Lake Michigan Shoreline near the City of South Milwaukee

Source Water Assessment
For South Milwaukee Water Utility

South Milwaukee, Wisconsin
March 27, 2003

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

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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 South Milwaukee'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 and cost 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 South Milwaukee is located in southeastern Wisconsin. South Milwaukee Water Utility relies solely on Lake Michigan to provide its more than 21,000 consumers with treated drinking water.

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. Due to its size and diverse variety of land covers, it is not feasible to assess the impact of the entire Lake Michigan drainage basin on South Milwaukee's source water. In an attempt to improve source water quality at a practical scale, the WDNR delineated local source water areas based on watersheds that may specifically impact source water entering the South Milwaukee surface water 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.

Located in Southeastern Wisconsin, South Milwaukee's source water area is located completely within Milwaukee County. The source water area is approximately 26 square miles and is drained solely by the Oak Creek. Soils of the source water area are characteristically clayey loams. Urbanized areas are the predominant land cover. The soils and land cover of the source water area coupled with historical clearing and draining of forest and wetland areas cause large amounts of precipitation and meltwater to flow overland. This overland flow results in contaminated surface water and drastically fluctuating stream flows.

South Milwaukee Water Utility reliably provides high quality drinking water to its customers. Treatment of the source water from Lake Michigan includes flocculation, sedimentation, filtration and chlorination. The treatment facility supplies an average of 2.5 million gallons of drinking water per day.

As with most surface water systems, South Milwaukee's source water is significantly impacted by local factors and highly susceptible to contamination. This is due to land usage in the source water area, proximity of potential contaminant sources and the intake's distance and relative direction from the discharge of a large stream. South Milwaukee's source water is commonly impacted during and immediately following spring thaw, periods of heavy precipitation and sustained easterly winds.

Source water protection for South Milwaukee should begin with the formation of a source water protection team composed of delegates from local, regional, state and federal organizations. This group could plan and implement best management practices in the source water area to prevent source water contamination. Initial source water protection projects should focus on managing runoff from urban and agricultural activities in the source water area.

A paper copy of the detailed assessment is available at the South Milwaukee 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 previously. 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 South Milwaukee'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

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. Nonpoint source pollution includes contaminated runoff and atmospheric deposition. Examples of nonpoint source pollution are runoff from agricultural and urban land covers and atmospheric deposition from burning of fossil fuels.

Source water contaminant categories include microbial, inorganic, synthetic organic, volatile organic, disinfection by-product precursors and radioactive contaminants. 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*.

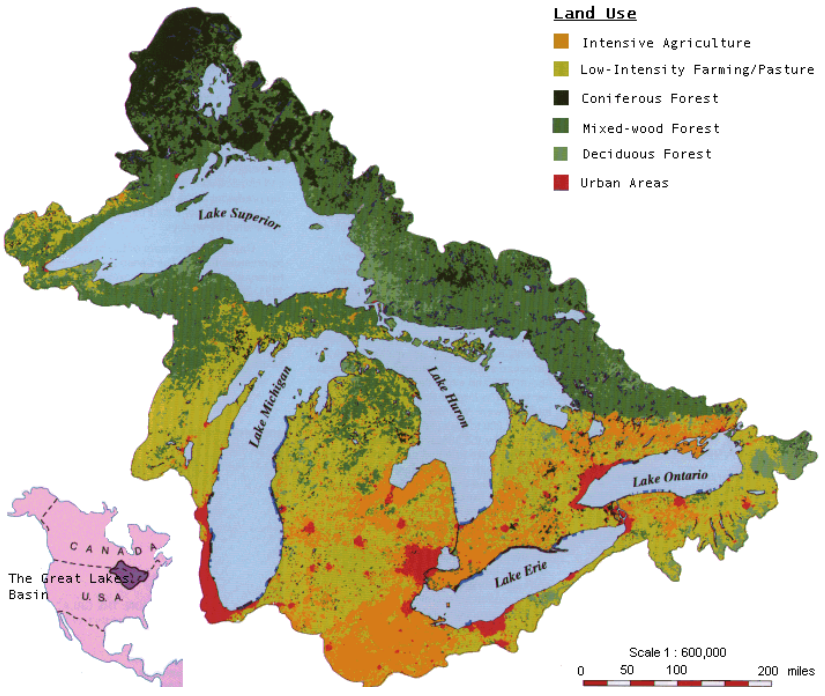
- *Inorganic contaminants*, such as salts and metals, which can occur naturally or result from among other sources, urban storm water runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming. Among other detrimental health affects, inorganic contaminants can negatively 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 the pesticides atrazine and lindane, as well as industrial products such as polychlorinated bi-phenyls (PCBs).
- *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. Some examples of precursors of disinfection by-products include dissolved organic carbon and bromide. Likely sources of dissolved organic carbon are from agricultural and urban storm water runoff.
- *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 over 200,000 square miles of varying land uses. The size and variety of land uses found in this drainage basin make a basin-wide assessment impractical and ineffective at identifying impacts on South Milwaukee's source water. In response to this, the WDNR identified smaller local source water areas that contribute 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

Figure 1: The Great Lakes Drainage Basin



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.

