st. joseph river watershed management plan

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project mission and vision statements

vision

The St. Joseph River Watershed will be an exceptional natural resource that provides for economic, agricultural, residential, and recreational needs in a balanced, sustainable way.

mission

Unite a diverse group of stakeholders throughout the watershed in a collaborative effort to protect, restore, and foster stewardship of the St. Joseph River Watershed as a critical component of the Great Lakes Basin.

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description of watershed

location and size

The St. Joseph River Watershed (Hydrologic Unit Code 04050001), located in the southwest portion of the lower peninsula of Michigan and northwestern portion of Indiana, is the third largest river basin in Michigan. Beginning in Michigan's Hillsdale County at Baw Beese Lake, it spans the Michigan-Indiana border and empties into Lake Michigan at St. Joseph, Michigan (Figure 1). The watershed drains 4,685 square miles from 15 counties: Berrien, Branch, Calhoun, Cass, Hillsdale, Kalamazoo, St. Joseph and Van Buren in Michigan and De Kalb, Elkhart, Kosciusko, Lagrange, Noble, St. Joseph and Steuben in Indiana. The main stem is 210 miles long. The watershed includes 3,742 river miles and flows through and near the Kalamazoo-Portage, Elkhart-Goshen, South Bend-Mishawaka, and St. Joseph/Benton Harbor metropolitan areas (Figure 2). Major tributaries include the Prairie, Pigeon, Fawn, Portage, Coldwater, Elkhart, Dowagiac, and Paw Paw rivers and Nottawa Creek. According to the Michigan Center for Geographic Information and the US Geological Survey, the St. Joseph River Watershed is comprised of 217 subwatershed units (Figure 3 & Table A), each with their own hydrological unit code, or HUC. However, such a fine scale delineation may prove confusing for the lay person, so these 217 subwatersheds have also been grouped to create more easily identifiable areas that mirror the boundaries of larger tributaries and the main stem (Figure 4).

land use and natural history

Before European settlement, the watershed consisted of tall, mostly deciduous forests dominated by maple, ash, oak, elm, walnut, and beech species. Pockets of white, red, and jack pine were also present. These large tracts of forest were interrupted by streams, lakes, wetlands, and prairies (Figure 5). The landscape supported a great diversity of fish and wildlife. Because they were easily cultivated and often grazed by elk, deer, moose, and bison, the area's prairies, some of which were several miles across, were the first lands to be significantly altered by human activity; both Native Americans and European settlers located their villages near them. Later, as the prairies disappeared, wetlands and forests were, with varying degrees of success, also converted to agricultural use. The vast majority of original forests were logged by 1900 to be used in construction or, in the case of many native hardwoods, the manufacture of fine furniture. Dams were constructed along the St. Joseph River and its tributaries to supply power for saw and grain mills and later to generate electric power for industry and the public.

Today, the watershed is still predominantly agricultural, though the technology and methods have changed. Approximately 70 percent of the land is used for crop and animal production, while 17 percent remains forested, and roughly 6 percent is wetlands. A significant remaining portion of the watershed is comprised of residential and commercial uses, particularly along the main stem (Figure 6). The watershed also has an abundance of inland lakes, which are, to varying degrees, increasingly impacted by development. Agriculture has the most significant impact on surface waters in the basin. However, residential and commercial uses, while proportionately much smaller, contribute greatly to the nonpoint source pollution as well. In the future, it is likely that these developing areas will have ever increasing impacts on water quality since agricultural land as a percentage of the total is slowly declining as traditional working lands get converted to residential, commercial, and industrial uses (see Critical Areas section). These two predominant land uses and all their attendant problematic impacts continue to converge, especially in the western half of the watershed. Despite land use planning legislation aimed at fostering sustainable growth and a growing recognition of the importance of protecting agricultural lands, the next decades will most likely see a continuation of the trend toward urban/suburban sprawl as populations around the watershed's metropolitan areas continue to increase and migrate into historically rural areas, bringing with them an additional set of water resource management challenges.

Of course, the St. Joseph River is also used extensively for recreation. Fish ladders built between 1975 and 1992 allow salmon, steelhead, and trout to ascend the river from Lake Michigan to spawn in coldwater tributaries like McCoy Creek. Canoeists can travel the entire length of the main stem, if they are prepared to portage, and many of the larger tributaries offer excellent opportunities for paddling, hiking, hunting, and fishing.

Among the unique natural features that remain in the watershed are prairie fens, coastal plain marshes, bogs, floodplain forests, hardwood swamps, and moist hardwood forests. Wetlands and floodplain forests provide habitat to nearly half of all migratory birds in Indiana and Michigan and are a vital habitat for resident species as well, such as wild turkey, coyote, fox, beaver, mink, Indiana bat, eastern box turtle, prairie dropseed, rosinweed, tall beak rush, umbrella grass, and the rare spotted turtle and red bellied snake, both protected by the State of Michigan. The lower Pigeon River is home to the federally endangered Indiana Bat. The Tamarack Bog Nature Preserve, adjacent to the Pigeon River Fish and Wildlife Area, is a National Natural Landmark; this National Park Service program recognizes and encourages the conservation of outstanding examples of our country's natural history. More than 40 threatened or endangered plant species are associated with coastal plain marshes in the watershed. These areas also provide benefits which go beyond the scope of fish and wildlife habitat and have a direct impact on human communities, including floodwater storage, water filtration, and groundwater recharge. Only a small fraction of these resources are protected or managed; the vast majority of land in the watershed is privately owned.

The Michigan Natural Features Inventory and Indiana Natural Heritage maintain a list of endangered, threatened, and otherwise significant plant and animal species, plant communities, and other natural features. Information is also available from the Michigan and Indiana Departments of Natural Resources (MDNR and IDNR) and the U.S. Fish and Wildlife Service (USFWS). Comprehensive lists of invasive exotic animal and plant species are available from Michigan State University and Purdue University Extension Offices (MSU-E and PU-E) and from organizations like the Nature Conservancy, the Indiana Native Plant Society, Wild Ones, and Natural Landscapers.

population

According to the 2000 U.S. Census, approximately 1.5 million people live in the 15 counties of the watershed, with 53.6 percent living in Michigan. The most populated county is St. Joseph, Ind. In 2002 the county was home to 267,120 people, over half of whom live in the greater South Bend/Mishawaka area. Berrien (Mich.), Elkhart (Ind.), Van Buren (Mich.), and St. Joseph (Mich.) counties also have sizable populations, but only Berrien and Elkhart counties have more than 100,000 people residing in them. Kalamazoo County (Mich.), is home to over 240,000 people; however only a very small portion of that is within the watershed. Outside the large metropolitan areas the population of the watershed is mainly clustered around smaller river and farm towns such as Three Rivers, Vicksburg, Sturgis, Niles, Paw Paw, and Hillsdale in Michigan, and LaGrange, Kendallville, Goshen, and Angola in Indiana. The U.S. Census Bureau anticipates the fastest growth between now and 2020 to occur in the western portion of the watershed.

geology, topography and hydrology

The landforms of southwest Michigan and northern Indiana are largely a result of the activities of the extensive glaciers of the Pleistocene period (from about 2 million years ago until 10,000 years ago). There were several stages of ice advance and retreat during that time, but it was the most recent ice advances during the Wisconsin stage that by and large sculpted the current St. Joseph River Valley. It caused major changes in the size and direction of the St. Joseph River (which had previously headed south near South Bend and into a confluence with the Kankakee River and eventually the Mississippi), and left behind a landscape dominated by moraines, till plains, and outwash plains and the heterogeneous grab bag of soils that overlay the shale and sandstone bedrock of the basin. As you may expect, the highest points in the watershed are clustered near the river's headwaters, where end moraine elevations exceed 550 feet above Lake Michigan (Figure 7). The well drained soils and high head pressure of the end moraines in eastern Hillsdale County contribute impressive amounts of water to the swales, lakes and wetlands that give life to the St. Joseph as well as four other major rivers flowing into Lake Michigan and Lake Eerie: the St. Joseph of the Maumee, the Kalamazoo, the Grand, and the Raisin. The dominance of sand, silt, and gravel in surficial material throughout the basin keeps groundwater yields high, which in turn helps stabilize temperature and flow in the tributaries and main stem (Figures 8 and 9). However, these soils also are prone to high rates of erosion, and sedimentation is a major concern throughout this highly agricultural basin. There are some predominantly clay soils present as well, but they occur in isolated pockets scattered throughout the watershed.

This abundance of groundwater allows nearly 100 percent of people in the basin to use it as their source of drinking water (St. Joseph and Benton Harbor make surface water withdrawals from Lake Michigan). Hundreds of millions of gallons of groundwater are withdrawn each day for drinking, agriculture, and industry. Communities in the basin are fortunate to have an abundance of groundwater that can be easily extracted for a variety of uses. The sand and gravel aquifers that allow for this ease also provide the perfect conduit for contaminants to reach the water source. (The St. Joseph aquifer system underlying much of St. Joseph and Elkhart counties is the only sole-source aquifer in Indiana. A sole-source aquifer is one that supplies 50 percent or more of the drinking water for an area and for which there are no reasonably available alternative sources should it become contaminated.) Leaks from solid waste management facilities and underground storage tanks, industrial spills, and improperly designed or maintained wastewater treatment facilities represent the major point sources for contamination, but a plethora of nonpoint sources also exist that can contaminate aquifers and surface waters that re-charge them — everything from leaking automobiles to pesticides to failing septic systems. Hundreds of contamination sites have been identified by MDEQ and IDEM. In addition, the U.S. Environmental Protection Agency (USEPA) has listed 54 sites under its Superfund program.

There are 190 dams in the St. Joseph River watershed registered with MDEQ and IDNR, 17 of which are located on the main stem (Figure 10). The majority of these dams are classified according to their purpose: 29 for hydroelectric power generation (11 retired), five for irrigation, 105 for recreation, nine for flood control, four for water supply, and 19 for miscellaneous reasons (private ponds, public ponds, hatchery ponds, etc.). Many additional small dams are suspected to exist but are not registered. Dams, channelization, culverts, drains, and other alterations made to the river system to benefit human communities can produce drastic, detrimental changes to aquatic and riparian communities by disrupting natural flooding cycles (which help control the distribution of sediments and nutrients), by altering flow rates, temperatures, chemistry, and water levels, or by simply destroying habitat entirely, as in the case of wetlands that are drained to be used as farm land or hydroelectric dams that create insurmountable barriers for spawning fish species.

Luckily, as our understanding and appreciation of the priceless benefits of natural systems grows, we can begin to effect positive changes by developing best management practices that are sustainable and balance human needs with those of the rest of the natural world.

project background and development

In the fall of 2002, the Friends of the St. Joe River, a nonprofit established in 1994 by Athens, Mich. residents Al and Margaret Smith for the purpose of cleaning and restoring the river and its tributaries, was awarded a grant from the Michigan Department of Environmental Quality to develop a Watershed Management Plan for the entire St. Joseph River Watershed. This plan will unite stakeholders in a concerted effort to address water quality issues and natural resource protection across jurisdictional boundaries. Although several Lake Michigan Lakewide Management Plan (LaMP), Lake and River Enhancement Program (LARE), and federally funded Clean Water Act (sections 319 and 205j) projects have been conducted in subwatersheds in both Michigan and Indiana, and the St. Joseph River has been identified by U.S. EPA as the biggest contributor of atrazine to Lake Michigan and a significant contributor of sediments and toxic substances such as mercury and polychlorinated biphenyl (PCB), no comprehensive planning effort for the entire watershed has been conducted. At this time, a number of areas have been added to the 303(d) lists (lists of water bodies that do not meet minimum water quality standards) in Michigan and Indiana and Total Maximum Daily Load (TMDL) parameters are scheduled to be developed to address impairments (see Table A), but only two have an approved TMDL — adjoining sections approximately 32 miles long from the Lake Michigan confluence upstream to the Michigan/Indiana state line south of Niles. These TMDLs address pathogen problems due to combined sewer overflows (CSOs), stormwater discharges, and agricultural inputs. The other impaired waters in the basin have TMDLs scheduled to be developed in 2005 and beyond. The reasonable assurance activities identified in the completed TMDL for the St. Joseph River mentioned above are incorporated into this watershed management plan. Furthermore, many of the strategies and best management practices (BMPs) identified in this plan will make significant impacts on the quality of impaired waters on the 303(d) lists and can be utilized, along with input from agencies and individuals involved in this planning project, in the development of future TMDLs.

The Friends of the St. Joe River, the lead agency, coordinated with other key organizations for watershed plan preparation. This included oversight of the development process for the plan, as well as associated information/education activities, community involvement, and public participation. Kieser and Associates of Kalamazoo, Mich. provided technical services and Web site design and programming for the project. Christina Bauer served as the Michigan Department of Environmental Quality (MDEQ) representative. Nathan Rice served as the Indiana Department of Environmental Management (IDEM) representative. Both provided valuable oversight, assistance, and advice to the Steering Committee, technical consultants, and Watershed Coordinator.

The watershed management plan was developed from November 2002 through June 2005. During the planning phase, technical data on the watershed (i.e. land use, subwatershed boundaries, population, soil types, topography, pesticide use, geological features, flora and fauna) was collected and analyzed in order to identify and prioritize pollutants (their sources and impacts), critical areas for preservation and mitigation, and the management practices that can most effectively achieve the goals determined by the Steering Committee. These data were collected from a variety of sources, such as 303(d) and 305(d) lists, nonpoint source models, subwatershed plans, United States Geological Services (USGS) water quality sampling stations, stakeholder interviews, the Natural Resources Conservation Service (NRCS), the Michigan Center for Geographic Information, and the Lake Michigan Mass Balance Study (visit www.stjoeriver.net for more detailed information on these sources). Technical Support Subcommittee (Steve Blumer, USGS Water Resources Division; Dennis Haskins, NRCS; Todd Kesselring, Elkhart County GIS; Dan List, MSU Extension; Beth Moore, Great Lakes Commission; Jim Coury, Potowatami RC&D; and Chris Bauer, MDEQ) assisted the technical consultants with this process.

All interested stakeholders were encouraged to become part of the watershed management plan development process. An information and education program was planned and conducted by the Watershed Coordinator in close consultation with the Information and Education Subcommittee (Sally Carpenter, MSU Extension; Korie Bachleda, MSU Extension; Chris Bauer, MDEQ; Sarah VanDelfzijl, Rocky River Watershed Coordinator; Fred Edinger, Friends of the St. Joe River Association; and Rutty Adams, Friends of the St. Joe River Association) and involved newsletters, press releases, newspaper articles, a brochure, public meetings, and educational workshops. The Watershed Coordinator also participated in several training programs. In order to identify issues of concern among residents in the watershed, a series of public meetings and educational workshops were held throughout the watershed. Both the public meetings and the educational workshops introduced the watershed project and provided residents with a forum to express their concerns or ask questions.

Date November 5, 2003
Location A Place in Time Banquet Hall, Three Rivers, Mich.
Topic/Speaker(s) Watershed-wide road stream crossing erosion control workshop for road commissioners, drain commissioners and surveyors, highway engineers, transportation planners, etc.

Date February 23, 2004
Location St. Joseph County Conservation Club, Sturgis, Mich.
Topic/Speaker(s) Public meeting with presentations on fish consumption advisories and walleye stocking efforts by representatives from MDEQ and the Colon Area Anglers Association, respectively.

Date	April 21, 2003
Location	Branch County Fairgrounds, Coldwater, Mich.
Topic/Speaker(s)	Hands-on educational workshop for teachers looking for new ways to engage students in water quality studies. Presented by Ray Leising, Water Quality Program Manager for the Friends of the St. Joe River Association.

Date	April 23, 2003
Location	Berrien County ISD, Berrien Springs, Mich.
Topic/Speaker(s)	Hands-on educational workshop for teachers looking for new ways to engage students in water quality studies. Presented by Ray Leising, Water Quality Program Manager for the Friends of the St. Joe River Association.

Date	July 21, 2004
Location	Three Rivers Public Library, Three Rivers, Mich.
Topic/Speaker(s)	Public meeting with informal talk by Jay Wesley, MDNR's Southern Lake Michigan Unit Manager, about the state of fisheries in the St. Joseph River watershed.

Date	July 30, 2004
Location	Elkhart Environmental Center, Elkhart, Ind.
Topic/Speaker(s)	Educational workshop on rain gardens and natural landscaping with presentations by Chris Bauer (MDEQ), Patricia Pennel (Rain Gardens of West Michigan) and Kevin Turgnevick (Spence Nursery).

Date	November 10, 2004
Location	Lawrence, Mich.
Topic/Speaker(s)	Project WET workshop conducted by Janet Vail of the Grand Valley State University Anis Water Resources Institute. Twelve teachers in Paw Paw River Watershed attended the training and also received an update on the MDEQ Environmental Education Curriculum Project. A brief overview of the St. Joseph River Watershed Management Planning Project also was given.

Date	November 17, 2004
Location	Van Buren County ISD, Lawrence, Mich.
Topic/Speaker(s)	Public meeting with presentations by Southwest Michigan Land Conservancy about the Paw Paw River watershed. Event cohosted by Friends of the St. Joe River Association and Southwest Michigan Commission.

The Steering Committee, listed below, met regularly and was instrumental in guiding the project. Consisting of individuals from a variety of backgrounds, the committee provided valuable information on such things as community needs, local geologic and ground water features, and land use issues as well as feedback, evaluation and prioritization of uses, concerns, BMPs, goals, objectives, measurements and other important components of the actual management plan. Representatives from the National Pollution Discharge Elimination System (NPDES) Phase II Storm Water communities of the Lower St. Joseph River and Galien River watersheds participated regularly in Steering Committee meetings and the Watershed Coordinator for the entire St. Joseph River Watershed project regularly attended the Phase II meetings in order that the two overlapping efforts could move forward in concert.

Chris Bauer *Michigan Department of Environmental Quality, Water Bureau*
Barb Cook *MEANDRS*
Jim Coury *Potowatami RC&D*
Chuck Cubbage, PhD *Cubbage Environmental Controls*
Matt Doppke *Michiana Watershed*
Fred Edinger *Friends of the St. Joe River Association*
Joe Foy *Aquatic Biologist, City of Elkhart*
Juan Ganum *City of Niles*
Jon Howard *Fishing Guide*
Deb Knepp *South Bend NRCS*
Ed Kretchman *Farmer*
Karen Mackowiak *St. Joseph River Basin Commission*
Jeffrey Reece *American Electric Power*
Nathan Rice *IDEM, Office of Water Quality*
Kregg Smith *Fisheries Management Biologist, Michigan Department of Natural Resources*
Don Sporleder, FAIA *Friends of the St. Joe River Association*
David Sturgis *Farmer*
Jennifer Tice *St. Joseph County Conservation Club*
Sarah VanDelfzijl *Watershed Coordinator, Rocky River*
Blaine VanSickle *Calhoun County Drain Commissioner*
Sarah Nerenberg *Hoosier Environmental Council*
Joe Margol *Berrien County Road Commission*
Rae Schnapp *Hoosier Environmental Council*
Troy Manges *St. Joseph County (Ind.) SWCD*
Tom Fox *Bertrand Township*
Gary Schrader *Niles Township*
Dona Hunter *LaGrange County SWCD*
Gaye Blind *St. Joe River/Galien River SWCD*

final water quality statement

The St. Joseph River Watershed was divided into five River Valley Segments (see Figure 11 and Table B to see which major tributaries fall within which segment) in order to evaluate watershed impairments on a manageable geographic scale. However, the size of the River Valley Segments did not allow for entire segments to be identified as "impaired," with the exception of the Mouth and Lower Segments, which were the focus of two E. coli Total Maximum Daily Loads (TMDLs) — one in Michigan and Indiana, respectively; both TMDLS have been approved for implementation by the USEPA. Site specific impairments and threats were derived from 305(b) and 303(d) lists, subwatershed projects and stakeholder interviews. Other indigenous aquatic wildlife was impaired in the greatest number of water bodies. According to the Indiana Department of Environmental Management's (IDEM) 2004 Integrated Water Quality and Assessment Report, aquatic life is not supported in six Indiana streams and in 17 lakes. Primary contact/recreation is not supported in 16 streams. Five water bodies are ranked high for pathogenic stressors. Of those water body segments surveyed by IDEM's TMDL program, 25 are listed as being fully supportive of aquatic life and 16 are fully supportive of recreational use. Septic systems have been identified as one source of pathogens to surface waters and have been the subject of a Section 319 project in Elkhart County, for example. Combined Sewer Overflows (CSO), which are overflows of inadequately or untreated sewage from older systems designed to carry both domestic and storm water loads, have also been identified as a source of pathogens, and municipal programs are working to address these issues. The Michigan Department of Environmental Quality (MDEQ) 2004 Waterbody System Nonattainment Survey indicates that one river did not meet the cold water fisheries designated use and five segments were impaired for body contact (three along the main stem). Noted sources of these impairments included untreated sewage, CSO's, pathogens, nuisance algae, thermal impacts, oils and agricultural nonpoint source pollution. Numerous water bodies previously listed for impairments to aquatic biota have been removed due to dredging which caused them to be inappropriate to list for biota. Indiana's TMDL Program identified many more waters on its 305(b) and 303(d) lists than the State of Michigan did. It is not clear whether these differences exist due to differences in actual surface water health, intensity of monitoring or criteria for nonattainment. Public Water Supply Surface Intake Point is primarily non-applicable, as the vast majority of drinking water in the watershed is supplied by groundwater. Some municipalities in Berrien County, Mich. utilize surface water for drinking water supplies. However, the quality of that drinking water obtained from Lake Michigan is dependent upon the quality of the water being discharged to the lake from the St. Joseph River. Navigation is impaired in a few select locations due to fencing across surface waters and obstructive vegetative growth. It is suspected that

