Drinking Water Source Assessment for the City of Cleveland

SUMMARY

Source Water Assessment and Protection. The following report for the City of Cleveland Division of Water was compiled as part of the Source Water Assessment and Protection Program for Ohio. This program is intended to identify drinking water protection areas and provide information on how to reduce the risk of contamination of the waters within those areas. The goal of the program is to ensure the long term availability of abundant and safe sources of drinking water for the present and future citizens of Ohio.

The 1996 Amendments to the Safe Drinking Water Act established the national Source Water Assessment and Protection Program, targeting drinking water sources for all public water systems in the United States. A public water system is a facility that provides drinking water to 15 or more service connections or that regularly serves at least 25 people a day for at least 60 days a year, whether from an underground well or spring, or from an above ground stream, lake, or reservoir. The program does not address residential wells or cisterns. In Ohio there are approximately 5,800 public water systems.

Background. The City of Cleveland Division of Water operates a community public water system that serves a population of approximately 1.5 million people and has 438,951 service connections. The water treatment system obtains its water from Lake Erie via four water treatment plants: Baldwin, Crown, Morgan, and Nottingham. Total plant design capacity is 519.5 million gallons per day.

Protection Areas. The drinking water source protection areas for Cleveland are shown in Figure 1. Ohio EPA, with the assistance of City of Cleveland, Division of Water staff, inventoried the facilities, water management activities, and land uses within this area that potentially could contaminate the water source. Due to the distance of Cleveland’s supply intakes from shore (approximately 2.5 - 4.5 miles), the potential threats identified in the watersheds nearest to the supply intakes is considered low. The potential pollution threats within the watersheds that may affect the quality of Lake Erie include contamination from municipal sewage treatment plants, industrial wastewater, and home sewage disposal system discharges, air contaminant deposition, combined sewer overflows, runoff from residential, agricultural and urban areas, oil and gas production and mining operations. The threat from these sources may be greater during storm events. Lake and harbor operations may pose a slight risk due to accidental releases and spills, especially from commercial shipping operations, dredge disposal operations and commercial and recreational boating.

Protective Strategies. The ultimate goal of source water assessment is implementation of protective strategies that will better protect the drinking water source. Strategies for protecting the City of Cleveland drinking water source, Lake Erie, include an effective and efficient emergency response plan as well as a plan to educate the responsible parties of
potential contaminant sources.

Continuation of intake monitoring efforts and consultation with U. S. Coast Guard officials regarding response to threats from spills and other sources is recommended. The contingency plan for the water system should be updated as necessary. It is further recommended that a coordinated Lake Erie biological and water quality monitoring system be instituted by state and/or federal agencies.

Future development and a change in land use practices may impact the ecological health of the Lake Erie watershed. This valuable water system should be protected to avoid further degradation of water quality by point and nonpoint sources of pollution such as those listed above. Local watershed planning efforts may also be underway to guide stream restoration and protection activities. These efforts can also serve to increase protection of the drinking water source. Additional management measures are underway for Lake Erie through the Lakewide Management Plan and Remedial Action Plan programs. More information on these programs can be obtained at the Ohio EPA district office in Twinsburg.

For More Information. Additional information on protective strategies and how this assessment was completed is included in the detailed Drinking Water Source Assessment Report for the City of Cleveland. For information on how to obtain a copy of this report, please visit Ohio EPA’s Source Water Assessment and Protection Program Web page at http://www.epa.state.oh.us/ddagw/pdu/swap.html or contact the City of Cleveland Division of Water for a copy at (216) 664-2444 x5634.
How to Use this Assessment

Clean and safe drinking water is essential to every community. Protecting the source of drinking water is a wise and cost effective investment. The purpose of this source water assessment is to provide information that your community can use to develop a local Drinking Water Protection Program. The Source Water Assessment benefits your community by providing the following:

A basis for focusing limited resources within the community to protect the drinking water source(s).