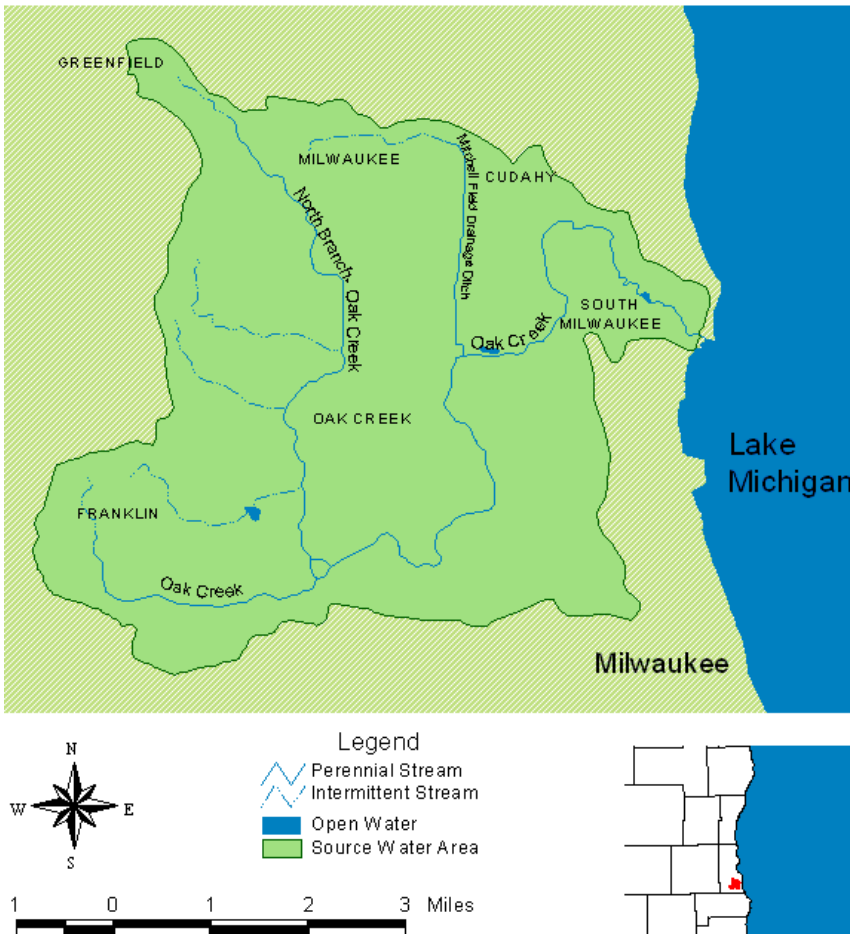
As shown in Figure 2, South Milwaukee's source water area is located completely in Milwaukee County in Southeastern Wisconsin. The cities and towns of Green Field, Franklin, Oak Creek, South Milwaukee and Milwaukee are located at least partially within the source water area. South Milwaukee's source water area is approximately 26 square miles and is drained by the Oak Creek.

Hydrology

As shown in Figure 2, the Oak Creek originates in the southwestern corner of the source water area in the Town of Franklin. It flows east receiving flow from the North Branch, which drains largely urban areas in the western and northern portions of the source water area. Prior to reaching the City of South Milwaukee, the Oak Creek receives flow from the Mitchell Field Drainage Ditch, which drains a mix of urban and grassland areas. After flowing through the City of South Milwaukee, the Oak Creek discharges into Lake Michigan approximately half a mile southwest of the drinking water intake.

The soil types and land cover throughout most of the source water area inhibit infiltration of water into the ground and cause precipitation to flow overland. This overland flow is referred to as runoff. High amounts of runoff cause stream flows to fluctuate dramatically with precipitation and springtime thaws. Runoff quickly transports contaminants from spills and human activities into surface water with little to no filtration. Following these periods of high runoff little water remains in the source water area to maintain stream flows during dryer periods of the year. At the City of South Milwaukee, the Oak Creek's average flow from 1964 to 1999 was 23 cubic feet of water per second. Highest flows are experienced during April and March.

Figure 2: Source Water Area



Soils and topography

Soil types in the source water area are relatively impermeable flat clayey loams. Large fragile bluffs are typical along the Lake Michigan shoreline near the drinking water intake. These bluffs have little natural protection and are prone to rapid erosion.

Land cover

Land cover can play a major role in source water quality. Spatial data in Figure 3 was generated based on locational data from 1995.

As shown in Figure 3, urbanized areas are the dominant land cover in the source water area. Residential areas occur throughout the source water area but are most concentrated in the north, east, central and southwest. Agricultural cropland and pasture make up the majority of the remaining land cover, particularly in the western portions of the source water area. Industrial activities are concentrated in the central portion of the source water area, along transportation corridors and in the City of South Milwaukee. Multiple major transportation corridors, such as railways and highways cross the source water area, as well as arterial and local roads. A large airfield is partly located in the northern portions of the source water area. Small pockets and corridors of natural vegetation, such as wetlands and woodlands dot the source water area but make up a relatively small percentage of the total land coverage. Recreational areas including parks and golf courses also compose a relatively small portion of the source water area.

