CHAPTER 4: ACTION PLAN FOR THE HURON CHAIN OF LAKES WATERSHED

Filling sandbags during the May 2004 flooding of the Huron River and Ore Lake
Photo: LCDC

Watershed management planning provides the opportunity for communities and other stakeholders to assess the current condition of their watershed and peer into the future to see what the watershed will look like if the status quo is maintained. The quality of life desired by the community for future residents often is not in step with the realities of where the community is headed.

This chapter outlines designated and desired uses of surface waters in the Watershed, the threats (impairments) posed to them, and the sources and causes of those threats. A set of goals and objectives has been developed by the Steering Committee to ensure that the designated and desired uses in the watershed will be met. Because surface water quality is ultimately a function of what water carries off of the land, much of the discussion will focus on how human activities impact the land and actions that can be taken to improve human land use from a water quality/quantity perspective. These recommended actions are described and summarized in the Action Plan (Table 4.6) at the end of this chapter.

4.1 DESIGNATED AND DESIRED USES

Photo: HRWC

According to the Michigan Department of Environmental Quality, the primary criterion for water quality is whether or not the waterbody meets its designated uses. Designated uses are recognized uses of water established by state and federal water quality programs. In Michigan, the goal is to have all waters of the state meet all designated uses. It is important to note that not all of the uses listed below may be attainable, but they may serve as goals toward which the watershed can move.

All surface waters of the state of Michigan are designated for and shall be protected for all of the

following uses.[161] The designated uses that apply to the Huron Chain of Lakes Watershed are in boldface:

- **Agriculture**
- **Industrial water supply**
- **Public water supply at the point of intake**
- Navigation
- **Warmwater fishery**
- **Other indigenous aquatic life and wildlife**
- **Partial body contact recreation**
- **Total body contact recreation between May 1 and October 31**
- Coldwater fishery

Due to human impacts throughout the Huron Chain of Lakes Watershed, not all of the designated uses are fulfilled. Warmwater fishery is impaired due to elevated levels of PCBs in Whitmore Lake and Woodland Lake and high mercury levels in fish tissue samples from Bishop Lake. Other indigenous aquatic life and wildlife is also impaired due to poor macroinvertebrate communities in portions of Honey Creek and Horseshoe Lake Drain, and low levels of dissolved oxygen in a small segment of Yerkes Drain between the South Lyon Wastewater Treatment Plant and Nichwagh Lake. Partial and total body contact recreation uses are threatened throughout the watershed due to high nutrient loads that can cause nuisance algal blooms in lake environments – most notably in Brighton, Ore, and Strawberry Lakes, for which phosphorus TMDLs have been established.

In addition to state-designated uses are uses of the watershed that are desired by its residents but not yet achieved. The Steering Committee identified the following desired uses:

- **Coordinated development**
  Promote a balance of environmental and economic considerations through intentional community planning and coordinated development within and among the Huron Chain of Lakes communities

- **Hydrologic functions of natural features**
  Protect and enhance natural features related to water quantity and quality, including wetlands, floodplains, riparian buffer zones, and stream channels that regulate the flow of stormwater runoff, protect against flooding, and reduce soil erosion and sedimentation

- **Open space and greenways**
  Protect priority natural habitat, recreational areas and trails, and agricultural lands from development in order to maintain their natural functions, preserve rural character, and enhance recreational opportunities for present and future generations

4.2 Impairments and Their Sources and Causes

Various pollutants, or impairments, to the water quality of the Huron River and its tributaries are found throughout the Huron Chain of Lakes Watershed, which present challenges to meeting the designated and desired uses. Analysis of existing data indicates that the Huron Chain of Lakes Watershed has areas of medium-quality and low-quality waters that require mitigation of existing impairments. This section summarizes current impairments in the watershed and identifies the sources and causes of those impairments. The Steering Committee spent one year gathering the information necessary to identify and understand these impairments and their sources and causes, as well as to prioritize them from greatest to least threat. This prioritization of impairments is based upon the results of analysis of existing data, Steering Committee member observations, and citizen input. Although the partners in this Plan intend to address all of these challenges in the long term with targeted programs, it has been important to rank the most pressing concerns in the watershed so that resources can be spent cost-effectively in a phased approach. Table 4.1 presents this prioritized listing of impairments, sources, and causes in the Huron Chain of Lakes Watershed.

The sources and causes of each impairment in Table 4.1 are not prioritized, but known causes (k) are listed above suspected causes (s). In cases where impairments, sources, or causes were suspected since not enough information was known about them, effort was made to gather additional information. Methods ranged from field work to desktop analyses using a geographic information system, to review of available literature and water quality studies. While much data was compiled to eliminate most suspected items in the table below, some items require further investigation to confirm their presence in the watershed and/or determine the extent to which they are hindering the designated uses in the watershed. As additional information is obtained that indicates a lower ranked impairment, source or cause should be elevated in priority, the ranking should be adjusted to reflect the new information.

4.2.1 Excess Nutrients

A certain amount of nutrients are found in water resources naturally. In excess, nutrients 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 and the river. Phosphorus is the primary nutrient of concern in the Huron Chain of Lakes Watershed because phosphorus is usually the limiting growth factor for algae and other nuisance plants in Michigan aquatic ecosystems. When excess phosphorus enters waterways from excess fertilizer or other sources, it encourages the accelerated growth of plants and algae, reducing the dissolved oxygen and light entering the water and creating an environment where it is difficult for most fish and aquatic insects to live. High nutrient concentrations interfere with recreation and

Excess phosphorus from nonpoint sources encourages algae blooms. *Photo: HRWC*

aesthetic enjoyment of waterbodies by causing reduced water clarity, unpleasant swimming conditions, foul odors, blooms of toxic and nontoxic organisms, and interference with boating.

Due to the persistent and systemic presence of high concentrations of phosphorus throughout many of the lakes and impoundments in the watershed, high nutrient loading is the top challenge identified in this Plan. TMDLs for excessive phosphorus loading from nonpoint sources exist in Brighton, Strawberry, and Ore Lakes. While the Huron River and its tributaries do not generally show signs of excessive phosphorus concentrations, many lakes and impoundments along these waterways tend to act as sinks for phosphorus loading, which can lead to eutrophic conditions. Sources of phosphorus in the watershed include fertilizers from lawns, golf courses, and croplands; failing septic systems; sediment and eroded soils; pet/wildlife wastes; illicit connections between sanitary sewers and storm drains; wastewater treatment plants; and contributions from upstream of the Kent Lake Dam. Most of these sources are associated with existing or newly developed areas, which continue to increase and therefore are a source of additional nutrient loads on water bodies in the watershed. Eroded soils can serve as a significant source of phosphorus to streams since the nutrient bonds with particles in the soil.

4.2.2 Altered Hydrology

Hydrology refers to the study of water quantity and flow characteristics in a river system. How much and at what rate water flows through a river system, and how these factors compare to the system's historic or "pristine" state, are critical in determining the long-term health of the waterway. In a natural river system, precipitation in the form of rain or snow is intercepted by the leaves of plants, absorbed by plant roots, infiltrated into groundwater, soaked up by wetlands, and is slowly released into the surface water system. Very little rainwater and snowmelt flows directly into waterways via surface runoff because there are so many natural barriers in between.

Undercut banks are a sign of flashy flows
Photo: HRWC

When vegetated areas are replaced by roads, rooftops, sidewalks, and lawns, a larger proportion of rainwater and snowmelt falls onto impervious (hard) surfaces. In less developed areas, this stormwater runoff flows either into roadside ditches that drain to the nearest creek, or, in the more densely developed areas, it flows into a system of storm drainpipes that eventually outlet to the creek. During a rain event, this increased runoff causes the flow rate of the creek to increase dramatically over a short period of time, resulting in what is referred to as "flashy flows."

In addition to rapidly increasing flows during storm events, the increase in impervious surface also decreases

base flows during non-storm conditions because less water infiltrates into the ground and is slowly released into the creek via groundwater seeps.

Extreme flashiness can lead to rapid erosion of streambanks (especially in areas where the streambank vegetation has been removed or altered) and sedimentation. These impacts create unstable conditions for the macroinvertebrates and fish. Directly connected impervious landscapes pose a significant problem to hydrology. An example of a directly connected impervious surface is a rooftop connected to a driveway via a downspout that is then connected to the street where stormwater ultimately flows into the storm drain and into local creeks and streams.

The Huron River and its tributaries in the Huron Chain of Lakes Watershed have been altered substantially by wetlands drainage, stream channelization, dam construction, deforestation, and urbanization. These activities have affected the hydrology of the Huron River and its tributaries, including flow volume and flow stability, and channel morphology, including channel gradient and shape. The extensive network of dams and lake control structures, developed areas, engineered drains, and construction sites all play a role in producing flashy, sediment-laden flows. The large mass of curly-leaf pondweed growing in the Huron River downstream of Hamburg Road has also altered the hydrology of the river by slowing down the flow, which is particularly noticeable and problematic during periods of heavy precipitation, leading to disproportionately large floods.

4.2.3 Sediment

While some sedimentation in a river system is natural, as the streambanks in one area erodes and the soil is deposited downstream, the Huron Chain of Lakes experiences heavy sedimentation on the Huron main-stem, its tributaries, and lakes and impoundments. Impacts of soil erosion and sedimentation on downstream water resources include decrease of aesthetic quality with an increase of turbidity, decreased light penetration and decreased plant growth, and decrease in aquatic habitat with increased sediment islands blocking fish migration and sediment covering and clogging gills of fish and aquatic insects. In addition, nutrients and other pollutants often bond with soil particles, increasing the detrimental impacts of sedimentation on water resources.

HRWC volunteer Eric Piehl measures erosion on South Ore Creek *Photo: HRWC*

Many streambeds in the Huron River system are naturally composed of sand, gravel, and cobble, but a problem arises when a dramatic shift from these coarse materials to more fine sediments occurs. Silt, which is fine-grained sediment, is an important factor when considering a creek's quality. Silt is smaller than sand and larger than clay. Dramatic fine sediment increases suggest unnaturally high erosion rates. Excessive deposits of fine sediment appear to contribute to the impairment

of macroinvertebrate communities in a number of locations, including Honey Creek, Davis Creek near Rushton Road, Yerkes Drain, and Horseshoe Lake Drain. Residents have also expressed concern for sedimentation in Brighton Lake, South Ore Creek from the Mill Pond downstream to Brighton Lake, and Lake Moraine on Mann Creek. Sediment also appears to be accumulating in the Huron River between Hamburg Road and Highway M-36, which is where the large mass of curly-leaf pondweed has become established that has exacerbated flooding around the Ore Lake area. Numerous other sites with sediment problems likely exist, but have not been reported or documented.

Increased stormwater flows result in increased sediment loadings for a variety of reasons. Soil particles are picked up by stormwater as it flows over roads, through ditches, and off of bridges into surface waters. Increased flows from stormwater runoff or dam discharge have enough energy to scour soils and destabilize stream banks, carrying bank sediments downstream. In addition, runoff from some construction sites are sources of sediment if proper soil erosion and sedimentation controls are not in place on bare soil that has been exposed during the construction process. Sediment enters the water at bridges as a result of inadequate construction and maintenance practices, and via road ditches, which convey sediment from unpaved roads into the stream. Other sources of sediment include sediment washed off of paved streets and parking lots. Active agricultural land may be a source of concern in the rural areas of the watershed since traditional farming practices leave soil bare and tilled at certain times of the year, which leaves soil vulnerable to wind and water erosion.

4.2.4 Pathogens

Impacts of pathogens in water resources include loss of recreational opportunities such as wading and canoeing due to public health concerns. Major sources of pathogens, specifically *E. coli,* in the Huron Chain of Lakes include failing on-site sewage disposal systems (OSDS, or septic systems), land application of untreated waste from these septic systems, and illicit discharges of sanitary waste into storm sewers that are mainly located in more urbanized areas. Little water quality data were found on pathogens in the watershed, and data provided by the Livingston County Health Department on *E. coli* monitoring at public beaches showed no instances of pathogen levels exceeding state water quality standards for designated uses in the watershed. Nevertheless, acceptable levels of pathogens are critical to overall water quality and BMPs must be implemented to ensure that pathogen levels are maintained or reduced throughout the watershed.

Approximately 42,000 households in Livingston County use septic tanks, generating 12 million gallons of untreated septage annually that is currently disposed of via land application at 13 permitted sites, which poses a risk to groundwater contamination. An estimated 1,000 new septic tanks are installed each year, which is predicted to increase septage volumes to 16 million gallons by 2020.[162] In an effort to reduce disposal of untreated septic waste via land application, Livingston County is in the process of designing a septage receiving station in Hartland Township that will allow trucks to unload their septage waste into a pipe that will transport the waste to a treatment plant in Genesee County.

Septic systems can fail for a number of reasons including inadequate soil conditions, long term use, and lack of proper maintenance or use. Failing septic systems may allow untreated human waste to eventually be discharged to nearby surface waters, where it

can affect drinking water supplies, cause unacceptable water quality, and present a public health risk. Little information exists for septic system failure rates in the Huron Chain of Lakes Watershed, but studies in surrounding counties provide some insight. In Washtenaw County, 19% of all inspected septic systems have been found to be non-conforming as part of its ordinance requiring inspection of all septic systems at time of property transfer.[163] Wayne County also has a time-of-sale septic system inspection ordinance, which has demonstrated a failure rate of 26% of all inspected septic systems between 2000 and 2003. An inspection program in the City of Southfield in Oakland County has shown a failure rate of 20%.

Illicit discharges may be broadly defined as the introduction of untreated pollutants into surface waters through improperly connected pipes or improper disposal (illegal dumping). Illicit connections, which can originate in residential or commercial areas, can include floor drains, toilets, or washing machines that are improperly connected to storm drains instead of sanitary sewers. Septic systems that connect to storm drains are also illicit connections. Other examples of illicit discharges include pouring used motor oil or holding tank waste from a boat, RV, or mobile home into a storm drain or roadside swale. The frequency of illicit connections is difficult to estimate accurately. In Oakland County, the Rouge River Watershed has implemented a successful program to detect and eliminate illicit connections, and their findings indicate that the pollutants carried by these discharges can result in overabundance of *e. coli*, high ammonia levels, fecal coliform, phosphorus, and excessive algal growth in surface water. In 2004, with 353 facilities dye-tested, 97 illicit connections (24%) were identified. 82 of these were discharges related to floor drains.

Pet, livestock and wildlife wastes are also sources of pathogens, but it is even more difficult to quantify the extent and impacts of these sources than of the aforementioned sources.

At this time, the extent of pathogen contributions from a lack of adequate septage facilities is unclear. Little water quality data was found on pathogens, and data provided by the Livingston County Health Department on *E. coli* monitoring at public beaches showed no instances of pathogen (specifically *E. coli*) levels regularly exceeding state water quality standards for designated uses in the watershed. Nevertheless, acceptable levels of pathogens are critical to overall water quality and BMPs must be implemented to ensure that pathogen levels are maintained or reduced throughout the watershed.

4.2.5 Salts, Organic Compounds and Heavy Metals

Salts typically enter waterways from road salting (de-icing) operations or from water softener backwash discharge into the environment. De-icing product, primarily sodium chloride, is used locally by MDOT, county road commissions, homeowners, and business/commercial establishments. Salts are highly soluble in water and easily wash off pavement into surface waters and leach into soil and groundwater. High concentrations of salt can damage and kill vegetation, disrupt fish spawning in streams, reduce oxygen solubility in surface water, interfere with the chemical and physical characteristics of a lake, and pollute groundwater making well water undrinkable.

Salt entering local waterways from road de-icing efforts was cited as a common concern among watershed residents. However, little data was found regarding salt concentrations in local waterways or impacts of salts on water quality. Conductivity data

collected through HRWC's Adopt-A-Stream program at several sites on Mann Creek, Davis Creek, Horseshoe Lake Drain, and one site on the Huron River at Whitmore Lake Road all show consistently excessive conductivity readings. These high conductivity readings may suggest the presence of high concentrations of dissolved salt ions, although the extent to which other non-salt ions are influencing the readings is unknown.

A study by the USGS in Oakland County on the effects of urban land use change on streamflow and water quality showed a strong positive correlation between salt ions (sodium, potassium, and chloride) and residential and commercial landcovers, as well as overall percentage of the watershed built, and population density. These ions were negatively correlated with agriculture, open space, forest, and wetland land covers.[164] While it may reasonably stated that the rapid urbanization in the Huron Chain of Lakes Watershed has lead to increased salt concentrations in the water, the extent to which this is occurring and the impacts of these salt concentrations requires additional monitoring data and studies.

