



Shore of Green Bay in Marinette's source water area
Photograph courtesy of E.J. Judziewicz

Source Water Assessment For Marinette Water Utility

Marinette, Wisconsin

March 27, 2003

A report by the
Wisconsin Department of Natural Resources
Bureau of Drinking Water and Groundwater



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Executive Summary

The 1996 amendments to the Safe Drinking Water Act require that States complete source water assessments for all public drinking water systems. The primary purpose of this assessment is to determine the relative susceptibility of Marinette's source water to contamination. For this assessment, susceptibility is defined as the likelihood that a contaminant of concern will enter a public water supply at a level that may result in adversely impacting human health. Source water is untreated water from streams, rivers, lakes, and groundwater aquifers. A susceptibility determination is based on a stepwise synthesis of information regarding the well or surface water intake vulnerability and the source water's sensitivity to a potential source of a contaminant of concern. Due to the vulnerable nature of surface water, most drinking water systems utilizing surface water are determined to have high levels of susceptibility to source water contamination.

Affordable, safe drinking water is essential to the health, development and stability of all communities. Conventionally, treatment has been the only step in maintaining safe drinking water for surface water systems. The quality of treated drinking water is a function of the pretreatment water quality. Little concern has been paid to a preventive approach of protecting the source water. One of the best ways to ensure safe drinking water is to develop a local program designed to protect the source of drinking water against potential contamination. Not only does this add a margin of safety, but it also raises the awareness of consumers and/or the community of the risks of drinking water contamination. It is expected that source water assessment results will provide a basis for developing a source water protection program.

The City of Marinette is located in northeastern Wisconsin at the Menominee River's discharge into Green Bay. Marinette Water Utility relies solely upon source water from Green Bay to provide drinking water to its more than 12,000 consumers.

A source water area is the area that contributes source water to the public drinking water system. Lake Michigan drains approximately 45,600 square miles of which, 15,625 drain into Green Bay. Due to its size and diverse land uses, assessing the entire Lake Michigan source water area is not a practical method for determining the individual susceptibility of Marinette's source water. In an attempt to improve source water quality at a practical scale, the WDNR delineated source water areas based on local watersheds that may specifically impact source water entering Marinette's intake. It is important to note that a source water area is only one potential factor in the quality and susceptibility of source water. Other factors may include unmanageable, lake-wide episodic events that have little to do with human activities.

Marinette's source water area includes land drained by the Menominee River and Hay Creek. This encompasses over 4,000 square miles of land in Northeastern Wisconsin and Southern Michigan's Upper Peninsula.

The source water area drains from northwest to southeast across relatively poorly drained sand and gravel glacial soils before discharging into Western Green Bay at the cities of Menominee and Marinette. With the exception of the southeastern portion of the source water area, forests and wetlands are the dominant land covers. In the southeastern portion of the source water area land cover becomes a mixture of agriculture and natural vegetation with a concentrated urban area near the mouth of the Menominee River.

Treatment of source water at the Marinette water filtration plant includes flocculation, sedimentation, filtration, chlorination, fluoridation and phosphate addition.

As with most surface water systems, Marinette's source water is significantly impacted by the source water area and highly susceptible to contamination. This is due to a high concentration of potential contaminant sources in the source water area near the drinking water intakes and the intakes' distance and relative direction from the discharge of a major stream. Green Bay water quality is frequently poor and winds coupled with discharge from the Menominee River and nearby intermittent streams allow contaminated source water to enter the drinking water intakes.

Source water protection for Marinette should begin with the formation of a source water protection team composed of delegates from local, regional, state and federal organizations. This group would plan and implement best management practices in the source water area to prevent source water contamination. Initial source water protection projects should focus on remediation of historical contamination sites and

managing runoff from agricultural, industrial and urban areas in the southeastern portion of the source water area.

A paper copy of the detailed assessment is available at the Marinette Public Library. An electronic version of the detailed assessment is accessible on the Wisconsin Department of Natural Resources website at <http://www.dnr.state.wi.us/org/water/dwg/gw/SWP.HTM>.

Introduction

In 1996, the U.S. Congress amended the Safe Drinking Water Act to provide resources for states to conduct Source Water Assessments. Information about Wisconsin's Source Water Assessment Program can be found on the Wisconsin Department of Natural Resources (WDNR) website mentioned in the Executive Summary. In cooperation with other Great Lakes states, WDNR has developed a method--Wisconsin's Source Water Assessment Program, Appendix R (Assessment Protocol for Great Lake Sources)--for conducting Source Water Assessments for water supplies that use the Great Lakes as their water source. A source water assessment involves identifying a source water area, analyzing the sensitivity of the source to natural conditions, conducting potential contaminant source inventories and determining the susceptibility of the source to contamination.

The requirements for public water supplies in Wisconsin to meet U.S. Environmental Protection Agency maximum contaminant levels (MCLs) provide a base level of assurance of safe drinking water. However, all systems are vulnerable to some degree to potential contamination. With this in mind, susceptibility determinations were made qualitatively relative to other systems.

Purpose of this Assessment

The purpose of this source water assessment is to determine the susceptibility of Marinette's source of drinking water to contamination and to make recommendations on how to help protect this valuable resource.

Safe, affordable drinking water in ample supply is essential to the health, development and stability of all communities. Conventionally, treatment has been the only step in maintaining safe drinking water for surface water systems and little concern has been paid to a preventive approach of protecting the source water. The quality and cost of treated drinking water is often a function of pretreatment source water quality.

Source water quality can be improved through the implementation of a source water protection program. A source water protection program is composed of four steps: assessment, planning, implementation and long term management. By assessing localized impacts on source water quality, this assessment completes the first step in a source water protection program. For more information on completing a source water protection program please visit <http://www.epa.gov/safewater/protect/protect.html> on the World Wide Web.

Source Water Contaminant Categories

Source water can be contaminated by microbial, inorganic, synthetic organic, volatile organic, precursors of disinfection by-products and radioactive contaminants. These contaminants can enter source water through various means. Pathways of contamination can be split into two major categories, point source pollution and nonpoint source pollution. Point source pollution includes specific, identifiable dischargers of contaminants. Examples of these include industrial and municipal wastewater outfalls. Point source dischargers are more easily regulated and held accountable for contaminating source water. Nonpoint source pollution comes from no specific source and diffusely enters source water. Examples of nonpoint source pollution include runoff from land cover and atmospheric deposition.

This assessment describes these general contaminant categories associated with potential contaminant sources. For a more detailed description of contaminants associated with potential contaminant sources please visit <http://www.epa.gov/OGWDW/swp/sources1.html> on the World Wide Web. For information on health effects and methods of protection from particular chemical contaminants please visit <http://www.epa.gov/safewater/hfacts.html> on the World Wide Web.

