Southern portions of Kenosha's source water area
Photograph courtesy of Thomas A. Meyer

Source Water Assessment
For Kenosha Water Utility

Kenosha, Wisconsin
April 2, 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 Kenosha'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 your community's 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 Kenosha, Wisconsin is located in the southeastern portion of the state. Kenosha Water Utility relies solely upon Lake Michigan to provide drinking water to its more than 80,000 consumers. The Kenosha Water Utility also exports drinking water to more than 7,000 additional consumers served by the Pleasant Prairie Water Utility, the Somers Water Utility and the Town of Bristol East.

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 Kenosha'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 Kenosha surface water intakes. 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, Kenosha's delineated source water area is over 80 square miles. It includes the Pike River and Pike Creek Watersheds. Streams in the source water area are prone to high flows during and immediately following storm events and very low flows in periods of low precipitation. This is due to the types of soils and land practices in the source water area. Generally soils in the source water area are relatively impermeable red clays and clayey loams. Land uses include a mix of agriculture and urban areas with little natural vegetative cover.

Kenosha Water Utility has reliably provided its customers with high quality drinking water. Kenosha Water Utility operates two different plants. One is a conventional water treatment plant, which includes flocculation, sedimentation, filtration and chlorination in the treatment process. The other plant uses microfiltration and chlorination to treat the water. The combined capacity of these water treatment facilities is 42 million gallons per day (mgd). There is a year round daily average demand of 12-mgd.

As with most surface water systems, Kenosha's source water is highly susceptible to contamination. Kenosha's source water is significantly impacted by both manageable local factors and less controllable features of southern Lake Michigan. Kenosha's source water is commonly impacted during and immediately following spring thaw, heavy precipitation and wind storms.

Source water protection for Kenosha 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 managing runoff from urban and agricultural activities in the source water area.

A paper copy of the detailed assessment is available at the Kenosha 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 Kenosha'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 quantity 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

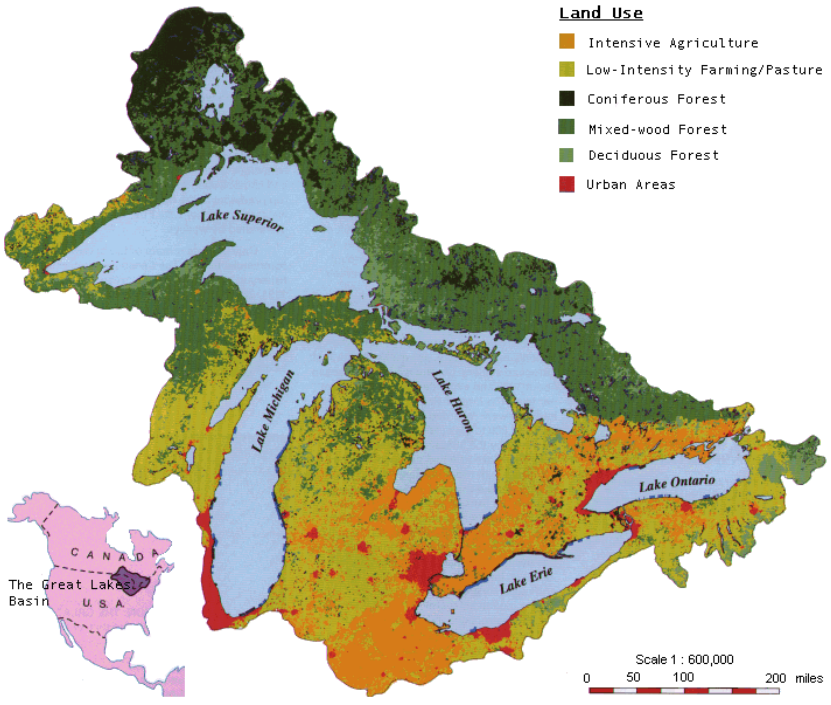
widespread acute illnesses in customers of a contaminated drinking water system. Examples of microbial contaminants include *Giardia*, *Cryptosporidium* and *E. coli*.

