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Buck Creek
Watershed Management Plan





Prepared for

Grand Valley Metropolitan Council
as part of the
Lower Grand River Watershed Project

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BUCK CREEK

WATERSHED MANAGEMENT PLAN

DECEMBER 2003

PROJECT NO. G02408

FISHBECK, THOMPSON, CARR & HUBER, INC. **Engineers • Scientists • Architects**
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The Lower Grand River Watershed Project was initiated through the work of many individuals, representing the following organizations, who participated in the Grand River Forum and the various committees and subcommittees involved in this watershed planning effort. Their contributions to this effort resulted in a realistic document for present and future watershed stakeholders to use in managing their valuable resources:

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Ms. Janice Tompkins	Michigan Department of Environmental Quality (MDEQ)
Mr. James E. Smalligan, P.E.	Fishbeck, Thompson, Carr & Huber, Inc. (FTC&H)
Ms. E. Wendy Ogilvie	FTC&H
Mr. Jason E. Buck	FTC&H
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Mr. Scott Conners	City of Walker
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EXECUTIVE SUMMARY

The Buck Creek Watershed (Watershed) drains approximately 51 square miles from its headwaters in southern Kent County to where it enters the Grand River in the City of Grandville. Many of the tributaries and a few sections of Buck Creek are maintained as designated county drains. Stretches of Buck Creek and many of the tributaries are also designated coldwater streams and could support viable populations of brown trout if water quality were improved.

The headwaters of Buck Creek are located in Byron and Gaines Townships, Michigan, where agricultural areas are becoming increasingly urbanized. Pine Hill Creek and Sharps Creek flow west through the City of Kentwood, and enter Buck Creek in the residential areas of the City of Wyoming. From the City of Wyoming, Buck Creek flows through the completely urbanized area of the City of Grandville where it enters the Grand River.

Water Quality Concerns

Sediment, pathogens, and nutrients are degrading the Watershed. The 1992 Michigan Department of Environmental Quality (MDEQ) biological survey report on Buck Creek rated the fish community structure as good (slightly impaired) to fair (moderately impaired). Macroinvertebrate communities were degraded at all survey stations, ranging from fair to poor (severely impaired). Overall stream quality of Buck Creek was rated fair to poor. The survey rated the physical condition as good to poor, with sedimentation identified as contributing to the severe impact on the macroinvertebrate communities. The report stated that storm water runoff was contributing substantially to flow fluctuations, which were impacting the macroinvertebrate communities by periodically scouring the streambed (MDEQ, 1992). Other urban pollutants of road salt, hydrocarbons, and other chemicals were also identified as possibly impairing Buck Creek.

The communities that include portions of the Watershed are: Byron Township, Gaines Township, the City of Kentwood, the City of Wyoming, the City of Grandville, and a very small portion in the City of Grand Rapids. All of these communities are required to obtain storm water permits through the National Pollutant Discharge Elimination System (NPDES) Phase II storm water program. These communities recognized the importance of monitoring and reducing storm water runoff to the streams and drains in their communities and have participated in the development of this Watershed Management Plan (WMP) for Buck Creek.

In the late 1980s, a series of water contamination events in Kent County served to increase public interest in the quality of local rivers and streams. Local governments began giving surface water quality closer scrutiny, examining root causes and contaminates, and the role of existing infrastructure in contamination events. The Kent County Board of Health, on September 9, 1988, adopted a resolution that called for the Kent County Health Department to develop a "...water quality surveillance and assessment procedure to be used in gathering information concerning the relative healthfulness of rivers and streams in Kent County." This information has identified areas of water quality impairments.

Section 303(d) of the Federal Clean Water Act and the United States Environmental Protection Agency's (EPA) require states to develop Total Maximum Daily Loads (TMDLs) for water bodies that are not meeting Water Quality Standards (WQS). The TMDL process establishes the allowable loadings of pollutants for a water body based on the relationship between pollution sources and instream water quality conditions. TMDLs provide a basis for determining the pollutant reductions necessary from both point and nonpoint sources to restore and maintain the quality of their water resources. The MDEQ has included a portion of Buck Creek, a 10-mile stretch from the Grand River confluence upstream to 68th Street, on the 303(d) non-attainment list for exceeding WQS for the pathogen, *E. coli.*

The 2003 physical inventory of the Buck Creek Watershed found the most abundant sources of nonpoint source (NPS) pollution to be trash and debris. The majority of the trash and debris sites were grass clippings and other yard waste, which add excessive nutrients to the streams. The construction sites noted were mostly associated with the new M-6 crossing over Buck Creek and the railroad ditch, causing sedimentation in the streams. Rill and gully erosion, which delivers sediment to the streams, was observed at a few sites in the City of Wyoming. Livestock have unlimited access to a tributary in Gaines Township, adding sediment from eroded streambanks and nutrients from their waste to the stream. Streambank erosion was observed mostly in the residential and commercial areas of the Watershed, where obvious human activities had disturbed the riparian buffer and allowed sediment to enter the stream. Urban NPS pollution was identified as turf runoff from residential lawns, which adds nutrients to the stream, and storm water runoff from impervious surfaces, which possibly adds road salt and increases water temperatures.

The State of Michigan has identified certain designated uses that all waters of the state must meet. The following table defines the status of the designated uses for the Watershed, in order of their priority to address:

Designated Use	Status of Designated Use	Pollutants
Coldwater fishery	Moderately impaired north of 84th Street to limits of City of Grandville. Severely impaired in Lemery Park and Burlingame Avenue areas	Sediment (k)
	Slightly impaired in the City of Grandville	Road salt (s)
	Might pose a threat	Temperature (s)
Partial body contact recreation	Fishing opportunities are impaired	Pathogens *(E. coli)* (k)
Total body contact recreation	Swimming (wading at Palmer Park) is impaired	Pathogens *(E. coli)* (k)
Coolwater fishery	Moderately impaired in the City of Grandville	Sediment (k)
	Slightly impaired in the City of Grandville	Road salt (s)
Warmwater fishery	Slightly to moderately impaired south of 84th Street	Sediment (k)
Other indigenous aquatic life and wildlife	Moderately to severely impaired habitats	Sediment (k)
Agriculture	WQS being met	
Industrial supply	WQS being met	
Navigation	Not a use	
Public water supply	Not a use	

(s) = suspected
(k) = known

Sediment originates from streambank erosion and runoff from construction sites, agricultural operations, and storm water. The suspected sources of *E. coli* are failing septic systems, concentrations of wildlife, agricultural operations, and pet waste. Nutrients enter the surface waters from mostly residential areas where lawns at the edges of streams allow fertilizers and yard waste to run off into the streams.

Goals and Objectives

The water quality goals are based on improving or restoring the designated uses of the Watershed and attaining compliance with the *E. coli* TMDL established in Buck Creek. The following long-term goals for the Watershed have been determined:

- Improve or restore the coldwater and coolwater fisheries
- Improve and protect the safety and enjoyment of fishing, canoeing, and swimming
- Improve or restore the warmwater fishery
- Improve and protect the habitats for other indigenous aquatic life and wildlife

The short-term objectives to reduce sediment in the Watershed are:

- Stabilize stream flows to moderate hydrology and increase base flow
- Protect riparian buffers through setbacks and buffer ordinances
- Adopt storm water ordinance
- Reduce soil erosion and sedimentation from construction sites
- Encourage cover crops and no-till practices
- Install livestock exclusion fencing and filter strips
- Stabilize improperly installed stream crossings
- Reduce impervious surfaces

The short-term objectives for reducing *E. coli* inputs in the Watershed are:

- Determine TMDL for *E. coli* and reduce inputs to meet water quality standards of 1,000 count/100 ml
- Encourage proper installation and maintenance of septic systems
- Encourage sanitary sewers in areas serviced by water utilities
- Install livestock exclusion fencing and controlled access sites
- Reduce the amount of pet waste entering waterways
- Control urban wildlife populations of geese and raccoons
- Locate and remove or correct illicit connections to storm sewers

The short-term objectives to reduce nutrients in the Watershed are:

- Encourage composting and curbside collection of yard wastes
- Encourage “Landscaping for Water Quality” techniques
- Install livestock exclusion fencing and filter strips
- Reduce the use of fertilizers with phosphorous in riparian and lakeside areas
- Require buffers between land disturbance activities and surface waters
- Encourage proper installation and maintenance of septic systems
- Encourage sanitary sewers in areas serviced by water utilities
- Locate and remove or correct illicit connections to storm sewers

The short-term objectives for reducing the amount of trash and debris in the Watershed are:

- Remove trash and log jams according to woody debris management principles
- Stabilize stream flows to moderate hydrology and increase base flow
- Institute an annual free trash collection day for household items and refuse
- Increase visibility of “No Dumping” signs
- Increase patrols in areas that have high volumes of trash dumped frequently

Desired uses of the Watershed reflect how the community wants to use the Watershed and what activities should be promoted within the Watershed. The ideas discussed for the Watershed include incorporation of smart growth techniques, increased education about watersheds and stewardship, and the use of the Watershed as a demonstration area of urban Best Management Practices (BMPs) as an example for the entire Lower Grand River Watershed (LGRW).

Recommendations

The LGRW Steering Committee (Committee) prepared the goals and objectives for each impairment to the designated uses and the directive to attain a TMDL for *E. coli* in the Watershed and developed recommendations for action. BMP recommendations were based on the underlying cause of the source of the impairment. The recommendations include structural and vegetative BMPs, management and policy BMPs, and information and education activities. The structural and vegetative BMPs were based on the findings of the Watershed inventory and the existing storm water management activities of local governments, which provided details about urban BMPs, their costs, frequency of use, and efficiency. The management and policy recommendations were based on preliminary reviews of local and state ordinances and regulations, and discussed at the meetings with the communities during the planning process. The information and education BMPs were derived from the Information and Education (I&E) Strategy and the NPDES Phase II Public Education Plan. The BMP recommendations are summarized in Table 6.1.

Evaluation

Evaluation of the Watershed project will be a two-phase process. The first phase evaluates the success of the planning process, divided into five areas of focus: Assessment and Characterization of the Watershed’s Natural Resources and Water Quality Conditions, I&E Strategy, Creating a System of Regional Governance for the Watershed, Reviewing and Recommending the Adoption of BMPs, and the Management Process for the project. The second phase of the evaluation will measure the success of the project following the implementation of the prioritized BMPs. The evaluation criteria were selected based

on the pollutants identified as impairments to the designated uses. This evaluation will determine the level and rate of water quality improvements, which are achieved in areas of physical, chemical, and biological improvements.

Sustainability

The Lower Grand River WMP will be a broad, reference-oriented document that builds upon and elevates existing efforts in the Watershed. The members of the Grand River Forum recognized that the plan should take a holistic, ecosystem approach and provide a vision for the entire Watershed under which to operate, with guidelines and recommendations to follow to achieve that vision. The Buck Creek WMP will provide the details on the recommendations to reach the overall goals and objectives of the Lower Grand River WMP. The remedies for the impaired urban areas of the Watershed will provide opportunities for other urban and urbanizing areas to evaluate management measures used and determine which management measure would be best for their particular situation. The “watershed-based” permit, under which the communities in the Watershed applied for their NPDES Phase II Storm Water permit, allows flexibility on how they develop and implement a storm water management plan. This WMP will be the basis on which the Phase II communities will write their Storm Water Pollution Prevention Initiative, which explains how each community will implement the recommendations of the Buck Creek WMP.

The LGRW Committee provides oversight and direction to the project and is responsible for all goals and objectives of the planning project to be completed. The Committee has met monthly since the project began and has coordinated efforts to ensure that the project is representative of as many interests and concerns as possible in the Watershed. The Committee will continue to meet after the project is completed as an organization, group, or council, and the structure of which will be determined by the end of the project.

CHAPTER 1 - INTRODUCTION

The quality of Buck Creek is influenced by many factors, such as human activities within the Buck Creek Watershed (Watershed), physical and biological characteristics of the natural resources, and the management of those resources. This document provides an overview of these diverse aspects of the Watershed and the strategies to improve this valuable resource.

1.0 PURPOSE OF BUCK CREEK WATERSHED MANAGEMENT PLAN (WMP)

The Watershed is one of the three urban areas selected as pilot project areas for the Lower Grand River Watershed (LGRW) Project. The Watershed was selected because of its diverse land uses, which provide for innovative solutions to urban and rural storm water issues. The Buck Creek WMP will provide detailed information about the sources and causes of the pollutants that are impairing the uses of Buck Creek and recommendations of the management measures needed to address the impairments. The Buck Creek WMP will be a model for other subwatersheds within the LGRW on which to base their planning efforts for improving water quality.

1.1 PUBLIC PARTICIPATION PROCESS FOR DEVELOPING WMP

The Urban Subcommittee (Subcommittee) was formed out of the greater membership of the Grand River Forum to specifically focus on urban issues within the LGRW. Members volunteered to serve on the Subcommittee because of their knowledge or interest in planning for resource protection in urban settings. The members are listed in Table 1.1. One of the first tasks of the Subcommittee was to develop selection criteria for the urban pilot project area for developing a watershed management plan. Criteria was selected from the Watershed Information Matrix (WIM), which was created to include information about all of the subwatersheds in the LGRW in the categories of water quality, watershed planning, land use planning, local participation, and regional planning. An excerpt of the WIM, illustrating information for the urban pilot project areas, is included in Appendix 1. The WIM was used to narrow the field of subwatersheds to select the pilot project areas that met the selection criteria. The Subcommittee agreed that the following criteria were most importance for an urban or developing area:

- Defined as an urban area according to land use categories
- Includes National Pollutant Discharge Elimination System Phase II communities
- Includes waters on the Michigan Department of Environmental Quality (MDEQ) 303(d) non-attainment list for Total Maximum Daily Load
- The MDEQ - Surface Water Quality Division Biosurveys information available

- MDEQ stream Crossing inventory completed
- Geographic Information System (GIS) layers of storm sewer and land use planning available
- High percentage of impervious cover
- Development pressures
- Existence of storm water master plan
- Local environmental leadership
- High potential for water quality improvement success

Using the WIM, the Subcommittee was able to narrow the selection of areas to the following three subwatersheds; Buck Creek Watershed, Millennium Park Watershed, and Grand City Watershed. Once selected, these areas were delineated and the planning process began. A watershed inventory and road crossing inventory were conducted to find nonpoint source (NPS) pollution sites.

A tour of sites in and around the Watershed highlighted areas where urban Best Management Practices (BMPs) had been implemented to reduce the effects of storm water runoff. The Cities of Grandville and Wyoming demonstrated practices, such as hydrodynamic separator units and vegetated swales, that were being considered for recommendation in the Buck Creek WMP. Educational opportunities were provided to ensure that the members of the Subcommittees making these decisions understood the benefits and impacts that these BMPs can have on the watersheds.

The involvement of the local governments is essential to the success of the WMP implementation. The local officials need to be able to answer questions about how the BMPs are used, what are the costs associated with the BMPs, what does the WMP mean to the local governments, and how will the WMP affect both the local governments and the residents. Meetings with each municipality in the Watershed were held to present the WMP and get input and comments from the local officials.

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1.2 COORDINATION WITH LOWER GRAND RIVER WATERSHED MANAGEMENT PLAN

The Lower Grand River WMP will be a broad, reference-oriented document that builds upon and elevates existing planning efforts in the LGRW. The members of the Grand River Forum (Forum) recognized that the plan should take a holistic, ecosystem approach and provide a vision for the entire Watershed under which to operate, with guidelines and recommendations to follow to achieve that vision. The Buck Creek WMP will provide the details on the recommendations to reach the overall goals and objectives of the Lower Grand River WMP. The remedies for the impaired urban areas of the Watershed will provide opportunities for other urban and urbanizing areas to evaluate management measures used and determine which management measure would be best for their particular situation. The recommendations will be able to be extrapolated from the urban areas into other areas of the LGRW experiencing similar problems.

The Forum meetings are an opportunity for residents, local officials, watershed coordinators, and other interested individuals to express their concerns and desires for the management of the Grand River Watershed. The members, at one of the early meetings, prioritized the concerns of water quality and water quantity. The highest concerns in the LGRW were impacts from development, bacteria, storm water, sediment, hydrology, and protection of wetlands. Goals and desired uses of the Watershed included recreational use, habitat, and educational opportunities. Steps listed that might be taken to reach the goals were smart growth techniques, enforcement of existing regulations, use of buffer zones along waterways, and public education.

The LGRW Steering Committee (Committee) provides oversight and direction to the project and is responsible for all goals and objectives of the planning project to be completed. The members of the Committee are listed in Table 1.2. The Committee has met monthly since the project began and has coordinated efforts to ensure that the project is representative of as many interests and concerns as possible in the Watershed. The Committee will continue to meet after the project is completed as an organization, group, or council, the structure of which will be determined by the end of the project.

Table 1.2 - Steering Committee Members

Name		Address	City	State	Zip	E-mail	Phone Number
Mr. Paul Geerlings	Ottawa County Drain Commissioner	414 Washington Avenue, Room 107	Grand Haven	MI	49417-1494	pgeerli@co.ottawa.mi.us	616-846-8220
Mr. Brian Donovan	City of East Grand Rapids	750 Lakeside Drive, SE	East Grand Rapids	MI	49506-3092	bdonovan@eastgr.org	616-940-4817
Ms. Erika Rosebrook	Kent County Administration	300 Monroe Ave, NW	Grand Rapids	MI	49503	Erika.Rosebrook@kentcounty.org	616-336-8768
Mr. Jim Beelen	Allendale Township	P.O. Box 539	Allendale	MI	49401-0539	jbeelen@altelco.net	616-895-6295
Mr. Corky Overmyer	City of Grand Rapids	1300 Market Ave, NW	Grand Rapids	MI	49503	covermye@ci.grand-rapids.mi.us	616-456-4636
Mr. Jim Holtvluwer	Georgetown Township	P.O. Box 769	Jenison	MI	49429-0769	supervisor@gtwp.com	616-457-2340
Mr. Jim Oosting	Coldwater River Watershed	10250 Morse Lake Road	Alto	MI	49302	jro6234@aol.com	616-891-8444
Ms. Janice Tompkins	MDEQ - Water Division	350 Ottawa Avenue, NW	Grand Rapids	MI	49503	tompkinsj@michigan.gov	616-356-0268
Mr. Scott Conners	City of Walker	4243 Remembrance Road	Walker	MI	49544	sconners@ci.walker.mi.us	616-791-6792
Ms. Kristine Huizen	Frey Foundation	40 Pearl NW, Suite 1100	Grand Rapids	MI	49503	huizen@freyfdn.org	
Mr. Andy Bowman	Grand Valley Metro Council	40 Pearl Street, Suite 401	Grand Rapids	MI	49503	bowmana@gvmc.org	616-776-3876
Mr. Tom Doyle	Barry County Drain Commissioner	220 West State	Hastings	MI	49058	tdoyle@barrycounty.org	616-948-4879
Mr. James Smalligan, P.E.	Fishbeck, Thompson, Carr & Huber, Inc.	1515 Arboretum Drive, SE	Grand Rapids	MI	49546	jesmalligan@ftch.com	(616) 575-3824

Table 1.2 - Steering Committee Members

Name		Address	City	State	Zip	E-mail	Phone Number
Ms. E. Wendy Ogilvie	Fishbeck, Thompson, Carr & Huber, Inc.	1515 Arboretum Drive, SE	Grand Rapids	MI	49546	ewogilvie@ftcg.com	(616) 575-3824
Mr. Jason E. Buck	Fishbeck, Thompson, Carr & Huber, Inc.	1515 Arboretum Drive, SE	Grand Rapids	MI	49546	jebuck@ftcg.com	(616) 575-3825
Mr. John Koches	GVSU - Annis Water Resource Institute	740 West Shoreline Drive	Muskegon	MI	49441	kochesj@gvsu.edu	(616) 331-3722
Ms. Abigail Matzke	GVSU - Annis Water Resource Institute	740 West Shoreline Drive	Muskegon	MI	49441	matzkea@gvsu.edu	(616) 331-3723
Ms. Laurie Beth Nederveld	GVSU - Annis Water Resource Institute	740 West Shoreline Drive	Muskegon	MI	49441	nedervla@gvsu.edu	(616) 331-3724

CHAPTER 2 - DESCRIPTION OF BUCK CREEK WATERSHED

2.0 STUDY AREA

The headwaters of Buck Creek are in light agricultural and urban developing areas of Byron and Gaines Townships in southern Kent County, Michigan. Pine Hill Creek and Sharps Creek flow west through the City of Kentwood, and enter Buck Creek in the residential areas of the City of Wyoming. From Wyoming, Buck Creek flows through the City of Grandville where it enters the Grand River (Figure 1). The Buck Creek Watershed (Watershed) drains approximately 51 square miles, with many of the tributaries and sections of Buck Creek maintained as designated county drains. Stretches of Buck Creek and many of the tributaries are also designated coldwater streams and could support viable populations of brown trout if water quality were improved (Figure 2).

The communities in the Watershed are growing rapidly and are planning for continued growth. Most of the Watershed is privately owned and could be affected by future development since Buck Creek runs through a variety of potential development areas.

2.1 SOIL DESCRIPTION

The soils in the Watershed are the result of glacial processes that occurred during the Wisconsin glacial period. Two lobes of this glacier, the Michigan and the Saginaw, met in Kent County forming a complex system of moraines and till plains. Glacial melt water formed huge valleys with rivers that are much larger than the creeks and streams found in the same valleys today. The Watershed is an example of one of these systems consisting of nearly level valleys and lake plains with well defined boundaries. The Watershed has some of the thinnest glacial drift in Kent County. The lower reaches of the Watershed near Grandville and Wyoming have layers of bedrock within a few feet of the surface (USDA, 1983).

The Watershed can be generally categorized by several soil associations. Northern areas of the Watershed above the creek valley are made up of well drained sandy soils in the Plainfield-Oshtemo-Spinks Association. These soils are not suited to agriculture, although the well drained nature of these soils make them excellent building sites. The poor filtering capacity of the soils, however, are not suited for septic systems (United States Department of Agriculture (USDA), 1983).

The Buck Creek valley, from Grandville upstream to Allegan County, has soils that fall into the Houghton-Cohoctah-Ceresco Association. These soils are nearly level, poorly drained, and are formed in organic material in alluvial deposits. Soils in this association have deep surface layers of dark muck. These soils are typically drained and used to cultivate specialty crops like celery, carrots, and lettuce. These sites are not suited for building sites or septic systems due to excessive wetness and seasonal ponding (USDA, 1983).

The headwaters of the tributaries that enter Buck Creek from the east are in the Ithaca-Rimer-Perrinton Association. The soils in this association are nearly level to gently rolling hills formed in glacial deposits. Drainage varies from somewhat poorly drained to well drained. These soils are well suited for cultivation, pasture, and woodland if protected from seasonal wetness and soil blowing. These sites are not recommended for building sites due to high shrink-swell potential and wetness (USDA, 1983).

The Watershed's western boundary and ridges between tributaries are made up of soils in the Marlette-Chelsea-Boyer Association. These soils are gently rolling to very steep, well drained soils formed in sandy glacial deposits. These soils vary widely in their ability to be used for both building sites and cultivation since slopes can range from 6% to 45%. Less steep slopes are usually well suited for building sites and septic leach fields (USDA, 1983).

2.2 HYDROLOGIC SOILS GROUPS

Hydrologic soil groups, which indicate the soil's runoff potential and drainage characteristics, are beneficial tools for predicting a watershed's response to storm events. The grouping is based on the inherent capacity of the soil, without vegetation, to permit infiltration. Group A soils have rapid infiltration and low runoff potential, while Group D soils have very slow drainage and high runoff potential. When soils are classified with two groups (i.e., A/D), the first letter represents the artificially drained condition and the second letter represents the soil's natural drainage condition. If a Group D soil is artificially drained with a resulting hydrologic characteristic of a Group A soil, the soil would be classified as a Group A/D soil (Marsh, 1998).

Group A Soils: High Infiltration rate, low runoff potential. Well drained to excessively drained sands or gravelly sands, High rate of water transmission. The northern and upland areas of the Watershed are mostly in this soil group.

Group B Soils: Moderate infiltration rates. Moderately well to well drained. Moderately fine to medium coarse texture, moderate rate of water transmission. The western portions and ridges of the Watershed are mostly this soil group.

Group C Soils: Slow infiltration rate. Has layers that impedes downward movement of water moderately fine to fine texture, slow rate of water transmission. The soils in the headwaters of the Watershed are in this soil group.

Group D Soils: Very slow infiltration rate, high runoff potential. Clays with high shrink/swell potential. Permanent high water table. Clay pan or clay layer at or near surface. Shallow over nearly impervious material. Very slow rate of water transmission. Most of the Buck Creek valley and areas in the southern portion of the Watershed that are drained for agriculture are associated with this soil group.

2.3 PRIME FARMLAND SOIL

The 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. Areas in the Watershed classified as prime farmland when drained are generally found in lower areas in the Buck Creek valley and along the outwash plain in Gaines Township.

2.4 STREAM HYDROLOGY

The Watershed is classified as a low gradient stream with groundwater base flows. Stream gradients in the Watershed are between 4 to 10 feet of drop per mile of stream in an unconfined groundwater aquifer. This type of stream is vulnerable to storm water runoff since its stream morphology is not capable of handling rapid fluctuations of surface water runoff (Schuler, 2000). In predevelopment conditions, storm water infiltrated into the ground and slowly made its way to the creek via groundwater flows. This type of system has stable base flow and coldwater temperatures that supported the coldwater fishery. Today, unstable hydrology due to storm water runoff is suspected to be the leading cause of streambank erosion in the Watershed. Eroding streambanks have caused trees to fall into the stream creating logjams and woody debris obstructions. These obstructions impede stream flow and are suspected to cause upstream flooding.

Stream hydrology and sediment transport are greatly affected by imperviousness of a watershed. In natural environments, trees and vegetation intercept storm water and slow the flow of runoff to the stream or river system. As development occurs, permeable land and wetlands are converted to impervious surfaces like roads, rooftops, and driveways. This eliminates most of the lands capacity to slow runoff by storing storm water flows and allowing infiltration.

The rapid fluctuations in Buck Creek's hydrology result from excessive storm water runoff. About 13% of the Watershed is covered with impervious surfaces, such as pavement and roofs, which contribute to pollution from storm water runoff (Watershed Generation Software, 2003). The City of Wyoming, the City of Kentwood, and Byron Township have storm water master plans for Buck Creek. The storm water master plans require new developments to maintain storm water runoff rates that will not cause downstream flooding. However, older developments prior to storm water management have inadequate onsite storm water retention that has resulted in localized flooding in the Cities of Wyoming and Grandville (Fishbeck, Thompson, Carr & Huber, Inc. (FTC&H) 2000).

A flood mitigation study of Buck Creek, completed for the Kent County Drain Commissioner, reviewed the hydrology of the creek and the feasibility of using regional detention. The study determined that regional detention of storm water was not feasible since the available open space for the detention ponds would not provide adequate capacity for storm water runoff storage. The study concluded that enlarging road crossings, removing log jams and debris, and installing floodway diversions would increase the stream capacity (FTC&H, 2000).

Prior to development, Buck Creek experienced bankfull flows at the one- and two-year rain events. These flows have the greatest effect on shaping stream channels. Development increases impervious surface and thus increases the frequency of bankfull events. Even with storm water regulations that require developments to maintain predevelopment runoff rates, the frequency of these events still increases due to increased impervious surface area (FTC&H, 2000).

Many of the tributaries to Buck Creek are channelized and maintained by the Kent County Drain Commissioner. The majority of the drainage districts in the Watershed are found in Gaines Township and the City of Kentwood. A list of all designated drains can be found in Table 2.1.

Table 2.1 - Local Rules and Regulations for Land and Water

Rules and Regulations	Kent County Road Commission	Kent County Drain Commissioner	Kent County Health Department	USDA, Natural Resources Conservation Service	Wyoming Clean Water Plant	Byron Township	Gaines Township	City of Wyoming	City of Kentwood	City of Grandville	City of Grand Rapids
Designated County Drains						Cutlerville	Van Oosten	Beman and Foley	Heyboer	Beman and Foley	
						Byron-Gaines Buck Creek Extension	Pine Hill Creek (Crippen)	Vanmannan	Pine Creek		
						Goose Creek	Cutlerville	Heyboer	Lyle Street		
						Winchester	Byron-Gaines Buck Creek Extension	Buck Creek	Lyle Street (Sophia Branch)		
						Carlisle	Sharps Creek	Meadowview Estates	Lyle Street (South Branch)		
						Willard	McDowell	Division Avenue	Slobe		
						Lanting	Van Schill		Crippen		
						Hudson	The Crossings		Home Acres		
						Ewing	Cryster Creek		40th Street		
						Mink Creek	Denbraber		South Lawn		
						Piedmont Industrial Park	Vantage Point				
						Buck Creek (Weaver)	Waterman				
						76th Street Industrial Park	Fennema				
						Matt Street					
						68th Street					
Soil erosion and sedimentation control	CEA, APA	APA							APA, MEA		APA, MEA
Storm water master plan	NO	NO	NO	NO	NO	YES	NO	YES	YES	NO	NO
Storm water ordinance		Developed Kent County model storm water ordinances				NO	NO	NO	NO	NO	NO

Table 2.1 - Local Rules and Regulations for Land and Water

Rules and Regulations	Kent County Road Commission	Kent County Drain Commissioner	Kent County Health Department	USDA, Natural Resources Conservation Service	Wyoming Clean Water Plant	Byron Township	Gaines Township	City of Wyoming	City of Kentwood	City of Grandville	City of Grand Rapids
Wetlands protection				WRP							
Stream protection ordinance											
Forest preservation				FIP							
Agricultural operations				EQIP, CRP							
Native vegetation ordinance											
Storm water treatments								Vortech units			
Land use planning											
Septic system maintenance											

CEA = County Enforcing Agent
APA = Authorized Public Agency
MEA = Municipal Enforcing Agency

2.5 NATURAL RESOURCES

Buck Creek provides recreational uses such as fishing, canoeing, wading, and wildlife watching to the many residents in the area. The creek is a highly visible natural feature in Douglas Walker Park in Byron Township and the Buck Creek Natural Area and Ideal Park in the City of Wyoming.

The Michigan Department of Natural Resources (MDNR) has designated all tributaries to the Grand River, except the Flat and Thornapple Rivers and Plaster and Rush Creeks, as trout streams. The 2003 Michigan Fishing guide covers all general fishing regulations and is in effect from April 1, 2003, through March 31, 2004. Buck Creek is designated as a Type 4, coldwater stream. The major tributaries to Buck Creek are designated Type 1, coolwater and warmwater streams. The 1992 Michigan Department of Environmental Quality biological survey report recorded the length and frequency data for brown trout in Buck Creek. Overall, eight fish were collected, ranging in size from 5 inches to 11 inches. The MDNR has regularly stocked Buck Creek with various strains of brown trout at eight different locations. Records from 1979 indicate that approximate 10,000 brwon trout, from 5 inches to 8 inches in length, have been introduced in the spring every year.

The Michigan State University Extension keeps a list of state and federally listed threatened and endangered species. Many of the species listed in the natural features inventory require wetland or native prairie habitats that are rapidly vanishing as development expands into the Watershed (Table 2.2).

Prior to settlement, the Watershed was primarily sugar maple and beech forests and forested wetlands. In the mid 1800s clear-cut logging removed trees from most areas in the Lower Peninsula (Michigan Natural Features Inventory, 2003). The Watershed was then used primarily for agriculture and pasture. During this period, the City of Grandville was established and surface mining of gypsum, gravel, and marl began to take place in Wyoming. Past mining operations are evident by the many artificial lakes northeast of Grandville and in Wyoming. Flooding that occurred in the Grand River floodplain and along Buck Creek left these areas relatively undeveloped. Today, many miles of forested riparian buffers still exist in the Cities of Grandville and Wyoming.

2.6 LAND USE

Land use in the Watershed is primarily suburban residential and commercial. Residential land use makes up 25% of the Watershed's area or about 8,500 acres. Another 2,900 acres is occupied by commercial land uses and only 200 acres are industrial. This translates into roughly 13% of the Watershed being impervious surfaces. Research completed by the Center for Watershed Protection suggests that watersheds greater than 10% impervious area will be impaired by excessive storm water runoff volume, velocity, and pollution (Schueler, 2000).

Land use changes in the Watershed have been characterized by outward growth into southern Gaines and Byron Townships. Both townships have experienced rapid growth over 20% from 1990 to 2000. This growth trend is continuing a pattern of low-density residential developments that began in the Cities of Wyoming and Kentwood between 1970 and 1980 along county arterial roads. Transportation improvements to accommodate growing rural populations has resulted in construction projects and road widening on many county roads in Gaines and Byron Townships. Rapid expansion of suburban residential development typically outpaces the growth of urban services. The result is an increase in the use of septic systems. This is most noted in communities in southern Gaines and Byron Townships.

Table 2.2 - Buck Creek Natural Features Inventory

Scientific Name	Common Name	State Status
Acris crepitans blanchardi	Blanchard's Cricket Frog	Special Concern
Adlumia fungosa	Climbing Fumitory	Special Concern
Arabis missouriensis var. deamii	Missouri Rock-cress	Special Concern
Astragalus neglectus	Cooper's Milk-vetch	Special Concern
Euphorbia commutata	Tinted Spurge	Threatened
Galearis spectabilis	Showy Orchis	Threatened
Gymnocladus dioicus	Kentucky Coffee-tree	Special Concern
Hydrastis canadensis	Goldenseal	Threatened
Lithospermum latifolium	Broad-leaved Puccoon	Special Concern
Mertensia virginica	Virginia Bluebells	Threatened
Morus rubra	Red Mulberry	Threatened
Terrapene carolina carolina	Eastern Box Turtle	Special Concern

Source: Michigan Natural Features Inventory

CHAPTER 3 - CONDITION OF BUCK CREEK WATERSHED

This chapter provides an overview of the past and present studies that have evaluated and determined the water quality and condition of natural resources in Buck Creek. Pollutants have come from a variety of past and present agricultural, industrial, private, and municipal activities, and include both point and nonpoint sources (NPS) of pollution. Point source pollution originates from an easily identifiable source, such as an outfall pipe from an industrial or municipal wastewater treatment plant. NPS pollution originates from indistinguishable sources, such as runoff from lawns, agricultural areas, construction sites, and impervious surfaces, or leaking septic tanks and atmospheric deposition.

3.0 HISTORICAL CONDITIONS REPORTED IN PREVIOUS STUDIES

3.0.1 MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY (MDEQ) BIOLOGICAL SURVEYS

The 1992 MDEQ biological survey report rated the fish community structure as good (slightly impaired) to fair (moderately impaired). Macroinvertebrate communities were reduced at all survey stations, ranging from fair to poor (severely impaired). Overall stream quality of Buck Creek was rated fair to poor. The survey rated the physical condition as good to poor, with sedimentation identified as contributing to the severe impact on the macroinvertebrate communities. The report stated that storm water runoff was contributing substantially to flow fluctuations, which also were impacting the macroinvertebrate communities by periodically scouring the streambed (MDEQ, 1992).

The MDEQ reported that the observed urbanization of the Buck Creek Watershed (Watershed), with increased impervious surfaces, is accelerating sedimentation and flow fluctuations from storm water runoff, which causes impairments to the physical habitat conditions. Habitat quality improved in the downstream sections, which might be caused by the increased flow clearing some of the sediment. The report is included in Appendix 3.1

3.0.2 SEWER SERVICE AREAS AND SEPTIC SYSTEMS

In the late 1980s a series of water contamination events in Kent County served to increase public interest in the quality of local rivers and streams. The City of Grand Rapids municipal sewer system frequently discharged sewage in to the Grand River following heavy rains. Although the sewer system had originally been designed to function in this manner, growing awareness of the effects of environmental contamination made these combined sewer overflow (CSO) events the source of public disdain. In 1988,

the contamination of the Rogue River in Northern Kent County from sewage overflows further heightened concern about local surface water quality, Kent County Health Department (KCHD).

