

# Testing the Waters

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June 2014, 24th Edition

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## GREAT LAKES SUPPLEMENT



The people of the Great Lakes region are justifiably proud of their beautiful lakeshore beaches. However, these beaches are threatened by pollution and major environmental stresses that can contaminate beach water and make people sick. In 2013, the Great Lakes region had the highest exceedance rate of regions with coastal and Great Lakes beaches, 13 percent, of the Environmental Protection Agency's most protective benchmark for assessing swimmer safety, known as the Beach Action Value, or BAV.

### PROTECTING SMALL AND SEASONAL STREAMS AND WETLANDS

By removing pollutants from water that passes through them, and by retaining stormwater that often causes pollution problems, wetlands and small streams help ensure that the Great Lakes remain safe for swimming and fishing. For years the Clean Water Act protected all wetlands and tributaries in the Great Lakes region—those by lakeshores and those inland. As detailed elsewhere in this report, those protections were cast in doubt as a result of Supreme Court decisions in 2001 and 2006 and subsequent agency guidance issued by former President George W. Bush. The Obama administration recently released a draft rule to address this lack of clarity and ensure that important surface waters are protected from pollution by the Clean Water Act.

Unfortunately, the Great Lakes region has already lost approximately 66 percent of its historic wetlands. Ohio has lost 90 percent, the second-highest loss rate in the nation; Illinois has lost 85 percent of its wetlands. Moreover, an estimated 90 percent of the wetlands remaining in the Great Lakes are at increased risk due to the uncertainty over whether they are subject to Clean Water Act safeguards. Because about 50 percent of the streams in Ohio, Michigan, Illinois, Wisconsin, and Minnesota do not flow all year, they too have been at risk of increased pollution and destruction because of a lack of clarity about their status under the law.

This uncertainty has taken its toll, slowing permitting decisions for responsible development and reducing protections for drinking water supplies and critical habitat.

Protecting these water bodies is not only important to beach water quality, but also critical to the goals of the Great Lakes Regional Collaboration Strategy and the Great Lakes Restoration Initiative. The former's goals, to restore a million acres of high-quality wetlands in the region and increase natural buffers for rivers and streams, would be significantly undermined by leaving the region's remaining intact wetlands and streams at risk. The Great Lakes Restoration Initiative has successfully invested hundreds of millions of dollars across the basin to restore degraded habitats. Those investments depend on healthy upstream waters.

### THE TOLL OF CLIMATE CHANGE

According to the National Climate Assessment, "climate change will exacerbate a range of risks to the Great Lakes, including changes in the range and distribution of certain fish species, increased invasive species and harmful blooms of algae, and declining beach health."<sup>1</sup>

The impacts of climate change on water systems—changes in precipitation patterns and intensity, greater incidence of drought, increasing evaporation and water temperatures, reductions in lake and river ice, changes in soil moisture and runoff—are increasingly evident in the Great Lakes region.<sup>2</sup> These shifts are magnified by other factors, including aging and failing infrastructure, runoff pollution, and invasive species.

The National Climate Assessment finds that the frequency of extreme storms—those delivering more than 3 inches of precipitation in 24 hours—will continue to increase in both number and intensity.<sup>3</sup> In southern Wisconsin, extreme precipitation events are projected to become 10 to 40 percent stronger; in Illinois, heavy downpours are already twice as frequent as they were a century ago; and Ohio is projected to have 30 percent more winter and spring precipitation, which could increase flooding risks to floodplain communities.<sup>4,5,6</sup>

Water levels in the Great Lakes are expected to return to almost normal levels in 2014, due to the near-record ice cover caused by below-normal winter temperatures. But lower water levels remain a long-term concern because of the irregular weather patterns over the past decade. The average annual maximum ice coverage from 2003 to 2013 was less than 43 percent, far lower than the 1962–2013 average of 52 percent.<sup>7</sup>

