THE IMPACTS OF NUTRIENTS ON WATER QUALITY IN THE GREAT LAKES

(110–127)

FIELD HEARING

BEFORE THE

SUBCOMMITTEE ON
WATER RESOURCES AND ENVIRONMENT

OF THE

COMMITTEE ON
TRANSPORTATION AND
INFRASTRUCTURE
HOUSE OF REPRESENTATIVES

ONE HUNDRED TENTH CONGRESS

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U.S. House of Representatives
Committee on Transportation and Infrastructure
Washington, DC 20515

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May 9, 2008

SUMMARY OF SUBJECT MATTER

TO: Members of the Subcommittee on Water Resources and Environment

FROM: Subcommittee on Water Resources and Environment Staff

SUBJECT: Field Hearing on the Impacts of Nutrients on Water Quality in the Great Lakes

PURPOSE OF HEARING

On Monday, May 12, 2008, at 12:00 p.m., at the Board of Commissioner's Room of the St. Clair County Commission, 200 Grand River Avenue, Port Huron, Michigan, the Subcommittee on Water Resources and Environment will receive testimony from representatives from the National Oceanic and Atmospheric Administration ("NOAA"), academia, and other interested stakeholders on the impact of nutrients on water quality in the Great Lakes.

BACKGROUND

Nutrients, such as nitrogen and phosphorous, in appropriate amounts, are essential to the health of aquatic systems. Excessive nutrients, however, can result in harmful or nuisance algal blooms, reduced spawning grounds and nursery habitat for fin fish and shell fish, fish kills, oxygen-starved hypoxic or "dead" zones, and public health concerns related to impaired drinking water sources and increase exposure to toxic microbes.[1] Nutrient problems can exhibit themselves locally or much further downstream, leading to degraded estuaries, lakes, reservoirs, and to hypoxic zones where fish and aquatic life can no longer survive.[2]

Recent reports on water quality conditions provided by the states indicate that nutrients are the leading cause of impairment in lakes, ponds, and reservoirs, and the second leading cause of impairment to bays and estuaries. In the National Water Quality Inventory: Report to Congress for

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[1] *See* Letter from Assistant Administrator of EPA's Office of Water, Ben Grumbles, to State water program directors, dated May 25, 2007 (hereafter referred to as "Grumbles letter").
[2] *See* Grumbles letter.

the 2002 Reporting Cycle,[3] states reported that excessive nutrients were key causes of water quality impairment for streams, rivers, lakes, bays, and estuaries. For example, states reported that roughly 40 percent of assessed lakes, 22 percent of assessed bays and estuaries, and 15 percent of assessed rivers and streams identified excessive nutrients as a causing the waterbody to fail to meet its designated uses. In the Great Lakes, states have identified nutrient contamination as a major cause of water quality impairment.

Similarly, the U.S. Department of the Interior's U.S. Geological Survey has determined that only about 40 percent of U.S. stream miles meet EPA's recommended goal for phosphorous (0.1 milligrams per liter) to control excessive growth of algae and other nuisance plants. For example, about 20 percent of stream miles in the Upper Mississippi River basin meet EPA's goal for phosphorous versus 56 percent in the Great Lakes basin, and nearly 85 percent in New England.

Impacts of Nutrient Pollution:

Nutrient pollution in the Great Lakes:

Excessive nutrient problems can have significant impacts over large areas, and within entire watersheds.

In the 1960s, Lake Erie was famously declared "dead" when excessive nutrients in the Lake fostered excessive algae that became the dominant plant species, covering beaches in slimy moss and killing off native aquatic species by soaking up all of the oxygen. Prior to the enactment of the Clean Water Act, pollution filled Lake Erie with far more nutrients than the lake could handle, with phosphorous being the main culprit.

Phosphorous is a fertilizer that induces plant growth and algae. At the time, phosphorous was also found in many commercial detergents. Plants began growing, dying and decomposing in Lake Erie, creating anoxia[4] (severe deficiency of oxygen) at the bottom of the lake and covering the surface with algal growth. This lack of oxygen killed fish and other aquatic species.

With the enactment of the Clean Water Act, and the signing of the Great Lakes Water Quality Agreement in 1972, a concerted effort was made to reduce the pollutant loadings into the Lakes, including a reduction in phosphorous. This effort has improved the overall health of the Lakes.

In recent years, there has been attention to the continuing problems of excessive nutrients in the Great Lakes, including the reemergence of a "dead" zone within Lake Erie. According to EPA, the bottom waters in the central basin of Lake Erie are again becoming anoxic in the late summer, in part, due to a concern about excessive nutrient loadings to the Lakes.

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[3] In this report, the Environmental Protection Agency ("EPA") summarizes water quality assessments submitted to the agency by states under section 305(b) of the Clean Water Act.

[4] Hypoxia is a condition where the lack of oxygen in a system results in impacts to aquatic species that depend on oxygen for their survival (e.g., finfish and shell fish). Anoxia is hypoxic condition of such severity as to cause permanent damage to the surrounding ecosystem.

Similarly, widespread outbreaks of harmful algal blooms have occurred throughout the Lakes, but most notably at Bear Lake, Michigan; Muskegon Lake, Michigan, Saginaw Bay, Michigan; and in Western Lake Erie. Although the controlling factors for growth of many harmful algal bloom species are not entirely understood, according to NOAA, harmful algal blooms may be linked to over-enrichment of nutrients when runoff from lawns, roads, and farmland accumulate at a rate that "overfeeds" the algae that exist normally in the environment.

Finally, there is growing concern on a relationship between excessive nutrients in the Great Lakes and the presence of two aquatic invasive species – the zebra mussel and quagga mussels. NOAA's Great Lakes Environmental Research Laboratory ("GLERL") is currently studying this relationship, which hypothesizes that, as nutrient laden waters flow into the Lakes, the near-shore microalgae flourish as they feed on the nutrients. The zebra and quagga mussels then feed on the abundance of microalgae, and deposit what they cannot digest or the byproducts of what they can on the bottom of the Lakes. This tends to concentrate nutrients in particular hotspots that often coincide where zebra and quagga mussels are found in abundance. These concentrations of nutrients, in turn, accelerate the growth of harmful algal blooms. In addition, because zebra and quagga mussels are filter feeders, they can quickly turn murky water into clear water, which allows sunlight to penetrate into deeper depths. This expands the depth of water in which algal blooms can grow.

Other Regional Nutrient Pollution Concerns:

Two additional widely known examples of nutrient impacts include the Gulf of Mexico and the Chesapeake Bay. Within these two areas, 35 states contribute to the nutrient loadings that have resulted in large scale water quality and habitat impacts.

In the Gulf of Mexico, each spring, the oxygen levels near the bottom become too low to allow most fish and crustaceans to live in an area that can stretch from the Mississippi River westward along the Louisiana and Texas coasts. According to the National Research Council, the causes of the Gulf of Mexico "dead zone" are "complex, but clearly related to nutrient over-enrichment" from nutrients carried down the waters of the Mississippi River to the Gulf.[5]

Excessive nutrients have also been identified as the primary cause of water quality degradation within the Chesapeake Bay.[6] Excess nutrients fuel large algal blooms that block sunlight and deplete oxygen as the algae decompose. Without sunlight, underwater bay grasses cannot grow, and without sufficient oxygen blue crabs and fish cannot live. In the Chesapeake Bay watershed, the nutrients of concern (phosphorous and nitrogen) come from many sources, such as lawn fertilizer, wastewater treatment plants, septic systems, cropland, livestock, and the air.

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[5] *See* National Research Council. "Clean Coastal Waters: Understanding and Reducing the Effects of Nutrient Pollution" (2000).

[6] *See* Report of the Environmental Protection Agency's Office of the Inspector General, "Despite Progress, EPA Needs to Improve Oversight of Wastewater Upgrades in the Chesapeake Bay Watershed" (Report No. 08-P-0049, January 8, 2008).

Sources of Nutrient Pollution:

While natural sources of nutrients are essential to sustain life in the environment, human activities can greatly accelerate eutrophication, or the process of increasing organic enrichment of an ecosystem where the increased supply of organic matter causes changes to the system, such as excessive or toxic production of algal biomass (including red and brown tides), loss of near shore habitat such as sea grass beds, changes in marine biodiversity and species distribution, increased sedimentation of organic particles, and depletion of dissolved oxygen (hypoxia and anoxia).[7]

In general, nutrients predominantly reach surface waters in one of three ways: pipes, runoff from the land, and air pollution deposition.

In heavily populated, urban areas, wastewater discharges from sewage treatment plants and industrial dischargers can be significant contributors of excessive nutrients to local waterbodies. These point sources of nutrients tend to be continuous over time, and enter waterbodies at specific locations, such as specific point sources, combined sewer overflows, or sanitary sewer overflows. Accordingly, point sources of nutrients tend to be the easiest to identify, and monitor, and can often be rectified by constructing additional treatment capacity, or implementing tertiary treatment technologies that can remove excessive nutrients from the wastewater before it is discharged.

Nonpoint sources of nutrient pollution, including failing septic systems, agricultural runoff of fertilizers and animal wastes, urban runoff of pet wastes and lawn fertilizers, atmospheric deposition, and construction runoff, tend to be diffuse, episodic, and more closely linked to seasonal activities such as agriculture growing seasons or construction seasons, or occur only during weather events, such as rainfall. Accordingly, nonpoint sources of nutrient pollution are more challenging to measure and to mitigate.

For example, septic systems may be a significant source of nutrients in suburban environments. Nutrient concentrations and loads entering and leaving septic systems may be well known, but it is less clear what extent these pollutants actually reach waterbodies.

Similarly, since World War II, there has been an expanded use of inorganic fertilizers, such as commercially purchased nitrogen and phosphorous, on agricultural lands, in response to the demand for increased agricultural output. This has more than doubled overall agricultural production (on less agricultural lands), but has resulted in increased concentrations of nutrients in certain watersheds, as well as increased loadings of nitrogen and phosphorous to the surrounding surface waters.

According to EPA, manure and wastewater from animal feeding operations also have the potential to contribute pollutants such as nitrogen and phosphorus, organic matter, sediments, pathogens, heavy metals, hormones, antibiotics, and ammonia to the environment. Decomposing organic matter (e.g., animal waste) can also reduce oxygen levels and cause fish kills. Pathogens, such as Cryptosporidium, have been linked to impairments in drinking water supplies and threats to human health. Pathogens in manure can also create a food safety concern if manure is applied directly to crops at inappropriate times. In addition, pathogens are responsible for some shellfish

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[7] *See* National Research Council. "Clean Coastal Waters: Understanding and Reducing the Effects of Nutrient Pollution" (2000).

bed closures. Nitrogen in the form of nitrate, can contaminate drinking water supplies drawn from ground water.

Finally, as noted by USGS, nutrient transport is not limited to runoff into surface waters, but also may occur through subsurface flows and groundwater flows. For example, agricultural best management practices ("BMPs") may focus on minimizing runoff while not reducing nutrient applications to land surfaces. The result of this is that nutrient transport may simply be transferred from surface waters to ground water.[8]

Potential Responses to Nutrient Pollution:

Increased monitoring:

In its 2000 report, the National Research Council recommended increased monitoring and modeling of nutrients as a first step towards addressing nutrient pollution throughout the nation. According to this report, before an effective strategy for nutrient management can be implemented, more information on the sources and impacts of nutrient contamination was necessary.

There is great variation in the amount of water quality sampling taking place with the waterbodies around the United States, and, due to Federal and state budgetary constraints, there has been a shift away from actual monitoring through water quality samples towards predictive monitoring based on comprehensive modeling. However, the utility of predictive modeling is diminished by a lack of data to validate predictive monitoring models. As a result, there may be an incomplete picture as to the nature and extent of the actual condition of the nation's waters.

For example, in 1973, the U.S. Department of the Interior's United States Geological Survey ("USGS") established the National Stream Quality Accounting Network ("NASQAN") to provide nationally comparable information on water quality, including nutrient loadings in the Great Lakes. NASQAN data were used by state agencies to document ambient water quality (in 305(b) reports required by the Clean Water Act) and by the U.S. Environmental Protection Agency for the first National Water Indicators report. However, due to Federal budgetary cuts, the number of monitoring sites, and the frequency of monitoring samples have been reduced, and the scope of the program has been limited to 4 major U.S. river systems (Mississippi, Rio Grande, Colorado, and Columbia).

To fill the gaps in actual monitoring, USGS developed the SPARROW (SPAtially Referenced Regression On Watershed attributes) model to better understand the linkages between monitoring data collected at a large network of sampling stations and the watershed factors that determine water quality.

Similarly, there has been a trend in shifting responsibility for actual monitoring from the Federal government to the states. This shift has produced mixed results, with certain states investing significant resources into comprehensive water quality monitoring, and other states cutting back on water quality monitoring.

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[8] *See* U.S. Geological Survey, "Review of Phosphorous Control Measures in the United States and Their Effect on Water Quality (1999). This report notes studies have found groundwater transport of phosphorous to be a substantial source phosphorous pollution. For example, in the Chesapeake Bay, it has been estimated that between 10 to 20 percent of the phosphorous entering the Bay travels through groundwater.

Without comprehensive and consistent water quality monitoring programs in place, it is difficult to develop an effective strategy to control pollutant loadings.

Water quality criteria for nutrients:

In 1998, the Environmental Protection Agency issued a national strategy for developing regional nutrient water quality criteria. According to EPA, numeric water quality criteria will drive water quality assessments and watershed protection management, and will support improved development of nutrient Total Maximum Daily Loads ("TMDLs"). Perhaps most importantly, they will create state and community developed environmental baselines to manage watersheds more effectively, measure progress, and support broader partnerships based on nutrient trading, Best Management Practices ("BMPs"), land stewardship, wetlands protection, voluntary collaboration, and urban storm water runoff control strategies.

In November 2001, EPA published a guidance document to states (and authorized tribes) on developing nutrient criteria plans, which would later be incorporated into state water quality criteria and standards for nutrients. EPA also published technical guidance for developing nutrient water quality criteria for lakes and reservoirs in May 2000, rivers and streams in June 2000, and estuaries and coastal waters in October 2001.

As of 2007, only 5 states (and territories) have approved complete nutrient water quality criteria, 6 states (including Michigan) are in the process of finalizing nutrient water quality criteria, and 42 states (and territories) are either collecting data or just starting this process.

Source Reduction and Control:

In its 2000 report,[9] the National Academy of Sciences recommended several management options for reducing the nutrient supply to coastal environments. These recommendations were:

(1) Reduce the overall nutrient loads to coastal areas through a variety of means, including improvements in agricultural practices, reductions in atmospheric sources of nitrogen, improvements in the treatment of municipal wastewater (including, in some cases, tertiary treatment), and better control of stormwater runoff from urban areas (streets and storm sewers) through both structural and non-structural controls.

(2) Minimize nutrient export from agricultural areas, including manure management strategies, careful estimation of native nutrient availability and crop requirements, and supplemental fertilizer application timed to meet crop demand.

(3) Long-term reductions of nutrient export from agricultural areas through consumer-driven (incentive based) programs and education.

(4) Factoring in reductions of nutrients to coastal waters in air pollution control strategies.

(5) Expanded use of "natural options" (such as the enhancement of coastal wetlands) for the management of nutrients.

[9] *See* National Research Council. "Clean Coastal Waters: Understanding and Reducing the Effects of Nutrient Pollution" (2000).

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AGENDA
Subcommittee on Water Resources and Environment
Field Hearing
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Monday, May 12, 2008
12:00 pm

County Administration Building - Board Room
200 Grand River Avenue, 2nd Floor
Port Huron, Michigan

The Impacts of Nutrients on Water Quality in the Great Lakes

WITNESS LIST

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U.S. Department of Commerce
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Mr. Jim Ridgway, P.E.
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Sierra Club Michigan Chapter
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Commander, Detroit District
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THE IMPACTS OF NUTRIENTS ON WATER QUALITY IN THE GREAT LAKES

Monday, May 12, 2008

HOUSE OF REPRESENTATIVES,
COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE,
SUBCOMMITTEE ON WATER RESOURCES AND ENVIRONMENT,
Port Huron, MI.

The Subcommittee met, pursuant to call, at 12:11 p.m., in the Board of Commissioners Room, St. Clair County Commission, 200 Grand River Avenue, Port Huron, Michigan, Hon. James L. Oberstar presiding.

Mr. OBERSTAR. The Subcommittee on Water Resources and Environment of the Full Committee on Transportation and Infrastructure will come to order.

Welcome, and good afternoon. I want to thank at the outset Congresswoman Candice Miller for inviting me and the Subcommittee to participate in a full regular hearing of the Subcommittee on Water Resources and Environment in Port Huron in this part of her district that borders right on one of our great treasures of the Great Lakes system, and to express my appreciation for her participation in the work of the Committee and for advocacy for clean water in the Great Lakes and for our whole nation.