In response, local governments began giving local surface water quality closer scrutiny, examining root causes and contaminates, and the role of existing infrastructure in contamination events. Such efforts, however, were hampered by the fact that there was very little data on the quality and cleanliness of water in Kent County rivers and streams. Because such data was necessary both to assess the impact of contamination events, as well as to develop solutions and prevention processes, the Kent County Board of Health, on September 9, 1988, adopted a resolution that called for the KCHD to develop a "...water quality surveillance and assessment procedure to be used in gathering information concerning the relative healthfulness of rivers and streams in Kent County."

The resulting surface water-monitoring program was initiated in 1989 and was charged with providing water quality information necessary for future decision-making. Initially, 11 Kent County rivers and streams were sampled at 14 locations. Sampling stations in Buck Creek were established in Douglas Walker Park in Byron Township (Station #15) and in Ideal Park, on Crippen Street, in the City of Wyoming (Station #17). The funding for the program has been suspended for the 2003 to 2004 fiscal year, but could possibly resume in the future years. Annual reports were prepared summarizing sampling results.

3.0.3 TOTAL MAXIMUM DAILY LOADS (TMDLS)

Section 303(d) of the Federal Clean Water Act and the United States Environmental Protection Agency's (EPA's) Water Quality Planning and Management Regulations require states to develop TMDLs for water bodies that are not meeting Water Quality Standards (WQS). The TMDL process establishes the allowable loadings of pollutants for a water body based on the relationship between pollution sources and instream water quality conditions. TMDLs provide a basis for determining the pollutant reductions necessary from both point and nonpoint sources to restore and maintain the quality of their water resources. The MDEQ has included a portion of Buck Creek, a 10-mile stretch from the Grand River confluence upstream to 68th Street, on the 303(d) non-attainment list.

The MDEQ has established the WQS for waters of the state protected for total body contact recreation as 130 *E. coli* per 100 milliliters [ml] as a 30-day geometric mean. At no time shall the waters contain more than a maximum of 300 *E. coli* per 100 ml. The WQS developed for partial body contact recreation is 1,000 *E. coli* per 100 ml as a 30-day geometric mean.

The impaired designated uses addressed by this TMDL are partial and total body contact recreations. Rule 100 of the Michigan WQS requires that water bodies be protected for total body contact recreation from May 1 to October 31.

E. coli is used as an indicator of possible sewage contamination of human origin. Animals (wildlife and domestic) are often a source of elevated *E. coli* levels (KCHD).

The possible pathogen sources for water bodies in the Watershed are typical of urban and agricultural land uses. Point source discharges, storm water discharges, agricultural inputs, and to a lesser degree, illicit discharges are all possible sources of *E. coli* in the Watershed.

Particularly high concentrations of *E. coli* were found in relation to precipitation events. Other possible sources of pathogens to Buck Creek could be due to agriculture, given that the headwaters of the Watershed are dominated by that type of land use. Surface runoff and field tile drainage are two possible mechanisms for delivering *E. coli* to the water bodies.

As discussed in the previous section, the KCHD has sampled surface waters for bacteriological quality in accordance with the Michigan Department of Natural Resources (MDNR), Part 4 WQS, Rule 62.(1), (2), Act 245, P.A. 1929, as amended. Samples were tested to determine the presence of *E. coli*. The number and frequency of samples collected at each station was determined by its designation as "total body contact" (swimming) or "partial body contact" (fishing and canoeing) recreational area. Total body contact areas must not have more than 130 *E. coli* per 100 ml as a 30-day average. Compliance is based upon the geometric average of all individual samples (minimum of three samples taken at five separate events) or *E. coli* per 100 ml calculated as the geometric average of three or more samples taken at a single event (KCHD). Partial body contact areas must not have more than 1,000 *E. coli* per 100 ml calculated as the geometric average of three or more samples, taken during the same sampling event. Warning signs were posted on waters which were determined not safe for human contact as a result of the testing.

Data collected in 2000 to 2003 is illustrated in the charts in Appendix 3.2 for the two stations in Buck Creek. *E. coli* levels in all tests at Douglas Walker Park, except for April and May of 2002, were above WQS for swimming. Only one test at that site, in July 2003, was above WQS for fishing, canoeing, and other non-immersion types of activities. The sampling site at Ideal Park indicated higher levels of *E.coli,* with all samples, except in April 2001, exceeding WQS for total body contact recreation. All tests in July, August, and September of 2001, 2002, and 2003 exceeded WQS for partial body contact recreation in Ideal Park.

The MDEQ has determined that the TMDL for *E. coli* in Buck Creek must be met by 2006.

3.1 PRESENT CONDITIONS IN THE BUCK CREEK WATERSHED

3.1.1 NPDES PHASE II STORM WATER REGULATIONS

Industrial and municipal point sources are generally well regulated and are no longer a large threat to Buck Creek. Municipal storm water, however, remains a large pollutant source that has been unregulated in the past, but is currently the focus of new regulations mandated from the EPA. Programs are being implemented in municipalities to remedy municipal storm water pollution, but adequate funding will be critical to ensure consistent and effective long-term enforcement and implementation of these programs.

The communities that include portions of the Watershed are: Byron Township, Gaines Township, City of Kentwood, City of Wyoming, the City of Grandville, and a very small portion in the City of Grand Rapids. All of these communities are required to obtain storm water permits through the National Pollutant Discharges Elimination System (NPDES) Phase II Storm Water program. These communities have recognized the importance of monitoring and reducing storm water runoff to the streams and drains in their communities and have initiated an Illicit Discharge Elimination Plan (IDEP) through the Watershed-based Phase II permit. The initial IDEP was implemented in the summer of 2003, completing the investigation of storm water outfalls in Buck Creek. Over 500 storm water outfalls were located in the Watershed. If dry weather flow was present, water quality sampling with field kits was conducted to detect the presence of pollutant. If intermittent dry-weather flow was suspected, the outfall was flagged for follow-up investigation. The program will continue for the duration of the NPDES Phase II permit, which includes creating an Illicit Discharge and Connection Ordinance to prevent future illicit discharges to Buck Creek and its tributaries

Only three outfalls were suspected of discharging pollutants and were identified to the appropriate municipality to find the source of the discharge and correct or eliminate the illicit connection. The small number of illicit discharges found in the Watershed is confirmation that Municipal Separate Storm Sewer Systems are not a significant contributor to the water quality problems in Buck Creek. Nonpoint sources, the diffuse runoff from upland and impervious areas, continues to be the most significant contributor of pollution to the surface waters and must be addressed through the holistic watershed management planning effort that is able to identify NPS pollution.

3.1.2 WATERSHED INVENTORY

The inventory process, to identify NPS pollution in the Watershed was developed through input and participation of the Urban Subcommittee (Subcommittee). Accurate assessment of the condition of the Watershed is best done by field observations. The watershed inventory consisted primarily of walking the length of Buck Creek and its tributaries. The inventory was completed in the summer of 2003.

Data sheets were filled out at each site where NPS pollution was evident. An example of a data sheet in included in Appendix 3.3. Nine categories were observed and recorded: debris and trash, construction site runoff, stream crossings, rill or gully erosion, livestock access, tile outlets, streambank erosion, and urban runoff, and other. The location of each NPS site was recorded geographically with a Global Positioning System unit when available. A photograph was also taken at each site to document the "before" condition of the site.

A unique identification number was created for each site, which was used to link the location of the point to the information in the data sheet in a Geographic Information System .

The sites of NPS pollution identified in the Watershed during the inventory are summarized in Table 3.1. The most abundant sources of pollution or impairments to the Watershed were trash and debris. The majority of the trash and debris sites were grass clippings, which add excessive nutrients to the streams. The construction sites noted were mostly associated with the new US-131 crossing over Buck Creek and the railroad ditch, causing sedimentation in the streams. Only one stream crossing appeared to have significant obstruction causing an impairment. Rill and gully erosion, which delivers sediment to the streams, was present at only a few sites in the City of Wyoming. Horses and cows have unlimited access to a tributary in Gaines Township, adding sediment from eroded streambanks and nutrients from their waste to the stream. One tile outlet was recorded as having blue or milky discharge, which was located near a car wash, possibly adding phosphorus or chemicals to the stream. Streambank erosion was observed mostly in the residential and commercial area of the Watershed, where obvious human activities had disturbed the riparian protection and allowing sediment to enter the stream. Urban runoff was categorized as turf runoff from residential lawns, adding nutrients to the stream, and one site with possible runoff from the landfill in Byron Township, possibly adding nutrients or other contaminants to the stream. The inventory data is sorted according to sources of pollutants in Appendix 3.4.

3.1.3 MDEQ ROAD CROSSING SURVEYS

The MDEQ stream crossing surveys have been completed for the Watershed. The data was collected and submitted to the MDEQ for their database of stream crossings for the State of Michigan. Crossings that had NPS pollution problems were identified and the problems defined. An example of the data sheet is included in Appendix 3.5.

Table 3.1 - Summary of NPS Watershed Inventory

Source	Pollutant	Severe	Moderate	Low	Total
Trash and debris	Nutrients and sediment	15	27	17	59
Streambank erosion	Sediment	4	4	8	16
Urban runoff	Sediment, nutrients, and others	3	2	7	12
Construction sites	Sediment	3	1	0	4
Rill and gully erosion	Sediment and nutrients	0	3	0	3
Livestock access	Sediment and nutrients	1	0	0	1
Tile outlets	Nutrients	1	0	0	1
Stream crossings	Sediment	0	1	0	1
Total		**27**	**38**	**32**	**97**

3.2 SUMMARY

The Subcommittee of the LGRW Project prioritized the water quality problems in the Watershed by discussing the results of the past studies and evaluating the findings of the field investigations of the Watershed. The prioritization of pollutants was determined through local knowledge from the members of the Subcommittee about the characteristics of the Watershed. The pollutants that should be addressed in the short-term objectives of the WMP categorized as high priority were sediment, *E. coli,* and nutrients. Figure 3 illustrates the NPS sites and areas of water quality impairments in the Watershed.

CHAPTER 4 - DESIGNATED AND DESIRED USES OF BUCK CREEK WATERSHED

4.0 DESIGNATED USES OF WATER BODIES IN BUCK CREEK WATERSHED

The State of Michigan (State) has determined that all water bodies in the State should meet the following designated uses:

- Agriculture
- Navigation
- Warmwater or coldwater fishery
- Indigenous aquatic life and other wildlife
- Partial body contact recreation
- Total body contact recreation
- Public water supply
- Industrial water supply

A task of the Urban Subcommittee (Subcommittee) is to determine which of these designated uses are being met, are impaired, are threatened, or are not a use in the Buck Creek Watershed (Watershed).

4.1 DESIGNATED USES BEING MET, IMPAIRED, OR THREATENED

The Subcommittee used a worksheet to determine the status of the designated uses in the Watershed and the known and suspected sources and causes of the impairments (Appendix 4). The following conditions were concluded for the Watershed.

- Agricultural uses are being met.

- Industrial water supply use is being met.

- The warmwater fishery is impaired by sediment, south of 84th Street. A warmwater fishery must allow warmwater fish, such as bass, pike, walleye, or panfish to live in these waters. The overall quality of the water is a concern, and temperature and habitat should also be maintained. Dissolved oxygen should not fall below 7 mg/l for rivers and streams. All needs for the various stages of the life cycles of the fish must be considered for populations to be sustainable.

- The coolwater fishery is moderately impaired by sediment and suspected to be slightly impaired by road salt where the Buck Creek runs through the City of Grandville.

- The coldwater fishery is moderately impaired by sediment north of 84th Street to the limits of the City of Grandville. The fishery is severely impaired by sediment in the Lamar Park and Burlingame Avenue area. A coldwater fishery must have summer temperatures 50 degrees F to 60 degrees F, not to exceed 68 degrees F to sustain trout. Suitable woody debris for habitat is also important to maintain.

- The indigenous aquatic life and other wildlife habitats are moderately to severely impaired by sediment. The considerations for indigenous aquatic life and other wildlife are similar to those for a warmwater fishery, but include broader concerns of surrounding habitats, including floodplains and forests. Large contiguous areas of forest, wetlands, and prairies are important for many species. Fragmentation of habitats divides wildlife areas into smaller less suitable tracts of land.

- Partial body contact recreation, such as fishing and canoeing, is impaired by *E.coli.* Partial body contact recreation includes activities where some skin contact is made with the water, but generally the body is not submerged. Water quality must meet minimum standards for health and safety, which for partial body contact recreation is below 1,000 count per 100 ml, as a 30-day geometric mean.

- Total body contact recreation, mainly wading at Palmer Park, is impaired by *E. coli.* Swimming is considered total body contact recreation. Safety concerns arise when the eyes and nose are submerged in the water when the possibility of ingesting the water exists. Water quality standards or total contact body recreation must be met between May 1 and October 31. *E. coli* must be below 130 count per 100 ml, as a 30-day geometric mean during the swimming season.

- Navigation is not a use.

- Public water supply is not a use.

The next step of the Subcommittee was to prioritize the designated uses. The Subcommittee evaluated the resources of the Watershed, according to the perceived value and the Subcommittee members' local knowledge of their importance, and prioritized uses. The members also evaluated the greatest benefit for cost of restoring the use, the importance for the resource use, and the impact on other uses. The uses for a coldwater fishery and recreation were determined to be high priority and the greatest concern (Table 4.1).

Table 4.1 - Status of Designated Use

Designated Use	Status of Designated Use	Pollutants
High Priority		
Coldwater fishery	Moderately impaired north of 84th Street to limits of City of Grandville. Severely impaired in Lemery Park and Burlingame Avenue areas	Sediment (k)
	Moderately impaired north of 84th Street to limits of City of Grandville	Nutrients (k)
	Slightly threatened in the City of Grandville	Road salt (s)
	Might pose a threat	Temperature (s)
Partial body contact recreation	Fishing opportunities are impaired	Pathogens *(E. coli)* (k)
Total body contact recreation	Swimming (wading at Palmer Park) is impaired	Pathogens *(E. coli)* (k)
Coolwater fishery	Moderately impaired in the City of Grandville	Sediment (k)
	Moderately impaired in the City of Grandville	Nutrients (k)
	Slightly threatened in the City of Grandville	Road salt (s)
Medium Priority		
Warmwater fishery	Slightly to moderately impaired south of 84th Street	Sediment (k)
	Slightly to moderately impaired south of 84th Street	Nutrients (k)
Low Priority		
Other indigenous aquatic life and wildlife	Moderately to severely impaired habitats	Sediment (k)
Agriculture	WQS being met	
Industrial supply	WQS being met	
Navigation	Not a use	
Public water supply	Not a use	

(k) = known
(s) = suspected

4.2 SOURCES OF IMPAIRMENTS AND THREATS TO DESIGNATED USES

Sediment originates from streambank erosion and runoff from construction sites, agricultural operations, and storm water. Sediment is impairing the coldwater, coolwater, and warmwater fisheries in the Watershed by covering that substrate and degrading the spawning habitat. Sediment is a minor impairment to the other indigenous aquatic life and wildlife by altering the habitats.

E. coli is an indicator of other pathogens in the water that impair fishing, canoeing, and swimming in the Watershed due to potential health and safety concerns. The suspected sources of *E. coli* are failing septic systems, concentrations of wildlife, and pet waste.

Elevated nutrients in surface waters result in the overabundance of certain aquatic plant species that are able to absorb nutrients, grow quickly, and adapt to changing conditions. Excessive nutrients impair the coldwater fishery by decreasing the dissolved oxygen in the water when the oxygen is consumed by the

plants to aid in decomposition. Nutrients enter the surface waters from mostly residential areas where lawns at the edges of streams allow fertilizers and yard waste to runoff into the streams.

4.3 CAUSES OF IMPAIRMENTS AND THREATS

The investigation into the condition of the Watershed was completed through the physical inventory of the nonpoint source sites in the Watershed and through discussion of the Subcommittee of their local knowledge of the Watershed. Best Management Practice (BMP) recommendations are based on the underlying causes of the sources of the impairments.

4.3.1 STREAMBANK EROSION

A known cause of streambank erosion is the fluctuating hydrology of Buck Creek, as observed at many sites in the Watershed. The Flood Mitigation Alternatives Study on Buck Creek (Fishbeck, Thompson, Carr & Huber, Inc. (FTC&H), 2000) discussed the feasibility of regional detention to mitigate the frequent flooding problems along the drain channel of Buck Creek. The study stated that storm water detention may adequately reduce current peak flow rates, but total runoff volume will increase in the future due to the greater percentage of impervious surfaces that will be contributing storm water. An increase in storm water rate and volume from increased imperviousness in the Watershed has had negative effects on the stream, particularly due to the increase in bankfull events. Bankfull events occur on a 1- to 2-year frequency in natural, undeveloped watersheds and have the greatest effect on shaping stream channels. The increase in volume from the development in the Watershed, even when detention is provided, has increased the frequency and duration of the bankfull events, which accelerates the rate of erosion in the stream channel.

4.3.2 AGRICULTURAL RUNOFF

The suspected causes of agricultural runoff include use of conventional tillage and plowing up to the edge of the stream. The lack of streamside buffers allow cropland runoff to carry sediment and nutrients into the surface waters.

4.3.3 CONSTRUCTION SITES

Further field investigations are needed to confirm the suspected causes of sediment from construction sites. A few sites were noted with a lack of soil erosion and sedimentation control measures, but the enforcement and compliance records of the sites have not yet been investigated.

4.3.4 SEPTIC SYSTEMS

E. coli is a known pollutant in the Watershed, but the sources of the *E. coli* are not confirmed. A suspected source is leaky or faulty septic systems from systems that are poorly maintained or improperly installed. Other suspected sources are pet waste washed into the stream during storm events from high use areas and urban wildlife populations where they impact storm sewer systems.

4.3.5 YARD WASTE

Observed dumping of yard waste in and near the stream is a known source of nutrients. Residential areas had many sites where yard waste was piled next to the stream or actually dumped in the stream. Private developments, serviced by lawn care companies, also had yard waste dumped near the stream.

4.3.6 URBAN RUNOFF

A suspected cause of pollution from urban runoff includes misapplication and over-application of road salt on paved roads near streams. Increased imperviousness is also suspected of causing an increase of temperature of storm water runoff, possibly threatening the coldwater and coolwater fisheries.

4.4 DESIRED USES IN BUCK CREEK WATERSHED

Desired uses of the Watershed reflect how the community wants to use the Watershed and what activities should be promoted within the Watershed that are not directly related to water quality. The Subcommittee discussed ideas for the Watershed and the desired uses include the incorporation of smart growth and low impact development techniques, increased education about watersheds and stewardship, and the use of the Watershed as a demonstration area of urban BMPs as an example for the entire Lower Grand River Watershed.

The Subcommittee also discussed the possibility of wetland restoration in the Watershed. The Subcommittee viewed maps, created by the Michigan Department of Environmental Quality, that illustrate potential sites for restoration. The maps indicate that areas in the headwaters of Buck Creek have potential for hydrologic improvement in the Watershed. The Watershed Wetland Resource map is available for viewing on the Lower Grand River website at:
http://www.gvsu.edu/wri/isc/lowgrand/library.htm.

CHAPTER 5 - WATER QUALITY GOALS AND OBJECTIVES FOR BUCK CREEK WATERSHED

5.0 GOALS OF WATERSHED

The goals for the subwatershed were discussed at the Urban Subcommittee (Subcommittee) meeting after the sources and causes of the impairments were identified through the watershed inventory and compared to past studies and reports. The goals are based on improving or restoring the designated uses of the Buck Creek Watershed (Watershed) and attaining compliance with the *E. coli* Total Maximum Daily Load (TMDL) established in Buck Creek. The following goals for the Watershed have been determined:

- Improve or restore the coldwater and coolwater fisheries
- Improve and protect the safety and enjoyment of fishing, canoeing, and swimming
- Improve or restore the warmwater fishery
- Improve and protect the habitats for other indigenous aquatic life and wildlife

The water quality management guiding principle used to develop the goal for complying with the TMDL to improve and protect the safety and enjoyment of fishing, canoeing, and swimming will meet the objectives of compliance with the numeric pathogen target in the Watershed by controlling *E. coli* from Combined Sewer Overflow's, point source discharges, storm water, agriculture influences, or illicit connections.

Additionally, desired uses of the Watershed, those uses not directly related to water quality, were discussed with the Subcommittee, the stakeholders in the Watershed, and the local officials. These desired uses reflect how the community wants to use the Watershed and what activities should be promoted within the Watershed. The resulting list of desired uses is as follows:

- Incorporation of smart growth techniques
- Increased education about watersheds and stewardship
- Use Buck Creek as demonstration area of urban Best Management Practices (BMPs) for example for entire Lower Grand River Watershed.

5.1 OBJECTIVES OF WATERSHED

The objectives required to meet the goals are based on addressing the identified causes of the sources of nonpoint source (NPS) pollution in the Watershed. The goals and objectives are further defined in Table 5.1. Pollutants were prioritized to help narrow the focus on the pollutants causing the greatest impairment to each designated use. Technical Subcommittee members evaluated each designated use and prioritized the pollutants based on the degree of impairment and the feasibility of reducing the pollutant to desirable levels. Pollutants that were known (identified by a "k") were given a higher priority than pollutants that were suspected (identified by an "s"). The pollutant prioritization is outlined in Table 5.1.

The Technical Subcommittee also reviewed the sources of pollutants and prioritized them according to the findings of the watershed inventory. For example, the highest prioritized source for sediment was streambank erosion, since 16 out of the 37 sites identified as contributing sediment to Buck Creek were from areas with eroding streambanks. The sources are listed in order of prioritization in Table 5.1.

The objectives to reduce sediment in the Watershed are:

- Stabilize stream flows to moderate hydrology and increase base flow
- Protect riparian buffers through setbacks and buffer ordinances
- Adopt storm water ordinance
- Reduce soil erosion and sedimentation from construction sties
- Encourage cover crops and no-till practices
- Install livestock fencing and filter strips
- Stabilize improperly installed stream crossings
- Reduce impervious surfaces

The objectives for reducing *E. coli* inputs in the Watershed are:

- Develop TMDL for *E. coli* and reduce inputs to meet water quality standards of 1,000 count/ml
- Encourage proper installation and maintenance of septic systems
- Encourage sanitary sewers in areas serviced by water utilities
- Exclude livestock access in high-risk areas
- Reduce amount of pet waste entering waterways
- Control urban wildlife, such as geese and raccoon, populations
- Locate and remove or correct illicit connections to storm drains

The objectives to reduce nutrients in the Watershed are:

- Encourage composting and curbside collections of yard wastes
- Encourage “Landscaping for Water Quality” techniques
- Install livestock exclusion fencing and filter strips
- Reduce the use of fertilizers with phosphorous for riparian and lakeside residents
- Require buffers between land and surface waters
- Encourage proper installation and maintenance of septic systems
- Encourage sanitary sewers in area serviced by water utilities
- Locate and remove or correct illicit connections to storm drains

The objectives for reducing that amount of trash and debris in the Watershed are:

- Remove trash and log jams according to woody debris management principles
- Stabilize stream flows to moderate hydrology and increase base flow
- Institute an annual free trash collection day for household items and refuse
- Increase visibility of “No Dumping” signs
- Increase patrols in areas that have high volumes of trash dumped frequently

Table 5.1 - Goals and Objectives for the Buck Creek Watershed

Priority	Designated Uses	Goals	Priority	Pollutants and Impairments to Designated Uses	Sources	Causes	Objectives
High	**Coldwater fishery (habitat north of 84th Street to limits of City of Grandville)**	Improve or restore the coldwater fishery	1	Sediment (k)	Streambank erosion (k)	Fluctuating hydrology (k)	Stabilize stream flows to moderate hydrology and increase base flow
					Construction site runoff (k)	Lack of SESC measures (s)	Reduce soil erosion and sedimentation
			2	Trash and debris (k)	Yard Waste (k)	Illegal dumping on streambanks (k)	Reduce dumping of yard waste
			3	Road salt (s)	Storm water runoff (s)	Misapplication or over-application of road salt (s)	Monitor use and investigate alternative practices
			4	Temperature (s)	Urban runoff (s)	Increased imperviousness (s)	Reduce imperviousness
High	**Coolwater fishery (habitat within City of Grandville)**	Improve or restore the cool water fishery	1	Sediment (k)	Streambank erosion (k)	Fluctuating hydrology (k)	Stabilize stream flows to moderate hydrology and increase base flow
					Construction site runoff (k)	Lack of SESC measures (s)	Reduce soil erosion and sedimentation
			2	Trash and debris (k)	Yard Waste (k)	Illegal dumping on streambanks (k)	Reduce dumping of yard waste
			3	Road salt (s)	Storm water runoff (s)	Misapplication or over-application of road salt (s)	Monitor use and investigate alternative practices
			4	Temperature (s)	Urban runoff (s)	Increased imperviousness (s)	Reduce imperviousness

Table 5.1 - Goals and Objectives for the Buck Creek Watershed

Priority	Designated Uses	Goals	Priority	Pollutants and Impairments to Designated Uses	Sources	Causes	Objectives
High	**Partial body contact recreation (fishing, canoeing)**	Improve and protect the safety and enjoyment of partial body contact recreation	1	Pathogens *(E. coli)* (k)	Failing septic systems (s), TMDL to be determined by 2006	Leaking, poorly maintained, and over capacity septic systems (s)	Determine TMDL for *E. coli* and reduce inputs to meet water quality standards of 1,000 count/100 ml
					Wildlife (geese and raccoons)	Overpopulations in urban areas (s)	Control geese and raccoon populations
					Pet waste (s)	Uncollected waste (s)	Reduce amount of pet waste entering waterways
			2	Trash and debris (k)	Residential trash (k)	Illegal dumping on streambanks (k)	Reduce dumping of yard waste
High	**Total body contact recreation (swimming, wading)**	Improve and protect the safety and enjoyment of total body contact recreation	1	Pathogens *(E. coli)* (k)	Failing septic systems (s), TMDL to be determined by 2006	Leaking, poorly maintained, and over capacity septic systems (s)	Determine TMDL for *E. coli* and reduce inputs to meet water quality standards of 130 count/100 ml
					Wildlife (geese and raccoons)	Overpopulations in urban areas (s)	Control geese and raccoon populations
					Pet waste (s)	Uncollected waste (s)	Reduce amount of pet waste entering waterways
			2	Trash and debris (k)	Residential trash (k)	Illegal dumping on streambanks (k)	Reduce dumping of yard waste

Table 5.1 - Goals and Objectives for the Buck Creek Watershed

Priority	Designated Uses	Goals	Priority	Pollutants and Impairments to Designated Uses	Sources	Causes	Objectives
Medium	**Warmwater fishery (habitat south of 84th Street)**	Improve or restore the warmwater fishery	1	Sediment (k)	Streambank erosion (k)	Fluctuating hydrology (k)	Stabilize stream flows to moderate hydrology and increase base flow
					Construction site runoff (s)	Lack of SESC measures (s)	Reduce soil erosion and sedimentation
					Agricultural runoff (s)	Conventional tillage, plowing up to edge of stream (s)	Promote conservation tillage practices and cover crops
			2	Trash and Debris (k)	Yard Waste (k)	Illegal dumping on streambanks (k)	Reduce dumping of yard waste
				Nutrients (k)	Agricultural runoff (s)	Unlimited livestock access, lack of buffer, over-fertilization of fields (s)	Install livestock exclusion fencing and establish filter strips
Low	**Other indigenous aquatic life and wildlife (habitats)**	Improve and protect the habitats for other indigenous aquatic life and wildlife	1	Sediment (k)	Storm water runoff scouring streambed (k)	Increased imperviousness (s)	Reduce imperviousness

(k) = known
(s) = suspected

5.2 WATER QUALITY SUMMARY FOR BUCK CREEK WATERSHED

The water quality of the Watershed impairs the designated and desired uses due to NPS pollution. Identified pollutants include sediment, pathogens (*E. coli*), nutrients, and trash and debris. Suspected pollutants include road salt and temperature. Biological surveys and water quality monitoring conducted by Michigan Department of Environmental Quality (MDEQ) have found water bodies with fair to poor fish and macroinvertebrate communities. The Watershed inventory has identified many areas with trash and debris, eroding streambanks, and urban sources of nutrients. Land use activities that increase storm water runoff, which intensifies the NPS pollution problems in the Watershed have also been identified. The following Water Quality Summary links the impairments to water quality with the long-term goals and short-term objectives of the Watershed. The impairments are listed in order of highest to lowest priority in the Watershed.

Known Impairments:

Impairment - Sediment

Description:

Excess sediment covers stream substrate necessary for fish and macroinvertebrate habitat. Suspended sediment causes turbidity.

Known Sources:

Sediment originates from upland and instream sources. The Watershed inventory identified streambank erosion, construction sites, rill and gully erosion, livestock access, and stream crossings as sediment sources.

Known Causes:

Human activities that disturb the riparian protection cause streambanks to erode. Exposed soil erodes from construction sites where proper soil erosion and sediment control (SESC) practices are not installed or maintained. Conventional tillage practices that leave soil exposed to water and wind cause rill and gully erosion. Unrestricted livestock and vehicle access to the stream can destabilize the streambank and cause erosion during rain events and peak flows.

Priorities:

Sediment is a high priority impairment to coldwater, coolwater, and warmwater fisheries and indigenous aquatic life and wildlife.

Goals:

- Reduce sediment loading to improve or restore the coldwater, coolwater, and warmwater fisheries.
- Reduce sediment loading to improve and protect the habitats of other indigenous aquatic life and wildlife.

Objectives:

- Stabilize stream flows to moderate hydrology and increase base flow
- Protect riparian buffers through setbacks and buffer ordinances
- Adopt storm water ordinance
- Reduce soil erosion and sedimentation from construction sites
- Encourage cover crops and no-till practices
- Install livestock exclusion fencing and filter strips
- Stabilize and properly install stream crossings
- Reduce impervious surfaces

Impairment - *E. coli*

Description:

E. coli has been a documented problem in the Watershed, placing Buck Creek on the MDEQ 303(d) non-attainment list for not meeting Water Quality Standards (WQS) for *E. coli.* The MDEQ has required that a TMDL for *E. coli* be established by 2006 for Buck Creek.

Suspected Sources:

E. coli is found in the digestive system of warm-blooded animals. The detection of *E. coli* in the water column often indicates that other dangerous types of pathogens may be present. *E. coli* cannot live for long periods outside of a host body; therefore, when found in surface water, the source must be relatively close. Potential sources include septic systems, pet waste, livestock operations, and wildlife.

Suspected Causes:

Leaking and undersized septic systems allow pathogens to enter surface and groundwater. Unlimited access to streams allows livestock to spread bacteria. Pet waste from residential and recreation areas washes into surface waters during rain events. Wildlife can introduce pathogens in feeding and nesting areas.

Priorities:

E. coli can cause serious illnesses in humans and animals, and is therefore a high priority impairment to partial and total body contact recreation.

Goal:

- Improve and protect the safety and enjoyment of partial body and total body contact recreation. The TMDL represents the maximum loading that can be assimilated by the water body while still achieving WQS. The target for this pathogen, TMDL, is the WQS of 130 *E. coli* per 100 ml.

Objectives:

- Determine TMDL for *E. coli* and reduce inputs to meet water quality standards of 1,000 count/100 ml for areas of partial body contact recreation and 130 count/100 ml for total body contact recreation.
- Encourage proper installation and maintenance of septic systems.
- Encourage sanitary sewers in areas serviced by water utilities.
- Install livestock exclusion fencing and controlled access sites.
- Reduce amount of pet waste entering waterways.
- Control urban wildlife, such as geese and raccoon populations.
- Locate and remove or correct illicit connections to storm sewers.

Impairment - Nutrients

Description:

Excess nutrients, such as phosphorus and nitrogen, cause eutrophication, a cycle that increases plant and algae growth. When algae and plants are unable to photosynthesize, they consume oxygen. Accelerated plant and algal growth can deplete oxygen to the point where many species are unable to

survive. Decaying plants, algae, and organic matter also increases biochemical oxygen demand (BOD) and can lead to fish kills.

Known Sources:

Yard wastes, such grass clippings, leaves, and woodchips, have high levels of phosphorus that enter ditches and streams through storm water runoff. Residential lawns, where landowners fertilize and maintain to the stream edge, add nutrients to the water through runoff and infiltration. Horses and cows having unlimited access to stream add nutrients through their waste.

Suspected Sources:

Nutrients concentrated in human wastes could be introduced into surface waters through leaking and faulty septic systems. Direct discharges from tile outlets draining commercial areas, could add nutrients to the stream.

Known Causes:

Illegal dumping of yard wastes were often found in residential and commercial area of the Watershed. Horses and cows have unlimited access to a tributary in the Watershed. Manicured lawns are maintained to the stream edge.

Suspected Causes:

Septic system failures are suspected to be allowing nutrients to enter the waterways.

Goal:

- Improve or restore the coldwater and coolwater fisheries.
- Improve or restore the warmwater fishery.
- Improve and protect the habitats for other indigenous aquatic life and wildlife.

Objectives:

- Encourage composting and curbside collections of yard wastes.
- Encourage “Landscaping for Water Quality” techniques.
- Install livestock exclusion fencing and filter strips.

- Reduce the use of fertilizers with phosphorus for riparian and lakeside residents.
- Require buffers between lawns and surface waters.
- Encourage proper installation and maintenance of septic systems.
- Encourage sanitary sewers in areas serviced by water utilities.

Impairment - Trash and Debris

Description:

Trash and debris accumulation blocks or diverts the flow of water. Log jams occur naturally when trees falls into the stream channel.

Known Sources:

Illegal dumping of trash at road crossings was observed in the Watershed. In some cases, toxic and unsanitary materials, such as oil filters, animal carcasses, and batteries were found. Trees that fall into the channel sometimes divert water into the bank causing more erosion and more premature tree fall.

Known Causes:

Lack of signs or threat of enforcement allow some area to become dumping grounds for neighborhood trash and garbage. Increased water volume during storm events causes severe erosion that undercuts the trees' root mass causing trees to fall into the stream.

Priorities:

Trash and debris is a medium priority to coldwater, coolwater, and warmwater fisheries, and other indigenous aquatic life and wildlife.

Goal:

- Improve or restore the coldwater and coolwater fisheries.
- Improve or restore the warmwater fishery.
- Improve and protect the habitats for other indigenous aquatic life and wildlife.

Objectives:

- Remove trash and log jams according to woody debris management principles.
- Increase visibility of “No Dumping” signs.
- Institute an annual free trash collection day for household items and refuse.
- Increase patrols of areas that have high volumes of trash.
- Stabilize stream flows to moderate hydrology and increase base flow.

Suspected Impairments:

Impairment - Road Salt

Description:

Road salts are used in communities for de-icing roads. Salt trucks spread salt on roads at various rates and times dependent of the conditions to keep roads open and safe for travel. Road salt impairs fisheries, aquatic life, and vegetation. Some species of macroinvertebrates, that are food sources for sport fish, are highly susceptible.

Suspected Sources:

Road salts enter surface water, soil, and groundwater after snow melt and spring rains.

Suspected Causes:

Improper storage, transport, or application of road salts can result in runoff to streams and ditches.

