Dowagiac River Watershed Management Plan

October 2002

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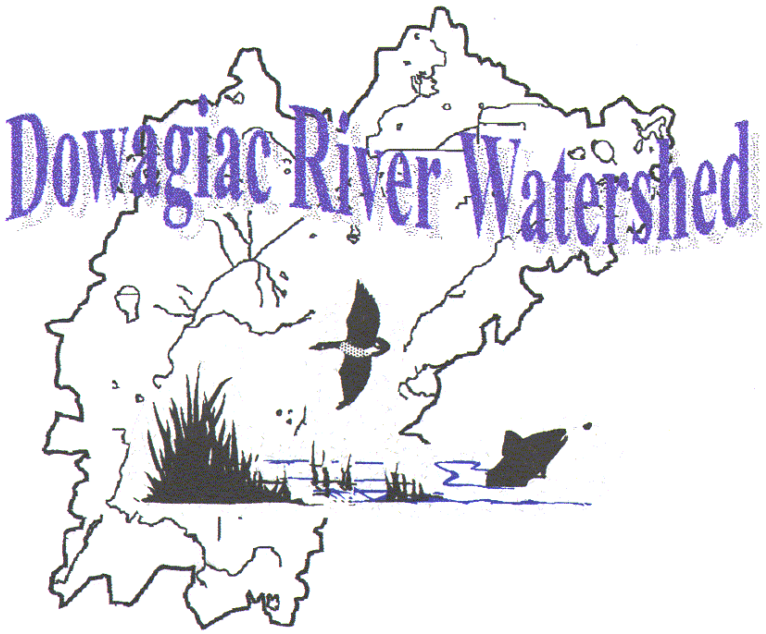

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Introduction

Decades ago it was recognized that planning and management activities based upon watersheds was necessary to address water quality problems and concerns. The watershed protection approach entails the development of a process among partners in a drainage area to identify and manage pollutants through cooperative action. Communities in the same watershed need to work together to address watershed issues because the flow of water does not follow political boundaries. Each community has an impact on the watershed and is also affected by the actions and land use of those communities upstream.

A watershed surpasses political boundaries by connecting several communities by water.

What is a Watershed?
It is all the land which drains into a body of water such as a lake, river, stream or wetland. In most landscapes, the surface watershed corresponds with the subsurface watershed which

This Dowagiac River Watershed Management Plan strives to lay out an action plan to work cooperatively toward an environmentally and economically healthy (sustainable) watershed that benefits all stakeholders. The plan identifies and prioritizes problems and issues, establishes goals and objectives and introduces an action strategy to meet the goals and objectives. The management plan was developed by drawing from the expertise and knowledge of many stakeholders in the watershed. Input from the general public was also gathered throughout the development of the plan.

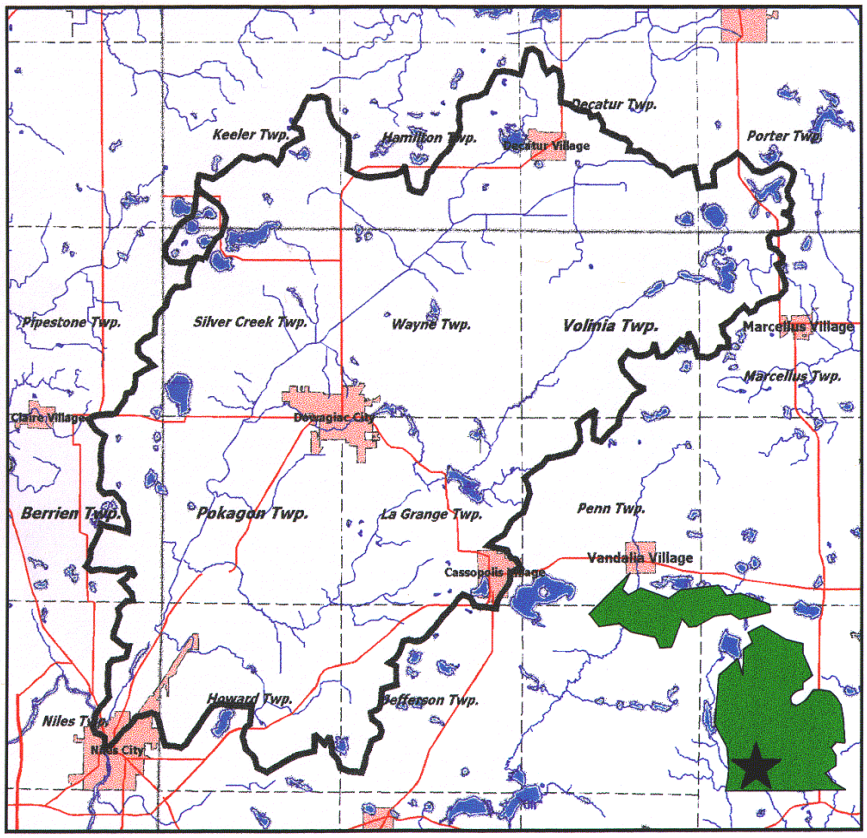

Figure 1. Dowagiac River Watershed Boundary

Background

Location

The Dowagiac River Watershed lies within the St. Joseph River Basin and is located in the southwestern corner of Michigan's lower peninsula in Cass, Van Buren and Berrien Counties. The Dowagiac River Watershed refers to all of the land area that is drained by the Dowagiac River. The Dowagiac River's headwaters region begins in the lower tier of townships in Van Buren County, encompassing a muck soils area near the village of Decatur. The Dowagiac River flows diagonally across Cass County in a southwesterly direction to its confluence with theSt. Joseph River in Berrien County, at the northern edge of the

City of Niles. The Dowagiac River Watershed is a large river system with several tributaries, wetlands and lakes. The largest tributary is the Dowagiac Creek (formerly known as the south branch of the Dowagiac River). Other tributaries include the Lake of the Woods and Osborn Drains and Silver, Peavine, Pokagon and McKinzie "Kinzie" Creeks. The Dowagiac Watershed contains several lakes. In fact, there are 23 lakes larger than 10 acres including Magician Lake, Barron Lake, Lake of the Woods, Twin Lakes, Stone Lake, Fish Lake, Bunker Lake and Big and Little Crooked Lakes. The watershed encompasses all or part of 20 municipalities (16 townships, two villages and two cities).

The communities that have land within the watershed:
Cass County - Howard, Jefferson, LaGrange, Marcellus, Penn, Pokagon, Silver Creek, Volinia and Wayne Townships, the Village of Cassopolis and the City of Dowagiac
Van Buren County - the Village of Decatur and Decatur, Hamilton, Keeler and Porter Townships
Berrien County - City of Niles and Berrien, Niles and Pipestone Townships
Pokagon Band of Potawatomi Indians

The Dowagiac Watershed has a total area of about 286 square miles or 183,117 acres. Planning efforts that work on the larger watershed scale include education and outreach efforts and some planning and zoning efforts. According to the Center for Watershed Protection, planning efforts that focus on structural best management practice implementation are usually most effective at the sub-watershed scale.

The Dowagiac River Watershed has been divided into 11 sub-watersheds for planning efforts. Dowagiac Creek is subdivided into 3 sub-watersheds because of the difference in the headwaters (mostly lakes), the next section downstream to Lake LaGrange is a cold water fishery and below Lake LaGrange it is a warm water fishery. The Transitional - Pipestone Creek sub-watershed was delineated by the local drain commissioners according to a control structure that was installed. The sub-watersheds are listed in Table 1 with their respective acreage. About 114,000 acres (5 sub-watersheds) contain cold water creeks or river stretches. This is 63 percent of the total watershed area (see Table 2).

Table 1. Sub-Watersheds of the Dowagiac River Watershed (DRW) (source: USGS and local information from drain commissioners)

ID #	Sub-Watershed	Major Water Bodies	Acreage
1	Headwaters - Dowagiac River above Osborn Drain	Lake of the Woods and Lake of the Woods Drain, Dowagiac River headwaters	28,341.91
2	Silver Creek (at mouth)	Magician Lake,. Dewey Lake, Priest Lake, Silver Creek	7,800.93
3	Transitional-Pipestone Creek	Big and Little Crooked Lakes	1,774.95
4	Dowagiac River Above Dowagiac Creek	Dowagiac River*, Osborn Drain*, Keeler Lake, Geer Lake, Pitcher Lake, Twin Lakes, Indian Lake, Brush Lake	35,115.04

5	Dowagiac Creek Headwaters -Dowagiac Creek at Bunker Lake	Cedar Lake, Gravel Lake, Swift Lake, Saddlebag Lake, Fish Lake, Finch Lake, Bunker Lake	14,295.47
6	Middle Dowagiac Creek - Dowagiac Creek at LaGrange Lake	Dowagiac Creek*, Kelsey Lake, LaGrange Lake	23,289.17
7	Lower Dowagiac Creek (at mouth)	Dowagiac Creek, Mill Pond	9,882.50
8	Middle Dowagiac River - River above USGS gauge	Dowagiac River*, Peavine Creek*, O'Brien Lake, Smith Lake, Rodgers Lake	20,212.66
9	Pokagon Creek (at mouth)	Stone Lake, Pokagon Creek*	22,083.89
10	Mudd Lake Extension Drain	Pine Lake, Mudd Lake Drain	6,297.77
11	Lower Dowagiac River (at mouth)	McKinzie Creek*, Dowagiac River*	14,022.44
Total Dowagiac River Watershed		entire watershed	183,116.73

*designated cold water fisheries

Table 2. Watershed Acreage according to Fishery Type (cold vs. warm water)

Fishery Type	Sub-Watershed ID #	Total Acreage
Cold Water Stream/River	4,6,8,9,11	114,723.2 (63%)
Warm Water Stream/River	1,2,3,5,7,10	68,393.53 (37%)

Rainfall Characteristics

Due to the proximity to Lake Michigan, the climate of the watershed is characterized by relatively high precipitation and moderate temperatures. The lake modified climate results in a long growing season for agriculture in the watershed. Silver Creek Township, in the northwest portion of the watershed, is in the fruit belt that runs from Berrien County to Allegan County.

Total annual precipitation is 21.66 inches at Dowagiac and usually falls from April to September. The growing season for most crops falls within this period. According to the Cass County Soil Survey (1991), the heaviest 1-day rainfall during the period of record was 4.9 inches at Dowagiac on July 23, 1959. High precipitation and high groundwater recharge lead to large amounts of groundwater storage, which helps maintain a high base flow and provides water for municipal uses and irrigation. However, in drought years, like the one experienced in 1999, there are reports of farmers needing to dig deeper and more wells to irrigate their crops.

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Figure 2. Sub-Watersheds and Major Tributaries of the Dowagiac River Watershed

Topography and Soils

The surficial geology of the watershed consists of glacial deposits from the Wisconsin Stage (10,000 to 75,000 years ago). The inner lobe of the Kalamazoo Moraine separates the Dowagiac Creek (the largest tributary) from the Dowagiac River. The inner lobe of the Kalamazoo Moraine is a dominant feature in the watershed and is composed of unconsolidated glacial deposits. The upland surface of the moraine is hummocky with numerous small depressions and intervening knob-like hills.

The inner lobe of the Kalamazoo Moraine is a long narrow ridge that runs south of Decatur to north of Dowagiac separating the Dowagiac Creek from the Dowagiac River.

Glacial sediments within the watershed consist of glacial outwash sand and gravel, ice-contact sand and gravel with end moraines of coarse-textured till and glacial lake deposits (Kirby and Hampton 1998). These highly permeable surficial materials along with head pressure provided by elevated moraines (ridges and hills) is the foundation for substantial groundwater contributions to the Dowagiac River and its tributaries.

Most soils in the watershed are well drained sandy and loamy soils representative of glacial deposits found in the basin. These sandy, loamy soils allow water to infiltrate into the ground, recharging the groundwater and contributing to the groundwater flow in the Dowagiac River and its tributaries.