- *Microbial contaminants*, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife. Microbial contaminants can lead to

widespread acute illnesses in customers of a contaminated drinking water system. Examples of microbial contaminants include *Giardia*, *Cryptosporidium* and *E. coli*.

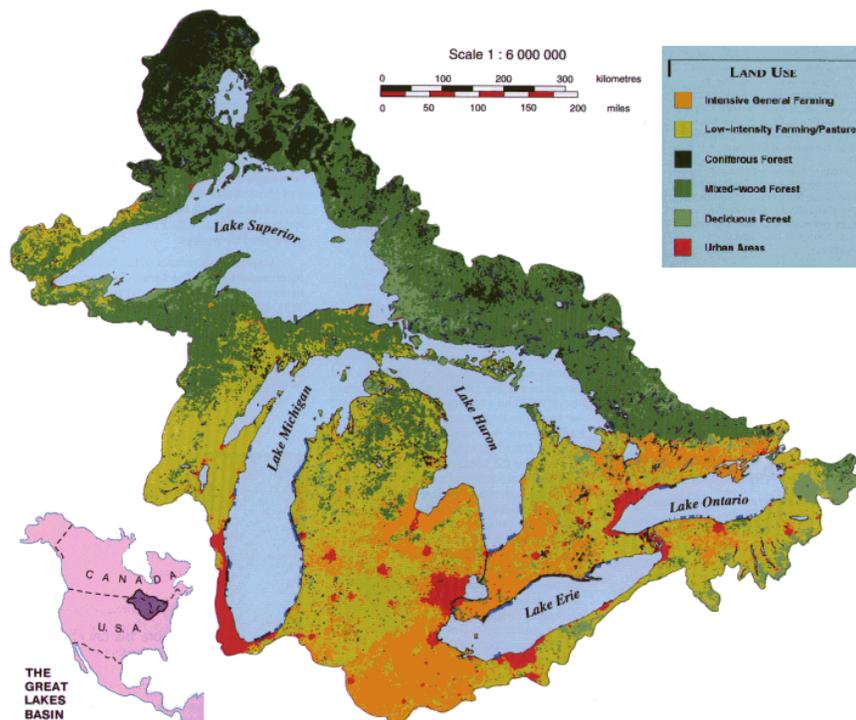
- *Inorganic contaminants*, such as salts and metals, which can occur naturally or result from among other sources: urban storm water runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming. Among other detrimental health affects, inorganic contaminants can negatively impact various organs and the circulatory system in the human body. Some examples of inorganic contaminants include nutrients such as nitrogen and phosphorous and heavy metals such as cadmium, lead and mercury.
- *Synthetic organic contaminants*, such as industrial products, pesticides and herbicides, which may come from a variety of sources such as agriculture, storm water runoff, industrial activities, landfills, wastewater treatment facilities and residential areas. As well as being carcinogenic, synthetic organic contaminants can negatively impact the nervous system, liver and kidneys and affect development. Some examples of synthetic organic contaminants include atrazine, polychlorinated bi-phenyls (PCBs) and lindane.
- *Volatile organic contaminants*, such as petroleum products, solvents, cleaners and degreasers, which may come from industrial activities, petroleum production, gas stations, urban storm water runoff, wastewater treatment facilities and septic systems. As well as being carcinogenic, volatile organic contaminants can negatively impact the nervous system, liver and kidneys and affect development. Some examples of volatile organic contaminants include benzene, vinyl chloride and styrene.
- *Precursors of disinfection by-products* lead to the formation of carcinogenic by-products during source water treatment. Likely sources of dissolved organic carbon are from agricultural and urban storm water runoff. Some examples of precursors of disinfection by-products include dissolved organic carbon and bromide.
- *Radioactive contaminants*, can be naturally occurring or be the result of oil and gas production and mining activities. Radioactive contaminants are carcinogenic. Some examples of radioactive contaminants include radium and uranium.

Hydrologic Setting

Description of the Source Water Area

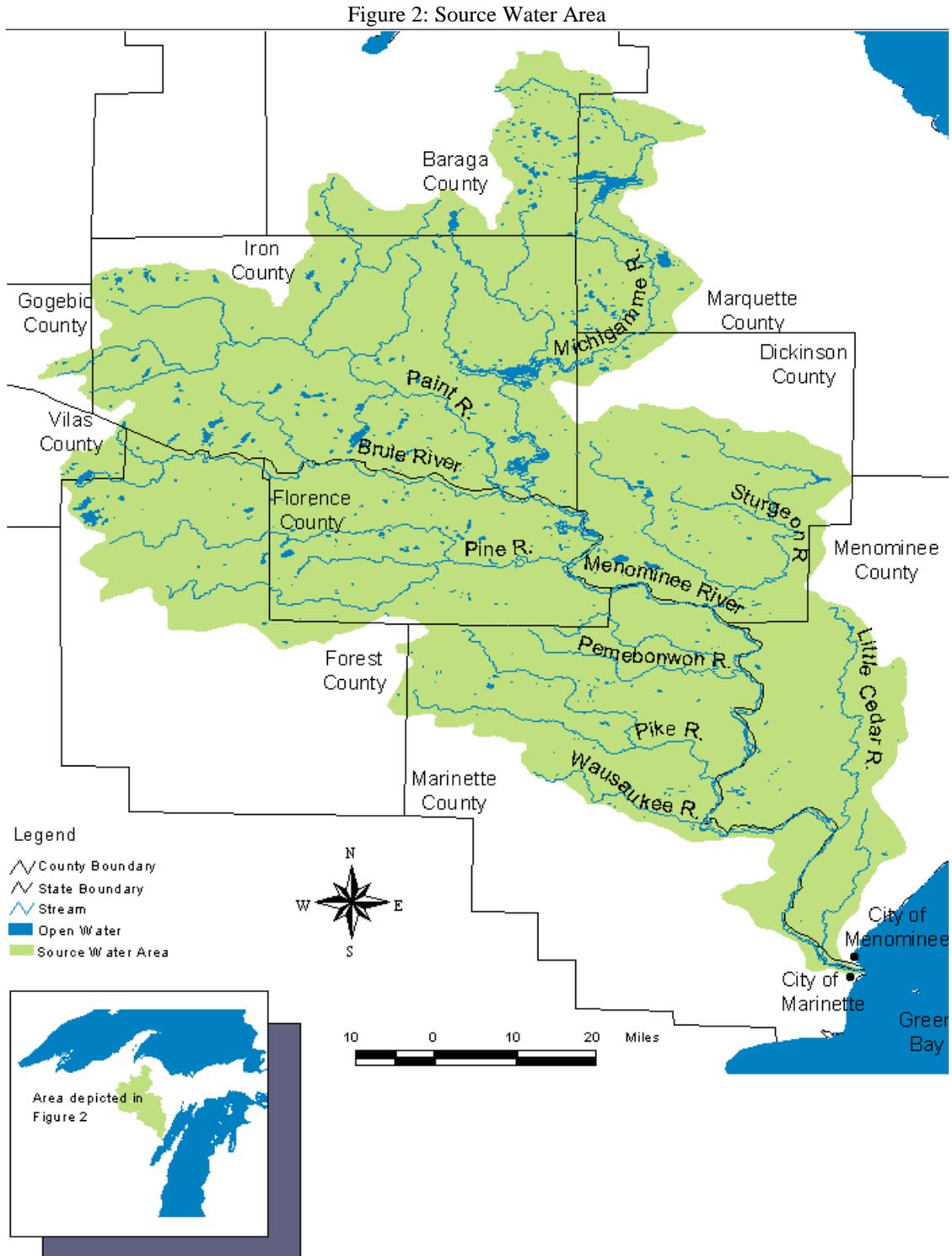
As shown in Figure 1, the Great Lakes drains more than 200,000 square miles of varying land uses. Green Bay alone drains more than 15,000 square miles. The size and variety of land uses found in this drainage basin make a basin-wide assessment impractical and ineffective at identifying impacts on Marinette's source water. In response to this, the WDNR identified smaller local source water areas that contribute