Agricultural Water Supply may be impacted in some regions by upstream CSOs or livestock access to streams. See Appendix A for more information on TMDL sites and schedules.

impaired designated uses

Water quality standards and identified designated uses for Michigan and Indiana surface waters were used to assess the condition of the watershed. Published management plans, relevant watershed documents, stakeholder interviews, and various nonpoint source models also were utilized. There are important differences between the five river valley segments making up the St. Joseph River Watershed and each one is unique in the challenges it faces to maintain water quality. None of the designated uses for the St. Joseph River Watershed are known to be impaired on a watershed wide scale or on a river valley segment scale. Rather, impairments occur at the sub watershed or smaller scale. Protected designated uses, as defined by Michigan's Department of Environmental Quality, include: agricultural, industrial water supply, public water supply (at point of intake), navigation, warm water and/or cold water fishery, other indigenous aquatic life and wildlife support, and partial and total body contact recreation. All Indiana waters are designated for aquatic life and full body contact recreation (often referred to as “fishable” and “swimmable“). Although MDEQ's designated uses are broken down into more categories, the standards used to assess water quality are comparable. The more comprehensive Michigan nomenclature when identifying impairments and threats is used in this plan. Typical pollutants, sources, and causes are listed in Table C (see also the Pollutants/Concerns, Sources and Causes section). More detailed information for particular locations can be found in subwatershed plans (listed in the References section) as well as the 303(d) lists. *Note: Industrial water supply is the only designated use that is currently being met throughout the watershed.*

threatened designated uses

Threatened waterbodies are defined as those that currently meet water quality standards, but may not in the future. Table D identifies the specific locations where threats are known to presently exist and pollutants impacting the designated use. Typical pollutants, sources, and causes are listed in Table D (see also the Pollutants/Concerns, Sources and Causes section). More detailed information for particular locations can be found in subwatershed plans (listed in the References section) as well as the 303(d) lists.

desired uses

In the course of consultation with the Steering Committee, review of existing watershed plans, and stakeholder interviews, one overarching desired use became apparent — the preservation, restoration and protection of open space as a system of natural areas, corridors, farmland, open land and parklands that can provide recreational opportunities, support plant and animal habitat, protect sensitive environmental resources (including surface and ground water quality) and ecological processes, and maintain scenic character and natural beauty. The St. Joseph River watershed provides residents with invaluable educational, recreational, and economic benefits such as hunting, fishing, paddling, birding, nature walks, flood control, and (perhaps most especially) the filtration and recharge of drinking water aquifers. As was noted earlier, almost 100 percent of the people living in the watershed depend on groundwater as their primary source of potable water for drinking, bathing, and cooking. Hydrologists continue to expand our understanding of the vital interconnection between surface and ground water systems. Land uses also impact aquifers significantly, whether those aquifers are in primarily agricultural or urban areas. Addressing the nonpoint source pollutants and other problems that degrade and threaten this open space system will not only benefit desired uses but will no doubt have profound positive impacts on impaired and threatened designated uses as well.

pollutants/concerns, sources and causes

Numerous pollutants are impairing or threatening designated and desired uses in the watershed. These pollutants were identified and prioritized through a review of subwatershed management plans, nonpoint source models, DEQ and IDEM water quality reports, ranking exercises, and discussions with Steering Committee members, watershed residents, local conservation agents, and government officials. The list may be used as a reference to distinguish what the major pollutants and concerns are on a watershed-wide scale. However, it does not distinguish between sources and causes in individual subwatersheds. Not all of the pollutants listed are a problem everywhere in the watershed. There are significant and important differences between the dozens of subwatersheds making up the St. Joseph River watershed. Each one is unique in the challenges it faces to protect and improve water quality. Tables C and D detail more specific impairments and threats to water quality on a subwatershed scale and have been included in this plan so that where detailed information exists it can be reviewed and acted upon by local stakeholders, who may need to perform additional reviews and surveys to determine the exact sources of pollutants before BMPs can be implemented. The following pollutants/concerns, sources, and causes are listed in priority order.

sediment

Excess sediment covers riffles, destroys spawning habitat, causes turbidity, impedes navigation, decreases flood storage capacity, and acts as a delivery vehicle for nutrients, toxins, and invasive species (increasing the detrimental impact of sedimentation on water resources). Sediment comes from both upland and in-stream sources. Cropland, construction sites (both large and small), eroding banks, road/stream crossings, and stormwater systems have all been identified as sources. Causes include conventional tillage practices, uncontrolled human, livestock, and vehicular stream access, construction sites where proper Soil Erosion and Sedimentation Control (SESC) practices are not installed or maintained, lack of riparian and drainage buffer strips, improperly designed culverts, and improperly maintained catch basins. *Note: Sediment loading calculations contained in the plan are estimates and additional review of the subwatersheds will be needed to determine the sources of soil erosion before implementing BMPs.*

nutrients

A certain amount of nutrients are found in water resources naturally. In excess, however, nutrients such as nitrates and phosphorus can cause aquatic systems, both flowing and impounded, to become out of balance favoring certain organisms over others and changing the function, use, and look of creeks, ponds, lakes, wetlands, and rivers. Nitrates in the body inhibit the ability of blood to carry oxygen. Nutrients and fertilizers used in agricultural applications, residential applications, and landscaping enter surface waters in storm water or tile water runoff when attached to sediment particles. Nutrients concentrated in human and animal wastes are introduced through leaking manure storage areas, failing or non-existent septic systems, and direct discharges from livestock access or runoff. Improper manure and fertilizer application and storage, lack of buffer strips, lack of homeowner education, and combined sewage storm water system overflows (CSOs) are all additional causes of excessive nutrient loading.

habitat and natural systems loss

Although some communities are making great strides in protecting habitat and natural systems through site planning and ordinances, the loss of habitat and natural systems that often comes hand-in-hand with development is of great concern in the watershed, especially in the southwestern portion which is under the most intense pressure and in headwaters communities, where water quality is threatened by the potential negative impacts of growth. Natural systems — woodlands, wetlands, watercourses, groundwater aquifers, and open space, to name just a few — provide many valuable functions for local communities. In natural areas, most storm water is infiltrated and utilized where it falls, allowing most pollutants to be filtered through soils. When these areas are lost, and their functions are not or are inadequately replaced (with infiltration, detention, or restoration measures), nearby water resources are negatively impacted by increased flow and pollutant loads. The other problem associated with the degradation of habitat is the loss of riparian corridor canopy. Buffers around streams, lakes, and wetlands not only provide shade to moderate water temperatures, they also filter nutrients, and stabilize banks, preventing sedimentation from erosion. Sediments cover sand and gravel beds that are essential spawning grounds for walleye, trout, and other popular game fish. Development of large tracts of land for residential and commercial use disrupts and degrades habitat and natural systems, as does lack of planning, both on the local and regional levels, to control and manage growth in a sustainable fashion. Many of the pollutants and concerns discussed in this section (sediment, nutrients, pathogens, pesticides and other toxins) are actually caused or exacerbated by land use changes. Invasive species such as purple loosestrife, reed canary grass, glossy buckthorn, Japanese honeysuckle, autumn olive, garlic mustard, zebra mussels, common carp, goby, eurasian watermilfoil, and flowering rush can also have swift and devastating effects on habitat and ecological processes.

pathogens

Disease-causing organisms in water include bacteria, viruses, and protozoa. Examples include Salmonella, Norwalk virus, and Giardia and Cryptosporidium, respectively. E. coli, the detection of which often indicates the presence of the aforementioned pathogens, has been a widely documented impairment throughout the St. Joseph River watershed. In fact, numerous water bodies in both states have scheduled TMDLs to address this problem so that recreational opportunities such as swimming, wading, and canoeing can be engaged in safely. E. coli and these other pathogenic organisms can be discharged directly to waterbodies or can be transported with surface runoff. Sources are numerous and include discharge of treated and untreated sewage (particularly CSOs), runoff from agricultural activities, and wildlife/pet waste. Unlimited access to streams allows livestock and wildlife to spread bacteria. Leaking and undersized septic systems allow E. coli to enter water bodies. Leaching and overflowing manure storage areas can also add bacteria to the streams.

pesticides, herbicides and other toxins

Pesticides and herbicides are an area of concern for maintaining water quality because of their widespread use. These chemicals are used in both urban areas and agricultural settings and are used by a wide spectrum of users, from individuals, to companies, to municipalities. The over-application or misuse of pesticides and herbicides, especially in riparian areas, and/or areas with porous soils, shallow water tables, or insufficient erosion control practices can allow these chemicals to enter surface water and ground water (via runoff or leaching) where they pose a significant risk to human health, aquatic habitat (both flora and fauna) and wildlife. Many pesticides and herbicides destroy plant and insect species other than the “targeted” ones and this disrupts the food chain and alters ecosystems. Atrazine, which is sprayed on crops to control weeds that often grow among corn, soybeans, turf grass sod, roses, and Christmas trees has been identified by the EPA as a potential human carcinogen or cancer-causing agent. The St. Joseph River watershed is the largest contributor of Atrazine to Lake Michigan according to the EPA’s Mass Balance Study. Furthermore, the cumulative effects of several types of pesticides present in water are not well understood. Improperly cleaning or disposing of containers, as well as mixing and loading pesticides in areas where residues or run-off are likely to threaten surface or ground water, are other potential sources of contamination. Some pesticide labels and some state statutes specify safe distances from well heads for pesticide mixing and loading. Furthermore, storm induced run-off carries toxic substances (e.g. gas, antifreeze, oil, asbestos, brake fluid) from roadways, driveways, parking lots, storage areas, and other impervious surfaces directly into streams via storm drains and ditches. Up to 90 percent of the atmospheric pollutants, deposited on impervious surfaces, are delivered to receiving streams.

hydrological modification

Changes in flow as a result of urbanization (and the corresponding loss of natural features), development in the floodplain/riparian corridor, stream channelization, poorly designed culverts, dams, removal of vegetation from stream banks, and construction of new drains can affect water levels, rates of water movement, and water temperatures and result in flooding, erosion, sedimentation, excessive nutrient loading, and elevated toxin levels. These problems in turn have negative impacts on aquatic habitat, agricultural water supplies, and navigation.

goals and objectives

The St. Joseph River Watershed Plan seeks to promote and facilitate coordinated, collaborative action among stakeholders in order that nonpoint source loads of sediment, nutrients, pathogens, and toxins in the St. Joseph River Watershed are reduced to levels sufficient to meet both states designated uses throughout the entire year and that open space (a system of natural areas, corridors, farmland, open land, and parklands) is preserved, protected, and restored. The management plan also seeks to establish and build the capacity of a stakeholder group that assumes responsibility for the fulfillment of the management plan and acts as the primary advocacy group, information clearinghouse, and planning partner for the watershed. This group — whether a modified version of the project Steering Committee, a watershed council, or an existing organization like the Friends of the St. Joe River Association — will identify and prioritize implementation, education, and legislative activities throughout the watershed, focusing first on designated critical areas. These activities, undertaken in a manner that maximizes human, financial, and institutional resources, will be achieved primarily through the formation of effective and sustainable local partnerships. The St. Joseph River Watershed is, as noted earlier, a large multi-jurisdictional watershed and this plan seeks to address nonpoint source pollution on that scale. However, the vast majority of decisions affecting the water quality in this watershed will be made by county commissioners, city councils, township boards, local planning staff, and the public at large. Management decisions must be made collectively because, in most cases, no single entity has jurisdiction over all aspects of the watershed.

The following goals and objectives were developed as strategies to address five primary concerns: sediments, nutrients, habitat and natural systems loss, pathogens, and toxins. Hydrological modification is also a concern, but many of the problems associated with it are alleviated as a result of addressing primary concerns (the designated and threatened use tables and the preceding section on pollutants are sources of more detailed information). Of course not all of these are concerns everywhere in the watershed, and these goals and objectives are by no means exhaustive. However, in those areas where any of these concerns do exist, the corresponding goals and objectives are generally applicable and will help improve surface water quality by addressing sources and causes of pollution.

Objectives are prioritized as high (should be initiated in the next one to three years), moderate (four to six years) and low (seven to 10 years). It should be noted that some tasks, especially those involving educational or legislative/policy components, are most appropriately done in an ongoing fashion regardless of when they are begun. Implementation timeframe, potential partners, typical BMPs/delivery mechanisms, milestones and measurements are also included to provide stakeholders a context in which to act and a foundation on which to base their actions. Parties listed in bold should be considered as the most likely lead agencies responsible for the task. However, depending on circumstances, other agencies or stakeholders may very well take the lead and should feel comfortable in doing so.

Note: Table E provides per unit cost estimates for BMPs mentioned in the goals and objectives.

goal #1

Establish and sustain the financial and institutional capacity of a stakeholder group (e.g. steering committee, joint basin commission, watershed council, Friends of the St. Joe River Association) that assumes responsibility for coordinating implementation of the management plan and acts as the primary advocacy group, information clearing-house, and planning partner for the watershed.

A Define more specifically the makeup, role, and responsibilities of the group and its relationship to other local, state, regional and federal entities.

Priority
High (0-3 years)

Implementation Timeframe
Six months

Partners
Stakeholder group

Milestones
Hold stakeholder group meeting

Measurement
Consensus position reached and statement drafted on which existing or new stakeholder group will assume responsibility for coordinating implementation of management plan and act as the primary advocacy group, etc.

B Define levels of operation by scope and cost (i.e. core service, enhanced service, premium service).

Priority
High

Implementation Timeframe
One year

Partners
Stakeholder group

Milestones
Hold a series of stakeholder group meetings to discuss, draft, and review a strategic plan

Measurement
Adoption of strategic plan

C Develop sustainable financial arrangements for the performance of routine operations (e.g. staff, office space, workshops, conferences, electronic and hard copy information library, Web site, etc.) as well as time limited implementation projects.

Priority
High

Implementation Timeframe
Five years/Ongoing

Partners
Stakeholder group

Milestones
- Potential funding sources and mixes identified (Year 1)
- Fundraising strategy is designed (Year 2)
- Fundraising strategy is implemented (Years 2–5)
- Operational funding is secured (Years 2–5)

Measurement
- Catalog of funding sources (private, corporate, government)
- Copies of grant proposals and other solicitation materials
- Record amount and source of funds received for implementation projects
- Record amount and source of funds received for operational expenses

goal #2

Reduce soil erosion and sedimentation so that surface water functions and aesthetics are improved and protected.

A Partner with the USACOE to make their sedimentation transport models available for use by stakeholders to complete load reduction estimates and illustrate the impacts of current practices and the effectiveness of alternatives.

Priority
High

Implementation Timeframe
One year

Partners
- Friends of the St. Joe River Association
- St. Joseph River Basin Commission
- MS4 Permittees
- Conservation Districts

Delivery Mechanisms
Training sessions for interested watershed agencies/organizations

Milestones
- Training session held in at least two distinct geographic areas of the watershed
- Sediment transport information available to be used in load reduction models

Measurements

- Number of attendees at each training session
- Before and after knowledge surveys
- Follow up with attendees to determine if models are being used in subwatersheds
- Sediment reduction goals set for communities

B Offer training to planning departments, road commissioners, building/permitting officials and contractors so that soil erosion control BMPs are considered as an integrated part of the site planning and design process.

Priority

- High (Michigan)
- Moderate (Indiana)

Implementation Timeframe

Three years

Partners

- Conservation Districts
- SESC officials
- Counties
- Planning with POWER
- IDNR Division of Soil Conservation
- Purdue Extension
- MDEQ
- IDEM
- MS4 Permittees
- Homebuilders Association
- RC&D Councils

Delivery Mechanisms

Workshop highlighting soil erosion BMPs and model storm water ordinances

Milestones

- Create list of planning officials, building/permitting officials, and contractors (Year 1)
- Develop materials and presentation (Year 1)
- Hold one training workshop in each county (Years 1–3)
- Develop model storm water ordinance (Years 1–3)

Measurements

- Number of attendees at each training session
- Before and after knowledge surveys
- Follow up with attendees to determine if practices have changed or if more training is needed
- Number of communities adopting storm water ordinance

C Develop and implement residential/commercial storm water education programs in urban areas (each MS4 permittee is required to have a public education plan in place).

Priority
High

Implementation Timeframe
10 years

Partners
- MS4 Permittees
- Southwest Michigan Commission
- Conservation Districts
- Friends
- Basin Commission
- MSU Extension
- Purdue University Extension
- Rain Gardens of West Michigan
- MDEQ
- IDEM
- Nature/Environmental Education Centers
- Unpermitted municipalities
- Homebuilders associations

Delivery Mechanisms
- Workshops/educational materials on urban stormwater problems and BMPs
- Newsletters
- Newspaper articles
- Newspaper ads
- Newspaper inserts
- Public service announcements
- Display ads
- Educational signage

Milestones
- Develop template for a bi-annual newsletter for urban residents (Year 1)
- Distribute bi-annual newsletter for urban residents (Years 1–10)
- Hold educational workshop for residents in each MS4 community (Every 3 Years)
- Hold training session for municipal officials and employees in each MS4 community (Every 3 Years)
- Develop annual awareness survey (Year 1)
- Awareness surveys completed annually (Years 1–10)
- Develop storm water education advertisements — e.g. public service announcements, display ads (Year 2)
- Distribute storm water education advertisements (Years 2–10)
- Installation of educational signage at existing BMP sites (Years 3–10)

Measurements
- Number of attendees at educational workshops
- Number of attendees at training sessions
- Before and after knowledge survey
- Record contacts made
- Photographs of signage
- Copies of newsletters, newspaper articles, brochures, PSAs, display ads, videos, etc.
- Record personal contacts made
- Number of citations for stormwater ordinance violations
- Number of illicit connections corrected
- Number and location of BMPs per jurisdiction
- Number of new developments integrating BMPs
- Number of construction inspectors trained to enforce storm water ordinances

D Provide riparian landowners (both private and public) in prioritized, targeted areas with information regarding shoreline protection and restoration. *Note: there is a need for a coordinated strategy that includes input from drain commissioners so that educational materials include information on easements and the maintenance of drains that may affect the scope and design of restoration projects.This is the type of coordination between agencies and stakeholders that Goal #4 seeks to foster.*

Priority
Moderate (four to six years)

Implementation Timeframe
Three 3 years per area
The timeframe depends a great deal on the size/scope of the targeted area. An education effort undertaken in the McCoy Creek watershed could take significantly less time than an effort undertaken in the Pigeon River watershed, for instance. However, an educational effort in the McCoy Creek watershed that targets all riparian property owners may be similar in timeframe to one in the Pigeon River watershed that only targets riparian property owners on the main stem or areas with known sediment impairments. Note: undertaking such an educational effort on anything larger than the major subwatershed scale may prove unmanageable unless the sites addressed are very specific and limited.

Partners
- Conservation Districts
- MSU Extension
- Purdue University Extension
- Southwest Michigan Land Conservancy
- Mid-Michigan Land Conservancy
- NRCS
- Hoosier Environmental Council
- Friends

- St. Joseph Basin Commission
- MS4 permittees
- IDNR Division of Soil Conservation
- Local government
- Environmental consultants
- Drain officials

Delivery Mechanisms

- Workshops that model and teach shoreline management techniques
- Demonstration projects
- Mailings that target riparian property owners with information on stewardship and conservation

Milestones

- Prioritize riparian properties to be targeted by geography, hydrology, jurisdiction, natural features, sediment loading, etc. (Year 1)
- Create an implementation schedule based on prioritization scheme (Year 1)
- Create mailing list of riparian property owners in targeted area (Year 1)
- Hold one workshop on landscaping for water quality for residents in the targeted area. Additional workshops may be needed if done in a large geographic area (Year 1)
- Send mailings on stewardship and conservation to riparian landowners (Years 2–3)
- Follow up on contacts made through mailings with technical assistance and more detailed information (Years 2–3)

Measurements

- Number of attendees at workshops
- Record contacts made
- Record requests for information
- Before and after knowledge surveys

E Increase knowledge, planning, and implementation of soil erosion reduction and runoff control techniques on agricultural land.