Reduced ice cover can have large impacts on the health of the Great Lakes. Less ice means more light penetration, which promotes algae growth and the survival of invasive species. Without ice and snow coverage, the lakes also suffer from water loss due to increased evaporation. Stable ice that once prevented shoreline and wetland erosion is disappearing—and, with it, parts of our beaches.<sup>8</sup> Known for its signature perched dunes, Michigan's Sleeping Bear Dunes National Lakeshore is one of many Great Lakes parks vulnerable to increased erosion. The loss of winter ice and snow cover renders the dunes' sands more vulnerable to wind and exposes the bluffs to undercutting waves.<sup>9</sup>

## FAILING INFRASTRUCTURE

The Great Lakes region also faces threats from outdated and failing infrastructure. The American Society of Civil Engineers' *2013 Report Card for America's Infrastructure* gave the nation's aging wastewater system a grade of D-plus. In the eight Great Lakes states, the report says, \$100.6 billion in wastewater infrastructure investment is needed over the next 20 years to achieve a basic level of functionality.<sup>10</sup> This infrastructure is especially susceptible to the impacts of climate change because its design is based on historical patterns of precipitation and streamflow, which are no longer reliable indicators of future needs.<sup>11</sup>

Crumbling and outmoded infrastructure causes several problems that can pollute Great Lakes beaches. For one, aging sanitary sewer systems can leak or allow stormwater to infiltrate, causing overflows or treatment facility bypasses. These system failures often lead to human waste in our waterways. Beyond that, many cities have stormwater systems that simply dump polluted runoff from buildings, streets, and parking lots into nearby water bodies; this stormwater commonly picks up fecal matter, pesticides, and other pollutants before flowing into the sewers. As high-intensity storm events occur more frequently, heavy rainfall will flush even more pollutants into waterways.<sup>12</sup>

In addition, there is the problem of combined sewer systems. In dry weather and small storms, combined sewers collect sanitary sewage and stormwater runoff within a single pipe system and route the mixture to sewage treatment plants. When heavier rainfall overwhelms these systems, they are designed to discharge untreated wastewater from outfall locations into local waterways. Although this approach can prevent sewage from flooding homes and businesses, it also causes serious contamination problems that can threaten public health. More than 70 percent of all combined sewers in the United States are located in the Great Lakes region.<sup>13</sup> Of the five states with the highest number of outfall locations, four of them—Ohio, Indiana, Pennsylvania, and Illinois—have Great Lake shorelines.<sup>14</sup> In 2010, these outfalls, along with those in Michigan, Wisconsin, Minnesota, and New York, released 18.7 billion gallons of combined sewage and storm runoff into the Great Lakes.<sup>15</sup>

Unless infrastructure improvements are made to capture stormwater, the instances of combined sewer overflows will increase with increased extreme rainfall event frequency.<sup>16</sup> In southern Wisconsin, the frequency of combined sewer overflows is expected to rise 50 to 120 percent by the end of the century.<sup>17</sup> The problem of increasing volumes of combined sewage is so acute in Chicago that runoff has caused the Chicago River to reverse its flow. In the past six years, the river has reversed eight times, sending more than 20 billion gallons of contaminated water into Lake Michigan.<sup>18</sup>

## THREATS TO HUMAN HEALTH

Despite the size of the Great Lakes, pollution pouring into lake waters is a threat to human health. Untreated sewage can contain more than 120 viruses, two of which, giardia and cryptosporidium, can cause intestinal illnesses and even death.<sup>19</sup> These viruses and pollutants don't simply disappear under the lakes' surface. For example, in a study of four Ohio beaches, researchers frequently found *Arcobacter*, a pathogen associated with human and animal fecal contamination, at each beach. *Arcobacter* is known to cause gastrointestinal disease in humans.<sup>20</sup>

Pollutants released into surface waters in the Great Lakes Basin increased by 12 percent from 2010 to 2011. Most of these were nitrates and pesticides from municipal wastewater treatment plants and agricultural sources. Primary metals facilities—such as iron and steel mills and smelters—and food and beverage manufacturers can also contribute nitrate pollution.<sup>21</sup>

As increasing temperatures reduce water levels and increasing storm events dump more pollutants into the Great Lakes, it is expected that climate change will increase the concentration of pollutants in the Great Lakes as well as instances of beach contamination and closings in the future.<sup>22</sup>