Figure 1: Great Lakes Drainage Basin and Land Use



source water to Lake Michigan in close proximity to the drinking water intakes. Source water areas are composed of one or more established watersheds that discharge near the surface water intakes. Source water areas for this assessment were delineated based on WDNR surface watersheds, not groundwater basins. Generally, groundwater basin boundaries are similar to their surface water counterparts but may vary due to geology.

As shown in Figure 2, Marinette’s source water area is located in Northeastern Wisconsin and the Southern



tip of Michigan's Upper Peninsula. It includes portions of Michigan's Baraga, Iron, Gogebic, Marquette, Dickinson and Menominee counties and Wisconsin's Marinette, Florence, Northern Forest and Northeastern Vilas counties. It includes portions of the Wisconsin communities of Marinette, Wausaukee and Niagra and the Michigan communities of Menominee and Iron Mountain.

Hydrology

As shown in Figure 2, the source water area is the Menominee River Drainage Basin, which extends north into the Upper Peninsula of Michigan. The headwaters of the Menominee River are the Michigamme, Paint and Brule Rivers, which flow southeast joining together to form the Menominee River northwest of the city of Iron Mountain. Flowing southeast the Menominee River gains flow from the Pine, Sturgeon, Pemebonwon, Pike, Wausaukee and Little Cedar Rivers. The Menominee River enters into western Green Bay at the cities of Menominee, Michigan and Marinette, Wisconsin. In 1989 the average flow of the Menominee River at the city of Marinette was 2,577 cubic feet per second. As expected highest water flows occur during the spring months of March and April.

Soils in the headwaters are generally well drained sand and gravel outwash soils. In the lower portions of the source water area, less permeable clayey and organic soils inhibit infiltration of water into the ground. Overall drainage of the source water area is slow due in part to end moraines running across the basins natural southeasterly flow and the basin's low amount of elevation change.

Land cover

Land cover can play a major role in source water quality. Spatial data in Figure 3 was generated from interpretations of aerial photographs taken from 1971 to 1982.

- *Urban*

Urban areas depicted in Figure 3 include residential, industrial and commercial activities. Contaminants associated with residential land cover include synthetic organic, volatile organic, inorganic, precursors of disinfection by-products and microbial contaminants. Due to high concentrations of impermeable surfaces, such as streets, driveways, parking lots, sidewalks and roofs, urban areas have increased potential to create large quantities of runoff during and following precipitation events. Runoff from residential areas transports contaminants associated with this land cover into source water. These contaminants can also enter source water from residential areas through point source discharges and atmospheric deposition.

As shown in Figure 3, small urban areas are located throughout the source water area. The cities of Menominee, Michigan and Marinette, Wisconsin are the largest, most concentrated urban areas in the source water area. The size, industrial economies and proximity of these cities to the surface water intakes make them areas of particular concern to source water quality.

- *Agricultural*

For this assessment agricultural land cover includes cropland, pasture, orchards and nurseries. Agricultural practices generally cause the land to be more susceptible to erosion and runoff than naturally vegetated land. Due to common practices and activities, agricultural land cover can be a major source of inorganic, treatment by-product precursors, microbial and synthetic organic contaminants for the source water.

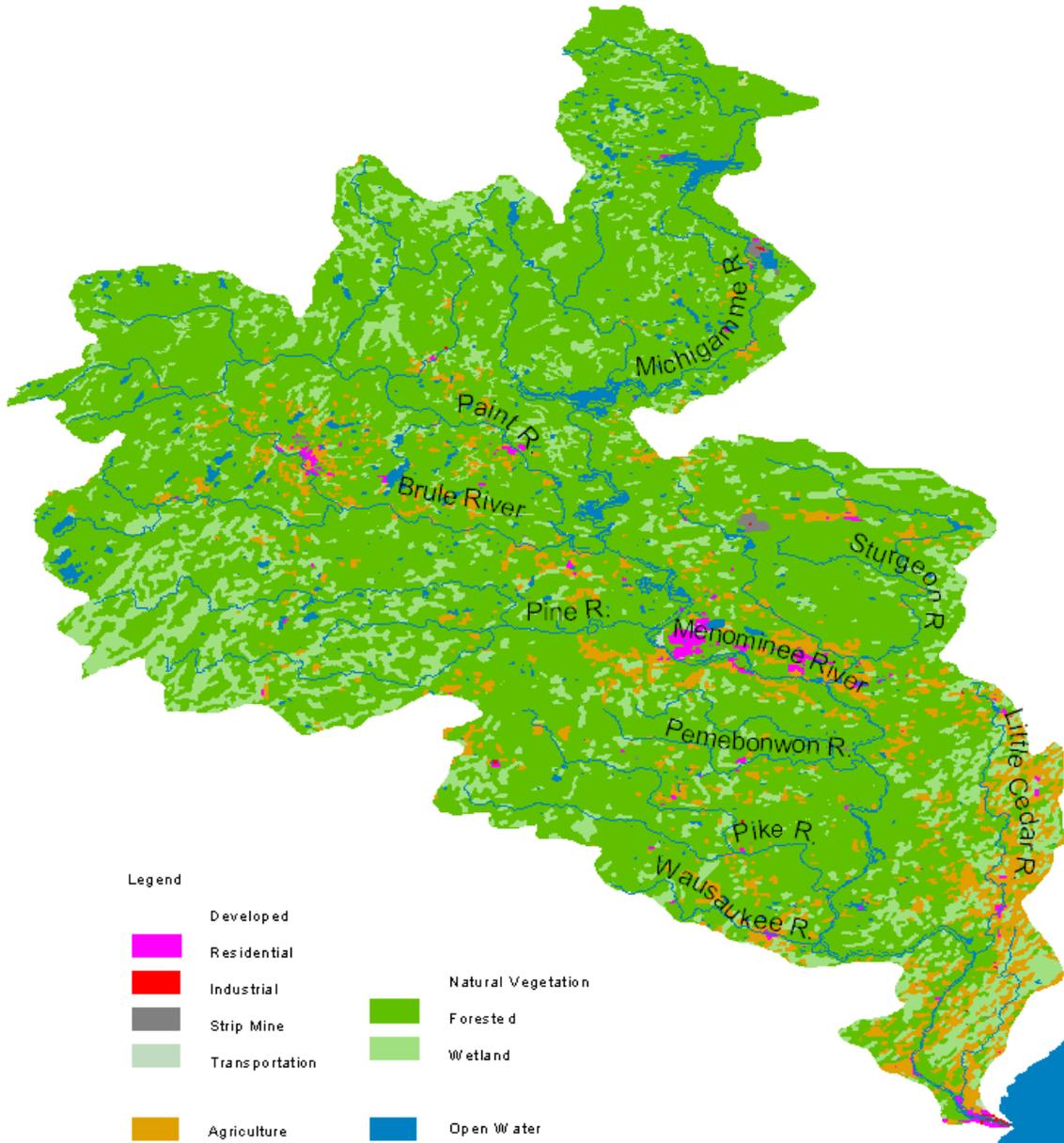
Land cover in the lower portions of the source water area includes a mixture of agricultural activities. These are predominantly corn, oats, hay and livestock production. Land used for agriculture in the source water area has been decreased from 1987 to 1997.

