hearing on the application may be requested by any property owner or the occupant of any structure located within three hundred (300) feet of the boundary of the property being considered for a special use.
(6) In the case of a Class II Special Use, the notice shall state when and where the public hearing will be held and that the Planning Commission will hold it.

(b) PUBLIC HEARING. A public hearing shall be held by the Planning Commission prior to a final decision being made regarding any Class II Special Use. A public hearing may be held by the Review Committee regarding any Class I special use. A public hearing shall be held upon request of the applicant or a property owner or the occupant of a structure located within 300 feet of the boundary of the property being considered for a Type I special use. If a request for pubic hearing is made by a property owner or occupant of property within 300 feet, on or prior to the date specified in the first notice, a public hearing shall be scheduled and notified with a second notice. The notice shall be published and delivered and shall contain the same indications as the notification of a request for special use as provided in subsection (a) herein with the added indication of the time and place for the public hearing.

The public hearing whether on the initiative of the reviewing body or upon request, shall be held before a decision is made by the approving body.

(c) DECISIONS - The review body shall, within a reasonable time after review or after the public hearing, deny, approve or approve with conditions the request.

Article 6 Existing Section15.525 [12B.05] SPECIAL USES ON NON NON-CONFORMING PARCELS shall be renumbered as Section 15.526 [12B.06] and a new Section 15.525 [12B.05] shall be inserted to read in its entirety as follows:

15.525 SECTION 12B.05 GENERAL STANDARDS

In addition to specific standards which may be applicable, the following set of standards shall serve as the basis for decisions involving the issuance of special use permits, and other discretionary decisions required to be passed under this Ordinance. The proposed use shall:

(1) Be compatible with adjacent uses of land;

(2) Be consistent with, and promote the intent, and purposes of this Ordinances;

(3). Be compatible with the natural environment;

(4) Be consistent with the capacities of public services and facilities affected b) the proposed use; and

(5) Protect the public health, safety and welfare.

WETLAND AND WATERCOURSE PROTECTION

(COMMUNITY NAME), MICHIGAN
Ordinance No. _____

An Ordinance for the control and preservation of wetlands and watercourses within (Community Name) and to protect the wetlands of the (Township/Municipality) from sedimentation, destruction, and misuse; to prescribe the powers, duties and functions of the (Township/Municipality) enforcing agency; to provide for the promulgation of rules; to establish permits and a fee schedule; to establish design standards, specifications, and bond requirements; to provide for variance and exceptions; to provide for inspections and enforcement; to provide for violations, remedies and penalties thereof; and to provide for severability and effective date of the Ordinance.

(COMMUNITY NAME) HEREBY ORDAINS:

SECTION 1. GENERAL

Section 1.1 - Findings

The (Township/Municipality) Board of (Community Name) finds that wetlands and watercourses of the Clinton River watershed, including the Clinton River and its tributaries, are indispensable and fragile resources that provide many public benefits including maintenance of surface and groundwater quality through nutrient cycling and sediment trapping as well as flood and storm water runoff control through temporary water storage, slow release, and groundwater recharge. In addition, wetlands provide open space; passive outdoor recreation opportunities, fish and wildlife habitat for many forms of wildlife including migratory waterfowl; and rare, threatened or endangered wildlife and plant species; and pollution treatment by serving as biological and chemical oxidation basins.

Preservation of the remaining (Township/Municipality) wetlands in a natural condition shall be and is necessary to maintain hydrological, economic, recreational, and aesthetic natural resource values for existing and future residents of (Community Name), and therefore the (Township/Municipality) Board declares a policy of no net loss of wetlands. Furthermore, the (Township/Municipality) Board declares a long term goal of net gain of wetlands to be accomplished through review of degraded or destroyed wetlands in the (Township/Municipality), and through cooperative work with landowners, using incentives and voluntary agreements to restore wetlands.

To achieve these goals, and with authority from Section 30307(4) of the Natural Resources and Environmental Protection Act (Act 451 Of l994 [previously Section 8 (4) of the Goemaere

Section 1.2 - Purposes

The purposes of this Ordinance are to provide for:

A. The protection, preservation, replacement, proper maintenance, restoration, and use in accordance with the character, adaptability, and stability of the (Township/Municipality)'s wetlands, in order to prevent their pollution or contamination; minimize their disturbance and disturbance to the natural habitat therein; and prevent damage from erosion, siltation, and flooding.

B. The coordination of and support for the enforcement of applicable federal, state, and county statutes, ordinances and regulations including, but not limited to, the:

1. Wetland Protection Act, enforced by the Michigan Department of Environmental Quality which is hereinafter referred to as the MDEQ;
2. Inland Lakes and Streams Act, Section 30101 et seq. of the Natural Resources and Environmental Protection Act (Act 451 of 1994 [previously Act 346, Public Acts of 1972, as amended]) enforced by the MDEQ;
3. Soil Erosion and Sedimentation Control Act, Section 9101 et seq. of the Natural Resources and Environmental Protection Act (Act 451 of 1994 [previously Act 347, Public Acts of 1972, as amended]), enforced by the County of Livingston;
4. Floodplain Regulatory Authority, incorporated into the Natural Resources and Environmental Protection Act (Act 451 of 1994 [previously Act 245, Public Acts of 1929, as amended]), enforced by the MDEQ.

C. Compliance with the Michigan Environmental Protection Act which imposes a duty on government agencies and private individuals and organizations to prevent or minimize degradation of the environment which is likely to be caused by their activities.

D. The establishment of standards and procedures for the review and regulation of the use of wetlands and watercourses.

E. The establishment of penalties for violation of this Ordinance.

F. A procedure for appealing decisions.

G. The establishment of enforcement procedures and penalties for the violation of this Ordinance.

H. Assurance that the right to reasonable use of private property is maintained.

Section 1.3 - Construction and Application

The following rules of construction apply in the interpretation and application of this Ordinance:

A. In the case of a difference of meaning or implication between the text of this Ordinance and any caption or illustration, the text shall control.

B. Particulars provided by way of illustration or enumeration shall not control general language.

Section 1.4 - Applicability to Private and Public Agency Activities and Operations

The provisions of this Ordinance, including wetland use permit requirements and criteria for wetland use permit approval, shall apply to activities and operations proposed by federal, state, local and other public agencies as well as private organizations and individuals.

SECTION 2 - DEFINITIONS

Section 2.1 - Definition of Terms

Terms not specifically defined shall have the meaning customarily assigned to them.

CONTIGUOUS shall mean any of the following:

A. A permanent surface water connection or any other direct physical contact with an inland lake or pond, a river or stream.

B. A seasonal or intermittent direct surface water connection to an inland lake or pond, a river or stream.

C. Partially or entirely located within five hundred (500') feet of the ordinary high water mark of an inland lake or pond or a river or stream, unless it is determined by the (Township/Municipality) or the MDEQ in accordance with Rule 281.924 of the Wetland Administrative Rules, adopted in connection with the Wetland Protection Act, that there is no surface or groundwater connection to these waters.

D. Two (2) or more areas of wetland shall be considered contiguous where separated only by barriers, such as dikes, roads, berms, or other similar features, but with any of the wetland areas contiguous under the criteria described in Subsections (1)(2) or (3) of this definition.

DEPOSIT means to fill, place or dump.

LOT means a designated parcel, tract, building site or other interest in land established by plat, subdivision, conveyance, condominium master deed, or as otherwise permitted by law, to be used, developed or built upon as a unit.

MATERIAL shall mean soil, sand, gravel, clay, peat moss and other organic material.

MITIGATION shall mean: (1) methods for eliminating or reducing potential impact to regulated wetlands; or (2) creation of new wetlands to offset unavoidable loss of existing wetlands.

PERSON means an individual, sole proprietorship, partnership, corporation, association, municipality, this state, any instrumentality or agency of this state, the federal government, or any instrumentality or agency of the federal government, or other legal entity.

PROTECTED WETLANDS shall mean any of the following:

A. All wetlands subject to regulation by the MDEQ including:

1. Wetlands, regardless of size, which are contiguous to any lake, stream, river, or pond whether partially or entirely contained within the project site.
2. Wetlands, regardless of size, which are partially or entirely within five hundred (500) feet of the ordinary high water mark of any lake, stream, river or pond unless it is determined by the MDEQ that there is no surface water or groundwater connection between the wetland and the water body.
3. Wetlands which are larger than five (5) acres, whether partially or entirely contained within the project site, and which are not contiguous to any lake, stream, river, or pond.
4. Wetlands, regardless of size, which are not contiguous to any lake, stream, river, or pond, if the MDEQ determines the protection of the wetland is essential to the preservation of the natural resources of the state from pollution, impairment or destruction.

B. All wetlands subject to regulation by the (Township/Municipality) including:

1. Wetlands two (2) to five (5) acres in size, whether partially or entirely contained within the project site, which are not contiguous to any lake stream, river or pond.
2. Wetlands smaller than two (2) acres in size which are not contiguous to any lake, stream, river or pond and are determined to be essential to the preservation of the natural resources of the (Township/Municipality) as provided for in Section 7.6 of this Ordinance.

RUNOFF shall mean the surface discharge of precipitation to a watercourse, drainageway, swale, or depression.

REMOVE means to dig, dredge, suck, pump, bulldoze, drag line, or blast.

RESTORATION means to return from a disturbed or totally altered condition to a previously

SEASONAL shall mean any intermittent or temporary activity which occurs annually and is subject to interruption from changes in weather, water level, or time of year, and may involve annual removal and replacement of any operation, obstruction, or structure.

STRUCTURE shall mean any assembly of materials above or below the surface of the land or water, including but not limited to, buildings, bulkheads, boardwalks, piers, docks, landings, dams, waterway obstructions, paving, gravel, and roadways, poles, towers, cables, pipelines, drainage tiles, and other underground installations.

(TOWNSHIP/MUNICIPALITY) BOARD shall mean the legislative body of (Community Name)(Township/Municipality), Livingston County, Michigan.

(TOWNSHIP/MUNICIPALITY) WETLAND MAP refers to the (Community Name)(Township/Municipality) Wetland Map, based on the National Wetland Inventory Map of the U.S. Fish and Wildlife Service; the Michigan Resource Information System Mapping (MIRIS) of the Michigan Department of Environmental Quality; the soils maps of the Soil Conservation Service; aerial photography; and on site inspections.

WATERCOURSE shall mean any waterway including a river, stream, lake, pond or any body of surface water having definite banks, a bed and visible evidence of a continued flow or continued occurrence of water.

WETLAND shall mean land characterized by the presence of water at a frequency and duration sufficient to support and that under normal circumstances does support wetland vegetation or aquatic life and is commonly referred to as a bog, swamp or marsh.

WETLAND ADMINISTRATOR shall mean a person(s) knowledgeable in wetland protection, appointed to administer this Ordinance and to carry out certain duties hereunder. Any firm or individual appointed on a contract basis.

WETLAND USE PERMIT shall mean the (Township/Municipality) approval required for activities in wetlands and watercourses described in Section 7 of this Ordinance.

WETLAND VEGETATION shall mean plants, including but not limited to, trees,

shrubs, and herbaceous plants, that exhibit adaptations to allow, under normal conditions, germination or propagation and to allow growth with at least their root systems in water or saturated soil.

SECTION 3 - RELATIONSHIP TO STATE AND FEDERAL PERMIT REQUIREMENTS

Whenever persons requesting a wetland use permit are also subject to state and/or federal permit requirements, the following shall apply:

A. The (Township/Municipality) shall have jurisdiction for the regulation of wetlands under this Ordinance concurrent with the jurisdiction of the Michigan Department of Environmental Quality.

B. Approvals under this Ordinance shall not relieve a person of the need to obtain a permit from the MDEQ and/or the U.S. Army Corps of Engineers, if required.

C. Issuance of a permit by the MDEQ and/or the U.S. Army Corps of Engineers shall not relieve a person of the need to obtain approval under this Ordinance, if applicable.

SECTION 4. ADMINISTRATION

Section 4.1 - (Township/Municipality) Wetland Map

The (Township/Municipality) Wetland Map is a guide to the location of wetlands in (Community Name)(Township/Municipality). The Map shall be used in the administration of this Ordinance.

The (Township/Municipality) Wetland Map, together with all explanatory matter thereon and attached thereto, as may be amended through the Wetland Verification and Delineation process, is hereby adopted by reference and declared to be a part of this Ordinance. The (Township/Municipality) Wetland Map shall be on file in the office of the (Township/Municipality) Clerk.

The (Township/Municipality) Wetland Map shall serve as a general guide for the location of protected wetlands. The (Township/Municipality) Wetland Map does not create any legally enforceable presumptions regarding whether property that is or is not included on the inventory map is or is not in fact a wetland.

The Wetland Verification Process, as set forth herein, shall be used to verify wetland on properties where wetland is shown on the Wetland Map or on properties where wetland exist as defined in Section 2.1 herein. The Wetland Delineation Process, as set forth herein, shall be used to establish the actual boundaries of wetlands in the (Township/Municipality). The identification of the precise boundaries of wetlands on a project site shall be the responsibility of the applicant and verified by the Wetland Administrator.

A. Wetland Verification Process

1. The (Township/Municipality) or property owners of wetland may initiate a verification of the areas shown on the (Township/ Municipality) Wetland Map as wetland or on properties where wetland exists as defined in Section 2.1 herein. The verification shall be limited to a finding of wetland or no wetland by the Wetland Administrator. The finding shall be based on, but not limited to, aerial photography, topographical maps, site plans, and field verification.
2. In the event that there is a finding of no wetland on the property, then no further determination would be required and the finding shall be included in the Map Amendment Process (found later in this Section).
3. In the event that there is a finding of wetland, then the establishment of the exact boundary through a wetland delineation shall be required to alter the (Township/Municipality) Wetland Map through the Map Amendment Process.
4. The applicant shall pay fees for the Wetland Verification Process as established in Section 9.1.

B. Wetland Delineation Process

Prior to the issuance of any permit or land development approval for a lot which is shown to include a wetland on the (Township/Municipality) Wetland Map, the applicant may be required to provide a wetland delineation to the (Township/Municipality). The Wetland Administrator shall determine whether a delineation is required, based on the proximity and relationship of the project to the wetland.