Priority

High

Implementation Timeframe

Five years per county or major subwatershed

Partners

- Conservation Districts
- NRCS
- IDNR Division of Soil Conservation
- MDA
- Michigan Agricultural Stewardship Association
- Core Four Conservation Alliance

Typical BMPs
- Conservation tillage
- Contour grass strips
- Filter strips
- Riparian buffers
- Critical area plantings
- Water and sediment control basin
- Grade stabilization structure
- Grass waterways
- Stripcropping
- Retention ponds
- Field windbreaks
- Alley cropping
- Vegetative barriers
- Cover crops
- Livestock exclusion
- Contour farming
- Conversion of marginal crop land to habitat

Delivery Mechanisms
- Field walks
- Farmer meetings
- Individual contacts
- Newsletter
- Articles in *Farmers Advance* and *Farmers Exchange*
- Recognition programs (MAEAP, EQIP, River Friendly Farmers)
- Web site information on location, type, cost, and efficacy of BMPs within the watershed

Milestones
- Creation of BMP map for each county or watershed to establish baseline (Year 1)
- Identification and prioritization using pollution reduction calculations of erosion sites (Year 1)
- Host field walks and farmer meetings (Years 2–5)
- Publish and mail bi-annual newsletter (Years 2–5)
- Publish one article per quarter in agricultural newspapers (Years 2–5)
- Make personal contact with producers (Years 2–5)
- Implement BMPs in prioritized counties or watersheds (Years 2–5)
- Develop pages on project Web site that provide information on BMP location, type, cost and efficacy

Administrative Evaluation
- Number of attendees at field walks and farmer meetings
- Record personal contacts made
- Copies of newsletters and newspaper articles

- Number and location of BMPs
- Annual update of BMP map
- Number of producers participating in cost share programs
- Before and after photographs of BMPs installed
- Track cost share dollars by subwatershed
- Number of hits of Web pages

Social Evaluation

- Number of producers recognized for sustainable and eco-friendly farming practices through MAEAP, EQIP, etc.
- Before and after knowledge survey

Environmental Evaluation

- Increased ranking of water quality (total suspended solids below 20mg/l)
- Increased biological rating of aquatic habitat (benthic macroinvertebrates, fish species, plant species, etc)
- Reduction in the amount (tons/year) of sediment entering waterways

F Track road-stream crossings and quantify sediment loading to establish a baseline and prioritize sites for future improvement projects.

Priority

Low (Seven to 10 Years)

Implementation Timeframe

Three years

Partners

- Stakeholder Group
- Road Commissions
- Drain Boards/Commissioners
- County Surveyors
- MDEQ
- IDEM

Typical BMPs

- Aerial photographs
- St. Joseph River stream bank erosion sediment form

Milestones

- Train staff and volunteers to assess crossings (Year 1)
- Survey 25 percent of total road stream crossings each year — 964 of the roughly 4,600 total crossings were surveyed by MDEQ in 2004 (Years 1–3)
- Develop sediment loading database (Years 1–3)
- Develop a prioritization scheme (including cost-benefit analysis) for future mitigation projects (Years 1–3)

Measurements

- Number of staff and volunteers trained to do assessments

- Number of road stream crossings surveyed
- Record information from road-stream crossing forms in database
- Prioritized list of eroding sites

G Reduce the volume and velocity of storm water runoff entering surface waters in urban and developing areas.

Priority

Moderate

Implementation Timeframe

Five years

Partners

- MS4 Permittees
- Municipalities
- Developers
- Planning commissions/officials
- Drain officials/commissions

Typical BMPs (Low-Impact Development)

- Wetland cells
- Rain gardens
- Rain barrels
- Porous pavements
- Buffer strips
- Green roofs
- Stream bank stabilization
- Tree planting
- Water and sediment control basins
- Outfall diversions
- Weir wells
- Check dams
- Bio-retention parking lot islands
- Bioswales
- Infiltration trench
- Downspout disconnections
- Grassed swales
- Retrofit retention basins
- Cisterns
- Storm water ordinance

Other Mechanisms

- Illicit discharge detection program
- Enhanced site plan review
- Enhanced site inspection and enforcement

- Storm water ordinance

Milestones

- Identify and prioritize runoff reduction opportunities (Year 1)
- Identify natural areas that help control runoff (Year 1)
- Protect natural area via zoning, easements, etc. (Years 2–5)
- Develop new or revise existing ordinances to encourage Low Impact Development (Year 2–5)
- Adopt regionally consistent ordinances (Years 2–5)
- Implementation of BMPs (Years 2–5)

Measurements

- Trend monitoring (number, type, and location of storm water BMPs installed)
- Flow, volume, velocity, TSS, and stream height monitoring during storm events
- Amount of sediment in catch basins
- Level of enforcement of ordinances
- Tracking of impervious surfaces
- Load reduction calculations
- Substrate composition

goal #3

Reduce the amount of nutrient loading that so that surface water functions and aesthetics are improved and protected.

A Increase property owner awareness about the value of properly designed, installed, and maintained septic systems, particularly in areas with high water tables, porous soils, and those near surface water or storm sewers.

Priority

High

Implementation Timeframe

One to two years

Timeframe is based on educational effort being undertaken on a county by county basis

Partners

- County health departments
- Association of Realtors
- St. Joseph River Basin Commission
- Friends of the St. Joe River Association
- Hoosier Environmental Council
- Nature/environmental education centers

Delivery Mechanism

Homeowner On Site Disposal System (OSDS) education packets distributed by realtors and health departments

Milestones
- Develop home owner education materials (Year 1)
- Hold one workshop for realtors to introduce materials and establish distribution networks (Year 1)
- Hold one workshop for homeowners (Year 1)
- Distribute educational packets (Years 1–2, Ongoing)

Measurements
- Number of realtors participating in program
- Number of homeowners receiving packets
- Before and after knowledge survey
- Reduction in the number of OSDS failing inspection

B Develop and implement residential/commercial storm water education programs in urban areas to reduce volume and velocity of runoff. *See Goal #2, Educational Objective C for detail.*

C Increase the number of small and medium size producers that have certified nutrient management plans.

Priority
High

Implementation Timeframe
15 years

Partners
- Conservation districts (MAEAP and groundwater technicians in Michigan)
- MSU Extension
- Purdue University Extension
- NRCS
- Michigan Department of Agriculture
- IDNR Division of Soil Conservation

Typical BMPs
Certified Nutrient Management Plan

Milestones
- Creation of BMP map/list for each county or watershed to establish baseline (Year 1)
- Identification and prioritization (using pollution reduction calculations) of nutrient loading sites (Year 1)
- Development of nutrient management plans (Years 2–15)

Administrative Evaluation
- Number of producers with approved nutrient and manure management plans
- Acreage covered by plans

Environmental Evaluation

- Increased ranking of water quality (phosphorus less than 1.0 mg/l or less monthly average)
- Increased biological rating of aquatic habitat (fish species, plant species, etc.)
- Reduction in the amount (tons/year) of nutrients entering waterways
- Reduction in observed eutrophic conditions in lakes and wetlands (algal blooms, excessive plant growth, etc.)

D Reduce the volume and velocity of storm water runoff entering surface waters in urban and developing areas. *See Goal #2, Implementation Objective C for detail.*

E Increase knowledge and use of soil erosion reduction and runoff control techniques on agricultural land. *See Goal #2, Implementation Objective A for detail.*

F Revise local weed and phosphorus use ordinances in urban areas to encourage the reduction of lawns and the use of natural landscaping, native plants, and low/no phosphorus fertilizers.

Priority

Low

Implementation Timeframe

One to two years

Timeframe is based on effort being undertaken primarily in MS4 permit areas

Partners

- Municipalities
- Planning commissions/officials

Milestones

- Review existing ordinance (Year 1)
- Provide educational materials to planning officials/commissions (Years 1–2)
- Adopt revised/new ordinance (Years 1–2)

Evaluation

- Number of ordinances reviewed
- Number of ordinances needing revision
- Number of planning officials/commissions receiving educational materials
- Number of revised ordinances adopted

G Upgrade/replace failing OSDS upon the sale of property.

Priority

Moderate

Implementation Timeframe

One year

Timeframe is based on effort being undertaken on a county by county basis

Partners
- County officials/commissions
- County health departments
- MS4 Permittees

Milestones
- Review existing OSDS ordinance
- Provide educational materials to officials/commissions
- Adopt revised/new OSDS ordinance that allows for inspection of systems and the assessment of fines for noncompliance

Evaluation
- Number of OSDS ordinances reviewed
- Number of OSDS ordinances needing revision
- Number of revised OSDS ordinances adopted

H Work with golf courses and parks departments to obtain certification in Audubon International Cooperative Sanctuary Program.

Priority
Moderate

Implementation Timeframe
Two years
On a course by course or park by park basis

Partners
- Golf courses
- Parks departments
- Kalamazoo Nature Center
- Conservation districts
- Audubon International Cooperative Sanctuary Program

Typical BMPs
- No spray zones
- Buffer strips
- Restricted access for waterfowl
- Plant health care programs
- Integrated pest management

Milestones
- Enrollment of facility in sanctuary program (Year 1)
- Progress through each step in order to become certified (Years 1–2)
- Obtain certification (Year 2)

Evaluation
- Number of facilities that obtained certification
- Track pesticide usage before and after
- Document number of practices changed

goal #4

Increase cooperation, coordination, and collaboration among stakeholders (both governmental and nongovernmental) on a regional basis to eliminate program duplication, reduce costs, find more effective solutions, and maximize human, financial, and institutional resources.

A Host annual watershed conference.

Priority
High

Implementation Timeframe
Ongoing

Partners
- Stakeholder group
- Friends of the St. Joe River Association
- St. Joseph River Basin Commission

Delivery Mechanism
Annual watershed conference

Milestones
Plan, advertise and hold annual watershed conference (Years 1–15)

Evaluation
- Copies of agendas/programs
- Number of attendees
- Record contacts made
- Record requests for information
- Conference evaluation survey

B Host workshops/conferences/training sessions that help local stakeholders identify, assess, and address water quality issues (preservation, mitigation, education, etc) in the context ofthe whole St. Joseph River Watershed.

Priority
Moderate (three to six years)

Implementation Timeframe
Ongoing

Partners
- Stakeholder group
- Citizen groups
- Nature/environmental education centers
- MSU Extension
- Purdue University Extension
- Conservation districts

- NRCS
- Land conservancies
- Advocacy groups

Delivery Mechanisms
- Workshops
- Conferences
- Training sessions

Milestones
Plan, advertise and hold one event per year in each of four geographic areas of the watershed: northeast, northwest, southeast and southwest (Years 3–15)

Evaluation
- Copies of agendas/programs
- Number of attendees
- Record contacts made
- Record requests for information
- Conference evaluation survey

C Ensure that stakeholder group is diverse and representative of the watershed.

Priority
High

Implementation Timeframe
One year

Partners
Stakeholder group

Milestones
- Gaps in current representation (by agency, geography, specialty, etc.) identified (Year 1)
- List of candidates compiled (Year 1)
- Individuals recruited to fill gaps (Year 1)
- Future representation needs assessed and protocol established to ensure vacancies are filled in a timely fashion (Year 1)

Evaluation
- Copy of current roster broken down by representative categories/needs (include vacancies)
- Copy of candidate list
- Record candidates contacted and status
- Copy of roster after recruitment
- Record attendance rates of committee members

D Develop a volunteer water quality monitoring program that offers training in the collection of habitat, chemical, and biological samples throughout the Michigan portion of the watershed (focusing on main stem and major tribs) and makes the results available online to citizens and governmental agencies working to protect surface water resources. *NOTE: Hoosier Riverwatch currently operates a similar program in the Indiana portion of the watershed, which will serve as a model for this monitoring program. The Friends of the St. Joe River Association have a more rudimentary volunteer monitoring program in place as well, which could be the foundation on which a more comprehensive, consistent program is built. This monitoring program, once developed, will be a component of the overall monitoring plan outlined in Section Y.*

Priority
High

Implementation Timeframe
Five years/ongoing

Partners
- Friends of the St. Joe River Association
- Hoosier Riverwatch
- MDEQ
- IDNR
- Conservation Districts

Typical BMPs
Volunteer water quality monitoring program

Milestones
- Secure part time paid/volunteer staff person to conduct training sessions
- Secure monitoring equipment and reliable kits
- Creation of an accessible, reliable online data management system
- Train 20 volunteers annually to sample and report quarterly for two years (Years 1–5)

Evaluation
- Number of volunteers trained per year
- Number of equipment kits provided to volunteers
- Record collected data on-line quarterly
- Record staff activities

E Partner with local stakeholder groups/agencies to develop watershed management plans or update existing plans in designated critical subwatersheds.

Priority
Moderate

Implementation Timeframe
Six months to two years

Timeframe depends on whether effort is to revise existing plan or develop a plan and on the size of the watershed in question.

Partners

- Conservation districts
- Regional planning agencies

Milestones

Develop four critical area watershed plans by 2015

Evaluation

Approval of management plans by MDEQ and IDEM

F Expand, enhance, and coordinate existing voluntary agriculture environmental education and natural resource conservation/protection programs in order to a) encompass areas of the watershed currently not served or under served and b) more effectively target areas for mitigation and preservation efforts

Priority

High

Implementation Timeframe

15 years/ongoing

Programs

- River Friendly Farmer
- MAEAP
- Farm-A-Syst
- EQIP
- CRP
- WRP
- WHIP
- Safe Water for the Future

Partners

- Conservation districts
- MAEAP
- MSU Extension
- Purdue University Extension
- NRCS
- Farm Service Agency
- MACD

Milestones

- Formation of working group (Year 1)
- Develop strategic plan (Year 1)
- Working group meets bi-annually (Years 1–15)
- Expand/enhance existing programs and coordinate services (Years 2–15)

Evaluation
- Record meeting minutes and attendance
- Copies of strategic plan
- Number of counties served by programs
- Record staffing levels and responsibilities

goal #5

Increase preservation, restoration, protection and appreciation of open space (a system of natural areas, natural systems, corridors, farmland, open land, and parklands).

A Educate local planning officials/commissions about water quality issues, smart growth and the protection of natural resources through coordinated planning, zoning and ordinances.

Priority
High

Implementation Timeframe
10 years
Assuming it is undertaken on a county by county basis and approximately one year is spent focusing on individual local planning units

Partners
- MS4 Permittees
- St. Joseph River Basin Commission
- Friends of the St. Joe River Association
- Planning officials/commissions
- County/regional planning authorities
- Planning with Power
- Michigan Society of Planning
- Indiana Planning Association
- Michigan Township Association
- NRCS
- RC&Ds
- Conservation Districts
- MSU Extension

Delivery Mechanisms
- Presentations at planning commission meetings
- Workshops for planning officials/commissions
- Watershed management short course

Milestones
- Create list of planning officials/commissions (Year 1)
- Develop basic materials and presentation (Year 1)
- Hold one training workshop in each county (Years 1–10)

- Give follow-up presentations at local planning commission meetings, retreats, etc. (Years 1– 10)

Measurements
- Number of attendees at each training session
- Number and location of follow-up presentations
- Record contacts made
- Before and after knowledge surveys
- Training session/presentation evaluation form
- Follow up with attendees to determine if practices have changed or if more training is needed

B Increase public understanding about basic water quality issues, including the economic benefits of natural systems and open space (e.g. flood control, groundwater filtration, recreation, tourism, air purification, higher property values).

Priority
Moderate

Implementation Timeframe
15 years/ongoing

Partners
- Stakeholder group
- St. Joseph River Basin Commission
- Friends of the St. Joe River Association
- Conservation districts
- Nature/environmental education centers
- MSU Extension
- Purdue University Extension
- Community colleges
- Hoosier Environmental Council

Delivery Mechanisms
- Public service announcements
- Cable access programs
- Newspaper articles
- Newsletters
- Public meetings
- Booths at fairs and other public events (Earth Day, Fish Fest, county fair, etc)
- Web sites
- Watershed management short course

Milestones
- Create display and handout materials (Year 1)
- Kiosk at one Earth Day celebration in each state (Years 1–15)
- Kiosk at MDNR Wolf Lake Fish Hatchery Fish Fest (Years 1–15)

- Kiosk at four county fairs each year (Years 3–15)
- Produce and air television program related to water quality issues on public access stations serving largest population centers (Years 5–10)
- Hold one public meeting in each geographic section of the watershed per year (Years 1–15)
- Post news about projects, events and meetings on project, Friends and Basin Commission Web sites (Years 1–15)
- Create catalog of newsletters (nonprofit, local government, agency, etc.) that relate to water quality issues (Year 1)
- Include article in one newsletter per quarter (Years 2–15)
- Create links to project, Friends and Basin Commission Web sites from other stakeholder sites (Year 3)

Evaluation
- Photographs of display
- Copies of handout materials
- Number of visitors to kiosks
- Record contacts made via kiosks, newsletters, public meetings, etc.
- Copies of television program
- Number of attendees at public meetings
- Copies of Web page content
- Copies of newsletter articles/information and newspaper articles
- Number of Web page hits

C Educate and engage the public about land conservation/stewardship efforts and tools (including strategies for the mitigation of invasive species).

Priority
Low

Implementation Timeframe
Two years
Done on the county or watershed scale

Partners
- Land conservancies
- NRCS
- Conservation districts
- U.S. Fish and Wildlife Service

Delivery Mechanisms
- Preserve tours
- Preserve work days
- Newsletters
- Newspaper articles
- Brochures

- Individual contacts
- Presentations/public meetings
- Web sites

Milestones

- Hold public meeting to gauge areas of concern/interest (Year 1)
- Create resource maps by county/watershed based on public input (Year 1)
- Prioritize and rank identified areas for protection (Year 1)
- Develop brochures/educational info and distribute to residents (Years 1–2)
- Hold tours and work days at existing preserves in areas of concern (Years 1–2)
- Identify and partner (if possible) with existing organizations/agencies that specialize in particular areas of concern (Years 1–2)

Evaluation

- Number of attendees at public meeting
- Number of volunteers at work days
- Number of attendees at preserve tours
- Record volunteer hours donated
- Before and after knowledge surveys
- Number of hits on Web site
- Copies of newspaper articles and newsletters
- Copies of educational materials distributed to residents
- Record contacts made with landowners
- Record requests for information from landowners
- Number of acres gifted or protected

D Support and provide environmental education resources to K-12 teachers.

Priority

Moderate

Implementation Timeframe

Ongoing

Partners

- Conservation districts
- Friends of St. Joe River Association
- Nature/environmental education centers
- MDEQ
- MSU Extension
- Purdue University Extension
- Intermediate school districts
- IDNR
- MDNR

Delivery Mechanisms

- Project WET

- Project WILD
- Project Learning Tree
- WOW! The Wonder of Wetlands
- MDEQ Environmental Education Curriculum
- USEPA educational resources
- Nature center educational programs

Milestones

- Hold one Project WET, Project WILD, Project WILDAquatic, WOW!, Project Learning Tree or volunteer water quality sampling training session per county (Years 1–2)
- Partner with MDEQ to hold training sessions for their environmental education curriculum (Years 1–2)

Evaluation

- Copies of press releases, PSAs and other advertisements
- Copies of sign-in sheets (number of attendees)
- Record contacts made
- Before/after knowledge survey
- Follow up to determine if practices have changed and if more training or resources are needed

E Provide riparian landowners, both private and public, with information regarding shoreline protection. *See Goal #2, Objective D for detail.*

F Develop interactive Web based mapping tool of green infrastructure (i.e. community information system) that identifies critical habitat and natural resources, 100 year flood plain, groundwater recharge areas, headwaters, parks, prime agricultural land and contiguous natural areas/open space throughout the watershed in the context of jurisdictional boundaries, property ownership and development/population trends.

Priority

Moderate

Implementation Timeframe

One year

Partners

- Stakeholder group
- Friends of the St. Joe River Association
- St. Joseph River Basin Commission
- Land conservancies
- Regional planning agencies
- County planning agencies
- Nature/environmental education centers
- Parks departments
- MDNR

- IDNR
- Michigan Natural Features Inventory
- U.S. Fish and Wildlife Service
- Citizen groups
- Planning agencies
- Municipalities

Typical BMPs

- Multi-layer GIS map
- Natural features/resources inventories

Milestones

- Form committee to determine base map and overlay content, audience and user features; establish protocol for updating data and product review; and identify a contractor to perform design and construction work (Year 1)
- Create interactive Web-based mapping tool linked to project Web site (Year 1)

Evaluation

- Committee roster and sign-in sheet
- Minutes of committee meeting(s)
- Record Web address of mapping tool and link addresses

G Establish Michigan Heritage Water Trails on all navigable rivers in the watershed.

Priority

Low

Implementation Timeframe

Five years

Partners

- Citizen groups
- Municipalities
- Western Michigan University's Great Lakes Center for Maritime Studies
- Regional planning agencies
- Economic development authorities

Typical BMPs

Michigan Heritage Water Trail Program

Milestones

Establishment of 200 miles of river trail by 2015

Evaluation

- Copies of river trail routes
- Photographs of signage
- Copies of newspaper articles and press releases
- Copies of maps and interpretive guides

goal#6

Eliminate/correct sources of disease causing organisms that are harmful to public health and that limit the use of rivers, creeks, and lakes.

A Educate property owners about the value of properly designed, installed, and maintained septic systems, particularly in areas with high water tables, porous soils and those near surface or sensitive water resources. *See Goal #3, Educational Objective A for detail.*

B Develop and implement residential/commercial storm water education programs in urban areas to reduce volume and velocity of runoff. *See Goal #3, Educational Objective C for detail.*

C Increase the development of certified manure management plans.