Organic compounds (PCBs, PAHs, DDT, etc.) and heavy metals (lead, copper, mercury, zinc, chromium, cadmium, etc.) can potentially cause adverse impacts on river ecosystems. These chemicals and metals can disrupt the physiology of aquatic organisms and can accumulate in their fatty tissues. Organic chemicals such as PCBs are by-products of manufacturing processes and the combustion of fossil fuels. They are also present in automobile fluids such as gasoline and oils. Other organic chemicals are found in pesticides and herbicides. Heavy metals are also a common by-product of manufacturing, but these contaminants are also common in agricultural and road runoff.

In the watershed, potential sources of organic compounds and heavy metals include urban areas, roads, permitted industries, existing in-stream contamination from historic activities, chemicals from lawns, and runoff from agricultural operations. Little data exists for organic compounds and heavy metals in the Huron Chain of Lakes. As discussed in Chapter 2, Huron River water chemistry data collected in 2002 by MDEQ at Whitmore Lake Road in Green Oak Township showed that all contaminants covered under Michigan Rule 57 (which includes a variety of organic compounds, trace and heavy metals, and PCBs) were in compliance with water quality values, with the exception of PCBs, which were also exceeded at all 35 monitoring stations throughout the state. TMDLs for PCBs in fish tissue are scheduled to be established for Whitmore Lake and Woodland Lake. A TMDL for mercury in fish tissue is scheduled to be established for Bishop Lake in the Chilson Creekshed.

4.2.6 Elevated Water Temperature

Water temperature directly affects many physical, biological, and chemical characteristics of a waterbody. Temperature affects the amount of oxygen that can be dissolved in the water; the rate of photosynthesis by algae and larger aquatic plants; the metabolic rates of aquatic organisms; and the sensitivity of organisms to toxic wastes, parasites, and diseases. These factors limit the type of macroinvertebrate and fish communities that can live in a stream. Thermal pollution, the discharge of heated water from industrial operations, dams, or stormwater runoff from hot pavement and other impervious surfaces often cause an increase in stream temperature. Suspended sediment loads can also contribute to elevated water temperatures.

All waters in the Huron Chain of Lakes are warmwater fish streams. However, some coldwater fish species are found in portions of watershed, and the presence of EPT and sensitive aquatic insect families at many monitoring sites is an indication of adequately cool stream temperatures. Davis Creek at Rushton Road had the warmest average stream temperature from available data at 77º F, which is warm enough to restrict or exclude many species of fish and macroinvertebrates. Monthly temperature fluctuations were greatest on sites at Hay and Honey creek, which varied by 20º F and 24º F respectively. Such high temperature fluctuations can impact biodiversity. Low flows below impoundments, removal of streambank vegetation, and inputs of stormwater runoff (which are typically substantially warmer than base stream flows) are all potential contributing factors to elevated water temperatures.

4.2.7 Litter/Debris

Observations from the stream crossing inventory, as well as observations from Steering Committee members and watershed residents, indicate that debris and litter is a problem throughout the Huron Chain of Lakes Watershed. Debris refers to broken down pieces of materials such as those used in construction while litter refers to strewn trash and wastepaper. The presence of debris and litter reduces the aesthetic value of water resources as well as poses potential hazards to humans and wildlife. Field observations indicate that the sources of debris and litter include roadways, residential areas, parks, urban areas.

Table 4.1. Prioritized Impairments, Sources and Causes in the Huron Chain of Lakes Watershed

Impairment: High Nutrient Loading (k)	
Sources	**Causes**
Excessive runoff from developed areas (k)	Lack of BMPs at existing development areas (k) Impervious surfaces (k) Poor storm drain maintenance (s)
Failing septic tanks (k)	Old units are too small or don't meet codes (k) Lack of a required maintenance program (k) Poor maintenance/lack of education (s)
Fertilizers from residential, commercial, and golf courses (k)	Lack of buffers (k) No ordinance in place (k) Overuse/improper application of fertilizers (s)
Illicit discharges (k)	Aging sanitary sewer infrastructure (s) Inadequate inspection/detection and repair due to cost (s) Illegal septic application and trailer waste disposal (s)
NPDES permitted facilities (k)	Nutrients in effluent (k)
Agricultural runoff from fertilizers/ livestock waste (s)	Lack of BMPs (upland and riparian buffers) (s) Exposed soils (s)
Pet and wildlife waste (s)	Improper disposal of pet waste (s) Ponds increase habitat for waterfowl, wildlife (s)

Table 4.1. (continued) Prioritized Impairments, Sources and Causes in the Huron Chain of Lakes Watershed

Impairment: Altered Hydrology (k)	
Sources	**Causes**
Runoff from developed areas (k)	Lack of BMPs at existing development areas (k) Impervious surfaces (k) Removal of woodland/forest, wetlands, and other pervious areas (k)
Runoff from construction sites, new development (k)	Removal of woodland/forest, wetlands, and other pervious areas (k) Rerouting channel for development (k) Lack of resources for enforcement/inspection (s) Site exemptions (s) Lack of education on alternatives (s)
Engineered drains and streams (k)	Loss of connection between stream and floodplain from channelization (k) Removal of riparian buffer (k)

Impairment: Sedimentation, Soil Erosion (k)	
Sources	**Causes**
Eroding stream banks and channels (k)	Flashy flows (k) Channelization (k) Drain maintenance (k) Eroding crossing embankments (k) Clear cutting/lack of riparian buffers (k)
Construction sites (k)	Clear cutting/lack of riparian buffers (k) Lack of resources for enforcement/inspection (s) Lack of soil erosion BMPs and BMP education (s) Exposed soils (s) Site exemptions (s)
Developed areas (k)	Lack of BMPs at existing development areas (k) Impervious surfaces (k) Clearcutting/lack of riparian buffers (k)
Dirt, gravel roads (k)	Poorly designed/maintained road stream crossings (k) Poor road maintenance (s)
Agricultural field runoff (s)	Lack of BMPs (upland and riparian buffers) (s) Exposed soils (s)

Impairment: Pathogens (k)	
Sources	**Causes**
Failing septic tanks (human waste) (k)	Old units are too small or don't meet codes (k) Lack of a required maintenance program (k) Inadequate enforcement by Health Departments (s) Poor maintenance/lack of homeowner education (s)
Illicit Discharges (k)	Aging development sanitary sewer infrastructure (k) Illegal septic application and trailer waste disposal (s) Inadequate inspection/detection and repair due to cost (s) Lack of education (s)

Impairment: Pathogens (k)	
Sources	**Causes**
Pet and waterfowl waste (s)	Improper disposal of pet waste (runoff from paved areas) (s) Ponds increase habitat for waterfowl, wildlife (s)
Illegal/improper septage application (s)	Lack of adequate septage disposal facilities (s)
Livestock waste from agricultural operations (s)	Lack of BMPs (s)

Impairment: Salts, Organic Compounds and Heavy Metals (k)	
Sources	**Causes**
Developed areas (k)	Lack of stormwater BMPs (k) Illegal dumping (s) Illicit connections (s)
Roads (k)	Auto emissions (k) Lack of BMPs during road de-icing (s) Poor road maintenance (s)
Existing in-stream pollution (k)	Illegal dumping (s) Oil spill in Yerkes Drain in 1970s (k) PCBs in Whitmore Lake and Woodland Lake (k) Excessive mercury in Bishop Lake (k)
NPDES permitted facilities (s)	Inadequate inspection (s) Lack of BMPs (upland and riparian buffers) (s)
Turfgrass chemicals from residential, commercial lawns (s)	Improper lawn care (s) Illegal disposal (s)
Agricultural runoff (s)	Lack of BMPS (upland, riparian buffers) (s)

Impairment: High Water Temperature (k)	
Sources	**Causes**
Directly connected impervious areas (k)	Heated stormwater from urban areas (k)
Eroded soil areas (s)	Soil erosion from channel and upland (k)
Solar heating (s)	Lack of vegetated canopy in riparian zone (k)

Impairment: Debris/Litter (k)	
Sources	**Causes**
Roadways, parks, urban areas, residential areas (k)	Illegal littering/dumping (s) Unsecured garbage containers and vehicles (s) Inadequate refuse containers (s)

Several overarching challenges play a role in generating the impairments discussed above. Addressing these challenges is a prerequisite to mitigating the sources and causes of the impairments in order to reach the designated and desired uses in the Huron Chain of Lakes Watershed.

Land Use Changes

Perhaps the greatest concern and threat to water quality degradation in the watershed is land use change. Between 1982 and 1992, Michigan lost approximately 854,000 acres

New development along surface waters often increases the amount of nonpoint sources of pollution in the waterbody. Photo: HRWC

of farmland to suburban development, which is comparable to losing the area of 3.75 Michigan townships per year.[165] Moreover, the conversion of farmland to other uses accelerated from 1992 to 1997 by 67% over the previous 5-year period.[166] The economic impact of such changes in land use is potentially significant. In fact, the Michigan Economic and Environmental Roundtable (2001) estimates that the state loses $66 billion of economic output annually from decreased tourism and recreation, farming, forestry, and mining due to poorly planned suburbanization. The U.S. Department of Agriculture considers much of southeast Michigan to be high-quality farmland facing high development pressure.[167]

When land is converted from natural areas and low-density use, as in a rural area, to a more intensive use such as medium density residential or commercial land use, water quality and quantity can be negatively impacted. Increased flow rates and velocities, increased stormwater pollutants, as well as a decrease of natural areas can lead to sedimentation, stream bank erosion, loss of wildlife habitat, water temperature increase, algal blooms, decreased dissolved oxygen and other impacts.

Loss of Natural Features

The loss of natural features often comes hand in hand with new development. Natural features - including groundwater recharge areas, woodlands, wetlands, watercourses, permeable soils, vegetative buffers, and steep slopes – provide many natural functions in the landscape with regard to protecting water quality, regulating water quantity and providing wildlife habitat to receiving watercourses. In natural areas, most of the stormwater 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 replaced (with infiltration, detention or restoration measures), nearby water resources are impacted negatively with increased flow and increased pollutant loads.

Areas where riparian vegetation is still fairly intact should be prioritized for preservation and restoration based on the critical importance of this natural feature to the whole Huron River watershed. Riparian vegetation has many benefits to water resources, including stream bank stabilization, terrestrial and aquatic wildlife habitat structure, and shading and cooling of water. The impacts of losing riparian vegetation include the increase of stream bank erosion, loss of habitat and warmer water, which could threaten the survival of fish and aquatic insects.

Studies indicate that half of the state's inland wetlands and 70% of the coastal wetlands no longer exist.[168] Permitted fills for commercial and industrial development, housing, roads, agriculture, and logging claim an estimated 500 acres of wetlands statewide each year. The Huron River Watershed has lost approximately 66% of its wetlands to human activities. This great change in the landscape has the potential to contribute to increased flooding, loss of property values, water pollution, and diminished and fragmented wildlife

habitat. Wetlands smaller than 5 acres or not within 500 feet of another waterbody are not regulated by the state. Such wetlands often serve as many or more important functions than do the larger wetlands.[169] Therefore, local protection of these systems is needed.

Need for Public Awareness and Action

A general lack of awareness exists regarding the wide range of behaviors and policies that affect water quality, and a misperception exists about who contributes to the pollution in the watershed. For example, the basic concept of a watershed is not grasped by a majority of the public. Likewise, many people are unaware that storm drains lead directly to surface waters without treatment of stormwater. Another common misperception is that point sources such as wastewater treatment plants and industrial facilities, rather than nonpoint sources, are responsible for a majority of the pollutants in our waterways. Such misperceptions leads to complacent attitudes and a lack of personal responsibility, which in turn translate into a lack of community-based action to protect and restore local water resources. The impact of this lack of awareness and action has direct and indirect consequences. Directly, it encourages the further degradation of the resource by continuing to allow stormwater runoff and pollutants into our waterways. Indirectly, lack of public awareness and action can lead to a lack of interest by local decision-makers and thus lack of initiatives, programs, policies, and funding to either protect or restore water resources.

Need for Administrative Support and Institutional and Financial Arrangements

The members of the Huron Chain of Lakes Steering Committee have made commitments to protect and restore water resources with a broad spectrum of projects and programs. There is a corresponding need for additional support within these communities in order to implement, document and report on the various aspects of these increased responsibilities. Some communities have responded to this need to integrate stormwater projects and education into their regular activities by contracting with a consultant or hiring new personnel. With this need for additional support comes a need for additional funding. Creative partnerships, new fees, and grant funds need to be explored. The potential impact of inadequate program support, financial resources and institutional arrangements is the failure to create and implement programs, policies and projects that ensure the designated and desired uses.

Monitoring Programs and Data

Integrated and coordinated water quality monitoring needs to be more firmly established within the watershed. Review of readily available and relevant data reveals a number of concerns. In some cases, studies and data significant to water quality decisions are only minimally distributed within the area of interest. In other cases, existing datasets are not complete enough to be used as a basis for watershed decisions. Other datasets are nearly non-existent, especially those dealing with emerging issues such as the presence or absence of endocrine disrupting compounds (EDCs) in the water, sediments, and biota. The wide range of EDCs includes birth control pills, steroids, pesticides, inorganics, and industrial chemicals. In addition, the quality of some of the existing data causes concerns, given that the quality assurance/quality control (QA/QC) protocols of sampling parties is unknown. The type of data that has been historically collected is often not useful for answering the key questions about the watershed. Moreover, the lack of time-series data prohibits the detection of trends.

4.3 GOALS AND OBJECTIVES FOR THE HURON CHAIN OF LAKES WATERSHED

The designated and desired uses for the Huron Chain of Lakes Watershed provide a basis from which to build long-term goals and objectives. Long-term goals describe the future condition of the watershed toward which the Steering Committee will work. Long-term goals are not expected to be met within the first five years of plan implementation, but are to be met at some time beyond the first five years of implementation. The long-term goals have been developed on a watershed-wide basis. No single community or agency is responsible for achieving all of the goals or any one of the goals on its own. The goals represent the desired end product of many individual actions, which will collectively protect and improve the water quality, water quantity and biology of the watershed. The communities of the Huron Chain of Lakes Watershed will strive together to meet these long term goals to the maximum extent practicable by implementing a variety of BMPs over time, as applicable to the individual communities and agencies, relative to their specific priorities, individual jurisdictions, authority, and resources.

Due to the complex ecological nature of the response of watersheds to stormwater management, it is difficult to predict when these goals will be met. Some of the administrative long-term goals might realistically be met in the next few years, whereas some of the ecological goals will require more study and improvements, and may take multiple permit cycles to achieve. Rather than attempting to predict when these goals will be achieved, the partners will continuously strive to meet these goals by implementing various best management practices (BMPs) that are recommended for addressing the various goals. The partners will understand what progress is being made to achieve these goals by using an iterative process of implementing BMPs and evaluating the effects of these BMPs by regularly monitoring the river for change and degree of improvement.

The long-term goals and objectives as agreed upon by the Steering Committe are presented in Table 4.2. Short-term objectives are presented for each goal, and will be partially or wholly fulfilled within the first five years of plan implementation. Long-term objectives are developed for some of the goals, and may be partially fulfilled during the first five years of plan implementation but realistically will be fulfilled in subsequent implementation phases.