- *Residential related land cover*

  Residential areas depicted in Figure 3 include single- and two-family homes, low and high rises and mobile homes, at varying levels of density. Due to high concentrations of impermeable surfaces, such as driveways, sidewalks and roofs, residential land cover has 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. Contaminants associated with residential land cover include synthetic organic, volatile organic, inorganic, precursors of disinfection by-products and microbial contaminants. These contaminants can also enter source water from residential areas through spills and atmospheric deposition.

  Residential areas are believed to be negatively impacting source water in various streams throughout the source water area. Particular areas of concern are drained by the headwaters of the Oak Creek and the Mitchell Field Drainage Ditch and the land buffering the lower 4 miles of the Oak Creek.

- *Industrial related land cover*

  For this assessment industrial land cover includes activities related to manufacturing, wholesale and storage and extractive processes. Similarly to residential land cover, industrial areas have high concentrations of impermeable surfaces, which prevent large amounts of precipitation from infiltrating the ground. This runoff transports contaminants associated with industrial activities into source water. These include volatile organic, synthetic organic and inorganic contaminants. Industrial activities can also lead to contamination of source water through point source discharges, spills and atmospheric deposition.

- *Transportation related land cover*

  For this assessment transportation related land cover includes all forms of motor vehicle corridors and parking lots along with rail-related and air-related forms of transportation. Most transportation related land cover is impermeable to precipitation. Contaminants associated with runoff from transportation related land cover includes volatile organic, synthetic organic and inorganic contaminants. Contaminants from transportation related land cover may also enter source water through spills and atmospheric deposition from exhaust.

- *Agricultural land cover*

  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. 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.

- *Natural vegetation*

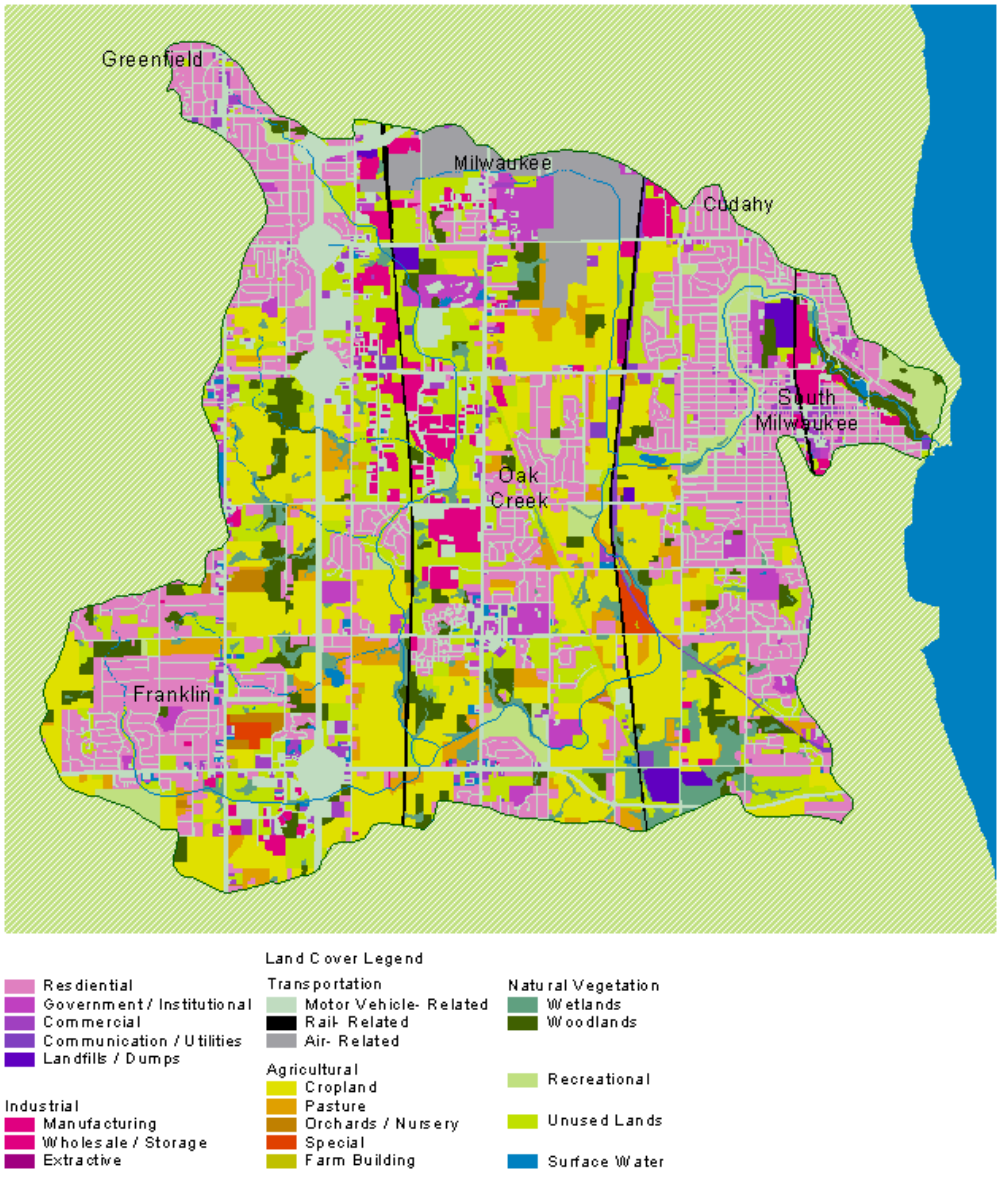
  For this assessment, natural vegetation includes wetlands, woodlands and some unused lands. Generally, natural vegetation has positive impacts on source water. These impacts include increased infiltration of precipitation into the ground, decreased quantity of storm water runoff, removal of