Priority
High

Implementation Timeframe
15 years

Partners
- Conservation Districts (MAEAP technicians in Michigan)
- MSU Extension
- Purdue University Extension
- NRCS
- Michigan Department of Agriculture
- Indiana Office of the Commissioner for Agriculture
- IDNR Division of Soil Conservation

Typical BMP
Certified Manure Management Plan

Milestones
- Creation of BMP map for each county or watershed to establish baseline (Year 1)
- Identification and prioritization (using pollution reduction calculations) of nutrient loading sites (Year 1)
- Development of nutrient management plans (Years 2–15)

Administrative Evaluation
- Number of producers with approved manure management plans
- Acreage covered by plans
- Reduction in the number of livestock with access to waterways

Environmental Evaluation
- Increased ranking of water quality (E. coli less than 1,000/100ml for partial body contact, less than 130/100ml for full body contact)

D Reduce the volume and velocity of storm water runoff entering surface waters in urban and developing areas. *See Goal #2, Implementation Objective C for detail.*

E Increase the knowledge and use of soil erosion reduction and runoff control techniques on agricultural land. *See Goal #2, Implementation Objective A for detail.*

goal #7

Reduce the levels of pesticides, and other toxins that are harmful to public health and that degrade aquatic habitat.

A Revise local weed and phosphorus use ordinances in urban areas to encourage the reduction of lawns and the use of natural landscaping, native plants, and low/no phosphorus fertilizers. *See Goal #3, Objective F for detail.*

B Develop and implement residential/commercial storm water education programs in urban areas to reduce volume and velocity of runoff. *See Goal #2, Educational Objective C for detail.*

C Increase knowledge about benefits of integrated pest management and the safe use of pesticides among property owners

Priority
Low

Implementation Timeframe
One year

Partners
- Conservation districts
- MSU Extension
- Purdue University Extension

Delivery Mechanisms
Workshop on IPM and landscape management to prevent pesticide runoff and leaching

Milestones
Hold one workshop in each of the four geographic sections of the watershed: northeast, southeast, northwest and southwest (Year 1)

Evaluation
- Number of attendees
- Before and after knowledge survey
- Follow-up survey to determine if practices have changed and if additional workshops are needed/desired

D Increase the number of small and medium size producers who complete chemical storage and handling assessments, particularly in areas with high water tables, porous soils, and those near surface or sensitive water resources.

Priority
Moderate

Implementation Timeframe
15 years

Partners
- MSU Extension
- Purdue University Extension
- NRCS
- Conservation districts

Typical BMPs
Farm-A-Syst program

Milestones
- Creation BMP map/list for each county or watershed to establish baseline – Michigan (Year 1)
- Prioritization of remaining farms/facilities – Michigan (Year 1)
- Conduct assessments (Years 2–15)

Evaluation
- Updates to BMP map/list – Michigan
- Number of producers completing assessments – Michigan (as recorded by MSU Extension groundwater technicians)
- Survey to determine number and location of producers that have completed self-assessments – Indiana (as conducted by Purdue University Extension Safe Water for the Future program staff)

E Increase knowledge and use of soil erosion reduction and runoff control techniques on agricultural land. *See Goal #2, Implementation Objective A for detail.*

F Work with golf courses and parks departments to obtain certification in Audubon International Cooperative Sanctuary Program. *See Goal #3, Objective H for detail.*

G Provide and/or enhance hazardous waste collection programs.

Priority
Low

Implementation Timeframe
Five years

Assuming effort is undertaken on the major subwatershed scale

Partners

- MSU Extension
- Purdue University Extension
- Conservation districts
- County governments
- MS4 Permittees
- Michigan Department of Agriculture
- Indiana Office of the State Chemist

Typical BMPs

- Household Hazardous Waste Collection Days and Centers
- Clean Sweep

Delivery Mechanisms

- Promotional flyers
- Public Service Announcements
- Newspaper "community calendars"
- Municipal Web sites

Milestones

Designate and promote a day for property owners to properly dispose of harmful substances (Years 1–5)

Evaluation

Record amount of hazardous substances brought in on collection days before and after promotion/educational campaign

H Reduce the volume and velocity of storm water runoff entering surface waters in urban and developing areas. *See Goal #2, Objective C for detail.*

critical areas

In general, groundwater recharge areas, wetlands, riparian corridors, forested areas, and headwaters should be considered critical areas for both preservation and mitigation efforts, depending on local circumstances. These areas are the most sensitive to human activity and paradoxically provide the greatest benefits to humanity (see Habitat and Natural Systems Loss under the Pollutants/Concerns, Sources, and Causes section). This plan, however, uses a tiered system that prioritizes critical areas so that community resources can be focused first on those subwatersheds where preservation and mitigation efforts can have the most profound impact. While the preceeding goals and objectives are generally applicable throughout the watershed and will help improve surface water quality by addressing sources and causes of pollution, more detailed analysis concerning preservation potential, future development, pollutant loading, and load reductions from particular best management practices was done with the goal of targeting specific strategies to those areas most in need of preservation and mitigation. The Elkhart, Fawn, and Pigeon river subwatersheds are critical agricultural areas in need of mitigation efforts. The St. Joseph/Benton Harbor, Elkhart/Goshen and South Bend/Mishawaka areas are critical urban areas in need of mitigation efforts centered around reduction and improved management of stormwater runoff. The Paw Paw, Dowagiac and Rocky river subwatersheds are critical areas in need of management efforts centered around the preservation of natural areas in a non-disturbed condition, which is the single most effective BMP for reduction of NPS pollutants from developing areas.

It should be noted that these prioritized critical areas are by no means the only areas in need of targeted preservation and mitigation efforts; these identified areas simply are the highest priority. For instance, Trout, Mill and Christiana (upper) Creeks also scored high for preservation potential but are under less development pressure at this time. Furthermore, as many smaller towns in the watershed that are not currently required to have stormwater management plans under NPDES continue to grow they will need to deal more proactively with storm water issues. These smaller population centers can still benefit from the strategies employed by larger communities but they are not the highest priority for storm water mitigation efforts at this time.

critical areas for preservation

Experience shows us that once land is developed it is unlikely to revert to a natural state. Perhaps more alarming is the sheer volume and rate at which open space is being consumed.

In Michigan, studies conducted by the Michigan Society of Planning disclosed that valuable farmland, wildlife habitat, and open space is being developed at a rate eight times greater than the state's population growth. Nationally, it is estimated that the amount of land covered by urban and suburban development has increased by nearly 300 percent since 1955 while population has increased by only 75 percent. We are losing the one-of-a-kind landscapes and critical ecosystems that support a vast array of wildlife — and ultimately, human civilization — because of unmanaged growth. Unfortunately, much of the growth in the St. Joseph River watershed is not managed or coordinated and this poses a clear and present danger to water quality in our streams, wetlands, lakes, and aquifers. Dealing with this problem means giving the "green infrastructure" of natural areas, working lands, and open space the same level of attention and concern as the "gray infrastructure" of roads, sewers, and utilities. Without the implementation of smart growth and other strategies outlined under the Goals and Objectives section of this management plan, the future negative impacts of growth in these critical subwatersheds will be significant and the mitigation of these impacts very costly (see No Action Scenario section for more information).

Preservation and protection efforts in the St. Joseph River watershed should focus first on the Paw Paw, Dowagiac, and Rocky River subwatersheds. These subwatersheds were designated and prioritized through a multi-layered evaluation process, rooted in a land cover analysis and refined through Steering Committee and Watershed Coordinator review of the scoring arising from that analysis as well as multiple other factors. The Paw Paw, Dowagiac, and Rocky River subwatersheds were identified as the highest priority areas for preservation efforts based on the following factors:

- All subwatersheds were scored based on the percentage of wetland and forest cover and trout lakes and streams in each. The highest average scores were identified in the northwest portions of the watershed, which is primarily comprised of the Paw Paw, Dowagiac, and Rocky River subwatersheds (see Appendices for full *Scoring of Major Subwatersheds* report).
- The three subwatersheds form a contiguous land mass surrounded on all sides by urban and developing areas that were shown by the Landscape Analyst model to be under moderate to intense future development pressures (see report entitled *Protecting a Bi-state Water Resource: Build-out Analysis of the St. Joseph River Watershed* in the Appendices for more information). The continued suburban development along the I-94 corridor from the Kalamazoo/Portage to the St. Joseph/Benton Harbor metropolitan areas impacts portions of all three subwatersheds, but especially the Paw Paw in Van Buren County, which has been identified as one of the richest areas of bio-diversity in Southwest Michigan. Continued development in the South Bend/Mishawaka and Elkhart/Goshen areas and along US 1-31 from Kalamazoo to Three Rivers pose a direct threat to habitat, natural features, agricultural land and ecological systems in the Paw Paw, Dowagiac and Rocky River sub-watersheds. There will be no better time to under

take a comprehensive strategy to protect these resources rather than simply "putting out fires" on a township by township basis than the next five to 10 years.

- There is much potential for regional cooperation. The three contiguous subwatersheds are easily seen and considered holistically as the land uses, populations, and attitudes are similar throughout the area. Some embryonic efforts are already underway in the Dowagiac River subwatershed (where a number of townships reviewed and revised their zoning to protect prime agricultural lands and natural resources), which can serve as models in the future.
- Two out of the three subwatersheds currently have management plans in place. The Dowagiac River plan focuses primarily on planning and zoning and provides a good deal of useful information on preservation and protection tools. The Rocky River plan focuses on steps necessary to preserve high water quality in a watershed with few major problems. The Paw Paw River subwatershed has a working stakeholder group actively seeking funds for management planning.

There are a variety of sound, proven preservation and protection strategies that communities across the United States have implemented (see particularly *Protecting Water Resources with Smarth Growth* and *Building Sustainable Communities* in the References section). Any preservation effort should seek to *identify, prioritize, protect and connect* natural areas, working lands, and open space in a proactive, comprehensive, and coordinated fashion. To be sure, land conservancies, conservation districts, drain commissions, and private property owners all have vital roles to play but local governments are responsible for most land use decisions and can have the most profound positive impact through coordinated planning and zoning. In both Indiana and Michigan mechanisms exist for communities to engage in such planning on a regional basis, but even coordination between communities within a watershed can be highly effective and lay the groundwork for expanded future efforts. The USEPA, Northeastern Illinois Planning Commission, and Michigan Society of Planning all have published excellent resource materials on this topic, which are listed in the References section of this plan. A report entitled *Mechanisms for Watershed Protection* drafted as a part of this management planning effort is included in the Appendices. Anyone interested in a more comprehensive, in-depth discussion of strategies should consult these materials, but the following tools will provide a general sense of the basics for individuals and communities interested in preserving natural areas, working lands and open space:

- Develop natural features or green infrastructure inventory on a township, watershed, county or regional basis.
- Conservation easements and gifts
- Purchase of Development Rights (PDR)
- Transfer of Development Rights (TDR)
- Density based zoning

- Development agreements and contract zoning
- Low Impact Development (LID) strategies
- Establish natural features setback ordinances
- Coordinate master plans/comprehensive plans between townships
- Conservation design ordinances
- Brownfield redevelopment to divert development from working lands or open space
- Restore natural processes on conserved lands and managed open space such as parks and golf courses through sound resource management practices
- Restore natural hydrology on ponds, wetlands, streams, and rivers disrupted by agriculture or development
- Stabilize eroding banks along streams, rivers, and lakes
- Remove invasive species
- Conversion of marginal farmland to habitat through USDA and USFWS programs

This watershed management plan includes goals and objectives directly related to the identification, prioritization, protection, and connection of natural resources, working lands, and open space — whether it be in the Paw Paw, Dowagiac and Rocky River subwatersheds or anywhere else in the St. Joseph River watershed. Of course, local conditions and needs will dictate what strategies and tools are implemented, but the following goals and objectives are, like the tools listed above, a good place to start:

- Goal #2, Objective D
- Goal #3, Objectives A, H
- Goal #4, Objectives A, B, E
- Goal #5, Objectives A, B, C, D, F, G

critical areas for urban storm water management

Cities and towns in the St. Joseph River watershed continue to grow, and with growth comes economic development essential to enhancing the competitiveness and quality of life of communities. However, growth at the expense of natural resources is unwise — not only in those high value natural resource areas that are under low to moderate development pressures like the Paw Paw, Dowagiac, and Rocky River subwatersheds previously discussed but in existing urban and rapidly developing areas as well, such as the NPDES Phase II communities of St. Joseph/Benton Harbor, Elkhart/Goshen, and South Bend/Mishawaka. These areas are characterized by extensive impervious surfaces. The displacement of cropland, open space, and forested areas by the impervious surfaces of driveways, streets, and buildings greatly intensifies the volume and velocity of stormwater runoff, exacerbates stream channel erosion, and diminishes groundwater recharge. Furthermore, the sediments, nutrients, toxins, and pathogens transported from impervious surfaces into surface water substantially degrades streams, rivers, wetlands, and lakes. Once the impervious area of a watershed exceeds 10 percent, aquatic ecosystem health tends to decline; at 30 percent impervious cover, the watershed becomes severely impaired. Urban land uses (residential and commercial/industrial/transportation) contribute disproportionately high loads of pollutants compared to the area they occupy in watersheds.

While the developing areas at the fringes of these major urban centers have more options to proactively manage stormwater (many of which are mentioned under the Critical Areas for Preservation section), protecting water quality in urbanized areas* is difficult because of many factors, such as diverse pollutant loadings, large runoff volumes, limited areas suitable for treatment systems, high implementation costs for structural controls, and destruction, degradation, or absence of buffer zones to filter pollutants and stabilize streambanks and shorelines. Ironically, the establishment and preservation of buffers and natural floodplains (by policy, code, or ordinance) may be the single most important component of any plan to mitigate the impacts of storm water runoff. Once these features are lost, mitigation of stormwater runoff becomes more complicated and costly. Where existing development precludes the use of effective non-structural controls such as buffers or bio-retention cells, structural practices that control flooding and improve water quality might be the only suitable option to decrease the nonpoint source pollution loads generated from developed areas. Where and whenever possible, surface water treatment systems should be an integration of source, conveyance, and infiltrative controls — both structural and nonstructural, natural and man-made.

In the past, conventional wet and dry pond systems were often considered the best way to manage flooding from storm water runoff. But these systems were not designed to improve water quality, protect aquatic ecosystems, or mimic natural hydrological regimes and in many urban areas the lack of suitable areas frequently restricts the use of ponds. The St. Joseph/Benton Harbor, Elkhart/Goshen, and South Bend/Mishawaka urban communities are no exception. Nonpoint source load modeling of these communities quantified the total amount of phosphorous and suspended solids in storm water runoff (see report entitled *Analysis of Urban Stormwater BMP Options for the St. Joseph River Watershed* in the Appendices for more detailed loading and reduction information) and concluded that a total of almost 85,000,000 cubic feet of wet retention pond (388 acres) would be needed to treat 21,454 pounds per year of phosphorous and 5,262,586 pounds per year of sediments at a capital cost of $82,390,377 and a 30 year annualized cost of $6,970,470. The same volume and area of dry detention ponds would be needed to treat 7,339 pounds per year of phosphorous and 2,923,659 pounds per year of sediments at a capital cost of $65,912,301 and 30 year annualized cost of $4,287,676. As noted above these urban areas simply do not have the acreage or resources available to build and maintain such extensive pond systems. Three other BMPs — vegetated swales, rain gardens, and constructed wetlands — were also analyzed for cost and effectiveness at removing phosphorous and suspended solids. Among the five BMPs examined, wet retention ponds and constructed wetlands provide the highest load reductions while vegetated swales show the highest cost-effectiveness. Caution should be taken, however, in interpreting these results due to uncertainties in design parameters and installation costs of vegetative swales and rain gardens. Keep in mind that cost effectiveness may not always be the only consideration — the value of rain gardens, for instance, goes well beyond treating runoff. Effective source control, rain gardens also provide habitat to native plants and wildlife, enhance the aesthetics of urban lands, and raise the awareness of storm water issues among the general public. Furthermore, many other LID and retrofit BMPs exist to address pollutant loads in these critical urban areas and which ones are most effective should be evaluated on a case by case basis by local stakeholders. But estimates for the five management and treatment options outlined above do provide a broad indication of the problem and a context in which other BMPs can be evaluated.

Relevant Goals and Objectives:

- Goal #2, Objectives A, B, C, D, G
- Goal #3, Objective F
- Goal #4, Objective E
- Goal #5, Objective F
- Goal #7, Objective G

**An urbanized area is a land area comprising one or more places — central place(s) — and the adjacent densely settled surrounding area — urban fringe — that together have a residential population of at least 50,000 and an overall population density of at least 1,000 people per square mile. This definition comes from the United States Census Bureau and is used by the USEPA to determine Phase II communities.*

critical areas for agricultural storm water management

Land use within the St. Joseph River watershed is largely agricultural — approximately 70 percent is in crops or livestock production — and the majority of that agriculture is row crops like soybeans and corn. As is the case in any agricultural watershed, storm water runoff carries significant amounts of nonpoint source pollutants into surface waters. Historically, tiling and ditches (whether natural streams or man-made conveyances) opened up large swaths of wetlands and marginal land to production, but the resulting alterations in natural hydrological systems and cycles has exacerbated the impacts of agriculture. Today, there are many ongoing efforts on the part of government agencies working closely with producers to lessen these impacts and restore some of the natural hydrology by changing practices. The Elkhart, Fawn, and Pigeon river subwatersheds — all largely agricultural and representing more than a third of the entire St. Joseph River watershed — had the highest watershed mitigation scores based on planning project efforts (see report entitled *Scoring of Major Subwatersheds* in Appendices for more information). These subwatersheds were examined using Soil and Water Assessment Tool (SWAT) modeling to assess phosphorus, nitrogen, sediment and atrazine loading, and BMP effectiveness.

SWAT modeling examined the load and concentration reductions resulting from a combination of agricultural BMPs and hypothetical BMP implementation rates (percentage of land implemented with the BMP). Results were interpreted as the load or concentration reductions expressed at the mouth of each tributary. However, keep in mind that because of in-stream settling, resuspension, and/or algal uptake/release, load reductions achieved at subwatershed level can be diminished at downstream observation points. The simulated BMP implementation scenarios (15 in all) were conservation tillage, nutrient management, filter strips, contour farming and combinations of the three most efficient BMPs in each subwatershed. These BMPs were applied at three different land area percentages (25, 50 or 75 percent) of the tributary watershed.

Model analysis concluded that in the Fawn River watershed, the no-till and the edge-of-field filter strips BMPs have the highest load reductions, especially at the 50 percent application rate. In the Pigeon River watershed, filter strips are the most effective BMP in most cases and become even more so as the implementation rate increases. This difference is due primarily to differences in soils and crops. Similar to the Pigeon River, the Elkhart River subwatershed has heavy, poorly drained soils and a significant presence of corn silage-hay as opposed to the Fawn River subwatershed where the soils are typically well drained and corn and soybeans dominate. Therefore, it is not surprising that filter strips are the best performing BMP in the Elkhart River subwatershed. When cost is not factored in, a combination of no-till, filter strips, and contour farming gives the highest overall load reductions in all cases. Unfortunately cost is often a major factor. In such situations, no-till appears to be the BMP of choice for all three of these major agricultural subwatersheds, due to its low cost per acre implementation cost and the high cost of establishing and maintaining filter strips. However, the analysis also revealed that as the implementation rate (percentage of watershed covered by a BMP) increased all BMPs had an increasing cost effectiveness, suggesting the advantage of large scale, multi-faceted BMP implementation efforts. (More comprehensive information on reductions and costs is available in the report entitled *SWAT Modeling of the St. Joseph River Watershed, Michigan and Indiana*, included in the Appendices.)

Again, depending on local soil, topographical, and crop conditions, different BMPs may prove more effective than those indicated at the subwatershed scale using SWAT modeling, which modeled for four pollutants and four popular BMPs. A county may rank high for hay and popcorn production, but also have many producers who raise specialty crops such as green beans, potatoes, and gladiolus. So it is important for local stakeholders to assess the needs of producers individually and design mitigation and management protocols tailored to those needs in the context of nonpoint source mitigation for the subwatershed in question. In many cases, this type of multi-faceted approach is already underway. For the past five years, the LaGrange County SWCD has been partnering with other SWCD and NRCS offices in the St. Joseph River watershed to conduct a livestock management program that focuses on limiting livestock access to waterways (including wetlands), development of nutrient management plans and conversion of cropland to pasture. This program reduces sediments, phosphorous, and nitrogen as well as pathogens such as E. coli. Groups such as Pheasants Forever in Indiana are also working to help reduce polluted runoff by establishing filter strips along streams and ditches and converting marginal cropland to habitat. It is just these types of local partnerships and initiatives that can make the most impact on the mitigation of pollutants from agricultural runoff.

