

Public Health at Risk

The Dangers Posed by Sewage Pollution
in Ohio's Lake Erie Basin



Ohio PIRG
Education Fund
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Executive Summary

The discharge of untreated human sewage to waterways poses severe potential threats to human health. Sewage commonly contains bacteria, parasites and viruses that can make people ill, as well as a variety of toxic chemicals.

Unfortunately, the discharge of untreated human sewage into waterways in Ohio's Lake Erie basin is extremely common, largely as a result of the region's antiquated sewer systems. Studies show that this pollution has the potential to harm the health of those who swim in or drink from those waterways.

Sewer overflows result in the dumping of billions of gallons of untreated sewage and stormwater to waterways in the Lake Erie basin each year.

- Fifty-three sewer systems in Ohio's Lake Erie basin—including the Northeast Ohio Regional Sewer District, which serves all or part of 60 Cleveland-area communities—have antiquated combined sewer systems that combine sewage and stormwater. These systems can allow untreated sewage to overflow into waterways during periods of rain. There are more

than 600 combined sewer outfalls that can dump sewage into Lake Erie basin waterways, including the lake itself.

- In 2004, discharges from just 11 of these combined sewer systems resulted in the release of more than 8 billion gallons of untreated sewage and stormwater to Lake Erie basin waterways.
- Untreated sewage can also find its way into waterways through overflows from sanitary sewer systems and “bypasses” of sewage treatment during mechanical failures or heavy rain events.

Exposure to contaminants commonly found in sewage can cause illness.

- Untreated sewage contains bacteria (such as *Salmonella*), viruses (such as Hepatitis A) and parasites (such as *Giardia* and *Cryptosporidium*) that are capable of causing disease. Some of these contaminants are infectious at very low levels of exposure. Sewage may also contain toxic chemicals dumped down drains from industrial facilities.

- Numerous scientific studies have linked drinking or swimming in contaminated water with elevated rates of disease. Waterborne illnesses cause an estimated 560,000 cases of severe disease and 7.1 million cases of mild to moderate disease in the U.S. annually.
- A recent study conducted at a Cleveland-area Lake Erie beach found that swimmers who fully immersed themselves in the water were 40 percent more likely to contract diarrhea, vomiting, nausea or severe stomach-ache than those who had no contact with the water.
- Because many waterborne illnesses produce symptoms (such as nausea and diarrhea) that do not require medical treatment and because people can contract these illnesses in a variety of ways (from contaminated recreational water, drinking water or food, or from person-to-person contact), many outbreaks and individual cases of waterborne disease go unreported.
- Industrial waste may also be included in the untreated sewage that is discharged into Ohio's waters. Industries in eight northern Ohio counties dumped an estimated 2.6 million pounds of toxic chemicals into the region's sewer systems in 2003—including such chemicals as chromium compounds, cyanide compounds, formaldehyde and lead. These toxic substances can be washed into waterways during sewer overflows.

Sewer overflows are among the contributors of health-threatening pollution to waterways in Ohio's Lake Erie basin, but more work needs to be done to document the impacts of sewage discharges on recreational and drinking water quality.

Contaminants found in sewage are frequently detected in Lake Erie basin waters.

- Recent research has found high *E. coli* levels at the mouths of several Ohio rivers—including the Maumee, Cuyahoga and Rocky rivers—that receive sewage overflows. However, *E. coli* in these rivers could also come from other sources, such as stormwater runoff.
- The degree to which sewer overflows affect drinking water and recreational water quality depends on many factors, including the quality of water treatment, the location of sewer overflows relative to beaches, and environmental conditions such as wave height and wind direction. In recent studies at Lake Erie beaches, local sources of pollution have been found to make a large contribution to high *E. coli* levels. But much remains unknown about the length of time that many pathogens present in sewage persist in the environment and how far they may travel in complex water bodies like Lake Erie. As a result, Ohio should take a precautionary approach toward warning the public about sewage overflows and undertake a long-term
- From 2000-2005, testing at Ohio's Lake Erie beaches found unsafe levels of *E. coli* bacteria in about one out of every six tests.
- Century Beach in Lorain had the highest percentage (82%) of tests violating the U.S. EPA's single-sample standard for *E. coli* bacteria from 2000 to 2005, followed by Camp Perry in Port Clinton (70%) and Edgewater State Park in Cleveland (50%).
- Water testing in the Cuyahoga River during 2000 and 2002 found infectious viruses in 73 percent of all water samples taken, with 20 percent of samples testing positive for Hepatitis A and 50 percent testing positive for *Salmonella* bacteria.

strategy to reduce the risk to public health.

Ohio residents have a right to know when combined sewer overflows affect their local waterways. And Ohio should take action to mitigate, and eventually eliminate, sewer overflows to waterways in the Lake Erie basin.

- Ohio has the worst system of public notification of sewer overflows in the Great Lakes states. Prompt, public notification of sewer overflows can give Ohioans the information they need to protect their health, and help researchers, government officials and the public understand and work toward the reduction of Ohio's sewage overflow problem.
- Specifically, the Ohio EPA and sewage treatment utilities should:
 - Track sewage overflows.
 - Sewage treatment utilities should track all sewage overflows from their systems and the resulting impacts on water quality.
 - Report sewage overflows.
 - Sewage treatment utilities should immediately report all sewage overflows to the Ohio EPA and the Ohio Department of Health.
 - Notify the public when sewage overflows occur.
 - Sewage treatment utilities should post warning signs at the affected waterways, include information on sewage overflows on their Web pages, and notify the media and the public when sewage is overflowing.
- The Ohio EPA should compile all sewage overflow data in the state and make it available to the public on its Web page, as well as in an annual report.
- The Ohio EPA should develop a statewide toll-free hotline and e-mail notification system to alert interested parties of sewage overflows.
- The state of Ohio and municipalities should adopt land-use practices that minimize stormwater runoff to sewer systems—thus reducing the potential for combined sewer overflows. Such practices include reductions in the use of impervious surfaces for paving, the creation of vegetated drainage systems to absorb runoff, and the adoption of ordinances to limit erosion and runoff from construction sites.
- The state of Ohio and its sewage treatment agencies should move to eliminate combined sewer overflows, as 13 Ohio communities have already done.
- The state of Ohio should improve its beach monitoring and advisory system to communicate the health risks of swimming in contaminated water to the public more quickly and accurately.
- Ohio should work with other Great Lakes states to pursue federal funding for a comprehensive restoration strategy for the Great Lakes that would include more resources for reducing sewer overflows.