contaminants from source water, reduced potential for erosion and less drastic fluctuations of streamflow.

- *Recreational land cover*

  For this assessment, recreational land cover includes public as well as private, land and water related recreational areas. Examples of these include parks, fields, golf courses and beaches. Recreational land cover can affect source water similarly to natural vegetation. However it is also associated with microbial, synthetic organic and inorganic contaminants.

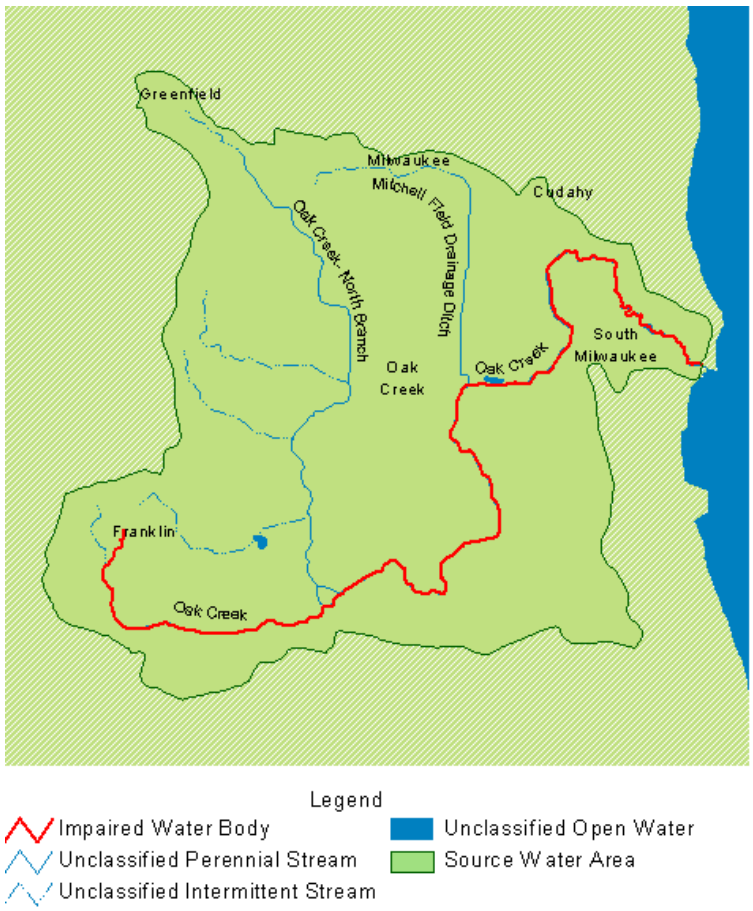
Figure 3: Land Cover



Water quality

Water quality monitoring has been carried out to a limited extent on the three larger streams in the source water area. Little is known concerning the remaining tributaries. As shown in Figure 4, the entire length of the Oak Creek is considered to be impaired from urban runoff. Impaired waters are defined by the WDNR as waters, which are not meeting water quality standards for specific substances or their designated uses. The North Branch of the Oak Creek is also being negatively impacted by urban runoff. There are no exceptional or outstanding water resources in the source water area.

Figure 4: Impaired Waterbodies

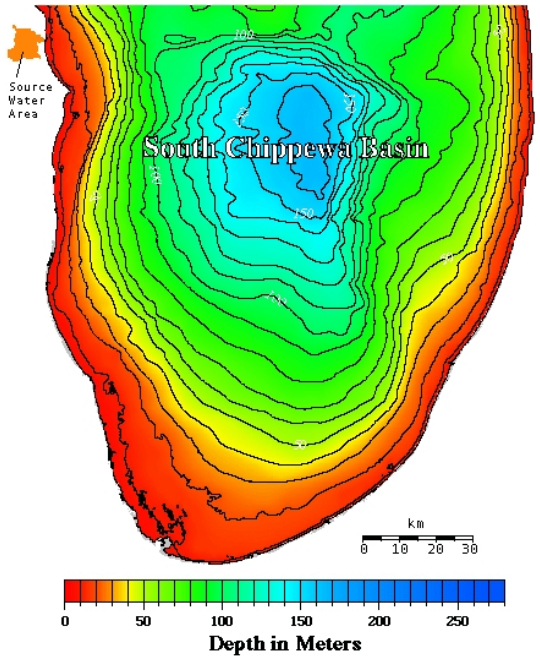


Description of Lake Michigan near the Source Water Area

Bathymetry

As shown in Figure 5, a shallow area extends parallel to shore, before dropping off into the relatively shallow South Chippewa Basin eight miles east of the intake. This relatively shallow area may have a negative impact on source water quality by preventing dilution of contaminants, allowing for more easily suspended lake bottom sediments and creating more variable currents near the intake.