1. To establish actual wetland boundaries on a property, the applicant shall provide a survey or dimensional site plan, drawn at an appropriate scale, showing property lines, buildings and any points of reference along with the wetland boundaries, according to one of the following:
   (a) Wetland delineation by the Michigan Department of Environmental

Quality (MDEQ).
(b) Wetland delineation by the applicant's wetland consultant subject to review and approval by the (Township/Municipality)'s Wetland Consultant.

2. Where a wetland delineation is required by this Section, the (Township/Municipality) Wetland Consultant shall establish wetland boundaries following receipt of the above required information and after conducting a field investigation.
3. The applicant shall pay fees for the Wetland Delineation Process as established in Section 9.1.

C. Map Amendment

1. The (Township/Municipality) Wetland Map shall be updated when new data is available or when corrections are needed in order to maintain the integrity of the map.
2. The (Township/Municipality) shall ensure that each record owner of property on the property tax roll shall be notified of any amendment to the (Township/Municipality) Wetland Inventory Map on an annual basis. The notice shall include the following information:
(a) the (Township/Municipality) wetland map has been amended;
(b) the location to review the map;
(c) the owner's property may or may not be designated as a wetland on the map;
(d) the (Township/Municipality) has an ordinance regulating wetlands;
(e) the map does not necessarily include all of the wetlands within the (Township/Municipality) that may be subject to the wetland ordinance.

SECTION 5 - ACTIVITIES IN A PROTECTED WETLAND OR WATERCOURSE

Section 5.1 - Activities Prohibited Without First Obtaining A Wetland Use Permit

Except for those activities expressly permitted by Section 5.2, it shall be unlawful for any person to do any of the following in a protected wetland or watercourse unless and until a wetland use permit is obtained from the (Township/Municipality) pursuant to this Ordinance.

A. Deposit or permit to be deposited any material or structures into any watercourse or within or upon any protected wetlands.

B. Remove or permit to be removed any material from any watercourse or from any

protected wetland.

C. Dredge, fill or land balance watercourses or protected wetlands.

D. Create, enlarge, diminish or alter a lake, pond, creek, stream, river, drain or protected wetland.

E. Construct, operate or maintain any development in or upon protected wetlands or watercourses.

F. Erect or build any structure, including but not limited to, buildings, roadways, bridges, tennis courts, paving, utilities, or private poles or towers in or upon protected wetlands or watercourses.

G. Construct, extend or enlarge any pipe, culvert, or open or closed drainage facility which discharges silt, sediment, organic or inorganic materials, chemicals, fertilizers, flammable liquids or any other pollutants to any lake, stream, pond, creek, river, protected wetland, or watercourse, except through a retention area, settling basin, or treatment facility designed to control and eliminate the pollutant. This Subsection shall apply to all land uses except single family uses.

H. Construct, enlarge, extend or connect any private or public sewage or waste treatment plant discharge to any lake, stream, river, pond, watercourse, or protected wetland except in accordance with the requirements of Livingston County, State of Michigan and/or the United States, to the extent that such entities have jurisdiction.

I. Drain, or cause to be drained, any water from a protected wetland or watercourse.

J. Fill or enclose any ditch which would result in a significant reduction of storm water absorption and filtration into the ground or would otherwise have an adverse impact on receiving watercourses or wetlands.

Section 5.2 - Permitted Activities

1) Notwithstanding the prohibitions of Section 5.1, the following activities are permitted within watercourses or protected wetlands without a wetland use permit, unless otherwise prohibited by statute, ordinance or regulation:

A. Fishing, trapping, or hunting.

B. Swimming or boating.

C. Hiking.

D. Grazing of animals.

E. Farming, horticulture, silviculture, lumbering, and ranching activities, including plowing, irrigation, irrigation ditching, seeding, cultivating, minor drainage, harvesting for the production of food, fiber, and forest products, or upland soil and water conservation practices. Wetland altered under this subdivision shall not be used for a purpose other than a purpose described in this subsection without a permit from the department.

F. Maintenance or operation of serviceable structures in existence on October 1, 1980 or constructed pursuant to this part of former Act No. 203 of the Public Act of 1979.

G. Construction or maintenance of farm or stock ponds.

H. Maintenance, operation, or improvement which includes straightening, widening, or deepening of the following which is necessary for the production or harvesting of agricultural products:

1. An existing private agricultural drain.

2. That portion of a drain legally established pursuant to the drain code of 1956, Act No. 203 of the Public Acts of 1956, being sections 280.1 to 280.630 of the Michigan Compiled Laws, w which has been constructed or improved for drainage purposes.

3. A drain constructed pursuant to other provisions of this part or former Act No. 203 of the Public Acts of 1979.

I. Construction or maintenance of farm roads, forest roads, or temporary roads for moving mining or forestry equipment, if the roads are constructed and maintained in a manner to assure that any adverse effect on the wetland will be otherwise minimized.

J. Drainage necessary for the production and harvesting of agricultural products if the wetland is owned by a person who is engaged in commercial farming and the land is to be used for the production and harvesting of agricultural products. Except as otherwise provided in this part, wetland improved under this subdivision after October 1, 1980 shall not be used for non-farming purposes without a permit from the department. This subdivision shall not

apply to a wetland which is contiguous to a lake or stream, or to a tributary of a lake or stream, or to a wetland that the department has determined by clear and convincing evidence to be a wetland that is necessary to be preserved for the public interest, in which case a permit is required.

K. Maintenance or improvement of public streets, highways, or roads, within the right-of-way and in which in such a manner as to assure that any adverse effect on the wetland will be otherwise minimized. Maintenance or improvement does not include adding extra lanes, increasing the right-of-way, or deviating from the existing location of the street, highway, or road.

L. Maintenance, repair, or operation of gas or oil pipelines and construction of gas or oil pipelines having a diameter of 6 inches or less, if the pipelines are constructed, maintained, or repaired in a manner to assure that any adverse effect on the wetland will be otherwise minimized.

M. Maintenance, repair, or operation of electric transmission and distribution power lines and construction of distribution power lines, if the distribution power lines are constructed, maintained, to repaired in a manner to assure that any adverse effect on the wetland will be otherwise minimized.

N. Operation or maintenance, including reconstruction of recently damaged parts, of serviceable dikes and levees in existence on October 1, 1980 or construction pursuant to this part or former Act No. 203 of the Public Acts of 1979.

O. Construction of iron and copper mining tailings basins and water storage areas.

2) An activity in a wetland that was effectively drained for farming before October 1, 1980 and that on and after October 1, 1980 has been continued to be effectively drained as part of an ongoing farming operation is not subject to regulation under his part.

3) A wetland that is incidentally created as a result of 1 or more of the following activities is not subject to regulation under his part:

A. Excavation for material or sand mining, if the area was not a wetland before excavation. This exemption does not include a wetland on a adjacent to a water body of 1 acre or more in size.

B. Construction and operation of a water treatment pond or lagoon in compliance with the requirements of state or federal water pollution control regulations.

C. A dike area associated with a landfill if the landfill complies with the terms of the landfill construction permit and if the dike area was not a wetland before diking.

Section 5.3 - Existing Non-conforming Lots, Uses and Structures

Lots, uses and structures lawfully existing at the effective date of this Ordinance shall be subject to the requirements of this Ordinance, except as follows:

A. Plats that have received tentative preliminary or later approval and site plans and condominium plans approved prior to the effective date of this Ordinance shall be entitled by right to all uses authorized by those approvals according to the zoning district in which the property is located, and provided that said lots have buildable sites outside of the wetland. Lots which do not have a buildable site outside of the wetland shall require a wetland use permit prior to any construction on said lot.

B. Any activity, structure, or use lawfully existing prior to the effective date of this Ordinance, but not in conformity with the provisions of this Ordinance, may be continued, maintained and operated.

C. Any structure lawfully existing prior to the effective date of this Ordinance damaged by fire, explosion, act of God, or other causes beyond the control of the owner, may be restored, rebuilt, or repaired without obtaining a wetland use permit.

SECTION 6 - APPLICATION

Application for approval, appeal, and issuance of wetland use permits shall be concurrent with the application for approval, appeal, and issuance of other necessary (Township/Municipality) approvals, except that in the case of any such application for another approval which is pending on the effective date of this Ordinance and which has not been approved and which, by the terms of this Ordinance, would require a wetland use permit application, the applicant shall be notified by the Wetland Administrator that an application for a wetland use permit is required, and processing of the other application shall not proceed until the wetland use permit application has been filed. The applicant for a wetland use permit shall submit four copies of the following to the (Township/Municipality):

A. An application completed in full, on a form supplied by the Michigan Department of Environmental Quality.

B. A wetland delineation including, but not limited to the following information: dominant tree, sapling, shrub and herb vegetation; presence or lack of accepted wetland hydrology indicators; analysis of soil including a description of the soil profile to at least 20 inches and comparison to Livingston County Soil Survey and maps of the wetland(s) mapped. Mapped data shall be represented in a manner that allows comparison to the (Community Name)(Township/Municipality) Wetland Map.

C. Soil drainage and stormwater management plans.

D. A mitigation plan, if the proposed activity will result in the loss of wetland resources.

E. A cover letter signed by the applicant including the following information:

1. Name of project and brief description.
2. Date upon which the activity is proposed to commence.
3. Explanation of why the project meets the wetland use permit standards and criteria contained in this Ordinance.
4. List of all federal, state, county or other local government permits or approvals required for the proposed project including permit approvals or denials already received. In the event of denials, the reasons for denials shall be given. Attach copies of all permits which have been issued.
5. Identification of any present litigation involving the property.

F. The wetland use permit application shall be reviewed, either prior to or concurrent with the review of the site plan, plat or other proposed land use submitted by the applicant, with the understanding that the land use review may not be completed at the time the decision is rendered on the wetland use permit application. Election of this alternative may require a reopening of the wetland use permit application if the land use approval is inconsistent with the wetland use permit approval; or,

G. Copies of wetland permit applications filed with the MDEQ and forwarded to the (Township/Municipality) in accordance with Section 30307(6) of Wetland Protection Act shall become part of the application for a (Community Name)(Township/Municipality) wetland use permit.

SECTION 7 - REVIEW

Section 7.1 - Method of Review of Wetland Permit Application

A. Before a wetland use permit application is submitted, the necessity of the wetland use permit shall be determined by the Wetland Administrator, or designee by reference to the "(Township/Municipality) Wetland Map".

B. Whenever a wetland use permit is required, applicant may request an administrative meeting with the Wetland Administrator to review the proposed activity in light of the purposes of this Ordinance.

C. Upon receipt of an application, the (Township/Municipality) shall ensure that all required information including a wetland determination has been submitted. The receipt of the application shall constitute permission from the owner to complete an on-site investigation. Applicant will pay fees as established in Section 9.1.

D. The (Township/Municipality) Clerk shall transmit one copy of the application and supporting materials to the (Township/Municipality) Wetland Consultant to confirm the boundaries of the wetland and to review the proposal in light of the purpose and review standards of Section 7 and other applicable sections of this Ordinance. If an application is not complete, the applicant may be granted additional time to complete the application provided that the applicant agrees that the additional time shall not be charged against the (Township/Municipality)'s 90-day time limit for making a decision. The receipt of the application shall constitute permission from the owner to conduct an on

E. The (Township/Municipality) Wetland Consultant shall prepare and transmit a report and recommendation to the Wetland Administrator documenting the review required by Section 7.1 D.

F. Upon receipt of an application, the (Township/Municipality) Clerk shall:

1. Transmit one copy of the application to the Michigan Department of Environmental Quality.
2. Advise the applicant of his/her obligation to post the subject property with a sign that shall be no less than two (2) square feet in size. The sign shall be clearly visible from the abutting street(s) and shall state that an application has been filed for a wetland use permit on the property.

Section 7.2 - Wetland Use Permit Decisions by the Wetland Administrator

The following process shall apply to wetland use permit decisions by the Wetland Administrator:

A. For wetland use permit applications submitted in conjunction with activities that do not require approval by the Planning Commission and/or (Township/Municipality) Board, the Wetland Administrator shall approve, approve with conditions or deny the application within 90 days after receipt of an application.

B. Persons wishing to comment on the application must submit their comments in writing to the Wetland Administrator prior to the date and time set in the notice. Persons wishing to receive notice of the Wetland Administrator's decision must submit a written request to the Wetland Administrator.

C. After completing the review and reviewing the written comments, the Wetland Administrator shall approve, approve with modifications or conditions, or deny the wetland use permit application in accordance with the standards of this Ordinance.

D. When a wetland use permit is approved, approved with modifications or conditions, or denied, written notice shall be sent to the applicant and to all persons who have requested notice of the Wetland Administrator's decision. A permit approved by the Wetland Administrator shall not be issued or effective until ten (10) calendar days following the date of approval.

Section 7.3 - Wetland Use Permit Decisions by Planning Commission or the (Township/Municipality) Board

The following process shall apply to wetland use permit decisions by the (Township/Municipality) Planning Commission or by the (Township/ Municipality) Board:

A. Wetland use permit applications submitted in conjunction with a related land development activity shall be decided by the same entity that decides the related land development activity consistent with the Wetland Protection Act. The Planning Commission shall decide any wetland use permits in conjunction with special use permit applications or site plan applications and shall require that the delineation and wetland use permit application requests be submitted prior to the special use permit hearing. The Wetland Administrator shall transmit application materials and the report and recommendation prepared by the (Township/Municipality) Wetland Consultant to the Planning Commission or (Township/Municipality) Board as applicable.

B. After review and study of the application materials and the (Township/ Municipality) Wetland Consultant's report and recommendation, the (Township/Municipality) Planning Commission or (Township/Municipality) Board, as

applicable, may hold one public hearing after publication in a newspaper of general circulation in the (Township/Municipality) not less than five (5) days nor more than fifteen (15) days prior to the date of the hearing. Such notice shall indicate the place, time and subject of the hearing and the place and time the proposed wetland use permit may be examined. The wetland use permit hearing may be held in conjunction with a review of the related land use request(s).