Introduction

The year was 1881. Cleveland, like many other Ohio cities, was in the midst of a growth spurt—one that would take the city’s population from just 17,000 in 1850 to more than 260,000 in 1890, a 15-fold increase.¹ Rapid population growth had intensified the problem of how to deal with increasing volumes of rainwater and human waste, so much so that Cleveland’s mayor, Rensselaer Herrick, complained that the Cuyahoga River had become an “open sewer through the center of our city.”²

Herrick’s remark came at the outset of a nearly half-century long program to build out Cleveland’s sewer system. As the 19th century came to a close, city leaders looked to reduce pollution of the Cuyahoga by creating a sewer network that would carry stormwater and human waste far out into Lake Erie.³ Within three decades of Herrick’s lament, Cleveland would have 505 miles of sewers crossing the city.⁴

Sewage treatment would come later. The working theory in many American cities was that dilution of sewage in large bodies of water like Lake Erie would reduce any threat to public health. But advances in science and medicine demonstrated that, even

in diluted form, exposure to human sewage could still harm public health. In response, Cleveland opened its first sewage treatment plant in 1922.⁵ Toledo’s first treatment plant came on line in 1932.⁶

Three quarters of a century later, scientists know much more about the ways in which exposure to contaminants in human sewage can cause disease. Sewage-contaminated water is known to carry an array of bacteria, parasites and viruses that can cause a variety of illnesses—and sometimes death—in those exposed to them. And scientists are still making discoveries. *Cryptosporidium*, the parasite that sickened more than 400,000 people in Milwaukee in 1993, was not identified as a waterborne threat to humans until the early 1980s.⁷ And norovirus, which has been linked to a variety of waterborne disease outbreaks, first came to serious scientific attention only in the 1990s.⁸

Unfortunately, despite the growing scientific understanding of how sewage contamination can impact human health, untreated sewage continues to spill from the sewer systems of Cleveland and many other Ohio cities and towns during moderate and heavy rains. The state-of-the-art

combined sewer systems that Ohio cities built in the late 19th and early 20th centuries are now technological dinosaurs. Even more alarming, the state of Ohio does an inadequate job of ensuring that sewage treatment operators monitor, track and alert the public to the volume of untreated sewage making its way into the state's waterways.

The stakes for public health are difficult to quantify, but they are undoubtedly high. This report reviews the latest scientific evidence—taken from studies in Ohio and elsewhere—linking exposure to sewage-contaminated recreational and drinking water with human health problems. It documents the levels of contamination that have been identified at Ohio's Lake Erie beaches. And it makes the case

for—at the very minimum—ensuring that the public is made aware of combined sewer overflows when they happen.

Much remains undocumented about the links between sewer overflows, beach safety, drinking water quality, the health of the environment and wildlife, and public health in Ohio's Lake Erie basin. But this much is clear: the discharge of vast quantities of untreated sewage into the region's waterways poses a threat to the health of Lake Erie, its tributaries and the millions of people who depend on these waterways for recreation and drinking water. The state and its cities and towns must make a long-term commitment to ending sewage overflows and an immediate commitment to expanding public understanding of when and how they occur.

Sewer Overflows in Ohio's Lake Erie Basin

How Do Sewer Overflows Happen?

Ohio cities and towns with public sewer systems rely on two sewage system designs for dealing with human waste and stormwater runoff. Both types of systems can overflow, resulting in the discharge of untreated human waste to waterways.

“Combined” sewer systems are a vestige of an earlier age of urban development in Ohio. Many towns and cities in Ohio built sewage systems during the late 19th and early 20th centuries to improve sanitary and public health conditions amid rapid urban population growth. These early systems combined sanitary sewage (human waste) with stormwater into a single sewer pipe. Since most sewage went untreated until the early decades of the 20th century, there was little perceived need to separate the two types of waste. (See Fig. 1, next page.)

In recent years, cities and towns have increasingly adopted “separated” sewer systems, in which one pipe handles human waste and another handles stormwater runoff. By separating sewer systems, cities and towns have been able to reduce the volume of waste entering sewage treatment plants

and thus reduce the cost of treatment. However, due to the high cost and great difficulty of replacing existing sewer systems (which usually requires excavation of miles of sewer lines buried under city streets), many cities and towns that originally built combined sewer systems have not yet opted to replace them.

Both combined sewer systems and sanitary sewers are designed to overflow into waterways when they exceed their capacity. (The alternative is for them to overflow into homes and streets.) Sewer systems may also overflow when sewer lines become blocked or when equipment or lines fail. But while wet weather can impact both types of systems, it poses particular problems in combined sewer systems, since the volume of stormwater running off of streets, parking lots and other paved surfaces can frequently overwhelm sewer system capacity.

Untreated sewage can also find its way into waterways as a result of “bypasses,” in which sewage is diverted around some or all of the sewage treatment process and discharged into a waterway. Bypasses can occur when the volume of incoming sewage exceeds the capacity of the treatment plant or as a result of mechanical failure.

Fig. 1. Operation of Combined and Separated Sewer Systems⁹



Why Focus on Combined Sewer Overflows?

While all types of sewer overflows are problematic, combined sewer overflows (CSOs) are a particularly important problem in Ohio. Ohio has the second-highest number of combined sewer outfalls in the nation, with more than 1,300 statewide.¹⁰ CSOs also discharge a far greater volume of water than sanitary sewer overflows (SSOs). The U.S. EPA estimates that between 23,000 and 73,000 SSOs take place nationally each year, discharging between 3 billion and 10 billion gallons of sewage into waterways.¹¹ By contrast, more than 8 billion gallons of combined sewer overflows were discharged into waterways in Ohio's Lake Erie basin alone during 2004.¹²

While this report focuses primarily on CSOs, any direct discharge of human waste to waterways poses the potential for public

health problems. Ohio should address all forms of sewage discharges as it acts to protect the quality of the state's waterways and the health of the public.