Figure 5: Southern Lake Michigan Bathymetry



Wind

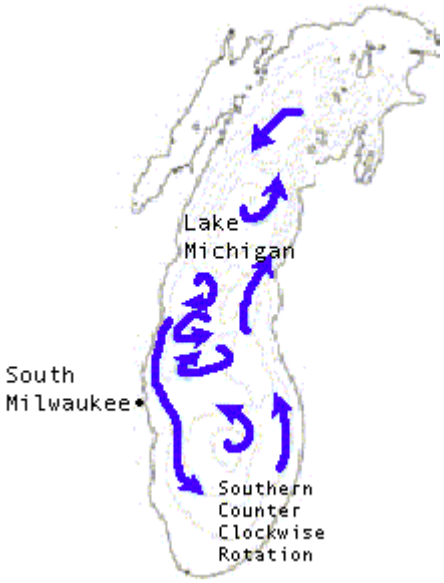
Wind plays a major role in Lake Michigan currents and water quality in near-shore areas. The prevailing westerly wind gives way to variable easterly and southerly winds during the spring and summer months. Variable winds alter current direction and speed along with causing fluctuations in water quality. Windstorms from any direction can stir up lake bottom sediments, which results in poor source

water quality. These events occur most commonly during the winter and spring months.

Currents

Direction and speed of currents in Lake Michigan are highly variable and largely dependent upon wind direction. As shown in Figure 6, unaffected circulation paths near the South Milwaukee intake travel south as part of a larger southern Lake Michigan counterclockwise rotation. The large shoreline bluffs located near the intake may lessen the impact of wind on current at the intake. Easterly and southeasterly winds can quickly reverse the current or cause lake water to stagnate along the shoreline near the intake.

Figure 6: Circulation Patterns of Lake Michigan



Water quality

Water quality in Lake Michigan improves with distance from shore. Nearshore water quality is generally lower and more prone to fluctuations. Nearshore water quality fluctuations frequently occur in spring when precipitation and snow melt transport contaminants from land into Lake Michigan. Fluctuations also occur during windstorms, which can churn up lake bottom sediments. Atmospheric deposition of contaminants occurs near concentrated urban areas.

With distance from shore most contaminants evaporate, settle into the lake bottom sediments or dilute to undetectable levels allowing water quality to reach near drinking water purity. Farther from shore, Lake Michigan contains very low concentrations of drinking water contaminants. Organic chemicals and heavy metals are below levels of detection. The majority of these contaminants enter the lake via nonpoint source pollution and atmospheric deposition. Coliform and microbial contaminants are higher nearshore, but have been detected farther from shore. Similar to nearshore areas, easterly windstorms can resuspend sediments far from shore, which can cause water quality fluctuations.

Based on water clarity monitoring source water quality at the South Milwaukee intake fluctuates throughout the year. Fluctuations frequently coincide with windstorms, heavy precipitation and spring thaw. Warmer source water temperatures from June to September can also result in taste and odor problems in treated drinking water. It is important to note that few contaminants have been comprehensively monitored in source water at the intake. The pathogen *Cryptosporidium* has been detected in the source water at the drinking water intake during spring. Synthetic and volatile organic contaminants typically associated with agriculture, urban and industrial activities are occasionally detected at very low levels in the source water.

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 an adverse human health impact. This definition applies to groundwater and surface water-based public water supplies. 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.

Methodology

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

An initial survey was performed on the South Milwaukee source water area to assess local impacts to the source water. The initial survey included interviewing South Milwaukee Water Utility, conducting a sensitivity analysis, delineation of a critical assessment zone and reviewing existing data. The initial survey revealed that source water is impacted by local factors.

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 Lake Michigan.

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. The calculated sensitivity rating for the drinking water intake is high. The actual sensitivity for the South Milwaukee intake is considered to be higher than calculated due to the proximity and size of Oak Creek's discharge into Lake Michigan.

Critical Assessment Zone

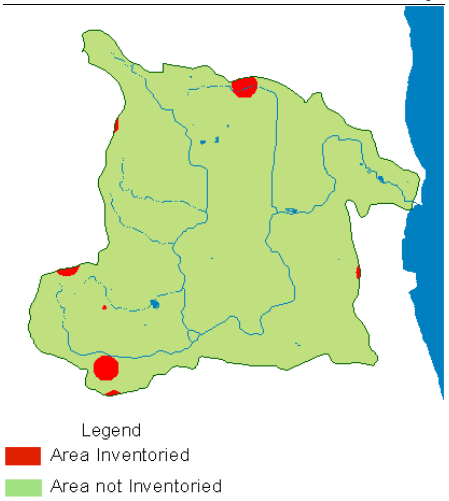
In keeping with the Great Lakes protocol, a critical assessment zone was delineated based upon the intakes calculated sensitivity. Any land, particularly shoreline, which is within the delineated critical assessment zone, must be part of an in-depth assessment. The zone is a circle centered on the intake.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

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 would indicate a higher probability of contaminating source water. Source water from a source water area with a low density of potential contaminant sources would be 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 may not impact the source water.