C. In the event of a public hearing, notice shall be sent by mail or personal delivery to the owners of property for which approval is being considered, and to all owners of property, as listed on the most recent tax roll, within 300 feet of the boundary of the property in question. Notification need not be given to more than one (1) occupant of a structure, except that if a structure contains more than one (1) dwelling unit or spatial area owned or leased by different persons, one (1) occupant of each unit shall receive notice. In the case of a single structure containing more than four (4) dwelling units, notice may be given to the manager or owner of the structure who shall be requested to post the notice at the primary entrance to the structure. A notice containing the time, date, place and purpose of the hearing shall be posted on the subject property by the applicant at least eight (8) days prior to the hearing. The posting sign shall be no less than two (2) square feet in size, shall be clearly visible from the abutting street(s), and shall state that an application has been filed for a wetland use permit.

D. After completing the review and holding one public hearing, if so required, the Planning Commission or (Township/Municipality) Board as applicable shall approve, approve with conditions or deny the application within ninety (90) days after receipt of an application, in accordance with this Ordinance.

E. Written notice shall be sent to the applicant upon approval, approval with conditions or denial of a wetland use permit by the (Township/Municipality). The denial of a permit shall be accompanied by a written reason for denial.

F. A permit approval by the Planning Commission or (Township/Municipality) Board, as applicable, shall not be issued or effective until ten (10) calendar days following the date of the approval and compliance with Section 7.5 of this Ordinance.

Section 7.4 - Appeals Of Decisions Of The Wetland Administrator, Planning Commission or (Township/Municipality) Board

The following process shall apply to appeals of decisions made by the Wetland Administrator, the Planning Commission, or the (Township/Municipality) Board, as applicable:

A. Any person who is aggrieved by the approval, approval with modifications or conditions, or denial of a wetland use permit by the Wetland Administrator, the Planning Commission or by the (Township/Municipality) Board, may appeal the decision to the Community Appeals Commission. A written letter containing the specific reasons for appeal shall be filed with the (Township/Municipality) Clerk within ten (10) calendar days after the date of the decision to be appealed. Timely filing of an appeal shall have the effect of suspending the effect of the permit pending the outcome of the appeal. In the event that the person(s) filing the appeal do not own property within 300 feet of the wetland affected, the Planning Commission shall determine whether the person(s) are aggrieved.

B. After a hearing, the Community Appeals Commission shall determine that the decision of the Wetland Administrator, Planning Commission or (Township/Municipality) Board be affirmed, affirmed with modification, or reversed. The Board's decision shall be based on written findings.

Section 7.5 - Wetland Use Permit Conditions

A. The Wetland Administrator, the Planning Commission or the (Township/ Municipality) Board, as applicable, shall attach any reasonable conditions considered necessary to ensure that the intent of this Section will be fulfilled, to minimize or mitigate damage or impairment to, encroachment in or interference with natural resources and processes within the protected wetlands or watercourses, or to otherwise improve or maintain the water quality. Any conditions related to wetland mitigation shall follow the provisions of Section 8 of this Ordinance.

B. The Wetland Administrator, the Planning Commission or the (Township/ Municipality) Board, as applicable, shall fix a reasonable time to complete the proposed activities.

C. The Wetland Administrator, the Planning Commission or the (Township/ Municipality) Board, as applicable, may require the applicant to file with the (Township/Municipality) a cash or corporate surety bond or irrevocable bank letter of credit in an amount, if any, determined necessary to ensure compliance with the wetland use permit approval conditions and this Section.

D. The Wetland Administrator, the Planning Commission or the (Township/ Municipality) Board, as applicable, shall require that final approval of a wetland use permit application shall be contingent upon receipt of evidence by the (Township/Municipality) that required state and federal permits, if any, have been

obtained by the applicant.

E. At no time shall the Wetland Administrator, the Planning Commission or the (Township/Municipality) Board, as applicable, issue a wetland use permit that allows a more extensive alteration of the wetland than permitted by state or federal law.

F. Wetland use permits for seasonal operations need not be renewed annually unless otherwise stated in the permit.

G. Any change that increases the size or scope of the operation and that affects the criteria considered in approving the permit as determined by the Wetland Administrator, the Planning Commission or the (Township/Municipality) Board, as applicable, may require the filing of a new wetland use permit application.

H. Any temporary, seasonal, or permanent operation that is discontinued for two (2) years or two (2) seasons shall be presumed to have been abandoned and the wetland use permit automatically voided.

I. Any permit granted under this Ordinance may be revoked or suspended by the Wetland Administrator, Planning Commission or (Township/Municipality) Board, as applicable, after notice and an opportunity for a hearing, for any of the following causes:

1. A violation of a condition of the permit.
2. Misrepresentation or failure to fully disclose relevant facts in the application.
3. A change in a condition that requires a temporary or permanent change in the activity.

J. An applicant who has received a wetland use permit under this Ordinance shall comply with the following in connection with any construction or other activity on the property for which the wetland use permit has been issued:

1. Maintain soil erosion control structures and measures, including but not limited to, silt fences, straw bale berms, and sediment traps. The permittee shall permit periodic inspections throughout the duration of the project by the (Township/Municipality) or it's representatives.
2. Maintain clear delineation of the protected wetlands and wetland setbacks (so marked by the Wetland Administrator or (Township/Municipality) Wetland Consultant during the on
3. Post on the site, prior to commencement of work on the site and continuing throughout the duration of the project, a copy of the approved wetland use

permit containing the conditions of issuance, in a conspicuous manner such that the wording of said permit is available for public inspection.

K. The wetland use permit shall remain effective for a time period coincidental with any other land use permit reviewed and approved concurrent with the wetland use permit. If applied for prior to the expiration date and concurrent with the expiring land use permit, the applicant may be granted an extension that corresponds to additional time granted for the underlying land use permit. Extensions shall be approved by the same person or body that made the original decision. The maximum number of extensions shall coincide with the maximum number allowed for the underlying land use permit.

L. When there is no other activity or permit involved, the wetland use permit shall remain effective for one (1) year. A maximum of a one (1) year extension may be approved by the granting authority upon request of the applicant.

Section 7.6 - Review Standards And Criteria For Non-Contiguous Wetlands Less Than Two (2) Acres in Area.

A. A wetland use permit shall be approved with respect to a non-contiguous wetland less than two (2) acres in area unless the Planning Commission or (Township/Municipality) Board determines that the wetland is essential to the preservation of the natural resources of the (Township/Municipality). It shall not be the burden of the property owner to prove that the wetland is not essential to the preservation of the natural resources of the (Township/ Municipality).

B. All non-contiguous wetland areas of less than two (2) acres which appear on the wetlands map, or which are otherwise identified during a field inspection by the (Township/Municipality), shall be analyzed for the purpose of determining whether such areas are essential to the preservation of the natural resources of the (Township/Municipality). If there is to be a denial of a wetland use permit in a non

1. The site supports state or federal endangered or threatened plants, fish, or wildlife appearing on a list specified in Section 36505 of the Natural Resources and Environmental Protection Act (Act 451 of 1994 [previously Section 6 of the Endangered Species Act of 1974, Act No. 203 of the Public Acts of 1974, being Section 299.226 of the Michigan Compiled Laws]).
2. The site represents what is identified as a locally rare or unique ecosystem.
3. The site supports plants or animals of an identified local importance.
4. The site provides groundwater recharge documented by a public agency.

5. The site provides flood and storm control by the hydrologic absorption and storage capacity of the wetland.
6. The site provides wildlife habitat by providing breeding, nesting, feeding grounds or cover for forms of wildlife, waterfowl, including migratory waterfowl, and rare, threatened, or endangered wildlife species.
7. The site provides protection of subsurface water resources and provision of valuable watersheds and recharging groundwater supplies.
8. The site provides pollution treatment by serving as a biological and chemical oxidation basin.
9. The site provides erosion control by serving as a sedimentation area and filtering basin, absorbing silt and organic matter.
10. The site provides sources of nutrients in water food cycles and nursery grounds and sanctuaries for fish.

C. In connection with the determination whether the wetland is essential to the preservation of the natural resources of the (Township/Municipality), the property owner shall make an election and response under Subsection 1 or 2 below, relative to each non-contiguous wetland area less than two (2) acres.

1. In lieu of having the (Township/Municipality) or its consultant proceed with the analysis and determination, the property owner may acknowledge that one (1) or more of the criteria in Subsections (B-1) through (B-10) above, exist on the wetland in question, including a specification of the one or more criteria which do exist; or
2. An election to have the (Township/Municipality) or its consultant proceed with the analysis of whether each of the criteria in Subsections (B-1) through (B-10) exist or do not exist in the wetland in question, including specific reasons for the conclusion in respect to each criteria.

D. If the (Township/Municipality) determines that the wetland is not essential to the preservation of the natural resources of the (Township/Municipality), the (Township/Municipality's) decision shall be so noted on the (Township/ Municipality) Wetland Map, at the time it is amended. The requested activity shall be approved subject to all other applicable laws and regulations.

When a wetland under two (2) acres in size has been determined to be essential to the natural resources of the (Township/Municipality) and the (Township/Municipality) has found that one or more of the criteria set forth exist at the site, the (Township/Municipality) shall notify the applicant in writing stating the reasons for determining the wetland to be essential to the preservation of the natural resources.

After determining that a wetland less than two (2) acres in size is essential to the preservation of the natural resources of the (Township/Municipality), the wetland use permit application shall be reviewed according to the standards in Section 7.7.

Section 7.7 - Review Standards for Wetland Use Permits

The criteria to evaluate wetland use permits under this Ordinance and to determine whether a permit is granted are as follows:

A. A permit for any activity listed in Section 5.1 shall not be approved unless the proposed activity is in the public interest and is otherwise lawful in all respects. Public input shall be evaluated in approving, approving with conditions, or denying the application. The reasonable use of the property involved in accordance with applicable local ordinances and state law shall also be considered.

In determining whether the activity is in the public interest, the benefit which reasonably may be expected to accrue from the proposal shall be balanced against the reasonably foreseeable detriments of the activity. The decision shall reflect the national, state, and local concern for the protection of natural resources from pollution, impairment, and destruction. The following general criteria shall be considered:

1. The relative extent of the public and private need for the proposed activity.
2. The availability of feasible and prudent alternative locations and methods to accomplish the expected benefits from the activity.
3. The extent and permanence of the beneficial or detrimental effects which the proposed activity may have on the public and private uses to which the area is suited, including the benefits the wetlands provide.
4. The probable impact of each proposal in relation to the cumulative effect created by other existing and anticipated activities in the watershed.
5. The probable impact on recognized historic, cultural, scenic, ecological, or recreational values and on the public health or fish or wildlife.
6. The size and quality of the protected wetland being considered.
7. The amount and quality of remaining wetland in the area.
8. Proximity to any waterway.
9. Extent to which upland soil erosion adjacent to protected wetlands or drainage ways is controlled.
10. Economic value, both public and private, of the proposed land change to the general area.
11. Findings of necessity for the proposed project which have been made by federal, state or local agencies.

B. A wetland use permit shall not be granted unless it is shown that:

1. An unreasonable disruption of aquatic resources will be avoided; and
2. The proposed activity is primarily dependent upon being located in the protected wetland; and
3. A feasible and prudent alternative does not exist; and
4. The manner in which the activity is proposed to be undertaken will result in the minimum negative impact upon protected wetlands, watercourses, and attendant natural resources under all of the circumstances.

C. Following approval of the application, a wetland use permit shall be issued upon determination that all other requirements of ordinance and law have been met, including site plan, plat or land use approval as applicable, and including issuance of a permit by the MDEQ, if required under the Wetland Protection Act. In cases where a MDEQ permit allows activities not permitted by the wetland use permit approval granted under this Section, the restrictions of the approval granted under this Section shall govern.

SECTION 8 - WETLAND MITIGATION AND RESTORATION

Section 8.1 - Findings That Wetland And Watercourse Loss Is Unavoidable

Mitigation shall not be considered a substitute for making all prudent attempts to avoid wetland impacts.

A. Prior to considering a proposal for wetland mitigation, the Wetland Administrator, the Planning Commission or the (Township/Municipality) Board, as applicable, shall make all of the following findings:

1. That all feasible and prudent efforts have been made to avoid the loss of protected wetland.
2. That all practical means have been considered to minimize protected wetland impacts.
3. That it is practical to replace the protected wetland which will be unavoidably eliminated.
4. That all alternatives for preserving protected wetlands and water courses have been evaluated and found to be impractical, inappropriate, or ineffective.

B. To ensure no net loss of wetlands in the (Township/Municipality), mitigation shall be required in instances where there are losses of wetland resources and where the

Wetland Administrator, the Planning Commission or the (Township/Municipality) Board, as applicable have made the findings required in Section 8.1.A.

Section 8.2 - Criteria For Approving Proposals For Wetland Mitigation

If the Wetland Administrator, Planning Commission or the (Township/ Municipality) Board, as applicable determines that it is practical to replace the protected wetlands which will be impacted, mitigation plans shall be approved only if all of the following criteria are met:

A. That the mitigation plan provides for the substantial replacement of the predominant functional values of the protected wetland to be lost.

B. That the mitigation plan provides for no net loss of protected wetland resources and watercourses unless the Wetland Administrator, the Planning Commission or the (Township/Municipality) Board, as applicable determines that the net loss will result in a minimum negative impact upon protected wetlands, watercourses, and attendant natural resources under all of the circumstances.

C. Mitigation shall be provided on

D. The mitigation plan will comply with all applicable federal, state, and local laws.

E. A plan to monitor preserved and replacement wetlands over a minimum of five years has been specified.

Section 8.3 - Other Mitigation Requirements

A. Wetland mitigation and monitoring plans shall become conditions to the wetland use permit and shall be the responsibility of the applicant.

B. Financial assurances that mitigation is accomplished as specified by the permit condition may be required by the Wetland Administrator, Planning Commission or (Township/Municipality) Board, as applicable.