As all of you who are here, I am quite confident, understand and concur, these Great Lakes of ours are home to one-fifth of all the fresh water on the face of the Earth except for that which is locked up in ice. And all the water there ever was or ever will be on Earth is with us today, can't make any more of it. So it is up to us in this generation to pass on to the next generation that treasure of clean water, hopefully in better condition than we received it.

So Congresswoman Miller's advocacy for clean water strikes a very responsive cord with me and—and I think with most Members of Congress and certainly with those who serve on our Committee on Transportation and Infrastructure.

Our Subcommittee Chair had intended to be here to chair this hearing but she had an unavoidable conflict in her own district, so you get the Chairman of the Full Committee to chair the hearing. I would have been here anyway but I don't get to chair very many meetings because the Subcommittee Chairs do that so I'm—I'm delighted, and I just want to observe that Miss Miller is also a very hardworking Member of our Committee. From where I sit I can look down and see who's—who's present, who's doing their homework and who's not, and Miss Miller shows up for our Subcommittee hearings and for our Full Committee markups and she's doing her homework and I appreciate that.

We're meeting to receive testimony on the impact of nutrients on Great Lakes water quality. Nitrogen, phosphorous, in appropriate amounts, are essential for aquatic systems and for land based systems. But excessive amounts of nutrients result in harmful consequences, the worst of which is algae blooms. They also result in reduced spawning grounds, reduced nursery habitat for fish, they also cause fish kills, hypoxic or dead zones and public health concerns that result from impaired drinking water and increased exposure to toxic microbes. Excessive nutrients have significant impacts over large areas and within entire watersheds.

The effects can be local, they can be downstream, they can lead to degraded estuaries, to deteriorated river systems, to adversely effected drinking water reservoirs, and to the creation of hypoxic dead zones where fish and aquatic life cannot exist.

The focus of this hearing is on the impact of nutrient contamination of the Great Lakes. Wide spread nutrient contamination is a national issue. It's one that deserves the Committee's continued attention, to which we have already devoted attention and will continue in the course of this Congress.

Some widespread examples are the Chesapeake Bay and the Mississippi River system and its Delta. In the Chesapeake Bay, excessive nutrient loading has been widely cited as the primary cause for water quality deterioration, loss of shell fish and fish life, deterioration of the blue crab community and the oyster community. At one time oysters were able to filter all the water of Chesapeake Bay, the largest estuary of the world. Now that's not happening.

Implementing proper control mechanisms are widely recognized as necessary to meet the 2010 deadline for cleaning up the Chesapeake Bay and yet we're falling ever further behind. The problems of the Chesapeake Bay don't begin at the waters edge on Kent Island, but they go all the way to upstate New York, to upstate Pennsylvania, to West Virginia, to Maryland.

Similarly, in the Gulf of Mexico, the Mississippi River system contributes the pollution and other toxic loading from 11 states and to that estuary that extends from New Orleans out into the Gulf.

But because of the national scale of the problem and the reluctance of states along the Mississippi, Ohio, Illinois, Missouri River system to shoulder their appropriate share of responsibility, the dead zone in the Gulf of Mexico is unlikely to be resolved anytime in the near future.

Now the first, I would say even the—having served on the Committee since I started in 1963 as Clerk of the Subcommittee on Rivers and Harbors, serving for my predecessor John Blatnik, who was Chair of that Subcommittee and later Chair of the Full Committee, go back a long ways; not to when the Hill was founded but just shortly afterward. The most extraordinary moment of the Cuyahoga River catching on fire, the large fish kills in Lake Erie, and the solemn pronouncement that Lake Erie was dead in the 1960s when excessive nutrients escalated the growth of algae, and soon it became the dominant plant species blocking out light, killing fish, covering the beaches with a slimy, mossy covering, and absorbing all of the oxygen galvanized the nation and the Congress to demand to do something.

The doing something was the Clean Water Act of 1972. But what was clear even before the enactment of that legislation was that phosphorus was the limiting element, that is if you remove the phosphorus even more than removing nitrogen, you will begin to restore oxygen levels and water quality. But plants and algae growing, dying and decomposing in Lake Erie causing oxygen deficiency at the bottom of the lake, or anoxia, resulted in fish kills and beaches covered with the slimy residue of—of the algae.

Well, enacting the Clean Water Act of 1972 and the funding reached almost $6 billion a year for building of sewage treatment facilities, interconnecting sewer systems, collector systems and the Canada-U.S. Great Lakes Water Quality Agreement, also in '72, began to reverse the process.

Lake Erie was then proclaimed a dead lake. One group of scientists suggested that we ought to just punch a hole in the bottom and let it all drain somewhere was for a while seriously considered, but then people realized that that was not a very good idea. That treatment of the watershed was critical, treatment of the point sources was critical, and industry, municipalities, individuals, federal and state government and local governments all joined together and restored the water quality of Lake Erie.

But we're beginning to see the re-emergence of a dead zone again. The bottom waters in the central basin are becoming anoxic at high summit partly due to excessive nutrient loadings, and some because of the nutrients that already were on the bottom haven't been cleaned out were beginning to resurge. We're also seeing harmful algal blooms at Bear Lake, at Muskegon Lake, Saginaw Bay and western Lake Erie.

Now, why? Well, we're beginning again to see runoff from lawns, from roads, from farm land, accumulate at a rate that overfeeds the algae that normally exist in the environment. And add to that, invasive species, the zebra muscles and the quagga muscles that are filter feeders that filter the food in—in the water column, and filter it out, deposit their own wastes in the bottom, and then allow more light to penetrate more deeply and create more growth that then create another cycle of deterioration.

Those are issues that witnesses today will help us to understand better, to give us a deeper understanding of how best to take on the problem of nutrient pollution, how to control it, contain it, control it and reverse it. And I'm looking forward to witnesses who can give us their insights on monitoring and control mechanisms, their sufficiency, the need for additional action, for perhaps funding for treatment of—or rebuilding of our waste water treatment systems and how together, federal, state and local government can work to successfully address this vexing but very, very dangerous problem of the resurgence of nutrient stimulated deterioration of lake quality.

Chair now yields to the gentlewoman from Michigan, Miss Miller, for her statement.

Mrs. MILLER OF MICHIGAN. Thank you very much, Mr. Chairman. And I want to welcome all of our witnesses certainly and those of you that are joining us in the audience today, and I certainly want to first of all, recognize and thank the county commissioners for allowing us to use their beautiful room here.

I know we have a couple of county commissioners in the audience, I saw Jeff Bloom and—and Commissioner Heidemann as well a little bit earlier. We also have some state representatives who have been working on many of these issues in the state level, State Representative Pavlov and Espinoza join with us as well as many people from the environmental community. I know the Farm Bureau is represented here and people who are really interested in this issue.

But most of all I certainly want to thank and welcome to Port Huron, the maritime capital of the world of the Great Lakes here, our wonderful Chairman, and you all heard a—had an opportunity to hear his opening comments here, but Chairman Oberstar and I share a very principal advocacy of protecting our Great Lakes and when I had an opportunity to go to Congress I said if I could get on any Committee there I would like to get on the Transportation and Infrastructure Committee for a number of reasons, not the least of which is because of the wonderful leadership that Chairman Oberstar has demonstrated and I knew he was a Great Lakes' guy and those very—issues very near and dear to me and the 30 years that I've been involved in public service and having an opportunity now to be on this Committee and work with him and other Members of the Committee on Great Lakes issues, which are so critical to all of us, has been a tremendous thing.

Our Committee just passed with his leadership, finally, after—its way overdue, but we—he has pushed this through the—our—our Subcommittee, our Full Committee, went to the full House and is now waiting at the Senate for action on invasive species, which you mentioned, and ballast water discharge.

All of us are painfully aware of the negative impact that invasive species have had on our Great Lakes and this—this piece of legislation essentially requires the salties, the ocean going freighters, before they come through the St. Lawrence Seaway entering into the Great Lakes, to discharge their ballast water out in adequate depth in the ocean before they come into the Great Lakes.

We've also worked together on state revolving funds, which was something we were discussing on our way traveling in from the airport today to the—to the hearing, which will allow for states and local municipalities to access funding to assist them with inadequate underground infrastructure.

We are in a community right now that is dealing with such a thing where you have combined sewer overflows that happen after heavy rains. It's not particularly inherent to—to Port Huron or any of the older industrial towns that have experienced growth, certainly since the time that they built their infrastructure, and we're trying to assist with those kinds of things and the Committee has been very, very involved and these are wonderful pieces of legislation.

We also have worked on the Water Resources Development Act, again something that was long overdue, and you really pushed that thing through and I appreciate that. It's very important for the Great Lakes, a number of different critical components of that—of the reauthorization of the WRDA Bill, as we call it, very important to the Great Lakes, so so many different issues that this Committee has worked at and all of—pretty much all of the Great Lakes issues do go through this—this Committee.

Transportation, of course, is absolutely a huge part of our national agenda, but often times as I say, people don't recognize all the water quality issues that go through the Committee, so it's been a wonderful experience for me.

And—and when I asked the Chairman about the possibility of having a field hearing in Port Huron his reaction obviously was very positive. And, not to talk out of school here, but I think I can tell the folks, that he's been to Port Huron many times besides today's event. His favorite uncle was a resident of Port Huron and so he's spent many happy hours here as a child and growing up and probably knows the City of Port Huron as well as anybody sitting in this room I will tell you, and so we had an opportunity to go take a look at the bridge and talk about the bridge plaza projects and we looked down at Desmond Landing, I was explaining to him some of the different waterfront development things, things that are happening, the positive things happening in the city.

And I also mentioned, and we are going to showcase with our testimony here today, how proud we are of our water quality monitoring system which can be a national model, and we'll talk about that during the Committee hearing here with our testimony, but I was mentioning to him about how SC4 just recently received some federal appropriation to—for their curriculum where they're going to be training young men and women on water quality monitoring systems and as—as our state changes a bit from some blue collar jobs to some green collar jobs we have wonderful opportunity right here in the Blue Water area to do that and as well working with the Chairman and other Members of the Committee on the phosphorus issues and on the nutrient issues which will be very interesting to hear the expert testimony on this today.

As many people know, there are two states that have been actually a leader on this, both Florida and Minnesota, the Chairman's state, have passed statewide restrictions, or bans, we'll hear some about that for phosphorus, and Michigan of course, has now got some legislation in the state house, a similar thing because we have so many of our local municipalities that are passing their own individual ordinances to deal with phosphorus. We see it in Lake St. Clair, we see it in the muck issue all around the thumb area into Saginaw Bay and various other parts of our state on the West Side and so I think from the federal level today we'll be interested to hear about what we can do as a Congress to bring more attention to this issue and what may be appropriate role for us to play, again all with a impetus toward protecting water quality and—and what we can do that is reasonable but is very, very necessary to protect the quality of our, as I say, our magnificent Great Lakes.

So again, I welcome the Chairman to Port Huron, and welcome back to Port Huron, and we are so delighted to have you and to have this hearing here today.

Thank you very much, Mr. Chairman.

Mr. OBERSTAR. Thank you, Miss Miller. And to that splendid recitation, I told you she does her homework, follows the work of the Committee and active participate.

I want to add, in light of your initiatives here in Port Huron, that we passed H.R. 569, the Water Quality Financing Act of 2007, through Committee and through the House to provide a billion six hundred million dollars in federal grants to communities to address their combined storm and sanitary sewer overflow problems. If only the United States Senate would act on it now and get that over to the President, have it signed, we did that last year, in the first session of this Congress.

So, without any further comment that might get me in trouble with the United States Senate, which I've done on many occasions, we'll proceed with our very distinguished panel of witnesses, the first panel of witnesses, and we'll—we'll begin with Dr. Craig Stow, Physical Research Scientist, the Great Lakes Environmental Research Laboratory of NOAA at the Department of Commerce.

Dr. Stow?

TESTIMONY OF MR. CRAIG STOW, PHYSICAL RESEARCH SCIENTIST, GREAT LAKES ENVIRONMENTAL RESEARCH LABORATORY, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, U.S. DEPARTMENT OF COMMERCE, ANN ARBOR, MICHIGAN; MR. CARL FREEMAN, PROFESSOR OF BIOLOGICAL SCIENCES, WAYNE STATE UNIVERSITY, DEPARTMENT OF BIOLOGY, DETROIT, MICHIGAN; MR. R. PETER RICHARDS, SENIOR RESEARCH SCIENTIST, NATIONAL CENTER FOR WATER QUALITY RESEARCH, HEIDELBERG COLLEGE, TIFFIN, OHIO; MR. JOHN LEHMAN, PROFESSOR OF BIOLOGY, UNIVERSITY OF MICHIGAN SCHOOL OF BIOLOGY, ANN ARBOR, MICHIGAN; MR. JIM RIDGWAY, P.E., EXECUTIVE DIRECTOR, ALLIANCE OF ROUGE COMMUNITIES, DETROIT, MICHIGAN; MS. LYNN HENNING, CONCENTRATED ANIMAL FEEDING OPERATION WATER SENTINEL, SIERRA CLUB MICHIGAN CHAPTER, CLAYTON, MICHIGAN

Mr. STOW. Thank you again, and good afternoon Chairman Oberstar and Congresswoman Miller. I am Dr. Craig Stow, a scientist at NOAA's Great Lakes Environmental Research Lab in Ann Arbor——

Mr. OBERSTAR. Please bring your microphone a little closer.

Mr. STOW. I'm sorry. Is that—is that better now?

Mr. OBERSTAR. A little—little closer.

Mr. STOW. All right. As I said, I'm a scientist at the NOAA Great Lakes Lab in Ann Arbor, also known as GLERL, and I've been working on the issues related to nutrient inputs it aquatic ecosystems for almost the past 30 years.

Mrs. MILLER OF MICHIGAN. Not to interrupt, but I still don't think people can hear you. Could you bring that—there you go.

Mr. STOW. Is that——

Mrs. MILLER OF MICHIGAN. Pull it right up to you.

Mr. STOW. That—that going to be adequate?

Mr. OBERSTAR. There you go.

Mr. STOW. Okay.

Mr. OBERSTAR. That's better, yeah.

Mr. STOW. All right.

Mr. OBERSTAR. You can even bend that microphone down a little bit. There you go.

Mr. STOW. Okay. Well, thank you for inviting me to testify today about GLERL's activities that relate to the larger issue of nutrient related pollution in the Great Lakes.

Our newest project is a study of the impact of multiple stressors from human activities such as toxic contaminants, invasive species, over fishing, changing water levels and excessive nutrients in Saginaw Bay, an area where we have a long history of studies. The combined effects of these stressors have compromised the health of Saginaw Bay and resulted in the loss of many ecosystem services that people value.

This five-year project began in 2008 and is funded by a $3.76 million grant from the NOAA Center for Sponsored Coastal Oceans Research. On this project the NOAA Great Lakes Lab is working in partnership with the University of Michigan, Michigan State University, Limno Tec, which is a private consulting firm, Western Michigan University, University of Akron, and Michigan's Department of Natural Resources and Environmental Quality, and this last association is important, they are integral partners on this project, and as information becomes available it is something they can use to effect changes as they see necessary.

The project also includes surveys to assess public values so that decision makers can devise policies that are consistent with public attitudes, and currently we are initiating a citizen monitoring program to provide additional data and engage residents in the area in our research.

Excessive nutrients, phosphorus in particular, have been important stressors in Saginaw Bay and the other Great Lakes areas for many years. Nutrients are essential for aquatic ecosystems but excessive nutrient inputs can cause eutrophication. And eutrophication has a number of undesirable symptoms that include nuisance and harmful algal blooms, reduced oxygen levels and sometimes fish kills.

These problems were recognized in the Great Lakes in the 1960s and limits on phosphorus inputs were set in 1978 under the Great Lakes Water Quality Agreement. The goal in Saginaw Bay at that particular time was to reduce problems associated with taste and odor at the drinking water intakes. These initial controls were fairly effective and resulted in documented decreases in phosphorus concentrations in the water and the symptoms of eutrophication diminished through the 1980s.

In the 1980s and 1990s our focus sort of shifted to toxic pollutants such as PCBs and nutrient related problems faded into the background. However, in the mid to late 1990s it became apparent that problems with eutrophication persisted, not just in the Great Lakes, but across the country. Non-point source nutrient inputs such as runoff from farm and towns are an ongoing problem and in some aquatic ecosystems phosphorus has accumulated in the bottom sediments serving as a continuing supply even though inputs have been reduced.

In addition, Saginaw Bay has experienced profound changes since the 1990s. In particular, the introduction of invasive zebra mussels and more recently the closely related quagga mussels. These mussels live on the bottom and filter large amounts of water. This filtering activity removes particles and other pollutants which makes the water clearer and is generally considered a beneficial effect, but it also fundamentally changes the way nutrients and other pollutants move through the system. Zebra and quagga mussels are also believed to foster the growth of toxic algal species promoting harmful algal blooms.

A major concern around Saginaw Bay currently is muck, which is what the local folks refer to as the—are the decaying algae that accumulates on the beaches. We believe that muck is primarily Cladophora, a species of algae that grows on the bottom, and has been a problem periodically in the past. The growth of Cladophora is fostered by the clear water that results from filtration by the zebra and the quagga mussels. As the water becomes clearer more sunlight can reach the bottom causing the Cladophora to grow. Cladophora growth may also be stimulated by the accumulation of phosphorous near the bottom that also results from filtering by the zebra and the quagga mussels.