Table 4.2. Goals and Objectives for the Huron Chain of Lakes Watershed, and the Designated and Desired Uses They Address

Long-Term Goal	Short-Term Objective	Uses(s) Addressed
1. Increase public awareness of their role in protecting water resources	a. Increase opportunities for public involvement in protection of watershed resources b. Promote education, incentive, and stewardship programs that encourage individual source control of pollutants c. Promote coordination among local units of government in educational program development and implementation. d. Encourage partnerships between public and private entities in funding and promoting educational messages and activities	Designated Uses: all Desired Uses: all
	Long-Term Objective	
	e. Reduce pollution that impacts to the Watershed by providing practical knowledge to key audiences	
2. Reduce nonpoint source nutrient loading	**Short-Term Objective**	Designated Uses: Warmwater fishery; Aquatic life and wildlife; Partial and total body contact recreation Desired Uses: Hydrologic functions of natural features
	a. Support establishment of water quality monitoring programs to measure progress toward phosphorus TMDL goals. b. Develop ordinances, strategies, and/or programs for reducing nutrient loading. c. Promote implementation of structural and vegetative BMPs at new and existing developed areas.	
	Long-Term Objective	
	d. Meet established TMDL goals for Brighton, Ore, and Strawberry lakes.	
3. Reduce flow variability	**Short-Term Objective**	Designated Uses: Warmwater fishery; Aquatic life and wildlife; Desired Uses: Hydrologic functions of natural features
	a. Establish current stream flow dynamics through established monitoring strategy b. Increase the use of Low Impact Development (LID) design principles c. Develop ordinances, strategies, and/or programs to manage peak flow rates	
	Long-Term Objective	
	d. Protect and increase storage in wetlands, floodplains, groundwater, and other pervious areas with infiltration capacity	
4. Reduce soil erosion and sedimentation	**Short-Term Objective**	Designated Uses: Warmwater fishery; Aquatic life and wildlife; Industrial water supply; Public water supply Desired Uses: Hydrologic functions of natural features
	a. Establish baseline data for sediment fines in monitored streams through established monitoring program b. Improve application and enforcement of soil erosion and sedimentation controls (SESC) c. Increase education of BMPs among property owners and the building community	
	Long-Term Objective	
	d. Increase clarity in surface waters	
5. Protect and mitigate loss of natural features for indigenous riparian and	**Short-Term Objective**	Designated Uses: Warmwater fishery; Aquatic life and wildlife; Industrial water supply; Public water supply
	a. Integrate natural features mapping data into land use planning decisions b. Develop policies that protect natural areas c. Monitor water quality and biota to measure progress	

aquatic animals and plants	d. Educate local decision makers and the public about the benefits of critical habitat protection e. Consider groundwater recharge data when identifying priority natural features protection areas **Long-Term Objective** f. Maintain or improve the aquatic community, including meeting TMDL goals for poor macroinvertebrate communities in Horseshoe Lake Drain and Honey Creek. g. Increase areas of natural features, including wetlands, woodlands, riparian buffers, and floodplains	Desired Uses: Hydrologic functions of natural features; Open space and greenways
6. Protect existing open space and agricultural land	**Short-Term Objective** a. Identify and prioritize key opportunities for protection of undeveloped lands b. Develop policy and planning tools that address urban sprawl c. Facilitate regional coordination in preserving open space corridors, especially riparian corridors d. Work with land conservancies and other land preservation groups to facilitate use of land protection/conservation tools	Designated Uses: Warmwater fishery; Aquatic life and wildlife; Desired Uses: Hydrologic functions of natural features; Open space/greenways
7. Protect and enhance recreational opportunities	**Short-Term Objective** a. Identify and reduce sources of pollution that inhibit recreational activities b. Increase regional coordination of recreational planning efforts c. Research and pursue grant opportunities for recreational planning efforts	Designated Uses: Partial and total body contact recreation; Warmwater fishery; Desired Uses: Open space/greenways; hydrologic functions of natural features
8. Increase monitoring of water quality, water quantity, and biological indicators	**Short-Term Objective** a. Develop a monitoring strategy b. Secure funding and develop partnerships to conduct short-term and long-term monitoring of key indicators c. Implement and maintain Illicit Discharge Elimination Program (IDEP) investigations	Designated Uses: all Desired Uses: all
9. Balance environmental and economic benefits in the subwatershed	**Short-Term Objective** a. Integrate stormwater management in planning and site plan review process b. Educate land use decision makers and developers on long-term economic benefits of stormwater BMPs, impacts of development on the watershed, and tools for low impact development c. Increase coordinated planning efforts and implementation among local units of government	Designated Uses: all Desired Uses: all
10. Attain full plan implementation	**Short-Term Objective** a. Establish financial and institutional arrangements for WMP fulfillment b. Ensure the long-term viability of the Huron Chain of Lakes Steering Committee to guide watershed-wide planning decisions. c. Increase public awareness of progress in WMP implementation	Designated Uses: all Desired Uses: all

4.4 WATERSHED MANAGEMENT ALTERNATIVES

Once the Steering Committee members identified the current conditions of the watershed and the direction in which they want the watershed to go (the designated and desired uses), they reviewed their existing management approaches. Communities identified existing ordinances, policies, and practices that contribute to the group's vision of a healthy watershed, as well as gaps and inconsistencies that present opportunities for improvement. Understanding current management provides a starting point for identifying alternatives to improve protection of critical sensitive areas and mitigation of critical degraded areas. The Steering Committee utilized two tools to inventory their current management strategies, the Codes and Ordinances Worksheet and the Best Management Practices Menu. Both of these tools are described in this chapter.

4.4.1 Assessment of Community Development Codes and Ordinances

If the watershed communities would like to protect the quality of the water resources and the character of the landscape under a continued growth scenario, local governments, developers, and site designers alike must fundamentally change the way land is developed. Deciding where to allow or encourage development, promote redevelopment, or protect natural resources are difficult issues jurisdictions have to balance. While effective zoning and comprehensive planning are critical, communities should also be exploring ways to minimize the impact of impervious cover, maintain natural hydrology, and preserve contiguous open space on development sites.

An in-depth review of local development standards, ordinances and building codes that shape how development occurs in a community was completed by the following ten communities in the Huron Chain of Lakes: Brighton Township, City of Brighton, Genoa Township, Green Oak Township, Hartland Township, Highland Township, Lyon Township, Milford Township, Village of Pinckney, and Putnam Township. The review utilized a Codes & Ordinances Worksheet (COW) adapted by the Huron River Watershed Council for Huron River Watershed communities from the original COW developed by the Center for Watershed Protection. The COW evaluates the level of protection afforded by a community's building codes and ordinances. It is a useful guide to review development rules, and serves as a basis for determining where future improvements can be made.

The responses to the COW were compared to a set of Model Development Principles which are set forth in the publication *Better Site Design: a Handbook for Changing Development Rules in Your Community*[170]. Taken together, these Development Principles reduce impervious cover, conserve natural areas, and prevent stormwater pollution from new development while maintaining quality of life within a community. Participating communities in the Huron Chain of Lakes Watershed received individual results, prioritized suggestions for improving codes and ordinances to address stormwater, and supporting materials for how to begin implementing the recommendations. In addition, HRWC presented the general results and facilitated a discussion that focused on the benefits and challenges of implementing a subset of common recommendations that applied to all or most of the participating communities.

The model development principles upon which *Better Site Design* is based are merely benchmarks; each community should adapt relevant principles and refine recommendations appropriate to local circumstances. Every community has opportunities to alter some part of its subdivision and development codes to foster development that better protects environmental resources and is economically advantageous for the development community.

BENEFITS OF APPLYING THE MODEL DEVELOPMENT PRINCIPLES[171]

The model land development principles have documented benefits for both the natural environment and the community. Communities implementing the model principles have realized the following benefits:

- Protected the quality of local streams, lakes, and estuaries
- Resulted in a more attractive landscape
- Reduced car speed on residential streets
- Generated smaller loads of stormwater pollutants
- Allowed for more sensible locations for stormwater facilities
- Helped to reduce soil erosion during construction
- Reduced development costs
- Increased local property tax revenues
- Increased property values
- Facilitated compliance with wetlands and other regulations
- Created more pedestrian friendly neighborhoods
- Provided open space for recreation
- Promoted neighborhood designs that provide a sense of community
- Protected sensitive forests, wetlands, and habitats from clearing
- Preserved urban wildlife habitat

Common gaps in local policies that were identified through this process yielded opportunities that are presented in Table 4.3.

Table 4.3: Policy Opportunities Identified in Communities of the Huron Chain of Lakes Watershed

Recommendation	Benefits
Adopt and implement ordinances for stream buffers, wetlands with natural features setback, and floodplains. Incorporate plans for buffer maintenance and management in the ordinances.	• Reduces amounts of nonpoint source pollutants (nutrients, sediment, oil, salt, metals, pesticides, etc…) • Reduce hydrologic impacts from loss of floodplains and wetlands, and increased imperviousness • Reduce stream temperature
Establish a land runoff program for water quality improvement; i.e. adopt a phosphorus reduction ordinance to reduce non-point sources of phosphorus to local waterways; provide incentives for reduction of fertilizer & herbicide use.	• Reduces amounts of nonpoint source pollution from nutrients, sediment, and pesticides • Reduces amounts of nonpoint source pollutants (nutrients, sediment, oil, salt, metals, pesticides, etc…)
Incorporate requirements for managing the quality and quantity of stormwater runoff from new development sites, including residential, commercial and institutional.	• Reduce hydrologic impacts from loss of floodplains and wetlands, and increased imperviousness • Reduces amounts of nonpoint source pollutants (nutrients, sediment, oil, salt, metals, pesticides, etc…)
Provide preservation and conservation options in development codes: - Develop land conservation incentives - Adopt and implement a farmland preservation ordinance - Preserve specimen trees - Establish open space management requirements	• Reduce hydrologic impacts from loss of floodplains and wetlands, and increased imperviousness
Allow for and promote more on-site retention of stormwater, i.e. allow for bioretention islands in landscaped areas of parking lots; allow for rooftop runoff to be discharged over pervious areas on residential sites.	• Reduce hydrologic impacts from loss of floodplains and wetlands, and increased imperviousness • Reduces amounts of nonpoint source pollutants (nutrients, sediment, oil, salt, metals, pesticides, etc…)
Establish a minimum percentage of parking lot area that is required to be landscaped	• Reduce hydrologic impacts from loss of floodplains and wetlands, and increased imperviousness • Reduce stream temperature
Incorporate options in development code to reduce impervious surface cover, i.e. street widths, right of ways, minimum cul-de-sac radius, driveway widths and parking ratios. Allow for pervious materials to be used in spillover parking areas.	• Reduce hydrologic impacts from loss of floodplains and wetlands, and increased imperviousness • Reduce stream temperature

Recommended alternative policies and programs deemed to yield the most benefit for the cost are included in the Action Plan. Appendix D contains a copy of the COW questions and corresponding desired responses, as well as the summarized results and recommendations for each community that completed the COW exercise. Based on the responses, there are many opportunities for enhancing current local standards within the Huron Chain of Lakes Watershed. The following areas seem particularly promising:

- Stream, wetland, steep slope, and floodplain buffer requirements, education and maintenance activities;
- Stormwater management in the site plan review process;
- Floodplain and wetland (<5 acres in size) protection criteria & standards;
- Impervious surface reduction through promoting incentives for clustering, reducing residential street widths and lengths, and reducing cul-de-sac radii;
- Open space requirements/encouragement (consolidation, use/alteration restrictions);
- Native landscaping techniques, soil testing, and integrated pest management;
- Enhanced soil erosion control standards and enforcement (e.g., based on site specific particle size analysis); and
- Rewarding the use of ecological landscaping design (e.g., capture of smaller and more frequent storms, disconnection of downspouts, utilization of bioretention, recycling of captured stormwater for on-site irrigation, reduced grading and alteration of natural slope, etc.)

Although not all communities in the watershed participated in this exercise, it is reasonable to assume that most of the recommendations presented to the participating communities could be extended to the non-participating communities, given the similarities in administrative resources and socio-economic conditions, among other factors.

4.4.2 Selection of Management Alternatives (Menu of Best Management Practices)

In the field of watershed management, management alternatives to address the sources and causes of the challenges are called Best Management Practices, or BMPs. BMPs cover a broad range of activities that vary in cost, effectiveness, and feasibility, depending on a complex set of factors. A stormwater best management practice is a technique, measure, or structural control that is used for a given set of conditions to manage the quantity and improve the quality of stormwater runoff in the most cost effective manner. BMPs fall into one of three categories:

Structural BMPs are engineered and constructed systems that improve the quality and/or control the quantity of runoff such as detention ponds and constructed wetlands. Structural BMPS are inherently site-specific and are designed to treat or manage stormwater at a specific location.

Vegetative BMPs are natural processes that preserve existing vegetation or establishes ground cover to minimize soil erosion. Vegetative BMPs are sometimes considered as a sub-set of structural BMPs.

Non-structural BMPs, also known as *Managerial BMPs*, consist of institutional, educational or regulatory pollution prevention practices designed to limit the generation of stormwater runoff or reduce the amounts of pollutants contained in the runoff.

No single BMP can address all stormwater problems. Each practice has certain limitations based on drainage area served, available land space, cost, pollutant removal efficiency, as well as a variety of site specific factors such as soil types, slopes, depth of groundwater table, etc. Careful consideration of these factors is necessary in order to select the appropriate group of BMPs for a particular location or situation.

Structural Practices

Structural stormwater BMPs are physical systems that are constructed for a development – new or existing – that reduce the stormwater impact of development. Such systems can range from underground, in-line storage vaults to manage peak flows, to slightly graded swales vegetated with wildflowers to slow flows as well as treat pollutants. Structural BMPs can be designed to meet a variety of goals, depending on the needs of the practitioner. In existing urbanized areas and for new developments, structural BMPs can be implemented to address a range of water quantity and quality considerations. Because the effect of these physical systems can often be quantitatively measured by monitoring inflow and outflow parameters, recent studies have suggested certain pollutant removal efficiencies of various BMPs. These data are summarized in table 4.4.

Residential stormwater BMPs, most of which are designed to reduce stormwater runoff via capture and later use by homeowners or via enhanced onsite infiltration, have several advantages. For instance, these practices can be readily applied in older development areas where space for drainage area BMPs is often limited, often low in cost, easily installed and maintained, and act as an educational vehicle for pollution reduction. Some examples of such practices include rain barrels (cisterns), rainwater gardens, concrete grid (porous pavers) walkways, and vegetated roofs. The application of individual homeowner BMPs can sometimes be variable and with uncertain pollutant removal rates. However, the importance of individual homeowner BMPs and managerial BMPs should not be discounted, and recommendations for implementation are provided below.

No single BMP type is ideally suited for every situation and each brings with it various performance, maintenance and environmental advantages and disadvantages. BMPs which consistently achieve moderate to high levels of removal for particulate and soluble pollutants include: wet ponds, sand filters, and infiltration trenches. Wet ponds have demonstrated a general ability to continue to function as designed for relatively long periods of time without routine maintenance. BMPs which are generally not capable of predictable pollution reduction rates until their fundamental design is improved or modified include: infiltration basins, grass filters and swales, and oil/grit separators.[172]

Table 4.4. Pollutant Removal Efficiencies for Stormwater Best Management Practices

	Pollutant Removal Efficiencies					
Management Practice	**Total Phosphorus**	**Total Nitrogen**	**TSS**	**Metals**	**Bacteria**	**Oil and Grease**
High-powered street sweeping	30-90%		45-90%			
Riparian buffers	forested: 23-42%; grass: 39-78%	forested: 85%; grass: 17-99%	grass: 63-89%			
Vegetated roofs	Note: 70-100% runoff reduction, 40-50% of winter rainfall. 60% temperature reduction. Structural addition of plants over a traditional roof system.					
Vegetated filter strips (150ft strip)	40-80%	20-80%	40-90%			
Bioretention	65-98%	49%	81%	51-71%		
Wet extended detention pond	48 - 90%	31-90%	50-99%	29-73%	38-100%	66%
Constructed wetland	39-83%	56%	69%	(-80)-63%	76%	
Infiltration trench	50-100%	42-100%	50-100%			
Infiltration basin	60-100%	50-100%	50-100%	85-90%	90%	
Grassed swales	15-77%	15 - 45%	65-95%	14-71%	(-50) - (-25)%	
Catch basin inlet devices		30-40% sand filter	30-90%			
Sand and organic filter	41-84%	22-54%	63-109%	26-100%	(-23) - 98%	
Stabilize soils on construction sites			80-90%			
Sediment basins or traps at construction sites			65%			

Sources: Claytor, R. and T. R. Schueler. 1996. Design of Stormwater Filtering Systems. Center for Watershed Protection, Ellicott City, MD.
Ferguson, T., R. Gignac, M. Stoffan, A. Ibrahim and J. Aldrich. 1997. Cost Estimating Guidelines, Best Management Practices and Engineered Controls. Rouge River National Wet Weather Demonstration Project.
Brown, W. and T. Schueler. 1997. National Pollutant Removal Performance Database for Stormwater BMPs. Center for Watershed Protection, Ellicott City, MD.
Schueler, T. R. and H. K. Holland. 2000. The Practice of watershed Protection. Center for Watershed Protection, Ellicott City, MD.
Tetra Tech MPS. 2002. Stormwater BMP Prioritization Analysis for the Kent and Brighton Lake Sub-Basins, Oakland and Livingston Counties, Michigan.
Tilton and Associates, Inc. 2002. Stormwater Management Structural Best Management Practices – Potential Systems for Millers Creek Restoration. Ann Arbor, MI.
U.S. EPA. 2002. National Menu for Best Management Practices for Storm water Phase II.