C. Any mitigation activity shall be completed before initiation of other permitted activities, unless a phased concurrent schedule can be agreed upon between the Wetland Administrator, Planning Commission or (Township/Municipality) Board, as applicable, and the applicant.

D. Wetland mitigation plans that create less than two (2) acre wetlands shall meet one of the conditions listed in Section 7.6 B. 1

SECTION 9 - FEES, PENALTIES AND ENFORCEMENT

Section 9.1 - Fees

Applications for a wetland use permit under this Section shall be accompanied by a non-refundable administrative application fee in an amount specified from time to time by resolution of the (Township/ Municipality) Board. In addition an applicant shall pay an additional escrow fee in an amount determined by resolution of the (Township/Municipality) Board for the estimated cost of outside consultant(s) who may be retained by the (Township/Municipality) in connection with the review of the application. In the event the cost of the services of the consultant(s) is less than the escrow fee, the applicant shall be refunded the balance. In the event the cost of the services of the consultant(s) exceeds the amount of the escrow fee, the applicant shall pay the deficiency to the (Township/Municipality) prior to the issuance of a wetland use permit. A denial of an application for a wetland use permit shall not affect the applicant's obligation to pay the escrow fee provided for in this Section.

Section 9.2 - Penalties And Enforcement

A. Restoration Requirements for Illegal Wetland Alteration. In the event of a violation involving illegal alteration of a watercourse or protected wetland under this Section, the (Township/Municipality) shall have the power to order complete restoration of the watercourse or protected wetland area by the person or agent responsible for the violation. If such responsible person or agent does not complete such restoration within a reasonable time following the order, the (Township/Municipality) shall have the authority to restore the affected watercourse or protected wetland to their prior condition wherever possible, and the person or agent responsible for the original violation shall be held liable to the (Township/Municipality) for the cost of restoration. Requirements and watercourse or protected wetland restorations order by the (Township/Municipality) shall be coordinated with state and/or federal agency requirements and specifications for watercourse or wetland restoration.

B. Penalties. In addition to the rights and remedies herein provided to the (Township/Municipality) any person violating any of the provisions of this Ordinance shall be deemed guilty of a misdemeanor and upon conviction thereof shall be fined

in an amount not exceeding Five Hundred Dollars ($500.00), or be imprisoned in the county jail for a period not exceeding ninety (90) days, or be both so fined and imprisoned. Each day such violation is continued or permitted to continue shall constitute a separate offense and shall be punishable as such hereunder.

C. Injunction. Any activity conducted in violation of this Section is declared to be a nuisance per se, and the (Township/Municipality) may commence a civil suit in any court of competent jurisdiction for an order abating or enjoining the violation, and/or requiring restoration of the protected wetland or watercourse as nearly as possible to its condition before the violation.

D. Stop-Work Order. The (Township/Municipality) may also issue a stop-work order or withhold issuance of a Certificate of Occupancy, permits or inspection until the provisions of this Ordinance, including any conditions attached to a wetland use permit, have been fully met. Failure to obey a stop-work order shall constitute a violation of this Ordinance.

E. Appearance Tickets. In all arrests and prosecutions for violation of this Ordinance, appearance tickets and the appropriate procedures set forth in Act 147, Michigan Public Acts of 1968, as amended, may be used.

F. Enforcement. The Wetlands Administrator or his/her agent, officer or employee shall have authority under this Ordinance to enter upon privately

SECTION 10 - STATE NOTIFICATION

Section 10.1 - Notice to the Michigan Department of Environmental Quality

The (Township/Municipality) shall notify the MDEQ of the adoption of this Ordinance. The (Township/Municipality) shall cooperate with the MDEQ in the enforcement of the Wetland Protection Act as to wetlands under the MDEQ's jurisdiction as defined under this Ordinance.

SECTION 11 - ORDINANCE CONFLICT

Section 11.1 - Abrogation and Conflict of Authority

Nothing in this Ordinance shall be interpreted to conflict with present or future state statutes in the same subject matter; conflicting provisions of this Ordinance shall be

abrogated to, but only to, the extent of the conflict. Moreover, the provisions of this Ordinance shall be construed, if possible, to be consistent with relevant state regulations and statutes. If any part of this Ordinance is found to be invalid or unconstitutional by any court of competent jurisdiction, such portion shall be deemed a separate, distinct and independent provision. Such holding shall not affect the validity of the remaining portions thereof, and the remainder of the Ordinance shall remain in force. Rights and duties which have matured, penalties which have been incurred, proceedings which have begun (except as set forth in Section 5.3 and Section 6 herein) and prosecutions for violations of law occurring before the effective date of this Ordinance are not affected or abated by this Ordinance.

SECTION 12 - PROPERTY TAX ASSESSMENT

If a wetland use permit is denied by the (Township/Municipality), a landowner may appear at the annual Board of Review for the purpose of seeking a reevaluation of the affected property for assessment purposes to determine its fair market value under the use restriction.

SECTION 13 - EFFECTIVE DATE

This Ordinance shall take full force and effect upon _____ (date), following final publication of said ordinance.

SECTION 14 - CERTIFICATION

I, _____, Clerk of (Community Name)(Township/Municipality), do hereby certify that the foregoing is a true and correct copy of an ordinance adopted by the (Community Name)(Township/Municipality) Board at a regular meeting on _____(date).

Published _____(date)

UPPER RABBIT RIVER WATERSHED PROJECT

WATER QUALITY ZONING IN REVIEW

This Nonpoint Source Pollution Control project has been funded wholly through the Michigan Nonpoint Source Program by the United States Environmental Protection Agency under assistance agreement [C9975474-01] to the Allegan Conservation District for the Upper Rabbit River Watershed Project. The contents of the document do not necessarily reflect the views and policies of the EPA, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

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WATER QUALITY ZONING IN REVIEW

PURPOSE

The Rabbit River Watershed Management Plan highlights the importance of water resources as a vital component when determining land use decisions at the local level. Communities in the Rabbit River Watershed (RRW) are interested in achieving sustainable development, defined as economic and social growth that also protects local water quality and natural resources. This Water Quality Zoning in Review document highlights the water quality ordinances adopted by RRW Townships to protect water quality and develop economic growth through land use planning.

Communities find that their development codes and standards give developers little or no incentives to conserve natural areas and, in some cases, actually work against watershed protection. Careful attention to appropriate water resource management can help Townships reach a level of sustainable development, which combines economic and social growth with the protection of natural resources.

Residents, business owners, and local planners are not always aware of the impacts that their individual actions might have on their natural surroundings. Cumulative effects of these actions are not considered in most development and land use decisions. 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. The adoption of local ordinances is one of many tools that local municipalities can use to protect their water resources.

The Rabbit River Watershed Project (RRWP) has taken the first step in realizing the regional consequences of the local land use decisions, by evaluating current policies and implementing appropriate measures to enhance and protect water quality while experiencing economic growth and development. The RRWP has implemented a water quality zoning adoption project for the City of Wayland and the six townships within the Watershed. The RRWP has developed seven water quality ordinances which are available at no cost for township to implement into their master plans and zoning ordinances. As of (12/31/2006) all seven municipalities have taken advantage of this Project and over $38,000.00 in local funds have been used to adopt these ordinances. This policy review document will highlight these ordinances and master plan adoptions by municipality and identify areas that will need additional natural resource protection for the future.

The assessment of the townships new ordinance adoptions and additional watershed protection needs will provide a baseline from which to measure changes in the coming years. A similar assessment of the

townships could be conducted in five years to determine if townships have made the additional changes to their rules and regulations that increase their level of watershed protection.

METHODOLOGY

This document identifies the changes within township and city zoning ordinances after implementation of the cost-share funds offered by the RRWP. Further, the document provides tools for planning and design that consider water quality protection. Many of the ordinances adopted by municipalities complement and enhance state and federal regulations.

This document identifies the changes within township zoning ordinances after implementation of the cost-share funds offered by the RRWP. The main goals of the RRWP Ordinance Cost-share Project are to reduce nonpoint source pollution, including sediment, nutrients, hydrology, *E. coli*, temperature and other contaminants, and fragmentation of habitat. The ordinance adoptions by each municipality reflect the following goals and objectives:

- Develop model ordinances or other mechanisms for: shoreline setbacks, greenbelts, storm water management, floodplain management, farmland and open space preservation, and protection of riparian corridors and functioning wetlands.

- Improve storm water management techniques through ordinances and site design criteria to reduce runoff. Include innovative storm water management practices in county storm water rules and township land use ordinances.

- Apply conservation, farmland, and open space easements to areas with high erosion potential to protect vulnerable slopes; for infiltration and storm water storage areas to reduce the volume and velocity of storm runoff; and to protect habitat.

THE WATERSHED

The Rabbit River Watershed has an extensive network of stream, creeks, and constructed drainage ways. Many formerly natural streams or creeks have been altered dramatically through channelization or other straightening, dredging, deepening, widening or other methods. Many drains have also been constructed, both public and private. The RRW also has many inland lakes, of all sizes. Several of the major lakes include Green Lake, East Lake, Selkirk Lake, and Miller Lake. Monterey Lake is a large man-made lake, constructed from former extraction services, and now harbors a large recreational/residential community.

The RRW is an important and valuable resource for our community. Portions of the Rabbit River Watershed are seriously impacted by non-point source pollution, and water quality is severely degraded. Streams in the Upper Rabbit River Watershed have suffered impairments due to human derived land based activities. Biosurveys conducted by the Michigan Department of Environmental Quality (MDEQ) indicate that habitat and biological communities in the Rabbit River and tributaries are significantly degraded due to nonpoint source pollution. Streams in the watershed are included on MDEQ non-attainment list. The Rabbit River Watershed is listed as one of eight watersheds on MDEQ's Michigan's Unified Watershed Assessment and Watershed Restoration Priorities. In addition, the Rabbit River Watershed is ranked third out of twenty-eight in the sate of Michigan as a Conservation Priority Area for the USDA's Environmental Quality Incentive Program (EQIP) to reduce non-point source pollution. Significant water quality impairments include degraded indigenous aquatic habitat and biotic diversity, reduced fish populations and flooding. Major nonpoint source pollutants include sediment, excessive nutrients, and high flow. Occasional spikes in fecal coliform bacteria have also been noted, raising concerns about water-body contact. Development is steadily increasing in the watershed as open space and agricultural land is re-zoned to residential and industrial districts. Allegan County's population has increased more than ten percent since 1990 (according to the 2000 census) and is now 113,200 people.

IMPLEMENTED ORDINANCES BY MUNICAPALITY

CITY OF WAYLAND

The City of Wayland is located off of U.S. 131 in the northeastern corner of Allegan County, Michigan. This growing community is approximately 30 minutes south of the City of Grand Rapids, 40 minutes north of the City of Kalamazoo and 45 minutes east of Lake Michigan. The City of Wayland is the most developed of all the municipalities in the RRW. The City of Wayland encompasses two large primary stretches of the Rabbit River and the northwest section includes some of the headwaters. The population was 3,939 at the 2000 census.

Cost-shared Adoptions

- Funnel Ordinance
- Riparian Corridor Ordinance (50' Overlay)
- Master Plan updates to support water quality

DORR TOWNSHIP

Dorr Township is located off U.S. 131 in the northeastern corner of Allegan County, Michigan. This growing community is approximately 15 miles south of Grand Rapids and continues to be one of fastest developing townships in the RRW due to its close proximity to Grand Rapids. The Township encompasses many important county drains which convey surface water to the southwest section of the RRW. The population was 6,579 at the 2000 census.

Cost-shared Adoptions

- Riparian Corridor Ordinance (50' Overlay)
- Master Plan updates to support water quality

HOPKINS TOWNHSIP

Hopkins Township is located 10 miles west of U.S. 131 in northeastern corner of Allegan County, Michigan. This community is increasingly seeing new developments within in its boundaries and expects a busy corridor to develop along U.S. 131 when the Gun Lake Tribe Casino is established in 2007. The Township contains many lakes including McDermott Lake, Three Corner Lake, East Lake, Herlan Lake, Ingerson Lake and Leggett Lake. The Township also contains many important drains and tributaries to the RRW including the Bear Swamp Drain, Buskirk Creek and Miller Creek. The population was 2,671 at the 2000 census.

Cost-shared Adoptions

- Funnel Ordinance
- Riparian Corridor Ordinance (50' Overlay)
- Master Plan updates to support water quality

LEIGHTON TOWNSHIP

Leighton Township is located off U.S. 131 in northeastern Allegan County, Michigan. Leighton Township like many northeastern townships in Allegan County has seen a large increase in developments over the past five years.

The Township contains the headwaters to the RRW and many lakes including Aubil Lake, Round Lake, Green Lake, Huckleberry Lake and Indian Lake. Leighton Township has over 335 acres of surface water within it's' boundaries. The population was 3,652 at the 2000 census.

Cost-shared Adoptions

- Riparian Corridor Ordinance (50' Overlay)
- Funnel Ordinance
- Master Plan updates to support water quality

MONTEREY TOWNSHIP

Monterey Township is located in the northern section of Allegan County, Michigan. The Township is 76.9% agricultural land. The township continues to be a strong hold for agriculture in the county with some of the most productive prime farmland soils. The two dominant water features in the Township are Pigeon Creek and Miller Creek. Beyond adopting numerous water quality ordinances Monterey Township has also amended their master plan to reflect the importance of the Rabbit River and other water bodies within it boundaries. The population was 2,065 at the 2000 census.

Cost-shared Adoptions

- Riparian Corridor Ordinance
- Funnel Ordinance
- Storm water management plans for single family developments of 5 or more houses
- Floodways and flood fringe regulations
- Stormwater management plans for commercial and industrial developments
- Master Plan updates to support water quality

SALEM TOWNSHIP

Salem Township is located in north central Allegan County, MI. The Township is a growing community with two metropolitan areas just north of its borders (Holland/Grand Rapids).

Salem Township includes the southern trunk of the Rabbit River as well as the most southern location of the Little Rabbit River. Beyond adopting the riparian corridor ordinance Salem Township has also amended their master plan to reflect the importance of the Rabbit River and other water bodies within it boundaries The Population was 3,486 at the 2000 census.