## INVASIVE SPECIES AND ALGAE

The National Climate Assessment identifies increasing numbers of invasive species as one of three primary threats to the Great Lakes Basin's natural ecosystems.<sup>23</sup> More than 180 invasive plants and animals are in the basin; the Aquatic Nuisance Species (ANS) Task Force estimates that the 15 most recent introductions of invaders could cost the United States \$134 billion by 2050.<sup>24</sup> The fight to limit zebra mussels in the 1990s took \$4.9 billion from the regional economy.<sup>25</sup> But far more costly are the potential threats to the lakes themselves. There is growing evidence that broad changes in the freshwater environment of the Great Lakes brought about by invasive species are promoting conditions that nurture bacteria, including *E. coli*, thereby deepening the threat.<sup>26</sup>

Healthy lakes are often murky, but efficient filter feeding by quagga and zebra mussels have eliminated so much phytoplankton and other microorganisms that they have quite literally cleared the water in many Great Lakes. Though that sounds good, it has allowed sunlight to penetrate to the bottom of the lakes, encouraging aquatic plant growth on formerly barren lake beds.

The most public invasive species threat to arrive in the region comes from Asian carp, which could reach the lakes from the Mississippi River Basin via Chicago's waterways and other connected bodies of water. Asian carp feed in a fashion similar to quagga and zebra mussels. Millions of dollars have been spent to keep the fish at bay, but at this time an electric barrier in the suburbs outside Chicago stands as the Great Lakes' last defense, despite a troubling and ineffective history.<sup>27,28</sup> Researchers are concerned that populations of Asian carp could establish themselves in portions of the Great Lakes, decimating native fish populations and compounding the ecological damage already inflicted by quagga and zebra mussels.<sup>29</sup> There is also the safety threat posed by 60-pound fish prone to jumping out of the water when startled.<sup>30</sup>

Temperature increases associated with climate change, including both rising overall temperatures and more extreme temperature fluctuations, also contribute to nutrient-fueled algal growth in the Great Lakes.<sup>31</sup> *Cladophora*, a green alga found in the Great Lakes, thrives in warmer temperatures. When toxic clumps of *Cladophora* wash onto beaches, they become smelly breeding grounds for bacteria such as *E. coli*, enterococcus, and type-B *botulinum*, creating high pathogen counts and triggering beach closures.<sup>32</sup> *Cladophora* is also a threat to wildlife that depends on the Great Lakes. In the fall of 2012, nearly 900 loons died while migrating south across Lake Michigan. Scientists believe that botulism fostered by the algae-rich environment worked its way up the food chain from tiny worms and invertebrates to the loons. Low water levels and high temperatures intensify these botulism outbreaks.<sup>33</sup>

Cyanobacteria (blue-green algae), which produce the hepatotoxin microcystin, pose another health threat. Acute exposure to the toxin can lead to gastrointestinal illness, while chronic exposure can result in liver disease and damage and possible tumor promotion.

Unfortunately, monitoring harmful algal blooms and their toxins is difficult, and methods for doing so are still under development.<sup>34</sup> None of the Great Lakes states currently have harmful algal bloom monitoring in place to protect swimmers.<sup>35</sup>

## GREAT LAKES BEACH WATER MONITORING FOR 2013

**Table GL-1: How Great Lakes States Compare Nationally by Percentage of Beach Water Samples Received Exceeding the BAV safety threshold in 2013**

National Rank (of 30 States)	Percent Exceedance	State	2013 Total Samples	Beaches with Reported Monitoring Results
7	6%	Michigan	9,704	237
9	8%	Minnesota	1,212	53
15	10%	Illinois	4,358	49
20	13%	New York	10,189	360
21	13%	Indiana	2,905	32
22	14%	Pennsylvania	1,042	10
23	14%	Wisconsin	3,512	101
30	35%	Ohio	2,726	60

In 2013, Great Lakes states reported 902 coastal beaches. Across the region, 13 percent of all reported beach monitoring samples exceeded the Beach Action Value (BAV) of 190 *E. coli* bacteria colony forming units (cfu) per 100 ml freshwater in a single sample. NRDC considers all reported samples individually (without averaging) when calculating the percent exceedance rates in this analysis. This includes duplicate samples and reported samples taken outside the official beach season, if any.