Relevant Goals and Objectives:

- Goal #2, Objectives A, D, E
- Goal #3, Objective C
- Goal #4, Objectives E, F
- Goal #5, Objective F
- Goal #6, Objective C
- Goal #7, Objectives C, D

no action scenario

The Great Lakes Commission awarded a grant to the Friends of the St. Joe River Association to conduct limited build out analyses using ArcView extension, Landscape Analyst as a tool to project future development in the watershed and to model potential threats to existing open space. Identification of threats to open space and loss of farmland highlights the need for preservation, smart growth, and the coordinated implementation of the watershed management plan. The analysis was also designed to illustrate the impacts of water quality from unplanned growth with no stormwater management. A nonpoint source loading model (using 2000 land cover data) for sediment and phosphorus was used to estimate loads to the St. Joseph River from future development on the county and subwatershed scales. As would be expected, future development that occurs as it currently does (that is to say without the implementation of the goals and objectives outlined in this plan) will have a profound negative impact on water quality. Overall, a 27 percent increase in runoff is expected. Sediment loading will increase 15 percent and phosphorus loading will increase 52 percent based on model projections. The increase in phosphorus loading is the greatest because the future predicted development is primarily residential (75 percent), which produces the highest concentration of phosphorus in runoff of all land types. Of course, a 27 percent overall increase in runoff which is primarily the result of residential development of agricultural and forested lands (as model analysis indicates) will not only produce marked increases in sediment and phosphorous loads but other nutrients and toxins as well from residential and commercial application of herbicides, fertilizers, and pesticides and automobile byproducts from roadways constructed to service the growth. Furthermore, future development undertaken without implementation of this management plan will no doubt reduce the effectiveness of the ecological systems and services so vital to human civilization as open space is converted and habitat is destroyed. Simply put, taking no action is not an option. Proactively addressing the potential threats to water quality, habitat and ecological systems has been proven to cost significantly less than future mitigation and remediation, as New York City's purchase of Catskill Mountain land to protect the watershed that purifies urban drinking water sources attests.

See report entitled *Protecting a Bi-state Resource: Build-out Analysis of the St. Joseph River Watershed* for more detailed information.

evaluation

Evaluation provides a feedback mechanism for periodically assessing the effectiveness of management practices and allows stakeholders to identify areas where program improvement is possible. Evaluation also gives stakeholders an opportunity to assess the efficacy and appropriateness of the original goals and objectives as conditions on the ground change through time. Programs that are periodically reviewed and evaluated (with results reported to participants, funders, and the general public) are more effective and are more likely to receive the public and political support necessary to achieve success.

The evaluation methods identified in relation to the general goals and objectives — while a helpful tool for local stakeholders seeking ways to assess the effectiveness of their implementation or education/outreach efforts — are by no means exhaustive. Many other assessment measures exist and local stakeholders must take care to create evaluation programs and protocols that meet local needs. The ways in which a stormwater education program or streambank stabilization project is evaluated in Three Rivers might be quite different from similar efforts undertaken in Angola. That said, there are some basic elements of assessment that should be considered as part of an overall evaluation program.

Typically, evaluation programs include two types of measures: quantitative and qualitative, each of which requires significantly different skill sets. Quantitative approaches focus on statistical analysis of project impacts while qualitative measures try to shed light on changes in attitudes, perceptions and knowledge levels. Below are some examples of the two approaches:

Quantitative Measures

- Chemical monitoring of surface waters (e.g. temperature, nutrients, dissolved oxygen, bacteria)
- Biological monitoring of surface waters (e.g. fish, macroinvertebrate, plant communities)
- Stream flow monitoring (e.g. volume, velocity)
- Sediment monitoring (e.g. deposition, composition)
- Increases in the amount of sediment/debris removed from streets and catch basins
- Increases in the amount of used oil and other hazardous wastes collected
- Number of illicit storm water connections detected
- Number of buffer ordinances adopted by townships and cities

- Increase in the number of construction sites that are implementing soil erosion control BMPs
- Educational workshop attendance levels
- Management practice surveys (e.g. land use, percent impervious area, type of waterbody protected, erosion and nutrient control plans, total acreage under management)

Qualitative Measures

- Public opinion surveys on health of Elkhart River fisheries
- Whether attendees at educational workshop on rain gardens felt that information was helpful and that the time was well spent
- Public assessments of surface water clarity, odor, color, etc.
- Increased awareness of impacts of nonpoint source pollutants on aquatic habitats
- Heightened appreciation of wildlife habitat and open space as they relate to quality of life issues
- More positive feelings about vegetated buffer strips along urban creeks
- Increase in producer interest in recognition programs like River Friendly Farmer and MAEAP
- Increased cooperation and networking among watershed groups
- Increased sense of empowerment on the part of grass roots advocacy groups to make positive changes
- Public confidence that groundwater is safe
- Belief that information from Friends of the St. Joe River Association is accurate, non-partisan, and valuable

Whether using quantitative or qualitative measures, monitoring the effectiveness of the St. Joseph River Watershed Management Plan will be two-tiered. First, individual agencies and communities will monitor certain projects and programs on the agency and community levels. Secondly, there will be a need to monitor progress and effectiveness on a regional watershed level in order to assess the administrative, environmental, and social effects of collective community and agency actions of the health of the St. Joseph River and its tributaries. This responsibility will most likely fall to the stakeholder group identified in Goal #1 — whether it is a new entity (like a watershed council) or an existing agency or group that expands its role. Currently, there exists limited institutional capacity for this type of monitoring. Although the Friends of the St. Joe River Association and the St. Joseph River Basin Commission operate on a regional basis and could be future partners in this effort neither presently engage in any kind of formal, sustained monitoring activities for the entire watershed.

Perhaps the most common environmental assessment tool used to measure the effectiveness of watershed management practices is water quality monitoring. This type of monitoring typically consists of chemical, biological, and habitat assessments. It can provide valuable information and offers a fairly objective and verifiable way to track water quality over the short and long term once a baseline is established. It is important to keep in mind that monitoring to evaluate water quality trends, water quality differences related to land use, or to relate improvements in water quality from implementation of program control measures can be difficult and usually requires technical expertise. Regional monitoring strategies should be utilized whenever possible, especially if the goal is to get an accurate picture of water quality trends on a watershed wide scale over time or if multiple pollutant sources are involved. IDEM's Office of Water Quality (www.in.gov/idem/water/assessbr), MDEQ's Water Bureau (www.michigan.gov/deq) and MDNR's Fisheries Division (www.michigan.gov/dnr) all have water quality monitoring programs that conduct ongoing biological, chemical and habitat assessments. IDEM conducts its monitoring statewide in targeted basins on a five-year rotating basin cycle; the St. Joseph River watershed (part of the Great Lakes Basin) will be monitored in 2005 and again in 2010. MDEQ monitors Michigan's watersheds on a statewide five-year rotating cycle as well. Representative sites in the Upper St. Joseph River watershed will be monitored in 2005 and 2010, etc. and the Lower portion will be monitored in 2006, 2011 and so on. MDNR has no set schedule for its surveys. It performs random water quality, fish and habitat surveys throughout the watershed. IDEM and MDEQ both seek public input on sampling locations. In addition to these efforts, Hoosier Riverwatch (www.hoosierriverwatch.com), Friends of the St. Joseph River Association (www.fosjr.org), the United States Geological Survey, or USGS (www.usgs.gov), the Indiana Clean Lakes program (www.spea.indiana.edu/clp), and county health departments also have monitoring programs in place. Riverwatch and the Friends rely on volunteers to collect samples and do field testing. USGS maintains gauges that measure water level and flow data and occasionally conducts special assessments. Health Departments primarily monitor for E. coli bacteria. The vast majority of these water quality data (along with contact information) is readily available to the public on agency and organization websites. Those who have questions or are interested in more detailed information about the specific parameters of the assessments are encouraged to visit these web sites or contact the agency/organization directly. Many other smaller, time/scope limited, or sporadic efforts also take place within the watershed, managed by state agencies, municipalities, lake associations, conservation districts, high school science teachers, and others in the community. Ideally, much of this data would be consistently incorporated into a comprehensive volunteer water quality monitoring and data management system (see Goal #4, Implementation Objective D) but at the present time is not.

Unfortunately, not all watershed management projects, whether the focus is local or regional, can afford water-quality monitoring and few rely on local funds for such monitoring.

When little or no funding is available for monitoring the effectiveness of BMPs, visual observations of qualitative changes such as fewer algal blooms, clearer water or increased recreational use can be helpful in assessing the effectiveness of the project. Even if citizens monitor a few key factors (such as dissolved oxygen, turbidity, pH, or temperature) on a monthly basis, they can contribute significantly to a project. *Note:the detectable limits for some indicators on volunteer test kits often times are so far above what is considered safe or acceptable by regulatory agencies that the tests results are irrelevant. It is important to make sure that volunteer monitoring methods and parameters correspond with identified watershed problems. For example, testing for pH in a watershed like the St. Joseph where the geology stabilizes pH is unnecessary (J. Rathburn, MDEQ, Personal Communication).* Furthermore, there is usually some kind of water quality monitoring already underway in almost any watershed and it is important to identify other groups who may have similar interests and goals in order to avoid costly duplication and overlap. Volunteers can acquire the training and equipment necessary to conduct basic sampling and analysis through Hoosier Riverwatch and Friends of the St. Joe River Association. These programs and the data they collect can be entered via internet based forms for sharing with other interested stakeholders and policy makers.

Because limited resources affect the design of water quality monitoring programs, an approach that includes a core set of indicators that correspond to designated/desire uses plus supplemental indicators selected according to site/project specific needs or to further investigate impairments and emerging concerns is often a good idea (see *Water Quality Monitoring Parameters* table at the end of this section). The challenge is to collect all water quality sampling data in a consistent manner that ensures the data are reliable and useful to stakeholders throughout the watershed, regardless of jurisdiction. In a multi-jurisdictional watershed like the St. Joseph —where the main stem itself crosses township, county, and state lines — consistency of approach and methodology is important.

Although a common and valuable approach, water quality monitoring is not a magic bullet. There are challenges associated with using methods for evaluation of projects. The central challenge is the fact that watersheds are extremely complex, fluid systems and are not easily studied. A dizzying multitude of factors, both natural and man-made, affect water quality and our ability to attribute improvements to any specific BMP or educational tool is limited, at best. Furthermore, common sense dictates that this problem grows exponentially as the size of the watershed under study grows. That is why qualitative assessments, which are uniquely suited to identify and analyze quantitative data trends, should be an integral part of any evaluation program. For sure, it is important to know how many low impact development presentations were made to township planning officials in Michigan during 2007 but just as important to have a sense of how they were received, what types of questions were raised, and the level of enthusiasm expressed about revising zoning ordinances and master plans — things that are difficult to assess quantitatively.

Finally, any program assessment should focus on basic activity measurements, consistent reporting, and the establishment of baselines. For instance, a water quality monitoring strategy that provides sufficient information to evaluate the effectiveness of BMPs — locally and regionally — needs to have established pre-BMP water quality conditions to provide a frame of reference for future evaluation. As the educational effort or BMP is implemented, the water quality monitoring strategy can be "pulsed" so that it consists of a series of short-term (three to five years), high-intensity studies separated by longer periods (10 to 15 years) of low-intensity data colletection (adjusted to reflect the implementation timeframe of the objective). These studies should focus first on biological and habitat indicators because changes in these indicators usually signal representative changes in chemical parameters. In general, a sense of what messages, delivery mechanisms, and BMPs are working and not working and why is utterly dependent on conscientious evaluation and reporting by all stakeholders responsible for implementation of the watershed management plan. As more and more of the objectives outlined in the management plan are implemented in subsequent years, an assessment based on trends as compared to the baselines established in the first several years will be possible. Such an assessment is needed if the plan is to remain flexible, relevant, and effective for those who use it.

In addition to the indicators below which help us assess overall water quality in the context of the major nonpoint source pollutants and stressors this management plan seeks to address, there are many existing and potential pollutants that are, at this time, beyond the scope of the plan; others may simply not be the subject of any existing monitoring regime or regulatory framework. PCBs, mercury, and metals (e.g. copper, lead, cadmium, chromium) that accumulate in tissue and sediments are primarily deposited atmospherically or remain residually from historical contamination and are beyond the ability of this plan to address. However, elevated PCB and mercury levels in fish do trigger consumption advisories. Volatile organic compounds (fuel additives, industrial solvents, septic system cleaners), semi-volatile organic compounds (diesel and motor oils, herbicides, pesticides, combustion residues) and numerous other organic and inorganic substances may be present locally at levels above those deemed safe but are not pervasive, chronic problems for which regional monitoring regimes have been developed. Of these, only the metals are tested routinely and since they are most often found in sediments are beyond the ability of this plan to address. The herbicides (like atrazine), pesticides, household chemicals, and combustion residues that are carried into surface waters via storm water runoff are not currently the subject of any routine water quality testing. Monitoring for these pollutants may become necessary in the future but it is not part of this plan; this plan will rely on load reduction calculations and other evaluation methods identified under Goal #7. Naturally, if local levels of any of the aforementioned pollutants warrant monitoring then a plan should be developed and implemented to track them over time.

water quality monitoring parameters

Type of assessment	Indicator(s)	Monitoring activities	Suitable for volunteers*	Agencies that can provide service or guidance for volunteers	Relevant pollutants and stressors
Biological	Macroinvertebrates	Field collection	Yes	HR, MDEQ	Sediment, nutrients, invasive species, hydrological modification
Chemical	Dissolved oxygen	Lab analysis DO meter DO test kit	Yes	HR, MDEQ	Sediment, nutrients
	Biochemical oxygen demand	Lab analysis DO test kit	Yes	HR	Sediment, nutrients
	Bacteria	E. coli test	Yes	HR, MDEQ	Pathogens
	Temperature	Thermometer HOBO logger	Yes	MDEQ	Sediments, hydrological modification
	Nutrients	Lab analysis	Varies	HR, MDEQ	Nutrients
	Conductivity	Lab analysis	Yes	MDEQ	Nutrients, toxins
	Turbidity	Lab and field analysis	Yes	HR, IDEM	Sediment, hydrological modification
	Total suspended solids	Lab analysis	No	MDEQ, IDEM	Sediment, hydrological modification
Habitat	Substrate composition	Visual inspection	Yes	HR, MDEQ	Sediment, hydrological modification
	Fish populations	Tagging Catch Surveys	No	MDNR, IDEM	Sediment, hydrological modification, nutrients, pathogens, invasive species
	Bank stability	Visual inspection Field analysis • BEHI index • Erosion pins • Etc.	Yes	HR, MDEQ	Hydrological modification
	Geomorphic characteristics • riffles • pools • runs • bends	Field analysis	No	MDEQ	Sediment, hydrological modification
	Land use	Visual inspection	Yes	HR	Hydrological modification, sediment, nutrients, pathogens, toxins, habitat loss
	Riparian vegetation	Visual inspection	Yes	HR, MDEQ	Hydrological modification, invasive species, habitat loss
	Flow regime • velocity • volume	Field analysis	Varies	HR, MDEQ	Sediment, hydrological modification, habitat loss
	Instream cover	Field analysis	Varies	MDEQ, IDEM	Sediment, hydrological modification, invasive species, nutri-ents

**In many instances volunteers may not have the background or level of training necessary to conduct field/lab analysis. However, with minimal training almost anyone can collect samples and send them to labs for analysis, a volunteer service which allows limited human and financial resources to be applied elsewhere.*

potential funding sources

The following are some of the possible funding sources (grant, loan, and cost share programs) available to stakeholder agencies and non governmental organizations for watershed management. This list is not exhaustive. Many other funding sources exist, especially on the local level. Information on these funding sources can be found on the internet or by contacting the agency or nonprofit.

agricultural

Agriculture in Concert with the Environmental Program (USDA)

Watershed Protection and Flood Prevention Program (USDA)

Conservation Reserve Program (NRCS)

Wetlands Reserve Program (NRCS)

Wildlife Habitat Incentive Program (NRCS)

Forestry Incentives Program (NRCS)

Environmental Quality Incentives Program (NRCS)

Farmland Protection Program (USDA)

Debt for Nature (Farm Service Agency)

SARE Producer Grant Program (USDA)

storm, waste and drinking water improvements and management

Section 104(b)(3) NPDES Related State Program Grants

MDEQ and IDEM Clean Water State Revolving Fund Loans

MDEQ and IDEM Drinking Water Revolving Fund Loans

Rural Business Enterprise Grants (water, wastewater, stormwater) (USDA)

Rural Development Water & Wastewater Disposal Program Grants & Loans (USDA)

habitat restoration and creation

Partners for Fish & Wildlife (US Dept Fish & Wildlife)

North American Wetland Conservation Act Grant Program (US Dept of Interior)

National Fish & Wildlife Foundation (US Dept of Interior)

Indianapolis Power & Light Company Golden Eagle Environmental Grant
US EPA Five Star Restoration Grant Program
Great Lakes Aquatic Habitat Network and Fund
Natural Heritage Grant Program (MDNR)
Inland Fisheries Grant Program (MDNR)
Private Stewardship Grant Program (US Dept of Interior, US Fish & Wildlife, Endangered Species)
Aquatic Ecosystems Restoration Grants (US Army Corps of Engineers)
Great Lakes Fishery Trust

education

Indianapolis Power & Light Company Golden Eagle Environmental Grant
US EPA Environmental Education Program
US EPA Five Star Restoration Grant Program

watershed planning and implementation

Section 205(j) Water Quality Management Planning Grants (IDEM)
Clean Water Act Section 319 Nonpoint Source Pollution Management Grants (MDEQ & IDEM)
Clean Michigan Initiative Grants

general

Lake and River Enhancement Program (IDNR)
Nonpoint Source Pollution Management Grant (MDEQ & IDEM)
US National Research Initiative Competitive Grants Program (USEPA)
Community Forestry Grant Program (IDNR and MDNR)
Great Lakes Basin Program for Soil Erosion and Sediment Control (Great Lakes Commission)
The Joyce Foundation
Kalamazoo Community Foundation
Nina Mason Pulliam Charitable Trust
Clean Michigan Initiative
Wal-Mart Environmental Grants
Frederick S. Upton Foundation
Branch County Community Foundation
Hillsdale County Community Foundation
Three Rivers Area Foundation
Berrien Community Foundation

Michigan Gateway Community Foundation
Sturgis Area Community Foundation
DeKalb County Community Foundation
Elkhart County Community Foundation
Kosciusko County Community Foundation
LaGrange County Community Foundation
Noble County Community Foundation
Community Foundation of St. Joseph County
Steuben County Community Foundation
Great Lakes Commission Grants
Great Lakes Protection Fund
Small Watershed Program (NRCS)
Hometown Indiana Grant Program (IDNR)

water quality monitoring

Clean Water Corps grant program (MDEQ)
Great Lakes Aquatic Habitat Network and Fund