Information regarding the pollutant removal efficiency, costs, and designs of structural stormwater management alternatives is evolving and improving constantly. As a result, information contained in Table 4.4 is dynamic and subject to change. While potential locations are recommended for some management alternatives in the Action Plan, general guidelines can be consulted for their common sense placement. The location guidelines shown in Table 4.5 are adapted from the Rapid Watershed Assessment Protocol of the Center for Watershed Protection.

Table 4.5. General Guidelines for Locating BMPs

Amount of Development	***Undeveloped***	***Developing***	***Developed***
Philosophy	Preserve	Protect	Retrofit
Amount of Impervious Surface	< 10 %	11 - 26 %	> 26 %
Water quality	Good	Fair	Fair-Poor
Stream biodiversity	Good-Excellent	Fair-Good	Poor
Channel stability	Stable	Unstable	Highly unstable
Stream Protection Objectives	Preserve biodiversity; channel stability	Maintain key elements of stream quality	Minimize pollutant loads delivered to downstream waters
Water quality objectives	Sediment and temperature	Nutrients and metals	Bacteria
BMP selection and design criteria	Maintain pre-development hydrology	Maintain pre-development hydrology	Maximize pollutant removal and quantity control
	Minimize stream warming and sediment	Maximize pollutant removal, remove nutrients	Remove nutrients, metals and toxics
	Emphasize filtering systems	Emphasize filtering systems	
Example locations	Rural headwater areas	Suburban and developing areas like Griggs Drain	Subwatersheds in Flat Rock, Rockwood

Non-Structural Practices

Non-structural stormwater BMPs include managerial, educational, and regulatory practices designed to prevent pollutants from entering stormwater runoff or reduce the volume of stormwater requiring management. These BMPs focus on modifying behaviors and practices through education programs, public involvement programs, land use planning, natural resource protection, regulations, operation and maintenance, or any other initiative that does not involve designing and building a physical stormwater management mechanism. Although most of these non-structural BMPs are difficult to measure quantitatively in terms of overall pollutant reduction and other stormwater parameters, research demonstrates that these BMPs have a large impact on changing policy, enforcing protection standards, improving operating procedures and changing public awareness and behaviors to improve water quality and quantity in a watershed

over the long term. Moreover, they target source control which has been shown to be more cost effective than “end-of-the-pipe” structural solutions. Therefore, these BMPs should not be overlooked, and in some cases, should be the emphasis of a stormwater management program.

Considerations in Selection of BMPs

The Steering Committee took steps to determine which BMPs are more environmentally effective and more cost effective toward meeting the goals for the Huron Chain of Lakes Watershed. An extensive, but not exhaustive, list of possible BMPs and their potential effectiveness, cost, and feasibility was discussed and additions were included based on ideas generated at meetings. The Steering Committee considered which BMPs would (1) best address their priorities for the watershed in their locality, (2) be among the more environmentally effective, and (3) be more likely to be implemented. This list of BMPs was shared among the Steering Committee members in order to coordinate ideas and resources, as well as to solicit suggestions from participants, identify gaps and ensure that watershed goals were being addressed adequately. These steps have resulted in the development of the Action Plan (Table 4.6).

The watershed is comprised of diverse communities, from rural townships to urban centers. Consequently, a variety of structural and non-structural management alternatives, or practices could be considered across the watershed. The alternatives described in this chapter may apply to one community but not to another, and so it is important to note that each of the alternatives is a unique solution to a specific pollution source or problem. This diversity of applications is described both in the Action Plan and in each individual SWPPI to be submitted after this plan is complete. Although each of these alternatives is applicable to at least one of the communities or agencies in the watershed, not all of them are appropriate for every community. Although it is not an exhaustive list of all of the possible management alternatives that could be considered, the recommended management alternatives for the watershed are summarized below in Section 5.5.

4.5 Huron Chain of Lakes Action Plan

To prepare the Action Plan Table, Steering Committee members assessed the information available about types of management alternatives and their appropriateness and efficiencies, the recommendations from the Codes & Ordinances Worksheet, the goals and objectives developed for the Huron Chain of Lakes, and their existing policies and programs. The management alternatives that are listed in the Action Plan include activities that entities are interested in or planning to implement, as well as other BMPs that may contribute to achieving the plans goals and objectives but are not feasible to implement at this time.

While the individual communities and entities are responsible for meeting the goals and objectives of the Plan by implementing the recommended actions, the Action Plan is intended as a resource for *all* stakeholders in the Watershed. Local planners and governmental officials can draw upon these tools in their everyday decisions in their jobs. Local citizens can become involved at the grass roots level to implement some of these ideas, and also press their elected and local officials to carry out the management alternatives. Watershed-wide awareness of, and active support for, the management alternatives in the Action Plan is ultimately needed to ensure that the goals and objectives of the Plan are realized.

The management alternatives presented in the Action Plan are described briefly below in the order in which they appear on the Action Plan.

4.5.1 Recommended Actions to Achieve Watershed Goals and Objectives

Managerial Actions: Ordinances and Policies

Sample ordinances and supplemental resources for several of the policies and ordinances described in this section are available in the Appendices. McComb County's Department of Environmental Planning and Economic Development also maintains a list of model ordinances at: http://macombcountymi.gov/planning/Model_Envir_Ordinances.asp.

BMP #1: Adopt Phosphorus Fertilizer Reduction Ordinance
Nitrogen, phosphorus, potassium and other nutrients are necessary to maintain optimum growth of lawns and most gardens. While phosphorus is a naturally occurring nutrient in Michigan waters, human activities such as turfgrass fertilizing contribute excess amounts of phosphorus to lakes and rivers. Over-nutrification of freshwater systems can create nuisance algal blooms that deplete oxygen needed by aquatic organisms, which can lead to fish kills, and prevent water-based recreation. A local phosphorus fertilizer reduction ordinance can address the proper selection, use, application, storage and disposal of fertilizers, and incentives to reduce residential and commercial herbicide/fertilizer use. The ordinance should be combined with a coordinated information and education campaign to communicate the need for the ordinance. Research has shown that phosphorus is not needed as a soil additive in most areas within southeast Michigan. Hamburg Township, West Bloomfield Township and Commerce Township have successfully implemented such ordinances, and the City of Ann Arbor will be implementing its own in the near future.

BMP #2: Implement Native Landscaping Ordinance
Many of the native plants and shrub landcover of the watershed have been replaced with non-native plants and shrubs and turfgrass, both of which require intensive cultivation and application of chemicals. Native plant and shrub species are adapted to this area and require less water and less maintenance because of their deep root system and resistance to disease. Natives improve stormwater infiltration and stabilize soils by replacing turf grass or other introduced cover with native grasses, flowers, shrubs and trees. In addition, native species provide habitat and food to insects and wildlife. Native landscaping resources are available in southeast Michigan from plant growers to landscaping consultants. A native landscaping ordinance would promote planting of native species and remove any existing obstacles to growing these plants on residential and commercial lands.

BMP #3: Adopt No Dumping Ordinance
Several communities in the Huron Chain of Lakes Watershed already have ordinances in place that address dumping of substances in surface waters and wetlands. The ordinance can address a variety of substances from toxics to organic waste such as leaves. Residents of the watershed have commented on the presence of litter in the Huron River, so this ordinance may go a long way toward reducing it if enforcement and education mechanisms are included.

BMP #4: Adopt Pet Waste Ordinance
Pet waste can be washed into nearby surface waters and wetlands via direct runoff or storm water systems, thereby adding *E. coli* and nutrients to these freshwater systems. An ordinance that states proper pet waste management practices and provides for education, enforcement

and necessary infrastructure (e.g., bag dispensers) can reduce the incidences of pet waste entering the watershed.

BMP #5: Adopt Private Roads Ordinance
A private roads ordinance complements efforts to reduce directly connected impervious surfaces by permitting roads to be built that are narrower than county road standards. Narrower roads produce a smaller area of impervious surface. The ordinance can promote rural character by allowing narrow roads in certain developments in order to preserve open space. Census data shows that most communities in the Huron Chain of Lakes Watershed will experience an increase in population and development, so this ordinance can be a preemptive means of protecting water resources. Sample ordinance language is available through County Planning Departments and the Huron River Watershed Council.

BMP #6: Adopt Purchase of Development Rights Ordinance
The purchase of development rights, known as PDR, is an effective tool for local government or non-governmental organizations such as land conservancies or land trusts, to purchase the development rights of a property to limit development and protect natural features, open space or agricultural land in perpetuity. The ordinance is a tool for guiding growth away from sensitive resources and toward delineated development centers. A PDR ordinance identifies areas that may be protected through conservation easements or purchased for public ownership either outright or through PDR. Communities in southeast Michigan have adopted PDR ordinances and garnered the resources to purchase important parcels of land for preservation in perpetuity.

BMP #7: Adopt Stormwater Management Ordinance
Regulations that can guide land development with regard to protecting the water quality, water quantity and biological integrity of the receiving surface water are important in undeveloped and soon-to-be-developed areas. This regulation can use existing data to determine the development impact that can be tolerated by the surface waters before that system will become degraded. Future development or redevelopment can be guided to control runoff so that local streams and water resources are not negatively affected by the development to the greatest extent practicable. The ordinance can incorporate requirements for managing the quality and quantity of stormwater runoff from new development sites, including residential, commercial and institutional sites. Adopting the Rules of the County Drain Commissioner's Office can be an element of the ordinance in order to be protective of local water resources. Modifications to existing engineering and design standards for stormwater management BMPs is a necessary element of this activity.

BMP #8: Adopt Local Wetlands Ordinances with Natural Features Setback
Wetlands serve as giant sponges, which soak up storm water during wet weather events allowing the water to infiltrate into the soil instead of running off directly to surface waters. As the stormwater infiltrates into the soil, pollutants are filtered out before it reaches groundwater. Wetlands serve to reduce storm water velocities, reduce peak flows and to filter out storm water pollutants, they also provide habitat for numerous wildlife species. A subset of all wetlands are regulated by state and federal authorities, i.e. in counties with 100,000 people or more, wetlands 5 acres or larger and wetlands within 500 feet of a waterbody are regulated. A wetlands ordinance that is more protective than required by the state or federal government is necessary to protect those smaller, isolated wetlands deemed important to a community. A model wetlands ordinance is available to local communities from the Huron River Watershed Council and the Michigan Coastal Zone Program of the MDEQ.

BMP #9: Support County-wide Septic System Time-of-Sale and/or Maintenance Ordinance

An ordinance requiring specified time and standards for septic tank maintenance measures can be used to prevent, detect and control leaks, overflows and seepage from occurring. Septic systems should be designed, sited, operated and maintained properly to prevent nutrient/pathogen loadings to surface waters and to reduce loadings to groundwater. Septic tanks should be pumped at least every three years depending on the size of the family or group using the tank. Educational materials should be distributed to new and current homeowners that use septic tanks so that pollution prevention is emphasized.

A county-wide "Time of Sale" program requires the inspection and evaluation of septic systems and/or wells before residential property changes ownership. Such programs, which have successfully been implemented in Washtenaw and Wayne counties, protect public health and safety by ensuring safe and adequate water supplies and proper disposal of human sewage. In Washtenaw County, a seller may not transfer ownership of their property unless they have a letter from the Washtenaw County Health Department stating that their well and septic systems are in substantial compliance with the rules of Washtenaw County. In order to obtain this certificate, the Seller must have their systems inspected by a certified inspector. This procedure takes a minimum of three weeks to accomplish (assuming the inspections are satisfactory). The inspector completes a series of tests and fills out a written report of the test results which he submits to the Health Department. Within 5 days the Health Department either: (l) issues a letter stating that the systems are in substantial compliance; or (2) issues a letter stating that the system is not in substantial compliance. If this happens, the seller must obtain and submit to the Health Department a written bid which outlines the correction of the problem. If it is approved, the seller may proceed to have the problem corrected. Once the correction is completed, the Health Department will issue the letter of compliance. If the Seller needs to close on the sale before the remediation work can be completed, the Seller must escrow 1 1/2 times the amount of the bid with the title company at closing. Once the work is completed and approved, any remaining escrow funds will be returned to the Seller.

BMP #10: Adopt Overlay Zoning for Riparian Corridor (as part of Natural Features Ordinance)

In order to direct land development while protecting key local natural resources, local ordinances that clarify why the protection of certain features is important and how they will be protected under the law are necessary. These local ordinances can be more protective than state or federal law and can better reflect the priorities of a local community. The Code and Ordinance Worksheet process identified the following components that local communities could consider in a Natural Features Ordinance: woodlands, preserve specimen trees, natural features setback, floodplains, provide preservation and conservation options in development code such as develop land conservation incentives; adopt and implement a farmland preservation ordinance, and establish open space management requirements. Plans for natural features buffer maintenance and management should be included in the ordinances. Sample language is available from resource agencies and organizations such as the Huron River Watershed Council and Wayne County Planning.

BMP #11: Enhance Site Plan Review Requirements

Community site plan review standards can be revised to include, if applicable, the 100-year floodplain, location of waterbodies and their associated watersheds, location of slopes over 12 percent, site soil types, location of landmark trees, groundwater recharge areas, vegetation types within 25 feet of waterbodies, woodlands and other vegetation on site, and site topography.

BMP #12: Incorporate Low Impact Development Principles
Land use planning and management involves a comprehensive planning process to promote Low Impact Development (LID) and control or prevent runoff from developed land uses. LID is a low cost alternative to traditional structural stormwater BMPs. It combines resource conservation and a hydrologically functional site design with pollution prevention measures to reduce development impacts to better replicate natural watershed hydrology and water quality. Through a variety of small-scale site design techniques, LID reduces the creation of runoff, volume, and frequency. Essentially, LID strives to mimic pre-development runoff conditions. This micro-management source control concept is quite different from conventional end-of-pipe treatment or conservation techniques. The LID planning process involves the following steps: 1) determine water quality and quantity goals with respect of human health, aquatic life and recreation; 2) identify planning area and gather pertinent hydrological, chemical and biological data; 3) determine and prioritize the water quality needs as they relate to land use and the proposed development; 4) develop recommendations for low impact development to address the problems and needs that have been previously determined; 5) present recommendations to a political body for acceptance and 6) implement adopted recommendations.

BMP #13: Improve Enforcement of Litter Laws and Nuisance Properties
According to surveys by Keep America Beautiful, litter is caused by any of the following: pedestrians, motorists, uncovered trucks, loading docks, construction sites, improper residential refuse set-out, and improper commercial refuse set-out. Of all litter, 40 percent is accidental, such as something blowing out of a dump truck, while much of the 60 percent that's intentional occurs in places where litter has already accumulated.

BMP #14, 15, and 16: Improve Enforcement of Soil Erosion and Sediment Control Policies/ Improve Enforcement of Construction Site Inspections
Regular inspection of control measures is essential to maintain the effectiveness of during construction and post-construction stormwater best management practices. Generally, inspection and maintenance of practices can be categorized into two groups—expected routine maintenance and non-routine (repair) maintenance. Routine maintenance refers to checks performed on a regular basis to keep the practice in good working order. In addition, routine inspection and maintenance is an efficient way to prevent potential nuisance situations (odors, mosquitoes, weeds, etc.), reduce the need for repair maintenance, and reduce the chance of polluting stormwater runoff by finding and correcting problems before the next rain. In addition to maintaining the effectiveness of stormwater BMPs and reducing the incidence of pests, proper inspection and maintenance is essential to avoid the health and safety threats inherent in BMP neglect. The failure of structural storm water BMPs can lead to downstream flooding, causing property damage, injury, and even death.[173]

BMP #17: Minimize Total Impervious Cover in Zoning Ordinance
Utilizing a Low Impact Development (LID) Plan for new developments can reduce directly connected impervious surfaces. LID plans combine a hydrologically functional site design with pollution prevention measures to compensate for land development impacts on hydrology and water quality. The result will be a reduction in storm water peak discharge, a reduction in runoff volume and the removal of storm water pollutants. LID principles can apply to new residential, commercial and industrial developments. Under the umbrella of LID are specific options such as reducing street widths, right of ways, minimum cul-de-sac radius, driveway widths and parking ratios, allowing for pervious materials to be used in spillover parking areas, and establishing a minimum percentage of parking lot area that is required to be landscaped (preferably with native plants). Communities are encouraged to minimize the total impervious cover in Zoning Ordinances to protect water resources in the buildout scenario.

BMP #18: Promote Open Space Preservation in Zoning Ordinance and Master Plan
Zoning maps may be amended to increase protection for water resources. Inclusion of natural features and open space zoning are two of the most common and useful ways. Allowing for compact development design increases the ability to preserve a significant amount of open, undeveloped land by grouping buildings and paved surfaces to provide more compact developments while maintaining open spaces.