- *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 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

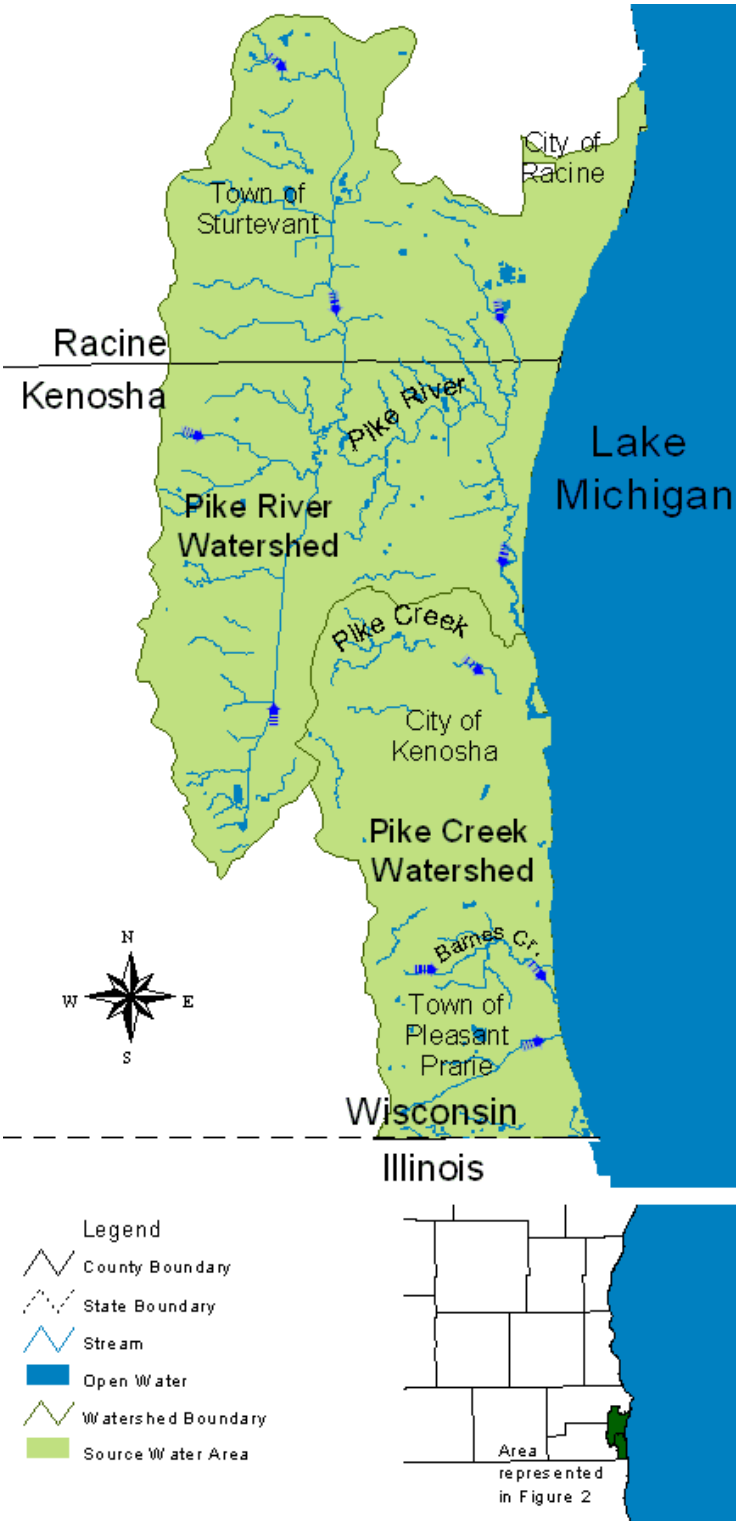
Figure 1: Land use of the Great Lakes Drainage Basin



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 Kenosha'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 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.

Figure 2: Drainage of source water area



As shown in Figure 2, Kenosha's source water area is located in Southeastern Wisconsin. It includes portions of Eastern Kenosha and Racine counties. Most of the city of Kenosha and the towns of Sturtevant and Pleasant Prairie are located in the source water area. The southern edge of the city of Racine is also located in the source water area. The total area of Kenosha's source water area is over 80 square miles and is drained by two independent watersheds.