Low water levels may also be contributing to this problem. With shallower water more light can penetrate to the bottom and there are more shallow areas and more exposed beach area. So Saginaw Bay is now fundamentally different than it was when phosphorus limits were established.

Additionally, as our concern with nutrients waned in the 1980s, so did nutrient monitoring and as we began this project it was unclear if phosphorus limits that were established under the Great Lakes Water Quality Agreement were being met currently. Further, since the introduction of the invasive mussels, it's unclear if these limits are even still relevant.

Given the influence of these invasive mussels and the lower lake levels, it may not be practically feasible to reduce phosphorus enough to effectively control these troublesome symptoms of eutrophication.

The goal of our multiple stressors project is to shed some light on these processes and to work interactively with managers and stakeholders to clarify possible management approaches and identify management limitations. Some of the problems I've mentioned are specific to the Great Lakes but the general problem of interacting stressors effects lakes and coastal ecosystems everywhere.

So thank you for inviting me to testify and I'm happy to answer any questions that you may have.

Mr. OBERSTAR. Thank you for your splendid scientific work and the contribution you've made today, broader and deeper understanding of this issue.

Our next witness, Dr. Carl Freeman, Professor of Biological Sciences, Wayne State University, Department of Biology from Detroit, welcome.

Mr. FREEMAN. Thank you very much. I appreciate this opportunity to speak with you today about water quality monitoring.

We sit here at the headwaters of a massive river, the St. Clair River, which flows at 6000 cubic meters per second, making it one of the largest rivers in North America. This massive volume of flow is incredibly important to what I'm going to say today. And I'm going to apologize for sounding like a teacher, but this is one of those important facts I would really like you to remember as I go along.

Why do we need monitoring? Because people, agriculture, and industry all use water and unfortunately also contribute to the pollution of the remaining water which others use. I'm going to argue that we need to enhance our monitoring capabilities to look at more types of organisms and more kinds of chemicals in the water than we presently screen for. And because of the flow of the river and the rapid time scale at which events occur, we must use more rapid monitors than we currently do. Let me first demonstrate the need for monitoring.

To quote from the Sarnia Chemical Industry brochure, ″Sarnia is Canada's largest cluster of chemical, allied manufacturing and R&D facilities. It includes companies such as Basell Canada, Dow Chemical Canada, INVISTA, Imperial Oil Limited, LANXESS (formerly Bayer), NOVA Chemical, Praxair Canada, Shell Canada Products, Air Products Canada, Terra International (Canada), SCU Nitrogen, Inc.″ Among these are both nitrogen and phosphorus fertilizer plants. These manufacturers ultimately use the St. Clair River or Lake St. Clair, as either a source of processing water or cooling water.

In July of 2006, GAO reported on chemical spills greater than 50 gallons that occurred in the connecting channels of the Great Lakes during the period 1994 to 2004.

And let me quote here, ″EPA spill data is of limited use.″ According to the data available, there were 991 spill reports from the U.S. Side of the corridor while Canadian authorities reported only 157 spills. However, GAO noted that ″these reports do not accurately portray the actual number or volume of spills.″ This is a huge understatement.

According to GAO, ″Spill notification on both sides of the corridor is largely dependent upon reporting by parties responsible for the spill, and many spills likely go unreported by responsible parties.″ Now as my friend Doug Martz notes, this system of self-monitoring and self-reporting is likely no more effective in this venue than it is with speeding on the freeway—in my opinion, the policy of self-policing is fatally flawed.

The GAO report went on to state that, ″According to {EPA} officials, with the current resource constraints, they can only inspect facilities once every 500 or more years.″ The report noted that EPA inspections had occurred—that had occurred often disclosed ″significant numerous spill prevention deficiencies,″ yet EPA issued only four fines from 1994 to 2004.

The Canadians have also examined their industry. According to the Canadian Industrial Pollution Action Team Report, quote, ″We found a system that was largely in compliance with its regulatory requirements, yet where spills to air and water still occur... We could not therefore avoid the conclusion that the existing system of approvals, inspection, enforcement, and prosecution is not working as well as it should.″

So, from this I conclude that industry has polluted the river and that there is ample opportunity for continued pollution. And that apparently will increase as they put in a new tar sands refinery in Sarnia.

Now, currently EPA requires drinking water plants to monitor the quality of both raw and processed water. However, they have infrequent testing. For example, the Detroit Drinking Water Plant tests for lead and copper every three years and volatile organic compounds four times a year. This frequency in testing is determined by EPA.

Now, the assumption that they're making implicitly is that water quality is static. This assumption is false.

In January of 2001 Nova Sarnia reported the release of 220,000 gallons of toluene, benzene and xylene—carcinogens and mutagens. This volume of chemicals would pollute 18 billion gallons of water, yet the Detroit Drinking Water Plant did not report the spill. It's quite likely they weren't monitoring for volatile organics that day.

Ironically, they must monitor for pesticides used on cotton and pineapple fields—the closest of which are thousands of miles away, but drinking water plants are not required to monitor for most of the chemicals that have actually been spilled upstream of their intakes.

Three years ago, I compiled a list of chemicals that had been spilled and compared it to the EPA's priority pollutants list. Their list contained only 20 to 30 percent of the chemicals that had been spilled. So even if drinking water plants were monitoring, their equipment will likely not detect most of the chemicals (harmful or otherwise) that are spilled.

Through the help of Congresswoman Miller and Senator Levin and state and local governments, a near real-time monitoring system now stretches along the U.S. Side of the border all the way from Marysville here in the upper reaches of the St. Clair to Lake Erie. The system has a variety of meters to detect changes in water quality, most of these are presently implemented. However, the heart of the system is a series of membrane induced mass spectrometers that are capable of analyzing more than 10,000 different chemicals in less than five minutes. This part of the system is still being deployed. Nevertheless, the system, when completed, will be the first in the country that analyzes water quality on the same temporal scale as the flow of the river, and it will be able to detect the overwhelming majority of the industrial pollutants likely discharged in the system.

If this system were coupled with a three-dimensional flow model of the river, it would be possible to compute when and where a spill occurred and thus to hold the polluting party responsible. The system itself needs to be expanded, it needs to involve more depths and more locations. As it stands now it looks only at the drinking water intakes and so the majority of the spills pass above it in the water column.

Now, I was going to address biological monitoring. I don't know if you'd like me to still do that, my time seems to have expired.

Mr. OBERSTAR. I think—I think we're going to—we'll come back to that——

Mr. FREEMAN. Okay.

Mr. OBERSTAR. —in the question period. We have a full agenda and we need to conclude by about 2:00——

Mr. FREEMAN. Thank you very much.

Mr. OBERSTAR. —but we'll—we'll return to that. And meanwhile, I want you to think about that three-dimensional flow model of the river and how it could be implemented.

Dr. R. Peter Richards, Senior Research Scientist, National Center for Water Quality Research at Heidelberg College, Ohio, welcome.

Mr. RICHARDS. Thank you Mr. Chairman, for the opportunity to testify today. Like the others, I'm going to address my remarks primarily to the need for improved monitoring of the systems that we're dealing with in the Great Lakes.

I am with the Heidelberg College, National Center for Water Quality Research, formerly the Water Quality Lab, and our group has been monitoring the major tributaries to Lake Erie on the U.S. Side since the early '70s and so we have considerable experience with what's going on in Lake Erie.

Mr. Chairman, you've already given the first half of my testimony for which I thank you. But I'd just simply point out that early in the process of trying to rehabilitate Lake Erie, a target load was established of 11,000 metric tons of phosphorus inputs on an annual basis from all sources. At that time the loads were on the order of 20 to 25,000 metric tons, so getting down to that level is quite a substantial achievement. But this was done about 1983 and since that time the loads of total phosphorus have fluctuated about that quantity, sometimes a little higher, sometimes a little lower, primarily in response to the non-point source component which is driven by weather events and is uncontrollable and fluctuates from year to year.

What I would point out is that we know pretty well what's been going on with Lake Erie and its loadings and how they meet the target primarily because we monitor and we have a very intensive monitoring program that provides very detailed data. The—Dr. David Dolan, who is the person who does the data gathering and calculations that allow us to assess what the total loads to Lake Erie are, indicates that if it weren't for the data that our lab produces he simply would be unable to calculate a respectable load estimate so this enhance—re-enforces the value of the monitoring.

And, in fact, phosphorus loads have not been calculated for any of the other Great Lakes since the mid 1990s because there simply is not enough data to support an estimation of the loads. So we don't know what's going on, what's going into those other Great Lakes the way we do with Lake Erie.

Monitoring data also provides us a way of assessing how we're doing at meeting environmental goals. With the data that we've gathered for example, we could now show conclusively that the loads of—of sediment and of the phosphorus attached to the sediment have decreased continuously over the last 30 years in the Maumee and Sandusky Rivers which are two of the major tributaries to Lake Erie.

If we look at the data in a careful and thorough way we can also demonstrate that these reductions are not just a factor of weather or chance or something like that, they're directly accountable to the management practices we put on the agricultural landscapes, primarily conservation tillage, no till, and other buffer strips and grass waterways, things of that sort. So, very often skeptics will say well, how do we know these Best Management Practices are working? We know because we monitor and we have the data to prove it.

Now at the same time over the last decade or so we've seen an alarming trend toward increases in the loadings of dissolved phosphorus, not the stuff that's attached to the sediment but the stuff that's dissolved in the water, going into Lake Erie through the same tributaries, and this is alarming enough that Ohio EPA has convened a Lake Erie Phosphorus Task Force to consider the problem and what the state's response should be to it. Again, we know about this problem because we're monitoring.

If we were not monitoring currently, we—we'd observe problems in the lake, we would now be running around try to figure out where the problems are coming from, it would take us a decade to establish with confidence the importance of the tributary inputs for this process, and we would never know about the substantial increases that have occurred since the mid 1990s when the dissolved phosphorus units were at their minimum.

What—what we find is that anytime you mention monitoring people throw up their hands and say well, we can't do that, it's too expensive and I guess I just have to say expense is a relative thing. You know, we—we operate our monitoring program which produces about 500 samples per year per tributary for $35,000 a station a year. Is that expensive? Well, it's money. But, you know, we—we visit doctors once a year to monitor our cholesterol and our blood pressure and so forth. That's expensive. We take our cars into the shop every 3,000 miles or so to change the oil and see how the engine's doing. That's expensive. We do these things because the alterative is potentially much more expensive and I think the same analogy applies here to the Great Lakes.

What's the cost of not knowing what's going into the Great Lakes? In my view, these lakes are so valuable that the potential cost of not knowing what's happening and trying to in effect manage them ″blindfolded″ is—far outweighs the cost of implementing a respectable monitoring program for them.

It's a simple fact that the current state of monitoring the Great Lakes is woefully inadequate and I just would encourage the Committee to do anything in their power to establish a more adequate monitoring program for the other Great Lakes.

That completes my testimony, thank you very much. I'd be glad to answer questions at an appropriate time.

Mr. OBERSTAR. Thank you very much Dr. Richards, for your splendid contribution.

Professor John Lehman, Professor of Biology, University of Michigan, School of Biology at Ann Arbor.

Mr. LEHMAN. Representatives Oberstar and Miller, thank you for inviting me to speak with you today.

And Mr. Oberstar, I have to congratulate you on having an excellent grasp of some of the principles that I was going to begin my talk with, so once again.

The underlying cause of excessive, nuisance growth of the aquatic flora, known as algae, is excessive abundance of plant mineral nutrients, particularly the mineral phosphate. Phosphate is ubiquitous in nature because it enters waterways through erosion and weathering of rocks and soil, but its abundance is greatly amplified by human activities. It's customary to distinguish between two categories of phosphate sources: Point sources and non-point sources.

Point sources include for instance, outfalls from sewage treatment plants. Non-point sources are diffuse, as for instance, drainage from streets and parking lots.

Control of phosphate income to the Great Lakes has been a cornerstone of management strategy for water quality since the 1970s. The strategy rests on a simple principle, in order for algae to flourish to excess, they need an abundance of simple mineral building blocks from which they can make their living cells. These most common are carbon, oxygen, and hydrogen, but those are freely available either from the gases of the atmosphere or from the molecules of water itself.

Next in importance are nitrogen and phosphorus. Of these, one group of algae that is symptomatic of nuisance conditions can use nitrogen gas from the atmosphere to make their own proteins. So that leaves phosphate as the critical control point for preventing nuisance conditions.

Phosphate is an absolutely essential mineral, it has no gas phase at environmental temperatures, and thus the supply of phosphate to lakes is a fulcrum point that leverages the size of the algal crops that can develop.

Historically, the focus of regulations limiting phosphate discharges to waterways has been point sources. More recently, non-point sources have been attracting increased scrutiny. In part this may reflect the fact that each incremental gain in phosphate removal from point sources comes at an accelerating cost, and there's a belief that modest and relatively inexpensive behavioral changes, such as retaining buffer strips of vegetation along stream banks, can yield positive results.

At the societal and political level, there's a cost-benefit analysis in which immediate costs associated with technical improvements to phosphate removal can be quantified relatively objectively, but future benefits are necessarily prospective and theoretical.

Good environmental management decisions depend first on decision-making being informed by good environmental data and second on existence of a predictive theoretical framework to interpret the data.

In the case of the Blue Ribbon Commission on Lake St. Clair that's now finalizing its report, it was fortunate that a body of data about phosphate in tributary streams exists. Those data had been collected in 2004 and 2005, recently enough to represent modern conditions. My analysis of those data caused me to conclude that the division between point source and non-point source phosphate in the Clinton River, one of the most notorious sources of nutrient pollution, is almost exactly 50-50. This suggests that future management controls on either point or non-point sources are equally viable strategies.

One strategy for controlling non-point sources of phosphate that's gaining political momentum is to restrict the use of lawn fertilizers containing phosphate. Many soils, particularly those derived from sedimentary rocks, contain enough phosphate to grow grass perennially, especially if the clippings are retained on the—on the lawn.

Unfortunately, at this stage I must report that there is not enough scientific evidence to demonstrate that statutory limitations have produced the demonstrable improvement in water quality in jurisdictions that have adopted the policy. It must be acknowledged that research in this area is in its relative infancy owing to the fact that the statutes and ordinances are new, and in many cases baseline data are scarce.

That is not so for the U.S. Streams tributary to Lake St. Clair. For—for the existence of baseline data makes these watersheds excellent candidates for phosphate control measures that can be subject to evaluation and assessment of effectiveness.

Such an assessment is currently underway nearby in the Huron River watershed of Southeastern Michigan. Ordinances banning phosphate from fertilizers were predicted to produce a mere 25 percent reduction in phosphate loading to the river. Statistical analyses indicate that it will take two years of weekly measurements now under way to learn whether the desired effect was achieved.

With respect to reducing point sources, the aging infrastructure at many wastewater treatment facilities makes them ripe for renovations and upgrades to incorporate modern phosphate removal technologies. As opposed to the present vagaries about water quality improvements that may result from non-point source controls, it's very easy to predict the reductions to phosphate loading that would result from reductions in the effluent phosphate concentrations from wastewater treatment facilities. In the case of the Clinton River, a 50 percent reduction in phosphate discharge will produce a 25 percent reduction in phosphate levels and a corresponding decrease in maximum algal biomass that can develop. Those numbers illustrate some of the insights and prediction that science can contribute to decision-making. Future water quality, however, depends ultimately on economic and political decisions, not on science alone.

Thank you for your attention.

Mrs. MILLER OF MICHIGAN. Thank you.

Mr. OBERSTAR. Well, you're so right in the latter observation, so often it's not the technology but the political will to carry it out, that's why we hold hearings.

Mr. Jim Ridgway, Executive Director, the Alliance of Rouge Communities of Detroit.

Mr. RIDGWAY. And a bunch of other things.

Mr. OBERSTAR. And a bunch of other things.

Mr. RIDGWAY. I'm really honored to be speaking particularly to you, Chairman. This is probably the only time I will ever address Congress and I will not waste my five minutes repeating what they've said; nutrients are bad for our Great Lakes. I also will not sugarcoat the many challenges that will prevent us from averting the demise of our lakes.

The Great Lakes will only be protected with strong federal leadership. I understand that you staffed the drafting of the Clean Water Act. At the same time, I happened to be in college and I was at the first Earth Day, I made it through a couple of engineering degrees, I've spent my career sort of on the other side, working with locals, working with industries, and we've done an awful lot of good, but there's also things that are falling through the cracks.

In 1972 the country looked to Congress to clean up our waters and Congress delivered. We're looking at you one more time and we hope that you can deliver.

Right now nutrients are degrading the Great Lakes and I have no reason to believe that that degradation will abate in my lifetime. I'm speaking to you as a citizen to Great Lakes and a couple of other titles.