Priorities:

Road salt is a medium priority to coldwater and coolwater fisheries.

Goal:

- Monitor areas of potential threats to water quality from road salt applications.

Objective:

- Determine impacts of road salt to water quality.
- Investigate alternatives to salt application as a de-icing technique.

Impairment - Temperature

Description:

Temperature is the critical factor for a healthy coldwater or coolwater fishery. Urbanization of watersheds has changed the hydrologic processes that in a natural state maintain temperatures and flows of streams. The control of temperature is often in conflict with recommended BMPs for controlling flooding and maintaining the natural hydrology of the stream, since detention basins and wetlands can increase water temperatures.

Suspected Sources:

Storm water runoff flowing over impervious surfaces can heat up, causing higher water temperatures of the runoff entering surface water after rain events. Storm water warms in detention ponds before it is discharged into streams.

Suspected Causes:

Increased amounts of impervious surfaces in developing communities create additional heated areas that carry runoff. Developments increases amount of storm water detention ponds.

Priorities:

Temperature is a medium priority to coldwater and coolwater fisheries.

Goal:

- Determine impacts from storm water runoff and adopt storm water management practices to protect the coldwater and coolwater fisheries.

Objective:

- Monitor coldwater and coolwater streams in highly impervious areas for temperature fluctuations.
- Identify critical areas for further investigation.
- Reduce impervious surfaces.

5.3 CRITICAL AREAS OF THE BUCK CREEK WATERSHED

Critical areas of the Watershed are those areas having specific NPS pollution concerns that need to be addressed with appropriate BMPs. The use of Geographic Information System and the field work through the Illicit Discharge Elimination Plan investigations and the Watershed inventory have assisted in the determination of the critical areas of the Watershed. The critical areas are based on the goals and objectives of the Watershed and delineated by where the pollutants are impairing or threatening the designated uses. Table 5.2 shows the results of examining goals and related objectives to determine which areas of the Watershed are most critical. The critical areas of the Watershed need to be defined in order to locate areas of high priority for remediation.

The riparian corridor is critical to the protection of water quality by buffering the effects of land use activities. The recommendation of buffer zones, filter strips, and riparian protection will reduce sediment and nutrients from entering the streams.

Wetland protection and restoration BMPs were evaluated under the managerial BMP category of Preservation and Conservation BMPs. Wetland mitigation and restoration can be used to create vegetated areas that filter and store runoff to limit flooding and sedimentation downstream. The MDEQ created maps that illustrate potential areas for wetland restoration, based on the existence of hydric soils, the historical wetland condition, and the Michigan framework classification of a wetland land use. The maps also illustrate areas that are critical to protect. The maps can be viewed at:
www.gvsu.edu/wri/isc/lowgrand.

Residential areas have been identified as contributing nutrients to the streams. Visual observation of algal blooms and excess aquatic plant growth suggested that nutrients could be entering the waterways from storm water runoff carrying fertilizers or pet waste from lawn areas, and from illegal dumping of yard waste. Failing septic systems in rural areas could also be contributing nutrients. The residential areas included in the critical areas of the Watershed included those areas zoned for residential or commercial development. The residential critical area includes areas with manicured lawns that are adjacent to streams and all residential areas that could benefit from composting or curbside collection of yard wastes.

Agricultural areas in the Watershed are contributing sediment, nutrients, and potentially *E. coli* to the streams through rill and gully erosion, manure applications, and drain tile outlets. Bare plowed fields up to the streams edge also allow these pollutants into the streams. Farms that provide their livestock unlimited access to the stream also contribute these pollutants. The agricultural critical area include farms with row crops, livestock, and any other farm adjacent to a stream.

The importance of creating buffers adjacent to the stream for protection of water quality initiated the concept of a setback or buffer zone critical area in the Watershed. The riparian critical area was established as 1/8 mile on either side of all the streams in the Watershed. BMPs will be implemented within this corridor and also on agricultural fields that contain the corridor.

A few areas in the Watershed are not served by the public sanitary sewer system. These areas are included in the critical area for possible faulty or leaking septic systems that could be adding nutrients and pathogens to the streams.

Trash and debris that accumulates in the stream channel often alters the hydrology of the stream by diverting or blocking the natural flow of the stream. Stretches of the streams that have excessive trash blocking culverts or logjams that are either blocking flow or diverting flow and causing streambank erosion are considered part of this critical area.

Table 5.2 - Critical Areas

Goals	Objectives	Critical Areas
Reduce sediment loadings to improve or restore the coldwater, coolwater, and warmwater fisheries and to improve and protect the habitats of other indigenous aquatic life and wildlife	Stabilize stream flows to moderate hydrology and increase base flow	Stream channels and reaches identified as coldwater fisheries
	Protect riparian areas through buffer zones and filter strips	Riparian corridor (1/8 mile on either side) of Buck Creek, Sharps Creek, and Pine Hill Creek
	Reduce soil erosion and sedimentation from construction sites	Areas zoned for growth and development
	Encourage cover crops, conservation tillage, and filter strips	Agricultural areas in row crops
	Install livestock exclusion fencing and filter strips	Agricultural areas with livestock
	Stabilize and properly install stream crossings	Crossings on critical bridge list and identified as in need of repair through the MDEQ stream crossing inventory
		Agricultural areas with livestock

Table 5.2 - Critical Areas

Goals	Objectives	Critical Areas
Reduce inputs to improve and protect the safety and enjoyment of partial body and total body contact recreation. The target for this pathogen, TMDL, is the WQS of 130 *E. coli* per 100 ml	Encourage proper installation and maintenance of septic systems	Areas not served by public sanitary sewer system
	Encourage sanitary sewers in areas serviced by water utilities	Areas served by water utilities but not served by public sanitary sewer system
	Exclude livestock access in high-risk areas	Agricultural areas with livestock
	Reduce amount of pet waste entering waterways	Parks and high density residential areas
		Public access sites where recreational activities take place
	Control urban wildlife, such as geese and raccoon, populations	Urban areas with high populations of wildlife
	Locate and remove or correct illicit connections to storm sewers	Urbanized areas with municipal separate storm sewer systems
Reduce nutrient loadings to improve or restore the coldwater, coolwater, and warmwater fisheries and improve and protect the habitats for other indigenous aquatic life and wildlife	Encourage composting and curbside collections of yard wastes	Residential areas
	Install livestock exclusion fencing and filter strips	Agricultural areas with livestock
	Reduce the use of fertilizers with phosphorus for riparian and lakeside residents	Riparian corridor (1/8 mile on either side) of Buck Creek, Sharps, Creek, and Pine Hill Creek
	Require buffers between lawns and surface waters	Residential areas adjacent to waterways
	Encourage proper installation and maintenance of septic systems	Areas not served by public sanitary sewer system
	Encourage sanitary sewers in areas serviced by water utilities	Areas served by water utilities but not served by public sanitary sewer system
	Locate and remove or correct illicit connections to storm sewers	Urbanized areas with municipal separate storm sewer systems
Reduce amounts of trash and debris to improve or restore the coldwater, coolwater, and warmwater fisheries and improve and protect the habitats for other indigenous aquatic life and wildlife	Remove trash and log jams according to woody debris management principles	Stream channels and reaches identified as coldwater fisheries
	Stabilize stream flows to moderate hydrology and increase base flow	Stream channels and reaches identified as coldwater fisheries
	Institute an annual free trash collection day for household items and refuse.	Communities with highest frequency of illegal dumping
	Increase visibility of “No Dumping” signs	Identified areas of frequent dumping
	Increase patrols of areas that have high volumes of trash	Identified areas of frequent dumping

CHAPTER 6 - PROPOSED IMPLEMENTATION ACTIVITIES FOR BUCK CREEK WATERSHED

6.0 BEST MANAGEMENT PRACTICES (BMPS) RECOMMENDATIONS

The Lower Grand River Water (LGRW) Steering Committee (Committee) reviewed the goals and objectives for each impairment to the designated uses and the directive to attain a Total Maximum Daily Load for *E. coli* in the Buck Creek Watershed (Watershed) to develop recommendations for BMPs. The recommendations include structural and vegetative BMPs, management and policy BMPs, and information and education (I&E) activities. The actions are defined as short-term (1 to 5 years), intermediate (3 to 8 years), or long-term (5 to 10 years).

The Michigan Department of Environmental Quality (MDEQ) provides a list of BMPs that have been evaluated based on their effectiveness for addressing pollutants. The list includes a description of the BMP, the pollutant controlled, impacts, applications, relationship to other BMPs, construction specifications, and maintenance requirements. The list of practices and the link to the website for each practice is listed in Appendix 6.1.

The Urban Subcommittee (Subcommittee) used the MDEQ BMP list to initially identify what structural and vegetative BMPs could be used to reduce potential sources of pollutants in the Watershed. The Subcommittee then developed a spreadsheet that listed the structural and vegetative BMPs and their characteristics that are currently being used or considered by the communities to address the pollutants. The categories of pretreatment, detention/retention, vegetated treatment, infiltration, and filtration are documented in the resulting Urban Structural BMP sheet in Appendix 6.2.

A similar spreadsheet was developed for managerial BMPs using the MDEQ BMP list, the Michigan Department of Transportation list of BMPs, and the MDEQ Wetland Protection Guide. The categories of pollution prevention, source control, education and training, and preservation and conservation were included in the resulting spreadsheet in Appendix 6.3.

6.1 DESCRIPTION AND PERFORMANCE OF BMPS CONSIDERED

The Subcommittee developed a list of questions that should be asked before selecting a BMP for a site:

- What is the primary pollutant of concern?
- What is the most efficient BMP for removing that pollutant?
- Which hydrologic variable is the critical factor that should be managed?
- Do the environmental impacts of some BMPs preclude their use in this Watershed?
- What is the most effective system of BMPs that can be used to meet those goals?
- What is the most economical way to administer watershed management?
- Which BMPs are most feasible to maintain within local budgets?

A worksheet was developed to evaluate the feasibility of certain BMPs in certain urban settings. The list of structural and vegetative BMPs developed by the Subcommittee was evaluated for application in eight different urban scenarios that exist in Buck Creek. Appendix 6.4 includes the results of that evaluation. The results show that BMPs can be adapted to many different sites, but for a few scenarios, specific BMPs are more appropriate than others.

This same worksheet was used to summarize the pollutant removal efficiencies of the structural and vegetative BMPs that were being considered for Buck Creek. The effect of the implementation of BMPs has been quantitatively measured by monitoring inflow and outflow parameters in previous studies on urban BMPs and the results are shown in Appendix 6.5.

A worksheet was also completed for the managerial BMPs. The results show that most managerial BMPs are applicable to most sites and are more flexible and adaptable than structural BMPs. Appendix 6.6 illustrates the results.

The Subcommittee compiled this information to create the recommendations and actions to address each impairment found and suspected in the Watershed. The Technical Subcommittee reviewed the drafts of the recommendations and made comments and revisions to the list. Table 6.1 identifies the structural and vegetative BMPs, the managerial BMPs, the land use policies, and the I&E activities that are recommended to address the objectives for each impairment.

The Subcommittees recognized that all remedies are site specific and the BMPs needed at each site should be customized to maximize the benefit to cost comparison for that particular site. Table 6.1 is organized such that the system of BMPs can be created from the recommendations for each impairment.

The structural and vegetative BMPs reflect the findings of the Illicit Discharge Elimination Plan (IDEP) and watershed inventories, which collected information about the sites of nonpoint source (NPS) pollution in the Watershed. Details about the sites, such as length of gully, height of streambank, and amount of trash were used to determine the extent of the problems and to prioritize the need of remediation. The storm water management activities of local governments were also included, detailing the information about urban BMPs, their costs, frequency of use, and efficiency. The recommendations are made on generalizations about the sites, therefore each specific site must be revisited before final plans are made for implementation.

The management and policy recommendations were based on preliminary reviews of local and state ordinances and regulations, and discussed at the Subcommittee, Technical Subcommittee, and Steering Committee meetings.

The I&E BMPs were derived from the LGRW I&E Strategy and the NPDES Phase II Storm Water Regulations Public Education Plan. The I&E Subcommittee reviewed the list of BMP recommendations and matched the appropriate I&E activity that would address that particular BMP.

Table 6.1 - Best Management Practices for Buck Creek Watershed

Impairments	Objectives	Structural and Vegetative BMPs	Managerial BMPs	Land Use Policies	Information and Education
Sediment	Stabilize stream flows to moderate hydrology and increase base flow	Ponded type detention basin	Storm water ordinance and storm water management design criteria	Designs for developments that protect wetlands	Tours of successful BMP sites, township ordinance meetings
		Vegetated swale		Green/open space protection	Homeowner workshops to explore ways to preserve land
		Bioretention			Lawn, garden, and landscape activities
		Constructed wetland			Articles in home builder publications about storm water management
	Reduce soil erosion and sedimentation	Hydrodynamic separator unit	Street sweeping		
		Streambank stabilization	Phased construction		Articles in neighborhood association publications about BMPs
		Catch basin inlet devices	Enforcement of SESC		
		Dry pond	Road/stream crossing inspections		Volunteer macroinvertebrate collection days
			Encourage stream protection in siting developments		
			Catch basin cleaning		"Did you Know?" list for taxpayers

Table 6.1 - Best Management Practices for Buck Creek Watershed

Impairments	Objectives	Structural and Vegetative BMPs	Managerial BMPs	Land Use Policies	Information and Education
	Encourage cover crops and no-till practices		Conservation tillage		Farmer workshops to coordinate resources
	Install livestock exclusion fencing	Exclusion fencing		Stream buffer ordinance	Fact sheets with cost and savings examples for agricultural improvements
	Install riparian buffers and storm water bioretention in residential areas	Rain gardens and vegetated swales		Investigate incentive programs for residents who use “Landscaping for Water Quality” techniques	Watershed tour and contest for rain gardens and riparian buffers
	Install filter strips	Filter strips		Stream buffer ordinance	Fact sheets with cost and savings examples for agricultural improvements
	Stabilize improperly installed stream crossings		Stream crossing and inspection program		
	Reduce impervious surfaces			Investigate density bonus programs for developers using impervious surface reduction strategies	

Table 6.1 - Best Management Practices for Buck Creek Watershed

Impairments	Objectives	Structural and Vegetative BMPs	Managerial BMPs	Land Use Policies	Information and Education
E. coli	Determine TMDL for *E. coli* and reduce inputs to meet water quality standards of 1,000 count/100 ml for areas of partial body contact recreation and 130 count/100 ml for total body contact recreation				Sign postings at public water access sites, and update articles in newspapers
	Encourage proper installation and maintenance of septic systems		Identify and prohibit illicit sanitary connections	Kent County Septage Plan	Use handbooks and already developed material to educate homeowners
			Septic system maintenance		
	Encourage sanitary sewers in areas serviced by water utilities			Kent County Septage Plan	Township and resident meetings
	Exclude livestock access in high-risk areas	Exclusion fencing		Stream buffer ordinance	Farmer workshops to coordinate resources
	Reduce amount of pet waste entering waterways		Install containers, bags, and signs for pet waste disposal in public parks		Awareness of pet waste impacts
					Storm drain stenciling
	Control urban wildlife, such as geese and raccoon, populations	Filter strips			Landscaping for wildlife fact sheets and workshops done in coordination with urban nature centers
	Locate and remove or correct illicit connections to storm sewers		Apply NPDES Illicit Discharge Elimination Plan to entire watershed		

Table 6.1 - Best Management Practices for Buck Creek Watershed

Impairments	Objectives	Structural and Vegetative BMPs	Managerial BMPs	Land Use Policies	Information and Education
Nutrients	Encourage composting and curbside collection of yard wastes		Composting and yard waste collection		Grounds maintenance training, promotion of alternative waste disposal activities and locations
	Encourage "landscaping for water quality" techniques				Distribute "Landscaping for Water Quality" booklet
	Install riparian buffers and storm water bioretention in residential areas	Rain gardens and vegetated swales		Investigate incentive programs for residents who use "Landscaping for Water Quality" techniques	Watershed tour and contest for rain gardens and riparian buffers
	Encourage proper installation and maintenance of septic systems		Septic system maintenance	Kent County Septage Plan	Distribute existing materials on good homeowner septic BMPs, Yellow Book advertising and coupons
	Encourage sanitary sewers in areas serviced by water utilities			Kent County Septage Plan and sewer master plans	Articles on benefits in newspapers and at local decision maker workshops
	Install filter strips	Filter strips			Farmer workshops with site tour to coordinate resources
	Install livestock exclusion fencing	Exclusion fencing		Stream buffer ordinance	Farmer workshops to coordinate resources
	Reduce amount of pet waste entering waterways				Awareness of pet waste impacts
					Storm drain stenciling

Table 6.1 - Best Management Practices for Buck Creek Watershed

Impairments	Objectives	Structural and Vegetative BMPs	Managerial BMPs	Land Use Policies	Information and Education
	Locate and remove or correct illicit connections to storm sewers		Apply NPDES Illicit Discharge Elimination Plan to entire watershed		
Trash and Debris	Remove trash and log jams according to woody debris management principles		Drain maintenance using woody debris management principles		Volunteer clean-ups
	Stabilize stream flows to moderate hydrology and increase base flow	see above	see above	see above	see above
	Institute an annual free trash collection day for household items and refuse		Organize a free collection day		
	Increase visibility of “No Dumping” signs				Install “No Dumping” signs in high volume dumping areas
	Increase patrols in areas that frequently have high volumes of trash dumped		Monitor occurrence of illegal dumping to establish trends for future enforcement		

Table 6.1 - Best Management Practices for Buck Creek Watershed

Impairments	Objectives	Structural and Vegetative BMPs	Managerial BMPs	Land Use Policies	Information and Education
Road salt (suspected)	Calibrate salt application equipment and have proper salt storage		Calibrated salt delivery		Training session for county and city employees
			Pre-wet road salt		Fact sheet on benefits distributed to public works department heads
			Emergency spill response and prevention plan		Workshops to assist with development of plan
	Encourage use of alternative de-icing techniques		Snow removal storage on grassy areas		De-icing alternatives demonstrations
Temperature (suspected)	Reduce the amount of impervious surfaces	Porous pavement		Low impact design practices	Workshops for homeowner
		Rain gardens	Promote urban forestry	Green/open space protection	Site tour promoting rain gardens
	Divert impervious surface runoff to prevent direct connection to surface water	Infiltration trench		Identify and prohibit illegal or illicit discharges to storm drains	
		Bioretention			Use handbooks and already developed material to educate homeowners
		Vegetated swale			
		Infiltration pond			Site tour illustrating successful sites for homeowners or municipal workers

6.2 ACTION PLAN FOR SHORT-TERM OBJECTIVES

The recommendations for actions and cost estimates are listed in Table 6.2. Costs will vary as each site is individually assessed and, generally, costs will be lower when multiple sites are remedied simultaneously.

Structural and vegetative BMPs recommended to meet short-term objectives include those that have been successfully implemented in surrounding areas and have a proven ability to reduce sediment, *E. coli,* nutrients, and trash and debris from entering surface waters. Storm water management techniques, such as detention basins, vegetated swales, bioretention, infiltration basins, filter strips, hydrodynamic separators, catch basin inlet devices, and livestock exclusion fencing, can be implemented in a short time frame to meet the objectives.

Managerial BMPs and land use policies that can be developed to meet the objectives in the near future include catch basin cleaning, street sweeping, enforcement of soil erosion and sedimentation control, conservation tillage, free trash collection days, and snow removal storage on grassy areas. Many of these BMPS are currently being used, but their frequency of use or application could be increased or improved.

The I&E activities that are recommended for carrying out immediately or continuing the existing program consist of BMP tours, homeowner workshops to explore ways to preserve land, lawn and garden activities, fact sheets with cost and savings examples for agricultural improvements, articles in neighborhood association publications about BMPs, volunteer macroinvertebrate collection days, storm drain stenciling, and farmers' workshops to coordinate resources. The use of handbooks, Yellow Book advertising and coupons, and already developed material are recommended to educate homeowners about the health and safety issues associated with *E. coli* and good homeowner septic system BMPs. Increasing the public's awareness of pet waste impacts is also recommended. Landscaping for wildlife fact sheets and workshops done in coordination with urban nature centers are recommendations to increase the recognition of the impacts of urban wildlife on surface waters. The installation of "No Dumping" signs in areas that frequently have high volumes of trash dumped are recommended. Recommendations for other pollutants from urban runoff include training session for county and city employees and a fact sheet on benefits of salt calibration and salt alternatives distributed to public works department heads. Workshops for homeowners are suggested to introduce and explain the concept of reducing impervious surface to protect water quality.

Table 6.2 - Action Plan for Buck Creek Watershed

Objectives	Recommended BMPs	Potential Partners	Estimated Cost	Implementation Schedule
Impairment	**Sediment**			
Stabilize stream flows to moderate hydrology and increase base flow	Ponded type detention basin	KCDC; local governments; private landowners	$41,600/ 1 acre-ft pond for 10-year storm - (3-5% construction costs annually)	Short-Term 0 to 5 years
	Vegetated swale	KCRC, local governments, private landowners, WMEAC	$339/ acre ($20/ acre annually)	Short-Term 0 to 5 years
	Bioretention	WMEAC, local governments, private landowners	$8,128/ acre ($100/ acre annually)	Short-Term 0 to 5 years
	Tours of successful BMP sites, township ordinance meetings	Local governments, WMEAC, CES, MSUE, DPW,	$300/tour	Short-Term 0 to 5 years
	Homeowner workshops to explore ways to preserve land	CES, WMEAC, RRWC, MSUE, KCD	$400/workshop	Short-Term 0 to 5 years
	Lawn, garden, and landscape activities	Local governments, private landowners, WMEAC, CES, RRWC	$400/workshop	Short-Term 0 to 5 years
	Constructed wetland	KCDC, KCRC, local governments, private landowners	$10,000/site	Intermediate 3 to 8 years
	Storm water ordinance and storm water management design criteria	KCDC, CES, GVMC, Local Governments	$2,000/local government	Intermediate 3 to 8 years
	Designs for developments that protect wetlands	Builders/developers, local governments, MSUE, MDEQ	No additional costs	Intermediate 3 to 8 years
	Articles in home builder publications about storm water management	KCDC, local governments, CES, GVMC	No additional costs	Intermediate 3 to 8 years
	Green/open space protection ordinance	County commissioners, local governments, MSUE, KCD	$2,000/local government	Long-Term 5 to 10 years

Table 6.2 - Action Plan for Buck Creek Watershed

Objectives	Recommended BMPs	Potential Partners	Estimated Cost	Implementation Schedule
Reduce soil erosion and sedimentation	Hydrodynamic separator unit	Local governments, builders/developers	$25,000+/unit	Short-Term 0 to 5 years
	Catch basin inlet devices (assuming 2 CB/acre)	Local governments, builders/developers	$3,000/ acre ($600/ acre annually)	Short-Term 0 to 5 years
	Dry pond	KCDC, local governments, builders/developers	Low to moderate	Short-Term 0 to 5 years
	Street sweeping	KCRC; local governments	$100,000-200,000 ($15-30/ curb mile annually)	Short-Term 0 to 5 years
	Enforcement of SESC	KCRC, local governments, builders/developer	($40,000-50,000 annually)	Short-Term 0 to 5 years
	Articles in neighborhood association publications about BMPs	MDEQ, neighborhood groups, NRCS, MSUE	No additional costs	Short-Term 0 to 5 years
	Volunteer macroinvertebrate collection days	Local governments, WMEAC, MDEQ, community groups	$1,000/site	Short-Term 0 to 5 years
	Watershed tour and contest for rain gardens and riparian buffers	MSUE – Master Gardeners, WMEAC, and CES	$1,200/annually	Intermediate 3 to 8 years
	Streambank stabilization	KCDC, KCRC, MDEQ, MDNR, WMEAC, local governments, private landowners	$28/foot	Intermediate 3 to 8 years
	Utility bill inserts about activities	Local governments, utility companies	No additional costs	Intermediate 3 to 8 years
	"Did you Know?" list for taxpayers	Local governments	No additional costs	Intermediate 3 to 8 years
	Phased construction	KCRC, local governments, builders/developers	To be determined	Intermediate 3 to 8 years
	Road/stream crossing inspections	KCRC, MDEQ, local governments	Moderate	Intermediate 3 to 8 years
	Encourage stream protection in siting developments	Local governments	To be determined	Intermediate 3 to 8 years
	Catch basin cleaning (2 CB Service 1 Acre)	Local governments	($96 annually)	Intermediate 3 to 8 years
	Radio spots and TV meteorologists	CES, local governments, MDEQ	To be determined	Long-Term 5 to 10 years

Table 6.2 - Action Plan for Buck Creek Watershed

Objectives	Recommended BMPs	Potential Partners	Estimated Cost	Implementation Schedule
Install filter strips	Filter Strips	NRCS, KCD, local governments, private landowners	$200/ acre ($4/ acre annually)	Short-Term 0 to 5 years
	Fact sheets with cost and savings examples for agricultural improvements	MDEQ; MDNR, NRCS, MSUE, KCD	No additional costs	Short-Term 0 to 5 years
	Stream buffer ordinance	County commissioners, local governments	Moderate to High	Long-Term 5 to 10 years
Encourage cover crops and conservation tillage	Conservation tillage practices	NRCS, MSUE, KCD, private landowners	($170/ acre Cover Crop; $10-15/ acre Mulch / No Till - annually)	Short-Term 0 to 5 years
	Farmer workshops to coordinate resources	NRCS, KCD, private landowners	$200/workshop	Short-Term 0 to 5 years
Install livestock exclusion fencing	Exclusion fencing	NRCS, KCD, private landowners	$1.50/linear foot	Short-Term 0 to 5 years
	Fact sheets with cost and savings examples for agricultural improvements	NRCS, KCD, private landowners	No additional costs	Short-Term 0 to 5 years
	Stream buffer ordinance	County commissioners, local governments	To be determined	Long-Term 5 to 10 years
Stabilize improperly installed stream crossings	Create and implement stream crossing maintenance plan	KCRC, MDEQ	To be determined	Intermediate 3 to 8 years
Reduce impervious surfaces	Ordinance that gives a density bonus for impervious surface reduction	Home Builders Association of Greater Grand Rapids, County Commissioners, local governments	To be determined	Long-Term 5 to 10 years
	Investigate tax incentive programs for property that reduces imperviousness	County commissioners, GVMC, local governments	To be determined	Long-Term 5 to 10 years

Table 6.2 - Action Plan for Buck Creek Watershed

Objectives	Recommended BMPs	Potential Partners	Estimated Cost	Implementation Schedule
Impairments	***E. coli***			
Determine TMDL for *E. coli* and reduce inputs to meet water quality standards of 1,000 count/100 ml for areas of partial body contact recreation and 130 count/100 ml for total body contact recreation	Use handbooks and already developed material to educate homeowners	Local governments, KCHD	No additional costs	Short-Term 0 to 5 years
Encourage proper installation and maintenance of septic systems	Sign postings at public water access sites, and update articles in newspapers	Local governments, KCHD, parks department	$150/sign	Intermediate 3 to 8 years
	Identify and prohibit illicit sanitary connections	KCDC, local governments	$600/ Dye Test; $100/ Staff Investigation per property	Intermediate 3 to 8 years
	Septic system maintenance	KCDC, KCHD, local governments, private landowners	No additional costs	Intermediate 3 to 8 years
	Kent County Septage Plan	Kent County Septage Plan Committee	To be determined	Long-Term 5 to 10 years
Encourage sanitary sewers in areas serviced by water utilities	Township and resident meetings	Local governments, residents	$100/meeting	Intermediate 3 to 8 years
Exclude livestock access in high-risk areas	Exclusion fencing	NRCS, KCD, private landowners	$1.50/linear foot	Short-Term 0 to 5 years
	Farmer workshops to coordinate resources	NRCS, KCD, private landowners	$200/workshop	Short-Term 0 to 5 years
	Stream buffer ordinance	County commissioners, local governments	To be determined	Long-Term 5 to 10 years

Table 6.2 - Action Plan for Buck Creek Watershed

Objectives	Recommended BMPs	Potential Partners	Estimated Cost	Implementation Schedule
Reduce amount of pet waste entering waterways	Install containers, bags, and signs at public parks	County and City Parks Department	$600/park	Intermediate 3 to 8 years
	Awareness of pet waste impacts	MDEQ, KCDC, local governments	No additional costs	Short-Term 0 to 5 years
	Storm drain stenciling	WMEAC, neighborhood groups, local governments	$0.45/ inch Mylar; $5-6 each Ceramic; >$100 each Metal	Short-Term 0 to 5 years
Control urban wildlife, such as geese and raccoon populations	Filter strips	NRCS, KCD, local governments, private Landowners	$200/acre establishment, $75/acre/year rental	Short-Term 0 to 5 years
	Landscaping for wildlife fact sheets and workshops done in coordination with urban Nature Centers	MDEQ, MDNR, CES, WMEAC	$200/workshop	Short-Term 0 to 5 years
Locate and remove or correct illicit connections to storm sewers	Apply NPDES Illicit Discharge Elimination Plan to entire Watershed.	Local governments, KCDC, KCRC	To be determined	Intermediate 3 to 8 years
Impairments	**Nutrients**			
Encourage composting and curbside collection of yard wastes	Composting and yard waste collection	WMEAC, DPW, local Governments	To be determined	Intermediate 3 to 8 years
	Grounds maintenance training, promotion of alternative waste disposal activities and locations	KCRC, parks departments, local governments	No additional costs	Intermediate 3 to 8 years
Encourage use of “Landscaping for Water Quality” techniques	Distribute “Landscaping for Water Quality” Booklet	CES, MDEQ, local governments, MSUE	No additional costs	Short-Term 0 to 5 years
	Watershed tour and contest for rain gardens and riparian buffers	MSUE - Master Gardeners, WMEAC, and CES	$1,200/annually	Intermediate 3 to 8 years
Encourage proper installation and maintenance of septic systems	Distribute existing materials on good homeowner septic BMPs, Yellow Book advertising and coupons	KCHD, MDEQ, local governments	No additional costs	Short-Term 0 to 5 years
	Identify and prohibit illicit sanitary connections	KCDC, KCRC, KCHD, local governments, private landowners	$600/ Dye Test; $100/ Staff Investigation per property	Intermediate 3 to 8 years
	Septic system maintenance	KCHD, private landowners	No additional costs	Intermediate 3 to 8 years
	Kent County Septage Plan	Kent County Septage Plan Committee	To be determined	Long-Term 5 to 10 years

Table 6.2 - Action Plan for Buck Creek Watershed

Objectives	Recommended BMPs	Potential Partners	Estimated Cost	Implementation Schedule
Install filter strips	Filter strips	NRCS, KCD, local governments, private landowners	$200/acre establishment, $75/acre/year rental	Short-Term 0 to 5 years
	Farmer workshops with site tour to coordinate resources	NRCS, KCD, private landowners	$400/workshop and tour	Short-Term 0 to 5 years
Install livestock exclusion fencing	Exclusion fencing	NRCS, KCD, private landowners	$1.50/linear foot	Short-Term 0 to 5 years
	Stream buffer ordinance	County commissioners, local governments	To be determined	Long-Term 5 to 10 years
Encourage sanitary sewers in areas serviced by water utilities	Create a sewer master plan for local governments in the Watershed	KCDPW, KCHD, local governments	To be determined	Long-Term 5 to 10 years
Locate and remove or correct illicit connections to storm sewers	see above	see above	see above	see above
Impairments	**Trash and Debris**			
Remove trash and log jams according to woody debris management principles	Selective log jam removal	KCDC, MDEQ, MDNR, local governments	$10/yd and $125/hr	Short-Term 0 to 5 years
	Lawn, garden, and landscape activities	Kent County; local governments; private landowners	$200/workshop	Short-Term 0 to 5 years
Stabilize stream flows to moderate hydrology and increase base flow	see above	see above	see above	see above
Institute an annual free trash collection day for household items and refuse.	Organize a free trash collection day.	DPWs, local governments	To be determined	Short-Term 0 to 5 years
Increase visibility of "No Dumping" signs	Install "No Dumping" signs in areas that frequently have high volumes of trash dumped	KCRC, WMEAC, local governments	$150/sign	Short-Term 0 to 5 years
Increase patrols in areas that frequently have high volumes of trash dumped	Greater enforcement of laws against illegal dumping	Local police, local governments	To be determined	Intermediate 3 to 8 years

Table 6.2 - Action Plan for Buck Creek Watershed

Objectives	Recommended BMPs	Potential Partners	Estimated Cost	Implementation Schedule
Impairments	**Other urban runoff (road salt, temperature, hydrocarbons, chemicals)**			
Calibrate salt application equipment and have proper salt storage	Training session for county and city employees	MDEQ, MDNR	$150/training	Short-Term 0 to 5 years
	Fact sheet on benefits distributed to Public Works Department heads	MDEQ	No additional costs	Short-Term 0 to 5 years
	Calibrated salt delivery	KCRC, local governments	To be determined	Intermediate 3 to 8 years
	Pre-wet road salt	KCRC, local governments	To be determined	Intermediate 3 to 8 years
	Emergency spill response and prevention plan	KCRC, MDEQ, local Governments	To be determined	Intermediate 3 to 8 years
	Workshops to assist with development of plan	KCRC, MDEQ, local governments	$200/workshop	Intermediate 3 to 8 years
Encourage use of alternative de-icing techniques	Snow removal storage on grassy areas	KCRC, local governments	To be determined	Short-Term 0 to 5 years
	De-icing alternatives demonstrations	Michigan Township Association	To be determined	Intermediate 3 to 8 years
	Site tour promoting rain gardens	WMEAC	$200/tour	Intermediate 3 to 8 years
	Porous pavement	KCRC; Kent County; local governments; private landowners	To be determined	Long-Term 5 to 10 years
	Rain gardens	Builders/developers, WMEAC, local governments	To be determined	Long-Term 5 to 10 years
	Promote urban forestry	Parks department, local governments	To be determined	Long-Term 5 to 10 years
	Low impact design practices	Builders/developers, local governments; private landowners	To be determined	Long-Term 5 to 10 years
	Green/open space protection	County commissioners, local governments, MSUE, KCD	To be determined	Long-Term 5 to 10 years

Table 6.2 - Action Plan for Buck Creek Watershed

Objectives	Recommended BMPs	Potential Partners	Estimated Cost	Implementation Schedule
Divert impervious surface runoff to prevent direct connection to surface water	Infiltration trench	KCRC; Kent County; local governments, builders/developers	$8,128/ acre ($732/ acre annually)	Short-Term 0 to 5 years
	Bioretention	KCRC, local governments, private landowners, WMEAC	$8,128/ acre ($100/ acre annually)	Short-Term 0-5 years
	Vegetated swale	KCRC, local governments, private landowners, WMEAC	$339/ acre ($20/ acre annually)	Short-Term 0 to 5 years
	Infiltration pond	KCRC, local governments, private landowners, WMEAC	$2/ft^3 (<5% construction costs annually)	Short-Term 0 to 5 years
	Use handbooks and already developed material to educate homeowners	KCRC, local governments, private landowners, WMEAC	No additional costs	Short-Term 0 to 5 years
	Identify and prohibit illegal or illicit discharges to storm drains	KCDC, KCRC, KCHD, local governments	($0.83-2.00/ acre; TV Inspection $50/ acre - annually)	Intermediate 3 to 8 years
	Site tour illustrating successful sites for homeowners or municipal workers	KCDC, KCRC, KCHD, local governments	$300/tour	Intermediate 3 to 8 years

KCDC = Kent County Drain Commissioner
KCRC = Kent County Road Commission
KCHD = Kent County Health Department
WMEAC = West Michigan Environmental Action Council
CES = Center for Environmental Study
MSUE = Michigan State University Extension
DPW = Department of Public Works
RRWC = Rogue River Watershed Council
KCD = Kent Conservation District
GVMC = Grand Valley Metro Council
MDEQ = Michigan Department of Environmental Quality
NRCS = Natural Resources Conservation Service
MDNR = Michigan Department of Natural Resources

6.3 ACTION PLAN FOR INTERMEDIATE OBJECTIVES

Intermediate goals were identified in the action plan as those needing more engineering or assessment before immediate implementation. The structural and vegetative BMPs requiring more investigation before implementation at certain sites are streambank stabilization, protection and restoration projects, and restoring and constructing wetlands.