- *Natural vegetation*

For this assessment, natural vegetation includes wetlands, woodlands and some unused lands. Generally, natural vegetation has positive impacts on source water. These impacts include increased infiltration of precipitation into the ground, decreased quantity of storm water runoff, removal of contaminants from source water, reduced potential for erosion and less drastic fluctuations of streamflow.

Much of the original natural vegetation still exists in the source water area. This includes large forested and wetland regions. Timber harvesting occurs in portions of the source water area

Figure 3: Land Cover



Water quality

Water quality varies throughout the source water area. Many of the smaller tributaries to the Menominee River are classified as outstanding and exceptional resource waters. Outstanding resource waters are defined as a lake or stream having excellent water quality, high recreational and aesthetic value, high quality fishing and is free from point and nonpoint source pollution. Exceptional resource waters are defined as a stream exhibiting the same high quality resource values as outstanding waters but may be impacted by point source or have the potential for future discharge from a small sewer community.

Water quality generally deteriorates downstream. The WDNR has delineated the lower 15 miles of the Menominee River as impaired due to contaminated sediments, atmospheric deposition and other contaminant sources. The EPA has designated the lower 3 miles of the Menominee River as one of 43 Great Lakes Areas of Concern. This includes approximately 3 miles of nearshore water north and south of the mouth. The major sources of contamination in this area include historical contamination sites and present day industry and urbanization. High concentrations of inorganic, volatile organic, synthetic organic and microbial contaminants have resulted in use impairments of this area. The Menominee Area of Concern encompasses the Marinette drinking water intakes.

Description of Green Bay

While attached to and occasionally impacted by Lake Michigan, Green Bay behaves as a relatively independent body of water. It drains over 15,000 square miles, which are divided into 7 major drainage basins. The primary tributary to Green Bay is the Fox River, which enters into Green Bay from the south. The Menominee River is the second largest tributary to Green Bay.

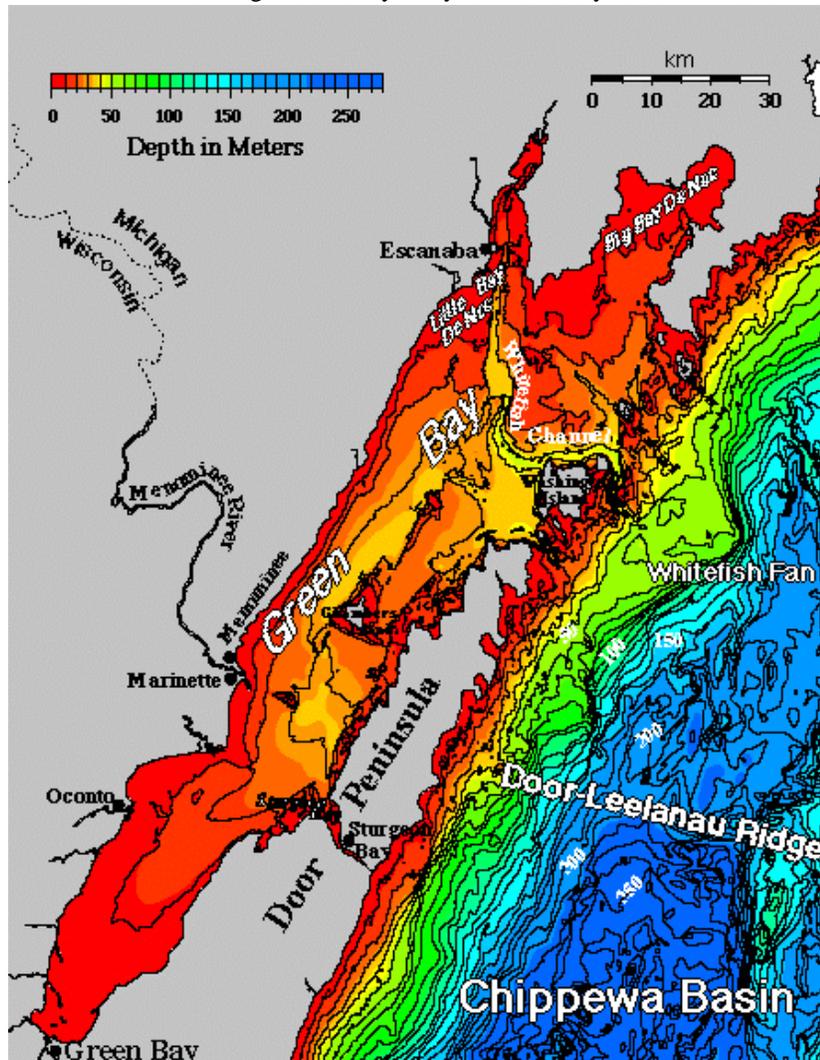
Bathymetry

As shown in Figure 4, southern Green Bay is a relatively long shallow bay with a muddy bottom. Farther to the north Green Bay becomes deeper and the bottom changes to rock. This plays a major role in the difference in water quality found in northern and southern Green Bay. The shoreline of Green Bay near the drinking water intakes may play a major role in source water quality.

Winds

Wind regularly affects both Green Bay and Lake Michigan circulation patterns and water quality in near-shore areas. Calm westerly breezes generally coincide with good water quality, and strong easterly winds coincide with the worst source water quality at the intakes. In a matter of hours strong easterly winds can cause a drop in source water quality by churning up lake bottom sediments and pushing discharge from the Menominee River towards the intakes.