Combined Sewer Overflows in Ohio's Lake Erie Basin

There are currently 53 combined sewer systems with overflows in Ohio's Lake Erie basin.¹³ These systems include the Northeast Ohio Regional Sewer District (NEORS), which serves all or part of 60 communities in the Greater Cleveland metropolitan area, including the city of Cleveland itself.¹⁴

At present, the region's combined sewer systems include 623 outfall pipes through which sewage can overflow into Lake Erie or its tributaries during wet weather.¹⁶

CSO-Related Pollution in Ohio's Lake Erie Basin

In 2004, 11 sewer systems in Ohio's portion of the Lake Erie basin discharged more than 8 billion gallons of untreated sewage into waterways from combined sewer overflows. This estimate is far from complete, since it includes only half of the CSO outfall pipes that drain into Lake Erie basin waters. The Northeast Ohio Regional Sewer District in the Cleveland area is responsible for the majority of the CSO discharges, dumping nearly 5.5 billion gallons of untreated sewage from outfall pipes on Lake Erie, the Cuyahoga River and other waterways.¹⁷

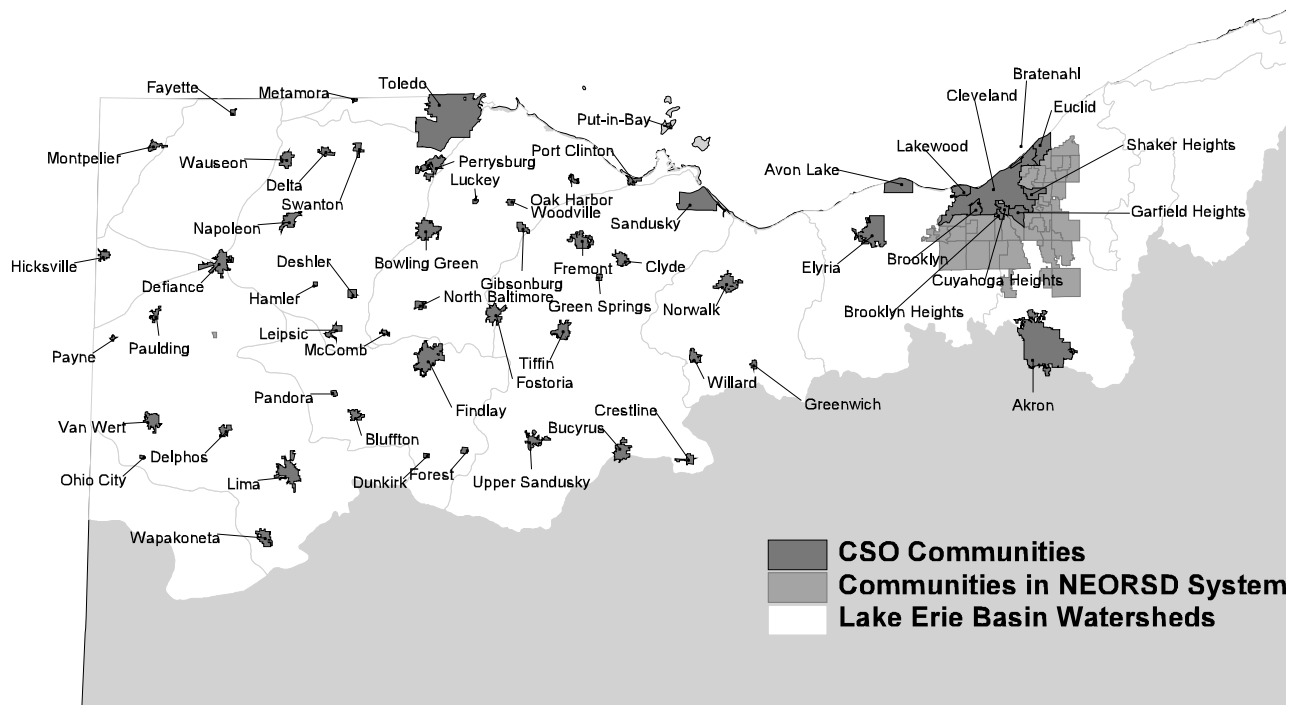
Unfortunately, some CSO communities do not monitor and track their combined sewer discharges, nor does Ohio require a uniform mechanism for reporting sewage overflows. Without tracking and reporting

about sewage pollution, Ohio EPA cannot effectively enforce the Clean Water Act and the public is kept in the dark about health threatening pollution present in local waterways. Without tracking and reporting data, local governments will struggle to convince the public that taxpayer investment is necessary to upgrade failing sewage systems. Finally, the state is left ill-equipped to demonstrate the real need for federal dollars for sewage infrastructure or to demonstrate whether sewage discharges are increasing or decreasing over time.

Pollutants in Combined Sewer Overflows

Combined sewer overflows contain many dangerous pollutants that flow directly—and untreated—into Ohio's waterways.

Fig. 2. Ohio Lake Erie Basin Communities with Combined Sewer Overflows¹⁵



Note: For the Northeast Ohio Regional Sewer District, only communities with outfall pipes are highlighted.

Pathogens

Perhaps the greatest immediate threat posed by CSOs is the danger posed by pathogens present in human waste. Bacteria frequently present in sewage include *E. coli*, *Shigella* and *Salmonella*, all of which are linked with gastrointestinal ailments. Exposure to bacteria in recreational water can also cause pneumonia, bronchitis and swimmer's ear.¹⁸ Sewage also carries viruses, such as Hepatitis A and norovirus (also called Norwalk virus because it first came to attention following an outbreak at a school in Norwalk, Ohio in 1972), and parasites such as *Cryptosporidium* and *Giardia*.