The beaches with the highest percent exceedance rates of the BAV in 2013 were in Ohio: Lakeview Beach in Lorain County (76%), Bay View West in Erie County (70%), Whites Landing in Erie County (62%), Edgecliff Beach in Ohio County (62%), Clarkwood Beach in Cuyahoga County (61%), and Sims Beach in Cuyahoga County (61%). Other beaches with exceedance rates of at least 50% included two beaches in New York, Wright Park East Beach in Chautauqua County (50%) and Copiague Harbor Beach in Suffolk County (50%); and one in Indiana, Jeorse Park Beach I in Lake County (52%).

## GREAT LAKES WATER QUALITY TREND 2009-2013

Table GL-2 below illustrates the general beach water quality exceedance trend in the eight Great Lakes states over the past five years. Note that only samples from a common set of beaches monitored each year from 2009 to 2013 are included in the table. Percent exceedance rates in 2009–2012 are based on the national single-sample maximum standard for designated beach areas of 235 *E. coli* bacteria cfu/100 freshwater that was in place during those years. For comparison purposes, exceedance rates for 2013 are shown based on the historical national standard of 235 *E. coli* bacteria cfu/100 ml freshwater, as well as on the EPA's new Beach Action Value of 190 *E. coli* bacteria cfu/100 ml freshwater.

**Table GL-2: Great Lakes Water Quality Exceedances 2009-2013**

STATE	# of common beaches	2009 % Exceeding National Standards	2010 % Exceeding National Standards	2011 % Exceeding National Standards	2012 % Exceeding National Standards	2013 % Exceeding Former National Standards	2013 % Exceeding BAV
IL	48	16%	14%	13%	9%	8%	10%
IN	27	14%	17%	11%	12%	11%	14%
MI	156	11%	14%	8%	6%	5%	6%
MN	46	5%	5%	9%	12%	7%	8%
NY	336	10%	9%	10%	9%	9%	12%
OH	58	15%	22%	22%	20%	32%	35%
PA	9	6%	6%	7%	10%	9%	13%
WI	96	8%	10%	10%	13%	12%	15%

## ECONOMIC IMPACTS

If the Great Lakes St. Lawrence River region (including the United States and Canada) were a country, it would have the fourth-largest economy in the world.<sup>36</sup> More than 1.5 million jobs in the United States are directly tied to the Great Lakes, with 200,000 jobs supported by recreation and tourism. Clearly, any damage inflicted on the Great Lakes has not only severe environmental and human health impacts, but wide-reaching economic effects as well.<sup>37</sup> Closing all the beach sites on Lake Michigan alone could cost local economies as much as \$2.7 billion.<sup>38</sup>

Spending on boats and boating activities in the Great Lakes states totaled nearly \$16 billion and directly supported 107,000 jobs in 2003.<sup>39</sup> Yet, in 2012 and 2013, increased evaporation due to early springs and hot summers lowered lake levels to a point where the recreational boating industry felt the impact of climate change. Low water levels made it difficult to move ships from deeper lake waters to shallow ports. They also shortened the boating season, impacting the livelihood of those who depend on Great Lakes recreation.<sup>40</sup>

Low water also has serious implications for Great Lakes–St. Lawrence Seaway shipping, a \$34 billion industry that affects commodity and manufacturing costs as well as consumer prices. To cope with low water levels, ship owners are forced to lighten the loads on their boats, making each shipment less efficient and less profitable.<sup>41</sup> In December and January, extreme drought reduced water levels on the Mississippi River and nearly halted the shipment of \$7 billion worth of grain, coal, crude oil, and other products moving between the Great Lakes and the Gulf of Mexico.<sup>42</sup>

Failing infrastructure, algal blooms, and climate change threaten more than regional and national economies—the Great Lakes are the source of 20 percent of the world’s freshwater and the drinking water source for more than 30 million people in the United States alone.

## ENDNOTES

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