Figure 4: Bathymetry of Green Bay



Currents

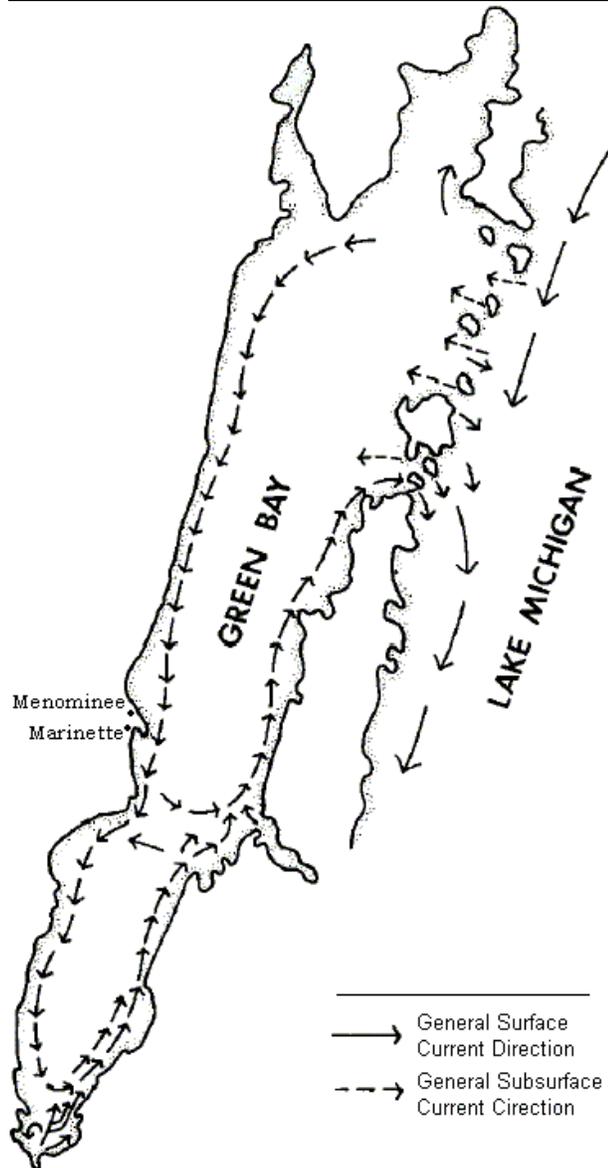
As shown in Figure 5, the typical circulation pattern of Green Bay is typified by separate northern and southern counterclockwise rotations. These rotations meet along a line extending from Marinette across the Bay to the southeast. Along this line, water can mix into the opposing rotation or continue in the original rotation. Water mixing from the southern rotation into the northern rotation passes along the Eastern Shore of the Bay creating a southerly nearshore current along the Door Peninsula. Water mixing from the northern rotation into the southern rotation passes across the drinking water intakes and the mouth of the Menominee River before entering the southern rotation. This rotation and mixing is important to source water quality at the drinking water intakes for three reasons. First, this brings cleaner water from the northern rotation over the drinking water intakes. Secondly, the mixing creates a northerly nearshore current that pushes discharge from the Menominee River to the south, away from the drinking water intakes. Thirdly, discharge from the Fox River at the southern tip of the bay stays along the eastern side of the Bay, away from the drinking water intakes.

Water quality

Water quality in Green Bay varies with distance from shore and location. Due to less inputs of contaminants, increased mixing with cleaner water from Lake Michigan, limited mixing with the southern portion of the Bay and a higher factor of dilution the northern portion of the Bay has much better water quality than the southern portion of the Bay. The shallow, confined nature of the southern portion of the Bay results in increased water temperatures, more easily suspended lake bottom sediments and lack of dilution of contaminants entering from the heavily industrial and agricultural areas draining into southern Green Bay.

It is important to note that water quality of source water at the intakes is based almost entirely on monitoring that occurs at the drinking water intakes. Few contaminants have been comprehensively monitored in source water at the intakes. Conventional water quality indicators such as color, taste and clarity indicate water quality fluctuations throughout the year. An indicator of microbial contaminants, total coliform is detected in the majority of samples of source water entering the drinking water intakes. High concentrations of the group of treatment by-products, total trihalomethanes are indicative of high levels of dissolved organic carbon in the source water. A synthetic organic contaminant typically associated with waste sites, industry and pesticides have been detected in the source water at the intakes.

Figure 5: Green Bay Circulation Patterns



Volatile organic contaminants typically associated with hazardous waste sites and industrial activities among other sources have also been detected in the source water the drinking water intakes.

Susceptibility Assessment

For the purposes of Wisconsin's source water assessments, susceptibility is defined as the likelihood that a contaminant of concern will enter a public water supply at a level that may result in adversely impacting human health. A susceptibility determination is based on a stepwise synthesis of information regarding the surface water intake's vulnerability and the source water's sensitivity to a potential source of a contaminant of concern.

Methodology

For a detailed explanation of the protocol for Great Lake source water assessments please see Appendix R of Wisconsin's Source Water Assessment Program Plan Appendices.

An initial survey was performed on the Marinette source water area to assess local impacts to the source water. The initial survey included interviewing Marinette Water Utility employees, conducting a sensitivity analysis, delineation of a critical assessment zone and reviewing existing data. The initial survey revealed that source water quality was frequently susceptible to contamination.

A more in-depth study of the source water area was carried out to determine what activities and areas within the source water area affect the source water's susceptibility to particular types of contaminants. This more in-depth study reviewed the distribution of potential contaminant sources in the source water area, historical data, localized water quality of tributaries and background water quality levels and characteristics of Green Bay.

Sensitivity Analysis

Sensitivity is defined as the likelihood that source water will be impacted by contaminants due to the intrinsic physical attributes of the source water area. Sensitivity is determined from the natural setting of the source water and indicates the natural protection afforded the source water. Factors in sensitivity include hydrologic characteristics of the source water area, proximity, direction and quantity of discharge relative to the intake and degree of dilution afforded by distance from shore and depth of intake. Based on the Great Lakes Protocol for conducting a sensitivity analysis, calculated sensitivity is the product of the intake's distance from shore and the depth of water at the intake. It is important to keep in mind that this does not take into account numerous site-specific variables. Relative levels of calculated sensitivity include moderate, high and very high. Marinette Water Utility has 2 surface water intakes located in Green Bay north of the Menominee River. The calculated sensitivities of the intakes are both high. The physical characteristics of Green Bay and proximity of the Menominee River discharge would make the actual sensitivity higher.