BMP #19: Review and Revise Grading and Land Clearing Practices
It is desirable for the protection of the Huron River that as much of a site be conserved in a natural state as possible. Areas of a site that are preserved in their natural state retain their natural hydrology and do not erode during construction. In general, grading and clearing ought to be restricted to the minimum area required for building footprints, construction access, and fire safety setbacks. Several tools may be adapted to limit clearing, including the soil erosion and sediment control ordinance, grading ordinances, tree or forest protection ordinances, and open space development.

BMP #20: Revise Parking Standards for New Developments and Redevelopments
The required parking ratio governing a particular land use or activity would be enforced as both a maximum and minimum in order to curb excess parking space construction. Parking codes would be revised to lower parking requirements where mass transit is available or enforceable shared parking arrangements are made. Reduce overall imperviousness of parking lots by providing compact car spaces, minimizing stall dimensions, incorporating efficient parking lanes and using pervious materials in spillover parking areas.

BMP #21: Revise Stormwater Management Standards for Pond Landscaping
This practice is meant to reduce nuisance geese habitat at storm water ponds through installation of shoreline buffer planting or other means. The practice is utilized each time the storm water system is reviewed or equivalent, with no end date. Parks departments may become involved to employ the same strategy near public water features.

Managerial Actions: Practices

BMP #22: Incorporate Results of Conservation Planning Analysis into Local Ordinances and Policies
In order to help state and local planning agencies, land conservancies, and local communities make better decisions about where to encourage growth and where to target preservation and restoration efforts, remaining natural areas in the Huron Chain of Lakes Watershed have been mapped and prioritized. In 2002, the Huron River Watershed Council mapped and ranked natural areas in the Huron River Watershed through the Conservation Planning in the Huron Watershed project. Mapped sites were ranked based on ecological and hydrological factors including size, presence of water, presence of wetlands, groundwater recharge, potential for rare plant communities, topographical diversity, and glacial diversity. Similar projects to map and prioritize natural areas are also found in Livingston County's High Quality Natural Areas Report (2003) and Oakland County's 2005 Potential Conservation/Natural Areas report. The results of these analyses need to be reviewed and then incorporated into each community's maps and land use decision making processes in order to protect the ranked priority areas.

BMP #23: Reduce Directly Connected Impervious Surfaces
After strategies have been employed to reduce overall site imperviousness in new developments and redevelopment, additional environmental benefits can be achieved and hydrologic impacts reduced by disconnecting impervious areas. Strategies include:

- Disconnecting roof drains and directing flows to vegetated areas or to dry wells
- Directing flows from paved areas such as driveways to stabilized vegetated areas
- Breaking up flow directions from large paved surfaces
- Encouraging sheet flow through vegetated areas
- Carefully locating impervious areas so that they drain to natural systems, vegetated buffers, natural resource areas, or permeable zones/soils. Ensure that flow velocities are maintained so as to not degrade the natural, vegetated filtering system.

In some cases, disconnecting impervious areas can reduce the effective impervious cover in a watershed by 20-50%.[174] In urban communities, especially older areas, there may be opportunities to disconnect impervious areas through downspout disconnection and the discharge of footing drains/sump pumps to green space rather than to stormwater conveyance systems.

BMP #24: Practice High-Powered Street and Paved Area Sweeping
High-powered street sweeping is a management measure that involves pavement cleaning practices on a regular basis to minimize pollutant export to receiving waters. These cleaning practices are designed to remove sediment debris and other pollutants from road and parking lot surfaces that are a potential source of pollution impacting urban streams. Recent improvements in street sweeper technology (e.g., regenerative air or vacuum assisted systems) have enhanced the ability of the current generation of street sweeper machines to pick up the fine grained sediment particles that carry a substantial portion of the stormwater pollutant load. Many of today's sweepers can now dramatically reduce the amount of street dirt entering streams and rivers. Street sweeping is recommended in cold climate areas during, or prior, to spring snowmelt as a pollution prevention measure.

BMP #25: Provide Pet Waste Bags in Parks and Public Areas
This program provides bags for pet waste clean up in order to reduce pet waste in parks, subsequently reducing the amount of *E. coli* entering surface waters from pet waste.

BMP #26: Increase Amount of Refuse Containers and Review Distribution
Some littering and dumping occurs for the simple reason that a refuse container are not in close proximity. Increasing public access to refuse containers reduces the motivation for intentional dumping or littering.

BMP #27: Alternative Drain Practices that Rehabilitate Stream and Riparian Habitats
The channelization of the Huron Chain of Lakes system to drain the land is the root of many problems in the watershed today. While the responsibilities of County Drain Offices continues to include maintenance of drains to prevent flooding by removing obstructive vegetation and sediment, opportunities to return stretches of drains to their more natural condition should be identified. Locations where agricultural uses have given way to development are candidates for alternative drain practices and rehabilitation. Breaking of drainage tiles in developing areas can be pursued in conjunction with rehabilitation of drains in order to increase the opportunity to restore hydrologic function to the river system. This practice should be done in conjunction with development, rather than after the fact. Often the tiles are not part of the drain, but are torn up as a result of development.

BMP #28: Practice Storm Drain/Catch Basin Marking
The purpose of storm water drain marking is to eliminate waste entering the Huron River through storm drains by creating public awareness of the danger of dumping into these drains. Storm drains are marked with a warning stating that any waste entering the drain goes straight to the Huron River. Along with the marking, the project places educational fliers on the doors of

residences in the vicinity of newly marked drains. Markers are continuously placed on drains and replaced every few years when old markers begin to fade or fall off.

Managerial Actions: Studies and Inventories

BMP #29: Reduce the Use of Conventional Road De-icers
Managers are encouraged to consider the use of alternatives to conventional road salt (sodium chloride) such as a calcium chloride, or to ensure proper calibration of salt spreaders to reduce the amount of salt needed to the maximum extent practicable.

BMP #30: Develop and Implement Coordinated Monitoring Strategy to Measure Water Quality, Water Quantity, and Biota
A consistent dataset of water quality parameters, biotic indicators and stream flow is needed for a better understanding of conditions in the Huron Chain of Lakes Watershed and to use as baseline when measuring conditions following implementation of recommended management alternatives. Furthermore, pollutant removal efficiencies should be measured as part of any implementation project since the literature remains incomplete. Monitoring needs to include dry and wet weather events and seasonal variation over multiple years. Some of the monitoring could be conducted by trained volunteers affiliated with the Huron River Watershed Council's Adopt-A-Stream program or the Stream Team.

BMP #31: Initiate Hydrologic and Hydraulic Studies
A comprehensive study of the hydrology of the Huron Chain of Lakes system would provide an understanding of the interaction of precipitation, infiltration, surface runoff, stream flow rates, water storage, and water use and diversions. A hydraulics study would yield information about the river's velocity, flow depth, flood elevations, channel erosion, storm drains, culverts, bridges and dams. Information resulting from these studies would provide greater detail on the sources and causes of problems related to hydrology-induced erosion and flooding. The studies are prerequisite to identify the most appropriate management alternatives and best locations for practices that can restore the hydrology of the river and its tributaries.

BMP #32: Inventory and Stabilize Eroding Streambanks
Streambank stabilization measures are treatments used to stabilize and protect banks of streams or constructed channels, and lake shorelines. Understanding the cause of the erosion problem is paramount to implementing any streambank stabilization measure. If the cause is extreme peak storm water flows, then peak flow problems must first be addressed before stabilization measures can be expected to succeed. Streambank stabilization measures work by either reducing the force of flowing water and/or by increasing the resistance of the bank to erosion. Vegetating streambanks also provides important ecological benefits such as shading water and providing crucial habitat for both terrestrial and aquatic wildlife species. Three types of streambank stabilization methods exist: engineered, bioengineered and biotechnical. Engineered structures include riprap, A-Jacks, gabions, deflectors and revetments. Bioengineering refers to the use of live plants that are embedded and arranged in the ground where they serve as soil reinforcement, hydraulic drains, and barriers to the earth movement and/or hydraulic pumps. Examples of bioengineering techniques include: live stakes, live fascines, brush mattresses, live cribwall and branch packing. Biotechnical measures include the integrated use of plants and inert structural components to stabilize channel slopes, prevent erosion and provide a natural appearance. Examples of biotechnical techniques include: joint plantings, vegetated gabion mattresses, vegetated cellular grids and reinforced grass systems. Bioengineered or biotechnical methods are preferred over engineered methods, so as to increase habitat and aesthetics.

BMP #33: Inventory Areas Lacking Stormwater Management for Retrofit Opportunities
Urban areas and older subdivisions in the watershed were developed in an era where the dominant philosophy was to move all water off-site. With the current understanding of the need to manage stormwater on-site, older developments should be inventoried for the most cost-effective and environmentally beneficial locations for management alternatives.

BMP #34: Investigate Opportunities for Recreation Areas
In order to encourage public awareness and concern for rivers, streams and wetlands, it is important to increase opportunities for people to access these water resources. If provided with aesthetic and accessible, well-advertised recreational areas - be it a canoe livery, a fishing pier, or a trail system - the public will be able to experience the human benefits that the water offers and in turn, may want to work to protect the resource. First, the designated and desired uses must be restored so that it is safe for the public to use the resource in the manner it is intended; i.e., reduce sediment in order to construct a canoe livery. Then, the recreational amenity can be planned, built and promoted.

BMP #35: Conduct Municipal Mapping of Wetlands
A current wetlands map is a required component of a local wetlands ordinance. Ground-truthing wetlands that appear on maps, that is assessing them in the field, improves municipal information about the size, type, performance, and delineation of wetlands. This information then can be incorporated into maps that the municipality can use to improve protection and preservation of the wetlands, as well as to assess the future impacts to a wetland from a proposed development.

BMP #36: Conduct Natural Features Inventories
The composition and condition of natural features throughout most the watershed is virtually unknown. Conducting natural features inventories is the typical approach to gathering natural features information. Several dozen state-listed and federally-listed plant and animal species have been sighted in the watershed. The distribution and status of those species should be surveyed and management plans for their survival and sustainability developed. These species and the habitats that they need for survival can serve as bellwethers for how management of the Huron Chain of Lakes Watershed is proceeding. The Livingston Natural Features Coalition, which is a partnership of public and private interests working to inventory the natural features of Livingston County, is a potential resource and partner in conducting community-driven natural features inventories.

Managerial Actions: Public Information & Education

The number one goal for the Huron Chain of Lakes Watershed is to increase public awareness of their role in protecting water resources. A key action to fulfilling that goal is the implementation of a coordinated information and education campaign throughout the watershed. An estimated 75% of the nonpoint source pollutants in the Huron River Watershed are the result of individual practices. Audiences need to include homeowners, local governments, riparian landowners, lake and home associations, commercial lawn care businesses, businesses, and institutions. It is critical that these target audiences understand and respond to their impacts on the River system. Preventing pollutants from reaching the River is far more cost effective than waiting until restoration is required.

This project should target nonpoint source pollution prevention through traditional marketing outlets including print advertising, direct mail and retail promotions. Behaviors addressed by the

campaign should include: proper lawn care practices; home toxics disposal; septic system maintenance; water conservation; storm drain awareness; and pet waste. Market research would be used to determine core behavioral motivations and how to use these motivations to inspire behavior change. Messages would focus on items of interest to the homeowner, such as savings in time and money, with water quality protection positioned as an "added benefit." Individual impacts should be stressed to empower homeowners with the message that "their actions do make a difference." Consistency of messages across the watershed and repetition will be crucial to success of the campaign.

Specific actions that can help fulfill the objectives for this goal are:

- **BMP #37: Conduct Homeowner Education about Septic System Maintenance**
- **BMP #38: Provide Watershed Education Materials to Residents**
- **BMP #39: Provide Trash Management Information and Education to Public**
- **BMP #40: Provide Information and Education Program to Homeowners on Yard and Lawn Care, and Native Landscapes**
- **BMP#41: Promote County Extension Service soil testing programs**
- **BMP #42: Provide Information and Education Program to Homeowners on Proper Pet Waste Management**
- **BMP #43: Provide Information and Education Program to Farmers**
- **BMP #44: Conduct Recreational Vehicle (RV) Waste Disposal Education**
  This program seeks to prevent the illicit discharge of black water from RVs. The plan can educate RV owners about proper waste disposal to prevent illicit discharges through signs and fliers. The plan may prohibit RVs from parking overnight in parking lots, except in parking lots posted for RV parking.
- **BMP #45: Submit Stormwater-Related Information to Cable TV**
- **BMP #46: Submit Watershed-related Articles to Community Newspapers**
- **BMP #47: Watershed-related News and Materials on Entity Website**
- **BMP #48: Develop and Distribute Materials on LID Tools for Land Use Decision Makers**
- **BMP #49: Promote Reporting System for Illicit Discharges**
- **BMP #50: Household Hazardous Waste Collection Site/Day**
- **BMP #51: Yard Waste Collection and/or Recycling**
- **BMP #52 Watershed and River Crossing Signage**

Increased watershed education and watershed ethic among watershed residents is needed along with a coordinated information and education campaign. Public participation and involvement programs are meant to be activities where people learn about the watershed and/or work together to control stormwater pollution. These programs would be based on the following four objectives: 1) promote a clear identification and understanding of the problem and solutions; 2) identify responsible parties/target audiences; 3) promote community ownership of the problems and solutions; and 4) integrate public feedback into program implementation. To achieve these objectives the audience needs to be identified, the program carefully designed and the program effectiveness periodically reviewed.

Public participation and involvement programs can include the following activities:

- Adopt-A-Stream programs – trained citizen volunteers conduct benthic macroinvertebrate and habitat monitoring on a regular basis
- Program identity – program message, logo and tag line
- Collateral material – newsletters, fact sheets, brochures, posters
- Coordinating committees – focus groups, stewardship/protection groups that meet regularly
- Residential programs – storm drain stenciling, demonstration lawns and gardens, rain barrels
- Presentations – environmental booths, speakers' bureau and special events
- School education – facility tours, contests and curriculum, outdoor education, schoolyard habitats
- Southeast Michigan Stewardship Network –brings together volunteer stewards to share their experiences and learn from each other about how to protect and restore natural areas in and around their neighborhoods. Volunteers study creeks, remove invasive species, collect seed from native plants, map the land around waterways, burn prairies, and participate in many other activities

Public information and education activities implemented by the communities in the Huron Chain of Lakes Watershed will dovetail with each community's MDEQ-approved Public Education Plan.

Managerial Actions: Illicit Discharge Elimination

Illicit discharge detection and elimination requires: 1) the prevention, detection and removal of all physical connections to the storm water drainage system that conveys any material other than storm water; 2) the implementation of measures to detect, correct and enforce against illegal dumping of materials into to streets, storm drains and streams; and 3) implementation of spill prevention, containment, cleanup and disposal techniques of spilled materials to prevent or reduce the discharge of pollutants into storm water. Crews must be trained on how to identify illicit discharges and locate illicit connections. Although this effort can be labor intensive, the pay off is a reduction in the amount sanitary sewage and chemicals that enters surface waters.

Specific activities within an Illicit Discharge Identification and Elimination program include:

- **BMP #53: Conduct Outfall Screening Program**
- **BMP #54: Perform Smoke/Dye Testing**
- **BMP #55: Develop Reporting System/ Follow-up Plan for Illicit Connections**

- **BMP #56: Trace Illicit Connections**
- **BMP #57: Enforcement for Non-correction of Illicit Discharges**
- **BMP #58: Train Staff to Identify Illicit Discharges**
- **BMP #59: Minimize Seepage from Sanitary Sewers**
- **BMP #60: Minimize Seepage from On-site Sewage Disposal Systems**
- **BMP #61: Update Outfall and/or Drainage Map**
- **BMP #62: Develop and Implement Method to Identify and Record Outfalls from New Construction**

Illicit discharge identification and elimination activities implemented by the Huron Chain of Lakes communities will dovetail with each community's MDEQ-approved Illicit Discharge Elimination Plan.

Managerial Actions: Coordination and Funding

BMP #63: Establish and Maintain Long-term Committee of Community/Entity Representatives to Promote Implementation of the Watershed Management Plan
Watersheds are formed by hydrologic boundaries, not political boundaries. Therefore, some level of institutional arrangements must be established so that the various local, county, state and federal jurisdictions of the watershed are coordinated. Local examples of watershed groups working on implementation of watershed management plans include the Rouge Assembly, the Middle Huron Watershed Partnership, and the Malletts Creek Coordinating Committee (a Huron River tributary in Washtenaw County). Program maturity and funding sources will help to determine which institutional arrangements will work best to continue restoration and protection efforts. Among the main functions of the committee will be to **Conduct Work Sessions to Prioritize Specific Projects for Funding, Establish Estimated Costs, and Identify Funding Mechanisms (BMP #64).**.