As shown in Figure 2, two independent watersheds drain the source water area. The Pike Creek Watershed drains the southern half of the source water area, and the Pike River Watershed drains the northern half of the source water area.

The Pike Creek Watershed has an area of 27 square miles and drains into Lake Michigan through multiple independent small streams. The Pike Creek which drains the northern portion of the watershed and discharges into Lake Michigan less than a mile south of the intake. Barnes Creek and Tobin Creek both discharge into Lake Michigan much farther south of the intake.

The Pike River Watershed has an area of over 56 square miles. The Pike River drains the Pike River Watershed almost solely. Multiple tributaries and canals drain agricultural land in the western portion of the source water area prior to merging into the Pike River. The Pike River discharges into Lake Michigan approximately a mile to the north of the drinking water intake.

The soil types and land cover throughout much of the source water area inhibit infiltration of water into the ground and cause precipitation to flow overland. This overland flow creates drastic fluctuations in stream flow. The average annual streamflow from 1972 to 1999 of the Pike River was 36 cubic feet of water per second (cfs). Historically, the highest flows occur during March and April. Stream flow for the Pike Creek is unknown

Land Cover and Soils

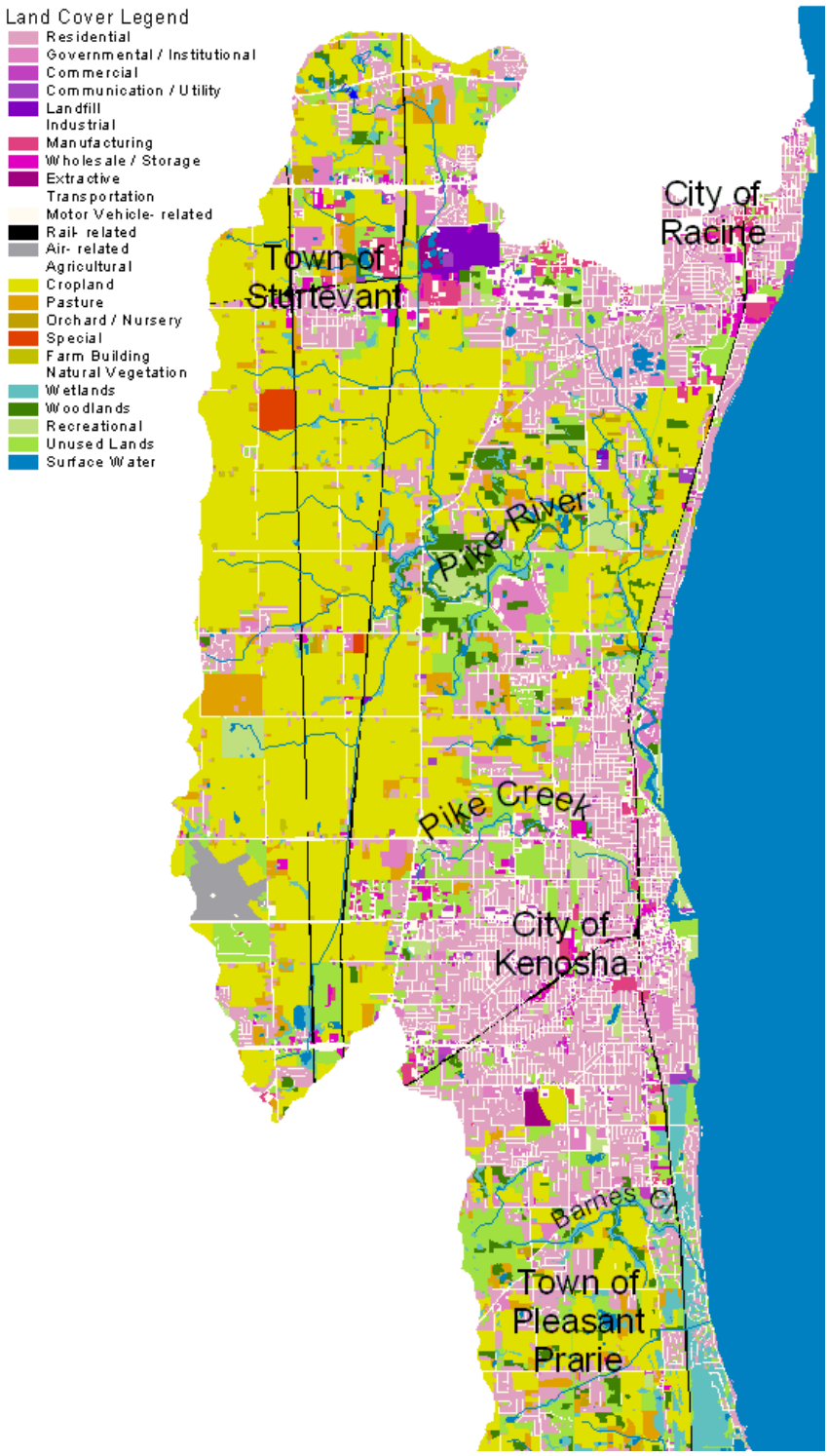
Land cover can play a major role in source water quality. Spatial data in Figure 3 as generated from 1995 locational data.