The soils near the Dowagiac River channel, consist of mucky, poorly developed, and very poorly drained soils (Glendora-Adrian-Cohoctah association and Adrian-Edwards-Houghton association). These soils are closely associated with the river's original floodplain and broad riparian wetlands. These soils are underlain by outwash plain deposits and do not impede the delivery of groundwater to the river. However, their poorly drained nature prevents infiltration and requires artificial drainage in agricultural areas.

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Figure 3. Elevation of the Dowagiac River Watershed (He, Shi, Agosti, 1998)

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Figure 4. Soil Associations in the Dowagiac River Watershed

Hydrology

The hydrology of the Dowagiac Watershed is mostly determined by the amount of rainfall and the soils and topography in the watershed. Understanding the hydrology of the Dowagiac Watershed is essential when determining how pollutants move in the watershed and the effects that development will have on the watershed. The Dowagiac River is classified as a relatively large, cold-water system with a high connection to groundwater. The river and its tributaries receive large amounts of groundwater from the watershed because of the permeable soils and surficial materials left by glaciers. Most of the rain that falls on the watershed infiltrates into the ground and is delivered to the river and streams underground rather than across the surface as run-off. It is estimated that 90 percent of the flow in the Dowagiac River and its tributaries is fed by groundwater and only 10 percent of the flow comes from surface run-off.

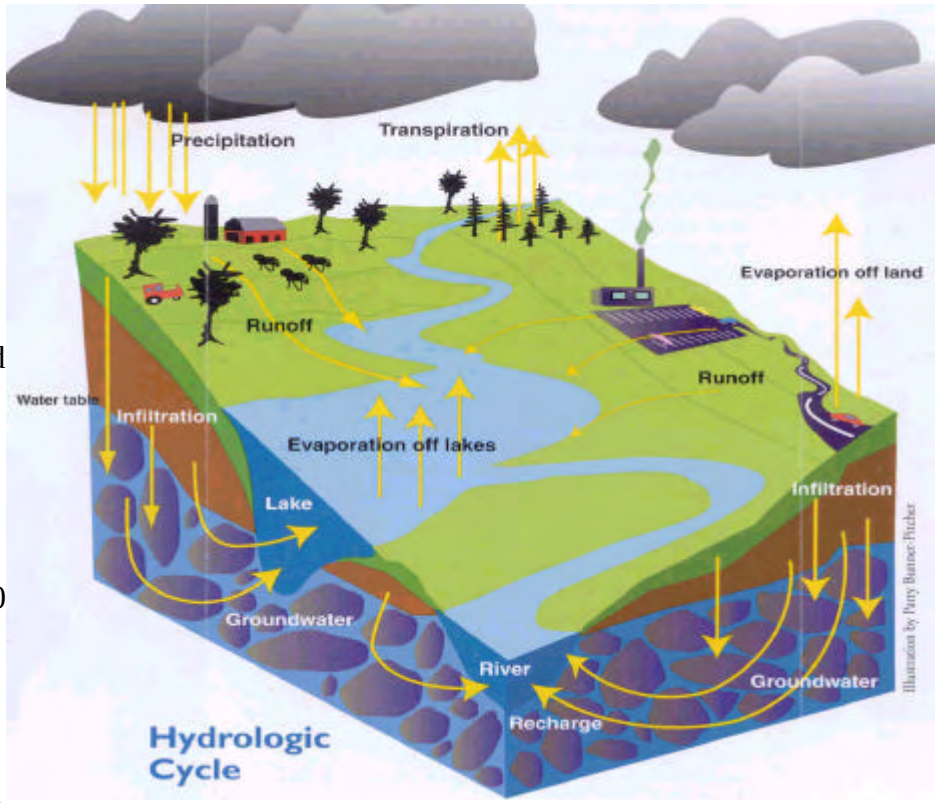


Figure 5. Hydrology

For its size and hydrology, the Dowagiac River is very unique in southern Michigan. The Dowagiac River exhibits similar characteristics (temperature and flow) to northern trout streams such as the Au Sable River. High groundwater contributions along much of the Dowagiac River's length provide cold temperatures and steady base flow throughout the summer season. The Dowagiac River's temperatures in the month of July average in the mid to upper sixties with diurnal temperature fluctuations at a minimum. In contrast, classic warm water systems fluctuate widely in daily temperatures, as much as 15 to 25 ^{o}F. Most of the tributaries support natural reproducing populations of brown trout. The majority of the mainstream, however, has little to no natural reproduction and supports a lower number of brown trout. This is most likely due to the lack of suitable habitat in the main channel. River and tributary water temperatures are optimal for brown trout, but are too cold for many other game fish. Brown trout have an upper optimal temperature of 66.2 ^{o}F.

The Dowagiac River has an average annual discharge of 301 cubic feet per second (255 square mile drainage area) at the town of Sumnerville. Approximately 80 percent of the watershed land area is assumed to be important for groundwater recharge; an average recharge rate was estimated to be 15.7 cubic inches per year per square mile of the watershed (Kirby and Hampton 1997). This results in a relatively high groundwater table, especially in the northern part of the watershed and in areas close to the river and its tributaries. Oftentimes, a high water table is more vulnerable to leaching of contaminants from fertilizers, pesticides, and septic systems.

Due to the straightening of the Dowagiac River in the early 1900's, the river exhibits uniform, high velocities without the characteristic pool and riffle sequence found in more natural river channels. The gradient of the river is low (3.2 feet/mile), but water velocities are accelerated by the straight narrow channel and lack of woody debris. In the last four miles of the Dowagiac River, the gradient is higher (5-25 feet/mile) and the river channel is more natural and exhibits meanders (this portion of the river channel was never straightened.) Besides extreme velocities, channel straightening has resulted in poor aquatic and riparian habitat, an unstable channel bottom with a homogeneous layer of sand in some places and disconnection of the river from its floodplain. Studies indicate that the Dowagiac River has difficulty managing sediment inputs because of the straightened channel.

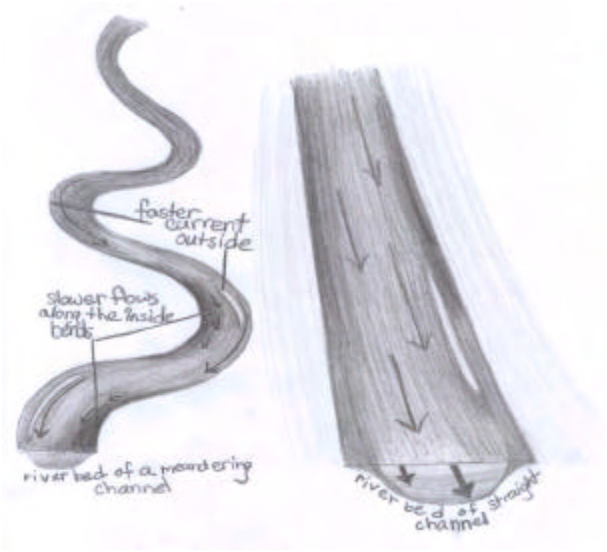


Figure 6: Natural Channel vs. Straightened/Dredged Channel

Significant natural resources

Historically, oak savanna and oak hickory forests dominated the sandy uplands of the watershed and beech-sugar maple forests covered the drier soils. There were also a few large pockets of tall grass prairie in the more fire prone areas. The lowland areas were dominated with forested floodplains and several types of wetlands.

Today the watershed is dominated by agriculture with only a few upland forests and small isolated prairies remaining. However, the lowlands, particularly those along the Dowagiac River and its

tributaries, still have a rich array of natural communities. Large tracts of forested floodplains are still found along the main branch of the Dowagiac River. These wet forests harbor a rich variety of wildlife such as wood ducks, tree frogs, salamanders, song birds, wild turkey, spotted turtle, red tailed hawks, and much more.

The watershed contains pockets of unique wet prairies, grasslands and wetlands that provide habitat for many species of plants, wildflowers, insects, animals and song birds. Prairie fens which are found in the watershed are considered to be globally rare by The Nature Conservancy and are home to a number of rare plants and the federally and state endangered Mitchell's satyr butterfly and the Massassaga rattlesnake.

There are several protected areas in the Dowagiac River Watershed. These include Russ Forest which contains a stand of old growth forest; Dowagiac Woods which is known for its abundant wildflowers, especially the Blue-eyed Mary; Rudolphi Woods which is located near Dowagiac; Dead Man's Hollow (the McKaye conservation easement) which is north of M-62 between Dowagiac and Cassopolis and Dodd Park which is along the Dowagiac River in Pokagon Township and is the site of a river restoration project. In 2001, the Southwestern Michigan Land Conservancy purchased a 12 acre preserve on Cook Lake just northwest of Dowagiac. This preserve contains a fen with several endangered plants and the Mitchell's satyr butterfly.

Along with natural features, there are also significant cultural and historical features found in the watershed. The Potawatomi Indians were the inhabitants of the watershed during the arrival of white settlers. In 2000, the Pokagon Band of Potowatomi's acquired over 1,000 acres in the watershed that will be put into trust with the federal government. Black ash trees which were used for basket making are an important tree to the tribe and are found in abundance in the lowland areas along the Dowagiac River. In the past, many springs in the area had spiritual significance to the tribe members.

The present day Crystal Springs Methodist Campground (just north of Sumnerville) was the site of a large spring that was estimated to produce 33,000 gallons of water per minute. Michigan's first fish hatchery was located here in 1873. Brook and lake trout, Atlantic and California salmon, grayling, whitefish, pickerel, eels and carp were all raised at the hatchery. In 1928, after the dredging of the Dowagiac River, the large spring along with several other springs and small lakes in the area dried up and disappeared.

Land use and development trends are extremely important to consider. The activities on the land have an effect on water quality. One of the most important considerations in this watershed, is the amount of impervious surfaces and its impact on the hydrology and water quality of the Dowagiac River and its tributaries. Currently about 90 percent of the flow in the Dowagiac River is attributed to base flow (groundwater contributions) with only 10 percent from surface water runoff. It will be important to maintain this hydrology as the watershed is developed.

<u>Land Use and Development Trends</u>

Pre-settlement land cover shows that when the settlers arrived, 87 percent of Cass County was forested with either beech-maple or oak forests (Kenoyer 1933). Today, agriculture is an important part of the Dowagiac River Watershed in terms of the amount of prime farmland in the watershed, the amount of land in production and the economic contribution to the local economy. The watershed supports a diversity of agricultural production. The upland areas of the watershed are used for hog production and

irrigated croplands and lowlands in the upper watershed are used for specialty vegetable crops. The western portion of the Watershed is in the fruit belt supporting orchards and vineyards.

Most of the industrial uses are centered around the urban centers of Dowagiac, Cassopolis, Decatur and Niles. The commercial businesses are also centered in these urban areas and also in areas serving lake communities. Residential areas are concentrated in the urban centers and around the lakes in the watershed. However, there is more and more residential development in the rural and agricultural areas of the watershed. As you can see from Table 3, over 7,000 acres of agricultural land was lost from 1978 to 1996. Over 5,000 acres of this land went into residential development.