An activity of the Committee should be to **Promote Consistency of Ordinances Among the Huron Chain of Lakes Watershed Communities (BMP #65)**. The Steering Committee expressed interest during the review of community development codes and ordinances in working toward consistent codes and ordinances to the maximum extent feasible that reduce stormwater runoff and thereby protect the watershed.

BMP #66: Improve Drain Maintenance Coordination with County Drain Offices and Road Commissions and/or MDOT
This activity will be necessary in order to make progress on BMP #29: Practice Alternative Drain Practices that Rehabilitate Stream and Riparian Habitats.

BMP #67: Create and Maintain Partnerships with Institutions, Schools, and Private Sector to Promote a Collaborative Effort in Watershed Management

BMP #68: Seek Alternative Funding Sources
Integrating stormwater management programs into the daily procedures of a community will generate new costs. In many cases, communities and agencies will need to explore creative

solutions to finance new staff, new programs, or new commitments. Specifically, **Secure Funding and Develop Partnerships to Conduct Monitoring (BMP #69)**. Grants may be available, often with a local match involved, but these grants usually are short term solutions for one-time projects. Solutions that have been tested in other areas include the following: implementing a stormwater utility fee incurred by users of the stormwater system; using impervious cover as basis for user fees; giving credits to fees if private detention/retention practices exist; assessing a one-time septic system installation fee; establishing forest and wetland mitigation banking system; creating a Buffer Restoration Incentive Program that provides $500/acre payment to landowners; purchasing environmental easements by the private sector; and participating in a statewide Purchase/Transferable Development Right Bank (PDR/TDR). Other activities that could help generate funds for program implementation include **Create a Funding Source for Land Acquisition and Protection (BMP #70)** or **Creating a Law to Allow Illicit Discharge Enforcement as a Source of Revenue (BMP #71).**

Vegetative Management Alternatives

BMP #72: Construct Stormwater Wetlands
Stormwater wetlands, or constructed wetlands, are structural practices similar to wet ponds that incorporate wetland plants into the design. As stormwater runoff flows through the wetland, pollutant removal is achieved through settling and biological uptake within the practice. Wetlands are among the most effective stormwater practices in terms of pollutant removal and they also offer aesthetic value. Although natural wetlands can sometimes be used to treat stormwater runoff that has been properly pretreated, stormwater wetlands are fundamentally different from natural wetland systems. Stormwater wetlands are designed specifically for the purpose of treating stormwater runoff, and typically have less biodiversity than natural wetlands in terms of both plant and animal life. Several design variations of the stormwater wetland exist, each design differing in the relative amounts of shallow and deep water, and dry storage above the wetland.[175]

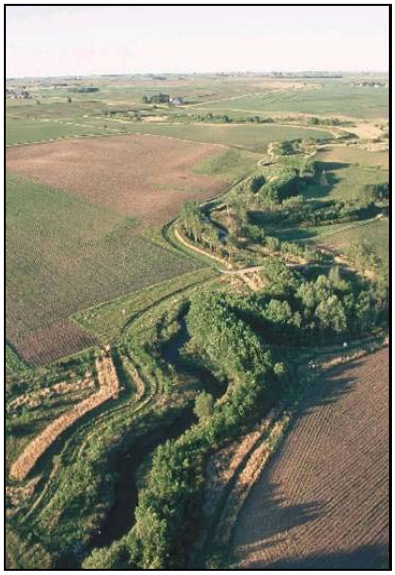

Grassed waterway. Photo: Washtenaw Co. Conservation District

BMP #73: Create and Maintain Grassed Waterways
A grassed waterway is a natural or constructed channel that is shaped or graded to required dimensions and established with suitable vegetation. This practice is used primarily on agricultural lands. On agricultural lands, land owners can be eligible for USDA programs such as Environmental Quality Incentives Program (EQIP) and Conservation Reserve Program (CRP) to help pay for the practice. Local NRCS (Natural Resource Conservation Service) Conservation Districts can provide expertise for this practice.

BMP #74: Install and Maintain Vegetated Filter Strips
This BMP is a strip of grass or other permanent vegetation designed to treat sheet flow from adjacent surfaces. Filter strips function by slowing runoff velocities and filtering out sediment and other pollutants, and by providing some infiltration into underlying soils. A Cross Wind Trap Strip – Field, a type of filter strip, is an herbaceous cover resistant to wind erosion, established in one or more strips across the prevailing wind erosion direction. A Cross Wind Trap Strip – Filter, another type, is an herbaceous cover resistant to

wind erosion, established adjacent to surface drainage ditches across the prevailing wind erosion direction. As with grass waterways (BMP #74), this practice is used primarily on agricultural lands and may be supported by financial and technical assistance from the USDA and local NRCS programs.

BMP #75: Install and Maintain Riparian Buffers



Riparian buffer. Photo: USDA NRCS

The effects of urbanization on low order streams (1st-3rd order) are well documented, and include alterations that results in degraded stream habitat and aquatic communities. Riparian buffer systems are streamside ecosystems managed for the enhancement of water quality through control of nonpoint source pollution and protection of the stream environment. These systems may be placed along a shoreline, stream or wetland. The primary function of the practice is to physically protect and separate the natural feature from future disturbance or encroachment by development. Buffers remove stormwater pollutants such as sediment, nutrients and bacteria, and slow runoff velocities. The degree to which buffer systems remove pollutants is dependent on loading rates from upland land uses, stream order and size, and the successful establishment and sustainability of the practice.[176] Design and size of the buffer also plays a large role in effectiveness. The three-tiered system recommended by the Center for Watershed Protection is detailed in the publication Better Site Design. On agricultural lands, land owners can be eligible for USDA programs that help pay for the practices. Local NRCS Conservation Districts can provide expertise for this practice.

BMP #76: Install and Maintain Bioretention Systems in Developed/ Redeveloping Areas

Bioretention areas are landscaping features commonly located in parking lot islands or within small pockets of residential land uses that are adapted to provide on-site treatment of stormwater runoff. Surface runoff is directed into shallow landscaped depressions where it pools above the mulch and soil in the system, then filters through the mulch to underdrain systems and a prepared soil bed. Typically, filtered runoff is collected in a perforated underdrain and returned to the storm drain system. Emergency overflow outlets are provided to direct flows in excess of the system's capacity to the stormwater conveyance system during large storm events.

Bioretention System. Photo: Center for Watershed Protection

BMP #77: Install Grassed Swales

Grassed swales are open channel management practices designed to treat and attenuate stormwater runoff. As stormwater runoff flows through these channels, it is filtered first by the vegetation in the channel, then through a subsoil matrix, and finally infiltrates into the underlying soils. Grassed swales are improvements on the traditional drainage ditch and are well suited for treating highway or residential road runoff. Grassed channels are the most similar to a conventional drainage ditch, with the major differences being flatter side and

longitudinal slopes and a slower design velocity for water quality treatment of small storm events. The type and coverage of vegetation grown in the swales will influence pollutant treatment. Pollutant reduction values in this analysis assume the use of well-established turf grasses consistent with traditional residential settings. Other plantings may provide greater pollutant reduction, but may also alter conveyance hydraulics.

BMP #78: Install Pond Buffer Native Plantings
This activity diminishes turfgrass cover at pond's edge and replaces it with native tall grasses and flowering plants that are suited to wet conditions. Native plantings discourage and displace foraging geese, subsequently reducing bacteria contributions to surface waters from bird droppings. Native plantings also slow stormwater runoff and filter out pollutants in the runoff prior to the water entering the pond.

BMP #79: Practice Conservation Cover
This BMP involves establishing and maintaining permanent vegetative cover to protect soil and water resources. This practice is used primarily on agricultural lands. Local NRCS Conservation Districts can provide expertise for this practice.

BMP #80:Practice Conservation Crop Rotation with Cover Crop and Mulch/No-till
This BMP involves a system of three individual practices. Conservation crop rotation describes the practice of growing crops in a recurring sequence on the same field. The crops may be grasses, legumes, forbs or other herbaceous plants established for seasonal cover and conservation purposes. Residue management as mulch till is the practice of managing the amount, orientation, and distribution of crop and other plant residue on the soil surface year-round, while growing crops where the entire field is tilled prior to planting. Residue Management as no-till and/or strip till is the practice of managing the amount, orientation, and distribution of crop and other plant residue on the soil surface year-around, while growing crops in previously untilled soil and residue. Local NRCS Conservation Districts can provide expertise for this practice.


No-till crop. Photo: Washtenaw Co. Conservation District

BMP #81: Restore Wetlands
A restored wetland is the rehabilitation of a drained or degraded wetland where the soils, hydrology, vegetative community, and biological habitat are returned to the natural conditions to the greatest extent possible. A constructed wetland is a human-made wetland with more than 50% of its surface area covered by wetland vegetation. It is ideal for large, regional tributary areas (10 to 300 acres) where there is a need to achieve high levels of particulate and nutrient removal. Wetland size and configuration, hydrologic sources, and vegetation selection must be considered during the design phase. Constructed wetlands provide a suspended solid removal of approximately 70%, while nutrient removal ranges widely due to a lack of standard design criteria, but is in the range of 40-80%. These wetlands also benefit the area by providing fish and wildlife habitat and aesthetic benefits.

BMP #82: Install Rain Gardens
The term "rain garden" refers to a constructed depressional area that is used as a landscape tool to improve water quality. Rain gardens should be placed strategically to intercept water

runoff, and typically are placed beside impervious surfaces such as driveways, sidewalks, or below downspouts. Rain gardens are designed to allow for ponding and infiltration of first flush stormwater. Nutrient removal occurs as the water comes in contact with the soil and the roots of the trees, shrubs or other vegetation. As such, plant selection should focus on native wildflowers and grasses that are adapted to local conditions. A rain garden can be as simple to establish and maintain as a traditional garden.

BMP #83: Reduce Turf with Shrubs and Trees

Unlike conventional turfgrass, native trees, shrubs and grasses have extensive, deep root systems that can improve stormwater infiltration. Research of stormwater runoff from various land surfaces indicates that runoff coefficients from turfgrass can more closely resemble runoff coefficients for paved areas due to the shallow root structure of turfgrass and more compacted soils on which it grows. A popular technique for reducing turf is to use native landscaping for attractive borders. Because native plants have adapted to local soils and pests, they require less watering and need no chemicals or fertilizers to protect them. So less turfgrass can mean cost savings.

Replacing turfgrass with native plants increases infiltration
Photo: Center for Watershed Protection

BMP #84: Evaluate Areas for Instream Habitat Restoration Techniques

Habitat restoration techniques include instream structures that may be used to correct and/or improve fish and wildlife habitat deficiencies over a broad range of conditions. Examples of these techniques include: channel blocks, boulder clusters, covered logs, tree cover, bank cribs, log and bank shelters, channel constrictors, cross logs and revetment and wedge and "K" dams.[177] The majority of these structures require trained installation with hand labor and tools. After construction, a maintenance program must be implemented to ensure long-term success of the habitat structures. In areas that experience high stormwater peak flows, instream habitat restoration should be installed after desired flow target is reached, to ensure the success of the habitat improvement project.

BMP #85: Stabilize Soils at Crossing Embankments

Soil erosion control is the process of stabilizing soils and slopes in an effort to prevent or reduce erosion due to storm water runoff. Source areas are construction sites where soil has been disturbed and exposed, streambanks that are eroding due to lack of vegetation and an excess of peak flows during storm events, and road crossing over streams where the integrity of the structure is compromised or where the road itself contributes gravel or dirt. Soils can be stabilized by various physical or vegetative methods, while slopes are stabilized by reshaping the ground to grades, which will improve surface drainage and reduce the amount of soil eroding from a site. In areas where development activity is underway, it is important to emphasize the Soil Erosion and Sediment Control ordinance inspection and enforcement, which often entails hiring an adequate number of field staff.

Structural Management Alternatives

BMP #86: Construct Stormwater Retention or Detention Basins or Other Structures that Promote Runoff Infiltration and Detention

Stormwater infiltration basins are any stormwater device or system, which causes the majority of runoff from small storms to infiltrate into the ground rather than be discharged to a stream. Most infiltration devices also remove waterborne pollutants by filtering water through the soil. Stormwater infiltration can provide a means of maintaining the hydrologic balance by reducing the impacts of impervious areas. Infiltration devices can include any of the following: basins, trenches, permeable pavement, modular pavement or other systems that collect runoff and discharge it into the ground. Infiltration devices should only be used on locations with gentle slopes, permeable soils and relatively deep water tables and bedrock levels. In new developments, permeable soil areas should be preserved and utilized as stormwater infiltration areas.

Extended wet detention ponds, or wet ponds, are constructed basins designed to contain a permanent pool of water in order to detain and settle stormwater runoff. The primary pollutant removal mechanism is settling as stormwater resides in the pool and pollutant uptake occurs through biological activity in the pond. Wet ponds are among the most cost-effective and widely used stormwater practices. A sediment forebay should be incorporated into the pond design, which promotes increased settling of sediments and helps prevent outlet clogging. Landscaping design requirements should include a natural vegetated buffer around the pond to increase aesthetics, reduce pollutants entering the area, and discourage goose habitation. Studies indicate that wet ponds may outperform dry detention basins for nutrient and sediment removal, and dry detention basins do not treat first flush stormwater.

BMP #87: Install and Maintain Infiltration Trenches

An infiltration trench is a rock-filled trench with no outlet that receives stormwater runoff. Stormwater runoff must pass through a pre-treatment measure, such as a swale or detention basin, to remove or reduce the amount of suspended solids prior to reaching the infiltration trench. Within the trench, runoff is stored in the voids of the stones and infiltrates through the bottom where it is again filtered by the underlying soils. Trenches are appropriate in most residential areas where curb and gutter would be considered.

Infiltration trench. Photo: Center for Watershed Protection

BMP #88: Install and Maintain Vegetated ("Green") Roofs

The green roof concept is akin to the popular, but traditionally heavy and difficult to maintain, garden roofs found atop buildings worldwide. Essentially, a green roof is the structural addition of plants over a traditional roof system. Green roofs reduce stormwater runoff and increase energy efficiency. In the past there were many concerns regarding the safety and durability of these structures; however, recent advances have dramatically and successfully addressed these concerns. A recent, highly visible green roof was installed on the roof of a large building at the Ford Motor Company's Rouge Plant in Dearborn, Michigan. Examples of smaller residential and municipal green roofs are present in Washtenaw County.

BMP #89: Install BAT to Reduce Nutrients at Permitted Point Sources
Best Available Technology (BAT) to reduce nutrients, pathogens and other pollutants in permitted point source effluent should be used to minimize contributions to surface waters. Communities can work with MDEQ and NPDES point source dischargers in their jurisdiction to determine whether the facilities' effluent would benefit from increased pollutant removal technology. Due to the decreasing rate of return for ever increasing technological standards, the more cost effective approach to improving water quality will be to prevent pollution in stormwater runoff in the first place.

BMP #90: Install and Maintain Catch Basin Inserts
A catch basin is an inlet to the storm drain system that typically includes a grate or curb inlet and a sump to capture sediment, debris, and associated pollutants. Catch basins require regular cleaning and maintenance for proper functioning. A number of proprietary technologies are now available to augment the pollutant capture rates of these systems. These technologies generally employ additional sump chambers to enhance the capture of solids, and many employ filtering media to capture additional pollutants or fractions of the pollutant inflows. The generic term "catch-basin inserts" is used here to describe a variety of in-sump or in-line designs.

BMP #91: Install Grade Stabilization Structures
A grade stabilization structure is used to control the grade and head cutting in natural or artificial channels (like a grassed waterway). This practice is used primarily on agricultural lands. On agricultural lands, land owners can be eligible for USDA programs such as Environmental Quality Incentives Program (EQIP) and Conservation Reserve Program (CRP) to help pay for the practice. Local NRCS Conservation Districts can provide expertise for this practice.