As shown in Figure 3, land cover in the source water area is a mix of agricultural and urbanized areas with small pockets of natural vegetation. Soil types found throughout the source water area include red clays and clayey loams.

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.

Urban areas in the source water area include the cities of Kenosha, Pleasant Prairie, Sturtevant and the

Figure 3: Land Cover



southern edge of Racine. According to WDNR urban runoff from the city of Kenosha is degrading source water in the lower four miles of the Pike River.

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.

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 all 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 could also enter source water through atmospheric deposition and spills.

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.

Agricultural runoff has a major impact on surface water quality in various areas of the source water area. Agricultural practices in the western portion of the Pike River Watershed are degrading water quality in the North Branch of the Pike River.

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.

Natural vegetation compromises a small portion of the source water area. Areas of natural vegetation, such as wetlands and forests are most concentrated in the southern portions of the Pike Creek Watershed and along the tributaries to the Pike River in the central portion of the Pike River Watershed.

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.

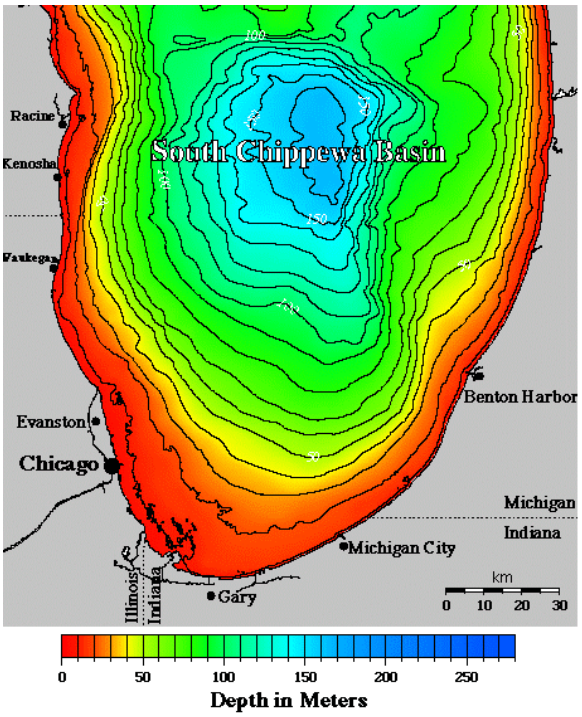
Water quality

Water quality in the source water area ranges from severely degraded to good. The lower portion of the Upper Branch of the Pike River is considered impaired. Impaired waters are defined by the WDNR as waters, which are not meeting water quality standards for specific substances or their designated uses. This impairment is due to both point and nonpoint source pollution that has resulted in fish kills. According to the WDNR, most streams in the source water area are degraded due to urban runoff, stream bank erosion and hydrologic modifications. There are no waterways in the source water area that are classified as exceptional or outstanding resource waters.

Description of Lake Michigan

Bathymetry

Figure 4: Bathymetry of southern Lake Michigan



As shown in Figure 4, a shallow area extends parallel to shore, before dropping off into the relatively shallow South Chippewa Basin two miles east of the drinking water intakes. This relatively shallow area may have a negative impact on source water quality by preventing dilution of contaminants, allowing for more easily resuspended lake bottom sediments and creating more variable currents near the intake.