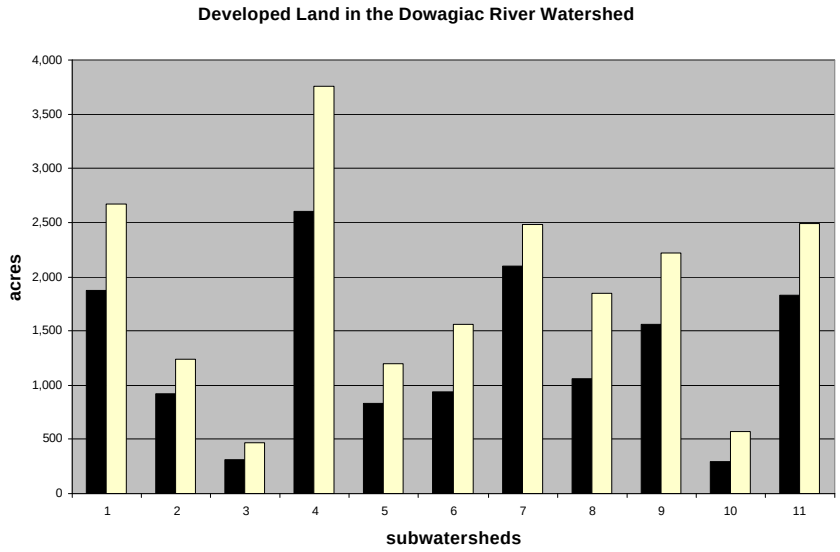
Table 3. Land Use in the DRW (1978 and 1996)

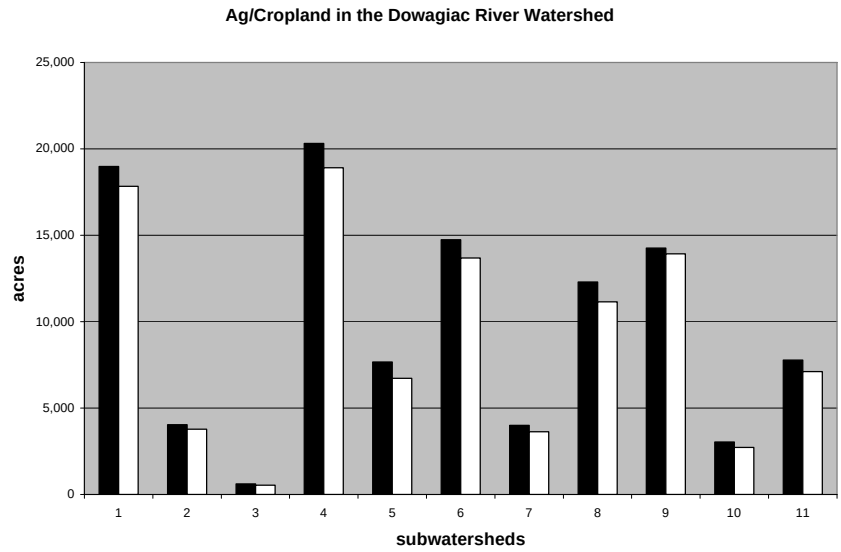
Land Use	**1978** **# of acres (percent)**	**1996** **# of acres (percent)**	**1978 - 1996 change** **# of acres**
Agricultural	107,676 (59%)	99,983 (55%)	-7,693
Residential	6,375 (3%)	11,661 (6%)	5,286
Commercial	213 (0.1%)	268 (0.1%)	55
Industrial	413 (0.2%)	520 (0.3%)	107
Forest/Wetlands	61,111 (33%)	62,629 (34%)	1,518
Other (mining, roads)	7,328 (4%)	8,055 (4%)	727
Total	183,116	183,116	

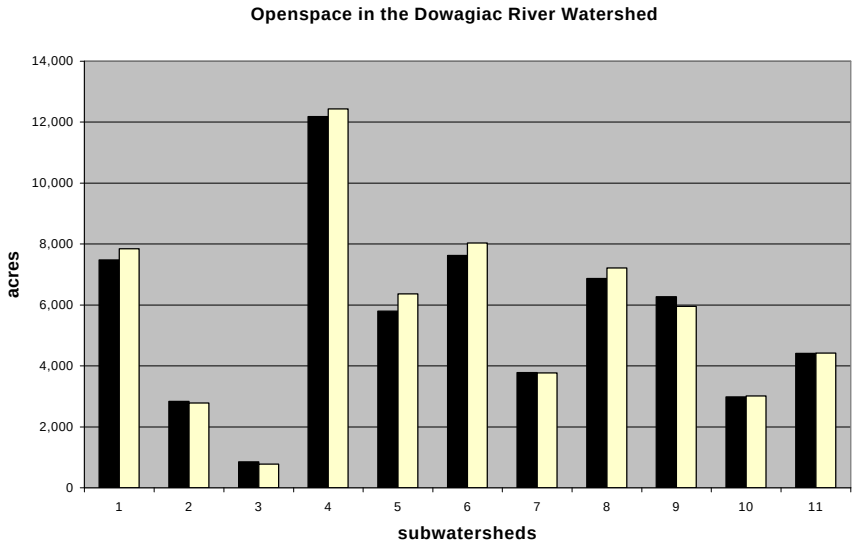
Figure 7. Developed, Agricultural and Open Space Acreage by Sub-Watershed (1978 and 1996)

Legend
■1978
□1996

subwatersheds
1 - Headwaters
2 - Silver Creek
3 - Transitional - Pipestone
4 - Dowagiac River above Dowagiac Creek
5 - Dowagiac Creek Headwaters
6 - Middle Dowagaic Creek
7 - Lower Dowagiac Creek
8 - Middle Dowagiac River
9 - Pokagon Creek
10 - Mudd Lake Extension Drain
11 - Lower Dowagiac River

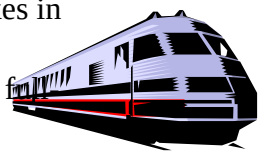






According to a 1998 study, from 1990 to 1998 a total of one industrial, 21 commercial and 860 residential building permits were issued in the core eight municipalities in the watershed. (The eight municipalities selected for the study had at least 50 percent of their area within the Dowagiac Watershed and included the City of Dowagiac, the Villages of Cassopolis and Decatur and Silver Creek, Wayne, Pokagon, Decatur and Howard Townships.) About 89 percent of the building occurred in the townships and only 11 percent within city or village limits. Nearly half of the building permits were issued in Silver Creek and Howard Townships. (Southwestern Michigan Commission, 1998)

The Dowagiac River Watershed is starting to experience growth pressures. There are several sources of development pressures building in the watershed. The proposed high speed rail service from Chicago to Detroit will allow commuters to live in and around Dowagiac and Niles with only an hour and half train ride to work in downtown Chicago. The I-94 corridor is seeing development pressure as people move out into more rural areas to enjoy the quality of life offered. The lakes in the watershed continue to see pressure because of the recreational opportunities available. In addition to new development, many seasonal cottages are becoming full time residences. The southern part of the Watershed is seeing some development pressures from the South Bend/Elkhart/Granger area. With residential development, commercial development will follow to meet the demands of new residents.



A build-out analysis was prepared for most of the watershed communities. The 1998 watershed population is estimated to be about 40,000. The estimated 1996 population for all of the municipalities that are partially and fully within the watershed was 69,158. The potential build-out population for watershed municipalities according to local zoning ordinances was 493,954 to 862,009. Silver Creek Township's build-out population was extremely high because the township was allowing one acre lots throughout the entire township. When removing Silver Creek from the build-out estimates the build-out population was reduced to a range from 366,323 to 591,164, still an incredibly high number of people in this relatively rural area. This analysis supports the need for proactive planning in the watershed that will protect water quality, natural resources and the overall quality of life.

Community Profile

Based on current trends along with housing and population projections, growth and development is occurring in the watershed. Growth is expected to be greatest in the northern portion of the watershed in Decatur, Hamilton, Keeler and Silver Creek Townships. Growth along the I-94 corridor may be the reason for the large increases in Decatur and Hamilton Townships. The numerous lakes in Silver Creek and Keeler Townships are a draw for development causing housing and population increases. In the southern portion, Pokagon and Howard Townships are expected to experience an increase in development. The anticipated development in Pokagon and Howard Townships may be the result of job and population growth expanding from Niles, northern Indiana and Dowagiac. There will also be much development occurring in Pokagon Township along Peavine Creek and the Dowagiac River. The Pokagon Band of Potawatomi Indians will be establishing their tribal lands in this area. They will be providing housing, commercial developments and government services.

Many of the watershed communities participated in the Dowagiac River Watershed Project to

update their master plans and zoning ordinances to increase the local efforts to protect water quality and natural resources. For each community, an initial meeting was held to determine which watershed issues were of concern. The Watershed Stewardship Team with input from the public determined the watershed issues to be:
1) Farmland Preservation
2) Open Space Protection
3) Water Quality Protection
4) Preserving Rural Character
5) Environmentally Sensitive Areas (wetlands, forests, etc) Protection

The master plans for each community were amended to include a broad range of language changes including:
- a general description of the Dowagiac River Watershed Project;
- natural features descriptions to highlight location, extent and relative values of the features
- individual descriptions of areas with significant resources;
- revisions to goals and policies, or additional ones where appropriate;
- some additions and revisions for the future land use classifications to strengthen the relationship between the natural features descriptions, goals and policies and land use;
- general information on sources of pollution and threats to water quality to provide an appropriate context for other discussions on resources and regulations; and
- an overview of available regulations, including those enforced by the state and federal governments to clearly outline the authority of the townships.

Once the local units identified issues and determined the degree of importance of each issue and their level of commitment for addressing the issue, the community selected implementation measures to include in their zoning ordinances. Some new concepts were incorporated and other communities that had a number of significant regulations only required refinement of existing language. A summary of the language offered to each community is contained in the chart below. As of this date, not all of the regulations have been adopted; however, it was clear that all communities were generally accepting of the regulations and would be proceeding with adoption of the zoning ordinance amendments. The full text of the master plan and zoning ordinance language adopted by the participating communities is available at the Cass County Conservation District at (269) 445-8643 x3.

Community	Regulations	
LaGrange	**Sliding Scale for lot splits in Prime Ag. District**	**Water Overlay District for vegetative buffering provisions adjacent to watercourses**
	Options for Residential Open Space Developments	**Site Plan Review Standards - stormwater and drainage, landscape preservation**
Wayne	**Site Plan Review Standards - stormwater and drainage, landscape preservation**	**Water Overlay District for vegetative buffering provisions adjacent to watercourses**
	Options for Residential Open Space Developments in both agricultural districts	**Change in minimum lot area in A-2 District**
Pokagon	**Limitations on riparian access**	**Options for Residential Open Space Developments**
	Supplementary standards for Agriculture Buffers	**Option for allowing an additional lot in AG-1 District**
Jefferson	**Options for Open Space Developments**	
Pokagon Band of Potawatomi Indians	**In Progress**	
Silver Creek	**In Progress**	
Decatur/Hamilton Joint	**In Progress**	
Volinia	**In Progress**	

Long term monitoring of the effectiveness of the regulations in each community has put into place will be an important element in determining the overall success of water quality improvement efforts in the watershed. The following monitoring actions are examples of actions that could be undertaken to indicate the seriousness of the commitment each community maintains toward this effort.
- Monitoring requests for variances from the provisions and the outcomes of those requests.
- Maintaining and reviewing records of enforcement efforts, including violation warnings, records of violations reported and their outcome.
- Reviewing the outcome of requests for amendments to the provisions covered by this project.
- Examining approvals, including any conditions placed on them, for site plans and development plans, particularly those near the river or its tributaries.
- Long term monitoring of land use patterns to determine the combined effect of the water quality regulations and land use planning within the community.
- Long term monitoring of water quality to determine if water quality is being maintained or improved.

WATER QUALITY SUMMARY

Designated Uses

A designated use is a recognized use of water by state and federal water quality programs. All surface waters in the state of Michigan are designated for and shall be protected for all of the uses listed in Table 4. The table also indicates whether the Dowagiac River Watershed currently meets these designated uses or if the use is impaired or threatened.

Table 4. Designated/Existing Uses in the DRW

Designated/Existing Uses	General Definition	Designated Use: Met (M), Impaired (I), Threatened (T)
Agriculture	water supply for cropland irrigation and livestock watering	T
Industrial water supply	water utilized in industrial processes	T
Public water supply	public drinking water source	N/A*
Warm water fishery	supports reproduction of warm water fish	I
Cold water fishery**	supports reproduction of cold water fish	I
Other indigenous aquatic life	supports reproduction of other indigenous animals, plants and insects	I
Partial body contact***	water quality standards are maintained for skiing, canoeing and wading	I
Total body contact	water quality standards are maintained for swimming	M

* Surface water is not used for drinking water; however, there are several threats to groundwater drinking supplies that are discussed later in the plan.

** The following water bodies in the Dowagiac River Watershed are also protected as cold water fisheries (MDNR designated trout streams):

Dowagiac River (Berrien Co. Line to Van Buren Co. Line)
McKinzie Creek
Pokagon Creek
Peavine Creek
Dowagiac Creek (between Lake LaGrange and Bunker Lake)
Glenwood Creek (Wayne Twp., Sec. 4)
Wilson Creek (Wayne Twp., Sec. 9)
Osborn Drain
Unnamed tributary (Wayne Twp., Sec. 18)
Cook Lake Drain (Wayne Twp., Sec. 30 and Silver Creek Twp. Sec. 24)

*** Partial body contact is only impaired in the headwaters of the Dowagiac River - tests indicated high levels of bacteria in this section. There is not much total body contact in this area.