Critical Assessment Zone

In keeping with the Great Lakes protocol, a critical assessment zone was delineated based upon the intakes calculated sensitivity. Any land, particularly shoreline, which is within the delineated critical assessment zone, must be part of an in-depth assessment. The zone is circle centered on the intake. The size of the circle depends on the calculated sensitivity rating. The critical assessment zones for the drinking water intakes do not encompass any land or shoreline.

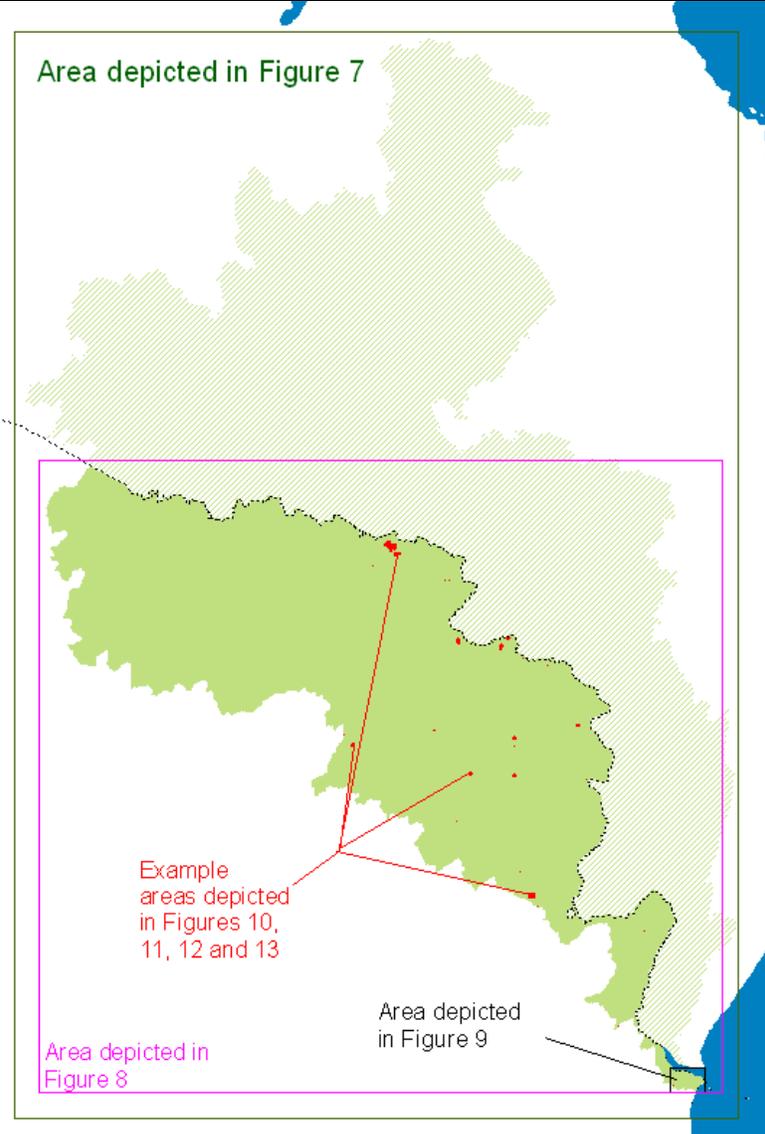
Introduction to the Potential Contaminant Source Inventory

A major component of the susceptibility determination is based on the distribution of potential contaminant sources in the source water area. A high density of potential contaminant sources in the source water area indicates a higher probability of contaminating source water. Source water from a source water area with a low density of potential contaminant sources is less likely to become contaminated.

It is important to understand that a potential contaminant source is not necessarily a source of contaminants. It has the potential to become a source of contaminants but if managed properly should not impact the source water.

In an attempt to identify all known potential contaminant sources, all locational data available was used for this assessment. However, based on the level of inventory, locational data is not currently available equally throughout the entire source water area and the sources of locational data vary. Unfortunately, this creates the appearance of an imbalance in the distribution of potential contaminant sources. For instance, an area that was rigorously inventoried because it is encompassed by a well head protection area may appear to have more potential contaminant sources than outside the well head protection area because all potential contaminant sources were not inventoried outside the well head protection area. Obviously this creates a visual bias of the distribution of potential contaminant sources in the source water area. In an effort to compensate for this, Figure 6 depicts the source water area broken down into types of inventories and the following potential

Figure 6: Identification of Potential Contaminant Source Inventories



- Legend
-  State Boundary
 -  Areas encompassed by Wisconsin DNR groundwater potential contaminant source inventories
 -  Area encompassed by US EPA potential contaminant source inventory and Wisconsin DNR potential contaminant source inventory
 -  Area encompassed by US EPA potential contaminant source inventory

contaminant source maps do not combine data from different types of inventories. This will be important to keep in mind when planning source water protection so that resources are not biased based on this imbalance.

US EPA Potential Contaminant Source Inventory

Industrial Facility Discharge

These sites are industrial or municipal point sources discharging to surface waters. The facilities are extracted from the U.S. EPA's Industrial Facilities Discharge (IFD) database, which is contributed to by a number of organizations including federal, state, and interstate agencies. For more information on this program please visit <http://www.epa.gov/OST/BASINS/metadata/ifd.htm> on the World Wide Web. As shown on Figure 7, IFD sites are concentrated in populated areas such as Marinette and Iron Mountain.

Figure 7: US EPA Potential Contaminant Source Inventory



Permit Compliance Discharge

Permit Compliance Dischargers shown on Figure 7 are tracked by National Pollutant Discharge Elimination System (NPDES) data and tracks permit issuance, permit limits and monitoring data, and other data pertaining to facilities regulated under NPDES. The NPDES permit program regulates direct discharges from municipal and industrial wastewater treatment facilities that discharge into the navigable waters of the United States. Wastewater treatment facilities (also called "point sources") are issued NPDES permits regulating their discharge. For more information concerning Permit Compliance Dischargers please visit <http://www.epa.gov/waterscience/basins/metadata/pes3.htm> on the World Wide Web.

Toxic Release Inventory site

Shown on Figure 7, this database contains data on annual estimated releases of over 300 toxic chemicals to air, water, and land by the manufacturing industry. Industrial facilities provide the information, which includes: the location of the facility where chemicals are manufactured, processed, or otherwise used; amounts of chemicals stored on-site; estimated quantities of chemicals released; on-site source reduction and recycling practices; and estimated amounts of chemicals transferred to treatment, recycling, or waste facilities. For more information concerning this data source please visit <http://www.epa.gov/OST/BASINS/metadata/tri.htm> on the World Wide Web.

Resource Conservation and Recovery Information System sites

Resource Conservation and Recovery Information System sites (RCRIS) shown on Figure 7 are generators, transporters, treaters, storers, and disposers of hazardous waste. For more information concerning RCRIS please visit <http://www.epa.gov/OST/BASINS/metadata/rcris.htm> on the World Wide Web.