Wind

Wind plays a major role in Lake Michigan circulation patterns and water quality in near-shore areas on Lake Michigan's western shore. The prevailing wind is out of the southwest going across the lake from the Kenosha source water area. Variable winds frequently alter circulation paths and speed along with causing fluctuations in water quality. Northeasterly and easterly winds are frequently associated with poor source water quality.

Currents

Direction and speed of near shore currents in Lake Michigan are highly variable and largely dependent upon wind direction. As shown in Figure 5, unaffected lake water near the Kenosha intakes travels south as part of a larger southern Lake Michigan counterclockwise rotation. Easterly and southeasterly winds can quickly reverse the circulation pattern or cause lake water to stagnate along the shoreline near the intakes.

Figure 5: Lake Michigan Currents

Water quality

Water quality in Lake Michigan improves with distance from shore. Near shore water quality is generally lower and more prone to fluctuations, which frequently occur during and following periods of thawing and precipitation when contaminants from land are transported into Lake Michigan. Fluctuations also occur during easterly windstorms, which can churn up lake bottom sediments. Atmospheric deposition of contaminants often occurs near more concentrated urban areas. The majority of contaminants enter the lake via non-point source pollution and atmospheric deposition. With distance from shore most contaminants evaporate, settle into the lake bottom sediments or dilute to levels below EPA Maximum Contaminant Levels, a standard for potable drinking water.

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. Water quality is generally very high at Kenosha's primary drinking water intakes. Water clarity, an overall indicator of water quality, drops from November to March. Organic contaminants typically associated with pesticides and industry have been detected at very low levels at the drinking water intake. Water quality at the emergency intake, located nearshore, tends to have lower water quality compared to the primary 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 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

Detailed guidelines for completing this source water assessment can be found in Wisconsin's Source Water Assessment Program Plan (W-DNR, 1999).

An initial survey was performed on the Kenosha source water area to assess local impacts to the source water. The initial survey included interviewing Kenosha Water Utility employees, conducting a sensitivity analysis, delineating critical assessment zones and reviewing existing data. The initial survey revealed source water to be susceptible to contamination.

Background water quality levels of Lake Michigan were reviewed and an assessment of potential danger from large spills was carried out to determine the susceptibility of Kenosha's source water to contamination. The emergency intake was determined to have a high susceptibility to contamination due to its sensitivity and potential contaminant sources within the critical assessment zone. An in-depth shoreline potential contaminant source inventory was carried out within the critical assessment zone.

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 sensitivities for the two primary intakes are moderate. An emergency intake, which is very rarely used, has a very high calculated sensitivity.

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 zones for the primary drinking water intakes do not encompass any land. The critical assessment zone for the emergency intake encompasses shoreline.

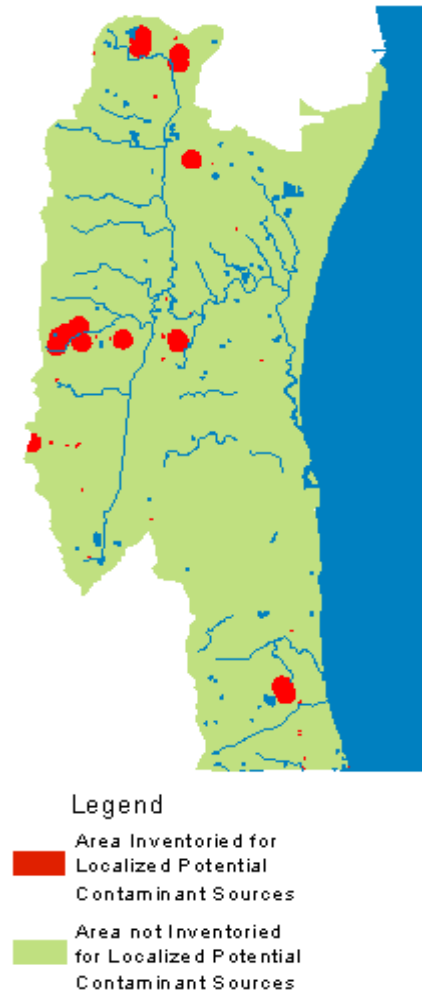
Potential Contaminant Source Inventory

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 won't impact the source water.