Desired Uses

Desired uses have also been identified for the Dowagiac River Watershed. Some of these desired uses may not have a direct impact on water quality, but it is important to consider these uses in the watershed planning process. The following designated and desired uses were identified by stakeholders and the general public:

1. Maintain the water supply for agricultural uses (cropland uses and livestock watering).
2. Maintain the water supply for industrial uses (water used in industrial processes).
3. Improve and maintain groundwater drinking supplies.
4. Maintain the warm water fishery.
5. Maintain and improve the cold water fishery.
6. Maintain and improve the habitat for other indigenous aquatic life.
7. Improve partial body contact (water quality standards are maintained for skiing, canoeing and wading) in the headwaters area of the Dowagiac River.
8. Maintain total body contact (water quality standards are maintained for swimming) in the watershed.
9. Provide convenient disposal options for household hazardous wastes
10. Improve recreational infrastructure along river - signs along river, more and improved public access sites, canoe stops with bathrooms and picnic areas, remove litter and trash in river and on banks, remove some log jams
11. Maintain/improve river habitat - restore existing meanders, promote riparian wildlife habitat
12. Increase awareness and stewardship ethic in watershed
13. Enforce and control recreational use of lakes to prevent shoreline erosion and protect shore habitats
14. Encourage smart growth and planning

    Improve coordination of planning and zoning efforts between communities

    Protect prime agricultural lands

    Maintain rural character/open-space

    Protect unique habitats (wetlands, forested floodplains, fens) and water quality with planning and zoning techniques and voluntary approaches (conservation easements)

    Use best management practices (limit impervious surfaces, stormwater management techniques that encourage infiltration where appropriate)

Critical Areas, Impaired/Threatened Uses, Pollutants, Sources and Causes

Table 5 lists impaired and threatened designated uses in the Dowagiac River Watershed. In the table, the pollutants are identified along with the sources and causes of each pollutant. To read the table, start at the left and proceed right. For each critical area listed, a threatened or impaired designated use, the associated pollutant(s) and its source(s) and cause(s) are identified. If a designated use is “impaired”, there is evidence that water quality is degraded and is negatively impacting the designated use. If a designated use in the watershed is “threatened”, there is evidence that current or future activities will soon have an impact on water quality and the designated use. The pollutant, source and cause of pollutants are listed either as “known” (k) or “suspected” (s). If a pollutant, source or cause is “known, “ it has been detected through sampling or observed in the watershed. If it is listed as

"suspected," the pollutant, source or cause has not been detected or observed, but there is reason to believe that it is present because of the activities occurring in the watershed.

The table is followed by a narrative that prioritizes pollutants and sources and provides supporting evidence and explanations for the impaired and threatened uses. The information in the table and narrative was gathered from studies conducted in the watershed, year 2000 surface water quality non-attainment lists from the Michigan Department of Environmental Quality, water quality sampling conducted by MDEQ and MDNR, general observations by the watershed coordinator and local and state agency staff and input from the general public (surveys and public meetings). Studies conducted in the watershed include:

Aponte, Batres-Marroquin, et al. Feasibility Assessment for Rehabilitating the Dowagiac River System in Southwestern Michigan. A Watershed Analysis of Potential Changes to the Ecology and Community. University of Michigan, School of Natural Resources and Environment. Ann Arbor, Michigan. August 1998.

Creal, W. A Macroinvertebrate Survey of Dowagiac Creek and Dowagiac River, Cass County, Michigan, August 18, 1977. Michigan Department of Natural Resources, Surface Water Quality Division. Report # 003170. 1978.

Dexter, James, Jr. Dowagiac Creek, Cass County, Surveyed July 7, 9, 21, 1992. Michigan Department of Natural Resources, Status of Fishery Resource Report. 1996.

Dimond. On-Site Aquatic Toxicity Evaluation of Dowagiac WWTP Outfall 001 Effluent and Dowagiac Creek. Michigan Department of Natural Resources, Surface Water Quality Division. Report # MI/DNR/SWQ-91/230. 1991.

Ervin, et al. Cass County Studies, Surface and Ground Water, Central Cass County, Michigan. Michigan State University, Institute of Water Research and Western Michigan University, Institute of Water Research. December 1994

Heaton, Sylvia. Biological Survey of Dowagiac Creek and Dowagiac River Watersheds. Berrien, Cass and Van Buren Counties, Michigan. August 27-28, 1990 and July 15-19, 1991. Michigan Department of Environmental Quality, Surface Water Quality Division. Report # MI/DEQ/SWQ-96/006. April 1997.

Heaton, Sylvia. Biological Survey of Dowagiac Creek and Dowagiac River Watersheds. Berrien, Cass and Van Buren Counties, Michigan. August 19-20, 1996. Michigan Department of Environmental Quality, Surface Water Quality Division. Report # MI/DEQ/SWQ-97/074. June 1997.

He, Shi, Agosti. Modeling Non-point Source Pollution Potential in the Dowagiac River Watershed, Michigan. Western Michigan University, Institute for Water Sciences. 1998.

Kirby and Hampton. The Hydrology and Hydrogeology of the Dowagiac River Watershed - Southwest Michigan. Western Michigan University, Department of Geology, Institute of Water Sciences. 1997.

Kogge, S. Stream Assessment of Dowagiac Creek, vicinity of Dowagiac POTW, October 21, 1985. Michigan Department of Natural Resources, Surface Water Quality Division. Report # MI/DNR/SWQ-94/048. 1986.

LSL Planning. Watershed Resource Papers: Dowagiac River Watershed Project. 2001.

Michigan Department of Environmental Quality, Surface Water Quality Division. A Biological Survey of the Dowagiac River Watershed and Selected Tributaries: Cass and Berrien Counties, Michigan. June, August and September 2001. May 2002.

Sauk Trails Resource and Development Area Council. Dowagiac River Watershed Nonpoint Pollution Inventory and Implementation Plan. July 1991.

Southwestern Michigan Commission. Build-Out Analysis for the Dowagiac River Watershed. 1998.

Southwestern Michigan Commission. Growth and Development Issues in the Dowagiac River Watershed. 1998.

Southwestern Michigan Commission. Inventory of Regulatory and Non-Regulatory Tools for Watershed Protection Planning. Dowagiac River Watershed Project. 1998.

Wesley, Jay K. and Joan E. Duffey. A Fisheries Survey of the Dowagiac River, July 1988 and 1989. Michigan Department of Natural Resources, Fisheries Division. July 1999.

Wesley, Jay K. and Joan E. Duffey. St. Joseph River Watershed Assessment. Michigan Department of Natural Resources, Fisheries Division. 1997.

There is still a great need for studies to be conducted on groundwater usage and its impacts on hydrology and the impacts on water quality and hydrology from increased development, stormwater management techniques, and the loss of natural areas (wetlands, floodplains, farmland). There is also a need for studies to better understand if the contributing watersheds are hydrologically stable and identify means and methods for maintaining stability. Another need is to better understand the sources and causes of sediment and nutrients in the watershed.

Table 5. Priority Areas/Uses/Pollutants/Sources/Causes

PRIORITY/CRITICAL AREAS	IMPAIRED (I) OR THREATENED (T) USES	POLLUTANTS	SOURCES	CAUSES
Dowagiac River Watershed (all lakes, streams, rivers and wetlands)	cold water fishery (I/T) nutrients - I sediment - I increased temp-erature and flow - T aquatic life/wildlife (I/T) nutrients - I sediment - I increased temp-erature and flow - T	nutrients (phosphorus and nitrogen) (k)	cropland/residential lawns (s)	over-application/ improper use/storage of fertilizers, septic waste and manure (s)
				lack of buffers between fields/lawns and surface water (s)
			septic systems (s)	failing septics / lack of maintenance (s)
		sediment (k)	cropland (k)	farming erodible land (s)
				lack of buffers between fields and surface water especially on lateral drains in headwaters area (k)
				conventional tillage (s)
			road crossings (s)	lack of soil erosion controls (s)
			stream banks (k) unstable channel bottom (s)	flashy flows from storm events (s)
				unlimited livestock access(s)
				human access (k)
			construction sites (s)	ineffective erosion control and stormwater management (s)
		increased temperature/ hydrologic flow (s)	storm water run-off (s)	increased impervious surfaces/ need improved stormwater management (s)
	agriculture (T)	decreased water level (s)	increased water use (s)	large scale farms with irrigation systems (s) increased industrial use (s)
Peavine Creek and McKinzie Creek	cold water fishery (T)	increased temperature/ hydrologic flow (s)	stormwater runoff (s)	increased impervious surfaces/ need improved stormwater management/loss of hydrologically sensitive areas (s)

(k) - known (s) - suspected

Table 5 continued:

PRIORITY/CRITICAL AREAS	IMPAIRED (I) OR THREATENED (T) USES	POLLUTANTS	SOURCES	CAUSES
lower Dowagiac River (below Niles Dam)	aquatic life/wildlife (I)	FCA/PCBs/ arsenic (k)	sediment (s)	historic pollution (s)
Silver Creek	aquatic life/wildlife (I)	sediment/nutrients (k)	unstable banks/crop-land/residential lawns (s)	lack of buffers between fields/lawns and surface water (s)
McKinzie Creek	aquatic life/wildlife (I)	sediment/temperature(k)	unpermitted former point source; stormwater runoff (k)	settling ponds at Nieb Concrete (k)
lower Dowagiac Creek	warm water fishery aquatic life/wildlife (I)	hydrologic flow/ sediment/nutrients/ oils and grease (s)	stormwater runoff (s) and sanitary sewer discharge(k)	increased impervious surfaces/need improved stormwater management/loss of hydrologically sensitive areas (s)
				increased volume of sanitary sewer discharge with expansion of service(s)
Dowagiac River (above Osborn Drain)	partial body contact recreation (I)	*E.coli* bacteria (pathogen) (k)	septic systems (s)	failing septics / lack of maintenance/poorly sited septics (s)
			manure (s)	over application of ag. wastes on fields/lack of manure mgt. (s)
				lack of buffers btwn fields and water (s)
				unlimited livestock access (s)
	aquatic life/wildlife (I)	sediment (k)	cropland (k)	wind and water erosion (k)
Lake of the Woods	warm water fishery (T)	sediment/oils and grease (s)	stormwater (s)	ineffective stormwater management system (s)
Dowagiac River at Rodgers Lake outlet	cold water fishery (I)	sediment (k)	road crossing/banks (s)	ineffective control structure (s)
		nutrients (k)	wastewater system/cropland (s)	failing wastewater system (k), over application of fertilizer/manure (s)

(k) - known (s) - suspected

The Dowagiac River Watershed is being impaired and threatened by many different types of pollution and the sources of pollution vary also. Most land uses and land users contribute to water quality problems. Water quality problems arise from residential, agricultural, commercial and industrial areas. For many of the pollutants in the watershed, the sources are not easily identifiable. Pollution that does not come from a direct source is referred to as non-point source pollution. Non-point source pollution is caused when rain, snow melt or wind carry pollutants off the land into water bodies. This watershed management plan deals mostly with non-point source pollution sources.

Contributions from point sources (releases from a pipe or direct conveyance into a water body) in the basin are small and localized. In fact, there are only 8 MDEQ permitted discharges in the watershed as of 1998. They include:

1. Dowagiac's municipal wastewater treatment plant to Dowagiac Creek
2. Decatur's municipal wastewater sewage lagoon system to Mud Lake
3. Six groundwater clean-up sites
    - Midway Grocery to Osborn Drain via ditch
    - Sunstrand Heat Transfer (National Copper Product) to Pine Lake via inlet
    - Service Oil (Dowagiac) to Dowagiac Creek via storm sewer
    - Keith's Garage (Cassopolis) to Stone Lake via storm sewer
    - Service Oil (Cassopolis) to Stone Lake via storm sewer
    - Westgate Oil (Pokagon) to Pokagon Creek via storm sewer

Priority Areas - Dowagiac River Watershed

A priority area is an area that has been identified as having specific water quality concerns. If possible a specific critical area may be identified in the priority area. The critical area is the geographical portion of the watershed that is contributing a majority of the pollutants and is having a significant impact on the water body. By identifying priority and critical areas, it will be possible to focus on areas needing the most attention. This will ensure that the money, time and technical resources are best used to reduce the greatest amount of pollutants.