references

references

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figures

figure 1

the st. joseph river watershed

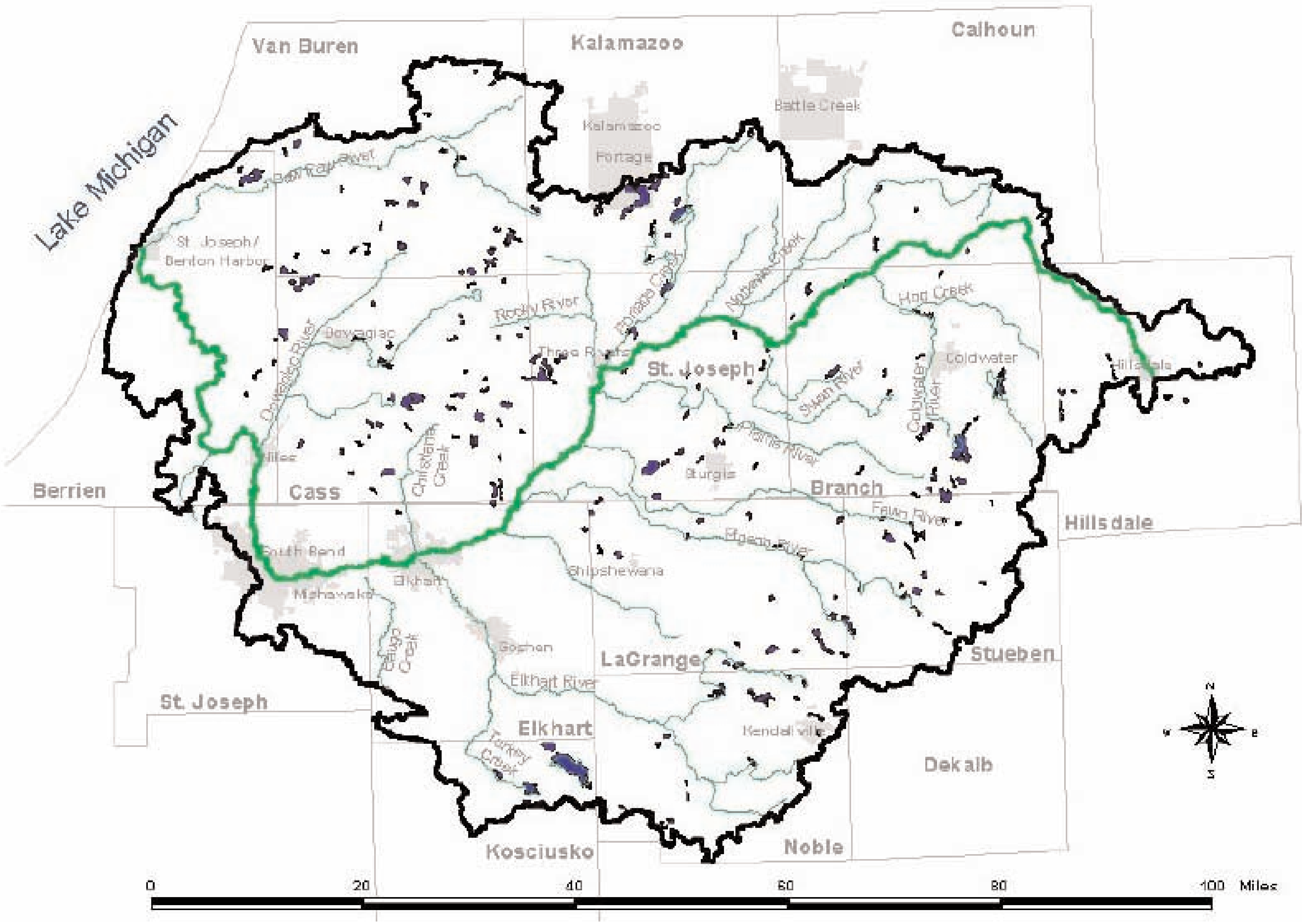


figure 2

cities and counties in the st. joseph river watershed

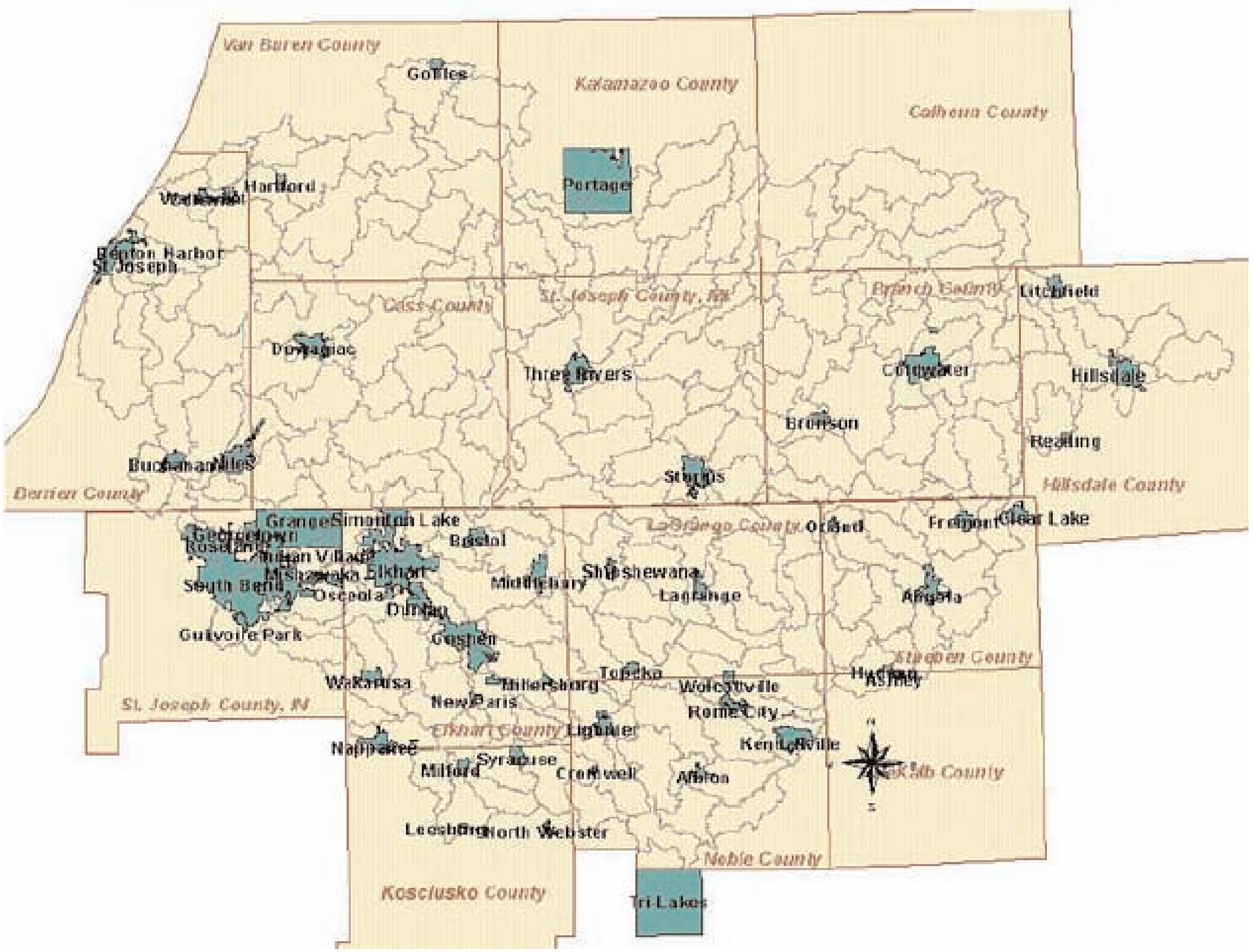


figure 3

subwatersheds of the st. joseph river watershed

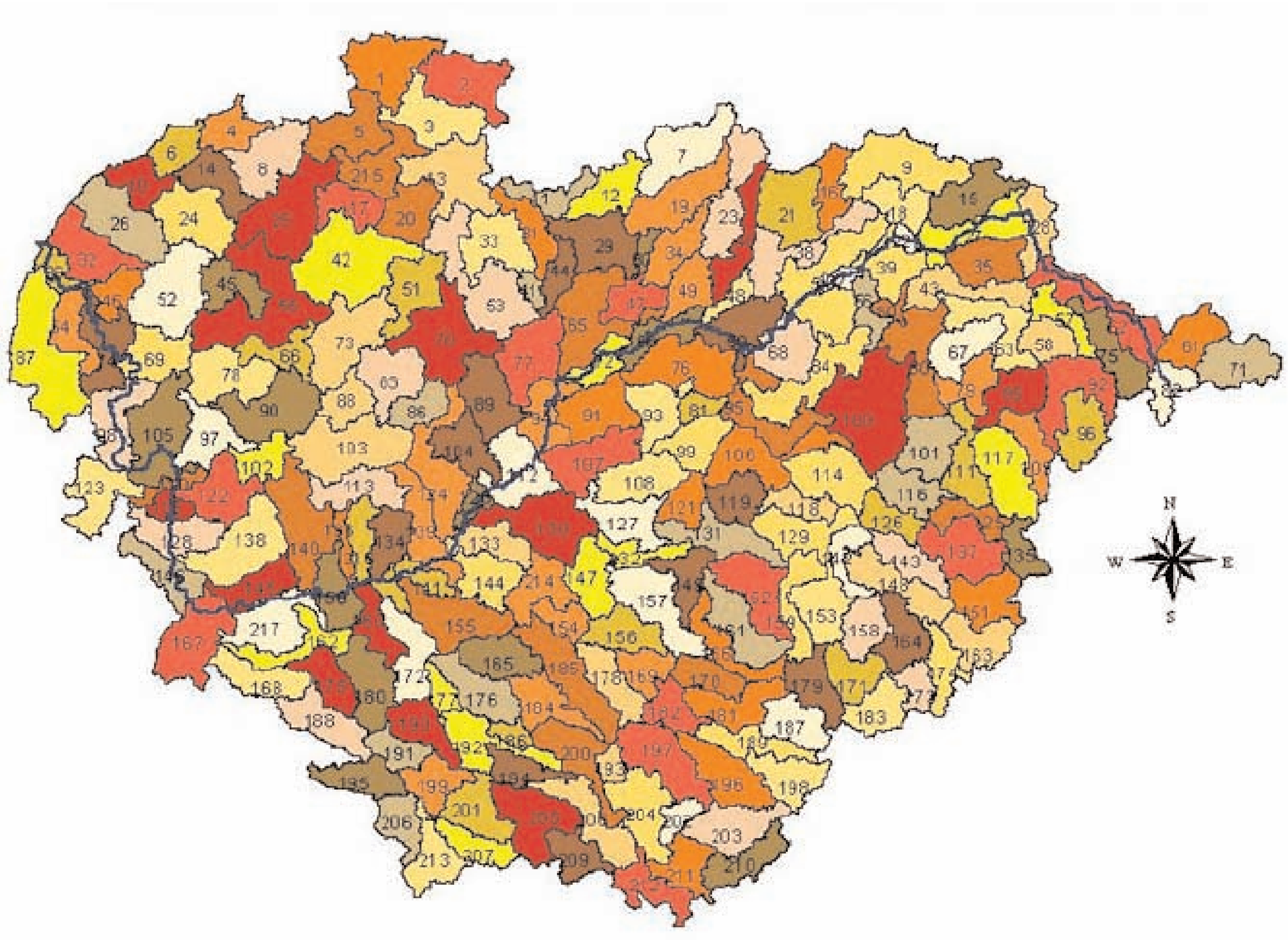


figure 4

main watersheds of the st. joseph river watershed

figure 5

presettlement vegetation in the michigan portion of the st. joseph river watershed