Many of the managerial BMPs and land use policies identified for intermediate scheduling are already in progress and are supported by the local agencies and governmental units. The Kent County Model Storm Water Ordinance has been adopted by a few communities in Kent County, but not yet in any of the communities in the Watershed. The Buck Creek and Plaster Creek Storm Water Management Master Plan was completed in 1991 and a review of the storm water management design criteria is a recommendation. Gaines Township is in the process of developing storm water management criteria. Other recommendations that will take a few years to evolve are designs for developments that protect wetlands, siting developments that encourage stream protection, phased construction practices, road/stream crossing inspections, catch basin cleaning, composting, and yard waste collection. The IDEP, currently being conducted in the NPDES Phase II communities, will identify illicit sanitary connections and assist the communities in adopting ordinances to prohibit those illicit connections. Greater enforcement of laws against illegal dumping is recommended to reduce the amount of trash and debris in the waterways.

BMP recommendations for other pollutants from urban runoff include calibrated salt delivery, pre-wet road salt, an emergency spill response and prevention plan, and de-icing alternatives demonstrations.

Additional activities that provide I&E about watershed and storm water management in the intermediate schedule include submitting articles in home builder publications about storm water management, using utility bill inserts to inform the residents about upcoming activities, and developing a "Did you Know?" list of storm water facts for taxpayers. Sign postings at public water access sites and updated articles in newspapers are recommended to educate the public about *E. coli* and the importance of maintaining private septic systems. Township and resident meetings are also recommended to bring the information to the public. Grounds maintenance training is recommended for maintenance personnel, and municipalities are recommended to promote alternative waste disposal activities and locations that are available to the public. Workshops to assist with development of a storm water management plan and site tours promoting rain gardens are recommended to address other pollutants from urban runoff.

6.4 ACTION PLAN FOR LONG-TERM OBJECTIVES

The long-term goals require actions that will create a sustainable water management program for the Watershed as well as the entire LGRW.

Most of the structural and vegetative BMPs are scheduled to be implemented in the short-term and intermediate schedules. Porous pavement and other experimental and innovative urban BMPs are recommended for demonstration to evaluate and monitor their performance in reduced storm water pollution. A few agricultural producers in the Watershed participate in the Unites States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) programs, but the rapid urbanization of the area is deterring producers from entering into any more long-term agreements or contracts. Practices would have to be on a site-to-site basis for determining the potential for long-term agricultural practices to improve water quality.

The Subcommittee identified the existing programs and policies of the represented entities in the Watershed that address resource concerns. Many opportunities exist for enhancing current management and standards within the Watershed. The following areas are particularly promising:

- Green/open space protection ordinance
- Rain gardens
- Urban forestry
- Stream buffer ordinance
- Low impact development techniques for selected sites in the Watershed
- Native landscaping in municipally owned properties
- Kent County Septage Plan

The I&E Subcommittee is pursuing a partnership with the local television meteorologists, modeled after a successful program in the Washington, D.C area. A solid agreement with roles and expectations spelled out for each partner is necessary before a program such as this can be launched. The City of Grand Rapids is conducting a storm water advertising campaign called “Radio Spots” that could be expanded to include the entire LGRW.

6.5 TECHNICAL AND FINANCIAL ASSISTANCE

Technical and financial assistance is needed to successfully implement many portions of this Watershed Management Plan (WMP). The following agencies and organizations are able to provide assistance:

The **USDA NRCS** provides the technical expertise to implement agricultural BMPs that are eligible under the Farm Bill. The **USDA Farm Service Agency** administers the financial aspects of the Farm Bill programs. The programs offer federal cost-share opportunities and coordinate the funding with state and local programs to maximize the benefits. Full listings and descriptions of the programs are available at: www.mi.nrcs.usda.gov

The **Kent County Drain Commissioner (KCDC)** spearheaded the efforts of developing the Model Storm Water Ordinance for Kent County townships and municipalities. The KCDC maintains and improves the county drains and provides assistance in the implementation of BMPs along waterways. Many projects are financed through drain assessments within the drainage districts.

The **Kent County Health Department (KCHD)** conducts water quality sampling and analysis to detect water quality impairments. The KCHD also conducts household hazardous waste collection days and provides information about septic system maintenance and proper disposal of other household wastes.

Builders and Developers can incorporate innovative designs and construction practices into their projects to help promote low impact development and smart growth techniques.

The **Local Governments,** cities, villages, and townships, are instrumental in the planning and development within the Watershed. Land use issues are a predominant concern in this area, and the cooperation of the local governments is essential for consistent and comprehensive land use planning.

The **MDEQ** administers programs and enforces laws that protect public health and promote the appropriate use of, limit the adverse effects on, and restore the quality of the environment. As stewards of Michigan's environmental heritage, the MDEQ works on behalf of the people of the Great Lakes State for an improved quality of life and a sustainable future, protecting and enhancing Michigan's environment and public health. Technical and financial assistance through grants provided by the MDEQ will guide the project implementation activities to create the most efficient systems of improvements for the Watershed.

The **Michigan Department of Natural Resources (MDNR)** is committed to the conservation, protection, management, use, and enjoyment of the State's natural resources for current and future generations. The MDNR will assist the implementation of the Buck Creek WMP through encouraging citizen participation and partnerships in developing new ways of addressing environmental issues.

The **Kent County Road Commission (KCRC)** is responsible for the construction, maintenance, and improvements of all county roads and highways. The KCRC will assist in the implementation of the BMPs by assisting with the evaluation of roadside erosion sites and serving as the contracting organization for constructing BMPs on the county road rights-of-way.

The **West Michigan Environmental Action Council (WMEAC)** is a non-profit environmental advocacy and education organization committed to citizen empowerment. Members are men, women, young people, retirees, families, professionals and students, hunters and anglers, sportsmen, executives, and homemakers with one thing in common: a desire to make a difference for the environment and their children's future. The Adopt-A-Stream program involves volunteers of all ages in cleaning up, monitoring, and restoring streams throughout Kent County and surrounding areas. WMEAC, in partnership with the City of Grand Rapids (City), Michigan, has started a community storm water education effort focused in the City and surrounding suburban communities. Stream Search is a program that partners WMEAC with the MDEQ in checking the health of Kent County streams and rivers. Teams that turn citizens into scientists do biological and habitat assessments, wading in streams, and catching creatures in nets. WMEA has all the equipment needed.

The **Center for Environmental Study (CES)** uses scientific information and a shared sense of community at all levels to create environmental awareness and involvement. Selecting projects on the basis of need, resources, and appropriateness to its overall vision, the CES will act as a facilitator and catalyst, creatively using partnerships to expand its reach and effectiveness. The current Statewide Storm Water Education project will collaborate with the LGRW Project to create clear and concise messages about storm water to all.

Grand Valley State University's Annis Water Resource Institute, (AWRI) is currently working on two implementation projects in the Rogue River Watershed, an I&E program, and a physical improvements project. The goal of the I&E program is to increase the involvement of the community in the Watershed protection activities through awareness, education, and action. The AWRI is working with both the users of resources within the Watershed and local decision-makers both within and outside the Watershed, providing educational workshops, biological monitoring events, stream clean-ups, and watershed fairs to lead to more appropriate land use throughout the Watershed. These efforts can be expanded to the Watershed and other area within the LGRW.

The **Grand Valley Metropolitan Council (GVMC)** is an alliance of governmental units in the Grand Rapids, Michigan metropolitan area that are appointed to plan for the growth and development, improve the quality of the communities' life, and coordinate governmental services. GVMC has served as the grantee for this watershed planning process and will continue to be a leader in environmental issues for West Michigan watersheds. Partnerships with community foundations and other financial resources create possible sustainable mechanisms for the future improvements of the Buck Creek Watershed and throughout the LGRW

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

The **Kent County Conservation District (KCD)** is a local unit of state government established to carry out programs for conservation promoting the wise use of natural resources for current and future generations. The KCD is organized by local people to address local natural resource concerns, governed by a five-member board of elected volunteers. The locally elected five-member board of directors makes all decisions regarding the district's programs and activities. The directors hire qualified staff to conduct and carry out the programs and activities that provide technical assistance, information, and education to properly manage natural resources. The KCD will assist the implmentation of the Buck Creek WMP through educational programs and providing technical assistnace for agricultural imrpovments.

The **KCHD** administers programs to monitor surface water, groundwater, and drinking water quality. The surface water quality program monitors the quality and contamination of surface waters (rivers and creeks) in Kent County. Warning signs are posted on waters, which are not safe for human contact. The groundwater program provides technical assistance in the design, construction, and abandonment of onsite well and septic systems. The well water program evaluates drinking water quality through laboratory analysis to detect chemical and/or bacteriological contamination. A water supply evaluation consists of a review of well construction, location, and water quality. Water samples for bacteriological and partial chemical analysis are collected and analyzed by the Kent County Laboratory. The KCHD will continue programs in the Watershed to monitor the improvements throughout the implementation period.

6.6 SCHEDULE FOR IMPLEMENTATION

How the various BMPs will be phased in or scheduled in relation to one another over time is a key question when planning to implement BMPs to address the water quality concerns. The most efficient system of BMPs requires careful examination of what the BMPs are to accomplish and what needs to take place first. The causes or the sources of the impairments need to be addressed before the actual, site specific problem can be solved in most cases.

The BMPs have been categorized in terms of their scheduled planning or implementation. These are recommendations of how the scheduling of the BMPs could be organized, however, many variables exist in the real world and adjustments to the schedule and the sequence of BMP implementation should surely occur.

Short-term BMPs are those that can be initiated immediately, require minimal costs or planning, and address the causes or sources of the problem. Examples include mostly the I&E programs, changes or modifications in standards, and perhaps revisions and updates to the master plans. This category of BMPs is considered to be implemented in one to five years.

Intermediate BMPs are those that require significant planning and development, design specifications, major cost commitment, and address the causes or sources of the problems. Examples include ordinance review and adoption, demonstration sites for testing and evaluating BMPs, large construction activities, and additional monitoring or water quality studies. These intermediate BMPS are considered to be implemented in three to eight years.

Long-term BMPs are those that must build on the success of other BMPs to support a sustainable program. Examples include streambank stabilization practices in areas that have been identified through a hydrologic and hydraulic analysis as necessary for the health of the stream. Land use policy changes are long-term BMPs that are incorporated into master plans that developers and builders support and use as guidance. These long-term BMPS are expected to be in progress within five to ten years.

CHAPTER 7 - METHODS OF MEASURING AND EVALUATING

Evaluation of the Buck Creek Watershed (Watershed) Project will be a two-phase process. The first phase evaluates the success of the planning process. The second phase will assess the methods and strategies of the implementation of the Watershed Management Plan (WMP).

7.0 EVALUATION OF THE PLANNING PROCESS

The planning process of the Watershed project began on July 1, 2002. The evaluation of the planning process was subcontracted out to TetraTech to complete an objective assessment of the success in meeting the goals and objectives of the project.

TetraTech is organizing and facilitating the Evaluation Team. The following description of the evaluation process is from the progress of the Evaluation Team. Only those components that apply to the development of the Buck Creek WMP are included in this chapter.

A representative from the Urban Subcommittee (Subcommittee) attended the Evaluation Team meetings to ensure the inclusion of urban issues into the evaluation process. Other Subcommittee members were asked to join the Evaluation Team based on the following criteria:

- Do they help create a more diverse cross section of the project members?
- Are they going to be impacted by the outcome of this project?
- Is this someone “new” to the world of watershed management?
- Are they representing government or non-government interests?
- Are they active in the Subcommittee meetings?

The following items were discussed during the first meeting of the Evaluation Team on March 12, 2003.

1. Establish purpose and goals of the project evaluation.

2. Describe the desired outcome of the project evaluation (i.e., final report).

3. Discuss the project evaluation process as developed and proposed to Annis Water Resource Institute. Obtain input from the Evaluation Team on this process.

4. Develop initial evaluation questions with the Evaluation Team that address the following issues:

    a. Goals/Objectives
    b. Organizational arrangements (related to committee structure and communication)
    c. Project processes (related to five focus areas and project deliverables)
    d. Project outputs (related to deliverables and project schedules)
    e. Project impacts (during and after implementation)

5. Discuss potential evaluation tools for answering evaluation questions.

6. Establish schedule for developing and collecting evaluation information for Project Year 1.

The evaluation for the Lower Grand River Watershed (LGRW) project is divided into five areas of focus.

1. **Assessment and Characterization of the Watershed's Natural Resources and Water Quality Conditions**, resulting in the development of an initial water quality statement, prioritization of problems, identification of tools to solve the problems, and development of an implementation plan.

2. **Information and Education Strategy**.

3. Creating a **System of Regional Governance** for the Watershed.

4. Reviewing and recommending the adoption of **Best Management Practices (BMPs)**.

5. The **Management Process** for the project including the timeliness and manner of implementation of various project elements, strategies, and activities.

All of these areas of focus can be applied to the planning process of the Watershed with the exception of the third element: Creating a System of Regional Governance for the Watershed. That area of focus will be completed under the development of the Lower Grand River WMP.

Team members conducted a brainstorming activity during the first meeting to identify potential evaluation questions in each of the five project focus areas. The questions address issues related to goals and objectives, organizational arrangements, processes, and outputs. Table 7.1 presents options for evaluation tools that could generate answers to each question. Many of the evaluation questions have the same type of evaluation tool options listed. This is not intended to indicate that a separate evaluation tool should be used for each question. The intent is to identify those questions that could use the same type of

evaluation tool and then consolidate related evaluation questions into one tool. The goal is to maximize the type of information generated by a specific evaluation tool.

In addition to overlap among evaluation tool options, overlap also exists among many of the evaluation questions. The next step in the project evaluation process was to refine the list of potential evaluation questions and engage in a prioritization process. The final evaluation questions will guide the project evaluator's efforts in developing appropriate evaluation tools.

The results of this evaluation will be presented in the updated Buck Creek WMP to be included in the Lower Grand River WMP at the end of his grant period.

Evaluation Goals:

- To facilitate a process of holistic and continuous evaluation of the values, goals, objectives, organizational arrangements, processes, outputs, and impacts of the project during and after implementation.

- To facilitate the identification of implementation problems as they occur and the resolution of those implementation problems in order to improve the potential for the attainment of project goals and objectives.

- To identify program design and management lessons learned in order to revise the current project and aid future project designs.

- To assess and ensure the future sustainability of the program after the termination of the current funding stream.

Each area of focus involved its own evaluation tools. For example, project staff and stakeholders were asked specific questions about the **Assessment and Characterization of the Watershed's Natural Resources and Water Quality Conditions.**

Table 7.1 - Evaluation Questions and Evaluation Tool Options

Project Focus Area	Potential Project Evaluation Questions and Evaluation Tool Options			
	Goals and Objectives	Organizational Arrangements	Processes	Outputs
Watershed Assessment and Characterization (Tasks 2 and 8)	Does the management plan reflect stakeholders' concerns as well as priority areas identified through the watershed characterization? **Tool Options:** ● Content analysis of management plan and Grand River Forum worksheet results (February 20, 2003) Are Phase II issues/concerns of watershed partners reflected in the WMP? **Tool Options:** ● Content analysis of management plan ● Focus group and/or survey of local watershed partners to capture Phase II issues/concerns	Does the structure or the context of the project lead to better project outcomes (e.g., availability of resources, access to data, participation)? **Tool Options:** ● Survey of project partners within each subcommittee ● Focus group of select representatives of each subcommittee ● Content analysis of subcommittee meeting summaries	Did the project have full participation? **Tool Options:** ● Content analysis of complete listing of project partners compared to subcommittee attendance records ● Focus group of select representatives of subcommittees to discuss perceptions about project participation Does the assessment follow a standard operating procedure? **Tool Options:** ● Content analysis of documentation on process used to conduct watershed assessment and characterization Are the processes used unique to this watershed or are they transferable to other watersheds? **Tool Options:** ● Identification of lessons learned through survey and/or focus group	Was the assessment of the watershed accurate? **Tool Options:** ● Conduct in-field verifications of any assumptions made in developing the management plan Were the tools used to assess the Watershed the right tools? **Tool Options:** ● Focus group of project partners and representatives of subcommittees Does this pilot project accurately characterize the LGRW? ➢ Does the public agree? ➢ Do the data support the selection of the pilot projects? **Tool Options:** ● Compare pilot projects selected by subcommittees to those identified through the Grand River Forum worksheet results (February 20, 2003) ● Compare overall Watershed data to baseline data collected for the pilot project areas

Table 7.1 - Evaluation Questions and Evaluation Tool Options

Project Focus Area	Potential Project Evaluation Questions and Evaluation Tool Options			
	Goals and Objectives	Organizational Arrangements	Processes	Outputs
Information and Education Strategy (Task 3)	Were the appropriate target audiences identified? ➢ For the project? ➢ For the Watershed? **Tool Options:** ● Focus group of subcommittee members and Grand Forum participants ● Content analysis of the final I&E strategy to examine processes used to identify target audiences	Were the appropriate stakeholders on the I&E Strategy team? **Tool Options:** ● Focus group and/or survey of members of the I&E Subcommittee, as well as other project partners	Was focusing on awareness now the right approach to take? **Tool Options:** ● Baseline survey of stakeholders throughout the Watershed to determine existing level of awareness conducted via quiz on educational materials and/or project web site Was developing the brochure and the news inserts by subcommittee an effective process? **Tool Options:** ● Focus group with I&E subcommittee members ● Content analysis of subcommittee meeting minutes ● Review of final products	Did people in the Grand Forum read and use the products developed through the I&E Strategy? **Tool Options:** ● Build feedback mechanism into educational products that allows project team to track use and user awareness ● Count numbers of products distributed throughout the Watershed ● Survey of Grand Forum participants Were the news inserts and brochures effective in raising awareness? **Tool Options:** ● Baseline survey of stakeholders throughout the Watershed to determine existing level of awareness conducted via quiz on educational materials and/or project web site ● Build feedback mechanism into educational products that allows project team to track use and user awareness

Table 7.1 - Evaluation Questions and Evaluation Tool Options

Project Focus Area	Potential Project Evaluation Questions and Evaluation Tool Options			
	Goals and Objectives	Organizational Arrangements	Processes	Outputs
BMP Review and Recommendations (Task 5)	Are the baseline conditions of each pilot area established? **Tool Options:** ● Content analysis of watershed characterization report to identify baseline data and conditions ● Content analysis of all related pilot project selection information Are effective evaluation mechanisms for determining BMP effectiveness being developed as BMPs are identified (i.e., monitoring plans)? **Tool Options:** ● Content analysis of BMP prioritization process and matrix, and any additional documentation related to BMP recommendations ● Survey and/or focus group of rural and urban subcommittee members to discuss development of evaluation mechanisms	Does the strategy for evaluating BMPs leverage partner resources? **Tool Options:** ● Content analysis of documentation related to BMP evaluation implementation ● Focus group with subcommittee members involved in developing BMP evaluation mechanisms to discuss allocation of resources Is there an assessment of resources available from all partners to support monitoring/evaluation of BMPs? **Tool Options:** ● Content analysis of documentation related to BMP evaluation implementation ● Focus group with subcommittee members involved in developing BMP evaluation mechanisms to discuss allocation of resources	Were BMPs selected based on a set of BMP evaluation criteria that addressed all aspects of feasibility (e.g., technical, financial, social acceptance, legal, etc.)? **Tool Options:** ● Content analysis of BMP prioritization process and matrix	Was a mix of short- and long-term BMPs identified? **Tool Options:** ● Content analysis of prioritization process and matrix ● Content analysis of selected systems of BMPs for urban and rural areas Are long-term BMPs feasible? **Tool Options:** ● Content analysis of BMP prioritization process and matrix ● Survey of Watershed stakeholders ● Focus group with participants in Grand Forum Did the assessment of BMPs reach target audiences? **Tool Options:** ● Build feedback mechanism into educational products that allows project team to track use and user awareness ● Count numbers of products distributed throughout the watershed ● Survey of Grand Forum participants and other project partners

Table 7.1 - Evaluation Questions and Evaluation Tool Options

Project Focus Area	Potential Project Evaluation Questions and Evaluation Tool Options			
	Goals and Objectives	Organizational Arrangements	Processes	Outputs
Project Management (Tasks 1, 4, and 7)	Have matching commitments from local governments been met for this project? **Tool Options:** ● Analysis of project budget to determine if local governments have met their matching commitments ● Conduct focus group and/or interview with local governments to determine reasons that matching commitments have not been met	How much of the project success is based on actual individuals versus partner organizations? **Tool Options:** ● Focus group with members of the subcommittees and the Grand Forum ● Focus group of local governments that contributed matching funds ● Content analysis of project documentation to identify any changes in organizational processes, deliverable schedules, decision-making capabilities, etc. during the project period of performance that may track with changes in key project individuals (e.g., Andy Bowman of Grand Valley Metro Council)	Were on-going sub-watershed activities promoted and sustained while engaging in this larger basin-wide project? **Tool Options:** ● Focus group of smaller subwatershed groups ● Survey of smaller subwatershed groups ● Interviews with smaller subwatershed groups ● Content analysis of progress reports and/or annual reports of subwatershed groups and activities to identify areas that may signify smaller groups suffered during this larger basin-wide project (e.g., decreases in funding, missed deadlines, decreases in volunteers, canceled events, etc.)	Was the project funder given review time that the contract calls for? **Tool Options:** ● Content analysis of progress reports and the project contract to compare timelines of proposed review schedules with actual dates of when project deliverables were submitted for review Were project budgets realistic? **Tool Options:** ● Comparison of proposed project budgets with actual project expenditures ● Focus group with key project managers to discuss budget and schedules What activities were accomplished that go beyond the requirements of the grant? **Tool Options:** ● Focus groups with members of the subcommittees and the steering committee ● Content analysis of progress reports compared to the original grant requirements

Project Staff Questions:

- What progress has been made in developing the initial water quality statement, delineating critical areas, in developing the overall WMP?

- Summarize the methods that were used for each activity?

- In your opinion, were the methodologies used effective in generating the needed information? Why or why not?

- What other challenges were encountered in the process?

Steering Committee and Stakeholder Questions:

- Are you aware of the water quality statement for the Watershed that was produced under the 319 project?

- Do you support the findings of the water quality statement? Why or why not?

- Are you familiar with the critical areas that the water quality statement identified, and in your opinion, are these the real critical areas?

- Do you support the WMP that was developed? Why or why not?

- This project has generated information that could be used as a decision support system for local policy makers, are you aware of this information, are you going to use it, and does it meet your needs? Why or why not?

- What suggestions would you make to improve the processes of developing the water quality statement, identifying critical areas, and compiling the final plan?

Project Staff and representatives of target audiences were asked questions about the **I&E Strategy**. Staff and participating local units of government helped assess the development of **BMPs.** Staff and Steering Committee members were asked specific questions about overall **project management.**

Success of the **Assessment and Characterization of the Watershed's Natural Resources and Water Quality Conditions** was determined in part by the Steering Committee, the stakeholders, and the Michigan Department of Environmental Quality (MDEQ) as an element of their review process. Participation in organized activities and response to survey questionnaires were used to measure the interest in the project stimulated by the **I&E Strategy**. The number of **BMPs** employed and the amount of sediment and other pollutants that are eliminated from the system or prevented from entering the system in the first place will ultimately determine the success of this strategy. The number and extent of **BMPs** will be useful in determining the success of this particular activity. Again, the ultimate measure of success will be the protection offered by these practices. The Steering Committee, the stakeholders, and the MDEQ will determine the accomplishments of the **management process**. The accomplishment of each objective was easily recognized by comparison with goals and objectives identified in the workplan.

The entire evaluation process for the LGRW will result in a written summary report. This report will include the following sections:

- Introduction: which will provide background information about the project (how and when it started, its general goals, objectives, and strategies) and introduces the purpose of the evaluation.

- Methodology: which will provide a description of the methods used to evaluate the project, including data gathering and data analysis.

- Results: which will present the results of the evaluation organized by evaluation focus area, including, the extent of implementation of the focus area, changes made during implementation, and challenges faced.

- Lessons Learned: which will outline the lessons emanating from the implementation of the project.

- Conclusions and Recommendations: which will present the evaluator's suggestions about ways to improve current and future project management.

7.1 EVALUATION OF THE IMPLEMENTATION ACTIVITIES

The second phase of the evaluation will measure the success of the project following the implementation of the prioritized BMPs as outlined in Table 7.2. The evaluation criteria were selected based on the pollutants identified as impairments to the designated uses. Both qualitative and quantitative measurements will be used. Evaluation criteria listed in Table 7.2 has been prioritized based on the cost effectiveness of the evaluation method. The pollution reduction calculations are identified as a required method. All criteria shown in Table 7.2 are worthwhile evaluation methods; however, lower priority methods will not be employed if the budget is not available.

7.1.1 QUALITATIVE METHODS

Qualitative methods measure success not directly related to water quality, such as stakeholder participation and community involvement in improving the quality of life in the Watershed. For example, the number of individuals attending a training and receiving a certificate could be a measure of the program's success. The I&E Strategy of this plan will be appraised in terms of the success in imparting a sense of ownership, pride, and knowledge of the Watershed for area residents. These types of measurements are considered interim measures of success, those that mark milestones rather than environmental improvements.

7.1.2 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 measure are further defined by categories of indirect indicators and direct environmental indicators. Indirect indicators are those that are measurements of practices and activities that could indicate water quality improvements, but do not actually measure the water quality itself. For example, estimating the pollutant reductions that a practice will achieve is stating that a certain amount of that pollutant 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 and the success could be measured.

Direct environmental indicators would be measuring the quality of the water through scientific investigation. Sediment load reduction could be measured by secchi disks and 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.

Table 7.2 - Evaluation Techniques for Buck Creek Watershed Project Implementation Phase					
Impairment	Evaluation Technique	Priority	Units of Measurement	Measurable Goals	Partners in Evaluation
Sediment	Pollution reduction calculations	Required	Tons of sediment prevented from entering the waterways	Prevent 10,000 tons/year of sediment from entering waterways	MDEQ, Natural Resources Conservation Service (NRCS), Consultants
	Implementation of BMPs	High	Number and location of BMPs implemented	Implement BMPs on all identified sites according to implementation schedule	Municipal Department of Public Works (DPW), County Departments
	Photographs of BMPs installed	High	Before and after photographs	Portfolio of photographs with supporting documentation	Municipalities, MDEQ
	Benefit to cost comparisons	Medium	Pollutant load reduction compared to cost of BMP implemented	Economic impact of pollutant load reduced outweighs cost of BMP implementation	Municipalities, contractors, consultants
	Macroinvertebrate surveys	High	Water quality assessment	Increased ranking of water quality	West Michigan Environmental Action Council (WMEAC), Grand Valley State University (GVSU), MDEQ
	MDEQ biological surveys	High	Fish, habitat, and physical properties of water	Increased rating of fish, habitat, and physical properties	MDEQ
	Creel surveys	Low	Amount, size, and species of fish caught	Establish baseline use and increase number of fishers using the stream and the number of fish caught	Michigan Department of Natural Resources (MDNR), Trout Unlimited (TU)

Table 7.2 - Evaluation Techniques for Buck Creek Watershed Project Implementation Phase					
Impairment	Evaluation Technique	Priority	Units of Measurement	Measurable Goals	Partners in Evaluation
E. coli	Pet waste collection bags	Medium	Number of pet waste collection bag sites in parks	Document increase of use of pet waste collection bags	County and township park departments, pet stores, humane society,
	Water quality monitoring	High	Pathogen counts per 100 ml	Meet water quality standards of 1,000 count *E.coli*/100 ml for partial body contact recreation and 130 count/100 ml in areas for total body contact recreation	Kent County Health Department (KCHC), MDEQ
	Elimination of sources	High	Number and location of sources identified	Eliminate all identified sources of *E. coli*	Municipalities, KCHD, agricultural producers
	Benefit to cost comparisons	Medium	Reduced health risks compared to cost of BMP implemented	Economic impact of reduced health risks outweigh cost of BMP implementation	Municipalities, contractors, consultants
Nutrients	Pollution reduction calculations	Required	Pounds of nutrients prevented from entering waterways	Prevent 5,000 pounds/year of phosphorous and 10,000 pound o nitrogen from entering waterway	MDEQ, NRCS, consultants
	Implementation of BMPs	High	Number and location of BMPs implemented	Implement BMPs on all identified sites according to implementation schedule	Municipal DPWs, county departments
	Photographs of BMPs installed	High	Before and after photographs	Portfolio of photographs with supporting documentation	Municipalities, MDEQ
	Benefit to cost comparisons	Medium	Pollutant load reduction compared to cost of BMP implemented	Economic impact of pollutant load reduced outweighs cost of BMP implementation	Municipalities, contractors, consultants

Table 7.2 - Evaluation Techniques for Buck Creek Watershed Project Implementation Phase					
Impairment	Evaluation Technique	Priority	Units of Measurement	Measurable Goals	Partners in Evaluation
	MDEQ biological surveys	High	Fish, habitat, and physical properties of water	Increased rating of fish, habitat, and physical properties	MDEQ
	Creel surveys	Low	Amount, size, and species of fish caught	Establish baseline use and increase number of fishers using the stream and the number of fish caught	MDNR, TU
Trash and Debris	Stream clean ups	Medium	Number of volunteers at event	Increase number of volunteers at stream cleanup events every year	WMEAC, youth groups, church groups, business, community service programs
	Stream restoration	High	Number and amount of logjams removed from stream	Assessment of log jam removal according to woody debris management principles	Kent County Drain Commissioner, Municipalities, MDNR, MDEQ, consultants
	Collection days	High	Number of participants in collection days	Increase number of household putting out trash and household items for collection	Municipal DPWs
	Trash removal	High	Pound of trash removed from waterways	Increase in number of areas selected for trash removal and inspection	Municipal DPWs, youth groups, community service programs

Table 7.2 - Evaluation Techniques for Buck Creek Watershed Project Implementation Phase					
Impairment	Evaluation Technique	Priority	Units of Measurement	Measurable Goals	Partners in Evaluation
Other Urban Contaminants	MDEQ biological surveys	High	Fish, habitat, and physical properties of water	Increased rating of fish, habitat, and physical properties	MDEQ
	Hydrologic analysis	Medium	Hydrographs of peak flows	Reduction of peak flows by limiting impervious cover, minimizing channelization of streams, and restoration of wetlands and storage areas	MDEQ, consultants
	Impervious cover calculations	Medium	Percentage of impervious cover in watershed	Changing development rules to limit amount of impervious cover in Watershed	GVSU, REGIS, MDEQ, consultants

Sediment

Surface waters of the state do not have a numerical standard set for sediment, or total suspended solids (TSS). Rather, the state requires that "the addition of any dissolved solids shall not exceed concentrations, which are or may become injurious to any designated use." Qualitative measurements for sediment reduction will include photographs of the site before and after implementation of BMPs. Indirect indicators for sediment include pollutant reduction calculations, tracking of BMP installation, benefit to cost comparisons of the BMPs, and creel surveys to document number and species of fish. Direct environmental indicators include macroinvertebrate and biological survey. TSS and stream embeddedness of the substrate are measured through the GLEAS protocol habitat assessment conducted by the MDEQ every five years. WMEAC also conducts the measurements on a more frequent basis.

E. coli

The designated uses of partial and total body contact recreation are not being met in the Watershed due to the high counts of *E. coli* in the water. State standards for partial body contact require measurements of no more than 1,000 count of *E. coli* per 100 milliliters (ml) as a 30-day geometric mean during five or more sampling events representatively spread over a 30-day period. For total body contact, counts of no more than 130 *E. coli* per 100 ml are required. Qualitative measurements will include number of pet waste collection bags installed in parks, adoption of the Kent County Septage Plan, brochures and workshops about pathogens, and groups participating in the storm drain stenciling projects. Quantitative measurements include direct water quality monitoring for *E. coli,* and indirect measurements of the number of sources eliminated and the health benefit to program cost comparisons.

Nutrients

Nuisance algae and aquatic plant growth are usually caused by excessive amounts of phosphorous and nitrogen entering the surface water. The state requires that "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 waters of the state." The qualitative measurements for nutrients are similar to those of sediment, since the sources of loadings of these pollutants have comparable paths. The qualitative measurements will be conducted through macroinvertebrate and biological surveys, using orthophosphate, total phosphorous, nitrite, nitrate + nitrite, and Kjeldahl nitrogen as the nutrient parameters. Levels of <0.05 mg/l of total phosphorus is considered a normal level adequate for plant and algal growth. The amount of Kjeldahl nitrogen normally

present in surface water is <3.0 mg/l. Elevated levels usually indicate recent, nearby pollution entering the surface water.

Trash and Debris

Dumping of trash and debris in the water can add nutrients, degrade fish habitat, and create unsightly and unhealthy conditions for enjoying Buck Creek. Stream clean-ups will reduce the amount of trash and debris in the Watershed, and a measurement of the number of volunteers year after year participating in the stream clean-ups will be a qualitative measurement. Municipalities offering free collection days for household items and refuse will reduce the occurrences of illegal dumping. A measurement of the number of households participating in the collection days will be a qualitative measurement.

Other Urban Contaminants

Urban runoff can carry many toxic and dangerous materials into the waterways. The objectives of reducing the amount of impervious cover and reducing peak flows in the Watershed can be measurements of indirect indicators for water quality improvements. A hydrologic analysis can produce hydrographs that show peak flows in the Watershed and the response of the Watershed to changes in land cover. The direct environmental indicator will be the MDEQ biological surveys, which will document fish species and diversity, chemical properties, and physical habitat conditions.

7.2 PARTNERS IN EVALUATION

The identification of partners in conducting the evaluations is an important part of collecting the needed information. The partners for each evaluation measure are included in Table 7.2

CHAPTER 8 - SUSTAINABILITY

8.0 VISION, MISSION, AND CORE VALUES

Goals and objectives included in this Watershed Management Plan (WMP) are based upon a vision of what the stakeholders in the Lower Grand River Watershed (LGRW) desire for the future. To capture this vision for the LGRW, a Vision Subcommittee was formed to ensure that recommendations made in the WMP will be sustainable. The Vision Subcommittee provided a means for stakeholders to develop a common goal and an action plan to achieve their ideals. The following vision was created by the Vision Subcommittee:

Grand River Watershed

Drinkable, swimmable, fishable, enjoyable,
connecting water with life.

Lower Grand River Watershed Mission Statement: Foster the discovery of our water resources and the possibilities within us to celebrate the legacy of our shared watersheds.

Lower Grand River Watershed Core Values: Diverse, collaborative, quality efforts, legacy/heritage, system approach, sustainable, evaluative, inclusive, holistic, triple bottom line (social, economic, and environment).

8.1 WATERSHED ORGANIZATION STRUCTURE

Michigan is home to a number of watershed organizations that have successfully leveraged community support to continue efforts to cleanup and beautify their rivers, lakes, and streams. Some of these watershed organizations are found within the LGRW. The Rogue River Watershed Council and the Coldwater River Watershed Council are examples of watershed organizations that are operating individually within the LGRW. A desire of the LGRW stakeholders is that all subwatersheds of the Grand River have complete WMPs and to create the capacity for a watershed organization to implement the plans' recommendations.