Figure 7: Area Inventoried for Localized Potential Contaminant Source Inventory



Data used in the potential contaminant source inventory includes area-wide and localized information sources. Source water area-wide potential contaminant source data is shown in Figure 8. Locational information for localized potential contaminant sources shown on Figure 9 were inventoried only within areas encompassed by the source water areas for ground water systems. Figure 7 depicts the limited amount and distribution of land in the source water area inventoried for localized significant potential contaminant sources. Information concerning the distribution of localized significant potential contaminant sources is not available for land outside of the red areas in Figure 7.

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 can be sources for inorganic, synthetic organic and volatile organic contaminants in source water.

As shown in Figure 8, there are eight known landfills in the source water area. According to the WDNR 2001 State of the Root-Pike River Basin, landfills are sources of environmental degradation for the Oak Creek and Mitchell Field Drainage Ditch.

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. During or following a storm event, the 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 will contain a high concentration 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.

Distribution of WWTF outfalls are shown on Figure 8. There are two WWTF outfalls located near the South Milwaukee drinking water intake. These outfalls are part of the South Milwaukee and the Milwaukee Metropolitan Sewerage District (MMSD) WWTFs. The MMSD and South Milwaukee outfalls are approximately 7,000 feet south and 4500 feet southwest respectively of the drinking water intake. Under normal conditions, these WWTFs discharge relatively clean effluent into Lake Michigan. However, following a period of high precipitation they have a history of experiencing sanitary sewer overflows.

WDNRs 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. 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. See Figure 8 for LUST site locations. As of 3/13/02, there were 78 LUST sites located within the municipal boundaries of Oak Creek and 57 in South Milwaukee Other high concentrations of LUST sites occur in urban areas throughout the source water area.

- 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. See Figure 8 for ERP site locations. As of 3/13/02, 39 ERP sites were located within the municipal boundaries of Oak Creek. Other high concentrations of ERP sites occur in urban areas throughout the source water area.

- Spills

  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 January of 1978 to March of 2002, there had been 238 spills reported in the Oak Creek municipality. Gasoline and oil are the most commonly spilled contaminants.

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 8, there are 6 large quantity hazardous waste generators located in the source water area. This does not account for the more numerous smaller quantity hazardous waste generators, which are concentrated in urban areas throughout the source water area.

Wildlife

Natural levels of wildlife generally do not have a negative impact on water quality. However, concentrated animal populations can have a major impact on water quality. They are known to contaminate water with microbial contaminants. These concentrations are frequently related to human activities, such as landfills, protected waterways and recreational areas where feeding occurs.

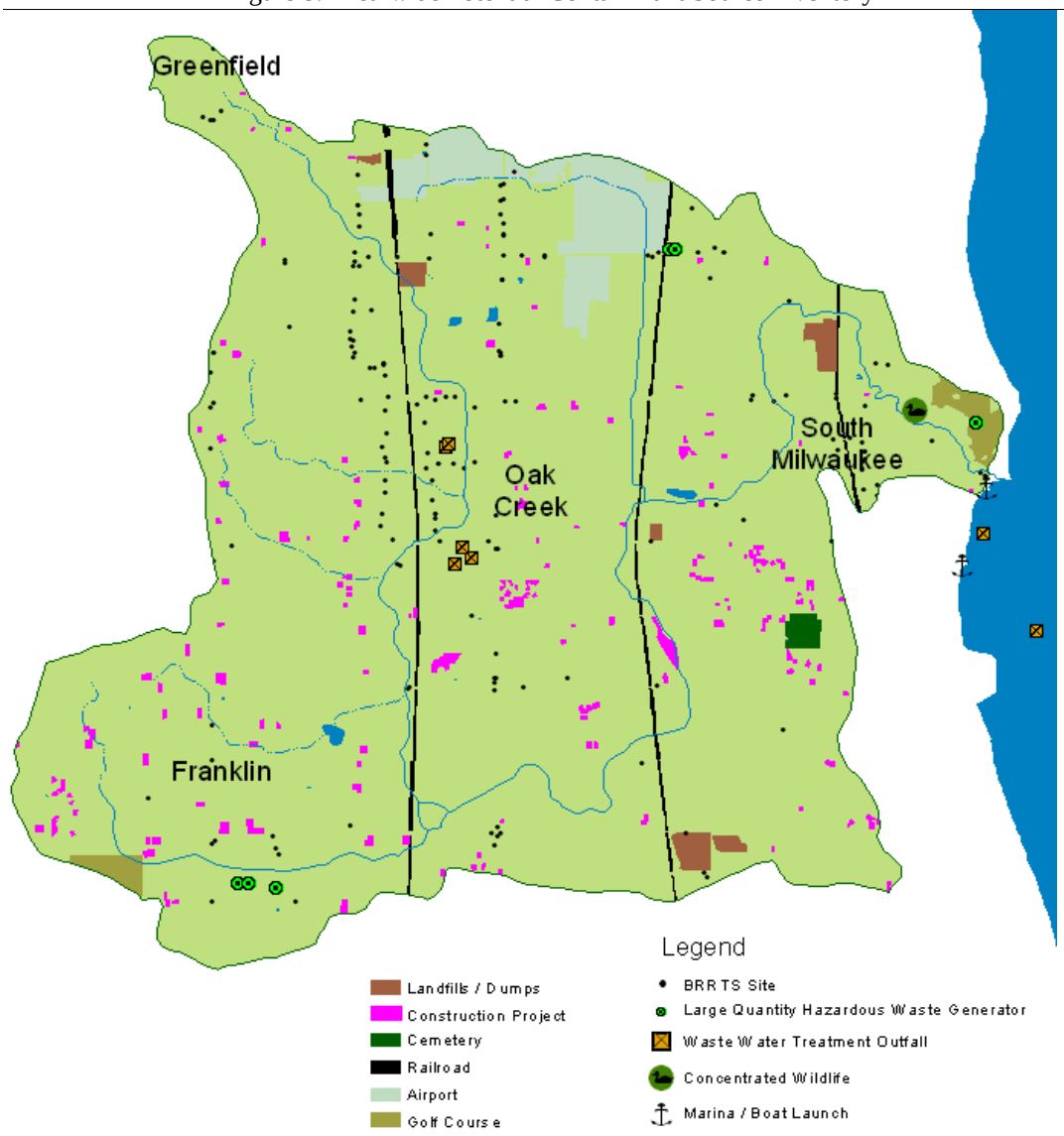
As shown on Figure 8, the Oak Creek flows through a small pond approximately half a mile from Lake Michigan. There is an extremely concentrated population of ducks and geese, which reside at this pond.