The assessment provides your community with information regarding activities within the Drinking Water Source Protection Area that directly affect your water supply source area. It is within this area that a release of contaminants from a spill or improper usage, may travel through the watershed and reach the surface water intake. By examining where the source waters are most sensitive to contaminants, and where potential contaminants are located, the assessment identifies the potential risks that should be addressed first.

A basis for informed decision-making regarding land use within the community.

The assessment provides your community with a significant amount of information regarding where your drinking water comes from (the source) and what the risks are to the quality of that source. This information allows your community planning authorities to make informed decisions regarding proposed land uses within the protection area that are compatible with both your drinking water resource and the vision of growth embraced by your community.

A start to a comprehensive plan for the watershed and source water area.

This assessment can be the beginning of a comprehensive plan for the water resource, one that addresses all of the uses the water resource provides. An ecologically healthy lake or stream will provide a stable, high quality resource for drinking water.

For information about developing a local Drinking Water Source Protection Program, please contact Ohio EPA Division of Drinking and Ground Waters at (614) 644-2752 or visit the Division’s web site at http://www.epa.state.oh.us/ddagw/pdu/swap.html.
1.0 INTRODUCTION

The 1996 Amendments to the Safe Drinking Water Act established a program for all states to conduct source water assessments for all public water systems. The Source Water Assessment and Protection Program is designed to help Ohio’s public water systems protect their sources of drinking water from becoming contaminated.

The purpose of this assessment is to identify where and how the source water is at risk of contamination. The report:

- Identifies the drinking water source protection area which is comprised of the Critical Assessment Zone (CAZ) and if applicable, the Potential Influence Zone (PIZ);
- Examines the characteristics and water quality of the lake and watershed;
- Identifies potential contaminant sources within the drinking water protection area, and evaluates impacts associated with shipping and dredging operations; and
- Discusses the susceptibility of the source water to contamination.

Finally, the report suggests actions that the public water supplier and local communities may take to reduce the risk of contaminating this source of drinking water and ensure the long term availability of abundant and safe drinking water resources.

Results and recommendations presented in this report are based on the information available at the time of publication. Ohio EPA recognizes that additional information may become available in the future that could be used to more accurately determine the drinking water source protection area. Also, changes in land use may occur after Ohio EPA completes the potential contaminant source inventory. This report should be used as a starting point to develop a plan to protect drinking water resources.

This report was written by Kelvin Rogers, Ohio EPA, Division of Surface Water, Northeast District Office and reviewed and edited by Barb Lubberger and Michael Eggert, Division of Drinking and Ground Waters.

2.0 PUBLIC WATER SYSTEM DESCRIPTION

The City of Cleveland Division of Water operates a community public water system that serves a population of 1.5 million people and has 438,951 service connections and 6 emergency feeds. A community public water system is a system that regularly supplies drinking water to at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.

The Division of Water uses surface water from Lake Erie from four intakes as source water for its four treatment plants. The distance from shoreline of the intakes varies, from approximately 2.5 to 4.5 miles. The intake structures are inspected and cleaned by divers one to two times per year with maintenance zebra mussel removal from intake screens performed during inspection.

The Garrett A. Morgan Water Treatment Plant began operation in 1917 as the Division Avenue Water Works on the site of the older Division pumping station. This plant has a
design treatment capacity of 150 million gallons per day (MGD). The Baldwin Water Treatment Plant was added in 1925 with a design capacity of 165 MGD. After World War II Cleveland initiated a massive water system expansion that resulted in the construction of the Nottingham Water Treatment Plant in 1951 (92 MGD capacity) and the Crown Water Treatment Plant in 1958 (112.5 MGD capacity). The combined plant capacity is 519.5 MGD. Five reservoirs in the water system provide 218.6 million gallons of storage for the four facilities. An additional 91.25 million gallons of storage is provided by secondary storage facilities such as elevated towers. Treatment processes include chemical addition, coagulation, settling, filtration, storage, and chlorination prior to distribution. The Division of Water provides approximately 98 billion gallons of finished water per year.