Cost-shared Adoptions

- Riparian Corridor Ordinance (50' Overlay)
- Master Plan updates to support water quality

WAYLAND TOWNSHIP

Wayland Township is located in north east Allegan County, MI. The Township is experiencing new developments such as the Gun Lake Tribe of Indians Casino. The Township also includes many lakes such as Boot Lake, Round Lake, Mud Lake, Geneva Lake and Selkirk Lake. The Population was 3,013 at the 2000 census.

Cost-shared Adoptions

- Riparian Corridor Ordinance (50' Overlay)

ALLEGAN COUNTY STORM WATER STANDARDS

The Watershed Project reviewed the Allegan County Storm Water Standards proposed by the Allegan County Drain Commissioner. The following recommendations were made by the Project and updated into the County Standards.

- Encouragement of mechanical means of storm water treatment in lieu of extended duration detention basins
- Below ground run-off storage may be used instead of above ground retention/detention basins. In some cases additional water quality treatment devices may be required to protect the ground water
- In well drained soils, such systems as perforated leaching basins and/or pipe surrounded by stone can be used instead of above ground retention basins

CONCLUSION

The principle product of this project is the adoption of land use regulations by all seven municipalities which will preserve and protect the long term water quality of the Rabbit River. The Riparian Corridor Ordinance was developed as a common ordinance to all seven communities in the watershed while other regulations have been adopted on an as needed basis.

A secondary but still significant product of this project were the amendments to Master Plans of each municipality, which publicly acknowledged the importance of the Rabbit River to the future of each community. This will raise public awareness of efforts to protect the water quality of the Rabbit River and ensure the continued recognition of the Rabbit River in all future planning and land use regulation efforts for each municipality.

A Powerful New Incentive for Private Land Conservation
Michigan Public Act 446 of 2006

What Does Public Act 446 Do?

Under current Michigan law, the taxable value of a parcel of property may not increase from one year to the next by more than 5% or the increase in the consumer price index, whichever is lower, until there is a transfer of ownership. When the property is sold or transferred, the assessment is "uncapped" and the parcel is taxed upon its state equalized value (SEV: 50% of its true cash value). This reassessment upon transfer creates a "pop-up" property tax.

P.A. 446, introduced as Senate Bill 1004, eliminates the "pop-up" property tax on the transfer of lands enrolled in a voluntary conservation agreement (also known as "conservation easement"). [1]

How Does This Benefit Conservation?

Until the signing of Senate Bill 1004 on December 7, 2006, property taxes on conservation lands, like developed lands, jumped dramatically upon their sale or transfer. Property taxes on conservation lands rose significantly even though their development is permanently limited.

This provided a disincentive for landowners to enter into conservation agreements. To afford the higher taxes, new landowners needed the option of developing the land. The elimination of the pop-up tax on conservation lands means that both current and future landowners have a strong incentive to keep the affected lands intact with habitat, environmental and scenic benefits. This law gives protected conservation property the same tax treatment as protected farmland.

How Does This Benefit Private Landowners?

The Act prevents the taxable value of conservation property from "popping-up" to the state equalized value when it is transferred. This means a potential direct tax savings of hundreds or thousands of dollars per year for new owners of the land.

What's an Example of How the New Law Works?

An 80-acre non-farm property with a current taxable value of $43,000 and a state equalized value of $252,000 would have been subject to $4,395 in annual property tax payments after transfer. Under the new law, if the 80 acres are all enrolled in a conservation agreement, annual property taxes will remain at their current level after transfer -- $750 per year. This means **an annual savings of $3,645**. Over a 50-year span, the new landowner will realize an estimated $149,131 in value from the change.

How Do I Find Out More?

Contact your local land conservancy, accountant and tax advisor to learn how the new law could benefit you.

[1] Residences and buildings on the lands are still subject to reassessment to the current SEV.

MODEL ORDINANCES
Upper Rabbit River Watershed Implementation Project

(Model) WETLAND AND WATERCOURSE PROTECTION

Author: Clinton River Watershed Council

Prepared for Townships within the Rabbit River Watershed, Allegan County, Michigan

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Allegan Conservation District
1668 Lincoln Rd.
Allegan, MI 49010

WETLAND AND WATERCOURSE PROTECTION

(COMMUNITY NAME), MICHIGAN
Ordinance No. _____

An Ordinance for the control and preservation of wetlands and watercourses within (Community Name) and to protect the wetlands of the (Township/Municipality) from sedimentation, destruction, and misuse; to prescribe the powers, duties and functions of the (Township/Municipality) enforcing agency; to provide for the promulgation of rules; to establish permits and a fee schedule; to establish design standards, specifications, and bond requirements; to provide for variance and exceptions; to provide for inspections and enforcement; to provide for violations, remedies and penalties thereof; and to provide for severability and effective date of the Ordinance.

(COMMUNITY NAME) HEREBY ORDAINS:

SECTION 1. GENERAL

Section 1.1 - Findings

The (Township/Municipality) Board of (Community Name) finds that wetlands and watercourses of the Clinton River watershed, including the Clinton River and its tributaries, are indispensable and fragile resources that provide many public benefits including maintenance of surface and groundwater quality through nutrient cycling and sediment trapping as well as flood and storm water runoff control through temporary water storage, slow release, and groundwater recharge. In addition, wetlands provide open space; passive outdoor recreation opportunities, fish and wildlife habitat for many forms of wildlife including migratory waterfowl; and rare, threatened or endangered wildlife and plant species; and pollution treatment by serving as biological and chemical oxidation basins.

Preservation of the remaining (Township/Municipality) wetlands in a natural condition shall be and is necessary to maintain hydrological, economic, recreational, and aesthetic natural resource values for existing and future residents of (Community Name), and therefore the (Township/Municipality) Board declares a policy of no net loss of wetlands. Furthermore, the (Township/Municipality) Board declares a long term goal of net gain of wetlands to be accomplished through review of degraded or destroyed wetlands in the (Township/Municipality), and through cooperative work with landowners, using incentives and voluntary agreements to restore wetlands.

To achieve these goals, and with authority from Section 30307(4) of the Natural Resources and Environmental Protection Act (Act 451 Of l994 [previously Section 8 (4) of the Goemaere

Section 1.2 - Purposes

The purposes of this Ordinance are to provide for:

A. The protection, preservation, replacement, proper maintenance, restoration, and use in accordance with the character, adaptability, and stability of the (Township/Municipality)'s wetlands, in order to prevent their pollution or contamination; minimize their disturbance and disturbance to the natural habitat therein; and prevent damage from erosion, siltation, and flooding.

B. The coordination of and support for the enforcement of applicable federal, state, and county statutes, ordinances and regulations including, but not limited to, the:

1. Wetland Protection Act, enforced by the Michigan Department of Environmental Quality which is hereinafter referred to as the MDEQ;
2. Inland Lakes and Streams Act, Section 30101 et seq. of the Natural Resources and Environmental Protection Act (Act 451 of 1994 [previously Act 346, Public Acts of 1972, as amended]) enforced by the MDEQ;
3. Soil Erosion and Sedimentation Control Act, Section 9101 et seq. of the Natural Resources and Environmental Protection Act (Act 451 of 1994 [previously Act 347, Public Acts of 1972, as amended]), enforced by the County of Livingston;
4. Floodplain Regulatory Authority, incorporated into the Natural Resources and Environmental Protection Act (Act 451 of 1994 [previously Act 245, Public Acts of 1929, as amended]), enforced by the MDEQ.

C. Compliance with the Michigan Environmental Protection Act which imposes a duty on government agencies and private individuals and organizations to prevent or minimize degradation of the environment which is likely to be caused by their activities.

D. The establishment of standards and procedures for the review and regulation of the use of wetlands and watercourses.

E. The establishment of penalties for violation of this Ordinance.

F. A procedure for appealing decisions.

G. The establishment of enforcement procedures and penalties for the violation of this Ordinance.

H. Assurance that the right to reasonable use of private property is maintained.

Section 1.3 - Construction and Application

The following rules of construction apply in the interpretation and application of this Ordinance:

A. In the case of a difference of meaning or implication between the text of this Ordinance and any caption or illustration, the text shall control.

B. Particulars provided by way of illustration or enumeration shall not control general language.

Section 1.4 - Applicability to Private and Public Agency Activities and Operations

The provisions of this Ordinance, including wetland use permit requirements and criteria for wetland use permit approval, shall apply to activities and operations proposed by federal, state, local and other public agencies as well as private organizations and individuals.

SECTION 2 - DEFINITIONS

Section 2.1 - Definition of Terms

Terms not specifically defined shall have the meaning customarily assigned to them.

CONTIGUOUS shall mean any of the following:

A. A permanent surface water connection or any other direct physical contact with an inland lake or pond, a river or stream.

B. A seasonal or intermittent direct surface water connection to an inland lake or pond, a river or stream.

C. Partially or entirely located within five hundred (500') feet of the ordinary high water mark of an inland lake or pond or a river or stream, unless it is determined by the (Township/Municipality) or the MDEQ in accordance with Rule 281.924 of the Wetland Administrative Rules, adopted in connection with the Wetland Protection Act, that there is no surface or groundwater connection to these waters.

D. Two (2) or more areas of wetland shall be considered contiguous where separated only by barriers, such as dikes, roads, berms, or other similar features, but with any of the wetland areas contiguous under the criteria described in Subsections (1)(2) or (3) of this definition.

DEPOSIT means to fill, place or dump.

LOT means a designated parcel, tract, building site or other interest in land established by plat, subdivision, conveyance, condominium master deed, or as otherwise permitted by law, to be used, developed or built upon as a unit.

MATERIAL shall mean soil, sand, gravel, clay, peat moss and other organic material.

MITIGATION shall mean: (1) methods for eliminating or reducing potential impact to regulated wetlands; or (2) creation of new wetlands to offset unavoidable loss of existing wetlands.

PERSON means an individual, sole proprietorship, partnership, corporation, association, municipality, this state, any instrumentality or agency of this state, the federal government, or any instrumentality or agency of the federal government, or other legal entity.

PROTECTED WETLANDS shall mean any of the following:

A. All wetlands subject to regulation by the MDEQ including:

1. Wetlands, regardless of size, which are contiguous to any lake, stream, river, or pond whether partially or entirely contained within the project site.
2. Wetlands, regardless of size, which are partially or entirely within five hundred (500) feet of the ordinary high water mark of any lake, stream, river or pond unless it is determined by the MDEQ that there is no surface water or groundwater connection between the wetland and the water body.

3. Wetlands which are larger than five (5) acres, whether partially or entirely contained within the project site, and which are not contiguous to any lake, stream, river, or pond.
4. Wetlands, regardless of size, which are not contiguous to any lake, stream, river, or pond, if the MDEQ determines the protection of the wetland is essential to the preservation of the natural resources of the state from pollution, impairment or destruction.

B. All wetlands subject to regulation by the (Township/Municipality) including:

1. Wetlands two (2) to five (5) acres in size, whether partially or entirely contained within the project site, which are not contiguous to any lake stream, river or pond.
2. Wetlands smaller than two (2) acres in size which are not contiguous to any lake, stream, river or pond and are determined to be essential to the preservation of the natural resources of the (Township/Municipality) as provided for in Section 7.6 of this Ordinance.

RUNOFF shall mean the surface discharge of precipitation to a watercourse, drainageway, swale, or depression.

REMOVE means to dig, dredge, suck, pump, bulldoze, drag line, or blast.

RESTORATION means to return from a disturbed or totally altered condition to a previously

SEASONAL shall mean any intermittent or temporary activity which occurs annually and is subject to interruption from changes in weather, water level, or time of year, and may involve annual removal and replacement of any operation, obstruction, or structure.

STRUCTURE shall mean any assembly of materials above or below the surface of the land or water, including but not limited to, buildings, bulkheads, boardwalks, piers, docks, landings, dams, waterway obstructions, paving, gravel, and roadways, poles, towers, cables, pipelines, drainage tiles, and other underground installations.

(TOWNSHIP/MUNICIPALITY) BOARD shall mean the legislative body of (Community Name)(Township/Municipality), Livingston County, Michigan.

(TOWNSHIP/MUNICIPALITY) WETLAND MAP refers to the (Community

Name)(Township/Municipality) Wetland Map, based on the National Wetland Inventory Map of the U.S. Fish and Wildlife Service; the Michigan Resource Information System Mapping (MIRIS) of the Michigan Department of Environmental Quality; the soils maps of the Soil Conservation Service; aerial photography; and on site inspections.

WATERCOURSE shall mean any waterway including a river, stream, lake, pond or any body of surface water having definite banks, a bed and visible evidence of a continued flow or continued occurrence of water.

WETLAND shall mean land characterized by the presence of water at a frequency and duration sufficient to support and that under normal circumstances does support wetland vegetation or aquatic life and is commonly referred to as a bog, swamp or marsh.

WETLAND ADMINISTRATOR shall mean a person(s) knowledgeable in wetland protection, appointed to administer this Ordinance and to carry out certain duties hereunder. Any firm or individual appointed on a contract basis.

WETLAND USE PERMIT shall mean the (Township/Municipality) approval required for activities in wetlands and watercourses described in Section 7 of this Ordinance.

WETLAND VEGETATION shall mean plants, including but not limited to, trees, shrubs, and herbaceous plants, that exhibit adaptations to allow, under normal conditions, germination or propagation and to allow growth with at least their root systems in water or saturated soil.

SECTION 3 - RELATIONSHIP TO STATE AND FEDERAL PERMIT REQUIREMENTS

Whenever persons requesting a wetland use permit are also subject to state and/or federal permit requirements, the following shall apply:

A. The (Township/Municipality) shall have jurisdiction for the regulation of wetlands under this Ordinance concurrent with the jurisdiction of the Michigan Department of Environmental Quality.

B. Approvals under this Ordinance shall not relieve a person of the need to obtain a permit from the MDEQ and/or the U.S. Army Corps of Engineers, if required.

C. Issuance of a permit by the MDEQ and/or the U.S. Army Corps of Engineers shall not relieve a person of the need to obtain approval under this Ordinance, if applicable.