WDNR Potential Contaminant Source Inventory

Animal feeding operations

Animal feeding operations are agricultural operations where animals are kept and raised in confined situations. Animal feeding operations generally congregate animals, feed, manure, dead animals, and production operations on a relatively small area of land. Feed is brought to the animals rather than the animals grazing or otherwise seeking feed in pastures. Animal waste and wastewater can enter water bodies from spills or breaks of waste storage structures (due to accidents or excessive rain), and manure spreading practices. Animal feeding operations have the potential to contribute pollutants such as inorganic, synthetic organic, microbial contaminants as well as hormones and antibiotics to the source water.

Animal feeding operations shown on Figure 8 include only the larger animal feeding operations (over 1,000 animal units), which are regulated for wastewater discharge. This does not provide an accurate distribution of the more common smaller animal feeding operations. A limited distribution of smaller animal feeding operations in the source water area is depicted in Figure 9.

Landfills

In the past landfills were unregulated and were common sources of contaminants. Some of these are now classified as Bureau of Remediation and Repair Tracking System sites, which are discussed below. Licensed landfills are now strictly regulated and monitored. Closed and active landfills are frequently sources for inorganic, synthetic organic and volatile organic contaminants in source water.

Landfills shown in Figures 8 include currently licensed landfills and sites listed on the Registry of Waste Disposal sites. Of the 10 licensed landfills in the source water area within Wisconsin, 9 are classified as Environmental Repair Program sites, which are discussed below. This does not take into account the more numerous abandoned small dumps that historically operated with no regulation.

Wastewater treatment facilities

Wastewater treatment facilities (WWTFs) include municipal and industrial operations. Municipal facilities can be sources of inorganic, microbial, synthetic organic and volatile organic contaminants as well as hormones, pharmaceuticals and other organic contaminants that have been linked to developmental and reproductive defects in animals. Following treatment, effluent is frequently discharged through an outfall directly into surface water. Typical treated and disinfected sewage contains low concentrations of

contaminants. A municipal WWTF may be inundated with more raw sewage than it can process. In the event of this a bypass or sanitary sewer overflow occurs. This allows untreated sewage to enter directly into surface water. A typical bypass may contain high concentrations of contaminants associated with urban runoff and WWTFs. Contaminants associated with industrial WWTFs are dependent upon the specific industry but may include microbial, volatile organic, inorganic and synthetic organic contaminants.

See Figures 8 and 9 for WWTF locations. There are several municipal and industrial wastewater dischargers located in the source water area. Industrial wastewater discharges have been identified by the WDNR as negatively impacting source water in the Menominee River and Twin Creek.

Figure 8: WDNR Potential Contaminant Source Inventory



WDNR's Bureau of Remediation and Redevelopment Tracking System

The WDNR Remediation and Redevelopment Program keeps track of sites where chemical contamination of soil, surface water and/or groundwater has occurred. The Bureau of Remediation and Redevelopment Tracking System (BRRTS) is the Department's database for tracking the status of investigation and cleanup activities at these sites. There are several types of sites that are tracked by BRRTS, including leaking underground storage tank sites, Environmental Repair Program sites, spill sites and Superfund sites. For

information on specific contamination sites in Wisconsin please visit BRRTS at, <http://www.dnr.state.wi.us/org/aw/rr/brrts/index.htm> on the World Wide Web.

- Leaking Underground Storage Tank sites

A Leaking Underground Storage Tank (LUST) site is defined as a leaking underground storage tank that has contaminated soil and/or groundwater with petroleum.

As of 8/12/02 there are 41 LUST sites in the municipal area of Marinette, Wisconsin.

- Environmental Repair Program sites

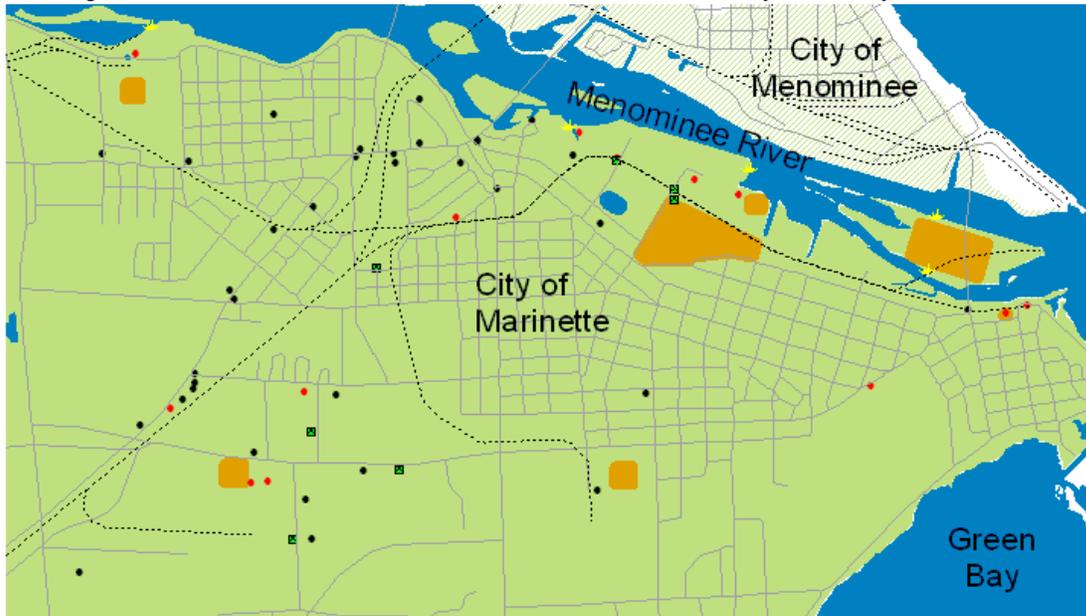
Environmental Repair Program (ERP) sites are sites other than LUSTs that have contaminated soil and/or groundwater. Often, these are old historic contaminant releases to the environment.

As of 8/12/02 there have been 19 ERP sites identified within the municipal area of Marinette, Wisconsin. Historical contamination sites in the lower Menominee River and Harbor have resulted in use impairments and the listing of this area as an EPA Great Lakes Area of Concern.

- Spill sites

Spills are defined as a discharge of hazardous substances that may adversely impact, or threaten to adversely impact public health, welfare or the environment. It is important to note that the number of unreported spills is unknown, but is probably well beyond those spills that are reported. From September of 1978 to August 2002, there have been 186 spills reported in the municipality of Marinette, Wisconsin. Of these, at least 17 entered into storm sewers and 35 entered directly into surface water. For information on particular spills in Wisconsin please visit the previously mentioned BRRTS Internet site.