The Baldwin Water Treatment Plant is the only plant in Cleveland’s system to utilize an above ground open air raw water reservoir. The Fairmount Reservoir is a 40 million gallon raw water storage/makeup reservoir that supplies water to the plant raw water pumping system. This reservoir receives raw water from the Lake Erie intake along with approximately 1 million gallons per day of finished water leakage from the underground finished water reservoir at the Baldwin Plant, and supernatent from the sludge thickeners.

Berms and landscaping around the perimeter of the Fairmount Reservoir prohibit surface runoff from the surrounding water treatment plant, residential area, and road surfaces from entering the reservoir. Although the reservoir water may be subject to contamination from aquatic fowl and algal growth, the relatively small amount (4 - 6 million gallons per day average) that is pumped to the head of the water treatment plant (approximately 5 percent of the total influent volume) preclude it from causing any problem with the finished water. The Baldwin Plant has recently initiated a significant upgrade of its facilities and has a long term plan to eliminate the reservoir by 2006.

### 3.0 DELINEATION OF PROTECTION AREAS

To provide some continuity for assessing the Great Lakes intakes, the concept of a CAZ around each intake was developed (Great Lakes States Workgroup, August 17, 2000). The two factors used to determine the sensitivity of Great Lakes intakes are the perpendicular distance from shore or length of the intake pipeline (L) in feet and the water depth (D) of the structure in feet. The shallower, near shore intakes are more sensitive to shoreline influences than the off shore, deep intakes. The factor for sensitivity (S) can be calculated by the formula: S=LxD. Generally, S values less than 25,000 represent highly sensitive intakes while S values greater than 125,000 indicate lower sensitivities. The perpendicular distance from shore and the depth of the intakes based on 1985 low water datum and measured from the top of each intake is:

- **Crown**: 12,504 ft. length, 34.25 ft depth;
- **Morgan**: 19,952 ft. length, 40.55 ft. depth;
- **Baldwin**: 20,356 ft. length, 7.65-27.4 ft. depth; and
- **Nottingham**: 18,390 ft. length, 40.45 ft. depth.

Based on this formula, the sensitivity of the Cleveland intakes was calculated to be very low, and the CAZ was determined to be a circle with a 1000 foot radius around each intake.
location. See Figure 1 for the location and delineation of the CAZ for the Cleveland Public Water Supply.

Where the CAZ intercepts the shoreline, or water quality data indicate an impact from on-shore contaminant sources, a “Potential Influence Zone” (PIZ) may also be delineated. Due to the distance from shore of the Cleveland intakes, a PIZ was not defined for the Cleveland public water system.

4.0 HYDROLOGIC SETTING

Drinking Water Quality Monitoring Summary
Available chemical and biological water quality data collected from the protection area, and sampling results from finished water reported to Ohio EPA by the public water system were screened for possible water quality impacts. A review of the City of Cleveland Division of Water compliance monitoring data from January 1991 through May 2002 revealed that the system had no water quality violations. Table 1 provides a summary of water quality results of treated water for the City of Cleveland Public Water System.

Water plant personnel monitor raw water from the Lake Erie intakes for alkalinity, turbidity, total organic carbon, hardness, nitrates, and total coliform bacteria. A Microscopic Particulate Analysis is conducted on a monthly basis for algae, Cryptosporidium, and Giardia. Although a very low presence of Cryptosporidium has been found in untreated Lake Erie water, almost no organisms have been found in the treated drinking water. During 2001, a Cryptosporidium test found one apparent oocyst attached to a piece of carbon in the finished water. Although it could not be examined for internal structures, the analytical method requires that it be assumed to be an oocyst unless demonstrated otherwise. The analyst indicated that it might also be algae, but was unable to examine it. Slight increases in turbidity, hardness and nitrates in raw water samples are associated with seasonal variations and severe weather conditions.