8.2 LOWER GRAND RIVER WATERSHED ORGANIZATION

A watershed organization can take many forms. Each type of organizational structure has advantages that vary from tax-exempt status to the ability to assess taxes to implement water quality improvements. The LGRW Steering Committee, through input from the Grand River Forum, is forming a more comprehensive persisting organization to sustain the future value of this effort and to someday reach a long-term vision adopted for the entire LGRW. To aid the LGRW Steering Committee in selecting an organizational structure for the LGRW, a watershed organization discussion panel was co-sponsored with the Rogue River Watershed Council. The panel had representatives from the Muskegon River Watershed Assembly, Friends of the Rouge, Clinton River Watershed Council, and the Pere Marquette Watershed Council. These watershed organizations are all 501(c)(3) non-profit organizations; however, their background, funding sources, and operational strategies were very diverse. The LGRW Steering Committee would like to take the best ideas from past examples and blend them to form a watershed organization that is effective and high profile with diverse funding sources.

The idea to form a watershed organization in the LGRW was envisioned very early in the planning process by the Grand River Forum and the Vision Subcommittee. The existing watershed organizations and environmental groups have started local initiatives and desire to maintain this status without being absorbed by a larger organization. The LGRW organization would fulfill this desire by serving as an umbrella under which these local groups would operate.

Existing watershed organizations would play a large role in fulfilling the goals of the LGRW organization. A board of stakeholders would include representatives from local government units, existing watershed organizations, and environmental organizations. The task of the LGRW organization would be to identify priorities within the Lower Grand River Watershed and to facilitate projects that address high priority concerns.

The role of the LGRW organization would be as a capacity builder to facilitate the formation of subwatershed groups that would be capable of creating watershed management plans and grassroots level opportunities for local governments and citizens to take ownership of their projects. The development of the Buck Creek WMP will provide an example of how subwatersheds would operate under the umbrella of the LGRW organization. Watershed projects initiated by the LGRW project will receive assistance with watershed management planning and the formation of a watershed advisory committee.

8.3 BUCK CREEK WATERSHED ORGANIZATION

The initiative behind the LGRW is municipally driven. Municipally driven projects tend to have greater stability for funding, as long as the watershed organization provides a service to local governments. However, stability and government services alone will not meet the LGRW Watershed Mission Statement of engaging the public to value water as a resource. A grassroots component involving the public and local governments is needed in the Buck Creek Watershed (Watershed) to capture the core values outlined in the LGRW Mission Statement.

Creating a grassroots watershed organization in small watersheds can be difficult. Holding meetings, mailing correspondence, setting up 501(c)(3) tax-exempt status, and organizing stakeholders may be tasks too large to overcome by small grassroots efforts without grant monies or a government interest. However, a larger organization that would encompass the entire LGRW could provide technical assistance and seed money for fledgling watershed organizations and grassroots efforts. Once subwatershed organizations are established, the LGRW organization would serve as a facilitator until the group is capable of sustainable independence.

While the LGRW organization would provide basin-wide oversight and prioritization of water quality concerns, the subwatershed organization would manage operations within the subwatershed, implement the WMP, and serve as a liaison between local stakeholders and the LGRW organization. For example, local government needs for storm water management identified by the subwatershed organization could be fulfilled through technical support offered by the LGRW organization. These services could include water quality data stored in a central database, Geographic Information System mapping, volunteer services, or grant administration.

8.4 UPPER GRAND RIVER WATERSHED COUNCIL

The Upper Grand River Watershed (UGRW) project was nearing completion at the onset of the LGRW planning phase. The UGRW Steering Committee was striving toward similar goals to create a watershed organizational structure within the confines of existing programs, organizations, and agencies. Similar to the LGRW project, the UGRW project found that most existing efforts were doing excellent work without centralized leadership. However, these groups were limited by a geographic scope that did not include the entire UGRW. This led the project consultants to recommend forming an organization that would encompass the entire UGRW to provide continuity through and beyond the watershed planning phase. The ultimate goal for the resulting organization would be to coordinate with the LGRW project and expand the geographic scope to include the entire Grand River Basin.

8.5 NPDES PHASE II COMMUNITIES

Portions of all communities within the Watershed have been identified by the United States Environmental Protection Agency (EPA) as having urbanized areas requiring a National Pollutant Discharge Elimination System (NPDES) storm water discharge permit. These communities, including the City of Grandville, City of Wyoming, City of Kentwood, Gaines Township, and Byron Township, are required by the EPA to develop a Storm Water Pollution Prevention Initiative (SWPPI) in accordance with NPDES Phase II Storm Water Regulations. These communities have worked together to develop a watershed-based strategy to pursue compliance with these regulations.

A WMP serves as a guide for communities to understand water quality concerns and voluntary actions needed to meet the water quality goals. The NPDES Phase II Storm Water Regulations create an opportunity for communities to implement recommendations of the WMP as compliance standards in their SWPPI.

The SWPPI component of the NPDES Phase II Storm Water Regulations require each jurisdiction to identify significant sources of storm water pollution and to develop an action oriented strategy to address each pollutant. The SWPPI will be designed to reduce the discharge of pollutants to the maximum extent practicable with guidance from the goals and objectives set forth in this WMP. Once submitted to the Michigan Department of Environmental Quality (MDEQ), the SWPPI will be used to evaluate each community's actions toward mitigating impairments caused by storm water pollution. Development of the SWPPI would occur under the auspices of the subwatershed organization. Maintaining local control of this task would offer the communities greater flexibility in determining what commitments will be included in their SWPPI.

8.6 LOCAL AGENCIES AND INTEREST GROUPS

8.6.1 METROPOLITAN DEVELOPMENT BLUEPRINT

The Grand Valley Metro Council (GVMC) was organized as a response to decades of ineffective efforts to coordinate the scores of governmental entities each acting independently, yet each striving for ways to better collaborate. Though now nearly a decade old, the Metropolitan Development Blueprint (MDB) was developed as a tool for governments to achieve that collaboration. The MDB defined what the metropolitan region looked like and offered a chance for communities to act in a more consistent, well organized manner.

GVMC began a process which enlisted hundreds of interested regional citizens in four subject groups: Land Use, Transportation, Utilities and Environment/Natural Resources. After a year long effort, which led to 23 visions supported by 53 individual strategies, the MDB Steering Committee condensed the final report into three central themes and seven broad initial strategies. These were adopted by GVMC in their effort to "change business as usual."

Themes

1. A network of open lands and greenways should be developed and preserved,
2. The creation of compact centers of regional economic activity, and
3. Promote compact livable communities.

Strategies

1. Create a Blueprint Commission.
2. Complete an inventory of natural assets.
3. Design a transit system based on Blueprint themes.
4. Define regional employment and activity centers.
5. Review region-wide water and sewer utility systems in relation to land use.
6. Convene a collaboration of public and private planners to encourage compact livable communities.
7. Create and encourage sub-regional planning alliances.

A newly established Blueprint Committee declared a set of guiding principles spelling out its beliefs pertaining to shared regional interests. These principles were adopted by GVMC in September 2000 and were used as one of many important guides in the remaining process. These principals added significantly to the central themes and initial strategies of the MDB and gave a much clearer picture of future directions for metropolitan planning.

The GVMC Planning Department soon determined that the best way to accomplish nearly all the remaining strategies and to do so living within the spirit of both the original MDB and the Blueprint Principles, a type of regional "plan" would be necessary for the Greater Grand Rapids metropolitan area. This plan would not be like a local land use plan in that it would cover development patterns and regional infrastructure in a much broader way. Over a two-year period, GVMC staff devised and proposed a methodology which established a process for planning the metropolitan region.

After discussions with local officials throughout the metro area, it was concluded that the best way to gain a single regional perspective on growth was to group the 50 or so governing entities of the metro area into logical divisions. The “logic” in this case applies to a particular regional perspective shared by many local governments in a particular portion of the metro region. For example, on the north end of the metro region, 14 communities within the Rogue River Watershed believed a Watershed Council was the most appropriate regional role for them. Ten communities in the southern part of the metro region saw their greatest regional role to be related to the newly forming M-6 Southbelt freeway. In all, GVMC staff helped establish seven such “subregional entities” through which joint planning could be conducted through a single metro-wide perspective. The opportunity exists for the communities involved in the M-6 Southbelt freeway subregional entity to also form a Watershed Council to incorporate the water quality concerns within the Buck and Plaster Creek Watersheds.

8.6.2 COMMUNITY ACTIVITIES

Prior to initiation of the Buck Creek WMP, a number of groups were already taking an active interest in the Watershed. Calvin Christian High School is conducting volunteer stream clean-ups and water quality monitoring at the confluence of Buck Creek and the Grand River. Numerous groups and individuals participate in West Michigan Environmental Action Council’s Stream Search and Adopt-A-Stream programs. The City of Grandville recognizes Buck Creek as a great community resource and hosts the Buck Creek Run and sponsors school groups to conduct storm drain stenciling. Buck Creek is a highly visible feature at Douglas Walker Park in Byron Township. Ideal Park and the Buck Creek Natural Area in the City of Wyoming have Buck Creek as a prominent feature. Creekside Park in Gaines Township and the Jaycee Park in the City of Kentwood are located on tributaries of Buck Creek.

The groups listed above have a vested interest in the sustainability and success of the Buck Creek WMP. These groups should be included in the LGRW organization. Assistance should be made available to volunteer groups to continue and enhance monitoring and clean-up efforts. Cities and townships are interested in the success of this project to improve their community’s water resources in parks and open space and to protect their infrastructure from erosion and flooding.

8.7 OPPORTUNITIES AND FUNDING SOURCES

GVMC

The GVMC participated extensively with planning efforts to complete this WMP. Support for future planning efforts could be provided by GVMC through grant provisions like local match and in-kind services. The GVMC could also house the LGRW organization in their offices.

Kent County Administration

Kent County Administration has provided support through local match and in-kind services during the planning phase of this Watershed project. Institutionalizing the WMP recommendations could be accomplished by the Kent County Administration through the Planning Commission, Department of Public Works, and Parks and Recreation.

Kent County Drain Commissioner

The Kent County Drain Commissioner already designates a large amount of the Watershed as a county drain. Reaches of Buck Creek and its tributaries designated as county drains are placed into a drainage district. Residents living in the drainage district are assessed for improvements to the creek that improved storm water drainage and reduce flooding. Recommendations in this WMP could be implemented through a special assessment from water quality improvements in the drainage district. A list of existing drainage districts in the Watershed can be found in Table 2.1.

Kent County Road Commission

Some road stream crossings were identified in the nonpoint source pollution inventory and past studies as sources of flooding and erosion problems. Road crossing improvements in the Watershed could be completed by the Kent County Road Commission in accordance with recommendations in this WMP.

United States Department of Agriculture (USDA)

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

Conservation Reserve Program (CRP)

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

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

Wetland Reserve Program (WRP)

The WRP receives technical assistance through NRCS. The landowner controls access to the land and may use it for recreational activities such as hunting and fishing. There are three options for the WRP.

1. Ten-year Cost Share Agreement: This agreement is a cost share program where the NRCS pays 75% of the restoration costs and the landowner signs an agreement to keep the wetland in place for 10 years. This option is very similar to the United States Fish and Wildlife Service's Partners for Wildlife Program.

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

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

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

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

Funding Sources

Typically, WMP implementation is funded through federal and state grants. These grant sources are highly competitive and could be risky for sustainable funding for a watershed organization. The LGRW Steering Committee desires to use federal and state grant monies, if necessary, to launch a watershed organization. However, the goal would be to wean off from grant funding from state and federal sources and focus on self-sustaining funds from endowments and revenues generated by community services. This strategy would blend the funding approaches of government supported and private foundation supported organizations. Examples of these income sources could be:

- Membership dues
- Fund drives
- Charity events (angler competition, dinners, auctions, etc.)
- Educational services
- Government services (storm water regulation administration, ordinance development, streambank stabilization, etc.)

8.8 RESOURCE LIBRARY

Materials, data sources, and publications used in the research to complete this WMP are listed in a resource library. This library can be found online at the website below.
http://www.gvsu.edu/wri/isc/lowgrand/library.htm.

Future watershed projects in the LGRW can access this library to find useful publications for completing a WMP. The library includes information on where publications are locally housed.

CHAPTER 9 - INFORMATION AND EDUCATION STRATEGY

9.0 INTRODUCTION

The Buck Creek Watershed (Watershed) Information & Education (I&E) Strategy is based on the larger I&E Strategy being formulated for the Lower Grand River Watershed Management Plan (WMP). An I&E Strategy is needed to help motivate the Watershed's stakeholders, residents, and other decision makers to take actions necessary to protect the water quality and environmental conditions in the Watershed. The Buck Creek I&E Strategy will serve as a working document that outlines the major steps and actions needed to successfully maintain and improve water quality and environmental conditions in the Watershed.

9.1 STRATEGY COMPONENTS

The primary goals of the Buck Creek WMP are to improve or restore the coldwater and coolwater fisheries, improve and protect the safety and enjoyment of fishing, canoeing, and swimming, improve or restore the warmwater fishery, and improve and protect habitats for other indigenous aquatic life and wildlife. These goals can be achieved by reducing the known pollutants affecting these uses: sediment, *E. coli*, nutrients, and trash and debris.

9.1.1 I&E STRATEGY GOAL

The I&E strategy will help to answer the question, "How will the I&E efforts help to achieve the watershed management goal?" The I&E efforts will achieve the watershed management goal by increasing the involvement of the community in watershed protection activities through awareness, education, and action. The watershed community can become involved only if they are informed of the issues and are provided information and opportunities to participate.

9.1.2 KEY TARGET AUDIENCE

Based on the I&E goal for the Buck Creek Watershed, key target audiences whose support is needed to achieve the Watershed management goal have been identified. Although the overall audience for the I&E Strategy is extremely broad, there are two major categories of audiences: (1) users of the resource within the Watershed and (2) local decision-makers (elected officials, planners) both within and outside the Watershed. Within the first category, the audience is further broken down to include the following:

Category 1: Residents of the Watershed, agricultural community, business owners, builders/developers, homeowners, riparian/corridor residents.

Category 2: Locally elected officials and municipal employees.

9.1.3 AUDIENCE CHARACTERISTICS

The level of understanding of watershed management, the types of values and concerns, and the level of enthusiasm that people have for participation in watershed management activities are expected to differ across the diverse groups that make up the community. Understanding these differences is critical to targeting appropriate audiences, developing effective messages and means of participation for them, and motivating them to become involved in the watershed management process. Appendix 9.1 includes summary information that describes the makeup of the audiences, shows how they receive information on environmental issues, identifies their existing level of knowledge on watershed issues, and outlines the communication tools used to reach their constituents.

9.1.4 RECOMMENDED STRATEGY OBJECTIVES

Specific objectives have been developed to achieve the I&E goals. These objectives will move the audience through the phases of outreach from awareness to education and finally to action. The messages and formats used to achieve these outcomes will vary with each audience. Four major objectives must be met to achieve the I&E goal. Under each objective, specific tasks and products will be developed to address how the objective will be achieved.

Objective 1 - Awareness: Make the target audience aware that they live in a watershed with unique resources and that their day-to-day activities affect the quality of those resources (Categories 1 and 2).

Objective 2 - Education: Educate target audiences on the link between urban development, agricultural activities. and water quality impacts, and highlight what actions can be taken to reduce impacts (Categories 1 and 2).

Objective 3 - Action: Motivate the audience to adopt and implement practices that will result in water quality improvements. These practices may include homeowner activities such as reducing fertilizer application, maintaining septic systems, purchasing properties with low-impact design elements, maintaining stream buffers on their properties, or supporting land use planning practices in the Watershed (Category 1).

Objective 4 - Action: Incorporate watershed protection activities into land-use planning decisions (Category 2).

9.1.5 DEVELOPING AND DISTRIBUTING EFFECTIVE MESSAGES

The objectives of the I&E strategy all involve raising awareness, educating people on the problems and solutions, and motivating people to participate in activities to protect the Watershed, which will in turn protect the Lower Grand River Watershed (LGRW). The I&E strategy will need to communicate effectively with the wide range of audiences that make up the Watershed community to achieve these objectives. Specific messages will be developed to make the different audiences aware of the issues and to support the watershed management effort. These messages should be repeated frequently to make an impact on the audience. Each audience will respond differently to the information presented, and it is critical that team members tailor the information to meet the needs of the audience. The members of each audience must understand specifically how the information being presented affects them. Messages have been developed for various audiences based on the available information on the audiences. Throughout the Watershed, these messages should be validated and modified based on new information collected from the community. Some key messages include the following:

- The Watershed is within the larger LGRW, which is a unique resource in which everyone can enjoy and take pride. A list of “Did you know?“ factoids that highlight unique features of the Watershed can be prepared.

- Protecting our watershed also protects your pocketbook. The connection for landowners and businesses between a healthy watershed and economic return is an important message. Information should be collected on revenue generated from recreational users of the Watershed and farming operations and on the property values along the river.

- Take part in shaping your future. Residents need to know how they can participate in land use planning decisions. A checklist should be developed that shows them who to contact and where their input is needed.

- We have the tools to help you get the job done. As audiences move from awareness to education, they need to be informed of the resources that may be available to them to help implement changes. Farmers, businesses, and local officials are more likely to participate if they are given access to resources and technical assistance.

9.1.6 FORMATS

Because the target audience is so broad, multiple formats will be used to reach these audiences and to reinforce the messages over time. These formats will be phased in over time as the audiences move from awareness to education and finally to action. Efforts will be largely focused on using media outlets (such as local press and established government publications, radio, and public television) to make the audiences aware of the issues in the Watershed during the awareness phase. General background materials will be developed for project team members to use when working with the various audiences. These materials include a general brochure, slide show, updated web site, and traveling display. Formats that focus on solutions and actions that can be taken to help improve and preserve the water quality in the Watershed will be developed as the audiences become more aware of the Watershed project. These formats include presentations throughout the Watershed, articles in the larger project newsletter, The Grand River Beacon, and technical workshops. Table 9.1 summarizes the target audiences reached using the different formats. Specific formats to be developed include the following:

Fact sheets: Fact sheets may be produced similarly to the general brochure but targeted to specific audiences as the I&E Strategy progresses.

“Did You Know” Questions or Watershed Factoids: A set of ten or more characteristics that highlight the unique features of the Watershed should be developed to be included in the brochure and fact sheets. Audiences respond very well to fun facts and tidbits about their community. This list will help to reinforce the concept that Buck Creek is worth protecting and improving. Once developed, this list can be disseminated through a variety of means: aired as public service announcements, printed in brochures and fact sheets, posted up on the display, printed in newspapers or news inserts, and reproduced on other materials.

Media: The primary tool to be used in the awareness phase for all audiences is the media. These markets include newspapers such as the Grand Rapids Press and The Advance. Radio stations include WBCT-FM, WBFX-FM, WOOD-AM, WOOD-FM, WSNX-FM, WTKG-AM, WVTI-FM, WKLQ-FM, WMUS-FM, and WMRR-FM. Public access stations include GRTV and WGVU/WGVK TV. The more often the target audiences read articles on watershed issues or watch watershed-related information on television, the more likely they are to respond and participate in the process. Keeping the message in front of people is vital to keeping them interested. News stories will be written with a local angle, be of interest to many people, or have a human-interest component. At a minimum, an article that mentions something about issues on the Watershed project should appear monthly. Producing articles about other activities in the Watershed project, such as the stream crossing inventories or model ordinances, provides an excellent opportunity for coordination with the rest of the Watershed efforts. A press kit that includes background information on the project with quotes from local representatives, a map of the Watershed with political boundaries, and contact information will be prepared.

Table 9.1 - Summary of Target Audiences, Desired Outcomes, and Formats

		Target Audiences							
Desired Outcome	Formats	Category 1						Category 2	
		Riparian/Corridor Residents	Residents of Buck Creek Watershed	Agricultural Community	Business Owners	Builders/ Developers	Homeowners	Locally Elected Officials	Municipal Employees
Awareness	Storm Drain Stenciling	X					X		
	Media Releases/articles	X	X	X	X	X	X	X	X
	"Did You Know List"	X	X	X			X	X	X
Education	Utility Bill Inserts	X	X				X		
	Presentations Throughout Watershed	X	X	X	X	X	X	X	X
	Fact Sheets on Landscaping for Wildlife	X	X	X	X	X	X	X	
	Tours of Successful BMP sites	X	X	X		X	X	X	X
	Fact Sheets with Cost/Savings Examples	X		X	X	X		X	X
	Distribute Materials on Alternative Waste Disposal	X	X	X	X	X	X	X	X

Table 9.1 - Summary of Target Audiences, Desired Outcomes, and Formats

		Target Audiences							
Desired Outcome	Formats	Category 1						Category 2	
		Riparian/Corridor Residents	Residents of Buck Creek Watershed	Agricultural Community	Business Owners	Builders/ Developers	Homeowners	Locally Elected Officials	Municipal Employees
	Distribute Materials on Landscaping for Water Quality	X	X	X		X	X		
	Distribute Materials for Pet Waste	X	X				X		
	Distribute Septic System Owner Guidebooks	X	X	X			X		
	Distribute Riparian Homeowner Guidebooks	X							
	De-Icing Alternative Demonstration							X	X
	Successful Township Ordinance Meeting				X	X		X	X
Action	Stream Stewards	X	X				X		
	Targeted Workshops	X	X	X	X	X	X	X	X
	Volunteer Macroinvertebrate Days	X	X	X			X		
	Grounds Maintenance Training			X	X	X		X	X
	Lawn, Garden, and Landscaping Activities	X	X			X	X		X

Local Newspapers: Articles should appear on a regular basis in all sections of the paper—human interest, sports, editorials, and news features. If possible, a regular column in the local paper that highlights activities regarding the development of the Watershed plan should be initiated. For example, quizzes can be developed for readers, and announcements can be inserted regarding field sampling days or field trips.

Public Access Channels: As part of the initial awareness efforts, and throughout the watershed assessment process, information should be posted on both television and radio public access stations. This coverage can be accomplished in a variety of formats, such as public service announcements, a talk show, filming sampling events out in the field, showing examples of water quality degradation, or covering events such as watershed fair or storm drain stenciling. The television station should be contacted whenever an event is planned.

Area Newsletters: In addition to submitting articles for publication in the local press, articles should be regularly submitted to periodicals in the Watershed to which the target audiences subscribe. Each article should be tailored to the interests of the publication.

The Grand River Beacon: The LGRW project has developed a periodic news insert, The Grand River Beacon, that provides updates on the Watershed project. The news insert is distributed to more than 4,000 people throughout the LGRW. A regular article highlighting the Watershed could be submitted for each new edition.

Watershed Presentations: Presentations are a very effective means to reach a variety of audiences and allow the presenter to get immediate feedback. Project team members will make presentations using the slide show developed for specific audiences. Key opportunities for making presentations include local schools, commissioner meetings, homeowner association meetings, local business meetings, and regional business meetings. At each presentation, a brief “show what you know” survey will be handed out to determine the audience’s level of understanding. A follow-up survey will be sent one month after the event to determine any changes in the audience’s knowledge.

Targeted Training Workshops: Topic specific workshops will be held for local decision-makers, businesses, and other audiences in the Watershed. These workshops will be scheduled once the project team members have initiated a dialogue with these audiences and determined the topics of greatest interest. The workshops may be presented as a stand-alone workshop or in conjunction with other activities sponsored by the target audiences.

9.1.7 DISTRIBUTION

The materials identified above will be distributed through a variety of mechanisms. One of the most effective means of distributing information is to piggyback it onto existing materials received by the target audience, such as the materials used by local governments and the Lower Grand River project. 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. These tools will be used to the extent possible to distribute information about the Watershed project.

9.1.8 EVALUATION

Evaluation provides a feedback mechanism for continuous improvement of the I&E Strategy. Evaluation tools must be built into the strategy at the beginning to ensure that accurate feedback is generated. Indicators of success will be developed throughout the planning and implementation process to help the project team members determine whether the objectives have been achieved. The indicators selected must include several parameters, not just the number of brochures mailed out or how many people attended a meeting. To successfully determine if the objectives were met, a pre- and post-survey is useful. Such a survey can be conducted by mail, by telephone, or in person at events. The kind of information needed includes the following:

- Demographic information on the audience
- Knowledge of the message
- How they heard about the meeting or event
- Current practices around their property
- Interest level in the issues
- Change in practices or behavior based on information received

Table 9.2 gives detailed information on the proposed tasks and tracking indicators to evaluate the success of the tasks. Although evaluation of specific components within the I&E Strategy will occur continuously, project team members will hold evaluation sessions semi-annually for the express purpose of reviewing the entire I&E Strategy. The evaluation worksheet in Table 9.3 can be used as a guide when reviewing the status of the I&E Strategy.

9.2 STRATEGY IMPLEMENTATION AND ADMINISTRATION

9.2.1 ORGANIZING STRATEGY ADMINISTRATION

The I&E Strategy to support the WMP will reside with I&E Subcommittee. Implementation of the I&E Strategy will be conducted with a variety of funding tools such as Section 319 funds, other United States Environmental Protection Agency grants, community foundations, local units of government, sportsman organizations, and Michigan Department of Transportation.

9.2.2 ROLES AND RESPONSIBILITIES

The I&E Strategy will primarily be administered by the I&E Subcommittee under direction from the watershed organization that develops from the Lower Grand River Watershed Project. The watershed organization will be responsible for administering the strategy and the I&E Subcommittee will coordinate activities with other organizations such as Michigan Department of Environmental Quality, West Michigan Environmental Action Council, The Center for Environmental Study, GVMC, Timberland RC&D, AWRI, Fishbeck, Thompson, Carr & Huber, Inc. (FTC&H), government land use planners, government zoning administrators, county drain commissioners, and West Michigan Trout Unlimited. The responsibilities of the I&E Subcommittee will include the following:

- Oversight of the project
- Obtaining grants or appropriations
- Establishing strategy development milestones and tracking progress
- Obtaining volunteer support
- Advertising the strategy
- Participating in activities

Table 9.2 - Information and Education Implementation

Objectives	Information and Education Activity	Products	Estimated Costs	Hours	Costs	Year/Qtr	Evaluation
Stabilize stream flows to moderate hydrology and increase base flow	Tours of successful BMP sites	Yearly	$125/each	16hrs each	$250 +32 hrs	Yr 2 / Qtr 2	Follow-up questionnaires to participants
	Successful township ordinance meetings	1yr x 2yr	$50 each	16hrs each	$150 + 16 hrs	Yr 1,2 / Qtr 2	Attendance, return of response forms
	Targeted workshop		$200 per workshop	40 hrs/ workshop			
	Lawn, garden, and landscape activities						
	Media releases/articles	1 kit develop yr. 1, and update as needed x 2 yr.		40 hrs/yr.	120 hrs	Yr 1 / Qtr 2 updates as needed	Responses, requests, comments
Reduce soil erosion and sedimentation	Storm drain stenciling	1 event x yr. x 2yr	$250/ event	30hrs/ each	$750 +90 hrs	Yr 1,2 / Qtr 2 each year	Participation, comments
	Media releases/articles	1 kit develop yr. 1, and update as needed x 2 yr.		40 hrs/yr.	120 hrs	Yr 1 / Qtr 2 updates as needed	Responses, requests, comments
	Media Releases/articles	1 kit develop yr. 1, and update as needed x 2 yr.		40 hrs/yr.	120 hrs	Yr 1 / Qtr 2 updates as needed	Responses, requests, comments
	Volunteer macroinvertebrate collection days						
	Utility bill insets						
	"Did you Know?"	30 factoids		30 hours	30 hours	Yr 1 / Qtr 1	Comments, times used

Table 9.2 - Information and Education Implementation

Objectives	Information and Education Activity	Products	Estimated Costs	Hours	Costs	Year/Qtr	Evaluation
Encourage cover crops and no-till practices	Targeted workshop		$200 per workshop	40 hrs/ workshop			
Install livestock exclusion fencing	Fact sheets with cost and savings examples						
Install filter strips	Fact sheets with cost and savings examples						
Determine TMDL for *E. coli* and reduce inputs to meet water quality standards of 1,000 count/100 ml for areas of partial body contact recreation and 130 count/100 ml for total body contact recreation	Media releases/articles	1 kit develop yr. 1, and update as needed x 2 yr.		40 hrs/yr.	120 hrs	Yr 1 / Qtr 2 updates as needed	Responses, requests, comments
Encourage proper installation and maintenance of septic systems	Distribute Septic System Owner Guidebooks						

Table 9.2 - Information and Education Implementation

Objectives	Information and Education Activity	Products	Estimated Costs	Hours	Costs	Year/Qtr	Evaluation
Encourage sanitary sewers in areas serviced by water utilities	Presentations throughout Watershed	3/yr x 2 yr	$20/ each	6 hrs each	$180 + 54 hrs	Yr 1,2 when needed	Q&A period at end of presentation, participation numbers
Exclude livestock access in high-risk areas	Targeted workshop		$200 per workshop	40 hrs/ workshop			
Reduce amount of pet waste entering waterways	Distribute materials on pet waste						
	Storm drain stenciling	1 event x yr. x 2 yr	$250/ event	30 hrs/ each	$750 + 90 hrs	Yr 1,2 / Qtr 2 each year	Participation, comments
Control urban wildlife, such as geese and raccoon populations	Distribute fact sheets on landscaping for water quality						
Encourage composting and curbside collections of yard wastes	Grounds maintenance training						
Encourage proper installation and maintenance of septic systems	Distribute septic system owner hand books						
	"Did You Know" lists	30 factoids		30 hours	30 hours	Yr 1 / Qtr 1	Comments, times used
Encourage sanitary sewers in areas serviced by water utilities	Media releases/articles	1 kit develop yr. 1, and update as needed x 2 yr.		40 hrs/yr.	120 hrs	Yr 1 / Qtr 2 updates as needed	Responses, requests, comments

Table 9.2 - Information and Education Implementation

Objectives	Information and Education Activity	Products	Estimated Costs	Hours	Costs	Year/Qtr	Evaluation
Install filter strips	Targeted workshop		$200 per workshop	40 hrs/ workshop			
Install livestock exclusion fencing	Targeted workshop		$200 per workshop	40 hrs/ workshop			
Reduce amount of pet waste entering waterways	Distribute materials on pet waste						
	Storm drain stenciling	1 event x yr. x 2yr	$250/ event	30hrs/ each	$750 +90 hrs	Yr 1,2 / Qtr 2 each year	Participation, comments
Calibrate salt application equipment and have proper salt storage	Grounds maintenance training						
	Fact sheets with cost and savings examples						
	Targeted workshop		$200 per workshop	40 hrs/ workshop			
Encourage use of alternative de-icing techniques	De-icing alternatives demonstrations						
Reduce the amount of impervious surfaces	Targeted workshop		$200 per workshop	40 hrs/ workshop			
	Tours of successful BMP sites	Yearly	$125/each	16hrs each	$250 +32 hrs	Yr 2 / Qtr 2	Follow up questionnaires to participants

Table 9.2 - Information and Education Implementation

Objectives	Information and Education Activity	Products	Estimated Costs	Hours	Costs	Year/Qtr	Evaluation
Divert impervious surface runoff to prevent direct connection to surface water	Stream stewards						
	Distribute materials on landscaping for water quality						
	Distribute Riparian Homeowner Guidebooks						
	Distribute materials on storm water education						
	Tours of successful BMP sites	Yearly	$125/each	16 hrs each	$250 + 32 hrs	Yr 2 / Qtr 2	Follow-up questionnaires to participants

Table 9.3 - Evaluation Worksheet



Lower Grand River Watershed Project

Project Worksheet

Questions to Answer at Project Evaluation Meetings

Date:

1. Are the planned activities being implemented according to the schedule?

2. Is additional support needed?

3. Are additional activities needed?

4. Do some activities need to be modified/eliminated?

5. Are the resources allocated sufficient to carry out the tasks?

6. Are all of the target audiences being reached?

7. What feedback has been received, and how does it affect the I&E program?

8. How do the technical activities on the Lower Grand River Watershed Project affect the I&E plan?

9.2.3 PROJECT PRIORITIES

Project priorities need to be established to direct resources to the areas that will realize the greatest benefits. The LGRW Project has determined the following public education activities will be considered high-priority in terms of resource allocation:

- Activities that build on existing efforts: These activities include watershed programs in adjacent areas, land use planning efforts, and statewide programs.

- Activities that consider future regulatory requirements, such as National Pollutant Discharge Elimination System Phase II Storm Water Regulations, and Total Maximum Daily Load actions.

- Activities that must be conducted to lay the foundation for future efforts, such as awareness campaigns in the local press to bring the major watershed issues to the forefront.

- Activities that strengthen relationships or form partnerships within the Watershed.

- Activities that leverage external funding sources (such as grants).

9.2.4 RESOURCES

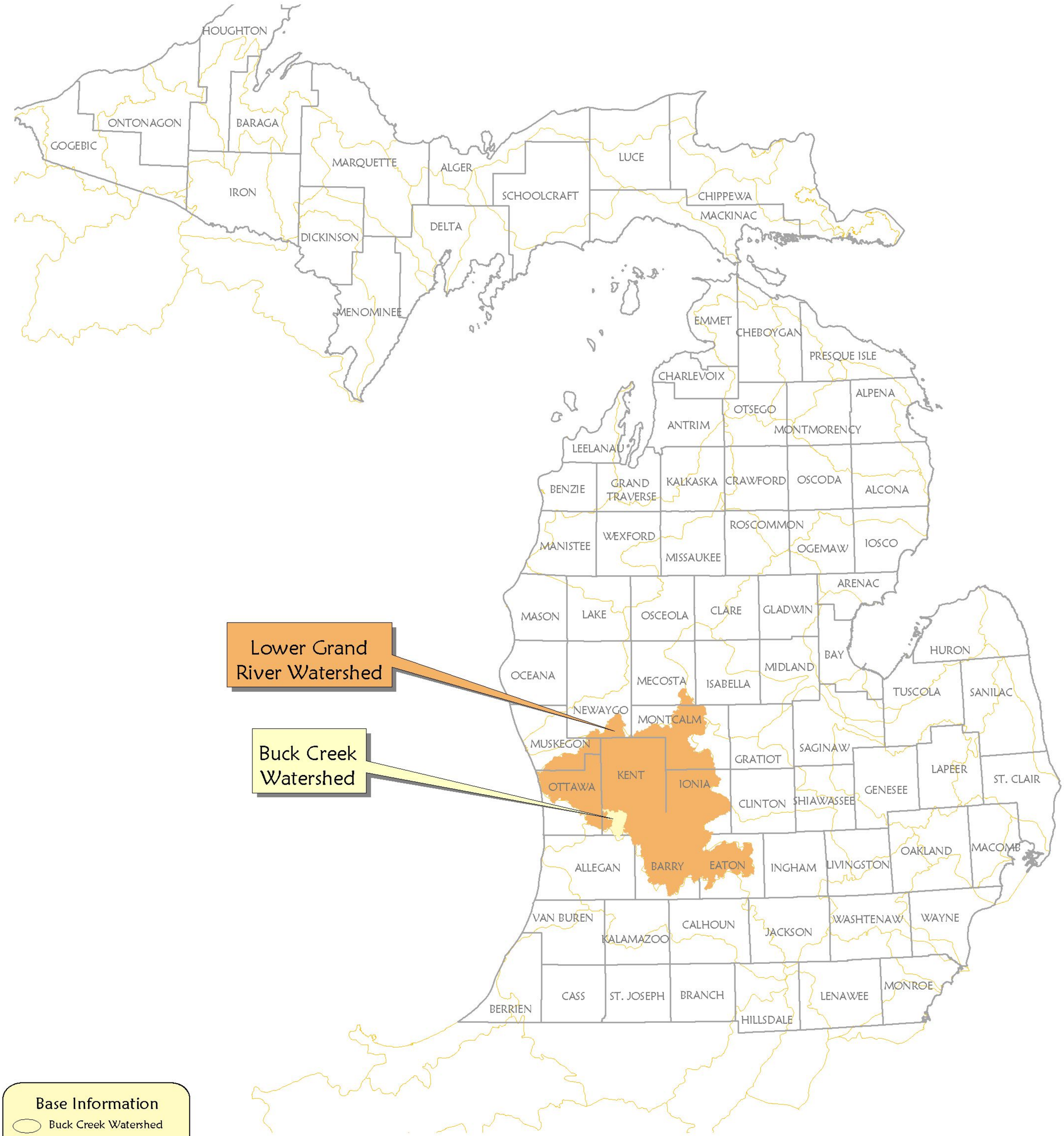
Communities and foundations could help to fund this project. The implementation of I&E activities will be phased in and will be coordinated with the other watershed efforts such as the critical areas inventory. Implementation will depend on several factors, including staff resources, technical capabilities, and interest shown by various key partners. Table 9.4 outlines a worksheet to be used as the main tool to track project progress.