The interesting thing about the Alliance for Rouge Communities is that the communities got together recognizing that the state was failing to do some things and the feds were failing to do some things, and the local communities got together to try to do those things. What I can say with all the folks I've worked with is they are the "A" students, they're the choir to which we preach. They all want a clean lake and they all recognize more needs to be done. They're willing to do what they can do but they are looking to the Federal Government to do more. They are also looking to the Federal Government for more support, and when I say more support I mean more money, money to facilitate the work that's being done locally, money to facilitate the work that's being done by the federal agencies and the state agencies.

Is there really a problem? Yes. They've talked about it and they had not even really gotten to the worst cases which are blue-green algaes, "Red Tides," botulism cases. There's a lot of things about the nutrients that many don't believe could happen on our Great Lakes. I know they can.

Excess nutrients kill lakes.

In the end of my testimony I've included a Google map. If you go to Google Earth, you look at it, and if you look at Saginaw Bay, Lake St. Clair, and western Lake Erie, it's really obvious we're overloading it. And I remind you that 90 percent of the water that goes over Niagara Falls, which you can visually see, goes through Lake St. Clair. And if you can get Lake St. Clair to turn that green in a hundred and eighty thousand CFS you're really loading that lake up.

So, Doug Martz likes to call Lake St. Clair the heart of the Great Lakes.

I say it's not a Great Lake but a damn good one. But reality is it's the "canary in the coal mine," and if we don't address what's going on in Lake St. Clair there's no reason to believe that we are going to address what's going on in the rest of our Great Lakes.

I've also included a little picture of Lake St. Clair and when you look in my testimony and at first you think oh, it's low water. No, it's not, that is algae in a great, well, a damn good lake, in our Great Lakes. I have hundreds of those pictures. It's not surprising that little lakes are eutrophying. It is concerning that Lake St. Clair is eutrophying. Clearly it's nutrient loaded. Clearly the citizens are outraged. Clearly something isn't working.

What's not working? Too many cooks are spoiling the soup. We get a lot of federal guidance. We've got the Army Corps, the EPA, Fish and Wildlife Service, the USGS, NOAA, and they all have good opinions, but none of them are responsible specifically for the Great Lakes, and as a result, too many cooks are spoiling the soup.

And it's not overlapping authority that's my concern, it's that there are a lot of things that are unregulated. There are a lot of sources of nutrients that end up in our lakes that are unregulated and the under-regulated nutrients are everybody's problem and they're nobody's problem and the discussions drag on for decades.

Permitting and enforcement is not working. There are pipes that are discharged that fall into the NPDES program and the states and feds do a good job of following those up. And then there are a lot of pipes that are not regulated. And the same pollutant from the same source falls out of the regulatory program.

So my recommendation would be assign the responsibility for all regulation to one authority. They can delegate it, they can share it, but at the end of the day if there's nutrients fouling our lakes, one authority should be responsible for it.

Secondly, as been spoken before, there's virtually no monitoring. The monitoring needs to be done and the recommendations here I think work.

And lastly, you have to prevent—to provide funding and identify single agencies responsible for collecting, maintaining and disseminating that funding. When you started with the Great Lakes—or the Clean Water Act there was a great construction grant program when you did 75 percent funding plus 10 percent from the states. Municipalities got stuff done. Since that time there is not enough money. We all know the infrastructure is failing, the EPA gap analysis says the infrastructure is failing, and these same municipalities cannot afford to do the things that we know need to be done, reducing nutrients, putting in monitoring programs, because they cannot afford to build what they have.

So, please as you work with your staff, and I know you're doing certain jobs with the Clean Water Act right now trying to clarify some things that have been eliminated from recent court decisions, I hope that you'll consider the—finding funding for the core programs, it's not the sexy part of the business, monitoring, permitting, enforcement. Find the funding for that, find the funding to help the municipalities build the infrastructure that they need to do, and if you get back to the—some of the same principles that we imposed in 1972 and recognize that a lot of the nutrients need to be regulated I think we've got a half a chance.

Thank you very, very much.

Mr. OBERSTAR. Well, thank you for splendid testimony of which I—all of which I've read ahead of time and which I'm very appreciative. We'll come back with some questions a little later.

Miss Lynn Henning, Sierra Club, Michigan Chapter, Concentrated Animal Feeding Operation Water Sentinel.

Ms. HENNING. Thank you.

Mr. OBERSTAR. We welcome a Sentinel, thank you.

Ms. HENNING. Thank you. I'm honored to be here, thank you for allowing me to provide testimony.

I am a family farmer, we farm 300 acres in Lenawee County, Michigan. I'm a CAFO Water Sentinel. I've done water monitoring for the past eight years downstream from CAFOs. I have a quality assurance plan that's been submitted to the Michigan DEQ. Within ten-mile radius of our farm we have over 20,000 cows and 20,000 pigs. They have capacity of storage of over 200 million gallons of waste.

I just brought a small map to show you visually, I live here where the red dots are, and all these areas are within ten miles of my farm. These are the headwaters of Lake Erie.

We have over 300 documented discharges downstream from each one of these CAFOs. We have 12. There's over a hundred and sixty-eight chemicals in and around manure that was documented by the U.S. EPA in 2001. I'm going to show a very short PowerPoint to give you some visuals, maybe.

First, I'm going to show you that the CAFOs are contributing nutrients and other pollutants to the Great Lakes. There are over 200 CAFOs in the State of Michigan. We have already seen impacts of crypto sporidium, giardia, which has been DNA'd by Dr. Joan Rose in our area. At three drinking water intakes they have found 11 sites of crypto and eight sites of giardia. We have seen algae blooms that we are being contacted by the people at lake area. I have brought a sample of the toxic blue-green algae from the Lake Erie water keepers.

We are seeing impaired waters. Downstream from one facility we have two open waterways that have been put on the state's impaired water list directly from the CAFO. We're seeing risk to human health from land-applied pathogens that can reach waterways to spread disease, bacteria, parasites, viruses through drinking and recreational waters. We're seeing nitrates in the ground water.

We're seeing the soluble phosphorus which contributes to the eutrophication, we're seeing acidification which damages our forests. Mobilization of aluminum, which is toxic to fish, disturbs the nutrient uptake from plants and trees and enhances sensitivity to stress factors like drought and fungi, causes undesire—changes in species composition which is important to our bio diversity. Methane, which will effect our ozone.

Overdosage of nutrients can lead to heavy metals such as copper, zinc and organo chlorines which accumulate in the food chain and become a health hazard. We're seeing studies that invasive species that they're using zebras, quaggas, round gobies and others in constructed wetlands to treat animal waste that can then be overflowed into the waterways. We're seeing blood worms in our open waterways that can cause hepatitis, these are just to name a few.

And I'll go back to my PowerPoint. This facility, to show you some of the problems, it is highlighted in light green because it was built in a flood hazard zone. The facility at the top discharged into the crick to the—in the dark color beside it.

The facility to the right has an open waterway running directly through the production area of the CAFO.

The X marks where the CAFO is located. This was directly discharged into Lake Huron when they had this discharge.

This is a annotated photo of one of the larger facilities in the state and you can look at it over on the side, it will show that our biggest problem are field tile. They're using liquid waste on fields that if you put grass waterways in it will protect surface discharges but it does not protect what soaks through the ground and gets into the field tile systems that drain to our waterways.

We're seeing silage leachate, we're seeing underground tile, we're seeing storm water containments that are used as secondary containment for animal waste and open ditches that go to waterways.

Here is a sample of downstream from a CAFO, we are getting E. Coli readings up to seven-and-a-half million milligrams per liter. 300 is full body contact.

This ditch shows the effects of nutrient loading from a CAFO that is downstream from the CAFO.

This is a brand new and empty animal waste storage pit with cracks before the animal waste is even put into it. This is a concern for our groundwater.

This is a poultry facility, if you look at the pavement below the fans, they were cited twice for discharges of contaminants into the waterway because this drains off into a catch basin that goes to an open ditch that has tile.

This is downstream, this is the drainage ditch, we're seeing algae blooms where we're having animal waste enter the waterways.

This shows field tile entering the roadside waterway and this is one of our biggest contributors to our animal waste distribution into the streams.

This aerial shows flowing straight through the production area of a CAFO. It was built in an undetermined flood hazard zone and the milk house they literally buried the tile below the facility.

This is not just happening in Michigan, this is happening across the United States that they are being sited close to the headwaters, over county drains, near waterways with field tile, catch basins, dikes, tile risers, that all are pathways for pollutions and nutrient to our waterways.

Thank you very much.

Mr. OBERSTAR. Thank you, Miss Henning.

And again, thanks to all members of the panel that have given us very thoughtful and constructive thought-provoking testimony.

I'll begin with Miss Henning. What is the size of the CAFO, for those who aren't familiar to the word, Concentrated Animal Feeding Operation, usually they—that refers to beef cattle fattening operations but in this case is it dairy farms that you're talking about?

Ms. HENNING. A dairy farm, yes, sir.

Mr. OBERSTAR. And what is the typical—of these large—what is the typical size of the dairy herd?

Ms. HENNING. Definition of would be 700 animal units.

Mr. OBERSTAR. 700?

Ms. HENNING. In Michigan. The largest facility in Michigan holds over 9,000.

Mr. OBERSTAR. 9,000?

Ms. HENNING. Yes, sir.

Mr. OBERSTAR. That's a factory, that's not a farm anymore. I mean, I'm used to 200 head of dairy cows is the average size farm in my district with a hundred milking and—and another hundred getting ready to be fresh, that's a—that's a big operation.

What containment is there on these facilities to prevent bleeding of nutrient from the operation into a drainage ditch or creek?

Ms. HENNING. Many of these facilities use an—urban lagoons which do have a capacity, I do not have the figures, but they do leak into the soil. They are allowed to——

Mr. OBERSTAR. It's getting into groundwater you're saying and then——

Ms. HENNING. It does leach.

Mr. OBERSTAR. —migrating——

Ms. HENNING. Yes.

Mr. OBERSTAR. —from there.

Ms. HENNING. It does leach.

Mr. OBERSTAR. Thank you.

Dr. Freeman, you—you made a very telling observation, self-policing is fatally flawed. We've seen that. Now the policy of self-policing is fatally flawed. We've seen that in our Committee.

When the Coast Guard launched its Deep Water Program they were doing just fine until they got moved over into the Department of Homeland Security and then things went awry, and the result was we had an 11-hour hearing in our Committee on the process by which the Coast Guard issued a hundred million dollar contract to extend surface cutters for their interdiction of drugs and illegal immigration in the Gulf of Mexico, and they were told you self-certified, tell us you're doing a good job, and they did except they weren't doing a good job, and now the taxpayers are stuck with a hundred million dollars' worth of vessels that we can't use that are going to be scrapped.

We found self-policing to be a fatally flawed policy with the FAA when they issued a customer service initiative to the airlines. Tell us you're doing a good job and we'll patty-cake with you when you say you've done a good job inspecting your aircraft, and now 985 aircraft later pulled out of service for reinspection we found it was fatally flawed, 200,000 people flew in unsafe aircraft.

So when you—when you say self-policing on production of chemicals that infect the waterways you're—you're right on. You're monitoring—your suggestion of—of when you do monitoring for air that comes from thousands of miles away reminds me of hearings I conducted in the 1980s on Great Lakes water quality.

What was happening, we are inquiring, when point sources have been addressed over $15 billion spent throughout the Great Lakes by federal and state government and industry alone, and yet while the fish were back they were back with cancers, the bald eagles' eggs were still not reaching maturity because of DDT, and there was no DDT in the environment.

What we found was researchers have told us it's coming from Central America. We were exporting DDT to countries that were using—U.S. Companies in other countries that were using it to protect their banana plantations and other plantations, and so the aerosols were being caught up in the upper atmosphere in that—in that stream that goes up the Mississippi flyway and being deposited on the Great Lakes in 14 days, in fact, in eight days according to the monitoring, faster than the Sandinistas could get there as President Regan said, in 14 days they'll be on our shores, well the DDT was there, and it was killing the bald eagles, the young. And we—and so you're right, we need—we need better protection.

Now I'm interested in your reference to the membrane spectrometer and—and the development of a three-dimensional flow model of the river. How would you do that?

Mr. FREEMAN. Well, actually the U.S. Geological Service is the one that is best equipped to do that. We—we need not only the model of the river but also of the lake and—and that's well within the—the capability of personnel here at the University of Michigan.

For example, Guy Meadows has developed a 3-D model of the lake, and what it does is it allows you to back calculate so you detect a substance at position X at time Y, you can then back calculate where it came from and then hold those polluters responsible.

Mr. OBERSTAR. Now the Corps of Engineers has—has two very remarkable models, one of the Mississippi River and the other of the Chesapeake Bay, and Mississippi River model is in Vicksburg, Mississippi where the Corps can—can create flows of the river to simulate various conditions that they want and what the effects will be of high water, low water, on channels and on navigation. Now a good deal of that is done by computer modeling so the actual river water flow at Vicksburg is—is less used than it once was, but would you say that USGS would be the appropriate agency to—to develop such a——

Mr. FREEMAN. They've actually taken a stab at it. There's a good 2-D model that they have developed here, the Army Corps certainly has the capacity to do that. But if you coupled that with a device like the membrane induced mass specs, which can screen for thousands of chemicals in minutes, then you—you have a real chance of catching the polluters.

You know, I'm reminded of when we had a vinyl chloride and a methel ethel ketone spill.

Mr. OBERSTAR. Uh-huh (affirmative.)

Mr. FREEMAN. The state police flew helicopters over here to—to grab bottles of water and then they would fly the helicopters back to Lansing and they were able to process two samples a day.

The system that we're proposing would have processed those two samples for at—at least a hundred times the chemicals the state police were looking at in less than ten minutes.

Mr. OBERSTAR. Well, I'm——

Mr. FREEMAN. And you're actually doing the monitoring on the same scale that the river flows and now you can really protect the public. Until you do that you're just doing something to be doing it.

Mr. OBERSTAR. Well, I think we'll pursue that with Miss Miller further on—on the Committee's work as we go through the Water Resources Development Act, we just—I think we need to—to take that idea to the next level.

Miss Miller.

Mrs. MILLER OF MICHIGAN. Thank you, Mr. Chairman. And I think I'll pick right up on that because that's been a real—an issue I had been working on along with this monitoring system and 3-D model as well.

But, first of all, let me say to all the witnesses you can see for all of your expertise and you are an unbelievably expert panel, you're never going to pull one over on our Chairman, he knows—he's—he has his own national treasure with his expertise on water quality and so many other issues under the transportation jurisdiction, so it's again, it's delightful to have him here.

But the 3-D model that we've talked about for a number of years in the St. Clair River could serve dual purposes and so if—if there's a possibility of us authorizing expenditures under the WRDA Bill or something, not only would we have the—and I—I do think the Corps of Engineers could probably build this thing, as you mentioned, the one in Mississippi which is—my dad was an aeronautical engineer and I remember when they would do various things at NASA, he always did wind tunneling.

Well, this is an asymmetrical 3-D model, similar, similar concept of course, but not only would you be able to understand and pinpoint immediately where any contaminants were actually introduced into the waterways and how they transit their way down the river, whether that's a sewer spill from a municipality or a chemical spill or what have you, that would be an invaluable thing.

But I will also mention on our next panel we're going to hear from the Corps about some of the various problems we might be having with water levels, but that has also been an impetus, it could serve dual purposes. Because as we're aware, there's a theory being advanced by one of the foremost coastal engineering firms in the—in the hemisphere really, that because of the extensive dredging that was done in the St. Clair River in the early, mid '60s to open up the upper Great Lakes to shipping, subsequent dredging and erosion is causing a decline in the water levels so they—so they are theorizing.

I know that you've been all working with the IJC and as I say, I'll guess we'll hear from the next panel, but that would be a tremendous way to compliment the monitoring system that we have so I think that is very important.

I don't know if you have any comment on that. Would you agree with that or——

Mr. FREEMAN. I completely agree with you. Not only your comments about the 3-D model but your comments also about the Chairman, he can serve on our faculty.

Mrs. MILLER OF MICHIGAN. He could teach your classes, I think that's true.

I might mention then, ask a question about the monitoring system here, and any of you that might have the expertise to answer, I was—I think Dr. Freeman was mentioning about the EPA and the still—the spill data that they had and that they were only able—they only had four fines, the EPA only had four fines from '94 to '04, I was trying to take some notes while you were talking, and can only test for 20 to 30 percent of the potential chemicals. Now our monitoring systems have 29 specific chemicals that they can monitor for as well.

Either yourself or Mr. Ridgway I suppose, do we have any incidents that we can report back to the full Congress of how the monitoring system has worked thus far, best practices, perhaps an incident where we have identified something and then how did we respond.

Mr. RIDGWAY. It's interesting, the challenge right now is getting the regulated and regulators to agree on some numbers because when you have no data you don't care. But things like benzene, which we're monitoring regularly, is going up and down because you can measure it and you—you know, can be coming from boats, can be coming from a spill, and so at this point we're collecting a great deal of data, we can see changes in that data and we're working with folks, and right now there's something called the MCL, which is the Mean——

Mr. STOW. Maximum Contaminant Level.