Boating Related Activities

Boating related activities are potential sources of volatile organic, microbial and inorganic contaminants to the source water. Contaminants can enter directly into the source water through spills and discharges, or indirectly through runoff from marinas and shipyards where many cleaning agents, paints and other chemicals are commonly stored and used.

Recreational boating and fishing are both popular on Lake Michigan near the drinking water intake. There is one marina and one public boat launch located near the intake.

Figure 8: Area-wide Potential Contaminant Source Inventory



Construction Sites

Due to uncovered material, handling of toxic chemicals and exposed ground construction sites can heavily impact the source water. They are potential sources of inorganic, volatile organic and synthetic organic contaminants. Locational information for construction sites in Figure 8 is based on 1995 data.

Cemeteries

Cemeteries are potential sources of microbial, inorganic and synthetic organic contaminants. Contaminants from cemeteries can enter source water via leachate into groundwater or runoff into surface water. There are multiple cemeteries located throughout the source water area.

Golf Courses

Golf courses are potential sources of inorganic and synthetic organic contaminants. There are many golf courses located in the source water area. As shown in Figure 8, there is only one golf course located in the source water area.

Airports

Airports are potential sources of inorganic and volatile organic contaminants. As shown in Figure 8, the southern portion of General Mitchell Field, a large international airport drains directly into the Mitchell Field Drainage Ditch.

Railroads and Switchyards

Railroads and switchyards can be sources of contaminants via spills, which are transported as cargo on trains or by contaminants used in the day to day operation of trains. Contaminants associated with cargo vary depending on individual trains and regions, but in 2000 there was an estimated 4.4 million tons of hazardous material transported by rail statewide. Contaminants associated with the day to day operation and maintenance of railroads and switchyards include synthetic organic, volatile organic and inorganic contaminants. The City of Milwaukee, located to the north of the source water area is a hub for railroads in Wisconsin. As shown in Figure 8, there are three railways that cross the source water area.

Coal Burning Power Plant

Coal burning power plants can be major sources of inorganic contaminants, including mercury and other heavy metals. After combustion, exhaust is released into atmosphere through smokestacks. Approximately 50% of mercury and other trace heavy metals will fall to earth within fifty miles of the smokestack. These contaminants can enter into surface water and threaten drinking water. A large coal burning power plant is located over a mile south of the intakes.

Localized Agricultural and Bulk Storage Potential Contaminant Sources

Localized agricultural and bulk storage activity locations for this assessment are shown in Figure 9. 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

Locations for localized commercial activities for this assessment are shown in Figure 9. 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