Table 9.4 - Project Worksheet Checklist for Tracking the Status of Tasks and Products				
Task/Product	Details	Status	Team Lead	Changes/Comments
Storm drain stenciling	Recruit participants, advertisements, purchase supplies			
Media releases/articles	Press kit, contact list, articles in local outlets, articles in relevant publications, public service announcements			
Radio spots	Coordination with media, design, release dates, market analysis			
"Did You Know List"	Posted in appropriate media outlets, updated yearly			
Utility bill inserts	Coordination with local governments or utility providers, content			
Presentations throughout watershed	Dates/times/locations, topics selected, evaluation method			
Fact sheets on landscaping for wildlife	Hard-copy, web version, content, evaluation method			
Tours of successful BMP sites	Dates/times/location, transportation, food/beverage, tour guides, evaluation method			
Fact sheets with cost/savings examples	Hard-copy, web version, evaluation method			
Distribute materials on alternative waste disposal	Hard-copy, web version, evaluation method, dissemination method			
Distribute materials on landscaping for water quality	Hard-copy, web version, evaluation method, dissemination method			
Distribute materials for pet waste	Hard-copy, web version, evaluation method, dissemination method			
Distribute septic system owner guidebooks	Hard-copy, web version, evaluation method, dissemination method			
Distribute Riparian Homeowner Guidebooks	Hard-copy, web version, evaluation method, dissemination method			

Table 9.4 - Project Worksheet Checklist for Tracking the Status of Tasks and Products				
Task/Product	Details	Status	Team Lead	Changes/Comments
De-Icing Alternative demonstration	Date/time/location, invite list, demonstration equipment organized, product partners organized, advertisements, evaluation method			
Successful township ordinance meeting	Date/time/location, invite list, advertisements, refreshments, speakers, materials, handouts, evaluation method			
River stewards	Training events, recruiting new members, data tracking and posting of results			
Targeted workshops	Date/time/location, topic selection, workshop materials, facilitator coordination, invitations			
Volunteer macroinvertebrate days	Dates/times/locations, advertisements, training, volunteer coordination, parking, site identification, transportation			
Grounds maintenance training	Date/time/location, invite list, demonstration equipment organized, product partners organized, advertisements, evaluation method			
Lawn, garden, and landscaping activities	Date/time/location, invite list, demonstration equipment organized, product partners organized, advertisements, evaluation method			

Location and Size

Buck Creek Watershed



Base Information

- Buck Creek Watershed
- Lower Grand Watershed
- Watershed Boundary
- County Boundary

N

30 0 30 60 90 120 150 Miles

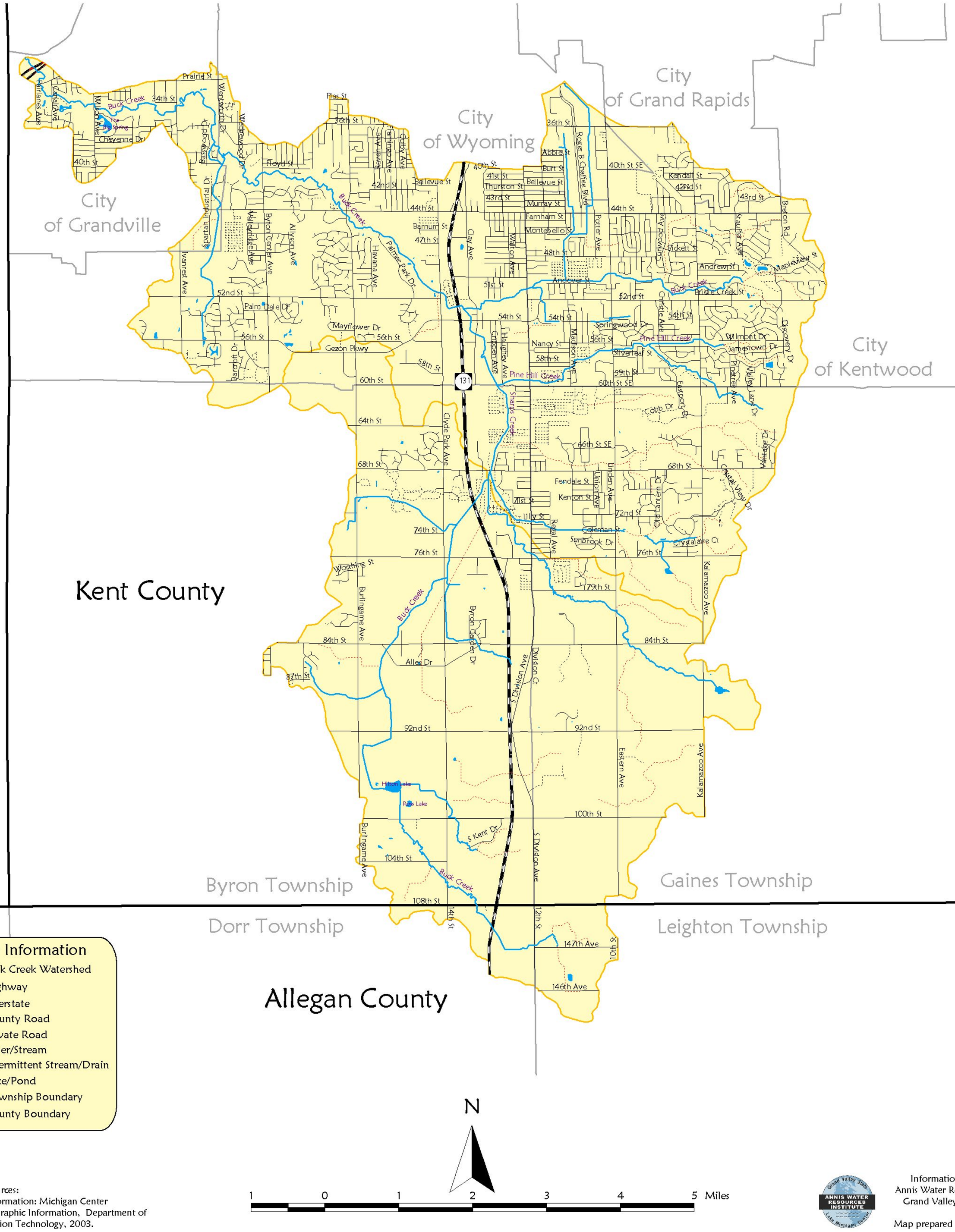
Data Sources:
Base Information: Michigan Center for Geographic Information, Department of Information Technology, 2003.

Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map prepared November 2003

Study Area

Buck Creek Watershed



Base Information

- Buck Creek Watershed
- Highway
- Interstate
- County Road
- Private Road
- River/Stream
- Intermittent Stream/Drain
- Lake/Pond
- Township Boundary
- County Boundary

N

1 0 1 2 3 4 5 Miles

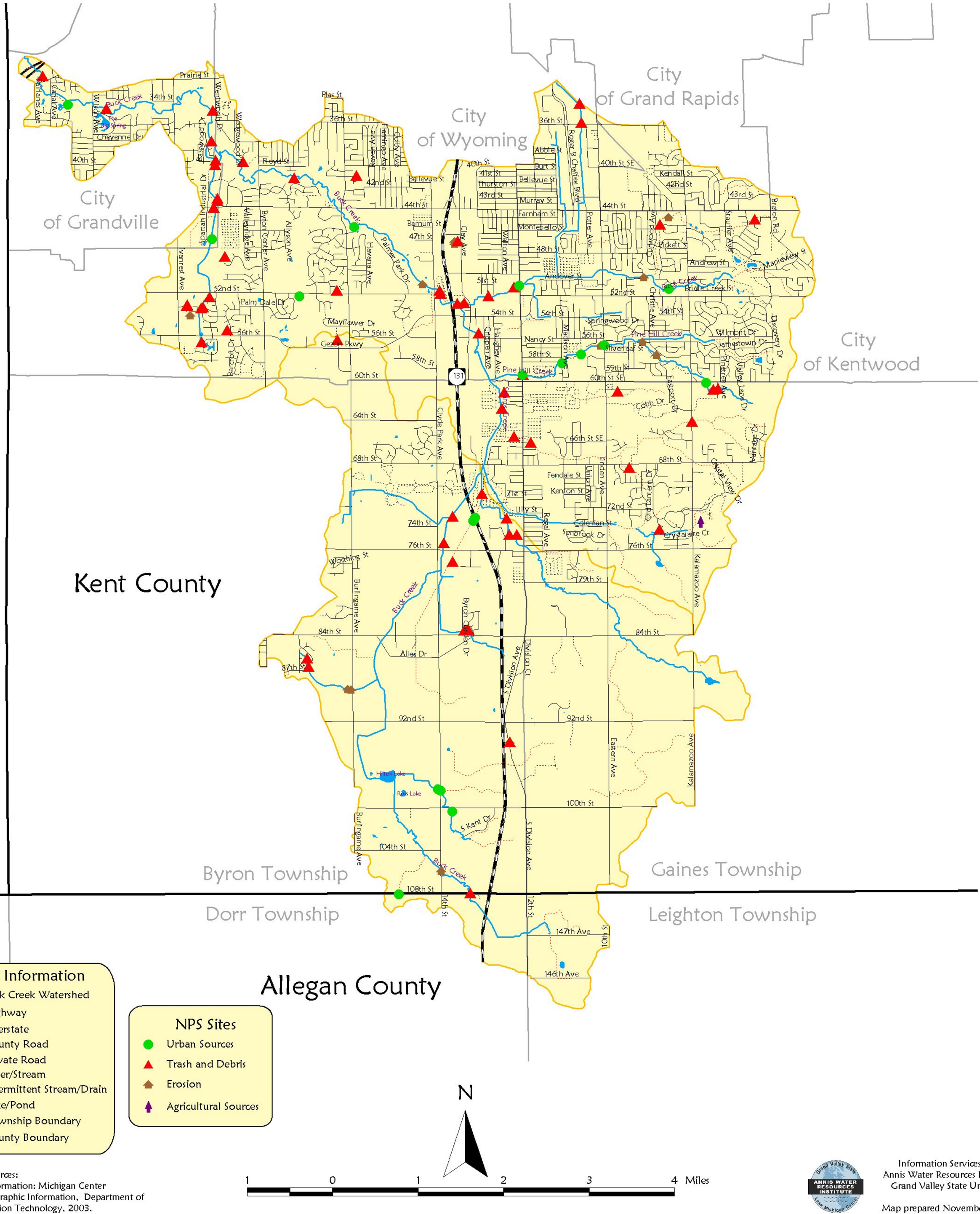
Data Sources:
Base Information: Michigan Center for Geographic Information, Department of Information Technology, 2003.

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Annis Water Resources Institute
Grand Valley State University

Map prepared November 2003

Nonpoint Source Pollutant Sites

Buck Creek Watershed



Base Information

- Buck Creek Watershed
- Highway
- Interstate
- County Road
- Private Road
- River/Stream
- Intermittent Stream/Drain
- Lake/Pond
- Township Boundary
- County Boundary

NPS Sites

- Urban Sources
- Trash and Debris
- Erosion
- Agricultural Sources

N

1 0 1 2 3 4 Miles

Data Sources:
Base Information: Michigan Center for Geographic Information, Department of Information Technology, 2003.

Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map prepared November 2003

Appendix 1.1 - Watershed Information Matrix

WATERSHED INFORMATION													
SHED_ID	MAJOR	MINOR	SWQAS	REPORT_NO	METRICS	LAST_SUR	INVENTORY	SS03	SS02	SS01	SS00	ROADX	WQ_MONIT
14 100	Grand River	Sand Creek	25300, MI/DEQ/SWQ-00/039	2	Yes	1996	Herman Miller/Volunteer		Not Assessed	Not Assessed	Not Assessed	Complete	
14 89	Grand River	Grand River	001502, 001670, 25300, 003920	4	No	1981			Not Assessed	Not Assessed	Not Assessed		Reeds Lake (Nutrients, chloro, E. coli, DO) KCHD (E. coli)
14 89A	Grand River	York Creek (Minor)	25300, MI/DNR/SWQ-93/019, MI/DNR/SWQ-95/064	3	No	1994			Poor	Poor/Fair	Poor/Fair		
14 89B	Grand River	Coldbrook Creek (Minor)	25300	1	No	1968			Not Assessed	Poor	Not Assessed		
14 89C	Grand River	Lamberton Creek (Minor)	25300	1	No	1968			Fair	Good	Good		
14 89D	Grand River	Comstock-Sligh											
14 89E	Grand River	Graceland-Lacey											
14 93	Grand River	Buck Creek	25300, MI/DNR/SWQ-92/212	2	No	1991			Not assessed	Good	Not Assessed		Calvin Christian High School
14 94	Grand River	Buck Creek	25300, MI/DNR/SWQ-92/212	2	No	1991			Poor	Good	Good		KCHD (Buck Creek--E. coli)
14 95	Grand River	East Branch Rush Creek (Bliss Creek Drain)	25300	1	No	1968			Not assessed	Good	Fair/Excellent		KCHD (Buck Creek--E. coli)
14 96	Grand River	Rush Creek	25300	1	No	1968			Not Assessed	Not Assessed	Not Assessed		
14 97	Grand River	Grand River	00690, 001502, 25300, 003920, MI/DEQ/SWQ-96/056	5	Yes	1996			Not Assessed	Not Assessed	Not Assessed		STORET (Grand River @ M-11), KCHD (Grand River--E.coli)
14 97A	Grand River	Roy's Creek (Minor)	25300, 002780, 004620	3	No	1984			Not Assessed	Not Assessed	Not Assessed		
14 97B	Grand River	Hogadone											
14 98	Grand River	East Fork Creek	25300, MI/DEQ/SWQ-00/038	2	Yes	1996	Herman Miller/Volunteer		Not Assessed	Not Assessed	Not Assessed	Complete	
14 99	Grand River	Sand Creek	25300, MI/DEQ/SWQ-00/039	2	Yes	1996	Herman Miller/Volunteer		Not Assessed	Not Assessed	Not Assessed	Complete	

* P = Pathogens
PFC = Poor Fish Community
PMC = Poor Macro Invertebrate Community
M = Mercury
P = Phosphorus
PCB = Polychlorinated Biphenyls
FK=Fish Kills
N=Nutrients
SD = Untreated Sewage Discharge
DO = Dissolved Oxygen Violations
S = Sediment

Appendix 1.1 - Watershed Information Matrix

WATERSHED INFORMATION														
SHED_ID	MAJOR	MINOR	FISH_CON	TMDL	TMDL_DATE	TROUT	WMP	WMP_STATUS	WMP_ACT	WMP_TYPE	GIS	BMP	IE	HYDRO
14 100	Grand River	Sand Creek	Inland Lakes Mercury Advisory	PFC	2006	Sand Creek and its unnamed tribs	Sand Creek	Started	Moderate	NA	YES	NO	YES	In Progress
14 89	Grand River	Grand River	Inland Lakes Mercury Advisory, Grand River PCBs, Reeds Lake PCBs	PCB, M	2010, 2011		None	Not Started	NA	NA	NA	NA	NA	NA
14 89A	Grand River	York Creek (Minor)	Inland Lakes Mercury Advisory	PFC	2006	York Creek	York Creek	Completed	Moderate	319	YES	YES	YES	YES
14 89B	Grand River	Coldbrook Creek (Minor)	Inland Lakes Mercury Advisory	None			None	Not Started	NA	NA	NA	NA	NA	NA
14 89C	Grand River	Lamberton Creek (Minor)	Inland Lakes Mercury Advisory	None		Lamberton Creek	None	Not Started	NA	NA	NA	NA	NA	YES
14 89D	Grand River	Comstock-Sligh	Inland Lakes Mercury Advisory	None										YES
14 89E	Grand River	Graceland-Lacey	Inland Lakes Mercury Advisory	None										YES
14 93	Grand River	Buck Creek	Inland Lakes Mercury Advisory	None		Buck Creek	None	Not Started	NA	NA	NA	NA	NA	NA
14 94	Grand River	Buck Creek	Inland Lakes Mercury Advisory	P	2006	Sharps Creek, Pine Hill Creek, Buck Creek and Unnamed trib of Buck Creek	None	Not Started	NA	NA	NA	NA	NA	NA
14 95	Grand River	East Branch Rush Creek (Bliss Creek Drain)	Inland Lakes Mercury Advisory	None			None	Not Started	Low	NA	NO	YES	NO	YES
14 96	Grand River	Rush Creek	Inland Lakes Mercury Advisory	None			None	Not Started	Low	NA	NO	YES	NO	YES
14 97	Grand River	Grand River	Inland Lakes Mercury Advisory	P	2006	Unnamed trib.	None	Not Started	NA	NA	NA	NA	NA	NA
14 97A	Grand River	Roy's Creek (Minor)	Inland Lakes Mercury Advisory	None		Roy's Creek	None	Not Started	NA	NA	NA	NA	NA	NA
14 97B	Grand River	Hogadone	Inland Lakes Mercury Advisory	None										YES
14 98	Grand River	East Fork Creek	Inland Lakes Mercury Advisory	PFC	2005	Sand Creek and its unnamed tribs	Sand Creek	Started	Moderate	NA	NO	NO	NO	NO
14 99	Grand River	Sand Creek	Inland Lakes Mercury Advisory	PFC	2006	Sand Creek and its unnamed tribs	Sand Creek	Started	Moderate	NA	NO	NO	NO	NO

* P = Pathogens
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M = Mercury
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FK=Fish Kills
N=Nutrients
SD = Untreated Sewage Discharge
DO = Dissolved Oxygen Violations
S = Sediment

Appendix 1.1 - Watershed Information Matrix

WATERSHED INFORMATION						WATERSHED PLANNING					
SHED_ID	MAJOR	MINOR	WELL	WELL_STAT	WELL_GIS	STORM_MP	STUDY	WS_TYPE	FLOOD_MAP	WQ_MP	SW_ORD
14 100	Grand River	Sand Creek	NO	NA		NONE	An Assessment of Water Quality and Aquatic Habitat and Recommendations for the Sand Creek Watershed (1996)	Rural	YES	YES	
14 89	Grand River	Grand River	NO	NA		City of Grand Rapids, MI, Storm Water Management Master Plan (1994), Grand Rapids Twp (In Progress)	Combined Sewer Overflow Study (1990)	Urban, Grand River	YES		
14 89A	Grand River	York Creek (Minor)	NO	NA				Urban			
14 89B	Grand River	Coldbrook Creek (Minor)	NO	NA		Coldbrook Creek Storm Water Management Plan (1986), Grand Rapids, MI, Storm Water Management Plan (1994), Grand Rapids Twp (In Progress)		Urban	YES		
14 89C	Grand River	Lamberton Creek (Minor)	NO	NA		City of Grand Rapids, MI, Storm Water Management Master Plan (1994)		Urban	YES		
14 89D	Grand River	Comstock-Sligh	NO	NA		City of Grand Rapids, MI, Storm Water Management Master Plan (1994)					
14 89E	Grand River	Graceland-Lacey	NO	NA		City of Grand Rapids, MI, Storm Water Management Master Plan (1994)					
14 93	Grand River	Buck Creek	NO	NA		Byron Township Storm Sewer Master Plan Sections 15, 16, 21, and 22 (1977), Buck Creek and Plaster Creek Storm Water Management Master Plan (1991), Gaines Twp (In Progress)		Rural, Urban			
14 94	Grand River	Buck Creek	NO	NA		Buck Creek and Plaster Creek Storm Water Management Master Plan (1991), Wyoming Storm Water Management Master Plan Sections 28-35 (1996), Gaines Twp (In Progress)	Kentwood Detention Ponds (1985)	Urban, Rural	Behan-Foley Drain Floodplain Analysis (1993)		
14 95	Grand River	East Branch Rush Creek (Bliss Creek Drain)	NO	NA		Bliss Creek Intercounty Drain WMP (1994)		Rural, Urban			
14 96	Grand River	Rush Creek	NO	NA		Huizenga Intercounty Drain Watershed Management Plan (1995)		Urban, Rural, Lake			
14 97	Grand River	Grand River	NO	NA		City of Grand Rapids, MI, Storm Water Management Master Plan (1994)	Combined Sewer Overflow Study (1990)	Urban, Grand River, Rural			
14 97A	Grand River	Roy's Creek (Minor)	NO	NA			Watershed Study 1997				
14 97B	Grand River	Hogadone	NO	NA		City of Grand Rapids, MI, Storm Water Management Master Plan (1994)					
14 98	Grand River	East Fork Creek	NO	NA		In progress, will adopt Kent County Model Ordinance in Walker, Alpine Twp (In Progress)		Rural, Urban			
14 99	Grand River	Sand Creek	NO	NA				Rural	FEMA	Stream set-back ordinances	

* P = Pathogens
PFC = Poor Fish Community
PMC = Poor Macro Invertebrate Community
M = Mercury
P = Phosphorus
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FK=Fish Kills
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MICHIGAN DEPARTMENT OF NATURAL RESOURCES
SURFACE WATER QUALITY DIVISION
APRIL, 1992

STAFF REPORT

A BIOLOGICAL SURVEY OF BUCK CREEK KENT COUNTY, MICHIGAN JUNE 19, 1991

As part of the point and nonpoint source surveillance activities, a biological survey was conducted on Buck Creek, a designated coldwater stream that flows through the city of Grand Rapids in Kent county. The objective of this survey was to assess the impact of the two point source discharges and surrounding general land use on the stream. The biological survey was conducted according to GLEAS Procedure 51 (available upon request).

The Station 1 and 2 segments of Buck Creek were determined to be third order stream segments. Station 3 was located on Sharps Creek, a tributary of Buck Creek, and was considered a first order stream segment. All stations lie within the Southern Michigan / Northern Indiana Till Plain. The two point sources on Buck Creek are De Bruyn Produce Co. (NPDES# MI0043532), which discharges process and noncontact cooling water, and DeJager Construction Co. (NPDES# MI0002810), which discharges groundwater used as noncontact cooling water.

SUMMARY

1) The locations of the sampling stations are shown in Figure 1. Fish community, aquatic macroinvertebrate community, habitat, and overall stream quality evaluation data are presented in Tables 1 through 4, respectively. Length/frequency data for Brown Trout are presented in Appendix 1.

2) Fish community structure was rated good (slightly impaired) at Stations 1 and 3 and fair (moderately impaired) at Station 2; however, the total scores for Stations 2 and 3 were close. Macroinvertebrate communities were reduced at all three stations, and rated fair at Station 1 and poor (severely impaired) at Stations 2 and 3. Station 2 in particular had a low diversity of macroinvertebrates, with only 7 taxa found. Overall stream quality of Buck Creek was rated fair at Station 1 and poor at Stations 2 and 3, based on the condition of the aquatic macroinvertebrate communities.

3) The physical habitat conditions of Stations 1, 2, and 3 were rated good, fair, and poor, respectively. Sedimentation was observed at all sites but to a greater degree at Stations 2 and 3, contributing to the severe impact on the

macroinvertebrate communities by covering colonizable substrate. Storm water runoff contributes substantially to flow fluctuations at Station 3, also impacting macroinvertebrate communites by periodically scouring the stream bed.

4) Visual observations of local land use patterns suggest that urbanization, with associated sedimentation and flow fluctuations from stormwater runoff, has caused impairment of physical habitat conditions in Buck Creek at Stations 2 and 3. Habitat quality improved in the downstream direction, suggesting that increased flow is clearing some of the sediment. However, macroinvertebrate communities at Stations 1 and 2 were more impacted than habitat conditions alone would indicate. These two stations, unlike Station 3, are downstream from both point source disharges into the creek. This may indicate an impact from either or both of these facilities.

Survey by: John Wuycheck, Aquatic Biologist
Andrew Scott, Aquatic Biologist

Report by: Sandra Kosek, Aquatic Biologist
Water Quality Appraisal Unit
GLEAS

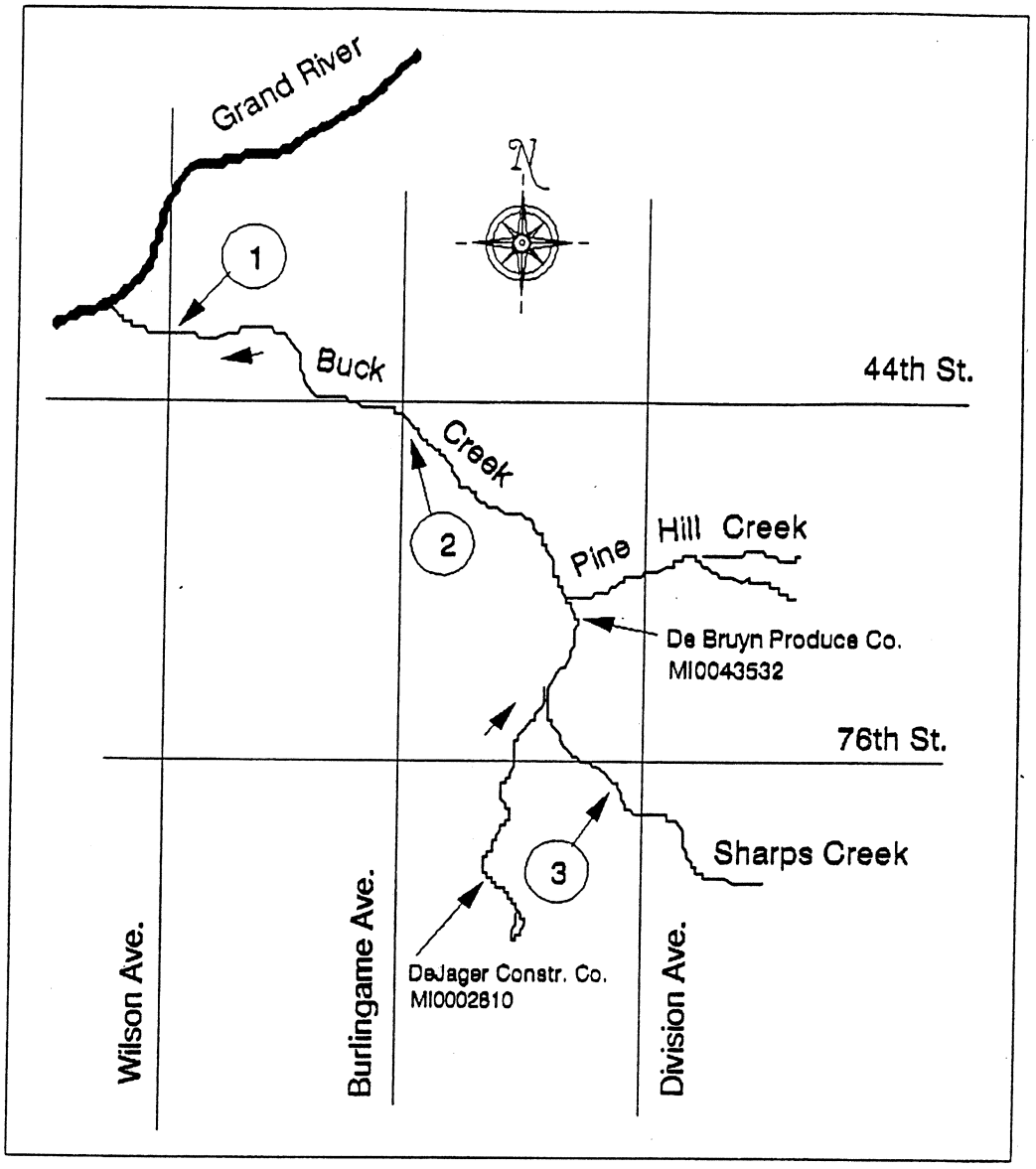


Figure 1: Biological Survey Stations on Buck Creek, Kent County, June 19, 1991.

(1) = survey station.

Table 1A. Qualitative fish sampling results for Buck Creek, Kent County, June 19, 1991.

TAXA	STATION 1	STATION 2	STATION 3
Salmonidae (Trouts)			
Salmo trutta (Brown trout)	2	6	
Umbridae (Mudminnows)			
Umbra limi (Central mudminnow)			1
Esocidae (Pikes)			
Esox americanus ver. (Grass Pike)		1	
Cyprinidae (Minnows and Carps)			
Cyprinus carpio (Carp)		8	
Semotilus atromaculatus (Creek)			3
N. cornutus (Common shiner)	30		
Cottidae (Sculpins)			
Cottus bairdi (Mottled sculpin)			2
Catostomidae (Suckers)			
Catostomus commersoni (W. sucker)	8	12	2
Moxostoma anisurum (Silver redh.)	4		
Minytrema melanops (Spotted skr.)		3	
Gasterosteidae (Sticklebacks)			
Culaea inconstans (Brook)		1	
Centrarchidae (Sunfish)			
Ambloplites rupestris (Rock bass)	1		
Lepomis cyanellus (Green sunfish)	1		
L. macrochirus (Bluegill)	2	2	2
P. nigromaculatus (Black crappie)		1	
Micropterus salmoides (Lm. bass)	1		
Percidae (Perches)			
E. nigrum (Johnny darter)			1
TOTAL INDIVIDUALS	49	34	11
NUMBER OF ANOMALIES			
SQUARE FOOT SAMPLED	10500	11500	2600
DENSITY OF INDIVIDUALS (#/SF)	0.005	0.003	0.004

Table 1B. Fish metric evaluation of Buck Creek, Kent County, June 19, 1991.

METRIC	STATION 1 Value	STATION 1 Score	STATION 2 Value	STATION 2 Score	STATION 3 Value	STATION 3 Score
TOTAL NUMBER OF TAXA	8	5	8	5	6	3
NUMBER OF DARTER SPECIES	0	1	0	1	1	3
NUMBER OF SUNFISH SPECIES	3	3	2	3	1	3
NUMBER OF SUCKER SPECIES	2	5	2	5	1	3
PERCENT CARP, G.SUNFISH, W.SUCKER	18.4	3	58.8	1	18.2	3
PERCENT OMNIVORES	16.3	5	58.8	1	18.2	5
PERCENT INSECTIVO. CYPRINIDS	61.2	5	0.0	1	0.0	1
PERCENT PISCIVORES	4.1	3	2.9	3	0.0	1
DENSITY OF INDIVIDUALS	0.005	3	0.003	1	0.004	1
PERCENT ANOMALIES	0.0	5	0.0	5	0.0	5
TOTAL SCORE		38		26		28
FISH COMMUNITY CATEGORY		GOOD (SLIGHTLY IMPAIRED)		FAIR (MODERATELY IMPAIRED)		GOOD (SLIGHTLY IMPAIRED)

Table 2A. Qualitative macroinvertebrate sampling results for Buck Creek, Kent County, June 19, 1991.

TAXA	STATION 1	STATION 2	STATION 3
PLATYHELMINTHES (flatworms)	3		1
ARTHROPODA			
Isopoda (sowbugs)	8	10	10
Amphipoda (scuds)	20	15	10
Decapoda (crayfish)	4	8	8
Insecta			
Ephemeroptera (mayflies)			
Ephemerellidae	1		1
Odonata			
Zygoptera (damselflies)			
Calopterygidae		4	8
Coenagrionidae	1		1
Hemiptera (true bugs)			
Corixidae	2		20
Gerridae		10	10
Trichoptera (caddisflies)			
Hydropsychidae	13		6
Leptoceridae			1
Coleoptera (beetles)			
Haliplidae (adults)	1		3
Hydrophilidae (total)	1		
Elmidae	3		
Diptera (flies)			
Simulidae	15	2	
Chironomidae	4	4	5
MOLLUSCA			
Gastropoda (snails)			
Physa	1		1
Pelecypoda (clams)			
Sphaerium			2
TOTAL INDIVIDUALS	77	53	87

Table 2B. Macroinvertebrate metric evaluation of Buck Creek, Kent County, June 19, 1991.

METRIC	STATION 1 Value	STATION 1 Score	STATION 2 Value	STATION 2 Score	STATION 3 Value	STATION 3 Score
TOTAL NUMBER OF TAXA	14	4	7	0	15	2
NUMBER OF MAYFLY TAXA	1	0	0	0	1	0
NUMBER OF CADDISFLY TAXA	1	0	0	0	2	0
NUMBER OF STONEFLY TAXA	0	0	0	0	0	0
PERCENT MAYFLY COMP.	1.3	0	0.0	0	1.1	0
PERCENT CADDISFLY COMP.	16.9	0	0.0	0	8.0	0
PERCENT CONTR. DOM. TAXON	26.0	4	28.3	4	23.0	4
PERCENT ISOPOD, SNAIL, LEECH	11.7	0	18.9	0	12.6	0
PERCENT SURFACE AIR BREATHERS	5.2	4	18.9	4	37.9	2
TOTAL SCORE		12		8		8
MACROINVERTEBRATE COMMUNITY CATEGORY		FAIR (MODERATELY IMPAIRED)		POOR (SEVERELY IMPAIRED)		POOR (SEVERELY IMPAIRED)

Table 3. Habitat evaluation for Buck Creek, Kent County, June 19, 1991.

HABITAT METRIC	STATION 1 SCORE	STATION 2 SCORE	STATION 3 SCORE
Bottom Substrate Available Cover:	12	7	2
Embeddedness:	12	6	0
Velocity:Depth:	16	11	3
Flow Stability:	9	10	6
Bottom Deposition:	7	7	2
Pools-Riffles-Runs-Bends:	11	6	5
Bank Stability:	7	7	6
Bank Vegetative Stability:	6	9	8
Streamside Cover:	6	8	5
TOTAL SCORE	86	71	37
HABITAT CONDITION CATEGORY	GOOD (SLIGHTLY IMPAIRED)	FAIR (MODERATELY IMPAIRED)	POOR (SEVERELY IMPAIRED)
Date:	June 19, 1991	June 19, 1991	June 19, 1991
Stream Type:	Coldwater	Coldwater	Coldwater
Weather:	Sunny	Sunny	Sunny
Stream Order:	Third	Third	First
Air Temperature:	72 Deg. F.	73 Deg. F.	80 Deg. F.
Water Temperature:	64.5 Deg. F.	62 Deg. F.	64 Deg. F.
Ave. Stream Width:	35 Feet	25 Feet	13 Feet
Ave. Stream Depth:	1 Feet	2 Feet	1 Feet
Surface Velocity:	0.75 Ft./Sec.	0.5 Ft./Sec.	0.25 Ft./Sec.
Estimated Flow:	26 CFS	25 CFS	3 CFS

Table 4. Overall Stream Quality of Buck Creek, Kent County, June 19, 1991.