SECTION 4. ADMINISTRATION

Section 4.1 - (Township/Municipality) Wetland Map

The (Township/Municipality) Wetland Map is a guide to the location of wetlands in (Community Name)(Township/Municipality). The Map shall be used in the administration of this Ordinance.

The (Township/Municipality) Wetland Map, together with all explanatory matter thereon and attached thereto, as may be amended through the Wetland Verification and Delineation process, is hereby adopted by reference and declared to be a part of this Ordinance. The (Township/Municipality) Wetland Map shall be on file in the office of the (Township/Municipality) Clerk.

The (Township/Municipality) Wetland Map shall serve as a general guide for the location of protected wetlands. The (Township/Municipality) Wetland Map does not create any legally enforceable presumptions regarding whether property that is or is not included on the inventory map is or is not in fact a wetland.

The Wetland Verification Process, as set forth herein, shall be used to verify wetland on properties where wetland is shown on the Wetland Map or on properties where wetland exist as defined in Section 2.1 herein. The Wetland Delineation Process, as set forth herein, shall be used to establish the actual boundaries of wetlands in the (Township/Municipality). The identification of the precise boundaries of wetlands on a project site shall be the responsibility of the applicant and verified by the Wetland Administrator.

A. Wetland Verification Process

1. The (Township/Municipality) or property owners of wetland may initiate a verification of the areas shown on the (Township/ Municipality) Wetland Map as wetland or on properties where wetland exists as defined in Section 2.1 herein. The verification shall be limited to a finding of wetland or no wetland

by the Wetland Administrator. The finding shall be based on, but not limited to, aerial photography, topographical maps, site plans, and field verification.

2. In the event that there is a finding of no wetland on the property, then no further determination would be required and the finding shall be included in the Map Amendment Process (found later in this Section).
3. In the event that there is a finding of wetland, then the establishment of the exact boundary through a wetland delineation shall be required to alter the (Township/Municipality) Wetland Map through the Map Amendment Process.
4. The applicant shall pay fees for the Wetland Verification Process as established in Section 9.1.

B. Wetland Delineation Process

Prior to the issuance of any permit or land development approval for a lot which is shown to include a wetland on the (Township/Municipality) Wetland Map, the applicant may be required to provide a wetland delineation to the (Township/Municipality). The Wetland Administrator shall determine whether a delineation is required, based on the proximity and relationship of the project to the wetland.

1. To establish actual wetland boundaries on a property, the applicant shall provide a survey or dimensional site plan, drawn at an appropriate scale, showing property lines, buildings and any points of reference along with the wetland boundaries, according to one of the following:
   (a) Wetland delineation by the Michigan Department of Environmental Quality (MDEQ).
   (b) Wetland delineation by the applicant's wetland consultant subject to review and approval by the (Township/Municipality)'s Wetland Consultant.
2. Where a wetland delineation is required by this Section, the (Township/Municipality) Wetland Consultant shall establish wetland boundaries following receipt of the above required information and after conducting a field investigation.
3. The applicant shall pay fees for the Wetland Delineation Process as established in Section 9.1.

C. Map Amendment

1. The (Township/Municipality) Wetland Map shall be updated when new data is available or when corrections are needed in order to maintain the integrity of the map.
2. The (Township/Municipality) shall ensure that each record owner of property on the property tax roll shall be notified of any amendment to the (Township/Municipality) Wetland Inventory Map on an annual basis. The notice shall include the following information:
   (a) the (Township/Municipality) wetland map has been amended;
   (b) the location to review the map;
   (c) the owner's property may or may not be designated as a wetland on the map;
   (d) the (Township/Municipality) has an ordinance regulating wetlands;
   (e) the map does not necessarily include all of the wetlands within the (Township/Municipality) that may be subject to the wetland ordinance.

SECTION 5 - ACTIVITIES IN A PROTECTED WETLAND OR WATERCOURSE

Section 5.1 - Activities Prohibited Without First Obtaining A Wetland Use Permit

Except for those activities expressly permitted by Section 5.2, it shall be unlawful for any person to do any of the following in a protected wetland or watercourse unless and until a wetland use permit is obtained from the (Township/Municipality) pursuant to this Ordinance.

A. Deposit or permit to be deposited any material or structures into any watercourse or within or upon any protected wetlands.

B. Remove or permit to be removed any material from any watercourse or from any protected wetland.

C. Dredge, fill or land balance watercourses or protected wetlands.

D. Create, enlarge, diminish or alter a lake, pond, creek, stream, river, drain or protected wetland.

E. Construct, operate or maintain any development in or upon protected wetlands or watercourses.

F. Erect or build any structure, including but not limited to, buildings, roadways,

bridges, tennis courts, paving, utilities, or private poles or towers in or upon protected wetlands or watercourses.

G. Construct, extend or enlarge any pipe, culvert, or open or closed drainage facility which discharges silt, sediment, organic or inorganic materials, chemicals, fertilizers, flammable liquids or any other pollutants to any lake, stream, pond, creek, river, protected wetland, or watercourse, except through a retention area, settling basin, or treatment facility designed to control and eliminate the pollutant. This Subsection shall apply to all land uses except single family uses.

H. Construct, enlarge, extend or connect any private or public sewage or waste treatment plant discharge to any lake, stream, river, pond, watercourse, or protected wetland except in accordance with the requirements of Livingston County, State of Michigan and/or the United States, to the extent that such entities have jurisdiction.

I. Drain, or cause to be drained, any water from a protected wetland or watercourse.

J. Fill or enclose any ditch which would result in a significant reduction of storm water absorption and filtration into the ground or would otherwise have an adverse impact on receiving watercourses or wetlands.

Section 5.2 - Permitted Activities

1) Notwithstanding the prohibitions of Section 5.1, the following activities are permitted within watercourses or protected wetlands without a wetland use permit, unless otherwise prohibited by statute, ordinance or regulation:

A. Fishing, trapping, or hunting.

B. Swimming or boating.

C. Hiking.

D. Grazing of animals.

E. Farming, horticulture, silviculture, lumbering, and ranching activities, including plowing, irrigation, irrigation ditching, seeding, cultivating, minor drainage, harvesting for the production of food, fiber, and forest products, or upland soil and water conservation practices. Wetland altered under this subdivision shall not be used for a purpose other than a purpose described in this subsection without a permit from the department.

F. Maintenance or operation of serviceable structures in existence on October 1, 1980 or constructed pursuant to this part of former Act No. 203 of the Public Act of 1979.

G. Construction or maintenance of farm or stock ponds.

H. Maintenance, operation, or improvement which includes straightening, widening, or deepening of the following which is necessary for the production or harvesting of agricultural products:

1. An existing private agricultural drain.

2. That portion of a drain legally established pursuant to the drain code of 1956, Act No. 203 of the Public Acts of 1956, being sections 280.1 to 280.630 of the Michigan Compiled Laws, w which has been constructed or improved for drainage purposes.

3. A drain constructed pursuant to other provisions of this part or former Act No. 203 of the Public Acts of 1979.

I. Construction or maintenance of farm roads, forest roads, or temporary roads for moving mining or forestry equipment, if the roads are constructed and maintained in a manner to assure that any adverse effect on the wetland will be otherwise minimized.

J. Drainage necessary for the production and harvesting of agricultural products if the wetland is owned by a person who is engaged in commercial farming and the land is to be used for the production and harvesting of agricultural products. Except as otherwise provided in this part, wetland improved under this subdivision after October 1, 1980 shall not be used for non-farming purposes without a permit from the department. This subdivision shall not apply to a wetland which is contiguous to a lake or stream, or to a tributary of a lake or stream, or to a wetland that the department has determined by clear and convincing evidence to be a wetland that is necessary to be preserved for the public interest, in which case a permit is required.

K. Maintenance or improvement of public streets, highways, or roads, within the right-of-way and in which in such a manner as to assure that any adverse effect on the wetland will be otherwise minimized. Maintenance or improvement does not include adding extra lanes, increasing the right-of-way, or deviating from the existing location of the street, highway, or road.

L. Maintenance, repair, or operation of gas or oil pipelines and construction of gas or oil pipelines having a diameter of 6 inches or less, if the pipelines are constructed, maintained, or repaired in a manner to assure that any adverse effect on the wetland will be otherwise minimized.

M. Maintenance, repair, or operation of electric transmission and distribution power lines and construction of distribution power lines, if the distribution power lines are constructed, maintained, to repaired in a manner to assure that any adverse effect on the wetland will be otherwise minimized.

N. Operation or maintenance, including reconstruction of recently damaged parts, of serviceable dikes and levees in existence on October 1, 1980 or construction pursuant to this part or former Act No. 203 of the Public Acts of 1979.

O. Construction of iron and copper mining tailings basins and water storage areas.

2) An activity in a wetland that was effectively drained for farming before October 1, 1980 and that on and after October 1, 1980 has been continued to be effectively drained as part of an ongoing farming operation is not subject to regulation under his part.

3) A wetland that is incidentally created as a result of 1 or more of the following activities is not subject to regulation under his part:

A. Excavation for material or sand mining, if the area was not a wetland before excavation. This exemption does not include a wetland on a adjacent to a water body of 1 acre or more in size.

B. Construction and operation of a water treatment pond or lagoon in compliance with the requirements of state or federal water pollution control regulations.

C. A dike area associated with a landfill if the landfill complies with the terms of the landfill construction permit and if the dike area was not a wetland before diking.

Section 5.3 - Existing Non-conforming Lots, Uses and Structures

Lots, uses and structures lawfully existing at the effective date of this Ordinance shall be subject to the requirements of this Ordinance, except as follows:

A. Plats that have received tentative preliminary or later approval and site plans and condominium plans approved prior to the effective date of this Ordinance shall be

entitled by right to all uses authorized by those approvals according to the zoning district in which the property is located, and provided that said lots have buildable sites outside of the wetland. Lots which do not have a buildable site outside of the wetland shall require a wetland use permit prior to any construction on said lot.

B. Any activity, structure, or use lawfully existing prior to the effective date of this Ordinance, but not in conformity with the provisions of this Ordinance, may be continued, maintained and operated.

C. Any structure lawfully existing prior to the effective date of this Ordinance damaged by fire, explosion, act of God, or other causes beyond the control of the owner, may be restored, rebuilt, or repaired without obtaining a wetland use permit.

SECTION 6 - APPLICATION

Application for approval, appeal, and issuance of wetland use permits shall be concurrent with the application for approval, appeal, and issuance of other necessary (Township/Municipality) approvals, except that in the case of any such application for another approval which is pending on the effective date of this Ordinance and which has not been approved and which, by the terms of this Ordinance, would require a wetland use permit application, the applicant shall be notified by the Wetland Administrator that an application for a wetland use permit is required, and processing of the other application shall not proceed until the wetland use permit application has been filed. The applicant for a wetland use permit shall submit four copies of the following to the (Township/Municipality):

A. An application completed in full, on a form supplied by the Michigan Department of Environmental Quality.

B. A wetland delineation including, but not limited to the following information: dominant tree, sapling, shrub and herb vegetation; presence or lack of accepted wetland hydrology indicators; analysis of soil including a description of the soil profile to at least 20 inches and comparison to Livingston County Soil Survey and maps of the wetland(s) mapped. Mapped data shall be represented in a manner that allows comparison to the (Community Name)(Township/Municipality) Wetland Map.

C. Soil drainage and stormwater management plans.

D. A mitigation plan, if the proposed activity will result in the loss of wetland

resources.

E. A cover letter signed by the applicant including the following information:

1. Name of project and brief description.
2. Date upon which the activity is proposed to commence.
3. Explanation of why the project meets the wetland use permit standards and criteria contained in this Ordinance.
4. List of all federal, state, county or other local government permits or approvals required for the proposed project including permit approvals or denials already received. In the event of denials, the reasons for denials shall be given. Attach copies of all permits which have been issued.
5. Identification of any present litigation involving the property.

F. The wetland use permit application shall be reviewed, either prior to or concurrent with the review of the site plan, plat or other proposed land use submitted by the applicant, with the understanding that the land use review may not be completed at the time the decision is rendered on the wetland use permit application. Election of this alternative may require a reopening of the wetland use permit application if the land use approval is inconsistent with the wetland use permit approval; or,

G. Copies of wetland permit applications filed with the MDEQ and forwarded to the (Township/Municipality) in accordance with Section 30307(6) of Wetland Protection Act shall become part of the application for a (Community Name)(Township/Municipality) wetland use permit.

SECTION 7 - REVIEW

Section 7.1 - Method of Review of Wetland Permit Application

A. Before a wetland use permit application is submitted, the necessity of the wetland use permit shall be determined by the Wetland Administrator, or designee by reference to the "(Township/Municipality) Wetland Map".

B. Whenever a wetland use permit is required, applicant may request an administrative meeting with the Wetland Administrator to review the proposed activity in light of the purposes of this Ordinance.

C. Upon receipt of an application, the (Township/Municipality) shall ensure that all

required information including a wetland determination has been submitted. The receipt of the application shall constitute permission from the owner to complete an on-site investigation. Applicant will pay fees as established in Section 9.1.

D. The (Township/Municipality) Clerk shall transmit one copy of the application and supporting materials to the (Township/Municipality) Wetland Consultant to confirm the boundaries of the wetland and to review the proposal in light of the purpose and review standards of Section 7 and other applicable sections of this Ordinance. If an application is not complete, the applicant may be granted additional time to complete the application provided that the applicant agrees that the additional time shall not be charged against the (Township/Municipality)'s 90-day time limit for making a decision. The receipt of the application shall constitute permission from the owner to conduct an on

E. The (Township/Municipality) Wetland Consultant shall prepare and transmit a report and recommendation to the Wetland Administrator documenting the review required by Section 7.1 D.

F. Upon receipt of an application, the (Township/Municipality) Clerk shall:

1. Transmit one copy of the application to the Michigan Department of Environmental Quality.
2. Advise the applicant of his/her obligation to post the subject property with a sign that shall be no less than two (2) square feet in size. The sign shall be clearly visible from the abutting street(s) and shall state that an application has been filed for a wetland use permit on the property.