Pathogens such as bacteria, viruses and parasites can be dangerous even at very low doses. Enteric (intestinal) viruses, for example, can be infective at doses of 1 to 10 particles. By contrast, a single individual infected with a virus can emit between 1,000 and 1 trillion particles of virus in a single gram of feces.¹⁹

Toxic Substances

In addition to handling human waste, sewer systems in Ohio also receive millions of pounds of toxic substances that are flushed into sewers from industries and homes. In the event of a sewer overflow, these substances can flow, without filtration or treatment, into local waterways.

In 2003, industries in the eight counties along Lake Erie released more than 24,000 pounds of toxic heavy metals and more than 2.6 million pounds of other toxic chemicals into public sewer systems.²⁰ These releases represent only the tip of the iceberg, since toxic release reporting is only required

of some industries and for a specific set of chemicals. (See Table 1.)

Among the substances released to public sewer systems in northern Ohio are the following:

- **Chromium and chromium compounds:** Chromium is suspected of causing cancer and of being toxic to a variety of bodily organs.
- **Cyanide compounds:** Cyanide compounds are suspected of toxicity to the blood, the endocrine system and the neurological system.
- **Formaldehyde:** Formaldehyde is recognized as a cancer-causing chemical and is suspected of being toxic to other bodily systems.
- **Lead:** Lead is widely recognized for its role in causing developmental problems. It is also linked to reproductive disorders and neurological problems.²¹

Toxic discharges to Lake Erie add to the historical toxic burden that continues to threaten the health of the lake's fish and wildlife. Not all of the toxics flushed into sewers find their way into Lake Erie basin waterways, but some do.

In 1997, for example, testing was conducted on samples from four CSO outfalls in Toledo. Discharge from two of the outfalls tested positive for short-term (acute) toxicity, while discharge from the other two outfalls tested positive for long-term (chronic) toxicity. Copper, lead, silver and zinc were identified as CSO pollutants of concern. In response, Toledo has encouraged industries to reduce their flow of wastewater during times when CSOs are likely to occur.²²

Table 1. Toxic Discharges to Sewer Systems in Counties Abutting Lake Erie, 2003, in pounds

County	Non-Metals	Metals	Total	Examples
Ashtabula	4	330	334	
Cuyahoga	2,046,125	18,387	2,064,512	cadmium compounds, chromium, lead
Erie	55,643	579	56,222	
Lake	1,191	2,393	3,584	chromium, lead
Lorain	206,623	674	207,297	cyanide compounds, lead
Lucas	201,048	1,628	202,676	chromium compounds, formaldehyde
Ottawa	0	0	0	
Sandusky	144,377	639	145,016	lead
Total	2,655,011	24,630	2,679,641	

Potential Health Impacts of Combined Sewer Overflows

The public health impacts of combined sewer overflows in Ohio have never been fully documented. Drawing a conclusive, cause-effect relationship between a particular sewage overflow and specific cases of illness is difficult for a variety of reasons:

- Human sewage is just one source of bacteria and other pathogens in waterways. Because waterways are rarely tested for pathogens that are unique to humans, it is difficult to determine with certainty when sewage is responsible for poor water quality.
- The gastrointestinal illnesses caused by exposure to sewage can also be caused by exposure to contaminated food, direct contact with feces or person-to-person contact. In addition, many of these illnesses do not produce symptoms until hours or days after exposure. As a result, individuals may have no clear idea whether contact with sewage-contaminated water caused their particular illness.
- Illnesses commonly caused by exposure to sewage—particularly gastroenteritis—are often not reported to doctors,

meaning that the public health system is often unaware of their existence.

Only in rare cases—such as outbreaks in which a large number of people fall ill at roughly the same time and share some common experience (such as bathing at the same beach or drinking water from the same source)—is it possible to find the “smoking gun” that connects exposure to contaminated water with a particular case of disease. And even then, it usually takes significant detective work by public health authorities to make the connection.

Scientific studies, disease tracking data, and water testing results in Lake Erie and its tributaries, however, provide ample reason to be concerned about the potential public health impacts of sewer overflows in Ohio’s Lake Erie basin. The available evidence tells us that:

- Exposure to contaminated water makes people sick.
- Outbreaks of waterborne illnesses occur, can be caused by exposure to both recreational and drinking water, and have happened in Ohio.
- Pollution levels associated with human

health problems occur in Lake Erie waters and in waterways that flow into Lake Erie.

- Sewage overflows are among the contributors to water contamination in the Lake Erie basin.

Exposure to Contaminated Water Makes People Sick

Numerous studies in the United States and elsewhere have linked exposure to sewage-contaminated water with a range of illnesses—most commonly gastroenteritis.²³

Waterborne illness—contracted either through recreational contact with water or through ingestion of tainted drinking water—is a major, though often unreported, cause of disease in the United States. A 1994 study estimated that waterborne illness causes 560,000 cases of severe disease and 7.1 million cases of mild to moderate disease annually.²⁴

Contact with polluted recreational water has been repeatedly linked to health problems.²⁵ One recent study of beach-goers at a Cleveland-area beach demonstrates the threat of swimming in contaminated water. The study found that beach-goers who immersed their heads in the water were about 40 percent more likely to report diarrhea, vomiting, nausea or stomachache afterwards compared to those who had no contact with the water. The risk of falling ill increased as concentrations of enterococci (an alternative water quality indicator to *E. coli*) in the water increased—indicating the presence of pollution.²⁶

Drinking contaminated water has also been linked to a startlingly high percentage of gastrointestinal illnesses. One recent study in the U.S. compared disease rates among households using a functional water filter versus households equipped with a “sham” filtering device. Residents of the households using the sham device were more likely to contract gastrointestinal illnesses than those in households using the

working water filter. The study estimated that about 24 percent of gastrointestinal illnesses could be attributed to drinking water, though the study did not include enough households to make a statistically significant finding about the impact of drinking water on health.²⁷

Interestingly, the water used by both groups of households—including the one with elevated rates of disease—met current U.S. health standards. The results of the study approximated those from an earlier Canadian study that attributed a statistically significant 35 percent of gastrointestinal illnesses to drinking water.²⁸

Outbreaks of Waterborne Illnesses Occur, Are Caused by Exposure to Recreational or Drinking Water, and Have Happened in Ohio

Because waterborne illnesses are typically underreported to public health authorities, data on actual outbreaks of waterborne disease represent only the “tip of the iceberg” of the impacts on public health. Nonetheless, U.S. and Ohio public health authorities have identified a disquieting number of waterborne disease outbreaks in recent years.