BMP #92: Install Porous Pavement
Porous pavement can be made of concrete, stone or plastic and promote the absorption of rain and snowmelt. The most common type of porous pavement is paving blocks and grids which are modular systems that contain openings filled with sand and/or soil. Some pavers can support grass or other suitable vegetation providing a green appearance. Porous pavement can be effective in reducing the quantity of surface runoff for small to moderate-sized storms, and may also reduce the amount of pollutants associated with these events. Typically, these systems will work better when overlaid on sandy, permeable soils (as opposed to less permeable clay soils). Effectiveness of these pavements can be improved by maximizing the opening in the paving material and providing a sub-layer of at least 12 inches. This type of pavement is particularly applicable for overflow and special event parking, driveways, utility and access roads, emergency access lanes, fire lanes and alleys.

BMP #93: Install and Maintain Media/Sand and Organic Filters
Filters are usually two-chambered storm water practices; the first is a settling chamber, and the second is a filter bed filled with sand, a sand/peat mixture, or another filtering media. As stormwater flows into the first chamber, large particles settle out, and then finer particles and other pollutants are removed as storm water flows through the filtering medium. Modifications include surface sand filter, underground sand filter, perimeter sand filter, organic media filter, and multi-chamber treatment train.

BMP #94: Install and Maintain Sediment Trapping Devices at Construction Sites
Sediment trapping devices such as a barrier, basin or other devices are designed to remove sediment from runoff. Sediment basins should be located at the downstream end of drainage areas larger than 5 acres, and before a treatment train of other BMPs such as a wet detention

pond or constructed wetland that is built to treat excess sediments and other pollutants. Dikes, temporary channels and pipes should be used to divert runoff from disturbed areas into the basin and runoff from undisturbed areas around the basin. Simpler devices for areas less than 5 acres include a sediment trap and sand bag barrier, silt fences and straw bales. Silt fences and straw bales can be placed along level contours downstream of exposed areas where only sheet flow is anticipated. Sediment trapping devices can also be used on storm drain inlets and can include filter fabric, excavated drop traps, gravel filters and sandbags. Maintenance is a key requirement of any of these soil erosion control BMPs. Sediment traps, barriers, basins and filters should be inspected frequently for repairs and sediment removal.

BMP #95: Repair Undersized Culverts/Repair Misaligned or Obstructed Culverts
During the Stream Crossing inventory, some sites were found to have erosion problems in the stream due to undersized culverts or because of culverts that are poorly aligned with the current channel shape or that are obstructed by an instream object. Where undersized culverts are the cause of the problem, the proper size culvert will need to be determined by the County Road Commissions in order to accommodate existing and anticipated future flows. Where misalignment or obstruction are the problems, the remedy may not be as straightforward as replacing the culvert. Changes in hydrology from upstream development or from an instream obstruction will need to be determined in order to find the appropriate solution. Local units of government, specifically the townships, will need to work through the county governments to implement this practice.

BMP #96: Stabilize Eroding Road and Bridge Surfaces
Many county roads in the watershed are unpaved. The gravel and sand/gravel composite used for road surface can be the source of sediment pollution to surface waters when precipitation washes it into the stream or when road grading builds piles of the surface along the sides of the road. Stabilization of the eroding road and bridge surfaces may involve structural techniques such as retrofitting the bridge to prevent runoff from entering the stream or managerial techniques such as altering grading practices and selecting a different road and bridge surface. Local units of government, specifically the townships, will need to work through the county governments to implement this practice.

Additional Resources for Stormwater Management Alternatives

Additional information on stormwater management alternatives can be found at the following web-based resources:

International Stormwater BMP Database:
http://www.bmpdatabase.org/

Low Impact Development Center:
http://www.lowimpactdevelopment.org/

MDEQ's Guidebook of Best Management Practices for Michigan Watersheds:
http://www.michigan.gov/deq/0,1607,7-135-3313_3682_3716-103496--,00.html

MDEQ's Index of Individual BMPs:
http://www.michigan.gov/deq/0,1607,%207-135-3313_3682_3714-13186--,00.html

MDOT Approved BMPs:
http://www.michigan.gov/documents/SWMP_05_MDOT_v_4_120609_7.0_Appendix_D.pdf

The Stormwater Manager's Resource Center:
http://www.stormwatercenter.net/

US EPA's National Menu of BMPs for Stormwater Phase II:
http://cfpub.epa.gov/npdes/stormwater/menuofbmps/menu.cfm

4.5.2 Understanding the Action Plan Table

The Steering Committee recognizes that the activities of entities holding jurisdictional stormwater permits within the Huron Chain of Lakes Watershed affect the integrity of the watershed and, therefore, influences the degree of success in meeting the goals and objectives. Entities with jurisdictional stormwater permits in the watershed are Dexter Township, Webster Township, Northfield Township, Salem Township, the Washtenaw County Drain Commissioner, and the City of South Lyon. These entities are required to develop their own action plans to meet the minimum requirements of the NPDES Phase II Stormwater program but those actions need not be reflected in this watershed management plan.

As previously mentioned, the Action Plan Table is intended to provide a broad, though not complete, list of management alternatives to address the Plan's goals and objectives. Not all management alternatives apply to all permitted entities; neither must they all be implemented in order to achieve the Plan's goals and objectives. The responses by each permitee for each management alternative, or BMP, indicate how that community intends to use that particular BMP to meet their Phase II stormwater permit obligations and the goals and objectives of the watershed. The seven possible responses are:

C (currently doing): The BMP is already established or is practiced by the entity or community and therefore is already contributing towards meeting the goals and objectives of the Plan and will continue to do so in the future. How the BMP is being practiced will be explained in that community's Storm Water Pollution Prevention Initiative (SWPPI).

S (planned for short term): The community intends to implement some form of the BMP within the next five years. Such BMPs will be incorporated in that community's SWPPI, which will outline in greater detail the schedule, scope, and methods of implementation.

L (planned for long term): The community intends to implement some form of the BMP, but not within the next five years. Implementation is expected to occur in future permit cycles and will be detailed in future versions of a community's SWPPI.

W (wish list item): According to the MDEQ's June 2005 draft Guidance for Watershed Management Planning for the Purpose of Writing Storm Water Pollution Prevention Initiatives, a wish list item is an activity that "may be included in the WMP without associated commitments." The guidance also states:

> Wish list items are activities for which the communities recognize a need, but can't or won't commit to them for reasons such as:
> - They go beyond the scope of the storm water controls
> - They are not yet technologically feasible

- They can't be implemented with the resources (not counting funds) currently available

There is no limit to the number of activities that may be added to the WMP wish list, as long as the WMP also includes a reasonable number of activities with commitments to accomplish the goals and measurable objectives.

SE (covered through County Soil Erosion and Sedimentation Control Standards): All of the permitees listed in the Action Plan Table use their County's standards for soil erosion and sediment control (SESC). Local community implementation of management alternatives that are governed by county SESC standards can only be carried out by local communities if allowed by county SESC standards. Therefore, for local communities that indicate "SE" for an action, the county's response (C, S, L, X, or NA) shall also apply to those communities.

X (not planned currently): These are BMPs which are not planned by a particular permitee to be implemented because of a lack of interest.

NA (not applicable): Not all BMPs apply to all permittees. For example, street sweeping does not apply to townships that do not own any roads or areas with only unpaved roads.

Table 4.6. Action Plan for the Huron Chain of Lakes Watershed

KEY:

C	currently doing	**X**	not planned currently
S	planned for short-term	**NA**	not applicable
L	planned for long term	**SE**	County Soil Erosion Control Standards apply
W	wish list item		

	Management Alternative	Goals Addresssed										Level of Effort	Cost		Technical/Financial Resources	Permitees													
		1 Public Info & Ed	2 Nutrient Loading	3 Flow variability	4 Erosion/Sedimentation	5 Protect Natural Features	6 Open Space	7 Recreation	8 Increase Monitoring	9 Envion./Econ. Benefits	10 Implementation of WMP		Capital	Annual		Brighton Twp	Brighton City	Genoa Twp	Green Oak Twp	Hartland Twp	Highland Township	LCDC	LCRC	Lyon Ttp	Marion Twp	Milford Twp	Cityof Novi	Oceola Twp	Oakland County	Pinckney Village	Putnam Twp
Managerial: Ordinances and Policies																														
1	Adopt phosphorus reduction ordinance	✔	✔			✔						1 entity	$10k		obtain sample ordinances	X	W	X	X	X	X	NA	NA	X	X	X	X	X	NA	X	S
2	Adopt native landscaping ordinance	✔	✔	✔	✔	✔						2 entities	$5k-10k		obtain sample ordinances	X	X	X	X	X	S	NA	NA	X	X	X	C	X	NA	X	W
3	Adopt no dumping ordinance	✔										6 entities	$5k-10k		obtain sample ordinances	C	C	C	W	X	X	NA	NA	X	C	L	C	X	NA	W	W
4	Adopt pet waste ordinance	✔	✔										$5k-10k		obtain sample ordinances	X	W	X	X	X	X	NA	NA	X	X	X	X	X	NA	W	W
5	Adopt private roads ordinance			✔		✔						9 entities	$5k-10k		obtain sample ordinances	C	NA	C	C	C	S	NA	NA	X	S	X	C	C	NA	C	W
6	Adopt Purchase of Development Rights ordinance					✔	✔						$5k-10k [d]		obtain sample ordinances; consultant services	X	X	X	X	X	W	NA	NA	X	X	X	X	X	NA	X	W
7	Adopt stormwater management ordinance (e.g., Livingston Co.)	✔	✔	✔	✔	✔						10 entities	$5k-10k [a]		obtain sample ordinances	NA	S	NA	S	L	S	C	NA	C	C	X	C	X	NA	C	S
8	Adopt wetlands ordinance w/ natural features setback	✔	✔	✔	✔	✔						10 entities	$5k-10k		obtain model ordinance from HRWC	C	S	C	X	L	S	NA	NA	L	S	X	C	X	NA	C	C
9	Support County-wide septic system time-of-sale and/or maintenance ordinance	✔	✔									11 entities	$300/inspection, $3k-5k [d]			S	NA	W	W	C	X	W	S	C	S	S	C/L	S	L	C	C
10	Adopt overlay zoning for riparian corridor	✔	✔		✔	✔	✔					3 entities				C	W	X	X	L	X	NA	NA	X	X	X	C	X	NA	W	W
11	Enhance site plan review requirements			✔		✔				✔		12 entnties	$5k-10k [d]		Co. drain offices; HRWC	C	C	C	C	L	S	NA	C	C	S	X	C	X	NA	C	C
12	Incorporate Low Impact Design principles		✔	✔	✔	✔	✔			✔		6 entities				W	C	W	W	X	S	W	W	X	S	C	C	X	NA	W	C
13	Improve enforcement of litter laws and nuisance properties	✔				✔		✔				9 entities			County Drain Offices	C	S	W	W	S	C	NA	NA	X	C	L	C	X	NA	C	C
14	Improve enforcement of SESC policies		✔		✔							watershed-wide				SE	SE	SE	SE	NA	SE	C	S	SE	S	SE	C	X	C	SE	SE
15	Review and revise SESC policies and practices	✔	✔	✔	✔	✔						watershed-wide	$5k-10k [a]		obtain sample standards	SE	SE	SE	SE	NA	SE	C	SE	SE	S	SE	C	X	C	SE	SE
16	Improve enforcement of construction site inspections		✔	✔	✔	✔						9 entities				C	C	NA	S	NA	S	NA	S	SE	S	SE	C	X	C	C	NA
17	Minimize total impervious cover in zoning ordinance			✔		✔						9 entities	$5k-10k		obtain sample ordinances	X	S	C	W	L	S	NA	NA	C	S	L	C	W	NA	W	S
18	Promote open space preservation in zoning ordinance and master plan	✔	✔	✔	✔	✔	✔	✔				watershed-wide	$5k-10k [a]			C	C	C	C	L	S	NA	NA	C	C	L	C	C	NA	C	C
19	Review and revise grading and land clearing policies		✔	✔	✔	✔						12 entnties	$5k-10k [a]		obtain sample standards	SE	SE	SE	SE	S	S	C	NA	SE	L	X	C	X	NA	SE	SE
20	Revise parking standards for new development/redevelopment			✔		✔						5 entities	$5k-10k [a]		obtain sample standards	X	C	C	W	X	S	NA	NA	X	L	X	C	X	NA	SE	W
21	Revise Stormwater Management Standards - pond landscaping		✔		✔							6 entities				X	S	C	W	S	W	NA	NA	X	S	X	C	X	C	W	X

[a] Combined Downriver WMP
[b] Mill Creek WMP
[c] Middle 1 Rouge SWMP
[d] HRWC Estimate
[e] Lower Grand WMP
[f] RPO Cost Estimating Guidelines 1997

Table 4.6. Action Plan for the Huron Chain of Lakes Watershed

KEY:

C	currently doing	**X**	not planned currently
S	planned for short-term	**NA**	not applicable
L	planned for long term	**SE**	County Soil Erosion Control Standards apply
W	wish list item		

	Management Alternative	Goals Addresssed										Level of Effort	Cost		Technical/Financial Resources	Permitees														
		1 Public Info & Ed	2 Nutrient Loading	3 Flow variability	4 Erosion/Sedimentation	5 Protect Natural Features	6 Open Space	7 Recreation	8 Increase Monitoring	9 Envion./Econ. Benefits	10 Implementation of WMP		Capital	Annual		Brighton Twp	Brighton City	Genoa Twp	Green Oak Twp	Hartland Twp	Highland Township	LCDC	LCRC	Lyon Ttp	Marion Twp	Milford Twp	Cityof Novi	Oceola Twp	Oakland County	Pinckney Village	Putnam Twp
Managerial: Practices																														
22	Incorporate results of conservation planning analyses (by HRWC or Counties) into local ordinances and policies	✔				✔	✔			✔		2 entities	$3k-5k [d]		HRWC/ County Planning analyses	W	S	W	W	X	W	W	W	W	C	X	NA	X	NA	W	W
23	Reduce directly-connected impervious surfaces (e.g. downspouts)	✔		✔	✔	✔						4 entities (1st: new development; 2nd: retrofits)	$50/house [b]			X	X	X	NA	X	S	W	NA	X	L	S	C	X	NA	W	NA
24	Practice high-powered street and parking lot sweeping		✔		✔							4 entities (1st: new development; 2nd: retrofits)	$100k-200k [a,b]	$30-65/curb mile $10-20/cubic yd disposal	in cordination with MDOT, Road Commissions	S	C	NA	NA	X	NA	NA	C	NA	X	X	C	X	NA	W	NA
25	Provide pet waste bags in parks and public areas	✔	✔									public facilities	$100/station [d]	some maintenance		X	X	X	X	X	C	NA	NA	X	S	X	X	X	C	NA	NA
26	Increase amount and distribution of refuse containers	✔				✔						7 entities				X	C	X	W	X	X	NA	NA	X	C	L	L	X	X	C	C
27	Practice alternative drain practices that improve protection of stream and riparian habitats		✔	✔	✔	✔				✔		watershed-wide	$5k-10k		in coordination with Co. drain offices	SE	SE	SE	SE	X	L	C	S	C	C	L	C	X	C	SE	SE
28	Storm drain/catch basin marking	✔	✔	✔		✔						sewered areas	$1.50 lexon marker, $3.00 crystal-coaterd marker		volunteers apply markers, hang educational flyers	NA	C	NA	S	NA	C	S	S	L	L	X	C	X	W	S	S
29	Reduce use of conventional road de-icers	✔				✔				✔		3 entities	$250 - 600/ton for salt alternatives			NA	W	NA	NA	NA	NA	NA	C	NA	NA	NA	C	NA	C	W	NA
Managerial: Studies and Inventories																														
30	Develop and implement a coordinated monitoring strategy to measure water quality, water quantity and biota		✔	✔	✔	✔			✔	✔	✔	3 entities		$50k-100k	in coordination with county goverments, HRWC Adopt-A-Stream, MDEQ, MDNR,	NA	W	X	S	L	W	W	W	W	W	W	L	X	W	W	W
31	Initiate hydrologic and hydraulic studies			✔					✔	✔		watershed-wide	$35k-75k [d]	$10k-25k	MDEQ; USGS; consultant services	SE	SE	SE	SE	L	X	C	C	C	X	X	C	X	X	SE	SE
32	Inventory and stabilize eroding streambanks		✔		✔	✔			✔			as needed	$1k/mile inventory [a,f] $1.50-3/pp live stake $2-9/pp joint planting stake $5-9/ft live fascine $10-25/sq ft live cribwall $25-35/sq yd 8" rip-rap $30-45/sq yd 16" rip-rap $20-30/ft gabion baskets $30-75/lineal ft A-Jacks		in coordination with co. drain offices	X	W	X	W	X	X	C	S	X	W	X	C	X	W	W	S
33	Inventory areas lacking stormwater management for retrofit opportunities		✔	✔	✔							2 entities	$100/hr per municipal staff		consultant services	X	W	X	W	NA	X	W	W	X	L	X	C	X	X	W	W
34	Investigate opportunities for recreation areas					✔	✔	✔				9 entities	$100/hr per municipal staff			C	C	C	W	X	C	NA	NA	X	C	X	C	C	NA	C	W
35	Municipal mapping of wetlands		✔	✔	✔	✔	✔					5 entities	$100/hr		GIS, GPS capabilities; consultant services	X	C	X	X	X	X	C	NA	X	S	S	C	X	NA	X	W
36	Conduct natural features inventories					✔	✔		✔			watershed-wide			MI Natural Features Inventory; universities; consultants; SE MI Stewardship Network; HRWC	W	W	X	W	L	W	W	NA	W	S	X	C	X	C	W	W