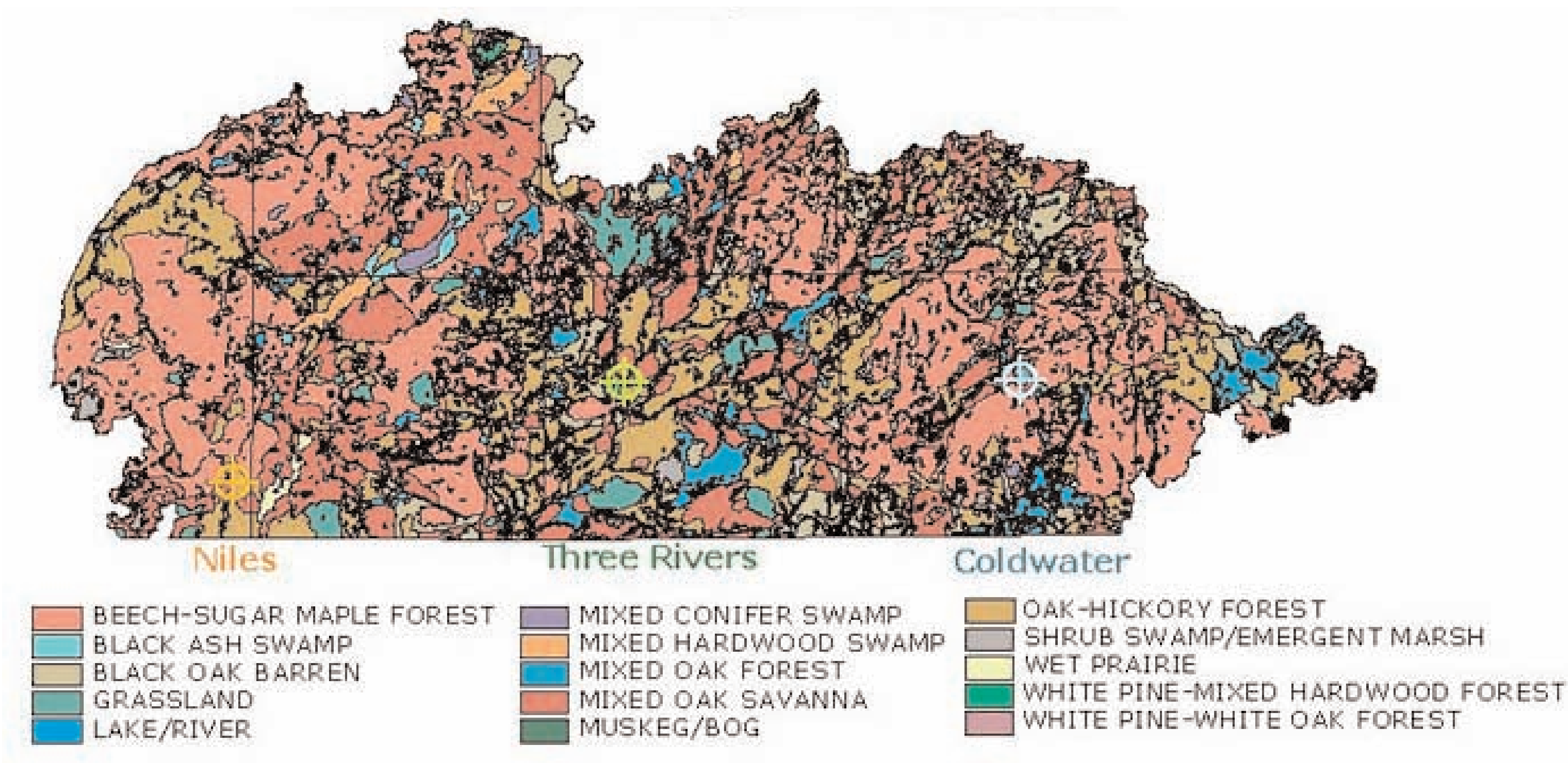


figure 6

land cover in the st. joseph river watershed

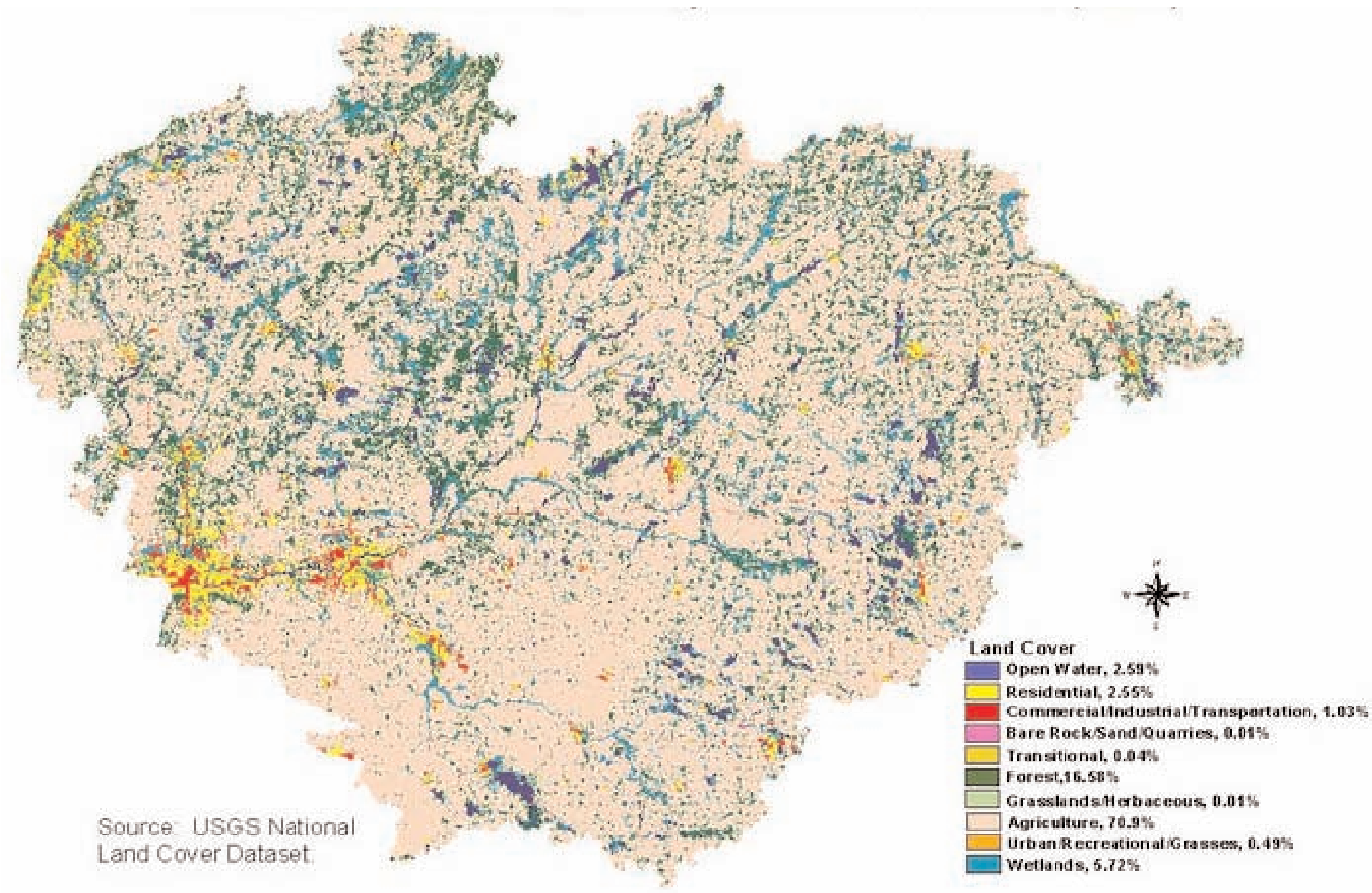


figure 7

elevation of the st. joseph river watershed

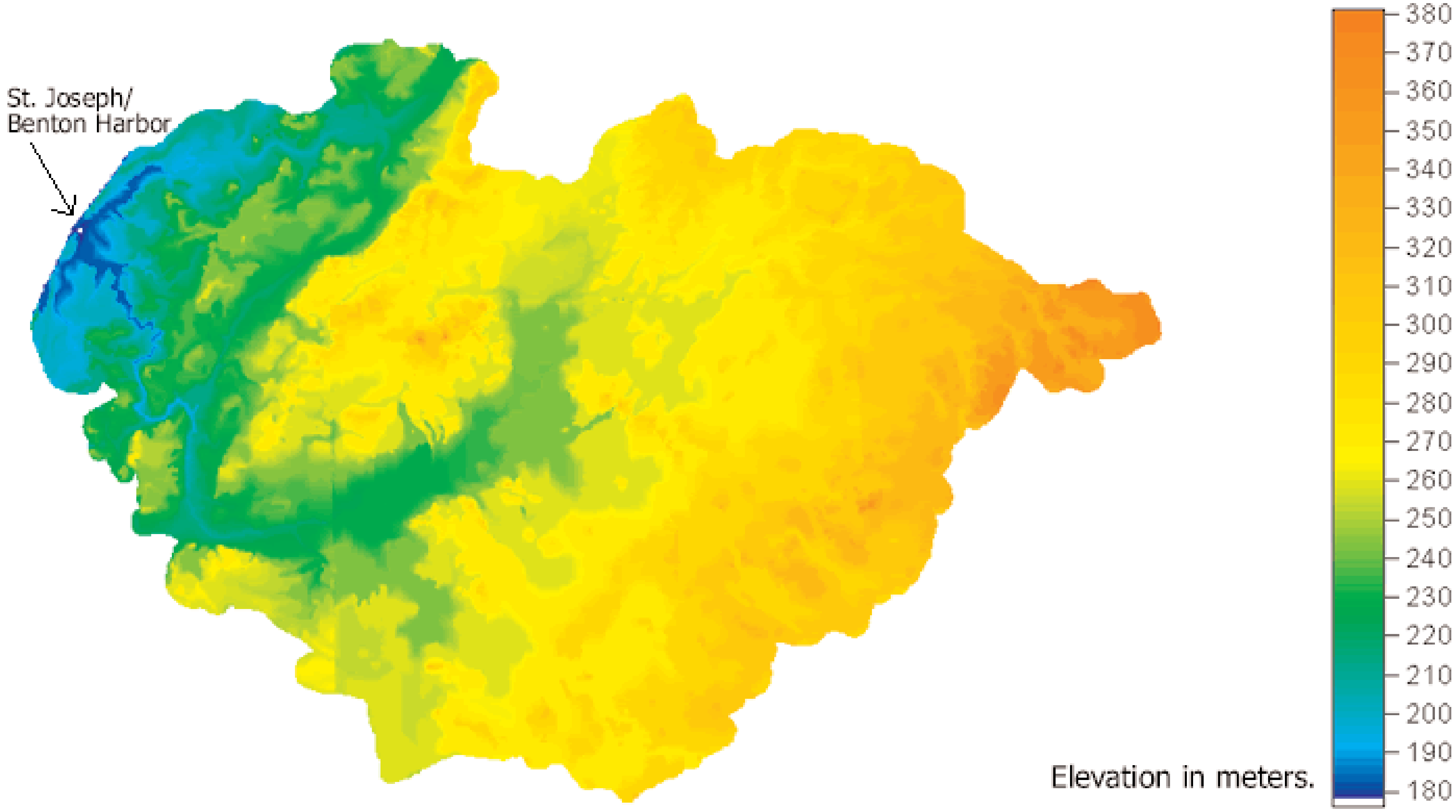


figure 8

watershed soil types

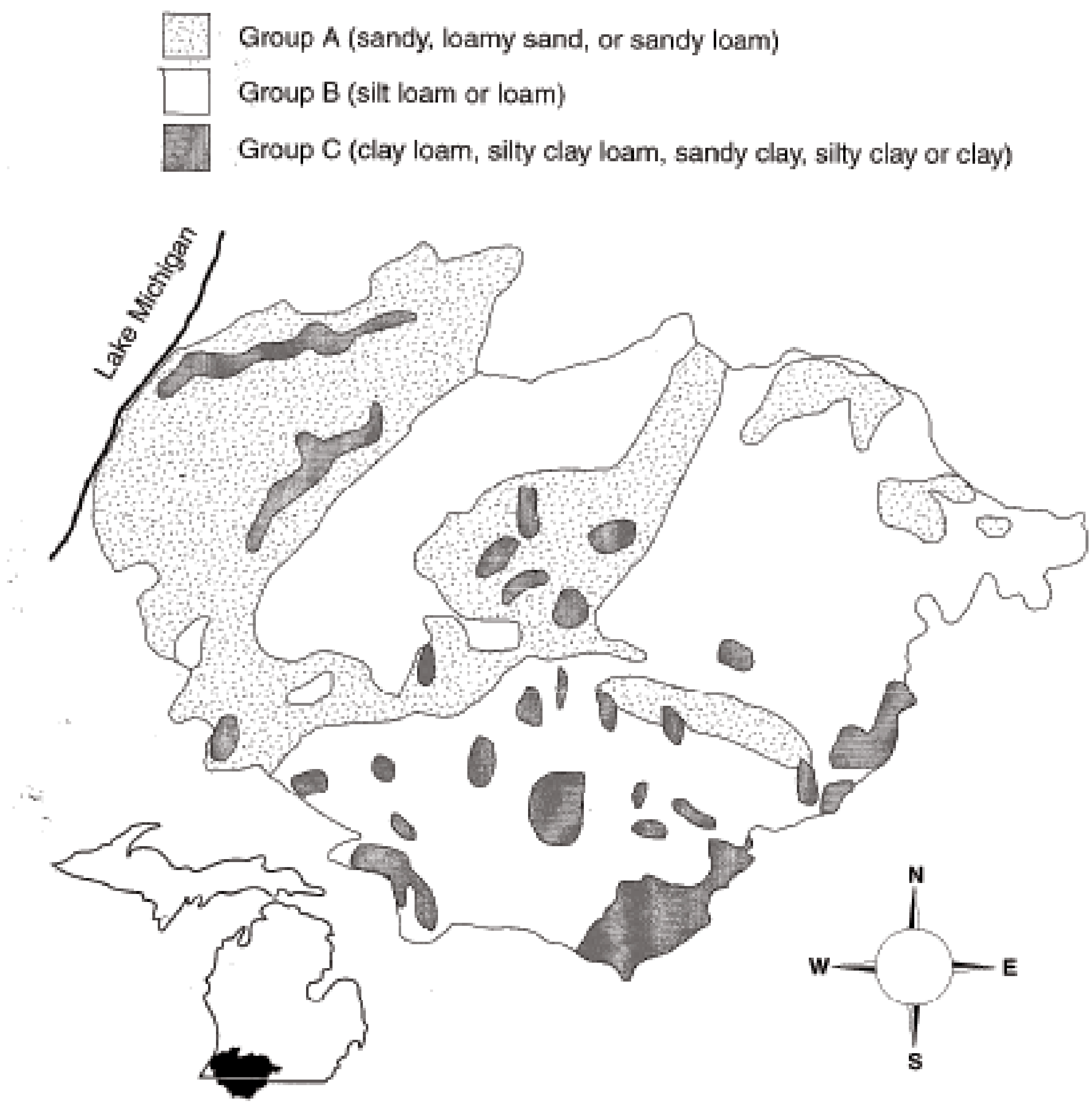


figure 9

STATSGO soils of the st. joseph river watershed

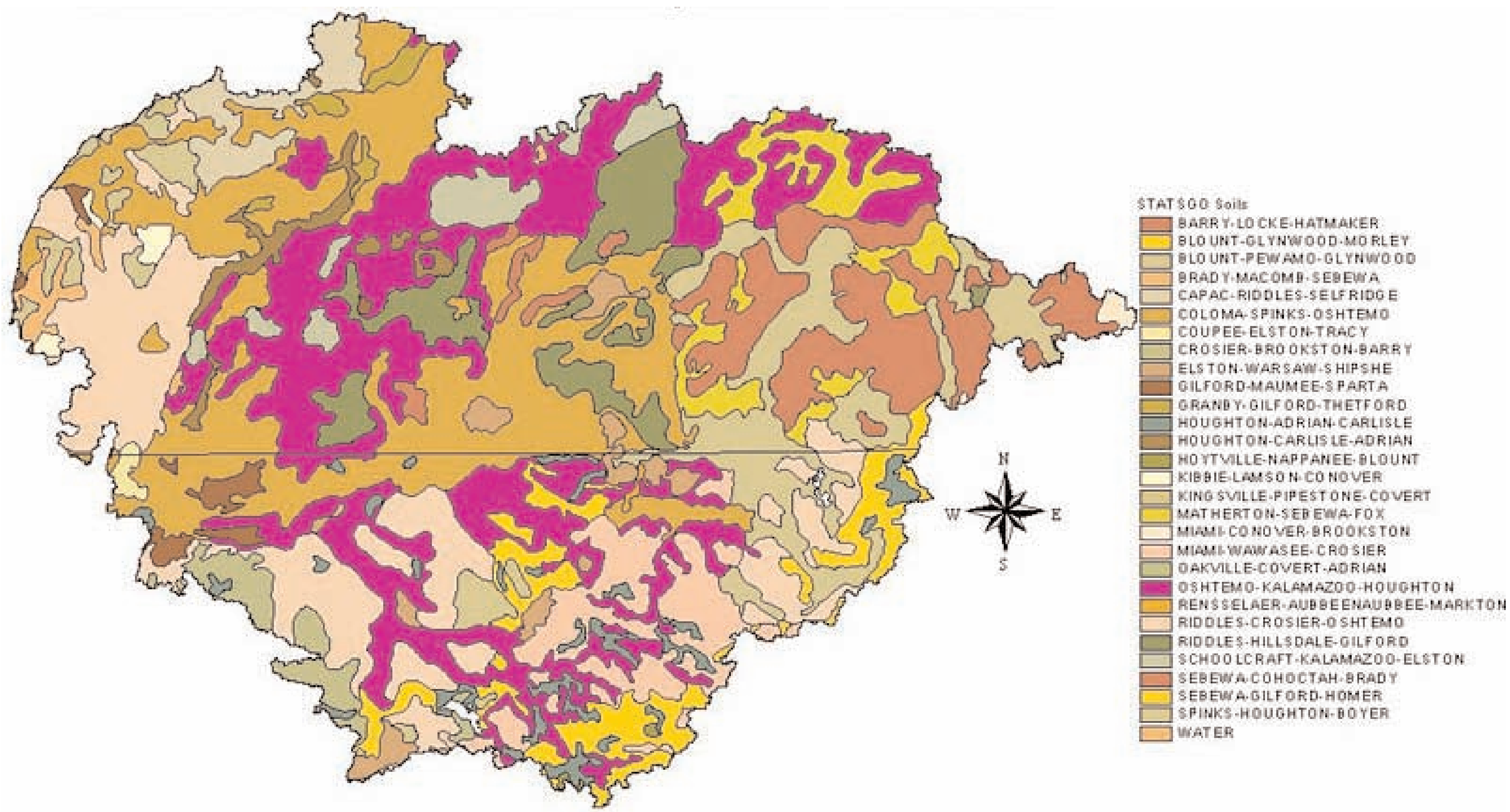


figure 10

dams within the st. joseph river watershed

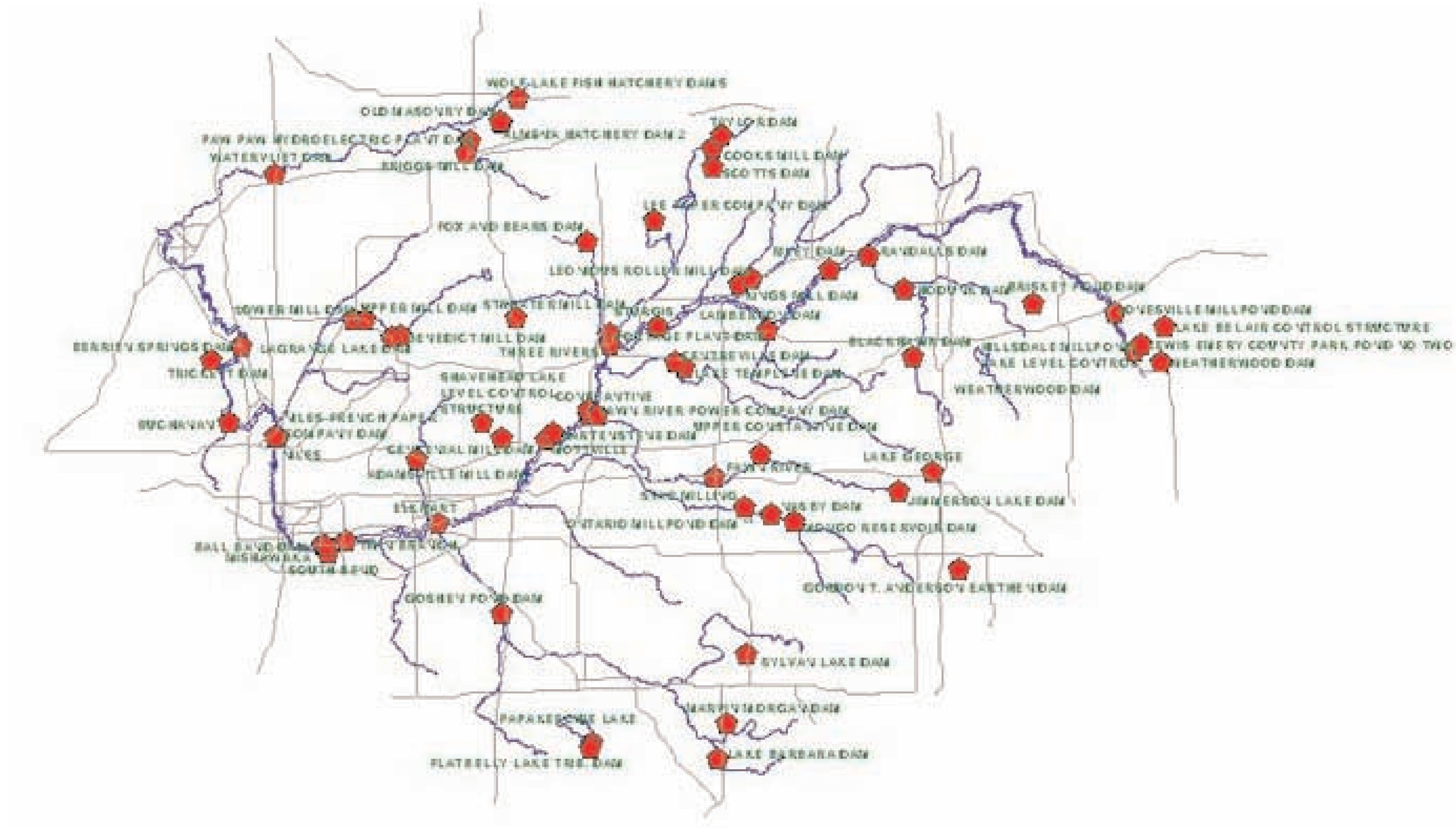
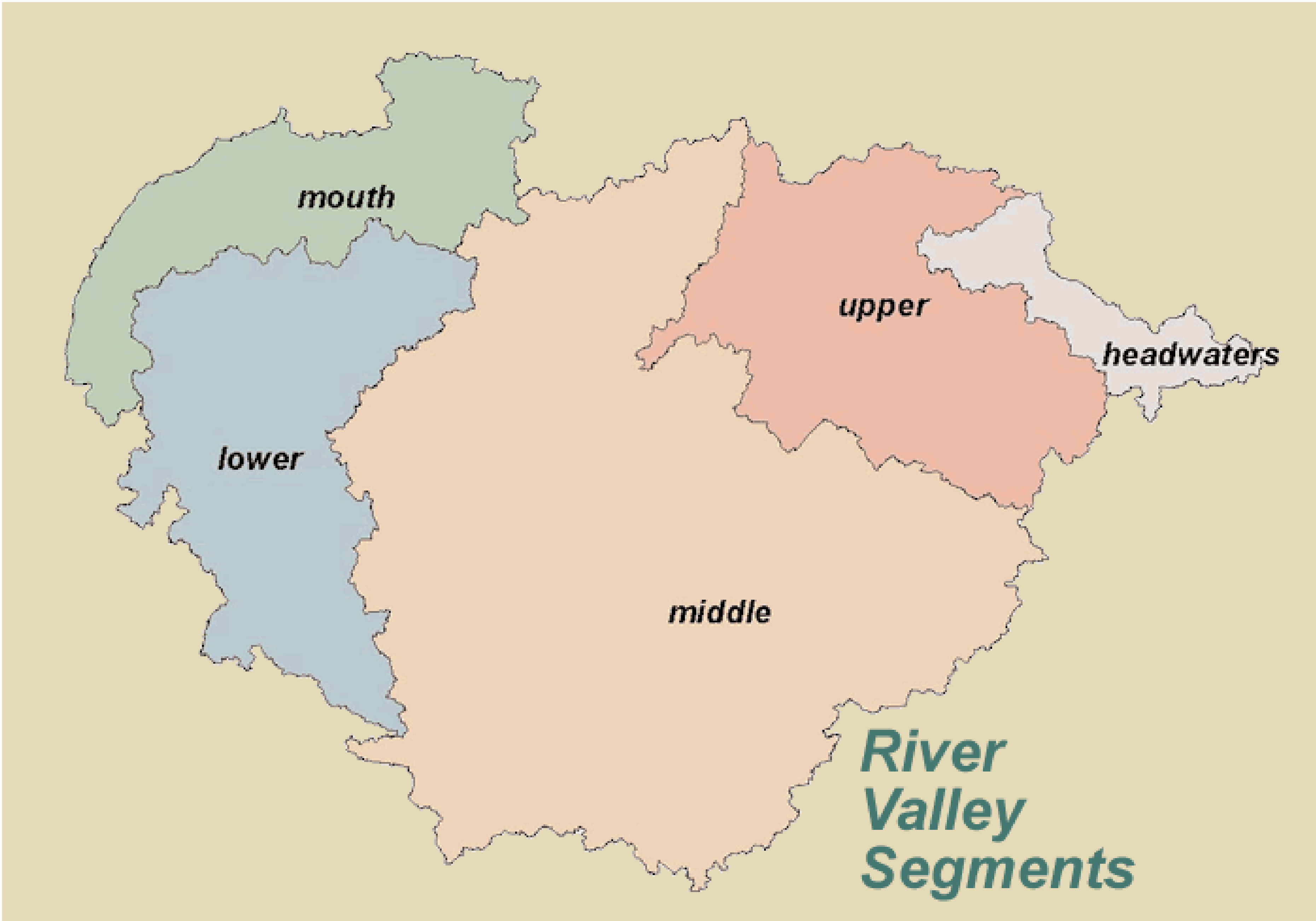


figure 11

river valley segments



tables

table a

subwatersheds

No.	Hydrologic Unit Code	Watercourse	Description
1	4050001260020	Brandywine Creek	at Mouth
2	4050001260010	N Br Paw Paw River	Above Ritter Creek
3	4050001260030	N Br Paw Paw River	at Mouth
4	4050001270030	Mud Lake Drain	at Mouth
5	4050001260080	Paw Paw River	at Brush Creek
6	4050001270040	Paw Paw Lake	at Outlet
7	4050001060010	Portage River	at Indian Lake
8	4050001270020	Paw Paw River	Above Mud Lake Drain
9	4050001040020	Nottawa Creek	at Mud Creek
10	4050001270070	Paw Paw River	at Gage #04102500
11	4050001060040	Gourdneck Creek	at Gage #04097200
12	4050001060060	Gourdneck Creek	Above Sunset Lake
13	4050001260060	E Br Paw Paw River	at Mouth
14	4050001270060	Paw Paw River	at Mill Creek
15	4050001040010	Nottawa Creek	at Unnamed Trib
16	4050001040040	Pine Creek	at Waterman Drain
17	4050001260050	Eagle Lake Drain	Above Unnamed Trib
18	4050001040030	Alder Creek	at Mouth
19	4050001060020	Portage River	at Gage #04097170
20	4050001260040	S Br Paw Paw River	at Lawton Drain
21	4050001040050	Pine Creek	Above Nottawa Creek
22	4050001010100	St. Joseph River	at Gage #04096405
23	4050001050010	Little Portage Creek	at Gage #04097060
24	4050001270050	Mill Creek	at Mouth
25	4050001270010	Brush Creek	at Mouth
26	4050001270080	Paw Paw River	at Blue Creek
27	4050001010090	St. Joseph River	at Gage #04096405
28	4050001010070	St. Joseph River	at Gage #04096340
29	4050001060070	Portage Creek	at Mouth
30	4050001060030	Portage River	Above Portage Creek
31	4050001070020	Flowerfield Creek	at Gage #04097370
32	4050001270090	Paw Paw River	at Mouth

No.	Hydrologic Unit Code	Watercourse	Description
33	4050001070010	Flowerfield Creek	Above Unnamed Tributary
34	4050001060080	Bear Creek	at Mouth
35	4050001010080	Tekonsha Creek	at Mouth
36	4050001280110	St. Joseph River	at Lake Michigan
37	4050001030010	St. Joseph River	at Union City Dam
38	4050001040060	Nottawa Creek	at Gage #04096900
39	4050001010110	St. Joseph River	Above Coldwater River
40	4050001040070	Bear Creek	at Mouth
41	4050001070030	Flowerfield Creek	Above Spring Creek
42	4050001250010	Dowagiac River	Above Osborn Drain
43	4050001020130	Hog Creek	at Mouth
44	4050001070040	Flowerfield Creek	at Mouth
45	4050001250020	Silver Creek	at Mouth
46	4050001280080	Pipestone Creek	at Mouth
47	4050001060090	Portage River	at Garman Foster Drain
48	4050001040080	Nottawa Creek	at Mouth
49	4050001050020	Little Portage Creek	at Mouth
50	4050001020140	Coldwater River	at Gage #04096600
51	4050001250040	Dowagiac Creek	at Bunker Lake
52	4050001280070	Pipestone Creek	at Unnamed Trib
53	4050001070060	Rocky River	at Flowerfield Creek
54	4050001030020	St. Joseph River	at Arney Road
55	4050001250030	Dowagiac River	Above Dowagiac Creek
56	4050001020150	Coldwater River	at Mouth
57	4050001010050	Soap Creek	at Gage #04096325
58	4050001020110	S Br Hog Creek	at Bowen Creek
59	4050001030080	St. Joseph River	Above Nottawa Creek
60	4050001050030	St. Joseph River	at Sturgis Dam
61	4050001010030	Beebe Creek	at Mouth
62	4050001010060	St. Joseph River	at Soap Creek
63	4050001020120	S Br Hog Creek	at Mouth
64	4050001280110	Big Meadow Drain	at Mouth
65	4050001060100	Portage River	at Mouth
66	4050001250060	Dowagiac Creek	at Mouth
67	4050001020070	Mud Creek	at Mouth
68	4050001030070	St. Joseph River	Above Sturgeon Lake
69	4050001280040	St. Joseph River	above Lemon Creek
70	4050001070050	Rocky River	Above Sheldon Creek

No.	Hydrologic Unit Code	Watercourse	Description
71	4050001010020	Beebe Creek	at Lake Beebe Outlet
72	4050001050040	St. Joseph River	at Gage #04097500
73	4050001250050	Dowagiac Creek	at La Grange Lake Boat Ramp
74	4050001280090	St. Joseph River	above Pipestone Creek
75	4050001010040	Sand Creek	at Gage #04096312
76	4050001080080	Spring Creek	at Mouth
77	4050001070070	Rocky River	at Mouth
78	4050001250080	Dowagiac River	at Gage #04101800
79	4050001020060	E Br Sauk River	at Gage #04096500
80	4050001020080	Coldwater River	at Hodunk Pond Dam
81	4050001080060	Prairie River	at Unnamed Trib
82	4050001010010	St. Joseph River	Above Beebe Creek
83	4050001160020	Christiana Creek	at Brownsville Street
84	4050001030050	Little Swan Creek	at Mouth
85	4050001020050	Marble Lake	at Outlet
86	4050001160010	Paradise lake	at Outlet
87	4050001280100	Hickory Creek	at Mouth
88	4050001160030	Diamond Lake	at Outlet
89	4050001100010	Mill Creek	at Unnamed Trib
90	4050001250070	Pokagon Creek	at Mouth
91	4050001080090	Prairie River	at Mouth
92	4050001020100	S Br Hog Creek	at Gage #04096515
93	4050001080070	Prairie River	Above Spring Creek
94	4050001080100	St. Joseph River	Above Fawn Creek
95	4050001030060	Swan Creek	at Mouth
96	4050001020090	S Br Hog Creek	at Carpenter Lake
97	4050001250100	Dowagiac River	at Mouth
98	4050001280030	St. Joseph River	at US 31
99	4050001080050	Prairie River	at Gage #04097540
100	4050001030040	Swan Creek	at Unnamed Trib
101	4050001020030	Coldwater River	Above South Lake
102	4050001250090	Mudd Lake Exit Drain	at Mouth
103	4050001160040	Christiana Creek	above Painter Lake
104	4050001100020	Mill Creek	at Mouth
105	4050001280010	St. Joseph River	at Gage #04102000
106	4050001080040	Prairie River	at Stewart Lake Drain
107	4050001090140	Fawn River	at Mouth
108	4050001090130	Sherman Mill Creek	at Fawn River