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 7. Locational information for localized potential contaminant sources shown on Figure 8 were inventoried only within areas encompassed by the source water areas for ground water systems. Figure 6 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 6.

Figure 6: Areas Inventoried for Localized Potential Contaminant Sources



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.

As shown in Figure 7, there are only two regulated landfills in the source water area. It is unknown how many inactive landfills exist in the source water area.

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. For more information on sanitary sewer overflows and bypasses please visit http://cfpub1.epa.gov/npdes/home.cfm?program_id=4 on the World Wide Web. Contaminants associated with industrial WWTFs are dependent upon the specific industry but may include microbial, volatile organic, inorganic and synthetic organic contaminants.

Location of WWTFs in the source water area are shown on Figure 7. WWTFs in the source water area do not have a history of exceeding effluent contaminant concentration limits. From 1995 to 2000, fourteen bypasses were reported to the WDNR in the source water area. The combined discharge of raw sewage into the source water area was more than 54 million gallons.

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 shown in Figure 7 LUST sites are concentrated in and around urban areas.

- 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 shown in Figure 7 ERP sites are concentrated in and around urban areas.

- 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. For information on particular spills please visit the previously mentioned BRRTS Internet site.

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.

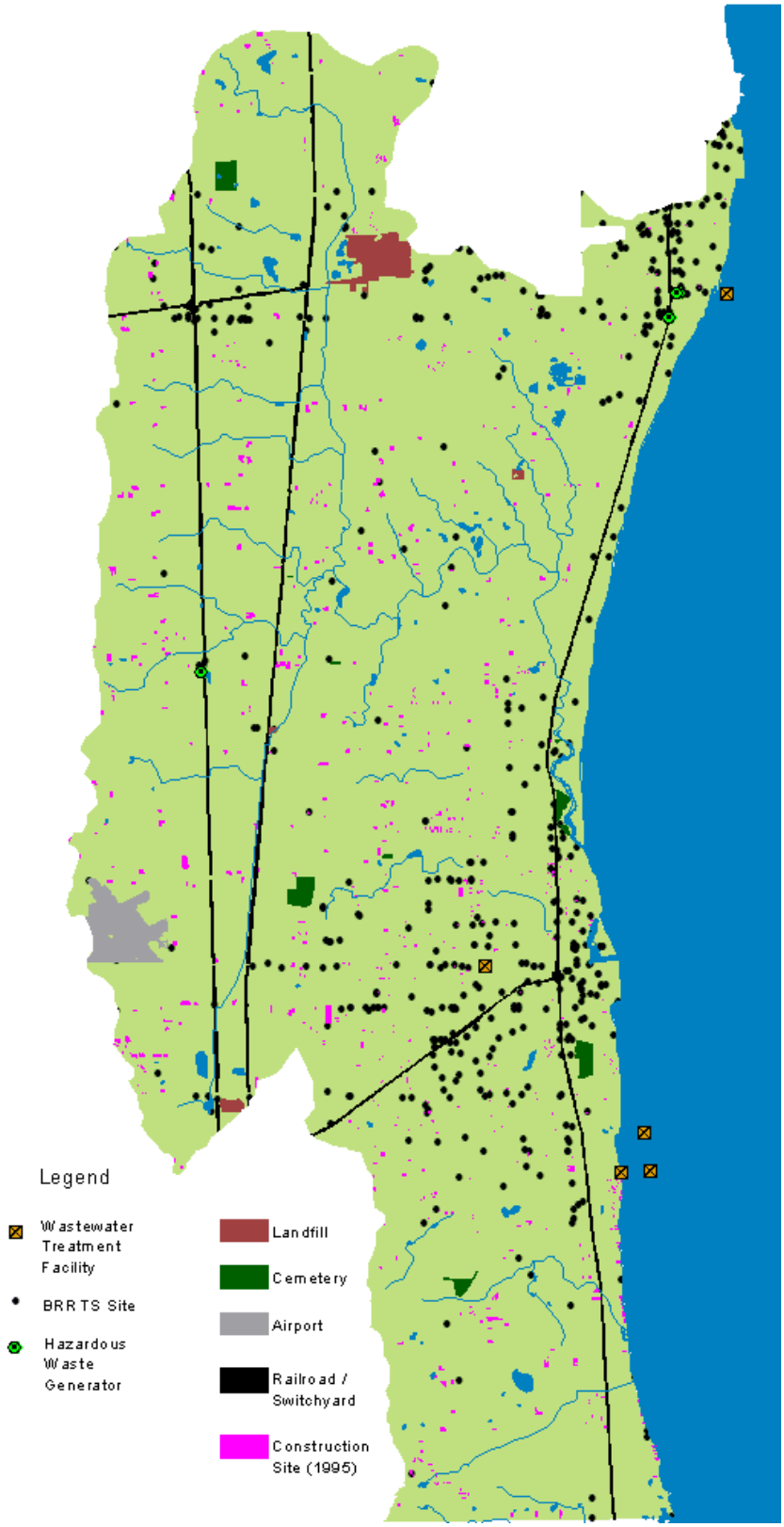
As shown in Figure 7, there are 3 large hazardous waste generators in the source water area. This does not include small and medium sized hazardous waste generators, which are much more numerous and concentrated in and around the City of Kenosha. For a more complete image visit USEPA's Enviromapper on the World Wide Web at http://maps.epa.gov/enviro/html/mod/enviromapper/index.html