Outbreaks of waterborne disease are defined by the U.S. Centers for Disease Control and Prevention (CDC) as having occurred when two or more people contract a similar illness after exposure to water and when evidence implicates exposure to water as the probable cause. In 2001 and 2002, the U.S. Centers for Disease Control and Prevention (CDC) documented 65 outbreaks of illness nationwide resulting from contact with recreational water—the highest number since the CDC began tracking recreational waterborne illness in 1978. Of those outbreaks, 21 occurred as a result of contact with fresh water (as opposed to treated water from pools and spas),

causing 280 people to fall ill.²⁹ In addition, the CDC documented 31 outbreaks of waterborne disease associated with drinking water in 2001-2002, which caused more than 1,000 illnesses and seven deaths.³⁰

Waterborne disease outbreaks have also occurred in Ohio. Between 1999 and 2003, the Ohio Department of Health (ODH) identified nine outbreaks of waterborne disease (which include both drinking water and recreational water), as well as 75 disease outbreaks of unspecified origin.³¹

Several specific outbreaks of waterborne disease in recent years demonstrate the potential for health damage when human waste is permitted to enter recreational or drinking water supplies.

Milwaukee *Cryptosporidium* Outbreak

In 1993, approximately 400,000 people in Milwaukee, Wisconsin became sick and 69 died when municipal drinking water drawn from Lake Michigan was contaminated with the parasite, *Cryptosporidium*.³² Run-off from farms and sewage discharge can both carry *Cryptosporidium*. But the type of *Cryptosporidium* found in stool samples from several victims of the Milwaukee outbreak was of the type seen in human waste, leading some researchers to conclude that sewage discharge was at least a major contributing cause of the outbreak.³³

Wisconsin Beach Outbreak

In Wisconsin in 2002, 44 people who swam at a Lake Michigan state park contracted gastrointestinal ailments, along with 22 others who visited the park. The outbreak was primarily attributed to exposure to norovirus (also known as Norwalk virus), as well as to the parasite, *Cryptosporidium* and the bacterium, *Shigella*.³⁴

Ohio South Bass Island Outbreak

In the summer of 2004, South Bass Island was struck by an outbreak of gastrointestinal

illness, with more than 1,400 cases reported among visitors and residents. The outbreak was linked to exposure to a range of contaminants associated with human sewage, including *Campylobacter* bacteria, norovirus (Norwalk virus), *Giardia* and *Salmonella*.

A subsequent investigation by the Ohio Department of Health determined that the outbreak was likely caused by drinking contaminated water or ice. Drinking water wells on the island tested positive for *E. coli* bacteria—often a marker for the presence of human pathogens.³⁵ While the island's water treatment system was found to be working properly, investigators did discover a number of illegal "cross-connections" that could have brought tainted well water into the water system.³⁶

Investigators have not been able to determine with certainty how the groundwater of South Bass Island became contaminated. Among the possibilities are the disposal of sewage underground in improperly sited septic systems and the intrusion of contaminated water from Lake Erie.³⁷

Pollution Associated With Human Health Problems Occurs in the Lake Erie Basin

Bacteria, parasites and viruses associated with human health problems have been found in Lake Erie and its tributaries.

***E. coli* Testing at Beaches**

Ohio's Lake Erie beaches are frequently contaminated during summer months with levels of *E. coli* bacteria associated with higher rates of illness. Ohio's beach testing program involves testing of water samples for *E. coli* bacteria. High levels of *E. coli* in water are correlated with higher rates of gastrointestinal illness among swimmers.³⁹

E. coli testing results form the basis of Ohio's beach advisory system. Historically, the Ohio Department of Health (ODH)

Incidence of Bacterial, Viral and Parasitic Illnesses in Ohio

Bacterial, viral and parasitic illnesses affect thousands of Ohio residents every year. The Ohio Department of Health (ODH) collects data on the reported incidence of some infectious diseases that can be contracted through exposure to sewage-contaminated water (as well as other sources of exposure). (See Table 2.) The ODH data reflect only reported incidences of disease, which likely understate the number of Ohioans who suffer from these illnesses.

Table 2. Cases of Selected Reportable, Infectious Illnesses in Ohio, 2003³⁸

County	<i>Campylobacteriosis</i>	<i>Cryptosporidiosis</i>	<i>E Coli O157:H7</i>	<i>Giardiasis</i>	<i>Salmonellosis</i>	<i>Shigellosis</i>	<i>Vibriosis, non-cholera</i>	<i>Hepatitis A</i>
Ashtabula	13	1	0	9	15	0	0	0
Cuyahoga	154	6	13	90	164	28	2	22
Erie	4	0	0	2	8	0	0	0
Lake	34	1	1	24	33	3	0	4
Lorain	23	2	6	17	26	1	0	3
Lucas	56	2	0	46	57	7	0	2
Ottawa	4	0	1	1	5	0	0	0
Sandusky	7	0	2	13	9	1	0	0
State Total	1265	173	132	903	1326	301	6	171

has recommended that beach advisories be issued on the basis of the geometric mean of *E. coli* results from the five most recent tests. The geometric mean method provides a good way to monitor overall trends in *E. coli* levels, but it does an inadequate

job of predicting whether the water at a particular beach will be safe for swimming on a particular day.

As a result, for the 2006 swimming season, ODH will move to a single sample standard for the issuance of beach advisories.

It is this single sample standard that we use to evaluate the testing results for *E. coli* presented below.