The priority area for the following resource concerns was defined as the entire Dowagiac River Watershed because these water quality threats and impairments were identified as being widespread problems and also as having widespread effects throughout the watershed. The designated uses that are either impaired or threatened include; 1) cold water fishery, 2) aquatic life/wildlife, 3) public water supply and 4)agriculture.

The pollutants of concern for the cold water fishery and other aquatic life/wildlife are nutrients (phosphorus and nitrogen), sediment, an increase in water temperature and a change in the hydrologic flow of the river system. Other pollutants of concern are chemicals and decreased groundwater levels. All of these pollutants impair the ecological functioning of the river system.

The pollutants of concern have been prioritized according to the information available at the time of this plan. Sediment and nutrients are the top priority pollutants because they are known pollutants in the watershed that can be addressed with best management practices. Increased temperature and changes in hydrologic flow are also a high priority. There is some indication in recent years of changes in hydrologic flow. However, increased water temperature and changes in hydrologic

flow are only listed as threats to the cold water system at this time. It is known that growth and development can affect temperature and flow if future growth and development is poorly planned and implemented without appropriate stormwater management practices that protect sensitive cold water bodies. Imperviousness studies conducted in the Dowagiac Watershed support this conclusion. However, more extensive monitoring is needed to determine if temperature and flow are having a significant effect at this time. Not enough information exists about chemicals and decreased water levels to list these pollutants as a high priority. *E-coli* bacteria has not been found recently. Both *E. coli* and arsenic/PCBs are isolated problems in the watershed and therefor are not a high priority overall for the watershed.

Cropland is listed as the priority source for several of the pollutants because agriculture is the primary land use in the watershed. There may be isolated cases especially around lakes or cities/villages where residential or other land uses are the primary or priority sources of pollutants.

Table 6. Prioritization of Pollutants and Sources

Rank	Priority Pollutants	Priority Sources
1	Sediment	1. Cropland 2. Stream banks/unstable channel bottom 3. Road crossings/construction sites
2	Nutrients	1. Cropland 2. Residential lawns/septic systems
3	Increased Water Temperature/Changes in Hydrologic Flow	1. Stormwater run-off
4	Chemicals and Nitrates (pesticides/herbicides/oils/grease)	1. Cropland 2. Septic systems 3. Residential lawns/golf courses
5	Decreased water levels	1. Irrigation 2. Industrial Use
6	*E-coli* bacteria	1. Cropland/manure 2. Septic systems
7	Arsenic/PCBs	1. Sediment (historic pollution)

Nutrients

Nutrients, phosphorus and nitrates, have been found in surface and groundwater throughout the watershed. Most of the data is from randomly collected samples. There are manypossible sources and causes of increased nutrients in the watershed.

A study by MDEQ found elevated levels of phosphorus where the Dowagiac River crosses Twin Lakes Road and Dewey Lake Street in 1991. Elevated levels for ammonia nitrogen were found at the following road crossings: 46th Street (Van Buren County), Twin Lakes Road, Dewey Lake Street, M-51, Yaw Street and Pucker Street. Elevated levels of nitrates have been found in many residential wells in Cass and Van Buren counties according to the Health Department. In addition, a map produced by the Center for Remote Sensing and Institute of Water Research at Michigan State University, showed that several areas in the watershed have nitrate concentrations in wells that exceed the 10 ppm level. The records used to produce this map were from wells sampled between 1984 and 1989. (Ervin, et al, 1994) Levels over 10 ppm are considered unsafe for children, elderly and people with compromised immune systems.

Effects of Nutrients and Sediment on Water Quality
Nutrients result in low dissolved oxygen in water bodies. Sediment settles in gravel areas ruining spawning grounds for trout and other aquatic life. Sediment also clouds the water making it difficult for certain aquatic insects to survive. Often the nutrients (phosphorus and nitrogen) travel to a water body attached to sediment that is flushed into a drain, stream or lake. Together nutrients and sediment choke out

Table 7. Nutrient Levels above SMNITP Averages* at Road/Stream Crossings

Pollutant	Sites -road/stream crossings (YEAR)
Phosphorus total	Twin Lakes Road (1991) Dewey Lake (1991)
Ammonia Nitrogen	46th Street (1991) Twin Lakes (1991) Dewey Lake (1991) M-51 (1991) Yaw Street (1991) Pucker Street (1991 and 1996)

**SMNITP refers to the Southern Michigan/Northern Indiana Till Plain Ecoregion. Averages for water quality data have been established to compare the water quality of rivers and streams in this region.*

A 1998 Western Michigan University (WMU) study that modeled non-point pollution potential for the Dowagiac River Watershed identified critical areas for nutrients and sediment. The areas around surface water bodies such as Magician Lake, Dewey Lake, Indian Lake, Gravel Lake and Saddlebag Lake had higher runoff rates while the streams and urban areas produced the highest peak

flows of up to 5,300 cfs. Sediment attached N and P seemed higher in the cropland areas of the central watershed, especially around the cities of Decatur, Dowagiac and Cassopolis and Magician Lake, Dewey Lake, Lake of the Woods, Grass Lake, Cedar Lake, Gravel Lake, Mill Pond and LaGrange Lake. Agricultural land in the west portion of the watershed produced the greatest amount of soluble N and P while agricultural land throughout the entire watershed had higher amounts of COD (chemical oxygen demand). The study showed that land cover had a significant effect on water quality. Forested and non-forested vegetated lands significantly reduced runoff and soil erosion while the agricultural and urban areas produced higher amounts of runoff, sediment and nutrients in the watershed. Approximately 29,749 tons of sediment would flow into the St. Joseph River from the Dowagiac River during a 24 hour storm event of 4.5 inches. (He, Shi, Agosti, 1998)

COD - chemical oxygen demand
COD is an indicator of how much oxygen is in water. A high COD may result in a low dissolved oxygen level. A low dissolved oxygen level is the most common cause of fish kills. COD is commonly used in municipal and industrial laboratories to measure the general level of organic contamination in wastewater. Pollution from organic materials, such as sewage, paper pulp, and food processing waste, will cause a high COD.

One of the sources of nutrients is from cropland and residential lawns. Often times fertilizers are over applied or used, stored and disposed of improperly. There are also concerns in the watershed about the proper application (in terms of technique and amount) of septage wastes from septic haulers onto fields. In addition, with the lack of adequate buffers between the fields/lawns and the bodies of surface water (drains, lakes, streams, rivers), unused nutrients either directly run-off into the water body or leach into groundwater and then move towards a surface water body.

Another source of nutrients is failing septic systems, especially in higher density residential areas along bodies of water. Home owners may not adequately maintain the septic system or the septic system may not have been designed for the increased use. For example, many cottages that were only seasonal are now year-round residences and have all the conveniences of washing machines, garbage disposals, etc. that contribute to increased nutrients that overload the septic systems. Another rising concern is an increase in medium to high density residential developments which are not being connected to municipal sewer systems. These developments could pose future water quality problems and it will be difficult (monetarily and politically) to install sewers at a later date.

Sediment

Another major pollutant of concern is sediment. Across the nation, sediment is recognized as the most common water pollutant. One of the functions of a river is to move sediments; however, a system can be overloaded with sediment causing water quality impairment. Extensive sand and silt deposition has been identified by the MDNR along many stretches of the Dowagiac River (especially in the upper portions of the river and above the Niles Dam) and also in many of the tributaries (Pokagon Creek, Peavine Creek, Osborn Drain, Red Run Creek, lower Dowagiac Creek and Silver Creek). Recent bed load estimates by MDNR Fisheries Division have revealed that sediment is a bigger concern than once thought. In the appendix, see turbidity and bottom composition results for the Dowagiac River in July 2000.

Table 8. Sediment Levels above SMNITP Averages at Road Stream Crossings

Pollutant	Sites -road/stream crossings (YEAR)
Suspended solids	Twin Lakes Road (1991)

A 1998 WMU study that modeled non-point pollution potential for the Dowagiac River Watershed identified critical areas. Agricultural lands produced the highest amounts of soil erosion and COD (chemical oxygen demand). Agricultural land in the west and northeast portions of the watershed had a greater amount of soil erosion than the rest of the watershed. The accumulated sediment yield at the mouth of the Dowagiac River was the highest, representing the contributions of the entire watershed. It is estimated that almost 30,000 tons of sediment flow from the Dowagiac River into the St. Joseph River in a 24 hour, 4.5 inch rain event. The urban land and non-forested wetlands generated the greatest amounts of runoff, peak flow, sediment and nutrients. Soil erosion, sediment and nutrient yield were highest in the cropland of the west portion of the watershed and around the Cities of Decatur, Dowagiac and Cassopolis. These areas are in need of best management practices for soil erosion management. (He, Shi and Agosti, 1998)

Sediment comes from a variety of sources. One source of sediment, like nutrients, is cropland, especially from those fields without adequate buffers along drains, streams, rivers, wetlands and lakes. Sediment can travel to water bodies either by water or wind. Sediments have been identified as a major problem in the headwaters of the Dowagiac River. The headwaters contain the "muck" lands of the Decatur area and is identified as a critical area for sediment. This area is heavily ditched to remove water from the cropland. Many of the landowners are farming to the edges of not only the main channel of the river, but also along the side drainage ditches. Even if only a small amount of sediment reaches the river at each ditch, the accumulation of sediment from the many ditches in this area will add up causing great problems by the time the water is downstream. Sediment can either run-off during storm events into these drainage ditches or it can be blown from the fields into waterways. The muck soils have a tendency to dry quickly and are carried off the fields by wind. In addition, unstable banks without adequate vegetation may erode after storm events. Sediment problems are worse with the farming of erodible land, the use of conventional tillage instead of no-till practices and the removal of wind breaks.

Sediment can also come from road crossings that lack proper soil erosion controls. Stream banks will experience erosion where there is unlimited livestock access and human access. The Sink Road access site has been identified as a site that is eroding as a result of human access for canoeing. Heavily used access sites are usually void of vegetation which would normally hold the soil in its place. Another contribution to the sediment problem is construction sites. With increased growth and development, especially in areas near water bodies (rivers, wetlands, lakes), ineffective erosion control and stormwater management during and after construction can lead to increased sedimentation of water bodies.

As a result of the dredging and straightening of the Dowagiac River, the channel bottom is unstable and unable to handle sediment inputs mostly from cropland. Once sediment enters the river, the lack of a meandering channel and the disconnection of the river from its floodplain provides no opportunity for the river to adequately handle normal and especially increased sediment loads. The channelization has also reduced in-stream and riparian habitats. The restoration of these areas will

benefit water quality and increase habitat and diversity. Studies have indicated that restoring the remnant meanders south of Dowagiac will not negatively impact the drainage of the farmland in the upper portions of the watershed.

Temperature and Flow

Other pollutants of concern for the cold water fishery and aquatic life/wildlife designations are increased temperature and disrupted hydrologic flow. Currently, the Dowagiac River has cold, stable flows that contribute to its ability to support brown trout and other aquatic life. However, examination of hydrographs for the Dowagiac River indicate that human activities such as channelization, drain construction, irrigation and urban development are affecting daily flow stability by causing more movement of stormwater over the land surface, which affects the quality of the river system (Wesley and Duffy 1997; Berry 1992; Dunne and Leopold 1978). The cold, stable flow is threatened by stormwater run-off which results from increased impervious surfaces, ineffective stormwater management and loss of hydrologically sensitive areas such as wetlands. The result is not only a degradation of water quality, but also an increased probability of flooding.