Construction sites

Due to uncovered material, handling of toxic chemicals and exposed ground, mismanaged construction sites can impact the source water more intensely than urban land coverage. For more information on impacts and regulations of construction sites please visit http://cfpub1.epa.gov/npdes/stormwater/const.cfm?program_id=6 on the World Wide Web.

From 1990 to 2000 Kenosha County grew by 16.7 %. Construction sites from 1995 are shown in Figure 7. Much of the land developed to accommodate this large increase in population is urban sprawl in the source water area. Residential areas have spread out in the form of suburbs and lakefront developments near the drinking water intakes.

Figure 7: Area-wide Potential Contaminant Source Inventory



Boating Related Activities

Boating related activities are potential sources of 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 is very popular along the southwestern shore of Lake Michigan. There are five marinas located in Kenosha, three of which have gas tanks.

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. As shown in Figure 7, several cemeteries are located in the source water area.

Airports

Airports are potential sources of inorganic and volatile organic contaminants. As shown in Figure 7, there is one large airport in the source water area.

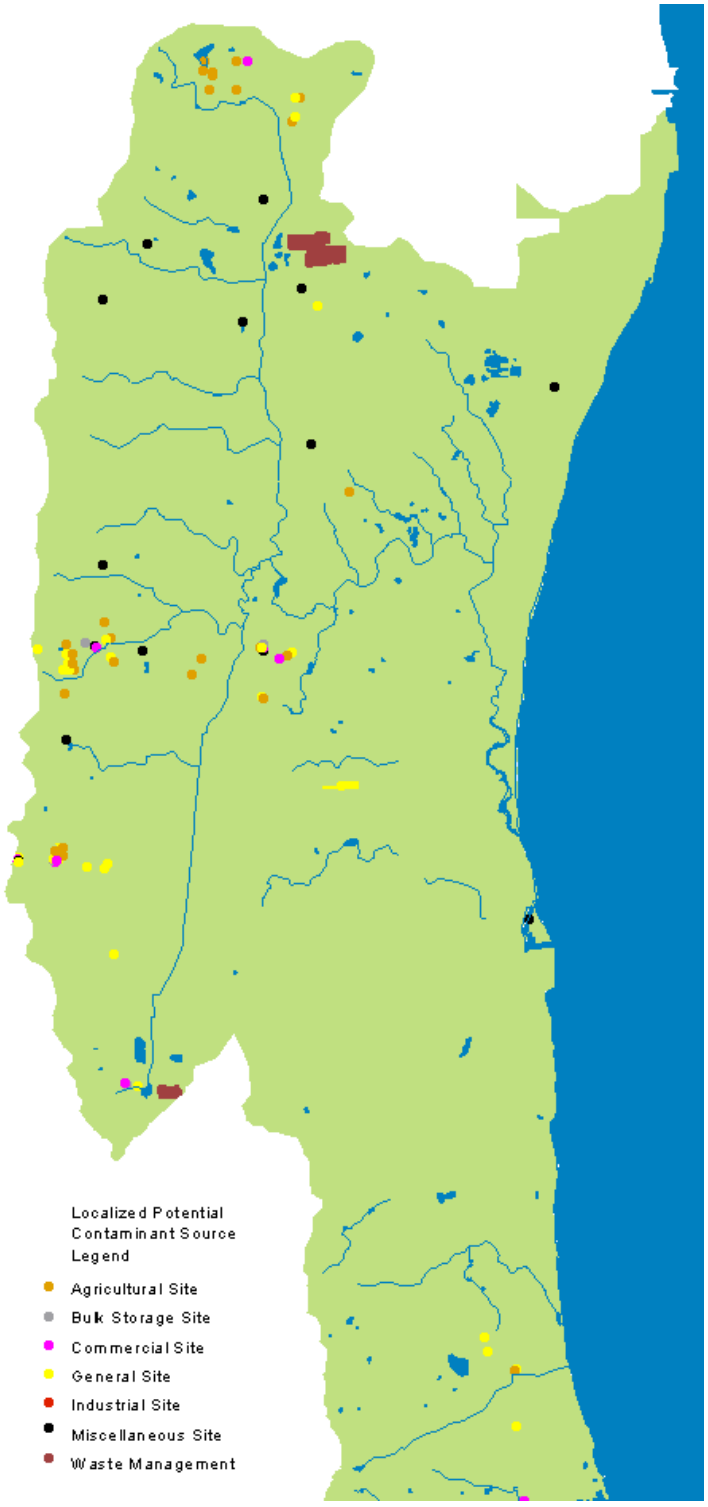
Railroads and Switchyards

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 spills of 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 and Chicago to the south of the source water area are hubs for railroads. As shown in Figure 7, there are multiple railways and switchyards that cross the source water area.

Localized Agricultural and Bulk Storage Potential Contaminant Sources

Localized agricultural and bulk storage activity locations for this assessment are shown in Figure 8. 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.

Figure 8: Localized Potential Contaminant Source Inventory



Localized Commercial Potential Contaminant Sources

Localized commercial activities locations for this assessment are shown in Figure 8. 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 8. 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 8. 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 Kenosha Drinking Water Treatment Facilities