Section 7.2 - Wetland Use Permit Decisions by the Wetland Administrator

The following process shall apply to wetland use permit decisions by the Wetland Administrator:

A. For wetland use permit applications submitted in conjunction with activities that do not require approval by the Planning Commission and/or (Township/Municipality) Board, the Wetland Administrator shall approve, approve with conditions or deny the application within 90 days after receipt of an application.

B. Persons wishing to comment on the application must submit their comments in writing to the Wetland Administrator prior to the date and time set in the notice. Persons wishing to receive notice of the Wetland Administrator's decision must

submit a written request to the Wetland Administrator.

C. After completing the review and reviewing the written comments, the Wetland Administrator shall approve, approve with modifications or conditions, or deny the wetland use permit application in accordance with the standards of this Ordinance.

D. When a wetland use permit is approved, approved with modifications or conditions, or denied, written notice shall be sent to the applicant and to all persons who have requested notice of the Wetland Administrator's decision. A permit approved by the Wetland Administrator shall not be issued or effective until ten (10) calendar days following the date of approval.

Section 7.3 - Wetland Use Permit Decisions by Planning Commission or the (Township/Municipality) Board

The following process shall apply to wetland use permit decisions by the (Township/Municipality) Planning Commission or by the (Township/ Municipality) Board:

A. Wetland use permit applications submitted in conjunction with a related land development activity shall be decided by the same entity that decides the related land development activity consistent with the Wetland Protection Act. The Planning Commission shall decide any wetland use permits in conjunction with special use permit applications or site plan applications and shall require that the delineation and wetland use permit application requests be submitted prior to the special use permit hearing. The Wetland Administrator shall transmit application materials and the report and recommendation prepared by the (Township/Municipality) Wetland Consultant to the Planning Commission or (Township/Municipality) Board as applicable.

B. After review and study of the application materials and the (Township/ Municipality) Wetland Consultant's report and recommendation, the (Township/Municipality) Planning Commission or (Township/Municipality) Board, as applicable, may hold one public hearing after publication in a newspaper of general circulation in the (Township/Municipality) not less than five (5) days nor more than fifteen (15) days prior to the date of the hearing. Such notice shall indicate the place, time and subject of the hearing and the place and time the proposed wetland use permit may be examined. The wetland use permit hearing may be held in conjunction with a review of the related land use request(s).

C. In the event of a public hearing, notice shall be sent by mail or personal delivery to the owners of property for which approval is being considered, and to all owners of property, as listed on the most recent tax roll, within 300 feet of the boundary of the property in question. Notification need not be given to more than one (1) occupant of a structure, except that if a structure contains more than one (1) dwelling unit or spatial area owned or leased by different persons, one (1) occupant of each unit shall receive notice. In the case of a single structure containing more than four (4) dwelling units, notice may be given to the manager or owner of the structure who shall be requested to post the notice at the primary entrance to the structure. A notice containing the time, date, place and purpose of the hearing shall be posted on the subject property by the applicant at least eight (8) days prior to the hearing. The posting sign shall be no less than two (2) square feet in size, shall be clearly visible from the abutting street(s), and shall state that an application has been filed for a wetland use permit.

D. After completing the review and holding one public hearing, if so required, the Planning Commission or (Township/Municipality) Board as applicable shall approve, approve with conditions or deny the application within ninety (90) days after receipt of an application, in accordance with this Ordinance.

E. Written notice shall be sent to the applicant upon approval, approval with conditions or denial of a wetland use permit by the (Township/Municipality). The denial of a permit shall be accompanied by a written reason for denial.

F. A permit approval by the Planning Commission or (Township/Municipality) Board, as applicable, shall not be issued or effective until ten (10) calendar days following the date of the approval and compliance with Section 7.5 of this Ordinance.

Section 7.4 - Appeals Of Decisions Of The Wetland Administrator, Planning Commission or (Township/Municipality) Board

The following process shall apply to appeals of decisions made by the Wetland Administrator, the Planning Commission, or the (Township/Municipality) Board, as applicable:

A. Any person who is aggrieved by the approval, approval with modifications or conditions, or denial of a wetland use permit by the Wetland Administrator, the Planning Commission or by the (Township/Municipality) Board, may appeal the decision to the Community Appeals Commission. A written letter containing the specific reasons for appeal shall be filed with the (Township/Municipality) Clerk

within ten (10) calendar days after the date of the decision to be appealed. Timely filing of an appeal shall have the effect of suspending the effect of the permit pending the outcome of the appeal. In the event that the person(s) filing the appeal do not own property within 300 feet of the wetland affected, the Planning Commission shall determine whether the person(s) are aggrieved.

B. After a hearing, the Community Appeals Commission shall determine that the decision of the Wetland Administrator, Planning Commission or (Township/Municipality) Board be affirmed, affirmed with modification, or reversed. The Board's decision shall be based on written findings.

Section 7.5 - Wetland Use Permit Conditions

A. The Wetland Administrator, the Planning Commission or the (Township/ Municipality) Board, as applicable, shall attach any reasonable conditions considered necessary to ensure that the intent of this Section will be fulfilled, to minimize or mitigate damage or impairment to, encroachment in or interference with natural resources and processes within the protected wetlands or watercourses, or to otherwise improve or maintain the water quality. Any conditions related to wetland mitigation shall follow the provisions of Section 8 of this Ordinance.

B. The Wetland Administrator, the Planning Commission or the (Township/ Municipality) Board, as applicable, shall fix a reasonable time to complete the proposed activities.

C. The Wetland Administrator, the Planning Commission or the (Township/ Municipality) Board, as applicable, may require the applicant to file with the (Township/Municipality) a cash or corporate surety bond or irrevocable bank letter of credit in an amount, if any, determined necessary to ensure compliance with the wetland use permit approval conditions and this Section.

D. The Wetland Administrator, the Planning Commission or the (Township/ Municipality) Board, as applicable, shall require that final approval of a wetland use permit application shall be contingent upon receipt of evidence by the (Township/Municipality) that required state and federal permits, if any, have been obtained by the applicant.

E. At no time shall the Wetland Administrator, the Planning Commission or the (Township/Municipality) Board, as applicable, issue a wetland use permit that allows a more extensive alteration of the wetland than permitted by state or federal law.

F. Wetland use permits for seasonal operations need not be renewed annually unless otherwise stated in the permit.

G. Any change that increases the size or scope of the operation and that affects the criteria considered in approving the permit as determined by the Wetland Administrator, the Planning Commission or the (Township/Municipality) Board, as applicable, may require the filing of a new wetland use permit application.

H. Any temporary, seasonal, or permanent operation that is discontinued for two (2) years or two (2) seasons shall be presumed to have been abandoned and the wetland use permit automatically voided.

I. Any permit granted under this Ordinance may be revoked or suspended by the Wetland Administrator, Planning Commission or (Township/Municipality) Board, as applicable, after notice and an opportunity for a hearing, for any of the following causes:

1. A violation of a condition of the permit.
2. Misrepresentation or failure to fully disclose relevant facts in the application.
3. A change in a condition that requires a temporary or permanent change in the activity.

J. An applicant who has received a wetland use permit under this Ordinance shall comply with the following in connection with any construction or other activity on the property for which the wetland use permit has been issued:

1. Maintain soil erosion control structures and measures, including but not limited to, silt fences, straw bale berms, and sediment traps. The permittee shall permit periodic inspections throughout the duration of the project by the (Township/Municipality) or it's representatives.
2. Maintain clear delineation of the protected wetlands and wetland setbacks (so marked by the Wetland Administrator or (Township/Municipality) Wetland Consultant during the on
3. Post on the site, prior to commencement of work on the site and continuing throughout the duration of the project, a copy of the approved wetland use permit containing the conditions of issuance, in a conspicuous manner such that the wording of said permit is available for public inspection.

K. The wetland use permit shall remain effective for a time period coincidental with any other land use permit reviewed and approved concurrent with the wetland use permit. If applied for prior to the expiration date and concurrent with the expiring land use permit, the applicant may be granted an extension that corresponds to additional time granted for the underlying land use permit. Extensions shall be approved by the same person or body that made the original decision. The maximum number of extensions shall coincide with the maximum number allowed for the underlying land use permit.

L. When there is no other activity or permit involved, the wetland use permit shall remain effective for one (1) year. A maximum of a one (1) year extension may be approved by the granting authority upon request of the applicant.

Section 7.6 - Review Standards And Criteria For Non-Contiguous Wetlands Less Than Two (2) Acres in Area.

A. A wetland use permit shall be approved with respect to a non-contiguous wetland less than two (2) acres in area unless the Planning Commission or (Township/Municipality) Board determines that the wetland is essential to the preservation of the natural resources of the (Township/Municipality). It shall not be the burden of the property owner to prove that the wetland is not essential to the preservation of the natural resources of the (Township/ Municipality).

B. All non-contiguous wetland areas of less than two (2) acres which appear on the wetlands map, or which are otherwise identified during a field inspection by the (Township/Municipality), shall be analyzed for the purpose of determining whether such areas are essential to the preservation of the natural resources of the (Township/Municipality). If there is to be a denial of a wetland use permit in a non

1. The site supports state or federal endangered or threatened plants, fish, or wildlife appearing on a list specified in Section 36505 of the Natural Resources and Environmental Protection Act (Act 451 of 1994 [previously Section 6 of the Endangered Species Act of 1974, Act No. 203 of the Public Acts of 1974, being Section 299.226 of the Michigan Compiled Laws]).
2. The site represents what is identified as a locally rare or unique ecosystem.
3. The site supports plants or animals of an identified local importance.
4. The site provides groundwater recharge documented by a public agency.
5. The site provides flood and storm control by the hydrologic absorption and storage capacity of the wetland.

6. The site provides wildlife habitat by providing breeding, nesting, feeding grounds or cover for forms of wildlife, waterfowl, including migratory waterfowl, and rare, threatened, or endangered wildlife species.
7. The site provides protection of subsurface water resources and provision of valuable watersheds and recharging groundwater supplies.
8. The site provides pollution treatment by serving as a biological and chemical oxidation basin.
9. The site provides erosion control by serving as a sedimentation area and filtering basin, absorbing silt and organic matter.
10. The site provides sources of nutrients in water food cycles and nursery grounds and sanctuaries for fish.

C. In connection with the determination whether the wetland is essential to the preservation of the natural resources of the (Township/Municipality), the property owner shall make an election and response under Subsection 1 or 2 below, relative to each non-contiguous wetland area less than two (2) acres.

1. In lieu of having the (Township/Municipality) or its consultant proceed with the analysis and determination, the property owner may acknowledge that one (1) or more of the criteria in Subsections (B-1) through (B-10) above, exist on the wetland in question, including a specification of the one or more criteria which do exist; or
2. An election to have the (Township/Municipality) or its consultant proceed with the analysis of whether each of the criteria in Subsections (B-1) through (B-10) exist or do not exist in the wetland in question, including specific reasons for the conclusion in respect to each criteria.

D. If the (Township/Municipality) determines that the wetland is not essential to the preservation of the natural resources of the (Township/Municipality), the (Township/Municipality's) decision shall be so noted on the (Township/ Municipality) Wetland Map, at the time it is amended. The requested activity shall be approved subject to all other applicable laws and regulations.

When a wetland under two (2) acres in size has been determined to be essential to the natural resources of the (Township/Municipality) and the (Township/Municipality) has found that one or more of the criteria set forth exist at the site, the (Township/Municipality) shall notify the applicant in writing stating the reasons for determining the wetland to be essential to the preservation of the natural resources.

After determining that a wetland less than two (2) acres in size is essential to the

preservation of the natural resources of the (Township/Municipality), the wetland use permit application shall be reviewed according to the standards in Section 7.7.

Section 7.7 - Review Standards for Wetland Use Permits

The criteria to evaluate wetland use permits under this Ordinance and to determine whether a permit is granted are as follows:

A. A permit for any activity listed in Section 5.1 shall not be approved unless the proposed activity is in the public interest and is otherwise lawful in all respects. Public input shall be evaluated in approving, approving with conditions, or denying the application. The reasonable use of the property involved in accordance with applicable local ordinances and state law shall also be considered.

In determining whether the activity is in the public interest, the benefit which reasonably may be expected to accrue from the proposal shall be balanced against the reasonably foreseeable detriments of the activity. The decision shall reflect the national, state, and local concern for the protection of natural resources from pollution, impairment, and destruction. The following general criteria shall be considered:

1. The relative extent of the public and private need for the proposed activity.
2. The availability of feasible and prudent alternative locations and methods to accomplish the expected benefits from the activity.
3. The extent and permanence of the beneficial or detrimental effects which the proposed activity may have on the public and private uses to which the area is suited, including the benefits the wetlands provide.
4. The probable impact of each proposal in relation to the cumulative effect created by other existing and anticipated activities in the watershed.
5. The probable impact on recognized historic, cultural, scenic, ecological, or recreational values and on the public health or fish or wildlife.
6. The size and quality of the protected wetland being considered.
7. The amount and quality of remaining wetland in the area.
8. Proximity to any waterway.
9. Extent to which upland soil erosion adjacent to protected wetlands or drainage ways is controlled.
10. Economic value, both public and private, of the proposed land change to the general area.
11. Findings of necessity for the proposed project which have been made by federal, state or local agencies.

B. A wetland use permit shall not be granted unless it is shown that:

1. An unreasonable disruption of aquatic resources will be avoided; and
2. The proposed activity is primarily dependent upon being located in the protected wetland; and
3. A feasible and prudent alternative does not exist; and
4. The manner in which the activity is proposed to be undertaken will result in the minimum negative impact upon protected wetlands, watercourses, and attendant natural resources under all of the circumstances.

C. Following approval of the application, a wetland use permit shall be issued upon determination that all other requirements of ordinance and law have been met, including site plan, plat or land use approval as applicable, and including issuance of a permit by the MDEQ, if required under the Wetland Protection Act. In cases where a MDEQ permit allows activities not permitted by the wetland use permit approval granted under this Section, the restrictions of the approval granted under this Section shall govern.