No.	Hydrologic Unit Code	Watercourse	Description
109	4050001020040	Fisher Creek	at Mouth
110	4050001240090	St. Joseph River	at Gage #04101500
111	4050001020020	Coldwater Lake	at Outlet
112	4050001100030	St. Joseph River	at Gage #04099000
113	4050001160050	Christiana Creek	at State Line
114	4050001080030	Prairie River	at Unnamed Trib
115	4050001240070	St. Joseph River	above Brandywine Creek
116	4050001080020	Prairie River	at Unnamed Trib
117	4050001020010	Tallahassee Drain	at Mouth
118	4050001090070	Himebaugh Drain	at Fawn River
119	4050001090080	Fawn River	at Lee Lake Outlet
120	4050001100040	St. Joseph River	above Pigeon River
121	4050001090100	Nye Drain	at Fawn River
122	4050001240080	Brandywine Creek	at Mouth
123	4050001280020	McCoy Creek	at Mouth
124	4050001130010	Trout Creek	at Mouth
125	4050001090010	Crooked Creek	at Toll Road
126	4050001080010	Unnamed Tributary	at Prairie River
127	4050001090110	Fawn River	at Gage #04098500
128	4050001240060	St. Joseph River	at Bertrand Road
129	4050001090060	Fawn River	at Himebaugh Drain
130	4050001120080	Pigeon River	Pigeon River-Fish Lake-Stone Lake
131	4050001090090	Fawn River	above Nye Drain
132	4050001120060	Pigeon River	Pigeon River-VanNatta Ditch
133	4050001130030	St. Joseph River	above Little Elkhart River
134	4050001150040	Peterbaugh Creek	at Mouth
135	4050001110010	Pigeon Creek	Pigeon Creek-Ryan Ditch
136	4050001160060	Christiana Creek	at Mouth
137	4050001090020	Snow Lake	at Outlet
138	4050001220020	Juday Creek	at Mouth
139	4050001150010	St. Joseph River	above Washington Twp Ditch
140	4050001220020	Cobus Creek	at Mouth
141	4050001150020	St. Joseph River	above Pine Creek
142	4050001090050	Fawn River	at State Line
143	4050001090030	Crooked Creek	below Bell Lake Ditch
144	4050001140070	Little Elkhart River	at Mouth
145	4050001240020	St. Joseph River	at Main Street
146	4050001240040	St. Joseph River	above Judy Creek

No.	Hydrologic Unit Code	Watercourse	Description
147	4050001120070	Lake Shipshewana	Page Ditch-Lake Shipshewana
148	4050001090040	Tamarack Lake Outlet	at Crooked Creek
149	4050001120050	Pigeon River	Pigeon River/Pigeon Lake-Twin Lakes
150	4050001220010	St. Joseph River	above Cobus Creek
151	4050001110020	Pigeon Creek	Pigeon Creek-Pigeon Lake
152	4050001120010	Pigeon River	Pigeon River-Cline Lake Outlet/Ontario
153	4050001110080	Pigeon Creek	Pigeon Creek-Green Lake/Shallow Lake
154	4050001140040	Little Elkhart Creek	above Rowe Eden Ditch
155	4050001150030	Pine Creek	at Mouth
156	4050001140020	Emma Creek	at Little Elkhart River
157	4050001120040	Buck Creek	Buck Creek/Buck Lake-East Buck Creek
158	4050001110070	Pigeon Creek	Pigeon Creek-Otter Lake
159	4050001110120	Pigeon Creek	Mongo Reservoir-Pigeon Creek/Turkey Creek
160	4050001210060	Elkhart River	Elkhart River-Yellow Creek (lower)
161	4050001120030	Fly Creek	Fly Creek-East Fly Creek
162	4050001230040	Baugo Creek	at Baugo Bay
163	4050001110030	Pigeon Creek	Pigeon Creek-Mud Creek
164	4050001110060	Pigeon Creek	Pigeon Creek-Hogback Lake-Silver Lake
165	4050001210020	Rock Run Creek	Rock Run Creek-Hoover Ditch-Boyer Ditch
166	4050001120020	Fly Creek	Fly Creek-Headwaters (LaGrange)
167	4050001240030	St. Joseph River	at Colfax Avenue
168	4050001230020	Grimes Ditch	at Baugo Creek
169	4050001140010	Emma Lake	at Outlet
170	4050001170030	Little Elkhart Creek	Little Elkhart Creek-Messick-Oliver Lakes
171	4050001110100	Turkey Creek	Turkey Creek-Big Turkey Lake/Mud Creek
172	4050001210040	Elkhart River	Elkhart River-Leedy Ditch
173	4050001110050	Mud Lake	Mud Lake-Johnson Ditch
174	4050001110040	Pigeon Creek	Pigeon Creek-Long Lake-Pleasant/Fox Lakes
175	4050001230030	Baugo Creek	at Roger's Ditch
176	4050001210030	Rock Run Creek	Rock Run Creek-Horn Ditch
177	4050001210010	Elkhart River	Elkhart River-Goshen
178	4050001140030	Little Elkhorn River	at Emma Creek
179	4050001110110	Little Turkey Lake	Little Turkey L-Big Long L/Lake of the Woods
180	4050001210050	Yellow Creek	Yellow Creek-Headwaters (Elkhart)
181	4050001170020	Little Elkhart Creek	Little Elkhart Creek-Dallas Lake
182	4050001170040	N Br Elkhart River	North Branch Elkhart River-Jones Lake
183	4050001110090	Turkey Creek	Turkey Creek-Headwaters (Helmer)
184	4050001190030	Stony Creek	Stony Creek-Phillips Ditch

No.	Hydrologic Unit Code	Watercourse	Description
185	4050001140050	Rowe Eden Ditch	at Little Elkhart
186	4050001190040	Elkhart River	Elkhart River-Dry Run
187	4050001170010	Little Elkhart Creek	Little Elkhart Creek-Tamarack-Cree Lakes
188	4050001230010	Baugo Creek	at Grimes Ditch
189	4050001170060	Middle Branch Elkhart River	Middle Branch Elkhart River-Oviatt Ditch
190	4050001200100	Turkey Creek	Turkey Creek-Swoveland Ditch
191	4050001200090	Dausman Ditch	Dausman Ditch
192	4050001190070	Elkhart River	Elkhart River-Whetten Ditch
193	4050001190010	Elkhart River	Elkhart River-Sparta Lake Outlet
194	4050001190060	Solomon Creek	Solomon Creek-Meyer/Hire Ditches
195	4050001200070	Berlin Court Ditch	Berlin Court Ditch
196	4050001170070	Waldron Lake	Waldron Lake-Clock Creek/Dry Run
197	4050001170080	N Br Elkhart River	North Branch Elkhart River-Boyd/Huston Dts
198	4050001170050	Henderson Lake	Henderson Lake Ditch-Waterhouse Ditch
199	4050001200080	Turkey Creek	Turkey Creek-Kieffler Ditch
200	4050001190020	Elkhart River	Elkhart River-Ligonier
201	4050001200030	Turkey Creek	Turkey Creek-Skinner/Hoopingarner Ditches
202	4050001180050	S Br Elkhart River	South Branch Elkhart River-Long Dt/Long L
203	4050001180040	Croft Ditch	Croft Ditch-Skinner Lake-Rimmell Branch
204	4050001180060	S Br Elkhart River	South Branch Elkhart River-Diamond-Eagle L
205	4050001200020	Turkey Creek	Turkey Creek-Lake Wawasee
206	4050001200060	Turkey Creek	Turkey Creek-Omar Neff Ditch
207	4050001200040	Wabee Lake	Wabee Lake-Dewart Lake Outlet
208	4050001190050	Solomon Creek	Solomon Creek-Headwaters
209	4050001200010	Turkey Creek	Turkey Creek-Headwaters (Noble)
210	4050001180010	Forker Creek	Forker Creek-Rivir Lake-Long Lake
211	4050001180030	S Br Elkhart River	South Branch Elkhart River-Muncie Lake
212	4050001180020	Carrol Creek	Carrol Creek-Winebrenner Branch
213	4050001200050	Turkey Creek	Turkey Creek-Coppes Ditch
214	4050001140060	Little Elkhart Creek	at Mather's Ditch
215	4050001260070	S Br Paw Paw River	at Mouth
216	4050001150050	St. Joseph River	above Christiana Creek
217	4050001240010	St. Joseph River	at Laing Park

table b

river valley segments

Valley Segment	Major Tributaries	Extent	Drainage Area
Headwaters	Beebe Creek Soap Creek	59 miles along main stem: Baw Beese Lake to Union City, MI	124,000 acres
Upper	Hog Creek Coldwater River Swan Creek Nottawa Creek Little Portage Creek	26 miles along main stem: Union City to Mendon, MI	491,000 acres
Middle	Portage River Rocky River Prairie River Fawn River Mill Creek Pigeon River Pine Creek Little Elkhart River Elkhart River Christiana Creek	52 miles along main stem: Mendon, MI to Elkhart, IN	1,500,000 acres
Lower	Baugo Creek Juday Creek Brandywine Creek Dowagiac Creek McCoy Crek Pipestone Creek	65 miles along main stem: Elkhart to confluence with Pipestone Creek	506,000 acres
Mouth	Paw Paw River Hickory Creek	8 miles along main stem: to Lake Michigan	337,000 acres

table c

impaired designated uses

Impaired Designated Use	Location	Pollutants & Stressors Impacting Use	Sources	Causes
Agricultural Water Supply	Upper (Nottawa) and Middle (Elkhart County)	Pathogens (impacting drinking water for livestock)	Animal and human waste (directly and via runoff)	
Navigation	Middle (Cobus, Christiana) and Upper (Hog)	Fencing across waterways	Lack of access, illicit barriers	Riparian property rights issues
Warm Water Fishery	Middle (Fawn) and Upper (Nottawa Creek)	Sediment, toxins, habitat modification, nutrients	Agricultural runoff, urban runoff, erosion from stream banks and construction sites, contaminated sediments	
Cold Water Fishery	Lower (Dowagiac, McKinzie, Juday) and Middle (Prairie)	Sediment, toxins, hydrological modification, nutrients, high temperatures	Agricultural runoff, urban runoff, erosion from stream banks and construction sites, contaminated sediments	Lack of buffers, poor tillage practices, high stormwater volumes due to increased imperviousness/urbanization and poor management, poor erosion control practices at construction sites, historic industrial uses of toxins, dams, channelization, dredging, automobile byproducts, improper storage, application, and disposal of fertilizers and hazardous household waste, thermal loading from urban

Impaired Designated Use	Location	Pollutants & Stressors Impacting Use	Sources	Causes
Other Indigenous Aquatic Wildlife	Mouth (Ox, Paw Paw S. Branch/Lawton Drain); Lower (Dowagiac); Middle (Silver, Emma Creek Tributary, Little Elkhart, Pigeon, Mather Ditch, Wisler Ditch, Mud Creek and Yellow, 17 Indiana Lakes: Big Otter, Seven Sisters, Meserve, Lime, Lake of the Woods, North Twin, Royer, Fish, Messick, Hackenburg, Dallas, Witmer, Jimmerson, Marsh, Snow, Lake James); Upper (Nottawa, Fisher, Hog) and Main stem (mouth, lower)	Sediment, toxins, hydrological modification, habitat loss, nutrients, temperature	Agricultural runoff, urban runoff, erosion from stream banks and construction sites, contaminated sediments	Lack of buffers, poor tillage practices, high stormwater volumes due to increased imperviousness/urbanization and poor management, poor erosion control practices at construction sites, historic industrial uses of toxins, dams, channelization, dredging, automobile byproducts, improper storage, application, and disposal of fertilizers and azardous household waste, thermal loading from urban
Partial Body Contact/Recreation	Lower (Lake of the Woods/ Dowagiac River, Farmers Creek) and Upper (Nottawa)	E. coli (pathogens)	Animal and human waste (directly and via runoff)	Livestock access to waterbodies, illicit discharges, failing septic systems, CSOs, improper manure storage and application, lack of buffers
Full Body Contact/Recreation	LLower (Baugo, Willow, Juday): Middle (Elkhart River-- Main, North & South Branches, Little Elkhart River, Fawn River, Fly Creek, Pigeon Creek, Pigeon River, Pine Creek-- North & South Forks, Rock Run Creek, Solomon Creek, Stoney Creek, Turkey Creek-Skinner & Hoopingarner ditches, Wisler Ditch, Yellow Creek); Upper (Nottawa); Main stem (mouth, lower, middle)	E. coli (pathogens)	Animal and human waste (directly and via runoff)	Livestock access to waterbodies, illicit discharges, failing septic systems, CSOs, improper manure storage and application, lack of buffers

table d

threatened designated uses

Threatened Designated Use	Location	Pollutants & Stressors Impacting Use	Sources	Causes
Agricultural Water Supply	Lower (Dowagiac) Middle (Rocky)	Decreased water levels, pathogens (impacting drinking water for livestock)	Pumping of surface water, animal waste	Large scale farms with irrigation systems, increased industrial use, livestock access to waterbodies
Industrial Water Supply	Lower (Dowagiac)	Decreased water levels	Pumping of surface water	Large scale farms with irrigation systems(s), increased industrial use(s)
Navigation	Mouth (main stem) Middle (Rocky, Little Elkhart River) Upper (main stem)	Sediment	Agricultural runoff, urban runoff, erosion from stream banks and construction sites	Poor tillage practices, lack of buffers, high stormwater volumes due to increased imperviousness/urbanization and poor management, poor erosion control practices at construction sites
Warm Water Fishery	Mouth (main stem, upper Paw Paw River) Lower (main stem, Dowagiac River) Middle (Rocky River, main stem, Lake Shipshewana, Prairie River, Elkhart River, Fawn River, Little Portage Creek, Trout Creek, Puterbaugh Creek) Upper (main stem)	Sediment, toxins, hydrologic flow fluctuation, toxins, nutrients, habitat loss	Agricultural runoff, urban runoff, erosion from stream banks and construction sites, hydrological modifications, contaminated sediments	Lack of buffers, poor tillage practices, high stormwater volumes due to increased imperviousness/urbanization and poor management, poor erosion control practices at construction sites, historic industrial uses of toxins, dams, channelization, dredging, automobile byproducts, improper storage, application, and disposal of fertilizers and hazardous household waste, habitat converted to residential and commercial uses

Threatened Designated Use	Location	Pollutants & Stressors Impacting Use	Sources	Causes
Cold Water Fishery	Mouth (main stem, Pipestone Creek, Hickory Creek, Yellow Creek) Lower (main stem, McCoy Creek, Brandywine Creek) Middle (Mill Creek, Willow Creek, main stem) Upper (main stem)	Sediment, toxins, hydrological modification, nutrients, temperature, habitat loss, toxins	Agricultural runoff, urban runoff, erosion from stream banks and construction sites, contaminated sediments	Lack of buffers, poor tillage practices, high stormwater volumes due to increased imperviousness/urbanization and poor management, poor erosion control practices at construction sites, historic industrial uses of toxins, dams, channelization, dredging, automobile byproducts, improper storage, application, and disposal of fertilizers and hazardous household waste, thermal loading from urban stormwater, invasive species
Other Aquatic Indigenous Wildlife	Mouth (Paw Paw River south branch, Pine Creek, Ox Creek) Lower (Baugo) Middle (Rocky River, Elkhart River, Fawn River, Little Portage Creek, Trout Creek, main stem) Upper (main stem)	Sediment, toxins, hydrological modification, habitat loss, nutrients, temperature	Agricultural runoff, urban runoff, erosion from stream banks and construction sites, contaminated sediments	Lack of buffers, poor tillage practices, high stormwater volumes due to increased imperviousness/urbanization and poor management, poor erosion control practices at construction sites, historic industrial uses of toxins, dams, channelization, dredging, automobile byproducts, improper storage, application, and disposal of fertilizers and hazardous household waste, thermal loading from urban stormwater, invasive species
Partial Body Contact/Recreation	Mouth (main stem) Lower (main stem) Middle (main stem, Rocky) Upper (main stem)	E. coli (pathogens)	Animal and human waste (directly and via runoff)	Livestock access to waterbodies, illicit discharges, failing septic systems, CSOs, improper manure storage and application, lack of buffers
Full Body Contact/Recreation	Upper (main stem)	E. coli (pathogens)	Animal and human waste (directly and via runoff)	Livestock access to waterbodies, illicit discharges, failing septic systems, CSOs, improper manure storage and application, lack of buffers

table e

bmp costs

INFORMATION AND EDUCATION BMPS		
Typical BMP/ Delivery Mechanism	**Estimated Cost**	**Notes**
Information meeting/training session/workshop	$500.00 each	Based on a educational workshop for 25 people at free facility with lunch provided and paid speaker. Costs are highly variable depending on size, scope, and location of meeting.
Newsletter/Mailing	$400.00 each	4 page newsletter sent to 200 addresses. First class postage used, rather than bulk rate which requires a permit. Includes 10 hours of newsletter preparation and the copying costs. Highly variable depending on size and scope of mailing
Newspaper article	Free	Plus staff/volunteer preparation time
Newspaper Ad	$40.00 to $55.00 per column inch	Kalamazoo Gazette; Rate depends on day of placement
	$44.00 to $62.00 per column inch	South Bend Tribune; Rate depends on day of placement
Newspaper Insert	$0.05 each	Cost of service only; reproduction is not included; 1 sheet maximum
Public service announcement	Free	Plus staff/volunteer preparation time; Less control of placement and timing but items provided well in advance are usually printed or read on-air multiple times before the event
Educational signage	N/A	Highly variable
OSDS education packets	$25 each	Include VHS cassette, copy of ordinance, and brochure on maintenance
Ordinance review/ development	$1,200 - $1,500 per township/municipality to work with a consultant to review, develop, and adopt an ordinance	Assumes minimal consultant oversight and the majority of the work being done by local government

Typical BMP/ Delivery Mechanism	Estimated Cost	Notes
Audubon International Cooperative Sanctuary Program certification	$150.00/yr membership fee plus cost of implementing BMPs	
Volunteer water quality monitoring program	$15,000 per year	Includes part-time staff person and cost of test kits
Watershed Management Short Course	$10,000 each	Includes materials, speaker fees, meals, and staff coordination time
Display Board	$500.00	Based on 3 panel display with overhead lights. Does not include cost of preparing materials for display.
PHYSICAL BMPS		
Nutrient management	$2.64 per acre annually	Source: US EPA
Chemical management	$5.00 per acre	Primarily costs related to technical assistance
Conservation tillage	3.08 per acre annually	
Filter strips	$190.00 per acre	Includes establishment and maintenance
Riparian Forested Buffer	$500.00 per acre	Includes establishment and maintenance
Riparian Herbaceous Buffer	$225.00 per acre	Includes establishment and maintenance
Wetland Creation/ Restoration/Enhancement	$1,000.00 to $2,000.00 per acre	Depends on site requirements and size
Critical area planting	$1,300.00 per acre	Includes grading, planting, herbicides, mulch, and labor
Water and sediment control basin	$1,700.00 each	
Grade stabilization structure	$1,000.00 each	
Grassed waterway/ vegetated swale	$2.00 to $3.50 per linear foot	Depends on width and depth
Stripcropping	$12.00 per acre	

Typical BMP/ Delivery Mechanism	Estimated Cost	Notes
Detention ponds	$35,000.00 to $110,000.00 per acre	Cost includes engineering, excavation, fill, compaction, inlet and outlet installation, landscaping, and legal fees
Field windbreaks, shelterbelts, and hedgerows	$1.50 per linear foot	
Cover crops	$14.00 per acre	
Pasture/Hay Planting	$120.00 to $150.00 per acre	Depends on type of grasses used
Livestock exclusion	$1.60 per foot	Cost of fencing
Other conversion of crop land to habitat	N/A	Highly variable depending on cost of conversion, type of habitat, and incentive payments
Rain garden/Bioretention cell	$5.00 - $40.00 per square foot	Cost depends on site requirements: some industrial and commercial sites may require professional engineering and control structures
Rain barrel	$75 to $200 each	Depends on size and features. Includes root repellant/waterproof membranes and irrigation; costs vary depending on site requirements
Green roof	$12 to $24 per square foot	Depends on site and methods used
Stream bank stabilization	$22.00 to $32.00 per linear foot	Depends on size and species of tree; cost includes collar guards, staking, and mulch
Tree planting	$50.00 to $300.00 per tree	Costs are comparable to traditional structures; Costs depend on site conditions and are based on seeding rather than plugging in plants
Check dams	$15.00 per linear foot	
Bioretention parking lot islands/Bioswales	$0.04 to $2.50 per square foot	Assumes a trench 2 feet wide; Costs are highly variable depending on site requirements
Downspout disconnections	$15.00 to $25.00 per downspout	Depends on material type
Infiltration trench	$4.00 per linear foot	Costs depend on site conditions and are based on seeding rather than plugging in plants

Typical BMP/ Delivery Mechanism	Estimated Cost	Notes
Permeable surfaces	$1.00 to $5.00 per square foot	Depends on material type
Retrofit detention basin	$0.05 to $3.00 per square foot	Costs depend on site conditions and are based on seeding rather than plugging in plants
Cistern	$225	200 gallon galvanized steel; degree of water treatment and location affect costs
	$160	165 gallon polyethylene; degree of water treatment and location affect costs
	$660	350 gallon fiberglass; degree of water treatment and location affect costs

glossary

glossary

BMP	Best Management Practice
CRP	Conservation Reserve Program
CSO	Combined Sewer Overflow
EPA	United States Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
HUC	Hydrologic Unit Code
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint source
NRCS	Natural Resources Conservation Service
PCB	Polychlorinated Biphenyls
RC&D	Resource Conservation and Development
SWCD	Soil and Water Conservation District
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WHIP	Wildlife Habitat Incentives Program