It should be recognized that sampling results presented in this report can only provide information on the quality of the water at the time the sample was collected. Water quality may change over time due to a number of reasons. Therefore, it is recommended that the reader also consult the most recent Consumer Confidence Report (CCR) for the City of Cleveland Division of Water. All community public water systems are required to annually prepare and distribute the CCR to their customers. This report is a good source of information on health effects associated with detected contaminants. The reports contain information on the community's drinking water, including the source of the water, contaminants detected, the likely sources of detected contaminants, and the potential health effects of contaminants at levels above drinking water standards.

Biological and Chemical Monitoring
An Ohio EPA fish community sampling survey of the Lake Erie nearshore area was conducted from 1993 to 1996 that included the Cuyahoga River lacustuary (the transition zone in a river that flows into a freshwater lake). This survey found continued improvements in the fish communities over a 12 year period as pollutant loadings from municipal and industrial sources have been reduced. Current fish communities in this area,
although considered to be in the poor range, are presently limited by a lack of suitable habitat rather than chemical and organic pollution.

Ohio EPA Intensive Ecological Aquatic Surveys of the Cuyahoga River and Rocky River watersheds conducted in the mid 1990’s summarize the stream conditions and identify pollution stressors. Poor biological communities were primarily found in stream segments subject to additional stressors such as combined and separate sewer overflows, heavy industrial and/or urban land usage, contaminated sediments (“legacy” pollutants), and habitat alteration. However, biological and water quality in the navigation channel was found to be significantly improved due to reductions in industrial production, elimination of discharges, and improvements in municipal wastewater treatment in Cleveland and Akron.

The Lake Erie Lakewide Management Plan (LaMP) report concluded that because there are currently no restrictions on drinking water consumption or taste and odor problems associated with the lake waters, there is no impairment to this beneficial use. However, the presence of contaminants in fish and wildlife tissue has caused degradation of fish and wildlife populations, fish tumors or other deformities, and restrictions on fish and wildlife consumption. Benthic macroinvertebrate communities (organisms visible without the use of a microscope which live on, in or near the bottom of a surface water body) are also considered impaired due to contaminated sediments and invasive non-indigenous species or exotics. Eutrophication or undesirable algae, once a major problem in Lake Erie due to high levels of phosphorus, is now limited to lake effect zones of certain tributaries, particularly in the western basin.

For more than the past decade, water and biological quality monitoring of Lake Erie waters has not occurred on a regular basis. It is recommended that state or federal agencies institute a coordinated long-term biological and water quality monitoring program or strategy in order to recognize current and future changes in the Lake Erie ecosystem that may impact drinking water quality.

5.0 POTENTIAL CONTAMINANT SOURCES

A review of available regulated facility databases and a field survey of the Lake Erie nearshore and major streams discharging to Lake Erie in the Cleveland vicinity indicate the presence of few potential contaminant sources within 2.5 miles of an intake, that have a potential to affect the Cleveland drinking water quality. Due to the distance of these sites from the intakes, the potential must be considered minimal, and current sampling data do not indicate any impacts from these sites.

If water quality sampling results would indicate impacts in the future, some potential sources of contamination could include dredge disposal operation sites, combined sewer overflow points and major point source dischargers. Table 2 provides a list of the identified major potential contaminant sources in Lake Erie and the watersheds of the major rivers that contribute flow to Lake Erie near Cleveland. Some of these potential contaminant sources are discussed in more detail below.
Cleveland Harbor is a commercial shipping port for dry-bulk cargo, primarily iron ore, limestone, cement, salt and sand. In the 2001 navigation season, a total of 745 cargos (vessel arrivals) passed through the harbor carrying just over 10 million net tons of these dry-bulk commodities, with about 40% consisting of iron ore. Although these dry-bulk materials are relatively inert with little potential for contamination of lake or tributary waters, accidental spills or releases of cargo materials, fuel, and other materials from commercial vessels may cause contamination in the immediate areas where such releases may occur. It should be noted that commercial shipping has decreased significantly over the past few years, with the 2001 tonnage and cargo numbers down almost 20% from 1999 levels.