SECTION 8 - WETLAND MITIGATION AND RESTORATION

Section 8.1 - Findings That Wetland And Watercourse Loss Is Unavoidable

Mitigation shall not be considered a substitute for making all prudent attempts to avoid wetland impacts.

A. Prior to considering a proposal for wetland mitigation, the Wetland Administrator, the Planning Commission or the (Township/Municipality) Board, as applicable, shall make all of the following findings:

1. That all feasible and prudent efforts have been made to avoid the loss of protected wetland.
2. That all practical means have been considered to minimize protected wetland impacts.
3. That it is practical to replace the protected wetland which will be unavoidably eliminated.
4. That all alternatives for preserving protected wetlands and water courses have been evaluated and found to be impractical, inappropriate, or ineffective.

B. To ensure no net loss of wetlands in the (Township/Municipality), mitigation shall be required in instances where there are losses of wetland resources and where the Wetland Administrator, the Planning Commission or the (Township/Municipality) Board, as applicable have made the findings required in Section 8.1.A.

Section 8.2 - Criteria For Approving Proposals For Wetland Mitigation

If the Wetland Administrator, Planning Commission or the (Township/ Municipality) Board, as applicable determines that it is practical to replace the protected wetlands which will be impacted, mitigation plans shall be approved only if all of the following criteria are met:

A. That the mitigation plan provides for the substantial replacement of the predominant functional values of the protected wetland to be lost.

B. That the mitigation plan provides for no net loss of protected wetland resources and watercourses unless the Wetland Administrator, the Planning Commission or the (Township/Municipality) Board, as applicable determines that the net loss will result in a minimum negative impact upon protected wetlands, watercourses, and attendant natural resources under all of the circumstances.

C. Mitigation shall be provided on

D. The mitigation plan will comply with all applicable federal, state, and local laws.

E. A plan to monitor preserved and replacement wetlands over a minimum of five years has been specified.

Section 8.3 - Other Mitigation Requirements

A. Wetland mitigation and monitoring plans shall become conditions to the wetland use permit and shall be the responsibility of the applicant.

B. Financial assurances that mitigation is accomplished as specified by the permit condition may be required by the Wetland Administrator, Planning Commission or (Township/Municipality) Board, as applicable.

C. Any mitigation activity shall be completed before initiation of other permitted activities, unless a phased concurrent schedule can be agreed upon between the

Wetland Administrator, Planning Commission or (Township/Municipality) Board, as applicable, and the applicant.

D. Wetland mitigation plans that create less than two (2) acre wetlands shall meet one of the conditions listed in Section 7.6 B. 1

SECTION 9 - FEES, PENALTIES AND ENFORCEMENT

Section 9.1 - Fees

Applications for a wetland use permit under this Section shall be accompanied by a non-refundable administrative application fee in an amount specified from time to time by resolution of the (Township/ Municipality) Board. In addition an applicant shall pay an additional escrow fee in an amount determined by resolution of the (Township/Municipality) Board for the estimated cost of outside consultant(s) who may be retained by the (Township/Municipality) in connection with the review of the application. In the event the cost of the services of the consultant(s) is less than the escrow fee, the applicant shall be refunded the balance. In the event the cost of the services of the consultant(s) exceeds the amount of the escrow fee, the applicant shall pay the deficiency to the (Township/Municipality) prior to the issuance of a wetland use permit. A denial of an application for a wetland use permit shall not affect the applicant's obligation to pay the escrow fee provided for in this Section.

Section 9.2 - Penalties And Enforcement

A. Restoration Requirements for Illegal Wetland Alteration. In the event of a violation involving illegal alteration of a watercourse or protected wetland under this Section, the (Township/Municipality) shall have the power to order complete restoration of the watercourse or protected wetland area by the person or agent responsible for the violation. If such responsible person or agent does not complete such restoration within a reasonable time following the order, the (Township/Municipality) shall have the authority to restore the affected watercourse or protected wetland to their prior condition wherever possible, and the person or agent responsible for the original violation shall be held liable to the (Township/Municipality) for the cost of restoration. Requirements and watercourse or protected wetland restorations order by the (Township/Municipality) shall be coordinated with state and/or federal agency requirements and specifications for watercourse or wetland restoration.

B. Penalties. In addition to the rights and remedies herein provided to the (Township/Municipality) any person violating any of the provisions of this Ordinance shall be deemed guilty of a misdemeanor and upon conviction thereof shall be fined in an amount not exceeding Five Hundred Dollars ($500.00), or be imprisoned in the county jail for a period not exceeding ninety (90) days, or be both so fined and imprisoned. Each day such violation is continued or permitted to continue shall constitute a separate offense and shall be punishable as such hereunder.

C. Injunction. Any activity conducted in violation of this Section is declared to be a nuisance per se, and the (Township/Municipality) may commence a civil suit in any court of competent jurisdiction for an order abating or enjoining the violation, and/or requiring restoration of the protected wetland or watercourse as nearly as possible to its condition before the violation.

D. Stop-Work Order. The (Township/Municipality) may also issue a stop-work order or withhold issuance of a Certificate of Occupancy, permits or inspection until the provisions of this Ordinance, including any conditions attached to a wetland use permit, have been fully met. Failure to obey a stop-work order shall constitute a violation of this Ordinance.

E. Appearance Tickets. In all arrests and prosecutions for violation of this Ordinance, appearance tickets and the appropriate procedures set forth in Act 147, Michigan Public Acts of 1968, as amended, may be used.

F. Enforcement. The Wetlands Administrator or his/her agent, officer or employee shall have authority under this Ordinance to enter upon privately

SECTION 10 - STATE NOTIFICATION

Section 10.1 - Notice to the Michigan Department of Environmental Quality

The (Township/Municipality) shall notify the MDEQ of the adoption of this Ordinance. The (Township/Municipality) shall cooperate with the MDEQ in the enforcement of the Wetland Protection Act as to wetlands under the MDEQ's jurisdiction as defined under this Ordinance.

SECTION 11 - ORDINANCE CONFLICT

Section 11.1 - Abrogation and Conflict of Authority

Nothing in this Ordinance shall be interpreted to conflict with present or future state statutes in the same subject matter; conflicting provisions of this Ordinance shall be abrogated to, but only to, the extent of the conflict. Moreover, the provisions of this Ordinance shall be construed, if possible, to be consistent with relevant state regulations and statutes. If any part of this Ordinance is found to be invalid or unconstitutional by any court of competent jurisdiction, such portion shall be deemed a separate, distinct and independent provision. Such holding shall not affect the validity of the remaining portions thereof, and the remainder of the Ordinance shall remain in force. Rights and duties which have matured, penalties which have been incurred, proceedings which have begun (except as set forth in Section 5.3 and Section 6 herein) and prosecutions for violations of law occurring before the effective date of this Ordinance are not affected or abated by this Ordinance.

SECTION 12 - PROPERTY TAX ASSESSMENT

If a wetland use permit is denied by the (Township/Municipality), a landowner may appear at the annual Board of Review for the purpose of seeking a reevaluation of the affected property for assessment purposes to determine its fair market value under the use restriction.

SECTION 13 - EFFECTIVE DATE

This Ordinance shall take full force and effect upon _____ (date), following final publication of said ordinance.

SECTION 14 - CERTIFICATION

I, _____, Clerk of (Community Name)(Township/Municipality), do hereby certify that the foregoing is a true and correct copy of an ordinance adopted by the (Community Name)(Township/Municipality) Board at a regular meeting on _____(date).

Published _____(date)

MODEL ORDINANCES
Upper Rabbit River Watershed Implementation Project

Appendix 12

NPDES Permits within Allegan County

NPDES Permits: non-municipal wastewater

Designated Name	Type	Facility ID/Ver	Status	Address	County	District	City
Acro Inc-Fennville	STAND	26341.4	Active	258 Park Street	Allegan	Kalamazoo	Fennville
Allegan Metal Finishing	STAND	8640.2	Active	1274 Lincoln Road	Allegan	Kalamazoo	Allegan
Allied Paper No7 SF-Plainwell	STAND	115046.1	Active	200 Allegan Street	Allegan	Kalamazoo	Plainwell
Amoco Oil Co-Dorr	STAND	15441.3	Active	1831 142nd Avenue	Allegan	Kalamazoo	Dorr
Ano-Kal Co	STAND	9112.1	Active	734 Jersey Street	Allegan	Kalamazoo	Plainwell
Bay Valley Foods LLC	STAND	19900.7	Active	652 West Elm Street	Allegan	Kalamazoo	Wayland
Birds Eye Foods-Fennville	STAND	7633.6	Active	100 Sherman Street	Allegan	Kalamazoo	Fennville
Boerman Grocery	STAND	105565.1	Active	5631 109th Avenue	Allegan	Kalamazoo	Pullman
Boeve Oil Co-Allegan	STAND	15445.1	Active	521 Water Street	Allegan	Kalamazoo	Allegan
BRATS	STAND	13293.4	Active		Allegan	Kalamazoo	Otsego
Bruce Alan Enterprises	STAND	20956.2	Active	4301 28th Street	Allegan	Kalamazoo	Dorr
Clark Retail-Plainwell	STAND	16977.2	Active	665 Allegan Street	Allegan	Kalamazoo	Plainwell
Crystal Flash LP-Wayland	STAND	102524.1	Active	1155 Superior Street	Allegan	Kalamazoo	Wayland
Electro-Heat Inc	STAND	6341.2	Active	2870 M-222 East	Allegan	Kalamazoo	Allegan
Hamilton Farm Bureau Coop	STAND	19892.3	Active	4581 135th Avenue	Allegan	Kalamazoo	Hamilton
Hudsonville Ice Cream	STAND	19985.3	Active	4311 30th Street	Allegan	Kalamazoo	Burnips
Kalamazoo Lake WTP	STAND	9768.2	Active	22 Bayou	Allegan	Kalamazoo	Douglas
Kruger Commodities Inc	STAND	6529.2	Active	5900 Old Allegan Road	Allegan	Kalamazoo	Hamilton
Lakeside MHP WTP	STAND	113214.1	Active	1925 8th Street	Allegan	Kalamazoo	Martin
Lynx GC-Condo WWTP	STAND	28161.1	Active	M-89 at 108th Avenue	Allegan	Kalamazoo	Otsego
MDEQ-RRD-Jersey St	STAND	100781.2	Active	734 Jersey Street	Allegan	Kalamazoo	Plainwell
Otsego Paper Inc	STAND	20016.4	Active	320 North Farmer Street	Allegan	Kalamazoo	Otsego
Packerland-Plainwell	STAND	18477.7	Active	11 Eleventh Street	Allegan	Kalamazoo	Plainwell
Parker Hannifin-Brass Prod Div	STAND	20930.3	Active	300 Parker Drive	Allegan	Kalamazoo	Otsego
Parker Hannifin-Pump Div	STAND	20931.4	Active	100 Parker Drive	Allegan	Kalamazoo	Otsego
Perrigo Co-Plant No 1	STAND	9296.3	Active	117 Water Street	Allegan	Kalamazoo	Allegan
Perrigo Co-Plants No 4 & 5	STAND	9300.3	Active	502 Eastern Avenue	Allegan	Kalamazoo	Allegan
Plainwell Inc	STAND	20015.4	Active	200 Allegan Street	Allegan	Kalamazoo	Plainwell
Preferred Plastics Prod	STAND	9184.3	Active	800 East Bridge Street	Allegan	Kalamazoo	Plainwell
R L Coolsaet Const-Menasha	STAND	27573.1	Active	453 Agard Road	Allegan	Kalamazoo	Muskegon
Rich Products Corp	STAND	6357.2	Active		Allegan	Kalamazoo	
River Coatings Inc	STAND	9236.3	Active	602 Lincoln Road	Allegan	Kalamazoo	Otsego
Rock-Tenn Co-Otsego	STAND	9948.2	Active	431 Helen Avenue	Allegan	Kalamazoo	Otsego
US EPA-Plainwell Dam SF	STAND	114127.1	Active	Plainwell Dam, near 12th Street	Allegan	Kalamazoo	Plainwell
Wolverine Power Supply-Vandyke	STAND	20036.3	Active	3150 143rd Avenue	Allegan	Kalamazoo	Dorr

NPDES Permits: municipal wastewater

Designated Name	Type	Facility ID/Ver	Status	Address	County	District	City
Allegan WWTP	N-INDSW	9140.3	Active	350 North Street	Allegan	Kalamazoo	Allegan
Green Lake WWSL	N-INDSW	20544.3	Active	5th Street	Allegan	Kalamazoo	Caledonia
Hamilton Com Schools	N-INDSW	20472.3	Active	4845 136th Avenue	Allegan	Kalamazoo	Hamilton
Hopkins WWSL	N-INDSW	20228.2	Active	128 South Franklin	Allegan	Kalamazoo	Hopkins
Kalamazoo Lake WWTP	N-INDSW	9096.3	Active	6449 Old Allegan Road	Allegan	Kalamazoo	Saugatuck
Moline WWSL	N-INDSW	9641.2	Active	11th Street	Allegan	Kalamazoo	Moline
Moline WWTP	N-INDSW	14673.2	Active	11th Street	Allegan	Kalamazoo	Moline
Otsego WWTP	N-INDSW	20253.2	Active	210 North Grant Street	Allegan	Kalamazoo	Otsego
Plainwell WWTP	N-INDSW	9188.4	Active	129 Fairlane Street	Allegan	Kalamazoo	Plainwell
Rabbit River Estates MHC	N-INDSW	20537.3	Active	774 135th Avenue	Allegan	Kalamazoo	Wayland
Saugatuck Twp WWTP	N-INDSW	16881.2	Active	Old Allegan Road	Allegan	Kalamazoo	Saugatuck

Groundwater discharge permits

Designated Name	Type	Facility ID/Ver	Status	Address	County	District	City
Aggregate Industries-Pullman	GWCOM	26455.5	Active	905 46th Street	Allegan	Kalamazoo	Pullman
Konos Inc	GWCOM	102749.1	Active	1240 8th Street	Allegan	Kalamazoo	Martin
Wayland WWTP	GWMSW	104373.2	Active	800 137th Avenue	Allegan	Kalamazoo	Wayland