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KEY:

C currently doing
S planned for short-term
L planned for long term
W wish list item
X not planned currently
NA not applicable
SE County Soil Erosion Control Standards apply

	Management Alternative	Goals Addresssed										Level of Effort	Cost		Technical/Financial Resources	Permitees													
		1 Public Info & Ed	2 Nutrient Loading	3 Flow variability	4 Erosion/Sedimentation	5 Protect Natural Features	6 Open Space	7 Recreation	8 Increase Monitoring	9 Envion./Econ. Benefits	10 Implementation of WMP		Capital	Annual		Brighton Twp	Brighton City	Genoa Twp	Green Oak Twp	Hartland Twp	Highland Township	LCDC	LCRC	Lyon Ttp	Marion Twp	Milford Twp	Cityof Novi	Oceola Twp	Oakland County	Pinckney Village	Putnam Twp
Managerial: Public Information & Education																													
37	Homeowner education about septic system maintenance	✔	✔									communities with septics	$.02/hh for print ads; $0.5/piece for print and mail [c]		HRWC; SEMCOG, SE MI Partners for Clean Water	S	NA	S	S	NA	C	C	NA	S	C	X	C/L	S	W	NA	W
38	Provide watershed education to residents	✔	✔	✔	✔	✔	✔	✔	✔		✔	community-wide	$.02/hh for print ads; $0.5/piece for print and mail [c]		HRWC; SEMCOG, SE MI Partners for Clean Water	C	S	S	S	C	C	C	S	C	C	S	C	L	C	C	W
39	Provide trash management information and education to public	✔						✔				community-wide	$.02/hh for print ads; $0.5/piece for print and mail [c]			L	C	S	S	NA	C	C	S	C	C	S	C	L	X	C	W
40	Provide information and education program to homeowners on yard and lawn care, native landscapes	✔	✔	✔	✔	✔						community-wide	$.02/hh for print ads; $0.5/piece for print and mail [c]		HRWC; SEMCOG, SE MI Partners for Clean Water	S	S	S	S	C	C	C	S	C	C	S	C	X	X	S	S
41	Promote county soil testing program	✔	✔									community-wide			MSU Extension services	W	X	W	W	C	X	C	S	X	C	S	X	S	X	C	W
42	Provide information and education program to homeowners on proper pet waste management	✔	✔									sewered areas	$0.5/piece for print and mail [c]			C	S	S	S	C	C	C	S	S	C	L	X	L	X	S	S
43	Provide information and education to farmers	✔	✔	✔	✔	✔	✔					agricultural communities				NA	NA	W	W	X	L	W	S	X	C	X	NA	X	NA	NA	S
44	Provide recreational vehicle (RV) Waste Disposal Education	✔	✔				✔	✔				public facilities			SEMCOG	NA	NA	W	X	X	L	S	NA	C	S	S	X	L	C	NA	NA
45	Regular storm water-related information on cable TV	✔									✔	community-wide	$100/hr+cost for cable TV, consult w/ local media [c]			C	S	NA	S	C	W	NA	NA	X	C	C	X	S	X	X	X
46	Watershed-related articles in community newsletters	✔									✔	community-wide	$50-100/hr [d]			C	NA	S	S	C	C	C	NA	X	C	C	C	S	X	S	X
47	Watershed-related news and I & E materials on entity website	✔									✔	community-wide	$50-100/hr to update website [a,c]			S	S	S	S	C	C	C	S	C	C	L	C	X	C	C	W
48	Develop and distribute education materials on Low Impact Design tools for land use decision makers	✔					✔			✔	✔	community-wide				W	NA	W	W	X	L	W	NA	X	C	L	C	X	C	W	W
49	Promote reporting system for illicit discharges	✔	✔									community-wide	$100/hr +cost for cable TV, consult w/ local media [c]			W	S	S	S	S	C	S	S	C	S	S	C	W	C	S	W
50	Household Hazardous Waste Collection Site/Day	✔										per community	Recycling station expenses [e]			W	C	S	W	L	C	C	NA	C	C	C	C	W	NA	W	W
51	Yard Waste Collection and/or Recycling	✔	✔									per community	Recycling station expenses [e]			C	C	C	W	L	C	C	NA	C	C	C	C	W	NA	C	X
52	Watershed and River crossing signage	✔										strategic locations along road ROW and public facilities			In coordination with road commissions, SEMCOG	S	X	S	S	S	S	S	S	X	S	L	L	X	W	S	X

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	Management Alternative	Goals Addresssed: 1 Public Info & Ed	2 Nutrient Loading	3 Flow variability	4 Erosion/Sedimentation	5 Protect Natural Features	6 Open Space	7 Recreation	8 Increase Monitoring	9 Envion./Econ. Benefits	10 Implementation of WMP	Level of Effort	Cost: Capital	Cost: Annual	Technical/Financial Resources	Permitees: Brighton Twp	Brighton City	Genoa Twp	Green Oak Twp	Hartland Twp	Highland Township	LCDC	LCRC	Lyon Ttp	Marion Twp	Milford Twp	Cityof Novi	Oceola Twp	Oakland County	Pinckney Village	Putnam Twp
Managerial: Illicit Discharge Elimination																															
53	Conduct outfall screening program		✔						✔			sewered areas	$100/staff investigation per property [b]			S	W	S	S	SE	C	S	C/S	S	NA	S	C	X	C	W	W
54	Perform smoke/dye testing		✔						✔			sewered areas	$600/dye test [b] $30/manhole for smoke testing [a]			NA	W	X	X	SE	X	S	S	X	W	X	C	X	X	X	X
55	Develop a reporting system/follow-up plan for illicit connections	✔	✔						✔			community-wide	$100/hr per municipal staff [a]			C	S	S	S	S	S	C	S	C	L	S	C	L	C	X	X
56	Trace illicit connections		✔						✔			sewered areas	$100/staff investigation per property [b]			W	C	X	W	S	S	S	S	C	L	S	C	X	C	X	X
57	Enforcement for non-correction of illicit discharges	✔	✔						✔			sewered areas	$5k-15k per property [b]			C	C	S	W	S	S	S	S	X	L	L	C	X	C	W	X
58	Train staff to identify illicit discharges	✔	✔						✔			community-wide	$100/hr municipal staff [a]			C	S	S	S	S	C	C	C/S	C	L	S	C	L	C	C	X
59	Minimize seepage from sanitary sewers		✔						✔			sewered areas	$1-2/lineal ft for TV inspection [c] and design/construction costs			C	C	W	W	C	L	S	NA	NA	C	NA	C	C	W	C	X
60	Minimize seepeage from on-site sewage disposal systems		✔						✔			5 entities				X	NA	W	W	NA	S	S	NA	C	W	X	C	X	W	C	X
61	Update outfall and/or drainage map		✔						✔			11 entities	$100/hr per municipal staff [a]		consultant assistance	C	S	S	W	SE	S	C	S	S	NA	L	C	X	C	W	W
62	Develop and implement method to identify and record outfalls from new construction		✔						✔			sewered areas	$100/hr per municipal staff [a]		in cooperation with Wayne Co DOE	X	S	S	W	SE	S	S	S	C	W	L	C	X	C	W	W
Managerial: Coordination and Funding																															
63	Establish long-term committee of community/entity representatives to promote implementation of the Watershed Management Plan	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	4 hrs/month	$100/hr per municipal staff		in coordination with existing Steering Commitee members	NA	C	S	S	C	S	C	S	C	C	X	C	W	C	X	W
64	Conduct work sessions to prioritize specific projects for funding, establish estimated costs, and identify funding mechanisms									✔	✔	4 hrs/month			through long-term comittees implementing WMP	W	S	W	W	S	S	W	NA	S	C	X	C	X	X	W	X
65	Ensure consistency of ordinances among Huron Chain of Lakes watershed communities	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	2 entities	$100/hr per municipal staff $200/hr legal review [a]			NA	W	W	W	S	X	NA	NA	X	C	X	X	X	X	X	W
66	Improve drain maintenance coordination with County and/or MDOT		✔	✔	✔	✔						4 entities	$10k-15k		in coordination with county drain commissioners, MDOT	NA	W	W	W	NA	NA	W	W	C	C	L	C	W	X	X	X
67	Create partnerships with institutions, schools, and private sector to promote a collaborative effort in watershed management	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	4 hrs/month	$100/hr per municipal staff			C	C	W	W	C	S	S	NA	X	S	X	C	X	C	X	X
68	Seek alternative funding sources	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	5 hrs/month	$100/hr per municipal staff			C	S	W	S	C	W	S	NA	L	S	L	C	X	C	W	W
69	Secure funding and develop partnerships to conduct monitoring	✔							✔	✔	✔	as needed			through long-term comittees implementing WMP	W	S	W	W	W	W	W	W	W	S	W	C	X	C	W	X
70	Create a funding source for land acquisition and protection		✔	✔	✔	✔	✔	✔		✔			$150/hr for development [a] $200/hr legal review		legal assistance	X	W	W	W	W	W	NA	NA	X	W	X	X	X	X	NA	X
71	Create law to allow illicit discharge enforcement as a source of revenue									✔	✔	1 entity	$100/hr for municipal staff $200/hr legal review [a]		legal assistance	X	W	X	W	W	X	NA	NA	X	L	X	X	X	X	NA	X

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	Management Alternative	Goals Addresssed										Level of Effort	Cost		Technical/Financial Resources	Permitees													
		1 Public Info & Ed	2 Nutrient Loading	3 Flow variability	4 Erosion/Sedimentation	5 Protect Natural Features	6 Open Space	7 Recreation	8 Increase Monitoring	9 Envion./Econ. Benefits	10 Implementation of WMP		Capital	Annual		Brighton Twp	Brighton City	Genoa Twp	Green Oak Twp	Hartland Twp	Highland Township	LCDC	LCRC	Lyon Ttp	Marion Twp	Milford Twp	Cityof Novi	Oceola Twp	Oakland County	Pinckney Village	Putnam Twp
Vegetative																														
72	Construct stormwater wetlands		✔	✔	✔	✔						where feasible	$30k-50k/acre [f]	2-4% of construction	USDA programs; USFWS; Ducks Unlimited; consultant services; co. drain offices	SE	SE	SE	SE	L	X	W	NA	W	W	X	C	X	X	SE	SE
73	Create and maintain grassed waterways		✔	✔	✔							3 entities	$3.5k/acre $4k/acre w/ tile [b]	$70-90/acre	USDA programs: EQIP, CRP; NRCS	X	W	X	X	L	X	NA	C/S	X	W	X	C	X	X	X	W
74	Create and maintain vegetated filter strips		✔	✔	✔	✔						4 entities	$200/acre	$4/acre	USDA programs: EQIP, CRP; NRCS	X	W	X	X	L	X	W	C/S	X	L	X	C	X	X	X	W
75	Plant and maintain riparian buffer		✔	✔	✔	✔						2 entities	$350/acre [b]	1-2% of installation	USDA programs; NRCS	X	W	X	X	L	X	NA	NA	X	W	X	C	X	X	X	X
76	Install bioretention areas in developed/redeveloping areas		✔	✔	✔							where feasible	$6.80/cubic ft [b]	2% for O & M		SE	SE	SE	SE	X	L	W	NA	SE	W	X	X	X	X	SE	SE
77	Install grassed swales, where feasible		✔	✔	✔	✔						13 entities				SE	SE	SE	SE	L	L	C	C/S	SE	C	X	C	X	X	SE	SE
78	Install pond buffer native plantings		✔	✔	✔	✔						3 entities	$350/acre [b]	1-2% of installation		X	W	X	X	L	L	NA	NA	X	W	X	C	X	X	X	W
79	Practice agricultural conservation cover		✔	✔	✔							2 entities	$225/acre	$11.15/acre	USDA programs: EQIP, CRP; NRCS	X	X	X	X	X	X	W	W	X	S	X	C	X	X	NA	W
80	Practice conservation crop rotation with cover crop and mulch/no-till		✔	✔	✔								$170/acre Cover Crop $10-15/acre Mulch/No-till	$170/acre Cover Crop $10-15/acre Mulch/No-till	USDA programs: EQIP, CRP; NRCS	X	X	X	X	X	X	NA	NA	X	X	X	NA	X	NA	NA	X
81	Restore wetlands		✔	✔	✔	✔	✔	✔				5 entities	$700-2k/acre b	2-4% of construction	USFWS; USDA; Ducks Unlimited	X	C	X	X	L	W	C	NA	X	L	X	C	X	X	X	W
82	Install rain gardens											residential sites w/ appropriate soils	$500/homesite, or $3-5/sq ft up to $10-12/sq ft for professional work	4% of construction		X	X	W	W	S	W	W	NA	X	C	W	X	X	X	W	X
83	Reduce turf/ replace with shrubs and trees		✔	✔	✔							3 entities				X	W	X	W	L	X	NA	NA	X	L	X	C	X	X	W	X
84	Evaluate areas for in-stream habitat restoration techniques					✔	✔	✔				2 entities	$60/ft [f]		consultant services	X	W	X	W	X	W	C	NA	X	X	X	C	X	X	W	W
85	Stabilize soils at crossing embankments		✔	✔	✔	✔						per Stream Crossing Inventory			coordination with co. drain offices, road commissions, and MDOT	SE	SE	SE	SE	X	X	C	C/S	C	X	X	C/S	X	X	X	SE

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Structural																														
86	Construct stormwater retention/detention basins or other structures that promote infiltration and detention of runoff		✔	✔		✔						variable, depends on amount of development/ redevelopment			in coordination with county drain offices	SE	SE	SE	SE	X	X	C	NA	C	C	X	C	X	X	SE	SE
87	Install infiltration trenches/basins		✔	✔	✔	✔						at strategic locations in 10 entities	$5/cubic ft	<5% of construction	consultant services	SE	SE	SE	SE	X	X	W	C	SE	X	X	C	X	X	SE	SE
88	Install vegetated roofs	✔		✔									$12-24/sq ft			X	W	X	X	X	X	NA	NA	X	X	X	X	X	X	X	X
89	Install best available technology to reduce nutrients at permitted point sources		✔									4 entities	varies depending on technology			W	S	X	W	X	X	C	S	X	X	X	C	X	NA	X	X
90	Install catch basin inserts		✔		✔	✔						4 entities	$50-800 each [f]	$20-40/each		SE	SE	SE	SE	SE	X	C	C/S	SE	X	X	C	X	X	SE	SE
91	Install grade stabilization structures		✔	✔	✔	✔						3 entities	$5k-6k geotextile $8.5k-9k fabricated	$50-95/each		W	NA	X	W	NA	X	C	C/S	X	X	X	C	X	X	W	W
92	Install porous pavement		✔	✔	✔							at appropriate new developments and redevelopments	$40k-80k/acre [f]	$200/acre	grant assistance	W	W	W	W	X	X	NA	W	X	L	X	X	X	X	W	W
93	Install sand and organic filters		✔		✔	✔						1st: new development; 2nd: retrofits	$5/cubic ft	$0.54/cubic ft		W	W	W	W	X	X	NA	C/S	X	X	X	X	X	X	W	W
94	Construct sediment trapping devices at construction sites		✔	✔	✔	✔						All sites	$6k [b]	10% of installation		SE	SE	SE	SE	NA	L	C	C/S	SE	C	X	C	X	C	SE	SE
95	Repair misaligned/obstructed culverts		✔	✔	✔	✔						as identified in Stream Crossing Inventory	$150k-200k/site		County Road Commissions; MDOT; consultant assistance	X	C	NA	NA	NA	NA	C	C/S	C	X	X	C	X	X	W	W
96	Stabilize road/bridge surfaces		✔	✔	✔										County Road Commissions; MDOT; consultant assistance	X	NA	NA	NA	NA	NA	NA	C/S	C	C	X	C	W	X	NA	W

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