Studies have shown that most of the watershed is important for groundwater recharge because most of the soils in the watershed are permeable. Critical areas include discharge areas such as the soils surrounding the river channel and in wetlands. Another critical area is the moraine (ridge) area and the riparian areas. These areas must be protected to maintain the hydrology of the river system. In this watershed, infiltration techniques should be used whenever possible to maintain the pre-development hydrology of a site. This will protect the temperature and flow of the Dowagiac River and its tributaries.

Chemicals

Surface water is not used as a drinking water source in the watershed. However, because of the geology and soils of the watershed, the groundwater supply is particularly vulnerable. The drinking water supply of the watershed is impaired and threatened by the use of pesticides, herbicides, insecticides and nutrients from fertilizers and septic systems. All residents in the Dowagiac River Watershed rely on groundwater supplies for their drinking water whether it comes from private or public wells. The over application, improper usage, storage and disposal of chemicals not only affects surface water, but also groundwater supplies. Unplugged abandoned wells also contribute to the problem, allowing chemicals and nutrients to directly enter the groundwater. Septic systems as discussed previously not only degrade surface water, but also the groundwater supplies. In this watershed with the high connectivity of ground and surface waters in some areas, water pollution can move between the two sources of water quite easily.

In June 1991, Sauk Trails Resource Conservation and Development Council tested the Dowagiac River for several name brand pesticides and herbicides. No pesticides or herbicides were detected in any of the water samples. Samples were taken at M-62 and Dewey Lake Road. The samples were analyzed for Atrazine, Simazine (Princep), Metribuzin (Lexone, Sencor), Metolachlor (Dual), Alachlor (Lasso), Diazinon, Hexazinone, Prometryne, and Terbacil (Sinbar). However, in 1981 there were detections of pesticides in Van Buren County. There has also been some detections of chemicals and nitrates in residential water wells in the watershed. At Holloway Lake (Wayne Township) high nitrate levels were detected in the areas where a natural spring enters the lake. The

nitrates were obviously entering the lake from the groundwater. The nitrates most likely came from the area agricultural lands. There has not been extensive testing for chemicals or nutrients in either surface or groundwater.

Decreased Water Levels

Increased water usage for irrigation is becoming more of a concern. The agricultural water supply is at risk especially during drought periods. There is also concern that increased water use at new power plants being installed in the watershed will have an impact. At this point, there is not enough information on groundwater supplies to know the threshold of water usage before it begins impacting surface water (stream, river and wetland) systems. Management is needed to ensure that water supplies are not exhausted and that the recharge of surrounding water bodies is not impacted severely.

Sub-Watershed Priority Areas

In addition to the above threats and impairments that have been identified for the entire watershed, more specific water quality problems and concerns have been identified for certain threatened or impaired sub-watersheds. Some of the identified priority areas are where threats are a special concern due to the high quality nature of the resource.

Peavine and McKinzie "Kinzie" Creeks

Peavine and McKinzie Creeks have been identified by the MDNR Fisheries Division as high quality cold water streams due to their year-round cold temperatures. Recently, the Peavine Creek sub-watershed, especially the headwaters area near Dowagiac, has seen an increase in industrial and residential development. In addition, the Pokagon Band of Potowatomi Indians have plans for commercial and residential developments in the Peavine Creek sub-watershed. In a 1992 MDNR Fisheries Report, Peavine Creek was reported as having silt in the upper section of the stream that needed to be investigated (Joan Duffey, 1992). The Dowagiac Industrial Park and the Tribal lands have been identified as critical areas in the Peavine sub-watershed.

The McKinzie Creek sub-watershed is threatened by future development and increases in impervious surfaces. Critical areas in this sub-watershed include the Niles Industrial Park and the rapid residential

A ten percent **increase in impervious surfaces** may cause a one degree increase in temperature!
The increase in impervious surfaces decreases the amount of area available for water to infiltrate into the soil and feed the creek through groundwater (its normal route). Instead, more water will run over the impervious surfaces (roads, parking lots) and enter the creek as over land flow with an increased temperature and with more pollutants. Obviously, the over land flow reaches the creek much quicker than the original route of groundwater feeding the creek. This fast flow to the creek is what results in the increased possibility of flooding downstream. In addition, if wetland and floodplain areas are disrupted or filled, the land loses its natural capacity to filter and slow the water reaching the creek. Wetland and floodplain areas also support a great diversity of plants and animals.

development in Howard Township.

Increases in impervious surfaces could threaten both the Peavine and McKinzie Creeks by increasing the pollutants entering the ground or surface water, increasing water temperatures and disrupting stable flows. If stormwater management systems do not mimic pre-development hydrology or treat stormwater before releasing to the creeks, there will be a degradation of water quality and an increase in temperature and flooding potential.

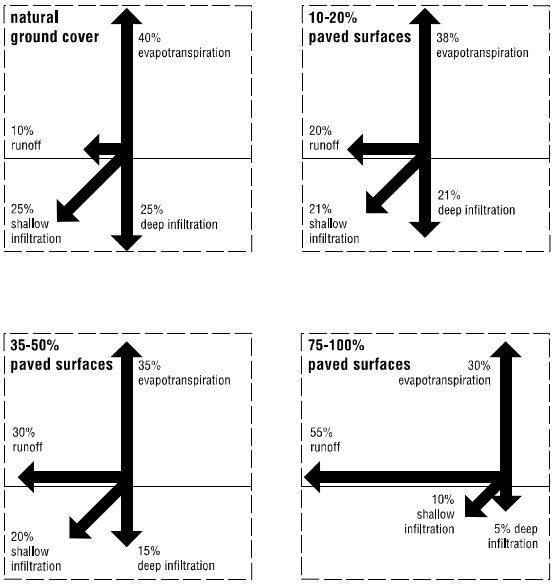


Figure 8: Impacts of Impervious Surfaces

Non-Attainment Areas - Lower Dowagiac River, Silver Creek, McKinzie Creek

The lower Dowagiac River (below Niles Dam), Silver Creek (from the confluence with the Dowagiac River upstream to the Magician Lake outlet) and McKinzie Creek (Nieb Concrete settling ponds at Barron Lake Road) have all been listed as non-attainment areas for water quality standards by the Department of Environmental Quality in 2000. In each sub-watershed the aquatic life/wildlife is impaired. The lower Dowagiac River has a fish contaminant advisory for carp because of PCB contamination. (This is the only fish advisory in the Dowagiac River Watershed.) Arsenic was also discovered in the sediments when MDNR began to lower the Pucker Street Dam in the late 1990's. The exact source and cause of these contaminants is not known, but most likely the PCB contamination is associated with historic industrial activity and the arsenic with historic farm use and background levels found in the area. In 1996, arsenic levels were also found to be elevated in the Dowagiac River where it intersects Middle Crossing Road.

polychlorinated biphenyls

PCBs are a group of toxic chemicals that were once widely used as industrial coolants, insulators and lubricants. PCBs are of concern because they concentrate in the environment and the food chain resulting in health hazards to humans, fish and wildlife. Because of these dangers, the United States banned the manufacture of new PCBs in 1976 and PCBs still in use are strictly regulated.

Table 9. Arsenic Levels above SMNITP Averages at Road/Stream Crossings

Pollutant	Sites -road/stream crossing (YEAR)
Arsenic	Middle Crossing (96) Pucker Street (96)

Silver Creek was listed as non- attainment by the MDEQ because of a poor macro invertebrate community which is an indicator of poor water quality and/or lack of habitat in the year 2000. Silver Creek was removed from the non-attainment list by MDEQ in 2002 because the stream was dredged and now as a highly modified stream was no longer appropriate to list for biota. The pollutants most likely contributing to the problem are sediment, nutrients and lack of channel structure. The source of nutrients and sediment are cropland and residential areas especially in areas with a lack of adequate buffers between fields/lawns and water bodies. Another source of nutrients may be failing septic systems around Sister Lakes; however, this is being addressed with the installation of a municipal sewer system in 2001. The lack of channel structure can be attributed to unstable banks. A direct cause for this has not been identified, but the lack of buffers probably contributes to the problem. This area needs to be inventoried to identify specific areas where buffers would be needed.

In both 2000 and 2002, McKinzie "Kinzie" Creek is listed as non-attainment with a poor fish community (also an indicator of water quality). In MDEQ's 2001 biological survey, no coldwater fish species were found immediately downstream of the in-stream gravel pit at Nieb Concrete. The in-stream settling pond or gravel pit causes an elevation in water temperature of McKinzie Creek downstream. The Nieb Concrete site is a critical area in this sub-watershed. MDEQ and MDNR officials have met with Nieb Concrete representatives to begin addressing these concerns.

Lower Dowagiac Creek

The Michigan Department of Natural Resources, Fisheries Division, identified threats and impairments to the warm water fishery in Lower Dowagiac Creek. The pollutants of concern are hydrologic flow, sediment, nutrients, chemicals and oils/ grease. These pollutants are mostly the result of stormwater run-off or from unknown sources. Currently, the City of Dowagiac's stormwater system is connected to the municipal sanitary system. The stormwater that reaches the Dowagiac Waste Water Treatment Plan (WWTP) is treated before being released into the Dowagiac Creek. With large rain events, the WWTP handles the extra

MDEQ's Biological Survey (2001)
Water Samples below the WWTP found slightly elevated levels of some metals, nutrients and total dissolved solids, but these levels did not exceed Michigan Water Quality Standards.

Sediment samples from upstream and downstream of the WWTP outfall had levels of anthracene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, and benzo(g,h,i)perylene. Phenanthrene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthrene and benzo(a)pyrene were detected at levels that greatly exceeded background concentrations in the SMNITP region.

flows by diverting water to a large clay lined lagoon before treatment. The WWTP is the only permitted discharge to the Dowagiac Creek. After improvements to the WWTP in 1979, the fish, macro invertebrate and habitat conditions improved greatly. According to MDNR, zinc, total phosphorus and suspended solids were elevated downstream of the Dowagiac WWTP outfall compared to upstream sampling stations. However, the ranges were still within range of the SMNITP ecoregion averages. At this time, the Dowagiac WWTP did not seem to be impacting the quality of the Dowagiac Creek. However, with more areas connecting to the public sewer system, the Creek may become impacted by the increased discharge of waste water at this point. There are also concerns about what level of discharge will begin to have an impact on the cold water temperature of the Dowagiac River.

There is an effort underway to disconnect the stormwater system from the sanitary sewer system by re-routing stormwater into wetlands east of the airport and to the north of the city. These actions are being taken to eliminate excess flows to the sanitary sewer system and prevent discharges associated with sanitary sewer overflows. The stormwater system will have 2-3 foot sumps to settle out sediment and litter. The City of Dowagiac has an annual maintenance program to clean out the sumps on a regular basis. With increased development in the area, there must be efforts to ensure that the stormwater discharge does not negatively impact water quality or the hydrology of the area.

An impervious surface analysis was conducted on the Lower Dowagiac Creek sub-watershed. In 1996, there was 2.71% impervious cover in the sub-watershed (see appendix 3). Much commercial and industrial development has occurred in the past few years and build out impervious cover could be as high as 18.3 to 25.9 percent. However, if cluster development options and conservation practices are used, the impervious cover could be reduced to 9.8 to 14.2 percent at build out. To ensure that future development does not negatively impact the Dowagiac Creek and River, development should be balanced with the protection of hydrologically sensitive areas. In addition, measures should be taken to encourage infiltration at the source thereby minimizing the effects on the hydrology of the creek and surrounding wetlands. With new development, best management practices that encourage infiltration should be encouraged or required and areas that have already been developed in this sub-watershed may need to be redesigned to encourage more infiltration. One critical area is the commercial development area on M-51 south. This area has seen recent development and will probably experience more in the near future.

Pine Creek

The Rudy Road Drain and Pine Creek/Lake system has had historic contamination by organic compounds including: trichloroethene (TCE), 1,1,1-trichloroethene, 1,2-dichloroethene and 1,1-dichloroethane (Creal, 1983). Currently, the MDEQ is overseeing a contaminated groundwater cleanup at the historic Sunstrand Heat Transfer plant. Pollutants of concern include TCE, vinyl chloride, mercury, cyanide, lead and chromium. In a 2001 MDEQ survey, the macroinvertebrate community was rated as poor with a noticeable lack of aquatic insects and no fish were collected. The habitat and flow were adequate to support fish and macroinvertebrate communities. Therefor, since the majority of flow within this system comes from the groundwater treatment system, the survey suggested that the effluent was unacceptably toxic.