From 2000 to 2005, approximately 5,600 water samples were taken at 21 Lake Erie beaches in Ohio to test for levels of *E. coli* bacteria. Tests occurred only during the swimming season, beginning around Memorial Day and ending around Labor Day. Of those 5,600 tests, 972, or nearly one out of six, detected levels of *E. coli* exceeding the U.S. EPA's single-sample standard for fresh-water swimming of 235 colonies per 100 milliliters of water—the standard that will be used beginning in 2006 to determine the safety of Ohio's Lake Erie bathing waters.⁴⁰

The beaches with the greatest percentage of tests showing excessive levels of *E. coli* are located in Port Clinton, Lorain and Cleveland. (See Table 3.) The variation in the number of tests exceeding the single-sample *E. coli* standard shows that local conditions—possibly including the location of sewage outfalls—can have a strong impact on *E. coli* levels on beaches

The degree to which bacteria levels exceed water quality criteria varies as well. That is, some beaches experience higher spikes of bacteria levels at certain times, e.g. after a rainfall. Villa Angela State Park in Cleveland had the highest mean concentration of *E. coli* from 2000 to 2005, with average *E. coli* concentrations more than

Table 3. Exceedences of *E. Coli* Guidelines at Ohio Beaches, 2000-05⁴¹

Beach	Tests Exceeding Single Sample <i>E. coli</i> Limits	Total Tests	Pct. Exceeding
Century Beach, Lorain	190	231	82.3%
Camp Perry, Port Clinton	183	260	70.4%
Edgewater State Park, Cleveland	208	415	50.1%
Catawba Island State Park, Port Clinton	99	255	38.8%
Euclid State Park, Cleveland	60	265	22.6%
Conneaut Township Park	50	260	19.2%
Lakeview Beach, Lorain	27	236	11.4%
Villa Angela State Park, Cleveland	34	414	8.2%
Fairport Harbor	27	335	8.1%
Crane Creek State Park, Oak Harbor	20	257	7.8%
Lakeshore Park, Ashtabula	19	263	7.2%
East Harbor State Park, Lakeside-Marblehead	13	257	5.1%
Maumee Bay State Park (Lake Erie beach), Toledo	11	286	3.8%
Headlands State Park East, Mentor	11	335	3.3%
Geneva State Park, Geneva	5	261	1.9%
Headlands State Park West, Mentor	6	331	1.8%
Port Clinton	5	295	1.7%
Lakeside Beach, Lakeside-Marblehead	4	254	1.6%
South Bass Island State Park	0	69	0.0%
Walnut Beach, Ashtabula	0	261	0.0%
Kelley's Island State Park	0	62	0.0%

Indicator Bacteria

To protect swimmers from contact with sewage-contaminated water, local and state officials monitor levels of *E. coli* bacteria in Lake Erie recreational waters during swimming season. Some strains of *E. coli* are pathogenic, but *E. coli* is also thought to be an indicator of the presence of human waste in water—and, therefore, the potential presence of other pathogens in sewage.

A variety of studies over the course of several decades have found a statistical relationship between the presence of *E. coli* in water and swimming-related ailments. Research has found that pathogen levels tend to be higher in waters with high levels of *E. coli* than in waters that meet water quality standards.⁴² Monitoring for *E. coli* has the advantage of being easier and less expensive than monitoring for the whole suite of pathogens that can impact human health.

However, *E. coli* is not a perfect indicator of when pathogens may be present in water. It is also an inadequate indicator of when human sewage is present in water.

Research has found that some pathogens, particularly viruses and parasites, persist in water for longer periods of time than bacteria such as *E. coli*.⁴³ In addition, *E. coli* monitoring only indicates the presence of fecal-oral pathogens and not other substances—such as toxic metals, pesticides, toxic algae, or pathogens that cause ailments such as swimmer's ear or skin rashes.

Recent research in the Great Lakes basin has also led to questions about the connection between the presence of *E. coli* and the presence of human waste in water. Runoff from farms and gull droppings deposited directly on beaches are now thought to be significant sources of *E. coli*.⁴⁴ Indeed, some scientists now suspect that *E. coli* can persist and even reproduce in the environment.

Thus, while testing for *E. coli* is a useful way to warn the public about potential health threats from swimming in contaminated water, it is not a foolproof measure.⁴⁵ Direct testing for pathogens can enrich understanding about the health threats posed by exposure to contaminated water and, in some cases, can help determine the role of sewage discharges in causing the contamination.

two times higher than the *E. coli* standard. Those levels are the result of dramatic, though infrequent, short-term spikes in *E. coli* concentrations at the beach.

Direct Testing for Pathogens in the Lake Erie Basin

Testing for *E. coli* bacteria provides a good indication of when water contains pollution levels that pose a human health risk. But it is not a perfect indicator (see “Indicator Bacteria,” above), and direct testing for viruses, parasites and harmful bacteria

can provide a clearer picture of the health threats present in Ohio waterways.

A detailed study of water quality in the Cuyahoga River in 2000 and 2002 tested water in the river for a variety of pathogens. Nearly three quarters (73 percent) of the samples analyzed tested positive for infectious enterovirus, 20 percent tested positive for Hepatitis A, and more than 50 percent tested positive for *Salmonella*. The study detected all three pathogens in some samples that met Ohio's standard for “secondary contact” recreation (e.g. boating and fishing), which is more lenient than

the bathing water standard. Unfortunately, only a small number of the samples taken from the Cuyahoga complied with the bathing water standard and none of them were analyzed for the presence of specific pathogens, meaning that no conclusions could be reached about whether pathogens were present in water that met the bathing water standard.⁴⁶

Parasites, such as *Giardia* and *Cryptosporidium*, are also sometimes present in waters of the Lake Erie basin. The Cuyahoga River study mentioned above found *Giardia* in 44 percent of water samples in the Cuyahoga River. *Cryptosporidium* was not found.⁴⁷ Sampling of water at drinking water intakes for the Cleveland Division of Water in 1997 and 1998 found *Cryptosporidium* and *Giardia* in a relatively small number of samples.⁴⁸ Cleveland draws its drinking water directly from Lake Erie.