Sediments are dredged from the Cuyahoga River navigation channel and harbor by the U.S. Army Corps of Engineers (USACE) to maintain a depth of approximately 28 feet for ship traffic to docks along the Lake Erie shoreline and at Cuyahoga River industries. Over 400,000 cubic yards of sediments may be dredged annually as needed. River sediments are sampled and analyzed by USACE on a regular basis. Sediments determined to be contaminated by metals and organic chemicals are disposed in confined disposal facilities (CDFs) located along the Lake Erie shoreline in Cleveland. Other uncontaminated sediments and sands are disposed at offshore sites in Lake Erie where they may utilized for beach nourishment. Although localized high levels of suspended solids are associated with open lake dredge disposal, water quality monitoring at all of the intakes has indicated no problems associated with these activities.

Combined sewer overflows (CSOs) are points where sanitary wastes combine with storm waters and may be discharged directly to streams or Lake Erie during storm events. In the Cleveland area there are over 100 CSOs which may discharge hundreds of millions of gallons of combined wastes in the area during a single storm event. Cleveland sewer authorities are currently implementing projects and strategies to reduce the frequency and amounts of CSO volume discharged. CSOs are a major source of fecal coliform bacteria and other contaminants.

Five major municipal wastewater treatment plants and two major industrial dischargers, a coal-fired power plant and an integrated steel manufacturing facility are located in the Cleveland area. Wastewater discharges from these facilities are regulated by the Ohio EPA. Potential contaminants from these sources include bacteria, nutrients, metals, and associated industrial chemicals. Numerous oil and gas wells are located within the watershed areas.

Industrial areas abound along the banks of the Cuyahoga River and other Lake Erie tributaries, as well as along the lakefront itself. The types of industries found here include chemical production, steel making, metal foundries, coal-fired power generation, metal finishing, automotive, oil and gas production, and many others. Industrial wastewaters, runoff, and hazardous material disposal are regulated by federal, state and local environmental regulatory agencies. Waste materials from these and former industries, along with construction and demolition debris and sanitary wastes may still be present in old landfills scattered throughout the area.
Figure 3 contains a map of land use in the Cleveland area watersheds. Although almost a third of the landscape is forested, these areas are generally far upstream of the river mouths and not near the Lake Erie shoreline. Storm water runoff from urban and suburban areas may contain a wide variety of inorganic and organic pollutants including pesticides and herbicides for residential and agricultural use. Salts and metals may be found in runoff from roadways and parking areas. Microbial contaminants such as bacteria may also be present due to failing home sewage disposal systems and unauthorized sewer connections.

Although the urban/industrial road and rail transportation network along the Lake Erie shoreline is a potential source of contamination through vehicular accidents that release hazardous materials to the lake or its tributaries, the offshore distance of the Cleveland intakes precludes such releases from being a major concern.

6.0 SUSCEPTIBILITY ANALYSIS

For the purposes of source water assessments, all surface waters are considered to be susceptible to contamination. By their nature surface waters are accessible and can be easily contaminated by chemicals and pathogens from an upstream spill. Contaminants may rapidly arrive at the public drinking water intake with little warning or time to prepare. However, based on the information compiled for this assessment, the Cleveland Critical Assessment Zones (CAZ), must be classified as low susceptibility due to the distance and depth of the intakes from potential contaminant sources.