The Kenosha Water Utility has two treatment plants, which have a combined capacity of 42 million gallons of drinking water per day (mgd). The average daily demand for drinking water is 12-mgd. The maximum water demand of 26-mgd occurs in summer and the minimum water demand of 9-mgd occurs in winter.

Under normal conditions, Kenosha Water Utility receives source water through two drinking water intakes located in southwestern Lake Michigan. No chemicals are applied at the intake to control zebra mussels, which historically have not inhibited water flow into the Kenosha intakes. During abnormal circumstances source water may enter the treatment plant through an emergency intake. As of October 2002, the emergency intake has only been used once in forty years.

The older, conventional water treatment plant uses flocculation and sedimentation to remove larger particulate material, filtration to remove smaller contaminants and chlorination to disinfectant source water prior to distribution. The newer plant uses microfiltration and chlorination to remove contaminants in source water prior to distribution. These plants treat an almost equal quantity of water.

Susceptibility Determination

As with most surface water systems, Kenosha's source water quality is highly susceptible to contamination and significantly impacted by local factors. Based on source water quality monitoring contaminants from local sources frequently reach the Kenosha's intakes. This is due to agricultural and urban activities in the source water area and the intakes' proximity to a large stream. Kenosha's source water quality normally degrades during spring thaw, warmer water temperatures, 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 managing the following,

- Runoff from urban areas in the source water area
- Agricultural areas of concern include the land in the western portion of the Pike River Watershed where runoff is degrading source water quality in the North Branch of the Pike River. Reducing the emergency intake's sensitivity would be the first step in minimizing its susceptibility.

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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