Sewage Overflows Are Among the Contributors to Health-Threatening Contamination in Ohio's Lake Erie Basin

Sewage overflows result in the dumping of billions of gallons of untreated sewage and stormwater into the waterways of Ohio's Lake Erie basin each year. Contamination consistent with the presence of human sewage occurs at Lake Erie beaches and viruses associated with human waste have been found in the Cuyahoga River.

However, much remains unknown or undocumented about the degree to which sewer overflows affect drinking water and recreational water quality. As noted earlier, at least two studies suggest that drinking water that meets health standards may result in higher rates of gastrointestinal illness. And standards for recreational

water quality are based on *E. coli*, which is an imperfect indicator of the presence of human sewage in waterways.

Recent research, largely conducted by the U.S. Geological Survey (USGS), has attempted to identify the sources of *E. coli* contamination that indicates potential threats to the health of Ohio beachgoers. The results paint a complex picture of how *E. coli* levels at Lake Erie beaches become elevated, but they suggest that human waste may be a contributor to high *E. coli* levels at some beaches.

- **Lakeshore Beach, Ashtabula** – USGS researchers determined that local sources, including runoff from a parking lot, could be responsible for high *E. coli* levels at the beach. Testing of *E. coli* for antibiotic resistance (indicative of human origin) suggests that, during days of only local rainfall, gull droppings may be the primary source of *E. coli* on the beach, but that on days of more widespread rainfall, *E. coli* could result from a mix of sources, including humans.⁴⁹
- **Edgewater Beach, Cleveland and Lakeview Beach, Lorain** – USGS research found high levels of *E. coli* at the mouths of the Cuyahoga and Rocky rivers in Cleveland, both of which receive CSO discharge. However, the study also found that local sources, and not river discharge, were likely the cause of high *E. coli* levels at Edgewater Beach. At Lakeview Beach in Lorain, antibiotic resistance testing suggested that gulls were the primary source of high *E. coli* levels.⁵⁰
- **Maumee Bay State Park, Toledo** – A USGS study documented high levels of *E. coli* at the mouth of the Maumee River (which receives CSO discharge from Toledo) and at the mouth of a ditch near Maumee Bay State Park. The study concluded that the ditch was a primary source of *E. coli* at the beach.⁵¹

The USGS studies document the complexity of determining how sewage overflows and other specific types of pollution impact public health. They also hint at the many important questions scientists have yet to answer about sewage overflows, contaminated water and public health, including:

- How long do pathogens in sewage persist in waterways and do they pose a threat even after *E. coli* levels in waterways return to normal?
- How do pathogens from sewage travel in large, complex water bodies like Lake Erie and how do environmental conditions (such as wind direction and currents) affect contamination levels at any particular beach?
- What is the relative contribution of sewage pollution to public health threats posed by water contamination

in the Lake Erie basin compared to the many other sources of pollution—including runoff from city streets and farm fields, bird droppings, contamination from swimmers, and storage of bacteria in sediments—that potentially affect the basin’s waterways and its beaches?

While these and other questions remain unanswered, the large volume of untreated waste discharged into waterways in Ohio’s Lake Erie basin, the unquestioned presence of human pathogens in that waste, and the detection of troubling levels of *E. coli* and other contaminants in Lake Erie and other waterways argue for Ohio to take a precautionary approach to sewage discharge based on prompt public notification and concerted action to reduce any threat to public health.

Recommendations: Reducing the Health Impacts of Sewer Overflows in Ohio

Sewer overflows pose a significant potential threat to the health of those who swim or recreate in Ohio's Lake Erie basin. Overflows also result in the release of pathogens and other contaminants into the drinking water sources for Ohio communities—raising a potential threat to drinking water as well.

Eliminating sewer overflows is a long-term process that should begin now. Indeed, 13 Ohio communities have already eliminated their CSOs and other CSO systems in the state have begun the long process of upgrading their antiquated sewer system.

In the meantime, the state of Ohio, municipalities and sewage systems can take several steps to protect the health of the public.

Notify the Public About Sewer Overflows

The potential for health problems related to exposure to sewage-contaminated water and the scientific uncertainty about how pathogens find their way into waterways

and how long they stay there argue for a comprehensive, real-time approach to notifying Ohio residents about the occurrence of sewer overflows in their communities.

Ohio's system for tracking and notifying the public about sewer overflows is the weakest in the Great Lakes states. There are no consistent requirements for communities to track or notify the public about combined sewer overflows. Communities face variable requirements for reporting overflows, with some reporting monthly, some annually and some still not reporting at all. There is no annual statewide report on sewer overflows and data on overflows are difficult to obtain, where they are available at all.⁵² The lack of consistent statewide standards leaves the task of disclosing overflows to local sewage authorities and departments of health. While a few Ohio cities do a reasonably good job of notifying the public about sewer overflows, or at least making the information available on a Web site, many do not.

Other Great Lakes states do a far better job. Michigan, for example, requires notification of the media, downstream communities, local health departments and the state within 24 hours of any sewage overflow. After dumping has ended, sewage

authorities must provide detailed data about the size, nature and reason for the discharge. This information is then compiled on a statewide Web site and used to produce an annual report of combined and sanitary sewer overflow events.⁵³ While Michigan's program is imperfect, it, and those of the other Great Lakes states, far surpass Ohio's program in providing important and timely information to the public.

Ohio should create a comprehensive sewage overflow notification program that includes the following elements:

Tracking

- Sewage treatment utilities must consistently measure and report all sewage that overflows from their sewer systems. This tracking should be done on a consistent basis throughout the state using forms provided by the Ohio EPA that can be submitted electronically.
- Sewage treatment utilities should test the quality of waterways that have received sewage overflows.

Reporting

- Sewage treatment utilities must immediately and consistently report sewage overflows to the Ohio EPA and the Ohio Department of Health.

Public Notification

- Sewage treatment utilities must post clear and informative signs at each sewage overflow point and at affected areas where the public has access to the waterways.
- Sewage treatment utilities should notify the local media (radio, television, and newspaper) and post information to their Web sites when a sewage overflow occurs, detailing the location and quantity of sewage that has overflowed and the actions the public should take to protect their health.