Mr. RIDGWAY. Yeah, Maximum Contaminant Level, and we're saying that anytime you hit 90 percent—or, well, 10 percent of the MCL you notify the operator, let the operator know something's going on at the water plant, 50 percent you notify the operator and the drinking water people at the MDEQ, and at 90 percent you do those two plus the spill response folks. That trigger is automatic. That—the computer, when it hits that number, it goes—it is paged, people's cell phones are text messaged and it says you got benzene at this number at this location.

As we're tweaking those, sometimes the alarms are too often, sometimes the alarms aren't often enough, so we are measuring stuff, we're getting good data, and now we're just trying to decide how to manage the data we're collecting.

Mrs. MILLER OF MICHIGAN. I think it is interesting that, I was mentioning this to the Chairman earlier, that as a result of us putting our monitoring system in place and chemical companies or others that might introduce the contaminant into the—into the waterways, and we've had rather horrific experience over the last several decades with the amount of incidents of contaminants into our waterways, now that they are aware that the monitoring system is up and is running and samples are being taken every 15 minutes, and that it is part of the notification protocol, and we are continuing to perfect it, but not only would we be able to understand rather immediately in real time that there has been something introduced harmful into the water supply, and we have the ability perhaps to actually figure out where it came from, I don't know if it's serendipity or coincidence or what have you, but guess what, the amounts of chemical spills have gone down dramatically.

Mr. RIDGWAY. If there's a radar gun on the expressway, I think I'll drive slow.

Mrs. MILLER OF MICHIGAN. That's exactly—that's a very good analogy, a radar gun on the expressway.

But, and I also want to say hats off to our wonderful Canadian neighbors because they have developed as well, their SWAT team, that's what I call it, their SWAT team within the Environment of Ministry there, who is also doing a tremendous amount of policing, and we have to continue to work together on that.

I'd also like to ask Mr. Snow I think, Stow, was telling us a little bit about the study that NOAA is doing in the Saginaw Bay and I'm somewhat familiar with that. I know you have almost $4 million I believe that's been authorized for that.

Could you just flesh out for us a bit exactly what you're looking at because this muck issue is so—such a large issue in the Saginaw Bay. Is that enough resources to do an adequate study? When do you think you might have some findings that are of consequence and how is all that going?

Mr. STOW. Okay. We are currently in year one of the study and in year one we're focusing on sort of gathering up the data that exists on the system that had been collected in the past.

When the original Great Lakes Water Quality Agreement was established in the 1970s there were four mathematical models that were used to help support this effort. One of those models has been updated over the years now, includes processes associated with zebra mussels and things like that, and so one of those original models is a—is a part of this project, the—the updated version.

In year one we're essentially focusing on developing some new approaches, looking at the existing data, and starting a light survey out on Saginaw Bay, in fact, today's the first day, in principal there's a boat out there right now that's doing some initial monitoring. That—that will be effectively what we accomplish by the end of this year.

Starting next year is our much more intensive field work—oh, and I should say we are also beginning some monitoring in the watershed looking at flows and concentrations of phosphorus in the tributaries into the Saginaw River, so all of that's occurring essentially as we speak.

Starting next year we'll have some more intensive field years, we—where we'll be out on a regular basis looking at such things as the phosphorus concentrations, the water—or the light penetration to the bottom, trying to establish some ways where we can measure the density of the algae that grows on the bottom, that's not a particularly easy thing to do.

And, in fact, our most recent surveys looking at the coverage of the zebra and the quagga mussels are from the late 1990s, it's not like there's somebody out there every year doing that sort of activity, so we'll have some better estimates on the degree to which they've colonized the bottom of Saginaw Bay and may be influencing the dynamics, we'll see.

So we're in the very early stages right now, as I say, monitoring is just beginning, we're initiating our citizen monitoring, we're working with DEQ representatives to get that up and going by hopefully the beginning of June, we're—we're in the ramping up stages as we speak.

Mrs. MILLER OF MICHIGAN. And you'll have some sort of reporting mechanism so we'll know as you're progressing?

Mr. STOW. Yes. We're working, as I indicated, that a couple of investigators on the project are representatives from the DEQ and the DNR, they're active—actively involved in the project, and they will be gathering information as it's revealed and as we learn more.

Mrs. MILLER OF MICHIGAN. Just one other question, in particular, since we're talking about the possibility of the 3-D model being authorized under the WRDA Bill as well.

I think everybody talks about monitoring, how important it is. I think we agree, there's a consensus that monitoring is absolutely critical.

I think it was Dr. Richards that was mentioning what is the cost, is it really expensive, yes, but, you know, what is the cost of not doing such a thing, and just throw out to the panel would you generally agree that the Congress should perhaps look to our model or some model to replicate through the Great Lakes basin, do it for all of the Great Lakes states for having adequate monitoring system, and do you think this is one we should look at or is there a better system or—and I don't know if you have any general idea of what the cost of such a thing would be throughout the Great Lakes but just——

Mr. STOW. One of the——

Mrs. MILLER OF MICHIGAN. —certainly need to get started on it.

Mr. STOW. One of the limitations with these sorts of models is, for instance, in the—when we developed the Great Lakes Water Quality Agreement I mentioned there were several models used in parallel, and what tends to happen is we develop a model, we make some decisions, and the model kind of gets pushed off into the background.

One of the particular features of this project is that we have one of these models that has been maintained over the years and I think having models that are maintained and updated as we get new information is essential for this sort of activity.

In particular in this project we're going to—there's quite a debate among modelers about the best way to model different things and when we put this grant together to—or this proposal together to get this grant we didn't try and justify one kind of model as being the absolute best, we said we're going to try a couple at the same time and compare them as we go along, so models are essential, they allow us to extend what we know and part of the trick I think is having models that we work with over a period of time and update as we learn more.

Mr. RICHARDS. I'd like—I would like to second that general thought. I think that monitoring can be crucially important in informing the models and allowing us to determine whether the models are really giving us a proper story or not. If you have to develop a model and you don't have any data to test it with it may be telling you the totally—totally wrong answer but you have no way of knowing it, so modelling and monitoring should go—go hand in hand and—and feed back upon each other.

I think, if I'm not mistaken, some of the folks in Chesapeake Bay have gotten into some fairly hot water because they were projecting that they were at such and such a place in saving Chesapeake Bay and somebody went out and looked and said, no, you're not, and it turned out all they were doing was looking at the projections from the model and presenting them as if they were reality without the—without the monitoring to—to ground truth that, they were playing a rather dangerous game, so I think that there's a need for both. They both do different things but they work very nicely together and we need to support both of them.

Mr. FREEMAN. Beyond that they—they also need to inform action and decisions and decision makers. I'm reminded of Doug Martz's experience with E. Coli counts where for 20 years health departments and others collected E. Coli, dutifully filed the counts away and nothing happened.

And so what I like about the system that Jim Ridgway's group has put together is that it does have some notification and it can inform decision making and action. We—we can't do these things as ends unto themselves, they have to drive action.

Mr. RIDGWAY. And I would just add one other piece and that's I—I would ask you to decide who's going to baby-sit this model for years to come. The area in which you are asking for a three-dimensional model has been modelled at least three times that I'm aware of in the last 20 years by different groups. The studies done answer a couple questions and it goes away.

If you were to decide, I don't care who it is, NOAA, this is the person that is responsible for handling this model forever and then allow other people to use it and put data in and make decisions and all that kind of stuff, but you need someone to maintain it over the years or the study will be done and it will go away.

Mr. FREEMAN. Similarly, monitoring data needs to be available, catalogued, made accessible to—to researchers and agencies in perpetuity.

Given the massive flow, and—and Jim's right about it starts here and then it goes over, you know, Niagara Falls, we really should have a center that maintains all of this information for the Great Lakes, all of the monitoring data that are collected by all of the agencies, and we don't have anything like that. So we get isolated reports here or there, 12 towns combined sewer overflow discharged today.

Mr. RIDGWAY. I suspect this panel has the best collection of data anywhere, but it's in six different little files, and what I have Dr. Lehman doesn't know about, and what Dr. Lehman has I don't know about, and if there isn't a central depository, every time you start a study the first thing you do is start trying to collect what data is out there.

Mr. OBERSTAR. Well, thank you. That's—and we'll come back to Miss Miller in a few minutes, we're going to alternate back and forth here a little bit.

You gather all this information as you say and it's deposited in—in different receptacles and studied and all too often scientists turn to each other and say this really is polluting, you know, this is awful, terrible, they agree with each other but somebody has to do something about it. The end of it is doing something about it and taking an enforcement action, building a treatment facility or upgrading that treatment facility, otherwise humans inevitably become the repositories of all the toxics we discharge into the waterways.

And again I'm reminded of a hearing conducted on the Great Lakes Water Quality Agreement with Canada and—and the progress on the—of the Clean Water Act of 1972. Dr. Henry Lykers (ph), a microbiologist, member of the governing council of the Aquasagany (ph) people at the outflow of the Niagara River, Mohawk Indians otherwise known, said that in the early—in the late '70s, early '80s, he had been noticing reports from people of—of his community of three times the national average spontaneous miscarriages, three times the national average tremors in joints, elbows, wrists, hips, knees, mental disorders and—and rising cancers that they'd never experienced before.

And he undertook to do surveys of—of various scientific—given his scientific experience and background and training, he found they were all eating fish for 3,000 years they'd been eating fish.

Fish are the repositories of the Niagara River, the outflow of all the Great Lakes, so they have three times the national average of everything of—of PCBs and dioxins and mercury, cadmium and lead, and so they stopped eating fish. And I said, "Was there any health consequence from that?"

"Oh, yes. Yes," he said. "Our people now have twice the national average of diabetes, arteriolosclerosis, cardiovascular disease and other—because they're getting their protein, they're getting their food energy from other sources that were not healthy for them," so we create all sorts of problems that ultimately people become the bio accumulators and not just the fish or the plant life.

So to get—get to the end of this, to stop this, we have to have—you have to have pollution prevention and pollution treatment.

Now, Mr. Ridgway, you said—and I appreciate, you looked to Congress in 1972 and you delivered. I was chief of staff of the Committee at the time, we were ten months in conference with the Senate fashioning the Clean Water Act. It was a vigorously heated, debated both sides working toward the same objective but from different perspectives but we got there, we did it. Then it deteriorated when the—when the grant monies dried up.

Now, as I said, we—we passed in the first session of this Congress, legislation to provide a billion six hundred million dollars to help communities with separate and combined storm and sanitary sewer overflows, but you also said we have eight agencies overseeing this work on the Great Lakes. Do we need a coordinating authority?

Mr. RIDGWAY. God, yes. Can I be more clear?

The problem you have right now is it——

Mr. OBERSTAR. Well, the day after Pentecost, yes. We don't want—we don't need the tongues of fire descending on eight agencies, all speaking in different tongues, maybe they need to speak with one tongue.

Mr. RIDGWAY. You have a number of people, many of who have taken the responsibility to do their job. Congress has asked different federal agencies and the locals, but it's like—it's like taking a test, now the analogy here to say is you got a bunch of locals and the locals that are the "A" students are taking the test and doing a good job, and right before you turn the test in, your teacher says take your exam and hand it to the guy next to you, and you're graded by the person next to you.

The good work you do goes downhill and you receive the bad work of the student uphill and until you make all of those people, all of the locals, held to an accountable level, and that means farmers and waste water plants and people's homes on—and I'm not saying you regulate it away, I'm just saying we have to address all sources—I suspect over 50 percent of the nutrients getting into the Great Lakes are unregulated or under regulated.

Mr. OBERSTAR. How often do these, in your experience, and any members of the panel, how often do these eight agencies talk to each other?

Ms. Henning?

Ms. HENNING. I'd like to respond to that, because when I started water monitoring I would contact the locals and would get no response. As I got into the monitoring and being shoved aside I started addressing the U.S. EPA, the Michigan DEQ, the local health department, the drain commissioner, and then we finally started seeing action by making the communication line amongst the agencies to let them all know what was going on. So I felt they were not informing each other, there was no communication.

Mr. OBERSTAR. Some years ago I—when I chaired the Investigation's Oversight Committee or Subcommittee, we—we looked at transportation provided by numerous federal government agencies who were not primarily transportation agencies, we found a hundred and thirty-seven agencies providing transportation, the cost of over a billion dollars a year, and they weren't talking to each other in three different departments of government.

So, this would be before your service in Congress, Bill Klinger from Pennsylvania, the ranking Republican Member on the Committee and I, we held their feet to the fire and—and by golly they came to the—to the second hearing we held and said well, Mr. Chairman, we've decided as you suggested to have a coordinating council and talk to each other and eliminate the duplications and the overlaps.

And maybe that's what we need here on the Great Lakes to have—and—and who and how, how to create that is something that we'll have to address.

Mr. FREEMAN. Could you include in that council our Canadian friends as well since whatever they discharge makes it over on our side in a matter of a few minutes?

Mr. OBERSTAR. Well, I'll discuss that at the U.S.-Canada Parliamentary Group meeting later this week. We can't legislate them into the picture but we can invite them in under the U.S.-Canada Great Lakes Water Quality Agreement.

Professor Lehman, what is the role of phosphorus and plant growth and how—how can we—what are the best means of eliminating it from the water column?

Mr. LEHMAN. Well, phosphorus is an—is an essential mineral, it's—it's a component of DNA, RNA, and components of cell membranes, so it's—it's absolutely essential for life. And organisms contain about one atom of phosphorus for every roughly hundred atoms of carbon that they contain but they can't get away with—they can't live without it.

Now, in terms of removal from the water column, frankly organisms, like micro algae, are extraordinarily successful at removing phosphate from the water column, hence their excessive growth at times when phosphorus is—is supplied to them in luxurious quantities.

There are—there are—the best way to—to prevent it from getting into the water columns is to treat it near its source, either provide an improved means to the infrastructure at which phosphorus is removed at waste water treatment plants and if you correctly recognize the—the infrastructure is failing all across the—the rust belt, and it is—it is possible for some improved management practices and agriculture and—and industries to—to reduce it at its source.

Mr. OBERSTAR. In sewage treatment facilities, is there—are there improved means of treatment beyond tertiary to address phosphorus removal?

Mr. LEHMAN. Well, there are a variety of techniques that would all fall under the category of tertiary treatment. You may be—you may be thinking of a particular chemical precipitation where iron is usually used to——

Mr. OBERSTAR. Right.

Mr. LEHMAN. —complex with the phosphorus and the—the particular limitation there is that to remove the first few grams of phosphorus it's relatively inexpensive. To remove the very last few grams it becomes progressively more and more expensive. But there—there are new technologies based on—on membrane uses and not just biomembranes but chemical membranes.

We had a presentation actually at the final meeting of the Blue Ribbon Commission on Lake St. Clair and that's—that is not my area of engineering expertise, I mean, but—but we certainly heard about these techniques.

Mr. OBERSTAR. Well, I have many more questions but I'm going to yield to the gentlewoman from Michigan, and then we have to get on to the next panel, but I certainly am grateful to all of you for your splendid contribution.

Miss Miller.

Mrs. MILLER OF MICHIGAN. Thank you, Mr. Chairman. And I will just follow-up with a quick question, because we are running out of time, we want to hear from our next panel, with the Colonel from the Corps of Engineers, and we appreciate all of you being here, but I think I'll follow-up with Professor Lehman just briefly.

As the Chairman was asking about how we might actually be able to address the problem of nutrients and I was trying to take some notes when you were talking as well about the Blue Water Committee, which I do sit on, and you mentioned about the data we had from '04 and '05, et cetera.

Mr. LEHMAN. Certainly.

Mrs. MILLER OF MICHIGAN. But you said something about the nutrient level in the Clinton River is 50/50? What did you mean by that?

Mr. LEHMAN. What that is we—we talk about two types of sources by which phosphate enters water bodies, one is the point source is discharged from the end of a pipe and the other is non-point source which could be overland runoff, runoff from parking lots, streets and so forth, and the—the analyses that I did by two—two different independent ways indicate that if you look at the total phosphorus content of that Clinton River and say which is more important, is it the point sources that are contributing the majority or is it the non-point sources. It turns out the breakdown is almost exactly 50/50.

And—and my point about that was that if you focus—if you—if you aim your—your attention at either one of those sources and you have a viable means for reducing the phosphorus, you—you—you have two equally good strategies by which you could reduce phosphate concentrations.

Mrs. MILLER OF MICHIGAN. If you were the Chairperson of the Clinton River Watershed and you were making a recommendation to the municipalities within the watershed on several things that they could do rather immediately to help the health of the Clinton River, what would they be?

Mr. LEHMAN. I would have them look pretty carefully at how their waste water treatment plants are operating and see if they can improve their—their effectiveness. They would get an absolute improvement by—by any kinds of increases in the efficiencies of phosphorus removal that they can implement.

Mrs. MILLER OF MICHIGAN. I see.

Well, thank you very much Mr. Chairman, and I appreciate all of the panelists again coming today, you really are a fantastic reservoir of information and we certainly appreciate all of your testimony, thank you very much.