STATION NUMBER	STATION LOCATION	FISH COMMUNITY	MACROINVERTEBRATE COMMUNITY	PHYSICAL HABITAT	OVERALL BIOLOGICAL
1	Buck Creek Wedgewood Park	GOOD	FAIR	GOOD	FAIR
2	Buck Creek Burlingame/44th	FAIR	POOR	FAIR	POOR
3	Sharps Creek Division/76th	GOOD	POOR	POOR	POOR

APPENDIX I:

Length/Frequency Data for Brown Trout in Buck Creek, Kent County, Michigan.

FISH COLLECTION

er Buck Creek T ____ R ____ Sec. ____ Date 6/19/91

nty Kent I.D ____ Sheet 1 of 1

mary of: (X) All sites ( ) Coll. site No. ____ ( ) Index site No. ____ ( ) All gear ( ) Gear ____

cies			Stn 2 Brown Trout		Stn 3 Brown Trout									
gths														
	No.	N_o	No.	N_o	No.	N_o	No.	W_o	No.	N_c	No.	N_n	No.	N
1				6		2								

LENGTH-FREQUENCY & LENGTH-BIOMASS SAMPLE

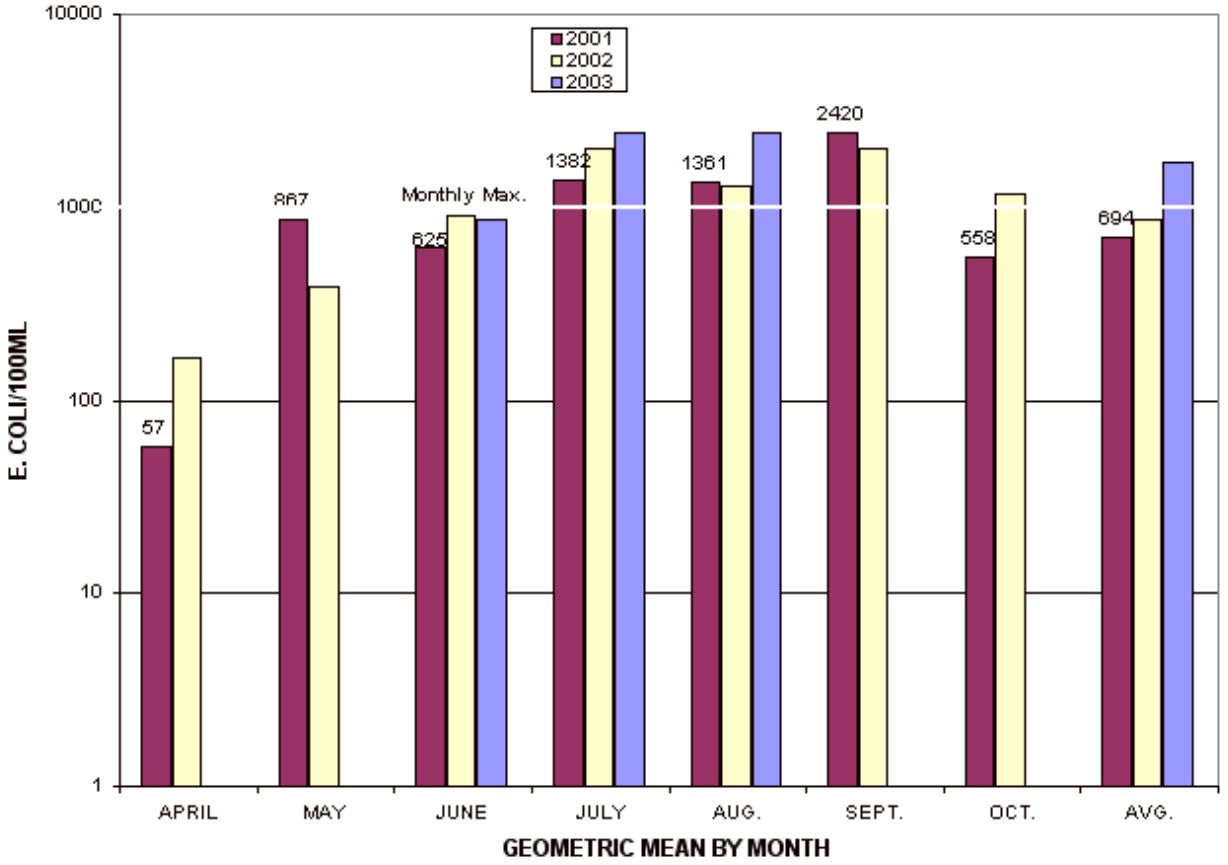
Inches														
1														
2														
3														
4														
5				3		1								
6				2										
7														
8														
9														
10						1								
11				1										
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36														
37														
38														
Sample total														

R6050-
Rev 3/8

Appendix 3.2 - Kent County Health Department Buck Creek Station No. 17

KENT COUNTY HEALTH DEPARTMENT
SURFACE WATER QUALITY MONITORING

BUCK CREEK
IDEAL PARK, CRIPPEN STREET
WYOMING
STATION # 17



Appendix 3.2 - Kent County Health Department Buck Creek Station No. 15

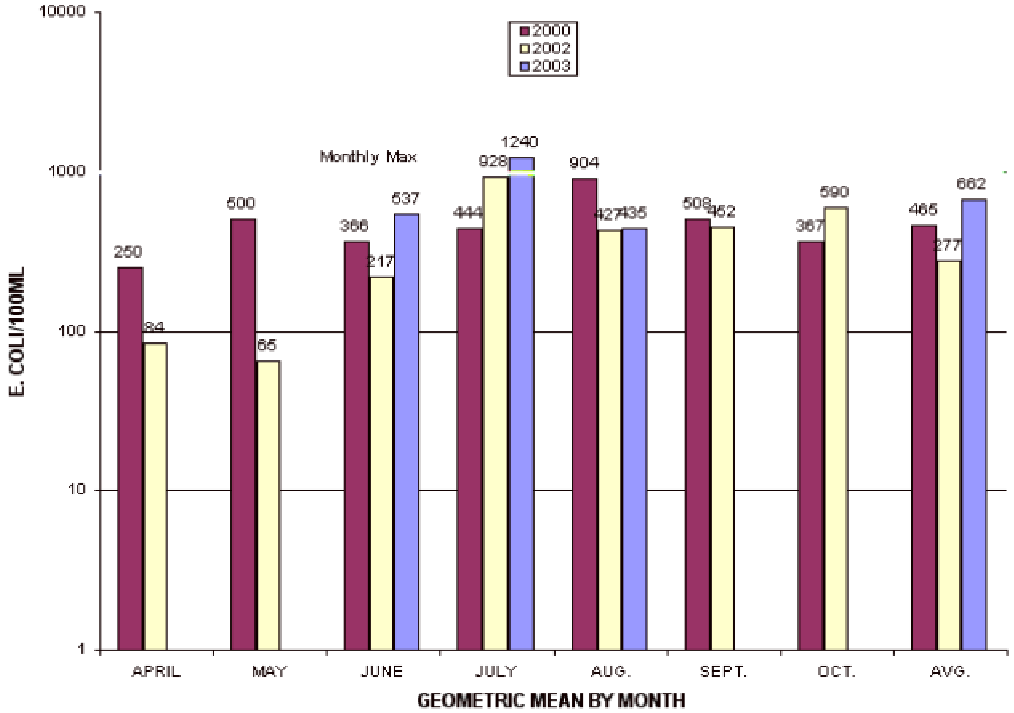
KENT COUNTY HEALTH DEPARTMENT
SURFACE WATER QUALITY MONITORING

BUCK CREEK

DOUGLAS WALKER PARK

BYRON TOWNSHIP

STATION # 15



Appendix 3.3 - Buck Creek Watershed Inventory Data Sheet

Watershed Inventory Data Sheet

Buck Creek Watershed

Date
Investigator
Water Body Name **Site ID#** _____
Site Reference

Pollutant Source (choose only one, complete section)

1. Debris/Trash	2. Construction Site Runoff		3. Stream Crossing	4. Rill or Gully Erosion
5. Livestock Access	6. Upland Source	7. Tile Outlet	8. Streambank Erosion	9. Urban Runoff

10. Other: _____

County	Kent	**Township**		**Section #**	**0.25**	**0.25**
Tract #(s)			**Owner**			
Current precipitation	None	Light	Moderate	Heavy		
Days since last rain	1 or less	2	3 or more	How much?	inches	
Water Color	Clear	Green	Milky	Brown	Very Muddy	Black
Water Odor	None	Musty	Rotten Eggs	Chemical	Oil	Sewage
Stream flow type	Dry	Stagnant	Slow Flow	Rapid Flow		
Average Stream Width	10' or less	11' - 25'	25' - 50'	50' or more		
Average Stream Depth	<1'	1' - 3'	>3'	Don't know		
Riparian Habitat	Trees	Shrubs	Herbaceous plants		Grass	Bare
Buffer/Filter Strip	Y / N	Width	<1'	1' - 3'	3' - 10'	>10'
Land Use (facing u/s)	Left Road	Woodland	Wetland	Idle	Agricultural	Res/Comm
	Right Road	Woodland	Wetland	Idle	Agricultural	Res/Comm

Comments:

SECTION 1. DEBRIS/TRASH/OBSTRUCTIONS

Slight	Moderate	Extensive	Description:	_____
Organic Waste Dumping	Left bank	Right Bank	Type:	_____

SECTION 2. CONSTRUCTION SITE RUNOFF

Location	Left Bank	Right Bank		
Construction type	road	residential	industrial	other
Soil erosion measures	not installed	needs repair	not adequate	
Sedimentation control measures	not installed	needs repair	not adequate	
Extent of erosion/sedimentation	slight	moderate	severe	

Appendix 3.4 - Nonpoint Source Data

Trash and Debris

SITE ID NUMBER	DATE	Trash and	PHOTO	TOWNSHIP	LAND USE LEFT	LAND USE RIGHT	TYPE OF TRASH AND DEBRIS	AMOUNT	COMMENTS
08BYR3601	26-Jun-03	BUCK CREEK	NO	BYRON CENTER	IDLE	IDLE	LOG JAM OBSTRUCTING FLOW OF CREEK	SLIGHT	
1154GRC2107	22-Aug-03	BEMAN AND FOLEY DRAIN	YES	GRANDVILLE			PRESENT		EXCESSIVE SAND AND TREES, LEAVES, BRANCHES BLOCKING WATERWAY. ALSO, CHAIR AND MISC. TRASH.
1154GRC2110	22-Aug-03	BEMAN AND FOLEY DRAIN	YES	GRANDVILLE			PRESENT		LOOKS LIKE CAR OIL.
1154GRC2116	25-Aug-03	BEMAN AND FOLEY DRAIN	YES	GRANDVILLE			PRESENT		GRASS CLIPPINGS
1154GRC2117	25-Aug-03	BEMAN AND FOLEY DRAIN	YES	GRANDVILLE			PRESENT		GRASS CLIPPINGS
1154GRC2809	3-Jul-03		NO	GRANDVILLE			PRESENT		
1154WYO2116	21-Aug-03	BEAMAN AND FOLEY DRAIN	YES	WYOMING			PRESENT		
1154WYO3333	23-Jul-03	BEAMAN AND FOLEY DRAIN	YES	WYOMING			PRESENT		GRASS CLIPPINGS
1154WYO3337	23-Jul-03	BEAMAN AND FOLEY DRAIN	YES	WYOMING			PRESENT		GRASS CLIPPINGS
1154WYO3339	24-Jul-03	BEAMAN AND FOLEY DRAIN	YES	WYOMING			PRESENT		GLASS CLIPPINGS ON THE BANK
1154WYO3347	24-Jul-03	BEAMAN AND FOLEY DRAIN	YES	WYOMING			PRESENT		GRASS CLIPPINGS
1154WYO3348	24-Jul-03	BEAMAN AND FOLEY DRAIN	YES	WYOMING			PRESENT		GRASS CLIPPINGS
1154WYO3357	25-Jul-03	BEAMAN AND FOLEY DRAIN	YES	WYOMING			PRESENT		GRASS CLIPPINGS
1155BYR2217	30-Jun-03	TRIBUTARY (1155)	YES	BYRON CENTER			PRESENT		NOT COMPLETELY FULL...JUST BEHIND HOUSES
1155BYR2218	1-Jul-03	TRIBUTARY (1155)	YES	BYRON CENTER			PRESENT		
1157BYR1323	20-Jun-03	TRIBUTARY (1157)	YES	BYRON CENTER			PRESENT		
1157BYR1324	20-Jun-03	TRIBUTARY (1157)	YES	BYRON CENTER			PRESENT		
1157BYR1325	20-Jun-03	TRIBUTARY (1157)	YES	BYRON CENTER			PRESENT		
1157BYR1326	20-Jun-03	TRIBUTARY (1157)	YES	BYRON CENTER			PRESENT		
11601GAI0838	6-Jun-03	TRIBUTARY (11601)	YES	GAINES TWP			PRESENT		CRYSTAL SPRINGS, GRASS CLIPPINGS BY POND
11611GAI0859	9-Jun-03	CUTLERVILLE DRAIN (TRIBUTARY)	YES	GAINES TWP			PRESENT		
1161BYR0126	17-Jun-03	CUTLERVILLE DRAIN	YES	BYRON CENTER			PRESENT		YARD WASTE ON STREAM BANK
1161GAI0620	23-May-03	CUTLERVILLE DRAIN	YES	GAINES TWP			PRESENT		
11631KEN2801	6-Aug-03	TRIBUTARY (11631)	YES	KENTWOOD	RES/COMM	RES/COMM	PARKING LOT RUNOFF / TRASH IN STREAM	MODERATE	RETENTION BASIN UPSTREAM / TRASH IN STREAM
11631KEN2901	6-Aug-03	TRIBUTARY (11631)	NO	KENTWOOD	RES/COMM	RES/COMM	GRASS CLIPPINGS ALONG LEFT BANK	SLIGHT	
11632WYO1811	14-Aug-03	HEYBOER DRAIN #2	YES	WYOMING			PRESENT		TWO HUGE CULVERTS
11632WYO1815	14-Aug-03	HEYBOER DRAIN #2	YES	WYOMING			PRESENT		
1163WYO2505	5-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		
1163WYO3614	5-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		TRASH, TREES AND STICKS ALMOST COMPLETELY RESTRICTING WATERWAY
1163WYO3628	6-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		TRUCK DUMP(WATER OR SOME LIQUID). BANK IS ERODED & THERE IS A LOT OF CARDBOARD TRASH. ALGAE GROWING ON GROUND
59GAI0402	4-Aug-03	PINE HILL CREEK	NO	GAINES TWP	RES/COMM	RES/COMM	GRASS CLIPPINGS ALONG BOTH BANKS	SLIGHT	
59KEN3105	4-Aug-03	PINE HILL CREEK	YES	KENTWOOD	IDLE		DEBRIS IN WATER	EXTENSIVE	
59KEN3302	4-Aug-03	PINE HILL CREEK	YES	KENTWOOD		WOODLAND	DEBRIS IN WATER	EXTENSIVE	
6511BYR1316	19-Jun-03	NORFOLK SOUTHERN RAIL ROAD	YES	BYRON CENTER			PRESENT		
65BYR1227	3-Jul-03	76TH STREET INDUSTRIAL PARK DRAIN	YES	BYRON CENTER			PRESENT		TRUNED OVER TRUCK, BEEN THERE FOR QUITE A WHILE, RUSTED
65BYR1228	3-Jul-03	76TH STREET INDUSTRIAL PARK DRAIN	YES	BYRON CENTER			PRESENT		GRASS CLIPPINGS
65BYR1232	3-Jul-03	76TH STREET INDUSTRIAL PK. DRAIN	YES	BYRON CENTER			PRESENT		GRASS CLIPPINGS AND YARD WASTE
65BYR1261	9-Jul-03	TRIBUTARY (65)	YES	BYRON CENTER			PRESENT		CAGE/BED FRAME BLOCKING WATER WAY, THERE IS AN EXTREME AMOUNT OF SEDIMENT AND GROWTH IN CAGE
674BYR2501	17-Oct-03	UNKNOWN (674)	YES	BYRON CENTER	IDLE	RES/COMM	BROKEN PVC PIPES	EXTENSIVE	BROKEN PVC PIPES IMPEDING FLOW THROUGH CULVERT (WEST OF DIVISION - DOWN STREAM)
675GAI0514	10-Jun-03	WATERMAN DRAIN	YES	GAINES TWP			PRESENT		WOODCHIPS OVERFLOWING INTO CREEK, YARD WASTE NEXT TO IT
8BYR0118	17-Jun-03	BUCK CREEK	YES	BYRON CENTER			PRESENT		
8BYR0121	17-Jun-03	BUCK CREEK	YES	BYRON CENTER			PRESENT		WHOLE POND IS TRASHED.... FOAM INSULATION, 2X4'S, TRASH CANS, GRILLS, STEAL BEAMS, BED FRAMES, TIRES, ETC.
8BYR1236	7-Jul-03	BUCK CREEK	YES	BYRON CENTER			PRESENT		OTHER DEBRIS DOWNSTREAM--FROM HERE OR PROBABLY NEXT COMPANY TO THE NORTH
8BYR1255	8-Jul-03	BUCK CREEK	YES	BYRON CENTER			PRESENT		
8GRC1607	17-Jun-03		NO	GRANDVILLE			PRESENT		
8GRC1713	17-Jun-03		NO	GRANDVILLE			PRESENT		
8GRC1815	17-Jun-03		NO	GRANDVILLE			PRESENT		
8GRC2124	25-Aug-03	BUCK CREEK	YES	GRANDVILLE			PRESENT		GRASS CLIPPINGS
8WYO2112	21-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		YARD DEBRIS
8WYO2219	12-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		VARIOUS BITS OF TRASH--PROBABLY FROM UPSTREAM.
8WYO2301	22-Jul-03	UNKNOWN	YES	WYOMING			PRESENT		GRASS CLIPPINGS
8WYO2515	12-Aug-03	UNNAMED LAKE	YES	WYOMING			PRESENT		
8WYO2706	17-Jul-03	WETLAND	YES	WYOMING			PRESENT		GRASS CLIPPINGS
8WYO2816	31-Jul-03	UNKNOWN	YES	WYOMING			PRESENT		CAT LITTER
8WYO3386	29-Jul-03	UNNAMED LAKE	YES	WYOMING			PRESENT		GRASS CLIPPINGS
8WYO3413	17-Jul-03	UNNAMED LAKE	YES	WYOMING			PRESENT		DEBRIS AROUND AND IN LAKE FROM CONSTRUCTION AND BUSINESSES
8WYO3629	6-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		REASH (WATER BOTTLES, SPRAY CANS, CHIP BAGS)
8WYO3634	6-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		GRASS CLIPPINGS
8WYO3636	6-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		GRASS CHIPPINGS
8WYO3645	7-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		

Watershed Survey Data Sheet

Date: **Time:**
Waterbody Name: **County:** **Station #:**
Location: **Township:** **Sec T R ¼ ¼**
Investigator: **Lat:** **Long:**
Coordinate Determination Method (check the one that applies):
___ GPS ___ GPS w/ DBR ___ Digital mapping software ___ Topographic map ___ Other (describe _____)
Map Scale (if known _____)

PHYSICAL HABITAT

BACKGROUND INFORMATION - pg. 18

Event Conditions noted at site	None	Light	Moderate	Heavy	
Days since Rain	≤ 1	2	≥3	Unknown	
Water Temp./D.O./pH *					
Water Color	Clear	Gray	Brown	Black	Green
Waterbody Type-u/s	Stream	Lake	Impd	Wetland	
Waterbody Type-d/s	Stream	Lake	Impd	Wetland	
Stream Width (ft.)	<10	10-25	25-50	>50	
Avg. Stream Depth (ft.)	<1	1-3	>3	Unknown	
Water Velocity (ft./sec)					
Stream Flow Type	Dry	Stagnant	L	M	H

PHYSICAL APPEARANCE - pg. 20

	U/S (Check all that apply)		D/S (Check all that apply)	
Aquatic Plants	Present	Abundant	Present	Abundant
Floating Algae	Present	Abundant	Present	Abundant
Filamentous Algae	Present	Abundant	Present	Abundant
Bacterial Sheen/Slimes	Present	Abundant	Present	Abundant
Turbidity	Present	Abundant	Present	Abundant
Oil Sheen	Present	Abundant	Present	Abundant
Foam	Present	Abundant	Present	Abundant
Trash	Present	Abundant	Present	Abundant

SUBSTRATE (add to 100%) - pg. 22

	U/S (%)	D/S (%)
Boulder – 10 in. diam.		
Cobble/Gravel –10 to .08 in. diam.		
Sand – coarse grain		
Silt/Detritus/Muck - fine grain/organic matter		
Hardpan/Bedrock – solid clay/rock surface		
Artificial – manmade		
Unknown		

INSTREAM COVER - pg. 23

	U/S (X)	D/S (X)
Undercut Banks		
Overhanging Veg.		
Deep Pools		
Boulders		
Aquatic Plants		
Logs or Woody Debris		

RIVER MORPHOLOGY - pg. 23

	U/S			D/S		
Riffle	Present	Abundant		Present	Abundant	
Pool	Present	Abundant		Present	Abundant	
Channel	Natr	Recv	Maintn d	Natr	Recv	Maintn d
Designated Drain	?	Y	N	?	Y	N

Highest Water Mark (ft.)	?	<1	1-3	3-5	5-10	>10

STREAM CORRIDOR - pg. 26

	U/S				D/S			
Riparian Veg. Width ft.(L)	< 10	10-30	30-100	>100	< 10	10-30	30-100	>100
Riparian Veg. Width ft.(R)	< 10	10-30	30-100	>100	< 10	10-30	30-100	>100
Bank Erosion	0	L	M	H	0	L	M	H
Streamside Land Cover	B	G	S	T	B	G	S	T
Stream Canopy %	<25	25-50	> 50		<25	25-50	> 50	

Stream Cross Section

Adjacent Land Uses

Wetlands	L	R	L	R
Shrub or Old Field	L	R	L	R
Forest	L	R	L	R
Pasture	L	R	L	R
Crop Land	L	R	L	R
Animal Feeding Operation	L	R	L	R
Maintained Lawns/Parks	L	R	L	R
Impervious Surfaces	L	R	L	R
Disturbed Ground	L	R	L	R
No Vegetation	L	R	L	R

Date: **Watershed Survey Data Sheet (pg. 2)** **Station #:**

ROAD CROSSING INFORMATION								
Crossing Type	Bridge	____ Round Culvert(s)	____ Box Culvert(s)	____ Arch Culvert(s)	Other:			
Road Surface	Paved	Gravel	Sand	Clay	Grass	Other:		
Road Ownership	MDOT	County	USFS	MDNR	Municipal	Priv/Corp	Unknown	Other:
Culvert Problems	Poor Alignment	Inadequate Armoring	Impounding Water	Obstructed	Structural Integrity	Other:		
Perched Culvert	< 3"	3-12"	> 12"	Plunge Pool				
Crossing Erosion	Crossing Embankment	Road Approaches	Road Ditches					

POTENTIAL SOURCES (Severity: S – slight; M – moderate; H – high) – pg. 28

	U/S			D/S				U/S			D/S		
Crop Related Sources	S	M	H	S	M	H	Land Disposal	S	M	H	S	M	H
Grazing Related Sources	S	M	H	S	M	H	On-site Wastewater Systems	S	M	H	S	M	H
Intensive Animal Feeding Operations	S	M	H	S	M	H	Silviculture (Forestry NPS)	S	M	H	S	M	H
Highway/Road/Bridge Maintenance and Runoff (Transportation NPS)	S	M	H	S	M	H	Resource Extraction (Mining NPS)	S	M	H	S	M	H
Channelization	S	M	H	S	M	H	Recreational/Tourism Activities (general)	S	M	H	S	M	H
Dredging	S	M	H	S	M	H	• Golf Courses	S	M	H	S	M	H
Removal of Riparian Vegetation	S	M	H	S	M	H	• Marinas/Recr. Boating (water releases)	S	M	H	S	M	H
Bank and Shoreline Erosion/ Modification/Destruction	S	M	H	S	M	H	• Marinas/Recr. Boating (bank or shoreline erosion)	S	M	H	S	M	H
Flow Regulation/ Modification (Hydrology)	S	M	H	S	M	H	Debris in Water	S	M	H	S	M	H
Upstream Impoundment	S	M	H	S	M	H	Industrial Pt. Source	S	M	H	S	M	H
Construction:Highway/Road /Bridge/Culvert	S	M	H	S	M	H	Municipal Pt. Source	S	M	H	S	M	H
Construction: Land Development	S	M	H	S	M	H	Natural Sources	S	M	H	S	M	H
Urban Runoff (Residential/ Urban NPS)	S	M	H	S	M	H	Source(s) Unknown	S	M	H	S	M	H

SITE SUMMARY INFORMATION – pg. 33			
SURVEY DIRECTION	N/A	U/S	D/S
SITE SIMILARITY	?	Y	N
OVERALL SITE RANKING	Good	Fair	Poor
FOLLOW UP	L	M	H

COMMENTS: _____

NOTE: * - Optional data item

Appendix 4.1 - Designated Uses

Buck Creek Watershed
14 93 Agricultural and suburban
14 94 Industrial and residential

Designated Use	Being Met	Threatened	Impaired	Pollutants	Source	Causes
Agriculture	Yes					
Navigation	Not a use					
Industrial Use	Yes					
Coldwater Fishery		Temperature might pose a threat		Temperature (s)	Urban runoff (s)	Increased imperviousness (s)
		Road salt might pose a threat		Road salt (s)	Urban runoff (k)	Misapplication or over-application of road salt (s)
			North of 84th Street to limits of City of Grandville moderately impaired.	Nutrients (k)	Yard waste (k)	Illegal dumping on streambanks (k)
			North of 84th Street to limits of City of Grandville moderately impaired. Severely impaired in Lemery Park and Burlingame Avenue areas.	Sediment (k)	Streambank erosion (k)	Fluctuating hydrology (k)
					Construction site runoff (k)	Lack of SESC measures (s)
Coolwater Fishery		Temperature might pose a threat		Temperature (s)	Urban runoff (s)	Increased imperviousness (s)
		Road salt might pose a threat		Road salt (s)	Urban runoff (k)	Misapplication or over-application of road salt (s)
			City of Grandville moderately impaired	Nutrients (k)	Yard waste (k)	Illegal dumping on streambanks (k)
			City of Grandville moderately impaired	Sediment (k)	Streambank erosion (k)	Fluctuating hydrology (k)
					Construction site runoff (k)	Lack of SESC measures (s)
Warmwater Fishery			Slightly to moderately impaired south of 84th Street	Sediment (k)	Streambank erosion (k)	Fluctuating hydrology (k)
					Construction site runoff (s)	Lack of SESC measures (s)
					Agricultural runoff (s)	Conventional tillage, plowing up to edge of stream, lack of buffer (s)
			Slightly to moderately impaired south of 84th Street	Nutrients (k)	Yard waste (k)	Illegal dumping on streambanks (k)
					Agricultural runoff (s)	Conventional tillage, plowing up to edge of stream, lack of buffer (s)
		Road salt might pose a threat		Road salt (s)	Urban runoff (k)	Misapplication or over-application of road salt (s)
Other Indigenous Aquatic Life and Wildlife			Habitats are moderately to severely impaired	Sediment (k)	Storm water runoff scouring streambed (k)	Increased imperviousness (s)
Partial Body Contact Recreation			Fishing and other recreational opportunities are impaired	Pathogens *(E. coli)* (k)	Failing septic systems (s), TMDL to be determined by 2006	Leaking, poorly maintained, and over capacity septic systems (s)
					Urban wildlife populations (s)	Overpopulations in urban areas (s)
					Pet waste (s)	Uncollected waste (s)
Total Body Contact Recreation			Swimming (wading at Palmer Park) is impaired	Pathogens *(E. coli*) (k)	Failing septic systems (s), TMDL to be determined by 2006	Leaking, poorly maintained, and over capacity septic systems (s)
					Urban wildlife populations (s)	Overpopulations in urban areas (s)
					Pet waste (s)	Uncollected waste (s)
Public Water Supply	Not a use					

Source: MDEQ Biological surveys
(k) = known
(s) = suspected

Appendix 6.1 - MDEQ Nonpoint Source Best Management Practices

BEST MANAGEMENT PRACTICES	BMP Links (Must Be Connected to the Internet)
MDEQ NPS BMP INDEX	http://www.michigan.gov/deq/0,1607,7-135-3313_3682_3714-13186--,00.html
Access Road	http://www.deq.state.mi.us/documents/deq-swq-nps-ar.pdf
Buffer/ Filter Strip	http://www.deq.state.mi.us/documents/deq-swq-nps-bfs.pdf
Catch Basins	http://www.deq.state.mi.us/documents/deq-swq-nps-cab.pdf
Critical Area Stabilization	http://www.deq.state.mi.us/documents/deq-swq-nps-cas.pdf
Community Car Washes	http://www.deq.state.mi.us/documents/deq-swq-nps-car.pdf
Check Dam	http://www.deq.state.mi.us/documents/deq-swq-nps-cd.pdf
Construction Barrier	http://www.deq.state.mi.us/documents/deq-swq-nps-cob.pdf
Constructed Wetlands	http://www.deq.state.mi.us/documents/deq-swq-nps-conw.pdf
Dust Control	http://www.deq.state.mi.us/documents/deq-swq-nps-dc.pdf
Diversions	http://www.deq.state.mi.us/documents/deq-swq-nps-div.pdf
Dune/ Sand Stabilization	http://www.deq.state.mi.us/documents/deq-swq-nps-dss.pdf
Dewatering	http://www.deq.state.mi.us/documents/deq-swq-nps-dw.pdf
Extended Detention Basin	http://www.deq.state.mi.us/documents/deq-swq-nps-edb.pdf
Equipment Maintenance And Storage Area	http://www.deq.state.mi.us/documents/deq-swq-nps-ems.pdf
Filters	http://www.deq.state.mi.us/documents/deq-swq-nps-fil.pdf
Fertilizer Management	http://www.deq.state.mi.us/documents/deq-swq-nps-fm.pdf
Grading Practices	http://www.deq.state.mi.us/documents/deq-swq-nps-gp.pdf
Grade Stabilization Structures	http://www.deq.state.mi.us/documents/deq-swq-nps-gss.pdf
Grassed Waterways	http://www.deq.state.mi.us/documents/deq-swq-nps-gw.pdf
Household Hazardous Waste Disposal	http://www.deq.state.mi.us/documents/deq-swq-nps-hhhw.pdf
Infiltration Basin	http://www.deq.state.mi.us/documents/deq-swq-nps-ib.pdf
Infiltration Trench	http://www.deq.state.mi.us/documents/deq-swq-nps-it.pdf
Land Clearing	http://www.deq.state.mi.us/documents/deq-swq-nps-lc.pdf
Lawn Maintenance	http://www.deq.state.mi.us/documents/deq-swq-nps-lm.pdf
Modular Pavement	http://www.deq.state.mi.us/documents/deq-swq-nps-mp.pdf
Mulching	http://www.deq.state.mi.us/documents/deq-swq-nps-mul.pdf
Organic debris Disposal	http://www.deq.state.mi.us/documents/deq-swq-nps-odd.pdf
Oil Grit Seperators	http://www.deq.state.mi.us/documents/deq-swq-nps-ogs.pdf
Porus Asphault Pavement	http://www.deq.state.mi.us/documents/deq-swq-nps-pap.pdf
Pond Construction and Management	http://www.deq.state.mi.us/documents/deq-swq-nps-pcm.pdf
Parking Lot Storage	http://www.deq.state.mi.us/documents/deq-swq-nps-pls.pdf
Pesticide Management	http://www.deq.state.mi.us/documents/deq-swq-nps-pm.pdf
Pond Sealing and Lining	http://www.deq.state.mi.us/documents/deq-swq-nps-ps.pdf
Riprap	http://www.deq.state.mi.us/documents/deq-swq-nps-rip.pdf
Roof Top Storage	http://www.deq.state.mi.us/documents/deq-swq-nps-rts.pdf
Sediment Basin	http://www.deq.state.mi.us/documents/deq-swq-nps-sb.pdf
Streambank Stabilization	http://www.deq.state.mi.us/documents/deq-swq-nps-sbs.pdf
Storm Water Conveyence Channel	http://www.deq.state.mi.us/documents/deq-swq-nps-scc.pdf
Subsurface Drain	http://www.deq.state.mi.us/documents/deq-swq-nps-sd.pdf
Seeding	http://www.deq.state.mi.us/documents/deq-swq-nps-see.pdf
Soil Management	http://www.deq.state.mi.us/documents/deq-swq-nps-sm.pdf
Stabilized Outlet	http://www.deq.state.mi.us/documents/deq-swq-nps-so.pdf
Sodding	http://www.deq.state.mi.us/documents/deq-swq-nps-sod.pdf
Spoil Piles	http://www.deq.state.mi.us/documents/deq-swq-nps-sp.pdf
Staging and Scheduling	http://www.deq.state.mi.us/documents/deq-swq-nps-ss.pdf
Slope/ Shoreline Stabilization	http://www.deq.state.mi.us/documents/deq-swq-nps-sss.pdf
Street Sweeping	http://www.deq.state.mi.us/documents/deq-swq-nps-sw.pdf
Tree Protection	http://www.deq.state.mi.us/documents/deq-swq-nps-tp.pdf
Water Course Crossing	http://www.deq.state.mi.us/documents/deq-swq-nps-wac.pdf
Wet Detention Basin	http://www.deq.state.mi.us/documents/deq-swq-nps-wdb.pdf
Wet Land Crossing	http://www.deq.state.mi.us/documents/deq-swq-nps-wec.pdf
Winter Road Maintenance	http://www.deq.state.mi.us/documents/deq-swq-nps-wrm.pdf