- Sewage treatment utilities should produce and distribute an annual report detailing the number of sewage overflows and the quantity of sewage that has been discharged, and providing information about the waterways impacted.
- Sewage treatment utilities should launch public education efforts to teach citizens how to avoid sewage overflows.
- The Ohio EPA should compile all reporting from sewage treatment facilities and post the information on its Web site.
- The Ohio EPA should send an e-mail notification to all interested parties when sewage overflows occur.
- The Ohio EPA should develop a statewide toll-free telephone hotline with timely information about sewage overflows.
- The Ohio EPA should produce and distribute an annual report with a compilation of the quantity of the state's sewage overflows, the quantity of sewage discharged and information about the impacted waterways.

Reduce the Volume of Stormwater that Causes Combined Sewers to Overflow

While the discharge of raw human sewage is the most dangerous result of combined sewer overflows, sewage itself doesn't cause sewer overflows. Rather, it is the flow of millions of gallons of stormwater into sewer systems after rain events that triggers the overflows that threaten human health in the Lake Erie basin and elsewhere in Ohio.

The immense volume of stormwater that

flows into sewer systems is, in part, the result of development. Open, vegetated spaces absorb rain and channel the water into the ground, where it slowly makes its way into aquifers, rivers, lakes and streams. Covering these open spaces with roofs and concrete and asphalt pavement leaves this water nowhere to go except into sewer systems. By taking “soft path” approaches to reducing stormwater runoff such as using porous paving materials, preserving natural buffers, collecting and storing rain water for later use, and creating vegetated stormwater retention and treatment facilities, Ohio communities can reduce the amount of stormwater that floods sewer systems during moderate to heavy rains.

Ohio municipalities should—with the help of the state—adopt ordinances and practices that promote “soft path” approaches to stormwater pollution. By doing so, the state and its cities and towns can reduce the strain on aging sewage treatment plants and reduce the potential for combined sewer overflows.

Eliminate Sewer Overflows Over Time

There is no technological barrier to eliminating sewer overflows in Ohio. The main barrier is cost. The remaining Ohio communities with combined sewer overflows should develop plans to eliminate CSO discharges entirely within the foreseeable future, either through sewer separation or the construction of holding facilities to retain sewer overflows until they can be properly treated. Communities that commonly experience sanitary sewer overflows should undertake prompt action to deal with any capacity, maintenance or operation problems that contribute to the overflows. Federal, state and local governments should make the necessary financial commitments to end the discharge of untreated sewage into Ohio waterways.

Improve Ohio’s Beach Monitoring and Advisory System

One way in which Ohio residents are potentially exposed to sewage pollution is by swimming at Ohio’s Lake Erie beaches. Ohio has made significant efforts to determine when water quality at beaches is unhealthy and the recent change to a single-sample standard for *E. coli* will further improve those efforts. However, there is much more that Ohio can do to improve protection for beach-goers.

- Sewage treatment utilities and local boards of health should notify the public when a sewer overflow has the potential to threaten the health of swimmers.
- The state of Ohio should adopt stronger and more accurate language for its beach advisory signs. The state’s suggested language for beach advisories states that “Children, elderly, and those in ill health are advised not to swim.”⁵⁴ In fact, the U.S. EPA’s criteria for *E. coli* are based on levels that are appropriate for the general population.⁵⁵ Indeed, some have suggested that more stringent guidelines may be necessary to protect children and other susceptible individuals.⁵⁶ The state’s current advisory signs can leave the false impression that only children, the elderly and those in ill health are susceptible to disease from swimming in contaminated water. Ohio should adopt language for its beach advisories that more accurately conveys the risks to swimmers.

Wisconsin, for example, has a color-coded system of warning signs: a green informational sign posted when water quality is within standards; a yellow “caution” sign that warns that “increased risk of illness may be present based on recent monitoring for *E. coli* bacteria” and advises swimmers to “swim at your own risk”; and a red

“closed” sign posted when bacteria levels are severely elevated warning swimmers that “serious risk of illness may be present.”⁵⁷

- Ohio should consider whether extremely high levels of bacteria warrant the closing of beaches. Currently, the Ohio Department of Health does not have the power to close a beach, or even to issue an advisory itself. Rather, it must recommend issuance of an advisory to local beach managers, who then have the final say.
- The state should investigate ways to expand the beach monitoring program to seven days per week for beaches with consistent water quality problems. Expanding the monitoring program would provide more timely and accurate information to weekend beach-goers.
- The state should continue to investigate rapid testing procedures that will give the public more timely and accurate information about health threats at beaches. It typically takes 18 to 24 hours to process water samples to detect the presence of *E. coli*. As a result, high *E. coli* levels one day can trigger advisories no sooner than the next day. The U.S. EPA and others are working to develop rapid testing procedures and predictive modeling that would allow beach advisories to be issued on the same day as excessive bacteria levels are found. One such measure will be tested this summer at Huntington Beach in Bay Village.⁵⁸

Great Lakes Restoration: An Opportunity for Resources and Innovation

Sewage dumping is a major problem throughout the Great Lakes region. Since all Great Lakes basin residents are dependent on an interconnected source of water and since the Great Lakes have such a high concentration of sewage dumping, a coordinated regional solution is needed. Fortunately, an unprecedented coalition of environmental and conservation organizations—the Healing Our Waters (HOW) - Great Lakes Coalition—was formed to advocate for restoration of the Lakes. This coalition recently worked with the EPA-led Great Lakes Regional Collaborative to develop a consensus Great Lakes Restoration plan, which was submitted to Congress in December 2005.

One major goal of the plan—which was developed by government officials, wastewater treatment plant operators, industry officials and environmental organizations—is to achieve the “virtual elimination” of sewage dumping in the Great Lakes. The plan would provide additional money to deal with sewer overflows but would emphasize “soft path” approaches to reducing stormwater runoff. If the restoration plan is acted on in Congress and in the Great Lakes states, this unprecedented approach and collaboration has the potential to turn the tide and put an end to sewage dumping in the lakes.

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