Figure 9: Wisconsin DNR Potential Contaminant Source Inventory in the City of Marinette



Legend

- | | |
|--|---|
|  Wastewater Treatment Facility Outfall |  Railroad |
|  Large Quantity Hazardous Waste Generator |  Roads |
|  Environmental Repair Project |  Landfill / Dump |
|  Leaking Underground Storage Tank | |

Hazardous Waste Generators

Hazardous waste generators are defined as facilities, which handle materials classified as hazardous waste. Hazardous waste is defined as any substance that is toxic to humans. Contaminants associated with hazardous waste generators are site specific. Hazardous waste generators include a wide array of facilities ranging from hospitals and schools to manufacturing and industrial operations.

As shown in Figure 9, there are 5 large quantity hazardous waste generators in the city of Marinette, all of which are listed on BRRS as either spill sites or LUSTs. This does not account for the more numerous smaller quantity hazardous waste generators.

Boating Related Activities

Boating related activities are potential sources of volatile organic, synthetic organic, inorganic and microbial contaminants to the source water. Contaminants can enter directly into the source water through spills or indirectly through runoff from marinas and shipyards where many cleaning agents, paints, petroleum products and other chemicals are commonly stored and used. For more information on the effects of and preventive measures for boating related activities please visit <http://www.epa.gov/owow/nps/mmsp/index.html>

Recreational boating and fishing are both popular on Lake Michigan near the city of Marinette and Menominee. The marina located to the northwest of the intakes is a point of concern due to its proximity to the intakes.

Transportation Related Activities

Transportation related activities have the potential to contaminate source water both through contaminants from maintenance and operation or from cargo spills. Examples of transportation related activities include highways, railroads, rail yards, harbors, shipping lanes and airports. These can all be sources of inorganic, volatile organic and synthetic organic contaminants. Contaminants from cargo spills are dependent upon particular cargoes, but generalizations can be made based on local economies.

As shown in Figures 7 and 9, Menominee and Marinette serve as major hubs for transportation and shipping. There is a major Great Lakes harbor and shipping lane located just south of the intakes. Railroads that experience a high volume of traffic parallel and cross the Menominee River at several locations. Based on the local industrial economy, cargoes of concern to source water transported through this area include volatile organic, synthetic organic and inorganic contaminants.

WDNR Groundwater Potential Contaminant Source Inventory

Localized Agricultural and Bulk Storage Potential Contaminant Sources

Localized agricultural and bulk storage activity locations for this assessment are shown in Figure 10. Agricultural activities include active farming operations, animal feedlots, agricultural irrigation and lined and unlined manure storage facilities. These activities are potential sources of synthetic organic, inorganic and microbial contaminants. Bulk storage activities include feed mills, agricultural co-ops, 500 gallon and larger petroleum and chemical storage sites and road salt storage sites. Contaminants associated with storage facilities are largely site-specific, but generally they are potential sources of inorganic, synthetic organic and volatile organic contaminants.

Localized Commercial Potential Contaminant Sources

Localized commercial activities locations for this assessment are shown in Figure 10. Commercial activities include airports, auto body shops, boat yards, car washes and Laundromats in unsewered areas, cemeteries, dry cleaners, gas service stations, machine/metal working shops, motor vehicle repair shops, paint shops, photo processing facilities, jewelry and metal plating facilities, printing facilities, rail yards, rail road tracks, scrap/junk yards and seed production plants. These activities are frequently associated with inorganic and volatile organic contaminants.

Localized General and Industrial Potential Contaminant Sources

Localized general and industrial activities for this assessment are shown in Figure 10. General activities include above-ground and below-ground storage tanks, municipal and non-municipal sewer lines, sewage holding tanks, septic tanks, sumps, drainfields, mounds and dry wells. These activities are potential sources for synthetic organic, volatile organic, inorganic and microbial contaminants. Industrial activities include asphalt plants, industrial chemical production facilities, electronic product manufacturers, electroplating / metal finishing facilities, furniture or wood manufacturing / refinishing / stripping facilities, foundries / smelting plants, mining operations / mine waste sites, paper mills, petroleum and chemical pipelines, plastics manufacturer / molding facilities, wood preserving facilities. These activities are potential sources of volatile organic, synthetic organic and inorganic contaminants.

Figure 10: Localized Wisconsin Potential Contaminant Source Inventory



Localized Waste Management and Miscellaneous Potential Contaminant Sources

Localized waste management and miscellaneous activities and contaminant conduits are shown in Figure 10. Waste management activities include municipal incinerators, injection wells, sludge spreading sites, solid waste transfer stations and wastewater lagoons. These activities are potential sources of inorganic, synthetic organic, microbial and volatile organic contaminants. Miscellaneous sources include fire training facilities, golf courses, gasification plants, laboratories and military installations. These sources are associated with microbial, synthetic organic and volatile organic contaminants.

Description of the Marinette Water Utility Drinking Water Treatment System

Marinette Water Utility reliably provides high quality drinking water for its 12,000 consumers. The average year-round water demand for the Marinette Water Utility is 2.9 million gallons per day (mgd).

Source water enters the treatment plant through 2 intakes located in western Green Bay. Permanganate is applied at the intakes for taste and odor control and to control zebra mussel growth. Upon entering the treatment plant source water undergoes flocculation and sedimentation to remove the majority of contaminants. Following sedimentation, source water is filtered to remove remaining contaminants. The final step of treatment is chlorination to disinfect source water prior to distribution. In addition, fluoride is added to reduce dental caries in children and phosphates are added to reduce elevated levels of copper in the distribution system.

Susceptibility Determination

As with most surface water systems, Marinette's source water quality is significantly impacted by local factors and highly susceptible to contamination. This is due to land usage in the lower portions of the source water area, proximity of the intakes to the discharge of the Menominee River and Hay Creek and the physical characteristics of Green Bay. Marinette's source water is particularly susceptible to synthetic organic, volatile organic, precursors of treatment by-products and microbial contamination. This is based on historical occurrences of contaminants in the source water, the high concentration of urban and agricultural areas in the lower portions of the source water area and sites of historical contamination.

Recommendations

Source water protection should begin with the formation of a team composed of local, regional, state and interstate members to more completely assess impacts to source water and implement best management practices to prevent source water contamination. The following is a preliminary list of negative impacts on source water that could be dealt with in a source water protection program.

- Historic contamination sites as well as spill sites in the lower portions of the source water area.
- Industrial and municipal wastewater dischargers in the source water area.
- Runoff from urban, agricultural and industrial areas in the lower portions of the source water area.

As mentioned previously a comprehensive source water protection plan is beyond the scope of this assessment. The source water protection team may consider using resources provided by the USEPA at <http://www.epa.gov/safewater/protect/sources.html> on the World Wide Web for overall source water protection planning. This website offers general source water information, financial assistance contacts, source water protection case studies, contaminant source inventories and contingency planning among other subjects. For specific information concerning best management practices and dealing with potential contaminant sources please visit <http://www.epa.gov/ogwdw/protect/swpbull.html> on the World Wide Web.

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