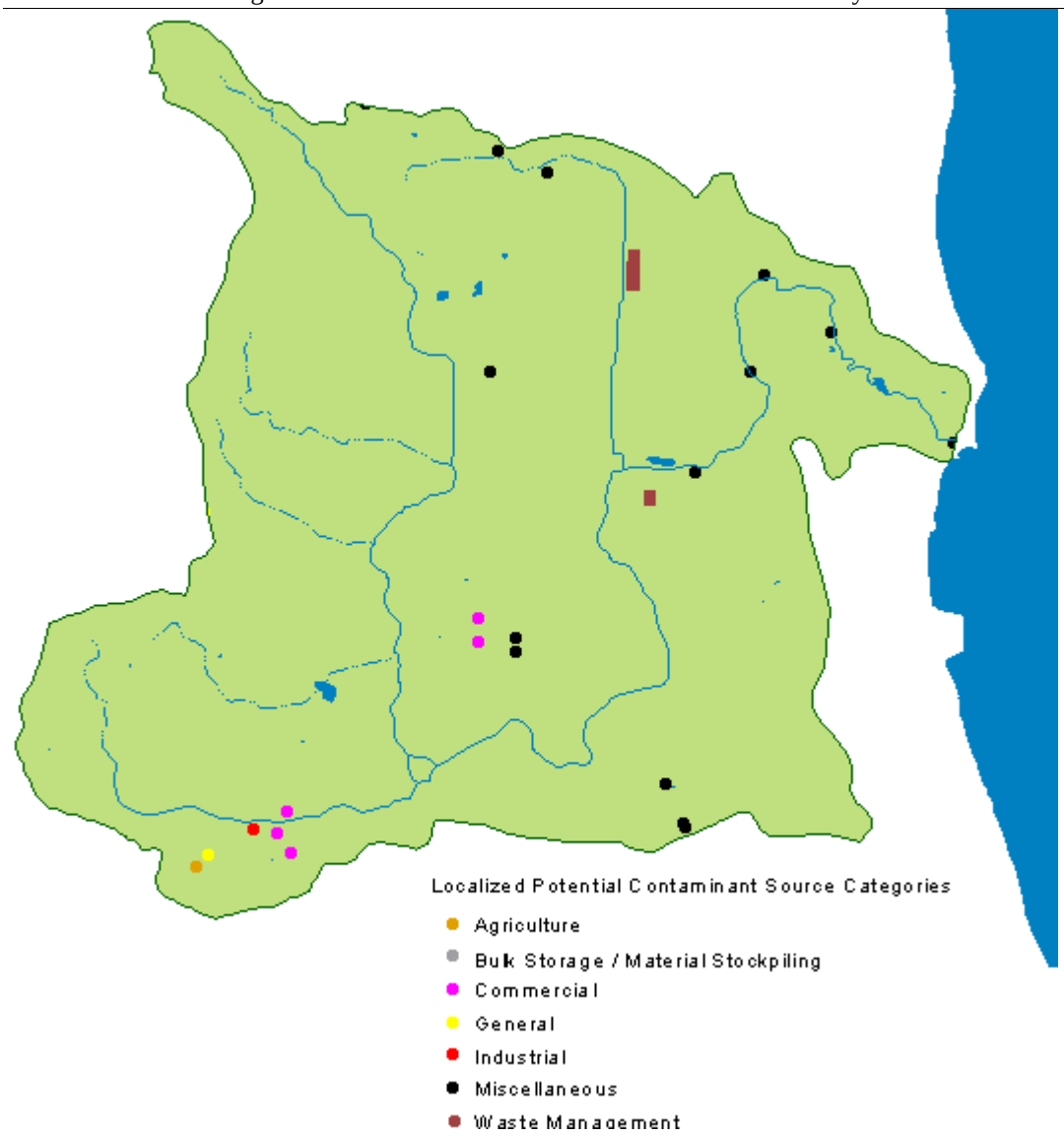
Localized general and industrial activities for this assessment are shown in Figure 9. General activities include above-ground and below-ground storage tanks, municipal and non-municipal sewer lines, sewage holding tanks, septic tanks, sumps, drainfields, mounds and dry wells. These activities are potential 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.

Localized Waste Management and Miscellaneous Potential Contaminant Sources

Localized waste management and miscellaneous activities and contaminant conduits are shown in Figure 9. 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.

Figure 9: Localized Potential Contaminant Source Inventory



Description of Treatment Facility

The South Milwaukee Water Utility reliably provides high quality drinking water to its more than 21,000 consumers. The year round daily average demand is approximately 2.5 million gallons of drinking water per day (mgd). The annual minimum and maximum demands of 2 mgd and 4mgd occur in winter and summer, respectively.

Potassium permanganate is applied at the surface water intake to control zebra mussel growth. Upon entering the treatment plant, source water undergoes chemical flocculation and physical sedimentation to remove the larger contaminants, filtration to remove finer contaminants and chlorination as a disinfectant prior to distribution.

Susceptibility Determination

As with most surface water systems, South Milwaukee's source water quality is significantly impacted by the source water area and highly susceptible to contamination. Source water entering the South Milwaukee

intake is significantly impacted by both manageable factors in the source water area and larger less controllable features of southern Lake Michigan. Local factors in the source water area include non-point source pollution by agricultural and urban land usage and other potential contaminant sources. Larger, less manageable southern Lake Michigan features, which affect source water quality, include wind-induced suspension of lake bottom sediments, variable currents and annual sediment transport. South Milwaukee's source water quality normally degrades during spring thaw, periods of heavy precipitation and windstorms.

Recommendations

Source water protection should begin with the formation of a team composed of local, regional and state members to more completely assess impacts to source water and implement best management practices to prevent source water contamination. Initial source water protection efforts of this team should focus on the following,

- Managing sanitary sewer bypasses from the Milwaukee Metropolitan Sewerage District (MMSD) and South Milwaukee wastewater treatment facilities
- Managing urban runoff in 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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