Mr. OBERSTAR. You've given us much thought—food for thought for follow up on the testimony you've given today. Thank you very, very much.

Our second panel consists of Lieutenant Colonel William Leady, he's the Commander of the Detroit District Office of the U.S. Army Corps of Engineers. He testified before the Subcommittee at Green Bay, our hearing there on water quality issues and we welcome you, Colonel. I read your very thoughtful, thoroughly prepared statement with excellent history on—on the Great Lakes and on the St. Clair River issue and I welcome your testimony.

TESTIMONY OF LIEUTENANT COLONEL WILLIAM J. LEADY, U.S. ARMY CORPS OF ENGINEERS, DETROIT DISTRICT, DETROIT, MICHIGAN

Colonel LEADY. Good morning—or good afternoon, sir.

Chairman Oberstar, Members of the Subcommittee, I'm Lieutenant Colonel Bill Leady, Commander of the Detroit District U.S. Army Corps of Engineers. Thank you for the opportunity to testify before you today on the lake levels in the Great Lakes.

In supporting the nation, the U.S. Army Corps of Engineers provides expertise to monitor and forecast Great Lakes water levels, and technical support to the International and Joint Commission, or the IJC, by regulating outflows of Lake Superior and Ontario. Lake levels directly affect the natural environment, commercial navigation, recreational boating, shoreline property, municipal water intakes and many other important features.

Before I discuss current lake levels I would like to provide some background on the main factors that affect lake levels. To illustrate this, I would like to direct your attention to the Hydrologic Components chart which you have in front of you, sir and ma'am.

The information on this chart uses long-term averages and does not represent any specific period. The poster illustrates four components, precipitation onto the lake in red, runoff from rivers and streams in orange, evaporation from the lakes' surface in yellow, and flow from one lake to the next in blue. Man-made diversions are also shown.

The relative importance of each of these factors shifts as the water flows from the basin's headwater of Lake Superior to the outflow on the St. Lawrence Seaway. For example, 57 percent of Lake Superior's water is precipitation that falls directly onto the lake whereas on Lake Ontario this accounts for only 7 percent of the inflow.

I would like to note that Lake Michigan and Huron are, for many purposes, treated as a single lake since they are joined at the Straights of Mackinaw and rise and fall together.

There are five man-made diversions on the Great Lakes basin. The Long Lac and Ogoki diversions which bring water into Lake Superior, the Lake Michigan diversion at Chicago which removes water for water supply, sewage disposal and commercial navigation. The Welland Canal provides a shipping route around Niagara Falls and the New York State Barge Canal diverts a small amount of water from the Niagara River. The last two diversions stay within the basins so they don't affect the overall Great Lakes.

The water levels on the Great Lakes fluctuate in three distinct cycles: Short-term, annual and long-term. Water levels fluctuate on a short-term basis usually due to winds and changes in barometric pressure. These changes can last a few hours to several days. The lakes also fluctuate on a seasonal cycle. On the Great Lakes, water levels decline to their lowest levels in the winter because more water leaves the lake due to evaporation than enters during this period. As the snow melts and spring precipitation increases, the lake levels rise. These factors contribute to more water entering the lakes and waters raise to their peak during summer months.

Long-term fluctuations occur over periods of consecutive years. Continuous wetter and colder than average years will increase water levels while warmer and drier than average years will cause levels to decline. Ice cover is a very significant factor affecting lake levels because ice acts as a lid preventing evaporation which is a major source of water outflow on the Great Lakes.

The IJC, with the Corps as one of the supporting agencies, does have some ability to influence relative lake levels.

Lake Superior outflows have been regulated by the IJC since 1921 by the IJC's Lake Superior Board of Control. The objective of the Lake Superior outflow plan is to have a relative balance between the long-term average of Lake Michigan, Huron and Lake Superior. Regulation of Lake Superior's outflow has a small effect on the lakes but to a far less degree than the effects of precipitation and evaporation.

Outflow from Lake Ontario is managed by the IJC St. Lawrence River Board of Control. The criteria for regulating outflows recognize the need of three major interest groups: riparian property owners, hydropower, and commercial navigation.

Now I'll turn to historic water levels on the Great Lakes and current conditions. The Corps began monitoring water levels in the 19th Century. The Great Lakes Water Levels poster shows these long-term fluctuations from 1918 to the present. On these graphs, the blue line represents the actual monthly average level and the red line represents the long-term average.

Several observations about Great Lakes water levels become apparent when the information is presented in this format. First, the lakes are rarely at their average level. Also, even at this scale, the average annual cycle, with lakes peaking in the late summer and dipping to the lowest point in the winter is apparent.

Each lake is independent of the other lakes. That is to say that one lake may be in an above average period while at the same time another lake may be at a below average period and the third lake can be near average.

Lastly, from 1918 to the present, there is not a definite or predictable pattern of level fluctuations on any single lake or the system as a whole.

For the reasons I mentioned earlier, water levels on the Great Lakes have gone through periods of high periods and low periods over the last 90 years. Following a period of above average levels across the lakes from the 1970s through the 1990s, the upper lakes have experienced low levels since the late 1990s. The increased water temperature, reduced ice cover, reduced precipitation and increased evaporation have contributed to the decrease in the upper lakes. Lake Superior and Lake Michigan-Huron are currently significantly below average while Lake Erie and Lake Ontario are currently above average.

There is some good news. A very active 2007-2008 winter storm track brought abundant amounts of snow to the Great Lakes basin. Also, ice cover formed much earlier over the northern lakes, and was much more extensive, limiting evaporation. Soil moisture across the Great Lakes basin is above average. These conditions hold promise for increased water levels on the Great Lakes this coming spring and summer.

Lake Superior has been below average since 1998 and is currently in its longest period below average in the 1918 to 2000 period of record. The lake set new monthly lows in August and September of 2007 and these records were brought on by drought conditions across the basin for the previous 15 months. Then the basin was inundated with ten inches of rain and water levels rose accordingly 9 inches. Lake Superior is expected to remain below average for the next six months although it will be 8 to 15 inches above last year's levels.

Mrs. MILLER OF MICHIGAN. That's good.

Colonel LEADY. Lake Michigan-Huron has been below average since 1999 and is currently in its second longest period below average since the period 1918 to present. The lake is currently below last year's levels. It will likely remain 12 inches to 16 inches below its record lows and 15 to 18 inches below its long-term average. Let me correct myself. It will likely remain 12 to 16 inches above its record lows but 15 to 18 inches below its long-term average for the next six months.

Lake St. Clair has fluctuated around average for the last two years. The April monthly average was two inches below average and one inch above last year's level. The forecast for the next six months shows the lake will remain slightly below average and near last year's levels.

Lake Erie has fluctuated around average for the past two years. The April monthly average level is seven inches above average and three inches above last year's level. The forecast for the next six months shows it will remain near or above average.

Lastly, Lake Ontario. Lake Ontario has fluctuated around average for the last two years but ended 2007 slightly below average. Since December 2007, the lake has risen significantly and in April the monthly average was 12 inches above average. The forecast for the next six months shows Lake Ontario will remain above average.

Another issue that received recent attention and possible cause for lower lake levels on Lake Michigan-Huron are flows in the St. Clair River. In order to answer these questions about the St. Clair River over time and the impacts on the rest of the system, the IJC has included these issues in the International Upper Great Lakes Study. The study will re-evaluate the regulation of Lake Superior and is investigating issues on the St. Clair River.

The Corps believes the IJC study is the appropriate vehicle to investigate the Lake St. Clair River issues. The Corps is one of several agencies supporting this study.

To close, I would once again like to thank you Mr. Chairman, for allowing the Corps of Engineers the opportunity to come before this Subcommittee and discuss the Corps' role in monitoring and forecasting Great Lakes water levels.

I would be happy to answer any questions that you or Representative Miller may have, sir.

Mr. OBERSTAR. Well, thank you very much Colonel, for participating today and—and again, contributing to the work of the Committee.

The issue of low water levels was addressed in the Water Resources Development Act Bill that our Committee moved in the first session of Congress and the Senate eventually did, President vetoed it, Congress overrode the veto, unfortunately the administration didn't include any of the projects in WRDA Bill in its fiscal year '09 budget. Among those issues is dredging of the channels and the harbors on the Great Lakes.

Our iron ore carrying ships from Minnesota and from the Upper Peninsula of Michigan are going out as much as 7500 tons light because from Minnesota they can't pass through the St. Mary's River because the 18 inches low water level compared to normal, and some of the lower lake harbors were as much as 40 to 50 inches low so that ships had to go out light, that means three extra voyages or more per vessel per season raising the transportation cost of iron ore to our lower lake steel mills. So we directed accelerated dredging to be done in the WRDA Bill and we're hoping in the appropriation process they can find money to do that.

I want to touch though very specifically on the St. Clair River issue. The compensating—weir compensating facility and the weirs.

When is the IJC likely to complete its ongoing study?

Colonel LEADY. Sir, the IJC has accelerated the study. It was originally a five-year study, which began last year. But the issue with the St. Clair River has been accelerated and moved forward in priority because it is such an important issue and that information should be done by the end of next summer, next fall sir, the fall of 2009.

Mr. OBERSTAR. Now you note that the—in your testimony that the issue of bottom sediment material removal in the river goes back into the mid 1800s and to the early part of the last century, but at one point compensating works in the 1930s were authorized and then deauthorized in the '70s.

What would be the cost estimate of weirs developed in the—can you just give us a horseback estimate of what that would cost and how much of a structure would be involved to install such facilities in the St. Clair River?

Colonel LEADY. Sir, I'll try to——

Mr. OBERSTAR. I'm not going to hold you to—come back in a year and say "You told us," but I just want a horseback estimate.

Colonel LEADY. That would be a project that would be similar in scope to building major locks. It would be a very expensive thing.

Mr. OBERSTAR. On the order of a couple hundred million dollars.

Colonel LEADY. It could be that high, sir.

Two things I would like to point out with this issue, sometimes they're not clear, there are two separate but related issues. One is what the IJC is looking at now which is what the Baird Report, or what some people refer to as the Georgian Bay Association Study, states that there is an ongoing problem in the St. Clair River that the bottom of the river is eroding and more water is flowing out of Lake Michigan-Huron, you know, every year, because the river is getting larger or the bottom is eroding. That issue is being looked at by the IJC.

The effects of dredging on the Great Lakes, the establishment of the 27 foot—first the 25-foot channel, then the 27-foot channel through Lake St. Clair and through the St. Clair River and certain stretches of the Detroit River, that is not being looked at by the IJC because the IJC has already looked at that in the 1930s and in the 1960s with Corps help and help from many other agencies, and the effects of that were determined to be lowering the Great Lakes—excuse me, lowering Lake Michigan-Huron by about seven inches. That is fairly undisputed by the scientific community, to include the Corps of Engineers, so that is a separate issue. The compensating weirs that were issued or authorized in the 1960s and in the 1930s when those deepenings were done, that was to compensate for that, so the IJC is looking at a slightly different related issue: is it the bottom of the river now eroding or is it changing shape that allows more water to move through the St. Clair River.

Mr. OBERSTAR. Well, we—we have another Water Resources Development Act under consideration by the Subcommittee and I am looking to move a bill by mid summer or certainly before September, and if there is some—some recommendation from IJC from the Corps that we can include, I know Miss Miller would—would be happy to sponsor that.

Miss Miller.

Mrs. MILLER OF MICHIGAN. You're absolutely right, Mr. Chairman. I'd be delighted to sponsor it and we are looking for some recommendation from both the Corps and the IJC on how we might proceed with that.

You mentioned Colonel, your best guesstimate, about what something compensating works would cost for that, but isn't part of that, I mean, at least I have heard this discussed, is actual weirs out in Lake Huron before it comes into the St. Clair River as well, is there some talk about that or——

Colonel LEADY. The actual proposals that took place in the 1970s were weirs within the river themselves and ma'am, I'm not clear whether they would be fixed weirs or they would be adjustable weirs, because we've gone through high water periods like we did in the 1970s and 1980s and early 1990s so during a high water period would you need the ability to adjust those weirs would be a question.

And one point I'd like to add to, is when I said seven inches, that is the effect that is not widely disputed, of the Corps, the federal dredging of the channel. Other human activity, which is slightly less documented, is estimated to be an additional seven or more inches, so a total effect on the level of Lake Michigan and Lake Huron is around 14 or more inches from human activity through the late 19th and 20th Century.

Mrs. MILLER OF MICHIGAN. You know, just discussing these weirs, I'm aware that at some point in the past the Corps of Engineers had talked about actually doing compensating works in Lake St. Clair as well with weirs.

I don't know if you're familiar with that or why they never did it or is there any use to be talking about such a thing now to compensate for the decrease in the water levels there?

Colonel LEADY. I am not familiar with it ma'am, but the effect on where you put the weirs would certainly have an effect on whether it is upstream or downstream of Lake St. Clair. I am not aware of anything that was ever proposed on Lake St. Clair, it may have been done, I just may not be aware of it, ma'am.

Mrs. MILLER OF MICHIGAN. Yeah. Just one other weir question, since we're on the weirs here but, at—in the City of Mount Clemens at Shadyside Park at the mouth of the spillway, talking about the Clinton River——

Colonel LEADY. Yes, ma'am.

Mrs. MILLER OF MICHIGAN. —back in the '50s there was a man-made diversion which you don't list, and perhaps it's such a small diversion that we don't talk about it, but you're essentially diverting the flow of maybe not the water but the flow of the Clinton River, we now divert it down the Clinton River spillway rather than letting——

Colonel LEADY. I'm familiar with that area, ma'am.

Mrs. MILLER OF MICHIGAN. —rather than letting the water go where Mother Nature wants it to go, and I think that has—I mean, you'd never be able to build something like that today, and it is controlled by the—not the Corps but the authority there, the drain authority, Macomb County Drain Authority I think, but they have an inflatable weir there that they inflate depending on the—on the water levels, I'm not sure if you have any comment about that. I don't know whether we should even have that weir and some people talk about that we should not have a spillway there anymore either.

Colonel LEADY. Ma'am, I'm familiar with that location, I know it was constructed by the Corps and turned over to the city, I would agree with your comment; it would probably be difficult to do today.

I have been asked what would it take and how long it would take to do this and my response was that an Environmental Impact Statement, which would necessarily be done, would be at least a two-year process because it would effect so many people on the shores of Lake Michigan and Lake Huron, so that itself would be a very long detailed process.

Mr. OBERSTAR. Would the gentlewoman——

Mrs. MILLER OF MICHIGAN. Certainly, of course.

Mr. OBERSTAR. What is the depth of the river at that—at this point that we're talking about?

Colonel LEADY. The depth of the river varies significantly, sir. Right under the Blue Water Bridge, it is as deep as 60 feet, at other areas it is less than 20 feet.

In major sections of the river, the Corps, in the 1920s dredged it to 25 feet to allow navigation, so it was obviously less than 25 feet there, and then the 1960s again the Corps deepened it to 27 feet, sir.

Mrs. MILLER OF MICHIGAN. Just one other question about diversions and man-made diversions.

I know you were talking about the five man-made diversions in the—in the basin, in the Great Lakes basin, two of which you said didn't really impact——

Colonel LEADY. Yes, they——

Mrs. MILLER OF MICHIGAN. —the water levels because it returns it to the basin.

Colonel LEADY. In fact, Niagara River, but they take water that would have gone through the Niagara River and put it into Lake Ontario anyway.

Mrs. MILLER OF MICHIGAN. Another project that could probably never happen today, but happened about a hundred years ago, was the change in the direction and the flow of the Chicago River——

Colonel LEADY. Yes, ma'am.

Mrs. MILLER OF MICHIGAN. —for the Chicago Diversionary Canal of which I do understand has gone through the Supreme Court and I get all of that, but when you think about 1.4 billion, I think that's the number, gallons of water each and every day that is being diverted outside of the basin because it's being used for sanitary purposes, for drinking water, et cetera, but also to be floating the barges in the Mississippi and when water diversion is such a huge issue in the Great Lakes I just raise that as—I don't know if you have any comment or if your——

Colonel LEADY. Well, ma'am——

Mrs. MILLER OF MICHIGAN. —your superiors would allow you to comment on whether or not that's an appropriate thing to do but, if you feel——

Colonel LEADY. —the history of the——

Mrs. MILLER OF MICHIGAN. —you can do that.

Colonel LEADY. —Chicago Sanitary Ship Canal is a very interesting engineering history, it was done about a hundred years ago, a little less I think, because of the sewage that the City of Chicago and the metropolitan area was putting into the lake, and they couldn't put their intake water for their drinking water out far enough to get clear of their own sewage so, just from a net effect, the Long Lac and Ogoki diversions were put in during World War II in Canada, and take water that would have gone into the Hudson Bay, put it into Lake Superior, and you can't really do a direct comparison because water evaporates along the way, but they put in a little more than five million cubic feet per second and the Chicago Sanitary Shipping Canal is a little more than three million cubic feet per second on average, that is a long-term average, and they vary quite a bit, so the net effects of diversions, at least the major diversions of the Great Lakes, is an add to the Great Lakes.