Dowagiac River above Osborn Drain (headwaters)

For the Dowagiac River (above Osborn Drain), partial body contact recreation has been identified as being impaired or threatened because of *E. coli* bacteria pollution. Unsafe levels of *E-coli* bacteria were found in water samples done by Sauk Trails RC&D Council and Michigan Department of Natural Resources in 1991 (see results in appendix). *E. Coli* indicates the presence of human or other warm-blooded animal wastes. Potential sources include animal manure and septic systems. The manure may be a result of unlimited access of livestock to streams and drains, the lack of manure management practices (storage, over application, etc) and the lack of buffers between fields and surface water bodies (drains, streams, rivers, wetlands). Septic systems may also be contributing to the problem if they have been installed in areas with a high water table or if they are not being maintained properly.

Lake of the Woods

Lake of the Woods has been identified as a priority area for threats/ impairments to the warm water fishery. The critical area has been identified as the Decatur School Complex and the surrounding neighborhood. Sediment and oils/grease from stormwater runoff generated from this area is entering Lake of the Woods with minimal pre-treatment. With the current stormwater system, some of the stormwater is not treated and piped directly to Lake of the Woods. The school is considering the creation of an infiltration basin that can also serve as an outdoor lab for students.

Rodgers Lake

Lastly, the Rodgers Lake outlet to the Dowagiac River has been identified as a priority area. The pollutants of concern are sediment and nutrients. The critical area has been identified as an ineffective control structure at the Rodgers Lake outlet. The control structure cannot handle large rain events and water runs over the road causing erosion problems. The nutrient problem is evident with the severe eutrophication of Rodgers Lake and a small impoundment just downstream. The source of the nutrients is not apparent but could be related to abandoned pit latrines or surrounding agricultural fields/hog operations.

Public Participation

The development of this watershed management plan depended heavily on public participation. Over the past few years several public forums have been held. The results of two recent public forums are included in the appendix. There was also a watershed stakeholders meeting where participants commented on watershed issues and concerns. At this meeting, the participants ranked the issues and concerns in the watershed. The results of this session are also included in the appendix. Surveys of local officials and riparian owners were conducted in the watershed. Some of these results can also be found in the appendix. In addition, the Watershed Stewardship Team, a group of citizens, local officials and state agency staff, were involved in the development and review of the plan. The Stewardship Team assisted in identifying designated and desired uses, pollutants, sources and causes of pollutants, priority areas and assisted with the development of the goals and objectives in the plan. The

Stewardship Team reviewed the plan in different stages and offered comments on it contents. The Dowagiac River Watershed newsletter also included information about the planning process. This newsletter is sent to over 500 households in the watershed.

Watershed Goals and Objectives

With water quality impairments and threats and desired uses identified, watershed stakeholders have formulated goals and actions to address these issues. See Table 10 for more details on implementing these goals and objectives.

1. Protect watershed hydrology (cold water system), water quality, natural features, farmland, open space and rural character through coordinated land use planning and zoning efforts

Water quality, natural features, farmland and rural character all factor into the quality of life in the watershed. Clean, safe water for use and recreation; forests and wetlands with rich species diversity; and planned residential, commercial and industrial development that is cost effective and sustainable are just a few of the concerns.

It is also important to understand the connection between land use decisions and the impacts on water quality. Changes in land use impact the hydrology of the watershed and the water quality. Currently the Dowagiac River system gets 90 percent of its flow from groundwater discharge and only 10 percent from surface run-off. Future development brings with it impervious surfaces and artificial drainage which upsets this balance by causing more surface water to reach the river and streams instead of through groundwater.

A regulatory framework is available to implement protections for water quality, natural features, farmland and rural character preservation. Watershed communities must coordinate planning efforts and learn from each others experiences. ***Local municipalities have the ability to create and enforce policies that will not only allow for growth and development, but also preserve natural features and water quality to ensure the quality of life of the area is maintained.***

Actions:

1. Continue to offer training opportunities for local officials on planning/zoning
2. Continue to update land use master plans and zoning ordinances to address water quality and natural resource issues by doing the following:
   - identify significant natural features to be protected or restored (springs, seeps, wetlands, floodplains, steep slopes, critical habitat areas)
   - maintain pre-development hydrology by limiting impervious surfaces, protecting open spaces and hydrologically sensitive areas (wetlands, forested floodplains)
   - require adequate setbacks from lakes, streams and wetlands for buildings, septic systems and other development with impervious surfaces (parking lots, etc.)
   - retain 50-100 foot natural protective vegetated strips along water bodies
   - allow for and encourage cluster development in areas most suitable (based on infrastructure availability, suitable soils, slope, presence of natural features**)**

- require effective stormwater management for residential, commercial and industrial developments (promote infiltration techniques where appropriate to ensure thermal impacts are minimized)
- require municipal sewers or septic system maintenance districts in high to medium density developments
- preserve greenways for wildlife and recreational use along the river and tributaries
- protect productive farmland (create a farmland preservation county committee to explore and promote options)

3. Create a watershed land use committee to oversee planning and zoning decisions for water quality and natural resource protection

2. Reduce sediment, chemicals, nutrients and thermal inputs to surface water

Actions:

1. Develop sub-watershed protection plans for threatened or impaired sub-watersheds
   - inventory, prioritize and retrofit road crossings with best management practices
   - inventory riparian and wetland conditions to identify problem sites
   - implement best management farming practices - no-till, buffers, wind breaks, manure management, soil testing, irrigation scheduling, pest scouting, restrict livestock access, abandon highly erodible land
   - implement bank stabilization using soft engineering practices when appropriate
   - improve existing recreation access sites
   - improve/retrofit existing stormwater management systems in villages and cities (encourage treatment trains and infiltration methods, reduce end of pipe methods)
2. Improve County Soil Erosion and Sedimentation Control Programs
   - educate local officials, general public and builders about the program
   - increase site visits during and after construction
   - consolidate permitting and enforcement activities within the county
3. Encourage landowners to maintain, enhance or install riparian buffers along drains, streams, lakes and wetlands (especially in the headwaters area)
4. Work with lake associations to implement demonstration sites with native riparian plantings
5. Increase soil testing to limit over use of fertilizers on residential lawns and gardens
6. Maintain existing septic systems and require municipal sewer in high to medium density developments
7. Inventory meander restoration sites and work with landowners to restore meanders and riparian areas

3. Protect public water supply by reducing nutrients and chemicals entering the groundwater

Groundwater protection is essential to protect the public water supply and private well supplies. Because much of the land surface is important for groundwater recharge, it is critical to examine land use practices and how they impact water quality.

Actions:

1. Work with local governments to develop and implement zoning ordinances, education campaigns and programs that will protect groundwater
    - require municipal sewer services or septic system maintenance districts in areas with new medium to high density residential developments
    - require secondary containment for industrial/farm activities involving chemicals or fuel
    - educate landowners about septic system maintenance
    - require routine maintenance and/or testing of septic systems, especially in high risk areas
    - develop and implement well head protection programs
    - increase convenient household hazardous waste disposal options
    - develop a program for testing of private drinking water wells for nitrates
2. Support the Groundwater Stewardship Program, Lake-A-Syst and Home-A-Syst programs to:
    - continue to close abandoned wells
    - educate landowners on proper storage, use and disposal of farm and lawn chemicals
    - install facilities on farms for storage and proper use of chemicals
3. Ensure septic haulers are following regulations for spreading septage wastes on fields

4. Increase public awareness about water quality issues and instill a sense of stewardship

Actions:

1. Distribute quarterly newsletter to general public
2. Work with schools to incorporate watershed and water quality issues into curriculum
3. Develop and implement a self sustaining volunteer stream monitoring/adopt-a-stream program (with a focus on biological indicators)
4. Host local workshops/seminars on water quality and land use planning
5. Promote watershed efforts and accomplishments through the local media
6. Participate in community events by having water quality information available
7. Organize annual stream/river clean-ups
8. Organize a program to stencil urban stormwater inlets
9. Promote land conservation options and stewardship and restoration of private lands
10. Create a packaged multi-media presentation for giving presentations to community groups/ schools/municipalities
11. Develop and install watershed boundary signs
12. Develop a targeted outreach plan for specific water quality pollutants or issues (buffers in the headwaters area)
13. Develop a watershed friendly program to recognize protection or improvement efforts of farmers, citizens, local governments and businesses
14. Develop a recreation plan for the Dowagiac River that focuses on education about the resource, sustainable use of the resource and expanding access sites to the river
15. Reprint watershed brochures - distribute to landowners and use in schools
16. Expand and maintain MEANDRS web-site
17. Expand the use of the Watershed CD-ROM project.

5. Evaluate and monitor changes in hydrology and improvements and/or degradations in water quality

1. Develop a water quality monitoring strategy of streams (with a focus on hydrological, biological indicators and total suspended solids) to identify improvements, problems and critical areas
2. Expand Michigan Lakes and Streams Association water quality monitoring program to more lakes within the watershed
3. Develop an annual water quality statement summarizing changes, improvements and degradations in hydrology and water quality and demonstrate need for new programs, policies and/or development standards
4. Use GIS to monitor changes in land use and loss of natural features (wetlands, forested floodplains, etc.)
5. Develop an on-going program to evaluate the effectiveness of zoning ordinances in protecting water quality and natural features
6. Seek grant funds to determine current and future amount of groundwater withdrawal and usage and its potential impacts

6. Develop an organization to coordinate and implement the watershed plan

1. Develop an umbrella organization for coordinating and implementing watershed efforts
2. Develop a fundraising strategy that includes a membership drive, community and private foundation support and local municipality and business support

Existing Projects and Efforts

Many of these goals, objectives and actions are being addressed in the watershed through several existing programs and initiatives.

The Dowagiac River Watershed Project is a grant funded initiative that focuses on planning and zoning issues in the watershed. With this project there has been an extensive information and education campaign, training for local officials, private land conservation efforts in partnership with the Southwest Michigan Land Conservancy and work with watershed municipalities to address water quality concerns in master plans and zoning ordinances. The watershed municipalities that have partnered with the project to update master plans and zoning ordinances include Pokagon, LaGrange, Silver Creek, Wayne, Jefferson, Volinia, Hamilton and Decatur Townships and

Existing Projects in Watershed

Dowagiac River Watershed Project
SW MI Land Conservancy outreach
Partnership for MEANDRS
EQIP priority area and targeted outreach
Conservation Reserve Program (CRP)
Groundwater Stewardship program
Soil testing (MSU Extension)
Lake-A-Syst Program
Wellhead Protection Programs
Lake Association water quality monitoring
County Household Hazardous Waste and Tire Collection Days

Decatur Village and the Pokagon Band of Potawatomi Indians.

At the **municipal level**, there are zoning ordinances already in place that protect water quality. A review of local ordinances as they pertain to water quality issues has been completed and distributed to watershed municipalities. Some of the policies in place include Wayne Township's open space district along the Dowagiac River which limits the placement and type of development in this sensitive area. In addition, Decatur, Cassopolis and Niles have wellhead protection programs in place. Wellhead Protection Programs are voluntary programs designed to protect municipal drinking water supplies. At the county level, a soil erosion and sedimentation control program is administered to protect water bodies. In Cass County this program is through the Information Systems Department. Berrien, Cass and Van Buren Counties currently provide household hazardous waste and tire collection events for residents.

Many **non-profits** are working to protect the watershed. In partnership with the Dowagiac River Watershed Project, the **Southwest Michigan Land Conservancy (SWMLC)** is conducting an outreach campaign in the watershed. Currently in the Dowagiac River Watershed, the SWMLC has one conservation easement (64 acres along the Dowagiac Creek) and one 12 acre preserve on Cook Lake. The goal of the outreach campaign is to educate landowners about the unique and interesting species and habitats found in the watershed. The education also addresses the options available for landowners to protect these areas for future generations.