On-shore potential sources of contamination that impact the major streams in the Cleveland vicinity include point and nonpoint source discharges along the shore and along streams that empty into the lake. However, Cleveland Division of Water has not documented any evidence that local shoreline and/or upstream potential contaminant sources influence water quality in the lake near their intakes (See Table 2). Lake Erie waters in the vicinity of the intakes generally flow from west to east, although fluctuations can occur due to wind direction. Flows from the Cuyahoga River move into the harbor area and tend to hug the shoreline as they move eastward. Because the City of Cleveland’s intake structures are located a considerable distance offshore, potential contamination from the Cuyahoga River, Rocky River and nearshore sources is minimized to a great degree.

It is important to note that this assessment is based on available data, and therefore may not reflect current conditions in all cases. Water quality, land uses and other activities that are potential sources of contamination may change with time. The source water (Lake Erie) for Cleveland is considered to have a low susceptibility to contamination due to the location of the intakes. The City of Cleveland Division of Water has effectively treated this source water to meet drinking water quality standards.

7.0 PROTECTIVE STRATEGIES

Source water protection efforts should be directed toward the establishment of an effective and efficient emergency response plan as well as a plan to educate the responsible parties of potential contaminant sources, if one does not currently exist. Source water protection efforts in the area surrounding the Critical Assessment Zones
should include:

1) Continuation of intake monitoring efforts and consultation with Coast Guard officials regarding response to threats from spills and other sources.
2) The contingency plan for the water system should be updated as necessary.
3) The City should continue to support Lake Erie LaMP, Cuyahoga River RAP, and Rocky River Watershed Council objectives, programs and projects to maintain and improve water quality of Lake Erie.
4) A coordinated long-term Lake Erie biological and water quality monitoring system should be instituted by state or federal agencies.
5) The City should provide education to consumers, local municipal officials and businesses on strategies to reduce contaminated storm water runoff.

Future development and a change in land use practices and water management activities may impact the ecological health of Lake Erie and affect the CAZ. This valuable water system should be protected to avoid further degradation of water quality by the excessive loading of nutrients and suspended solids. Watershed management plans for this area, if not currently available, should be drafted by area stakeholders such as the Cuyahoga River RAP and Rocky River Watershed Council and should be utilized to guide future protection activities. A guidance document titled A Guide to Developing Local Watershed Action Plans in Ohio is available on the internet at www.epa.state.oh.us/dsw/hps/ws guide.pdf. For more information on drinking water source protection, please contact the Drinking Water Protection staff at (614) 644-2752.
References


H2O - A History of Serving Cleveland Customers. City of Cleveland Division of Water.


Targeting the Future - Cleveland Division of Water Annual Report 1999. City of Cleveland Division of Water.


Thoma, Roger F. Biological Monitoring and an Index of Biotic Integrity for Lake Erie’s Nearshore Waters in Assessing the Sustainability and Biological Integrity of Water Resources Using Fish Communities. Edited by Thomas P. Simon. CRC Press, 1999.
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<td>By-product of drinking water chlorination</td>
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MCL = Maximum Contaminant Level (AL = Action Level).

MFL = Millions of fibers per liter

1 MCL set by federal or state drinking water standards. A sampling result that exceeds the MCL value does not necessarily indicate a violation by the public water system. MCL violations for many contaminants are based on a running annual average.

2 Secondary Maximum Contaminant Level (SMCL) for this parameter. SMCLs are non-health-related limits.

3 Total Trihalomethanes (TTHMs): (MCL = 0.80 mg/l) calculated as the sum of the concentrations of Bromodichloromethane, Dibromochloromethane, Bromoform, and Chloroform.

Five Haloacetic Acids (HAA5): (MCL = 0.060 mg/l) calculated as the sum of the concentrations of Monochloroacetic acid, Dichloroacetic acid, Trichloroacetic acid, Monobromoacetic acid, and Dibromoacetic acid.
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Figure 1 - Critical Assessment Zones of the Cleveland Public Water System
Figure 2 - Potential contaminant sources
Figure 3 - Land use in the Cleveland Metropolitan Area