I am not trying to justify the Chicago Sanitary Ship Canal; I am trying to highlight the facts, ma'am.

Mrs. MILLER OF MICHIGAN. Yeah. Well, it's great if you're in Chicago from a sanitary purpose and in the Great Lakes we didn't want all of that in the Great Lakes. Perhaps if you live in St. Louis you're not so happy with all of that flowing by you now, but at any rate, it is an interest thing.

And the whole issue of water diversion, and I'll close on this because I know we're out of time, is a huge issue obviously for all of us in the Great Lakes basin. There's a—as we see the other parts of the country that are very hot and dry and thirsty, et cetera, and they are looking very enviously at our Great Lakes and I think for all of us in the Great Lakes basis we always want to be ever vigilant to make sure that there is not a wholesale diversion of our Great Lakes.

So I appreciate your testimony Colonel, and you're doing a great job, and thank you for your service to our nation as well.

Mr. OBERSTAR. I concur. Yeah, you've been a great contribution to this particular hearing and as the Corps always does it's extraordinary work at the command of Congress. People often blame the Corps for this, that or the other thing but it's Congress that gives the Corps its marching orders and the Corps carries them out whether—whether we do a right job or not, whether we're on the right mark or not, you carry it out or you tell us not to do it.

I was a little concerned that you say the IJC is not going to address this matter of the—of the weirs?

Colonel LEADY. Well, sir, what the IJC, their study is going to look at whether there's an ongoing—or not is going to, is looking at the—specifically looking at what the Baird Report or what some people refer to as the Georgia Bay Associates Report, is whether the bottom of the St. Clair River especially upstream, the kind at the headwaters and throughout the whole reach, is eroding due to dredging and due to human activity, so in very general terms that report alleged that by breaking through the rock basin and the clay basin there, the bottom is now eroding and the levels of Lake Erie really and Lake Huron are coming more in line. And there is some evidence that they report to and certainly, you know, Lake Erie is above average and Lake Michigan and Huron are below average. That is what that report stated.

The IJC is looking to see if that is substantiated and they are looking at it from a more detailed long-term perspective than that original report. But the issue of whether or not human activity lowered Lake Michigan and Huron in the late 19th and early 20th Century, they are not looking at it specifically because it is pretty much a documented fact that it has, how much, whether it is 14 inches or 17 inches is up for scientific debate, but there is no doubt that it is in that range or at least that is what the scientific community to include the Corps and the IJC and others believe now, sir.

Mr. OBERSTAR. Going back even to the early 1900s when sand and gravel was removed without permitting and without any oversight and—and probably some three million cubic meters were removed.

Well, we—we will need some further consultation with your—with you and your staff and—and maybe with the division, probably with the Chief's office, as we go through this WRDA to see whether—WRDA, Water Resources Development Authorization, see whether there's something we can include to accelerate this work on the St. Clair that has a great many people concerned.

Colonel LEADY. Yes, sir.

Mr. OBERSTAR. Miss Miller, any further comments?

Mrs. MILLER OF MICHIGAN. I just wanted to thank the County Board of Commissioners again for their gracious hospitality in letting us utilize this beautiful room for the—for the hearing today.

And Colonel, we're aware that you're going to be traveling in theater in Iraq in several months and we certainly wish you well as an ambassador of freedom, we certainly and again, appreciate your service to the nation, and all of our witnesses were terrific.

And again Mr. Chairman, I can't tell you how absolutely delighted I am personally and I think I speak for—on behalf of all the citizens of the Blue Water area here, and Port Huron, one of your adopted homes, to welcome you back and we certainly sincerely appreciate you traveling here today and I think the Committee has a lot to digest and think about as we continue our work to protect our magnificent Great Lakes.

Mr. OBERSTAR. We've had a great start on doing that and I thank you for your kind words and—and again, thank the Board of Commissioners for this splendid facility. We've held hearings throughout the country, rare—rarely do we have something quite so accommodating as—as this and quite—that reflects our Committee hearing facility in Washington.

I again, thank all of the witnesses and all those that came to participate, I hope you've learned as much as we have and we'll take these lessons back to the Committee with us and—and work to weave them into legislative action.

Committee is adjourned.

Mrs. MILLER OF MICHIGAN. Thank you.

[Whereupon, at 2:13 p.m., the Subcommittee was adjourned.]

STATEMENT OF
THE HONORABLE JAMES L. OBERSTAR, CHAIRMAN
COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE
SUBCOMMITTEE ON WATER RESOURCES AND ENVIRONMENT
FIELD HEARING ON THE "IMPACTS OF NUTRIENTS ON WATER QUALITY IN THE GREAT LAKES"
PORT HURON, MICHIGAN
MAY 12, 2008

Good afternoon.

Today, the Subcommittee on Water Resources and Environment meets to receive testimony on the impacts of nutrients on water quality in the Great Lakes.

Nutrients, such as nitrogen and phosphorous, in appropriate amounts, are essential to the health of aquatic systems.

Excessive nutrients, however, can result in harmful or nuisance algal blooms, reduced spawning grounds and nursery habitat for fish, fish kills, the creation of hypoxic "dead" zones, and public health concerns related to impaired drinking water sources and increased exposure to toxic microbes.

Excessive nutrient problems can have significant impacts over large areas, and within entire watersheds. These problems can manifest themselves locally or much further downstream, leading to degraded estuaries, river systems, lakes, reservoirs, as well as to the creation of hypoxic "dead" zones where fish and aquatic life can no longer survive.

While the focus of this hearing is on the impacts of nutrient contamination in the Great Lakes, the issue of widespread nutrient contamination is a national issue, and one that deserves continued attention. Two leading examples of widespread nutrient pollution are in the Chesapeake Bay and in the Mississippi River system.

In the Chesapeake Bay, excessive nutrients have been identified as the primary cause of water quality degradation; yet, the difficulty in pinpointing all of the potential pollution sources, as well as implementing proper control mechanisms will force the Federal government and the States to miss their 2010 deadline for cleaning up the Bay.

Similarly, in the Mississippi River system, scientists have identified the likely causes for the creation of the Gulf of Mexico "dead zone;" however, because of the national scale of the problem, as well as a reluctance of individual states to take responsibility for controlling nutrient discharges into the river system, it is unlikely that the "dead zone" will be addressed anytime in the near future.

To some extent, the first national attention on nutrient contamination occurred here in the Great Lakes. In the 1960s, Lake Erie was famously declared "dead" when excessive nutrients in the Lake fostered excessive algae that became the dominant plant species, covering beaches in slimy moss and killing off native aquatic species by soaking up all of the oxygen.

Prior to the enactment of the Clean Water Act, pollution filled Lake Erie with far more nutrients than the Lake could handle, with phosphorous being the main culprit. Phosphorous induces plant and algal growth. Yet, at the time, phosphorous was also found in many commercial detergents.

Plants and algal blooms began growing, dying and decomposing in Lake Erie, creating anoxia (severe deficiency of oxygen) at the bottom of the Lake and covering the surface with algal growth. This lack of oxygen killed fish and other aquatic species.

With the enactment of the Clean Water Act, and the signing of the Great Lakes Water Quality Agreement in 1972, a concerted effort was made to reduce the pollutant loadings into the Lakes, including a reduction in phosphorous. This effort has improved the overall health of the Lakes.

However, in recent years, there has been renewed attention to the problems of excessive nutrients. In fact, with the beginning of the new century, scientists have notices the reemergence of a "dead" zone within Lake Erie.

According to EPA, the bottom waters in the central basin of Lake Erie are again becoming anoxic in the late summer, in part, due to a concern about continued excessive nutrient loadings to the Lakes.

Similarly, widespread outbreaks of harmful algal blooms have occurred throughout the Lakes, but most notably at Bear Lake, Michigan; Muskegon Lake, Michigan, Saginaw Bay, Michigan; and in Western Lake Erie.

Although the controlling factors for growth of many harmful algal bloom species are not entirely understood, according to NOAA, harmful algal blooms are likely to over-enrichment of nutrients when runoff from lawns, roads, and farmland accumulate at a rate that "overfeeds" the algae that exist normally in the environment.

Finally, there is growing concern on a relationship between excessive nutrients in the Great Lakes and the presence of two aquatic invasive species – the zebra mussel and quagga mussels. NOAA's Great Lakes Environmental Research Laboratory is currently studying this relationship.

NOAA has hypothesized this relationship, as follows.

As nutrient laden waters flow into the Lakes, the near-shore microalgae flourish as they feed on the nutrients.

The zebra and quagga mussels then feed on the abundance of microalgae, and deposit what they cannot digest or the byproducts of what they can on the bottom of the Lakes. This tends to concentrate nutrients in particular hotspots that often coincide where zebra and quagga mussels are found in abundance.

These concentrations of nutrients, in turn, accelerate the growth of harmful algal blooms. In addition, because zebra and quagga mussels are filter feeders, they can quickly turn murky water into clear water, which allows sunlight to penetrate into deeper depths. This expands the depth of water in which algal blooms can grow.

Today's hearing should start the debate on how best to take on the national problem of nutrient pollution in the Great Lakes and elsewhere.

I am also hopeful that our witnesses can provide us with their insight on whether existing monitoring and control mechanisms are sufficient to address this issue.

If they are not, I would hope that today's witnesses can recommend suggestions on how we can improve Federal, State, and local efforts to address this troubling problem.

I yield to Ms. Miller for her opening statement.

Opening Statement by Congressman Bart Stupak
Subcommittee on Water Resources and the Environment
"The Impacts of Nutrients on Water Quality in the Great Lakes"
May 12, 2008

Thank you, Chairwoman Johnson, for holding this field hearing on the impacts of nutrients on water quality in the Great Lakes. I also want to express my thanks to the Committee for holding this field hearing in my state of Michigan.

Nutrients such as phosphorus, at the proper levels, can be essential to aquatic ecosystems. However, excessive nutrients are entering our Great Lakes as a result of agricultural run off, aging sewage treatment plants, industrial discharges, and other numerous point and non-point sources. When discharged into waterways, these nutrients cause excessive growth of algae, which robs the water of the oxygen that aqua life need to survive.

States have been trying to address this complex problem for decades. For example, in 1987 the State of Michigan adopted a supplemental plan that attempted to reduce phosphorus levels in Saginaw Bay by addressing point source discharges. At the time, the bay contained one of the highest levels of phosphorous in the Great Lakes area.

While much has been done to reduce the amounts of phosphorous that entered Saginaw Bay through its rivers, the problem still persists today. The Michigan Department of Environmental Quality's Saginaw Bay Coastal Initiative continues to work to reduce phosphorous levels. However, significant work remains.

Record low water levels in the Great Lakes have made this even more difficult to address. Low water levels reduce the Great Lakes' ability to flush out excessive levels of nutrients such as phosphorous and nitrogen. Typically, Lake Superior retains a pollutant for 191 years, Lake Michigan for 62 years, and Lake Huron for 31 years. With low water levels, these nutrients stay in the system even longer.

To address high levels of nitrogen and phosphorus in the Great Lakes, I along with my colleague Congresswoman Candice Miller introduced legislation to require the Environmental Protection Agency (EPA) to analyze all of the accumulated data from federal agencies researching harmful algae blooms and create a Great Lakes response plan.

The EPA would be required to review the economic feasibility of the different components of the response plan and provide that information to Congress. This information is vital to understand the unmet funding obligations in combating harmful algae blooms caused by excessive nutrients for the Great Lakes.

The response plan would also require EPA to review current state water quality criteria plans and offer revisions to improve them.

In addition, the legislation would require the Consumer Product Safety Commission to prohibit domestic cleaning products, such as laundry detergents and dish washer soap, from containing more than .5 percent phosphorous.

Several states have enacted similar bans on phosphorous in domestic cleaning products. A federal ban would ensure that every state, county, and city is covered.

While our Great Lakes face many challenges, I look forward to working with my Great Lakes colleagues and the Members of this Committee to address this problem.

Thank you Chairwoman Johnson and Ranking Member Baker for holding this hearing on this critical issue. I look forward to working with you to address this issue through the legislation Congresswoman Miller and I have introduced.

Testimony to the U. S. House of Representatives
Committee on Transportation and Infrastructure
Subcommittee on Water Resources and Environment

Monitoring Water Quality in the Great Lakes

Monday, 12 May 2008
St. Clair County Administration Building
Port Huron, Michigan 48060

D. Carl Freeman
Professor
Biological Sciences
Wayne State University

I appreciate the opportunity to speak with you today about water quality monitoring. We sit here at the headwaters of a massive river, the St. Clair River which flows at more than 6000 cubic meters per second, making it one of the largest, rivers, in the North America. The massive volume of this flow is incredibly important to what I am going to say. I apologize for sounding like a teacher, but this is an important fact one should remember whether or not it is going to be on a test at that end of my talk.

Why do we need monitoring? Because people, agriculture, and industry all use water and unfortunately also contribute to the pollution of the remaining water-- which others will use. I am going to argue that we need to enhance our monitoring capabilities to look at more types organisms and more kinds of chemicals in the water than we presently screen for. And, because of the flow of river and the rapid time scale at which events occur, we must use more rapid monitors than we currently do. Let's begin with chemicals—I first want to demonstrate the need for monitoring.

To quote from the Sarnia Chemical Industry brochure, "Sarnia is Canada's largest cluster of chemical, allied manufacturing and R&D facilities. It includes companies such as Basell Canada Inc., Dow Chemical Canada Inc., INVISTA, Imperial Oil Limited, LANXESS (formerly Bayer Inc.), NOVA Chemicals Corporation, Praxair Canada Inc., Shell Canada Products, Air Products Canada Ltd., Terra International (Canada) Inc. and SCU Nitrogen Inc." These manufacturers all ultimately use the St. Clair River or Lake Huron, either as a source of processing water, or cooling water.

In July of 2006, the GAO reported on chemical spills, greater than 50 gallons that occurred in the connecting channels of the Great Lakes during the period 1994-2004. Let me quote here,

"EPA's spill data set is of limited use." According to the data available, there were 991 spill reports from the U.S. side of the corridor while Canadian authorities reported only 157 spills. However, the GAO noted that "these reports do not accurately portray the actual number or volume of spills." This is a huge understatement.

> According to the GAO, "Spill notification on both sides of the corridor is largely dependent upon reporting by parties responsible for the spill, and that many spills likely go unreported by responsible parties. " As my friend Doug Martz noted, this system of self-monitoring and self-reporting is likely no more effective in this venue than it is with speeding on the freeway—in my opinion, self-policing is a concept that is fatally flawed.
>
> The GAO report went on to state that,
>
> "According to [EPA] officials, with the current resource constraints, they could only inspect facilities once every 500 years or more." The report noted that the EPA inspections that had occurred often

disclosed "significant and numerous spill prevention deficiencies," yet EPA issued only four fines from 1994 to 2004.

The Canadians have also examined their industry. According to the Canadian Industrial Pollution Action Team Report, ""We found a system that was largely in compliance with its regulatory requirements, yet where spills to air and water still occur... We could not therefore avoid the conclusion that the existing system of approvals, inspection, enforcement, and prosecution is not working as well as it should."

So, from this I conclude that industry has polluted the river and there is able opportunity for continued pollution. To protect public health we need to warn drinking water plant operators whose plants are downstream of spills. Similarly people who recreate in these waters should be warned in the event of chemical spills. Finally, we need to monitor to ultimately stop the pollution of this precious resource.

Currently, the EPA requires drinking water plants to monitor the quality of both raw and processed water. However, the requirements call for infrequent testing. For example, the Detroit Drinking Water Plant tests for lead and copper every three years and volatile organic compounds four times a year. Now this testing frequency is not set by the drinking water plants, they merely comply with the EPA. But the infrequent testing implicitly assumes that water quality is static. This assumption is clearly false given the reports of chemical spills, sewage discharges, and the very flow of the river. In my opinion, the EPA's protocol does not inspire much confidence.

Consider that in January of 2001 Nova Sarnia reportedly have released 220,000 gallons of toluene, benzene and xylene—carcinogens and mutagens. This volume of chemical will pollute 18 billion gallons of water at the EPA limit. Yet the Detroit drinking water plant did not report the spill. It is quite likely that they were not monitoring volatile organic compounds that day.

Ironically, the Detroit Drinking Water Plant must monitor for pesticides used on cotton and pineapple fields—the closest of which are thousands of miles away, but drinking water plants are not required to monitor for most of the chemicals that have actually been spilled upstream of their intakes. Three years ago, I compared the list of chemicals that had been spilled to the EPA's list of priority pollutants, only 20 to 30% of the chemicals that have reportedly been spilled into the St. Clair River are on the EPA's priority pollutant list. So, even if the drinking water plants are monitoring, they will likely not detect the chemicals that are spilled, simply because their testing procedures do not look for all the likely chemicals (harmful and otherwise) that may be spilled.