The **Partnership for MEANDRS** (Meeting Ecological and Agricultural Needs of the Dowagiac River System) has focussed its efforts on river restoration, riparian education and buffer installation in partnership with the Inter-County Drain Board and the Natural Resource Conservation Service. The Partnership for MEANDRS has conducted a survey of riparian owners and co-sponsored a riparian wildlife workshop. MEANDRS has secured grant money and is seeking additional funds and assistance from the Army Corps of Engineers to complete a pilot river restoration project at Dodd Park in Pokagon Township. This restoration project is in partnership with the Inter-County Drain Board, the Cass County Parks Department, Michigan Department of Natural Resources and many others.

Other watershed/water organizations active in the watershed include the **Michigan Lake and Stream Association** (MLSA) and **Friends of the St. Joseph River**. MLSA has several member lakes in the watershed that conduct water quality monitoring activities in cooperation with the Michigan Department of Environmental Quality. **Trout Unlimited** and the **St. Joseph River Valley Fishermen Association** are sporting groups that have completed many small habitat restoration projects on Dowagiac Creek. One project was at Russ Forest and others have been done just downstream on a private landowner's property.

County Conservation Districts in partnership with the **Natural Resource Conservation Service** (NRCS) and the **Farm Service Agency** have several programs available in the watershed. NRCS has designated the Dowagiac River Watershed as a priority area for the Environmental Quality Incentive Program (EQIP). With this effort, many farmers have installed practices on their land to protect and/or improve water quality. Practices installed include buffers between fields and surface water, manure management systems and fuel pads In addition, the Conservation Reserve Program (CRP) has helped farmers to install several hundred acres of buffers along streams, rivers and drains.

The Groundwater Stewardship Program through the Cass, Galien and St. Joseph River and

Van Buren County Conservation Districts is working with agricultural landowners to close abandoned wells, assist with the financing of best management practices and perform Farm and Field-A-Systs to identify potential water pollution problems and solutions. The Cass County Conservation District will begin a Lake-A-Syst Program in Cass County that will address many of the water quality issues around lakes. This program will work with residential homeowners to identify potential water pollution problems and provide solutions.

Soil testing is available through the **Michigan State University Extension** and the Cass County Conservation District. Both agricultural and residential landowners can utilize this service to determine the amount (if any) and type of fertilizer needed on crops or gardens and lawns.

The ideas and actions presented in this plan are not intended to duplicate existing programs, but to build upon the successes of these efforts. These existing programs demonstrate the on-going commitment to protect water quality by the different partners and residents/landowners in the watershed.

Action Plan

The goals and objectives lay out the general direction for actions in the watershed. However, an action plan is needed to ensure that the goals and objectives are met. In an action plan, the tasks and responsibilities are assigned to different agencies, organizations and/or persons. It is also imperative to have a time frame associated with the tasks and to identify the cost of the activities and possible funding sources. The following pages contain the action plan for the Dowagiac River Watershed.

Table 10. Action Plan for the Dowagiac River Watershed

Goal/Action	Primary	Partner	Time frame	Cost	Funding Source
Goal #1: Protect watershed hydrology (cold water system), water quality, natural features, farmland, open space and rural character through coordinated land use planning and zoning efforts.					
Offer training opportunities	Tri-County Planning Committee, municipalities	CCCD	on-going	$10-$40 per person/workshop	municipalities, Tri-County Planning Committee, registration fees
Update land use plans/zoning ordinances	municipal officials	Watershed Land Use Committee	on-going	$5,000/plan update and $5,000/ordinance update	municipalities, land use planning grants
Create and maintain watershed land use committee	Watershed Stewardship Team, CCCD	MEANDRS	2003-continually	volunteer time 200 hours/year @ $12/hr = $2400/yr	municipalities, CCCD, grants
Goal #2: Reduce sediment, chemicals, nutrients and thermal inputs to surface water.					
Inventory and develop plans for impaired/threatened sub-watersheds	CCCD, Watershed Council, MEANDRS	All watershed partners	one sub-watershed every 3-5 years	$130,000 - $250,000/sub-watershed	319 Clean Water Section grants, municipalities, county, CCCD

Improve soil erosion and control	county	CCCD	on-going	cost not determined	county
Install riparian buffers	CCCD, NRCS, municipalities	MEANDRS	on-going	$1,000/acre	NRCS programs, 319 grant, drain commissioners
Implement riparian native planting demonstration sites	landowners	CCCD, MLSA, MSUE	2003-2005	$1,000/planting	CCCD, 319 grant
Increase soil testing	landowners, CCCD, MSUE		2003-2004	$40/acre	landowner
Check and maintain septic systems	landowners	County Health Department, municipalities	on-going	depends on system	landowner
Inventory and restore meanders and riparian areas	MEANDRS	CCCD, County Parks Department	2003-2025	$1 million/mile	Army Corps of Engineers, MDEQ 319 grant, Great Lakes Fisheries Trust, TU, foundations
Goal #3: Protect public water supply by reducing nutrients and chemicals entering the groundwater.					
Implement zoning ordinances and education campaign	municipalities	county, CCCD	2002-2005	$2,000/municipality	319 grant, land use planning grants, municipalities

Support Lake-A-Syst, Home-A-Syst, Groundwater Stewardship Program	CCCD, MDA	county, lake associations, MLSA	2002-2005	$5,000 part-time employee at CCCD	county, grants, MDA
Enforce septic hauler regulations	County Health Department, MDEQ		2002-2005	cost not determined	not determined
Goal #4: Increase public awareness about water quality issues and instill a sense of stewardship.					
Distribute a quarterly newsletter	CCCD	MEANDRS	on-going	$600/newsletter $2,400/yr	Dowagiac Commercial Press
Develop school curriculum	CCCD, schools, MEANDRS		2003-2005	$5,000 employee at CCCD, 200 hrs/yr volunteer time $2,400	grants, CCCD
Develop volunteer monitoring program	CCCD, schools, MEANDRS		2003-2005	$8,000 employee at CCCD, 200 hrs/yr volunteer time $2,400	grants, CCCD, local foundations
Host workshops	CCCD, MEANDRS	MLSA, MSUE	on-going	$10 -40/person/ workshop	cover costs with registration fees
Promote watershed activities in media	CCCD, MEANDRS		on-going	60 hrs/yr volunteer time $720/yr	
Participate in community events	CCCD, MEANDRS	MSUE	on-going	30 hrs./yr volunteer time $360/yr	
Organize annual river/creek clean-up	CCCD, MEANDRS		on-going	$500/clean-up	local business donations

Organize stormwater inlet stenciling program	CCCD, MEANDRS	municipalities	2003-2005	$500/municipality	local business donations
Promote private land conservation and stewardship	SWMLC, CCCD	municipalities	on-going	60 hrs/yr @ $40/hr $2,400/yr	SWMLC, CCCD
Create multi-media presentation	CCCD, Watershed Council, MEANDRS		2003	20 hrs volunteer time $240	
Develop and install watershed boundary signs	MEANDRS	County Road Commission, MDOT	2004-2005	$50/sign	MEANDRS, municipalities
Develop and implement target outreach plans	MEANDRS	CCCD	on-going	$1500/plan	MDEQ - 319 grant, MEANDRS
Develop watershed friendly programs	CCCD, MEANDRS	MSUE	on-going	$20/award	MEANDRS
Develop recreation plan	MEANDRS	CCCD, County Parks Department	2003-2005	$3000	Parks Department, MEANDRS, foundations
Reprint watershed brochures	MEANDRS, CCCD, SWMLC		2003	$4,000	SWMLC, CCCD, grants
Expand & maintain MEANDRS website	MEANDRS		on-going	$30/month	MEANDRS
Expand use of watershed CD-ROM	CCCD	County, municipalities	2003-2004	$6,000	grants

Goal #5: Evaluate and monitor changes in hydrology and improvements and/or degradations in water quality.					
Develop and implement volunteer monitoring strategy	CCCD, MEANDRS	local governments, MDEQ, MDNR, NRCS	2003-2005	$15,000/year for equipment and coordinator 200 hrs/yr volunteer time $2,400/yr	local governments, MDEQ - 319 grant, foundation
Expand MLSA monitoring program	MLSA	MSUE, CCCD, MEANDRS	2003-2005	$500/lake/year in equip., 30 hrs/lake/yr volunteer time $360/yr	lake associations
Develop annual water quality statement	CCCD, MEANDRS	MDEQ, MDNR, NRCS	on-going	$3,000/year	319, CCCD, MEANDRS
Use GIS to monitor land use changes	County, CCCD		on-going	$5,000/5 yrs	municipalities, county
Develop evaluation for zoning ordinances	municipalities, CCCD, watershed council		on-going	$1,000/year	municipalities, grants
Develop and implement groundwater study	CCCD, MEANDRS, municipalities	County Health Department	2004	$100,000/study	grants
Goal #6: Develop an organization to coordinate and implement the watershed plan.					
Develop umbrella organization (Watershed Council)	CCCD, WST, MEANDRS	MSUE, county	2002 - 2003	coordinator $17/hr 1040 hrs/yr $17,680 /yr	grants, foundations, memberships, etc
Develop and implement fundraising strategy	MEANDRS, Watershed Council	CCCD	2003-2004	$2,500	319, CCCD, MEANDRS

Evaluation of Plan

Evaluation provides a feedback mechanism for continuous improvement of watershed efforts. The actions listed in Table 10 in the management plan should be reviewed every year to determine whether they are supporting or attaining the goals and objectives of the plan. The time line should be reviewed to ascertain if the plan is being implemented as initially proposed. Another important evaluation will be to determine if the watershed efforts are being implemented without duplication of efforts. This organizational evaluation can be done on an on-going basis and at the yearly review.

In addition, for each educational/outreach effort the target audience, the message and the delivery method should be evaluated. Performance measures of watershed outreach/educational efforts include increased awareness, knowledge of an issue, change in behavior, repeat participation in an activity and changes in perceptions and beliefs. Assessment tools include focus groups, surveys, interviews and possibly measurements of water quality improvements.

Some of the actions identified in the management plan will help to evaluate watershed efforts. For example, the water quality monitoring and sub-watershed planning efforts will help to establish baselines for future comparison. Goal #5 in the action plan (Table 10), addresses many of the evaluation concerns for the management plan. For many of the other actions, evaluations will be completed by the agency responsible for certain programs, such as the groundwater program and NRCS programs. The responsible agency is usually required to evaluate progress and programs, the number of participants and the outcomes or conservation techniques applied.

Reporting results is an important part of an evaluation. Reports can be developed as technical reports, press articles, news releases, public meetings, workshops/meetings, memos or individual discussions. Formal reports should include project history, project achievements, evaluation findings, future considerations and budget expenditures. One of the best reporting methods used in the Dowagiac River Watershed Project to date has been updates at Watershed Stewardship Team meetings.

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Appendices

Appendix 1 - Acronyms

CCCD - Cass County Conservation District
CRP - Conservation Reserve Program (NRCS, FSA)
FSA - Farm Service Agency
DRW - Dowagiac River Watershed
EQIP - Environmental Quality Incentive Program (NRCS, FSA)
GIS - geographic information system
MDA - Michigan Department of Agriculture
MDEQ - Michigan Department of Environmental Quality
MDNR - Michigan Department of Natural Resources
MDOT - Michigan Department of Transportation
MEANDRS - Partnership for MEANDRS (Meeting Ecological and Agricultural Needs of the Dowagiac River System)
MLSA - Michigan Lakes and Streams Association
MNFI - Michigan Natural Features Inventory
MSUE - Michigan State University Extension
NRCS - Natural Resource Conservation Service
SWMC - Southwestern Michigan Commission
SWMLC - Southwestern Michigan Land Conservancy
USDA - United States Department of Agriculture
USFWS - United States Fish and Wildlife Service
USGS - United States Geological Survey
WMU - Western Michigan University
WST - Watershed Stewardship Team

Appendix 2 - Public Participation Summaries

(available at the Cass County Conservation District (269) 445-8643 x3**)**

Appendix 3 - Studies/Data for the Dowagiac River Watershed

(available at the Cass County Conservation District (269) 445-8643 x3)