URBAN STRUCTURAL BEST MANAGEMENT PRACTICES

BEST MANAGEMENT PRACTICES	POLLUTANT ADDRESSED	POLLUTANT REMOVAL RELIABILITY	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	COMPARATIVE COSTS	FUNDING SOURCES	SPECIAL CONSIDERATIONS	COMMUNITIES USING BMP
PRETREATMENT (ex. Sediment traps, drainage channels, water quality inlets)														
Hydrodrynamic Separator Units (CDS Units, Stormceptors, Vortechnics, Downstream Defender)	Sediment, oils, solids	Effective	Storm sewer system		50+	Moderate	Minimum	Widely applicable - underground unit		Catches first flush, high flows by-pass unit through pipe system		General fund	Placed upstream of storm sewer discharge into lake. Also, unit is below grade. Needs to allow for access for cleaning the chambers.	East Grand Rapids
Catch basin inlet devices	Solids, sediments	Moderate to high	Stormwater runoff	Catch basin cleaning program	Short	High	Low/moderate	Needs less than 5 acres of drainage area		Lack of maintenance can lead to flooding if catch basin clogs	Low		Useful for retrofit	MDOT
Permanent Sediment Basin														
Combination curb with water spreader														
Check dams, Grade control structures														
DETENTION/RETENTION (ex. Extended detention basin)														
Ponded Type Detention Basin	Sediment	Moderate	Stormwater runoff		20+ years	Low	Minimum	Widely applicable, larger drainage areas (10+ acres)	Possible downstream warming; low bacteria removal	Reduced peak flows, storage, West Nile Virus	Low to moderate	General fund	Need available land area, design standards, can include sediment forebay.	East Grand Rapids, OCRC
Dry Detention Basin	Sediment	Moderate	Stormwater runoff		50+ years	Low	Moderate	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		Hard to establish vegetation	MDOT, OCDC
Regional Detention														OCDC
VEGETATED TREATMENT (ex. Constructed wetland, grassed swale)														
Constructed Wetland	Sediment, nutrients, bacteria	Moderate to high depending on season	Stormwater runoff		50+ years	Low	Moderate to High	Needs large land area with appropriate soils and slope	Potential for nutrient release in winter months	Slows flow and reduces peak flow	High		2% of drainage area needs to be wetland for efficient pollutant removal. Harvesting may be necessary if plants are uptaking large amounts of toxics	MDOT
Wooded Buffers	Thermal pollution	Moderate to high	Runoff from parking lots and roof tops and outflow from ponds		50+ years	Low	Moderate to High	Widely applicable	Lack of maintenance can increase erosion if trees fall into streams	Trees in floodplain can impede flow	Moderate to high		At minimum keep south and west sides of streams wooded to provide shade	
INFILTRATION (ex. Infiltration basin)														
Infiltration Trench	Nutrients, sediment, metals	High	Stormwater runoff		Short (10 years or less)	Annual	Moderate	Site specific depends on soils	Potential to contaminate groundwater		Moderate		Avoid areas with potential hazardous material contamination	MDOT
Infiltration Pond	Nutrients, sediment, metals	High	Stormwater runoff		25 years	Annual	Moderate	Site specific depends on soils	Potential to contaminate groundwater		Moderate		Avoid areas with potential hazardous material contamination	MDOT
Porous Pavement	Nutrients, sediment, metals	High	Stormwater runoff		Varies	Moderate		Not suited for high traffic areas	Potential to contaminate groundwater		Moderate		Avoid areas with potential hazardous material contamination	MDOT
FILTRATION (ex. Sand filters)														
Vegetated Swale or Bio-filtration	Sediment and Metals	High	Stormwater runoff		20-50 years	Moderate	Moderate	Highly applicable to residential areas, not suited to steep slopes	Potential to contaminate groundwater and does not remove nutrients	Slows flow	Low		Does not require a large land area. Should not be used in steep areas or well head areas	MDOT
Sand Filters	Sediment, Bacteria, Nutrients, Metals	Moderate	Stormwater runoff		Yet to be determined	Moderate to high depending on amount of sediment	Moderate		Will not filter soluble nutrients and toxics		Low to moderate		BMP performance is still experimental	

URBAN MANAGERIAL BEST MANAGEMENT PRACTICES

BEST MANAGEMENT PRACTICES	BENEFIT	POLLUTANT ADDRESSED	POLLUTANT REMOVAL RELIABILITY	POTENTIAL SOURCES OF POLLUTANTS	ADDITIONAL BMPS TO COMPLETE TREATMENT TRAIN	EXPECTED LIFE SPAN	MAINTENANCE REQUIREMENTS	O&M COSTS	TRAINING REQUIREMENTS	APPLICABILITY TO SITE	ENVIRONMENTAL CONCERNS	HYDROLOGIC EFFECTS TO CONSIDER	COMPARATIVE COSTS	FUNDING SOURCES	SPECIAL CONSIDERATIONS	COMMUNITIES USING BMP
Pollution Prevention																
Planning and zoning																
SESC plans																
Dust Control (MDEQ)	Prevents soils and attached chemicals, such as fertilizer and pesticides, from entering surface waters.	Silt and clay		Lack of vegetation	Mulching, permanent vegetative cover.					Rural, urbanizing, and transportation sites subject to wind erosion						
Encourage stream protection when siting developments																
Site planning																
Green space protection - preserving environmentally sensitive and open areas																Ottawa County Parks and Recreation Commission, Land Conservancy of West Michigan
Emergency Spill Response and Prevention Plan	Can be highly effective at reducing the risk of surface and groundwater contamination.	Hazardous Wastes	Low to high, depending on preparedness		Training		Plan needs to be updated		Moderate						Speed and containment are critical. Requires a well-planned and clearly defined plan. May require training, Equipment must be readily available. (MDOT)	Ottawa County, MDOT
Identify and prohibit illegal or illicit discharges to storm drains (MDOT)	Eliminate hazardous and harmful discharges.							$0.83/acre/year $50/ac/yr (with TV inspection)					$2/ac (assuming 1 system monitored every 5 sq. miles			Phase II communities, MDOT
Litter Control (MDOT)	Reduce potential clogging. Proper disposal of paper, plastic, and glass.							$16/acre/year					$20/trash can			MDOT
"No Littering" Ordinance (MDOT)	Prevents litter from entering storm drain.							Potentially self-supporting					$20,000			
Fertilizer Ordinance - fertilizers containing more than 1% by weight of anhydric phosphoric acid are NOT allowed in the Reeds Lake Watershed.		Phosphorus		Fertilizers			High		Low/moderate	Widely applicable to drainage area	Reduces amount of phosphoric acid in the watershed		High	Costs assessed to resident	Locations of fertilizers are few	East Grand Rapids
Material Management Plan (MDOT)	Identified hazardous and non-hazardous materials in the facility. Ensures that all containers have labels. Identifies hazardous chemicals that require special handling, storage, and disposal.															MDOT
Household hazardous waste management																
Composting																Ottawa County
Yard waste collection and disposal		Nutrients and organic sediment	High	Yard waste and leaf litter	Composting of collected refuse		Compost application, sale, and delivery		Minimal	Widely applicable to dense residential or riparian sites	Waste needs to be composted and correctly applied as fertilizer		Low		Need large collection facility for compost operations	Cascade Township, City of Wyoming, City of Kentwood, City of Grand Rapids, Byron Township, Ada Township, City of Coopersville, Georgetown Twp

URBAN MANAGERIAL BEST MANAGEMENT PRACTICES

BEST MANAGEMENT PRACTICES	BENEFIT	POLLUTANT ADDRESSED	POLLUTANT REMOVAL RELIABILITY	POTENTIAL SOURCES OF POLLUTANTS	ADDITIONAL BMPS TO COMPLETE TREATMENT TRAIN	EXPECTED LIFE SPAN	MAINTENANCE REQUIREMENTS	O&M COSTS	TRAINING REQUIREMENTS	APPLICABILITY TO SITE	ENVIRONMENTAL CONCERNS	HYDROLOGIC EFFECTS TO CONSIDER	COMPARATIVE COSTS	FUNDING SOURCES	SPECIAL CONSIDERATIONS	COMMUNITIES USING BMP
Pesticide management for turf grass and ornamentals																
Lawn maintenance																
Fertilizer management																
Pet waste disposal																
Street Sweeping	Reduction in potential clogging of storm drain material. Some oil and grease control (MDOT).	Sediment, metals, hydrocarbons	Moderate	Atmospheric, construction, vehicles	Vehicle maintenance and sweeping schedules				Moderate		Sweeping may wash sediments into catch basins if wash is not vacuumed		Moderate to High	KCRC Road maintenance budget - $300,000/yr Ottawa County Local units	Disposal of collected materials must be handled by the governing agency (MDEQ, Public Health, Transportation.) Timing critical - sweep after snow melt and before spring rains	City of East Grand Rapids, Cascade Township, City of Wyoming, City of Kentwood, Gerald R. Ford International Airport - Mostly contracted out to Sanisweep by KCRC, MDOT
Sidewalk Cleaning (MDOT)	Reduction of material entering storm drain.							$60/acre/year								
Clean and maintain storm drain channels (MDOT)	Prevent erosion in channels. Improve capacity by removing sediment. Remove debris toxic to wildlife.							$21/acre/year								MDOT
Clean and maintain storm inlets and catch basins (MDOT)	Removes sediment. May prevent local flooding.	Solids, sediments	Moderate	Stormwater runoff		1 - 3 years	High	$21/acre/year	Low/moderate	Widely applicable to drainage area			Moderate/high	General fund, KCRC road maintenance budget - $250,000		East Grand Rapids, KCRC contracts out to Plummer's Environmental, MDOT
Snow and ice control operations	Removes snow and ice before it requires ice control operations (MDOT).	Salts	High	Snow melt runoff	Training of road maintenance crew		Calibration of equipment		Moderate, all KCRC equipment operators are trained.	Need ROW for snow removal	Snow storage may damage vegetation and possible soil erosion	Piled snow melts at a slower rate	Low	KCRC winter maintenance budget - $3.5 million	KCRC maintains State trunk lines for Michigan Department of Transportation (MDOT), primary, local and gravel roads within Kent County. Subdivisions and Platted areas contracted out.	KCRC, MDOT
Calibrated Salt Delivery		Salts	Low	Over application of salt	Training of road crew		Annual training and calibration		Minimal	Applicable to all municipalities	Calibration does not guarantee efficient application of road salt		Low			Wyoming, KCRC
Pre wet road salt				Road salt	Environmentally friendly "Ice Ban"		Low		Minimal				Low/Moderate	General fund		East Grand Rapids
Snow removal storage on grassy areas		Sediment, metals, hydrocarbons, salt	Low	Snow melt runoff			Low		Minimal	Applicable to all municipalities	Snow storage may damage vegetation and possible soil erosion		Low	General fund	Need large grassed area adjacent to buildings and parking areas	City of Grandville
Minimizing effects from road deicing (MDOT)																MDOT
Clean and inspect debris basin (MDOT)	Flood control, proper drainage and preventing flooding.							$21/acre/year								
Recycling Program (MDOT)	Reduction in potential clogging and harmful discharge.							$1.15/person/year					$200,000/year			

URBAN MANAGERIAL BEST MANAGEMENT PRACTICES

BEST MANAGEMENT PRACTICES	BENEFIT	POLLUTANT ADDRESSED	POLLUTANT REMOVAL RELIABILITY	POTENTIAL SOURCES OF POLLUTANTS	ADDITIONAL BMPS TO COMPLETE TREATMENT TRAIN	EXPECTED LIFE SPAN	MAINTENANCE REQUIREMENTS	O&M COSTS	TRAINING REQUIREMENTS	APPLICABILITY TO SITE	ENVIRONMENTAL CONCERNS	HYDROLOGIC EFFECTS TO CONSIDER	COMPARATIVE COSTS	FUNDING SOURCES	SPECIAL CONSIDERATIONS	COMMUNITIES USING BMP
Used oil recycling program (MDOT)	Reduces risk of surface water and groundwater contamination.										Oil may easily become contaminated during collection making it a hazardous waste.		$79 - $179 recovery charge			MDOT
Annual Road/Crossing Inspections		Sediment	Moderate	Erosion of streambank	Training and road crossing improvements		Moderate		Low/moderate				Moderate	Assessment		Coopersville
Operation and maintenance programs																
BMP Inspection and Maintenance Plan (MDOT)	A regular inspection and maintenance program will maintain the effectiveness and structural integrity of the BMPs.												$150-$9,000 depending on the BMP.		Materials needed for emergency structural repairs may not be easily obtainable and may require stockpiling (MDOT)	MDOT
Source Control Practices																
Establish stream buffer ordinance		Thermal pollution	Moderate to high	Runoff from parking lots and roof tops and outflow from ponds		50+ years	Low		Moderate to High	Widely applicable	Lack of maintenance can increase erosion if trees fall into streams	Trees in floodplain can impede flow	Moderate to high		At a minimum, keep south and west sides of streams wooded to provide shade	
Promote urban forestry																
Onsite impervious surfaces																
Green Parking (MDOT)	Promotes infiltration and filtering of storm water.												High		This BMP is experimental for MDOT until proven valuable and cost effective	MDOT
Residential impervious surfaces							High			Experimental						
Rain gardens																
Low Impact Design practices - bioretention, dry wells, filter strips, vegetated buffers, grass swales, rain barrels, cisterns, infiltration trenches																
Education and Training Practices																
Public Education (MDOT)	Can reduce improper disposal of hazardous waste.							$257,000/year					$200,000/year			
Grounds maintenance training		Nutrients and organic sediment	Moderate	Leaf litter, grass clippings, fertilizer, and pesticides			Annual		Low	Highly			Low	General fund		Cascade Township, City of Grandville, City of Grand Rapids
Employee Training (MDOT)	Low cost and easy to implement storm water management BMPs.															MDOT
Lawn, garden, and landscape activities																

URBAN MANAGERIAL BEST MANAGEMENT PRACTICES

BEST MANAGEMENT PRACTICES	BENEFIT	POLLUTANT ADDRESSED	POLLUTANT REMOVAL RELIABILITY	POTENTIAL SOURCES OF POLLUTANTS	ADDITIONAL BMPS TO COMPLETE TREATMENT TRAIN	EXPECTED LIFE SPAN	MAINTENANCE REQUIREMENTS	O&M COSTS	TRAINING REQUIREMENTS	APPLICABILITY TO SITE	ENVIRONMENTAL CONCERNS	HYDROLOGIC EFFECTS TO CONSIDER	COMPARATIVE COSTS	FUNDING SOURCES	SPECIAL CONSIDERATIONS	COMMUNITIES USING BMP
Storm Drain Stenciling	Educates the general public that the storm drain discharges into a natural waterbody.	Hazardous waste and nutrients	Moderate	Household hazardous waste, motor oil, and yard waste	Hazardous waste collection, yard waste collection	Short	Paint will wear from weather in a short period of time. Decals may need to be replaced if vandalized or improperly installed.		Minimal	Residential	Volunteers need to take care with paint around storm drains. Permanent castings may be more effective.		$0.45/inch - Mylar stencils $5-$6 each - ceramic tiles $100 or more - metal stencils	Private donations and grants	Public education campaign is also needed for effective reduction in illegal dumping.	East Grand Rapids, MDOT, Spring Lake Lake Board
Preservation and Conservation Practices																
Native Plantings		Pesticides, nutrients	Moderate	Fertilizers, pesticides, lawn waste	Training of road and grounds maintenance crew		Low		Moderate	Increase in animal/car collision			Low	General fund		City of Grand Rapids
Tree and natural resource preservation ordinances																
Non-regulatory wetland protection techniques																
Land donations	Most direct and cost-effective method of protecting wetlands.															
Conservation Easements	Voluntary agreement that is used to transfer certain rights to another party.															
Deed restrictions and Covenants	Clauses placed in deeds restricting future use of land.															
Purchase	Politically attractive, but expensive method of protecting wetlands.															
Eminent domain	Power of federal, state, or local municipal government to take private property for public use.															
Tax incentives	tax reductions for short-term wetland "easements" to encourage landowners to protect wetlands.															
Private landowner subsidies	Programs that pay landowners to protect wetlands.															
Designing development to protect wetlands																
Open space development																
Cluster development																

Appendix 6.4 - Structural Best Management Practice Worksheet

Worksheet for Evaluating Urban Best Management Measures
Urban Subcommittee
Lower Grand River Watershed

		Downtown	Residential	Residential	Residential	Industrial	Commercial	Residential	Open Space
	Recommended Management Measures	85% impervious	3 - 5 feet of grass between road and sidewalk	10 - 12 feet of grass between road and sidewalk	Vacant grassed lot	Vacant paved lot	Paved parking lot	Large lots, rural, private condominiums	Farmland, idle
1	Catch Basin Inlet Devices - temporary and permanent								
2	Trees (appropriate tree species and size for each site)								
3	Infiltration Trench			Private					
4	Porous Pavement (Parking lots or sidewalks)								
5	Infiltration Pond								
6	Bioretention (Rain Gardens)								
7	Vegetated Swale						with rain gardens		
8	Ponded Type Detention Basin								
9	Dry Pond (Detention Basin)								
10	Hydrodynamic Separator Units (CDS Units, Stormceptor, Vortechs, Downstream Defender)								
11	Regional Detention Pond (high water quality) - Regional Storm Water Management (basin, wetland, sediment basin)								
12	Daylighting								
13	Constructed Wetland								
14	Permanent Sediment Basin								
15	Check dams, grade control structures								
16	Wooded buffers								
17	Street Maintenance and Street Cleaning								
18	Green Roofs								
19	Sand Filters								

Appendix 6.5 - Structural Best Management Practice Nonpoint Source Removal Efficiency

Urban Subcommittee
Lower Grand River Watershed

		Pollutant Removal Efficiencies					
	Recommended Management Measures	Total Phosphours	Total Nitrogen	Total Suspended Solids (TSS)	Metals	Bacteria	Oil and Grease
1	Catch Basin Inlet Devices - temporary and permanent		30% - 40% sand filters	30% - 90%			
2	Trees (appropriate tree species and size for each site)						
3	Infiltration Trench	50%- 100%	43% - 100%	50% - 100%			
4	Porous Pavement (Parking lots or sidewalks)						
5	Infiltration Pond	60% - 100%	50% - 100%	50% - 100%	85% - 90%	90%	
6	Bioretention (Rain Gardens)	65% - 98%	49%	81%	51%-71%		
7	Vegetated Swale	15% - 77%	15% - 45%	65% - 95%	14% - 71%	(-50%) - (-25%)	with rain gardens
8	Ponded Type Detention Basin	48% - 90%	31% - 90%	29% - 73%	38% - 100%	66%	
9	Dry Pond (Detention Basin)						
10	Hydrodynamic Separator Units (CDS Units, Stormceptor, Vortechs, Downstream Defender)						
11	Regional Detention Pond (high water quality) - Regional Storm Water Management (basin, wetland, sediment basin)						
12	Daylighting						
13	Constructed Wetland	39% - 83%	56%	69%	(-80%) - 63%	76%	
14	Permanent Sediment Basin			65%			
15	Check dams, grade control structures						
16	Wooded buffers	23% - 42%	85%				
17	Street Maintenance and Street Cleaning						
18	Green Roofs	70% - 100% reduction in runoff, 40% - 50% of winter rainfall, 60% temperature reduction					
19	Sand Filters	41% - 84%	22% - 54%	63% - 109%	26% - 100%	(-23%) - 98%	

Appendix 6.6 - Managerial Best Management Practice Worksheet

Worksheet for Evaluating Managerial Best Management Practices
Urban Subcommittee
Lower Grand River Watershed

MANAGERIAL BEST MANAGEMENT PRACTICES	Downtown 85% impervious	Residential High to medium density	Residential Low density to open space	Industrial Vacant paved lot	Commercial Paved parking lot	Subcommittee Priorities
Pollution Prevention						
Planning and zoning						
SESC plans	During development					
Encourage stream protection when siting developments						
Site planning						
Green space protection - preserving environmentally sensitive and open areas						
Emergency Spill Response and Prevention Plan						
Identify and prohibit illegal or illicit discharges to storm drains (MDOT)						
Litter control (MDOT)						
"No Littering" Ordinance (MDOT)						
Fertilizer Ordinance - fertilizers containing more than 1% by weight of anhydric phosphoric acid are NOT allowed in the Reeds Lake Watershed						
Material Management Plan (MDOT)						
Household hazardous waste management						
Composting						
Yard waste collection and disposal						
Pesticide management for turf grass and ornamentals						
Lawn maintenance						
Fertilizer management						
Pet waste disposal						
Street Sweeping						

Appendix 6.6 - Managerial Best Management Practice Worksheet

MANAGERIAL BEST MANAGEMENT PRACTICES	Downtown 85% impervious	Residential High to medium density	Residential Low density to open space	Industrial Vacant paved lot	Commercial Paved parking lot	Subcommittee Priorities
Clean and maintain storm drain channels (MDOT)						
Clean and maintain storm inlets and catch basins (MDOT)						
Snow and ice control operations						
Calibrated salt delivery						
Pre wet road salt						
Snow removal storage on grassy areas						
Minimizing effects from road deicing (MDOT)						
Clean and inspect debris basin (MDOT)						
Recycling program (MDOT)						
Used oil recycling program (MDOT)						
Annual road/crossing inspections						
BMP Inspection and Maintenance Plan (MDOT)						
Source Control Practices						
Establish stream buffer ordinance						
Promote urban forestry						
Onsite pervious surfaces						
Green parking (MDOT)						
Residential pervious surfaces						
Rain gardens						

Appendix 6.6 - Managerial Best Management Practice Worksheet

MANAGERIAL BEST MANAGEMENT PRACTICES	Downtown 85% impervious	Residential High to medium density	Residential Low density to open space	Industrial Vacant paved lot	Commercial Paved parking lot	Subcommittee Priorities
Low Impact Design practices - bioretention, dry wells, filter strips, vegetated buffers, grass swales, rain barrels, cisterns, infiltration trenches						
Education and Training Practices						
Public 3education (MDOT)						
Grounds maintenance training						
Employee training (MDOT)						
Lawn, garden, and landscape activities						
Storm drain stenciling						
Preservation and Conservation Practices						
Native plantings						
Tree and natural resource preservation ordinances						
Non-regulatory wetland protection techniques						
Land donations						
Conservation easements						
Deed restrictions and covenants						
Purchase						
Eminent domain						
Tax incentives						
Private landowner subsidies						
Designing development to protect wetlands						
Open space development						
Cluster development						

Appendix 9.1 - Target Audience Profiles

Target Audience: Urban Pilot Project Areas

1. What is the makeup of the target audience?
   b. Average Age Varied Families
   c. Gender M & F
   d. Place of Residents (home or apartment, any unique characteristics) Population : 474,296 ; Owner Occupied Housing Units: 118,816; Renter Occupied Housing Units: 59,173
   e. Level of Education: 87.67% have high school education or higher
   f. Level of Income: median family income $60,619.00
   - Other pertinent facts: 39.05% of families have children under 18

2. How do they communicate with each other? Grand Rapids Press, Grand Rapids Times, Grand Rapids Business Update, Paper, On-The-Town Magazine, Community Voice, Ottawa Press, West Michigan Christian Newspaper, Associated Press, Michigan Outdoor News, Catholic Connector, The Holland Sentinel. West Michigan Today, Alive, mlive, Bulletin Boards, Church newsletters, Restaurants

3. How do they receive information on environmental issues? Mass Media and possibly through organizations active in the area.

4. Of what other community organizations are they members? Timberland Resource Conservation & Development Area Council, American Legion, Girl Scouts of Michigan Trails, Boy Scouts of America, UAW-United Automobile, Aerospace & Agricultural Implement Workers of America, Rotary Club of Grand Rapids, Kent County Conservation League, Kent County Farm Bureau, Marne Conservation Club, Land Conservancy of West Michigan, West Michigan Alive, The Nature Conservancy, Isaac Walton League, Trout Unlimited, Ducks Unlimited

5. What are their major environmental concerns:

Urban Pilot Project Area

General Demographic Profile

Using Demographic Profile 1 (DP-1) Profile of Genera Characteristics:2000
DP-2 Profile of Selected Social Characteristics: 2000
DP-3 Profile of Selected Economic Characteristics: 200
Geographic Comparison Table-Population Housing (GCT-PHI) Population, Housing, Area, and Density: 2000

Using the United States Census Bureau, American FactFinder,
www.factfinder.census.gov

Information was collected from above sources for the following Minor Civil Divisions (MCD): Alpine Township, Kent County; Byron, Kent County; Dorr, East Grand Rapids, Kent County; Gaines, Kent County; City of Grand Rapids, Kent County; Grand Rapids Charter, Kent County; City of Grandville, Kent County; City of Kentwood, Kent County; Leighton, Allegan; Plainfield, Kent County; Tallmadge, Ottawa County; City of Walker, Kent County; City of Wyoming, Kent County;

- Total Population: 474,296
- Female Population: 241,560
- Male Population: 232,736
- Average Water Area/square mile/MCD: 0.33
- Total Water Area/square mile: 4.67
- Average Population Density/square mile of land use/ MCD: 1,419
- Average Housing Unit Density/square mile of land use/MCD: 553
- Number of Owner Occupied Housing Units: 118,816
- Number of Renter Occupied Housing Units: 59,173
- Median Household Income/MCD: $52,630.21
- Median Family Income/MCD: $60,619.00
- Average % of Families with Children under 18/MCD: 39.05%
- Average % Have high school education or up/MCD: 87.67%
- Average % have BA or higher/MCD: 25.84%
- Average % have only high school: 30.30%

Target Audience Profile

Target Audience: Agricultural Community

1. What is the makeup of the target audience (answer if appropriate) ?
   a. Average Age N/A
   b. Gender N/A
   c. Place of Residents (home or apartment, any unique characteristics) Homes in watershed
   d. Level of Education: N/A
   e. Level of Income: refer to following table
   f. Other pertinent facts: Major crops for Kent County are corn, oats, and soybeans

2. How do they communicate with each other? Michigan State University Extension, Farm Bureau, Natural Resource Conservation District, Natural Resource Conservation Service, Internet, 4-H fairs

3. How do they receive information on environmental issues? Mass Media, local publications, small group discussions.

4. Of what other community organizations are they members? Churches, sporting clubs

5. What are their major environmental concerns: Flooding, water storage, dredging of drains (sedimentation)

Target Audience Profile

Target Audience: Agricultural Community, Extra Information

Agricultural Census Information for Kent County, Michigan			
	1997	1992	1987
Farms (number)	1,136	1,190	1,368
Land in farms (acres)	186,453	190,706	203,842
Land in farms - average size of farm (acres)	164	160	149
Land in farms - median size of farm (acres)	63	(N)	(N)
Estimated market value of land and buildings@1: average per farm (dollars)	453,387	301,712	202,820
Estimated market value of land and buildings@1: average per acre (dollars)	2,686	1,832	1,274
Estimated market value of all machinery/equipment@1:aver per farm (dollars)	74,189	59,263	42,890
Farms by size: 1 to 9 acres	97	97	126
Farms by size: 10 to 49 acres	383	347	430
Farms by size: 50 to 179 acres	399	470	489
Farms by size: 180 to 499 acres	178	196	234
Farms by size: 500 to 999 acres	45	52	62
Farms by size: 1,000 acres or more	34	28	27
Total cropland (farms)	1,043	1,113	1,268
Total cropland (acres)	149,898	154,552	163,275
Total cropland, harvested cropland (farms)	934	1,046	1,175
Total cropland, harvested cropland (acres)	127,476	119,403	121,233
Irrigated land (farms)	128	164	144
Irrigated land (acres)	6,120	9,030	7,445
Market value of agricultural products sold ($1,000)	121,041	105,990	82,983
Market value of agricultural products sold, average per farm (dollars)	106,550	89,067	60,660
Market value of ag prod sold - crops, incl nursery and greenhouse crops ($1,000)	91,987	73,688	50,383
Market value of ag products sold - livestock, poultry, and their products ($1,000)	29,054	32,302	32,600
Farms by value of sales: Less than $2,500	309	325	397
Farms by value of sales: $2,500 to $4,999	152	139	163
Farms by value of sales: $5,000 to $9,999	127	157	196
Farms by value of sales: $10,000 to $24,999	158	161	188
Farms by value of sales: $25,000 to $49,999	87	99	105
Farms by value of sales: $50,000 to $99,999	89	96	108
Farms by value of sales: $100,000 or more	214	213	211
Total farm production expenses@1 ($1,000)	93,300	88,084	66,289
Total farm production expenses@1, average per farm (dollars)	82,131	74,082	48,421
Net cash return from agricultural sales for the farm unit (see text)@1 (farms)	1,136	1,189	1,369
Net cash return from agricultural sales for the farm unit (see text)@1 ($1,000)	27,844	19,863	16,075
Net cash return from ag sales for fm unit (see text)@1, average per farm (dollars)	24,510	16,705	11,742

Operators by principal occupation: Farming	487	536	625
Operators by principal occupation: Other	649	654	743
Operators by days worked off farm: Any	667	701	809
Operators by days worked off farm: 200 days or more	501	531	610
Livestock and poultry: Cattle and calves inventory (farms)	356	431	531
Livestock and poultry: Cattle and calves inventory (number)	27,633	32,184	34,672
Beef cows (farms)	189	184	227
Beef cows (number)	2,769	2,327	3,286
Milk cows (farms)	93	148	173
Milk cows (number)	9,097	11,218	12,343
Cattle and calves sold (farms)	336	391	519
Cattle and calves sold (number)	11,272	13,420	17,002
Hogs and pigs inventory (farms)	52	88	108
Hogs and pigs inventory (number)	7,949	14,203	17,065
Hogs and pigs sold (farms)	49	89	112
Hogs and pigs sold (number)	14,364	26,356	27,198
Sheep and lambs inventory (farms)	27	27	37
Sheep and lambs inventory (number)	523	1,282	949
Layers and pullets 13 weeks old and older inventory (see text) (farms)	32	45	62
Layers and pullets 13 weeks old and older inventory (see text) (number)	976	(D)	2,795
Broilers and other meat-type chickens sold (farms)	5	11	10
Broilers and other meat-type chickens sold (number)	283	782	880
Corn for grain or seed (farms)	373	404	596
Corn for grain or seed (acres)	42,188	39,798	39,847
Corn for grain or seed (bushels)	4,550,863	3,271,022	3,684,369
Wheat for grain (farms)	155	206	205
Wheat for grain (acres)	6,918	7,744	5,565
Wheat for grain (bushels)	361,368	318,398	243,064
Soybeans for beans (farms)	123	85	38
Soybeans for beans (acres)	14,120	5,743	2,520
Soybeans for beans (bushels)	526,560	163,833	91,803
Dry edible beans, excluding dry limas (farms)	17	18	9
Dry edible beans, excluding dry limas (acres)	2,876	2,243	1,346
Dry edible beans, excluding dry limas (hundredweight)	50,270	32,961	19,108
Hay-alfalfa, other tame, small grain, wild grass silage, green chop, etc(see txt)(farms)	553	634	757
Hay-alfalfa, other tame, small grain, wild grass, silage, green chop, etc(see txt)(acres)	30,713	34,196	39,950
Hay-alfalfa, other tame, small grain, wild grass, silage, green chop, etc(see txt)(tons, dry)	78,350	89,707	109,579
Vegetables harvested for sale (see text) (farms)	80	114	118
Vegetables harvested for sale (see text) (acres)	3,747	4,507	4,311
Land in orchards (farms)	184	236	257
Land in orchards (acres)	15,143	16,988	16,332

(D) Withheld to avoid disclosing data for individual farms.
(N) Not available.

Data From: “Census of Agriculture: 1987, 1992, 1997.” GovStats. Oregon State University Libraries. Updated: February 28, 2002. Retrieved: November 23, 2003. <http://govinfo.kerr.orst.edu/php/agri/show2.php>

Target Audience Profile

Target Audience: Business Owners

1. What is the makeup of the target audience (answer if appropriate)?
   a. Average Age: Adult
   b. Gender M/F
   c. Place of Residents (home or apartment, any unique characteristics)
      Most residing in Grand River Watershed, if not Buck Creek
   d. Level of Education: Varied
   e. Level of Income: Varied
   f. Other pertinent facts: Is very urban area with numerous types of businesses

2. How do they communicate with each other? Trade newsletters, magazines, conferences, day to day business operations.

3. How do they receive information on environmental issues? Regulations on industrial processes and waste disposal, as well as through mass media.

4. Of what other community organizations are they members?

5. What are their major environmental concerns: Sustainable business practices.

Target Audience Profile

Target Audience: Builders and Developers

1. What is the makeup of the target audience (answer if appropriate) ?
   a. Average Age N/A
   b. Gender Majority is Male
   c. Place of Residents (home or apartment, any unique characteristics) Focused on Ottawa and Kent County, not townships
   d. Level of Education: Specialized on building tasks, not overly scientific technical information.
   e. Level of Income: varies by number of projects and size of company
   f. Other pertinent facts: Group does better with hands on items that can be used at work site rather than with products or meetings that take them away from projects.

2. How do they communicate with each other? Newsletters, workshops, educational programs supplied by Home Builders Association

3. How do they receive information on environmental issues? Regulations governing construction activities, classes required to obtain permits, newsletters, and mass media.

4. Of what other community organizations are they members? Home Builders Association

5. What are their major environmental concerns: Depends on builder, a lot of emphasis is put on erosion and sediment controls, will want environmental practices that help to sell homes, atheistically, practically, and financially.

Information from Home Builders Association, phone interview with Mr. Chris Hall, November 24, 2003

Target Audience Profile

Target Audience: Homeowners

1. What is the makeup of the target audience (answer if appropriate) ?
   b. Average Age Varied
   c. Gender M/F
   d. Place of Residents (home or apartment, any unique characteristics)
      Owner Occupied Housing Units: 118,816
   e. Level of Education: 87.67% high school diploma or more
   f. Level of Income: Household median income, $52,630
   g. Other pertinent facts: can get possible riparian homeowner listing from Grand Valley REGIS program

2. How do they communicate with each other? Through mass media, Advance is the local newspaper, attending children's' school events, church events, one on one

3. How do they receive information on environmental issues? Flyers, newspaper, radio, television, home improvement stores.

4. Of what other community organizations are they members? Homeowners associations, schools, churches, etc.

5. What are their major environmental concerns: Value of homes, safeness of area for family.

Data from same source as urban residents.

Target Audience Profile

Target Audience: Locally Elected Bodies

1. What is the makeup of the target audience (answer if appropriate)?
    a. Average Age 30+
    b. Gender M/F
    c. Place of Residents (home or apartment, any unique characteristics) Generally residing in watershed or close to watershed, many living in own homes
    d. Level of Education: High school and up
    e. Level of Income: varied
    f. Other pertinent facts: Have townships of Alpine, Chester, Tallmadge, and Wright, and City of Walker involved, along with Ottawa County Commissioners

2. How do they communicate with each other? Board meetings, planning meetings, day to day operations. Also, often being friends and neighbors of the same community, there are ample opportunities to communicate at local venues such as church and school functions as well as local socially oriented businesses such as restaurants or entertainment spots.

3. How do they receive information on environmental issues? Since many locally elected officials have "day jobs" it depends on their other associations. Many are involved in occupations where they may receive information on such issues from sources slanted to a point of view, depending upon the occupation. Also, information on a specific issue upon which they are deliberating may well be supplied by applicants or professionals hired to inform them on specific aspects of such an issue as part of the legislative or administrative review. Information may also be found in publications associated with membership organizations such as those cited below.

4. Of what other community organizations are they members? Grand Valley Metro Council, Michigan Township Association, Michigan Municipal League, Michigan Association of Counties, local chapters of some of these organizations as well as national counterparts organizations, though these are not as active. There may also be memberships associated with smaller geographical levels such as neighborhood associations, business associations and other special purpose organizations such as watershed groups or multi-jurisdictional discussion groups. Other important groups are based more on profession such as Michigan Local Government Managers Association, and ICMA.

5. What are their major environmental concerns? Accomplishing the decisions of their constituents, to implement cost effective measures, meet regulated standards for stormwater. To ensure appropriate levels of development and redevelopment occurs without causing health and safety concerns for local residents, businesses and other constituents. Getting their jobs done on a daily basis without doing great and obvious harm to major environmental assets.

Information is from Andy Bowman, Grand Valley Metro Council, on November 26, 2003.

Target Audience Profile

Target Audience: Municipal Employees

1. What is the makeup of the target audience (answer if appropriate)?
   a. Average Age Varied
   b. Gender M/F
   c. Place of Residents (home or apartment, any unique characteristics)
      In Grand River Watershed, if not Buck Creek
   d. Level of Education: Varied
   e. Level of Income: Varied
   f. Other pertinent facts: Pay special attention to departments that deal with streets and highways, water transport, water supply at both the County and City level.

2. How do they communicate with each other? Staff meetings, telephone, email, training seminars, day to day operations, websites.

3. How do they receive information on environmental issues? Regulations, policies, mass media, and through training.

4. Of what other community organizations are they members? Varies

5. What are their major environmental concerns: Safe workplace, cost effective control measures, within mandated levels for pollutants.