Through the help of Congresswoman Miller and Senator Carl Levin, and state and local governments, a near real-time monitoring system now stretches along the USA side of the border from the upper reaches of the St. Clair River near Marysville nearly all the way to Lake Erie. The system uses a variety of meters to detect changes in water quality most of these are presently implemented. However the heart of the system is a series of membrane induced mass spectrometers that are capable of analyzing more than 10,000 different chemical in less than five minutes. This part of the system is still being deployed. Nevertheless, this system, when completed, will be the first in the country that analyzes water quality on the same temporal scale as the flow of the river, and it will be able to detect the overwhelming majority of the industrial pollutants likely to be discharged upstream.

The system needs to be further expanded to sample water at a variety of depths and more sampling locations. Now the system samples water at the depth of the drinking water intakes. But this does not protect people that recreate in the water as most volatile organic compounds are relatively light and thus will be found at the surface. Thus, while the system will protect our highest priority water use, as it stands now the system will not detect the majority of spills. Moreover, if the this system were coupled with a three dimensional flow model of the river, it would be possible to predict when and where the spill occurred finally enabling enforcement to hold the polluting party responsible. I want to stress that all of this is within the existing capability of science today.

The other type of monitoring that needs to be done is biological monitoring. Presently, various county health departments follow EPA protocols and monitor E. coli. This testing typically involves culturing the organism and takes 18 to 72 hours. Given the flow of the river, it takes about 11 hours for water to go from Port Huron to the Lake St. Clair. Most of the water will then move on through Lake St. Clair to the Detroit River within a day or so. Water that enters one of the two main gyres in Lake St. Clair may stay in residence for days to weeks. But, my understanding is that most water moves through the main channel in a day or so. Accordingly, we must ask of what relevance is a test that requires such a long culture period? If water is collected from Port Huron on Monday, cultured on Tuesday and the culture read Tuesday evening or Wednesday morning, should Port Huron close its beach or should Toledo? We need monitoring that has a time scale relevant to the flow of the water being tested.

When the EPA was established it made sense to focus on a surrogate organism to indicate contamination. But, science has marched on and E. coli, the chosen surrogate, was a lousy surrogate to start with. E. coli lives not only in the intestines of all vertebrates, but also in the sand of beaches. So a high E. coli count might indicate fecal contamination or heavy wave action eroding a beach. Ironically, when there is a high bacterial count we deny people access to the water. However, their children may still play in the sands on the beach, where E. coli is at least a billion times more common.

Normally E. coli causes no harm. When it harbors a virus, such as the Shigella virus, it can be pathogenic—but usually it is both in our gut and all over our skin causing no harm. On the other hand, we know that Great Lakes waters harbor many pathogenic microbes and these go unmonitored. Here is a short list of potential problems.

Viruses	Bacteria	Protozoa	Algae	Yeasts/Fungi	Worms
Hepatitis A	E. coli	Entamoeba	Cyclospora	Candida	Schistosomes
Norwalk	Leptospira	Cryptosporidium	Microcystis		
Rota	Legionella	Giardia			
Adeno	Coliforms	Naegleria			
Entero	Salmonella	Toxoplasma			
Reo	Aeromonas				
	Pseudomonas				
	Shigella				
	Staphylococcus				

I find it absolutely remarkable that, in a time when we can sequence the entire genome of bacteria in couple of days, we still rely upon the same technology to protect public health that Pasteur used more than a century ago. Surely we should and could have developed a dip-stick test or device analogous to a pregnancy test for determining the concentrations of true pathogenic micro-organisms in our water in a matter of seconds to minutes. I assure you the lack of such a test has little to do with the difficulty of the science.

SIERRA CLUB

FOUNDED 1892

Testimony by Lynn Henning

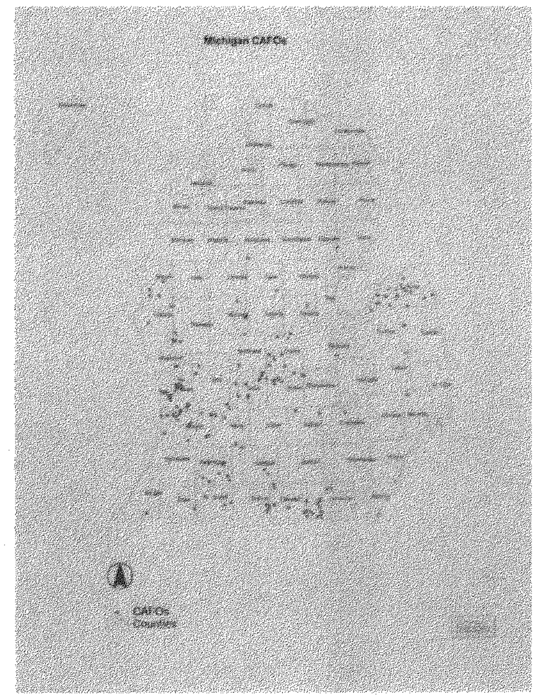
CAFO Sentinel, Michigan Sierra Club

Before the Subcommittee on Water Resources and Environment

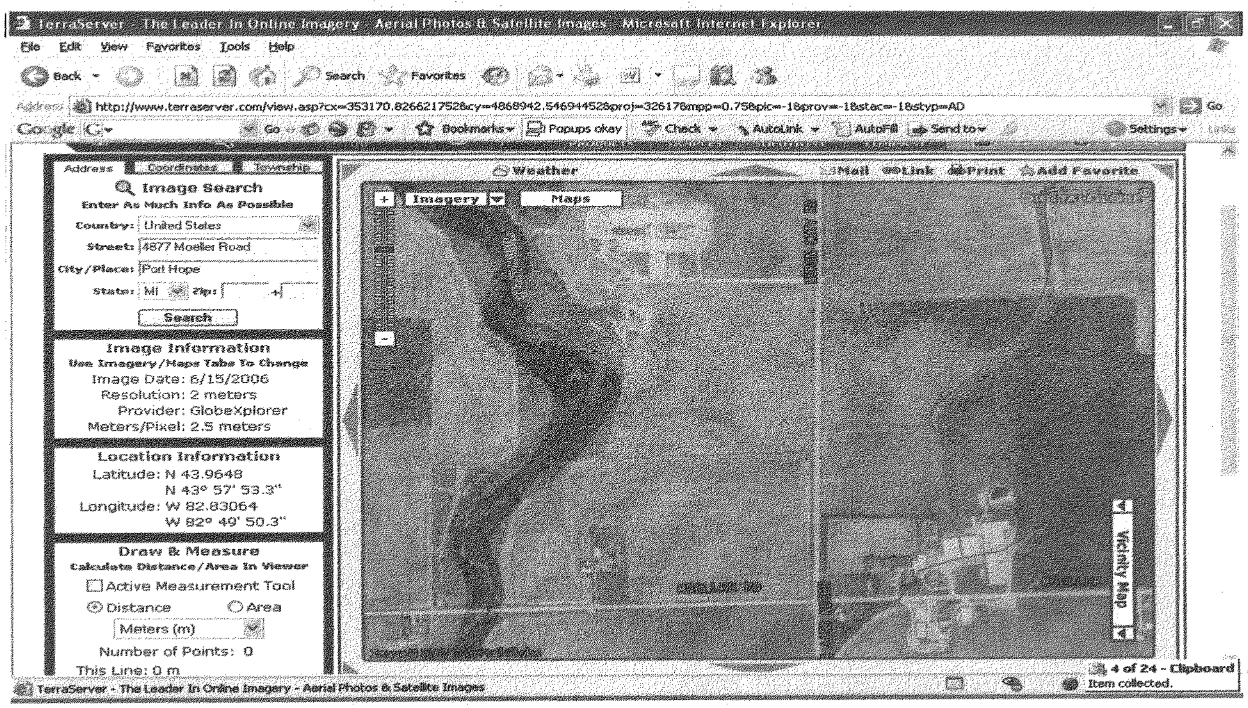
The Impacts of Nutrients on Water Quality in the Great Lakes

May 12, 2008

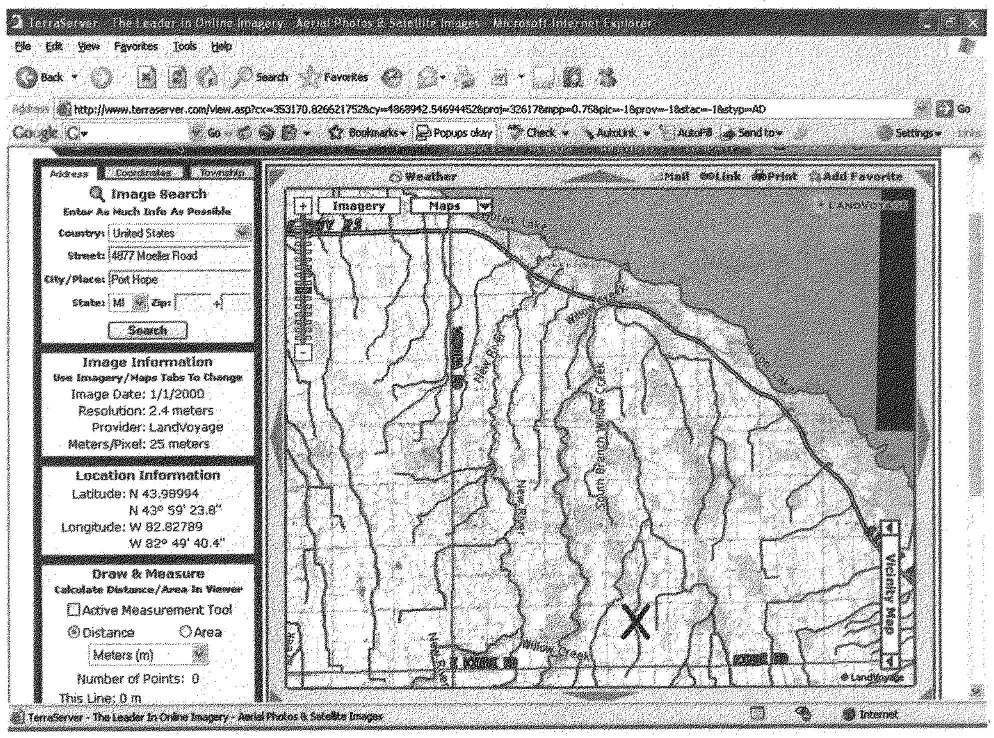
CAFOS are contributing nutrients and other pollutants to the Great Lakes



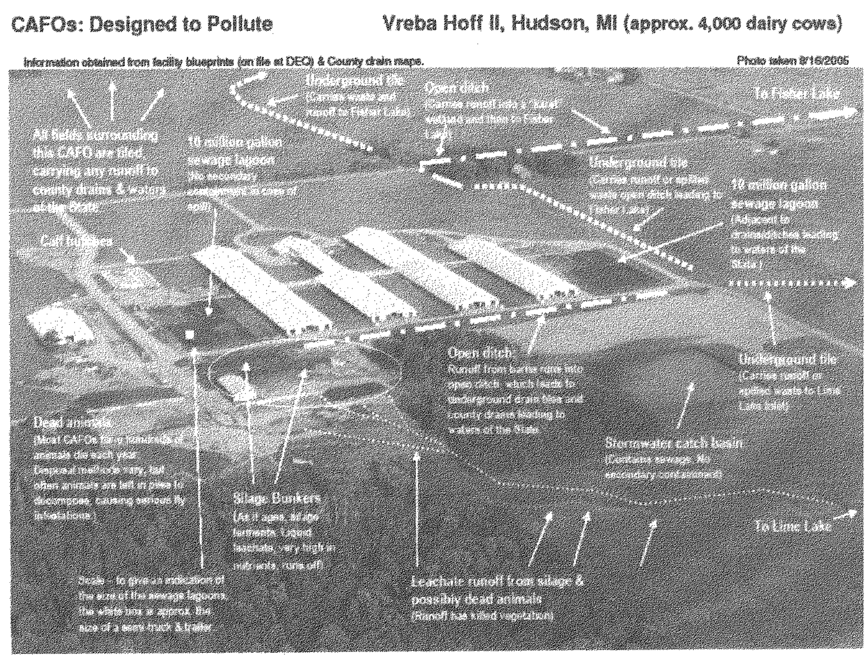
Current laws don't adequately protect the Great Lakes from animal waste



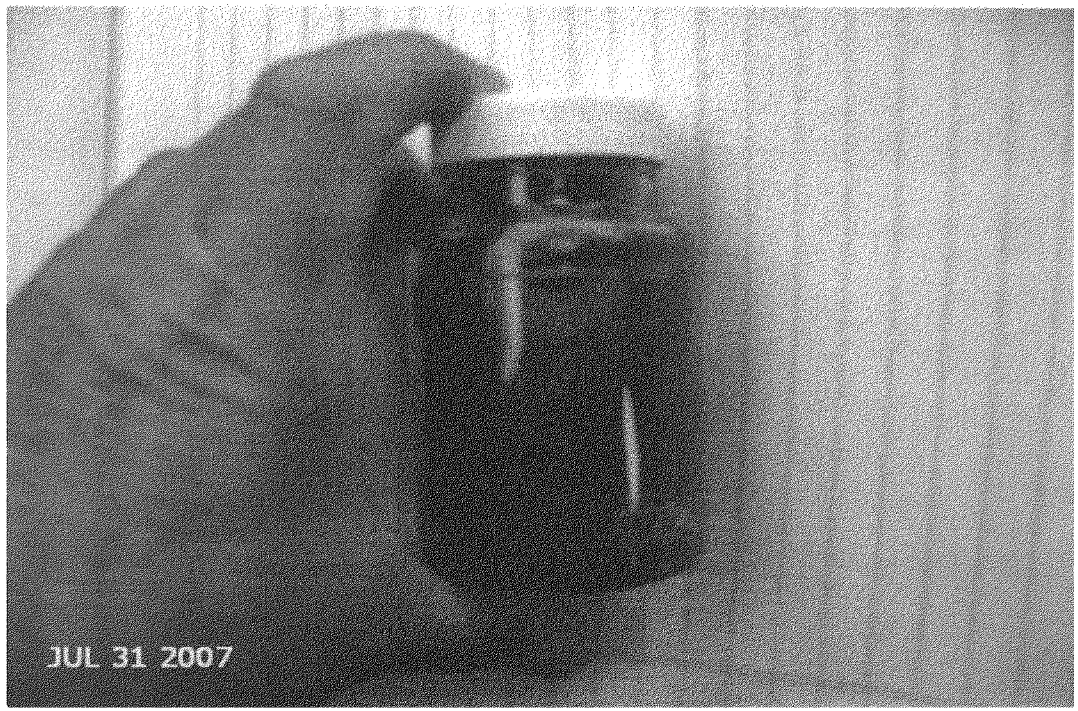
This image shows the facility (at the X) that drains straight to Lake Huron.



Pollutants travel into the *Great Lakes* from multiple sources associated with *CAFOs*

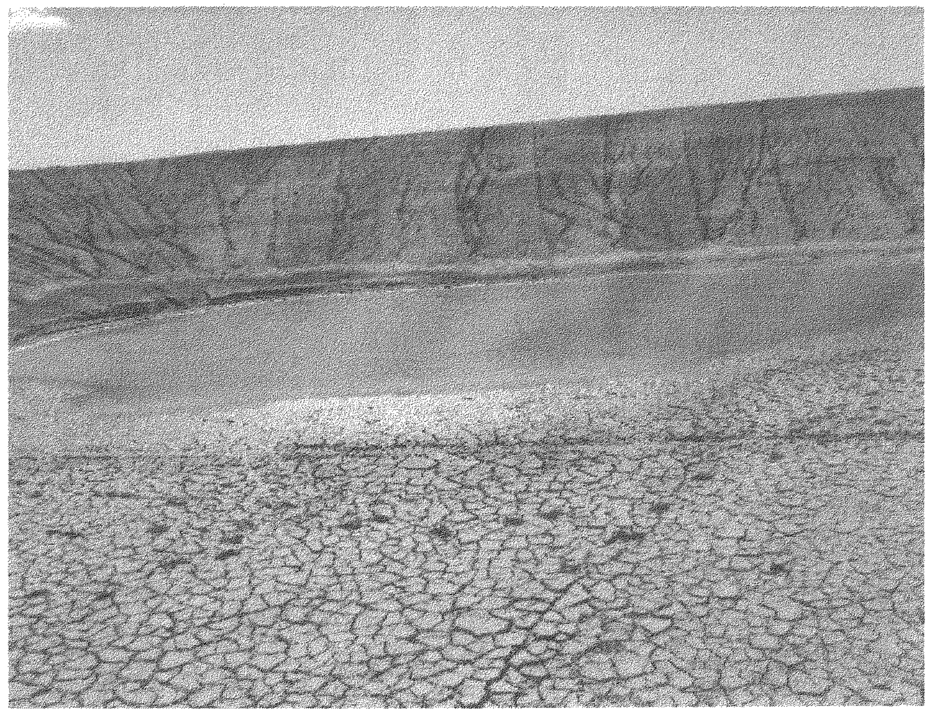


All CAFOs must demonstrate they can operate
without polluting. This is a water sample downstream from a CAFO.

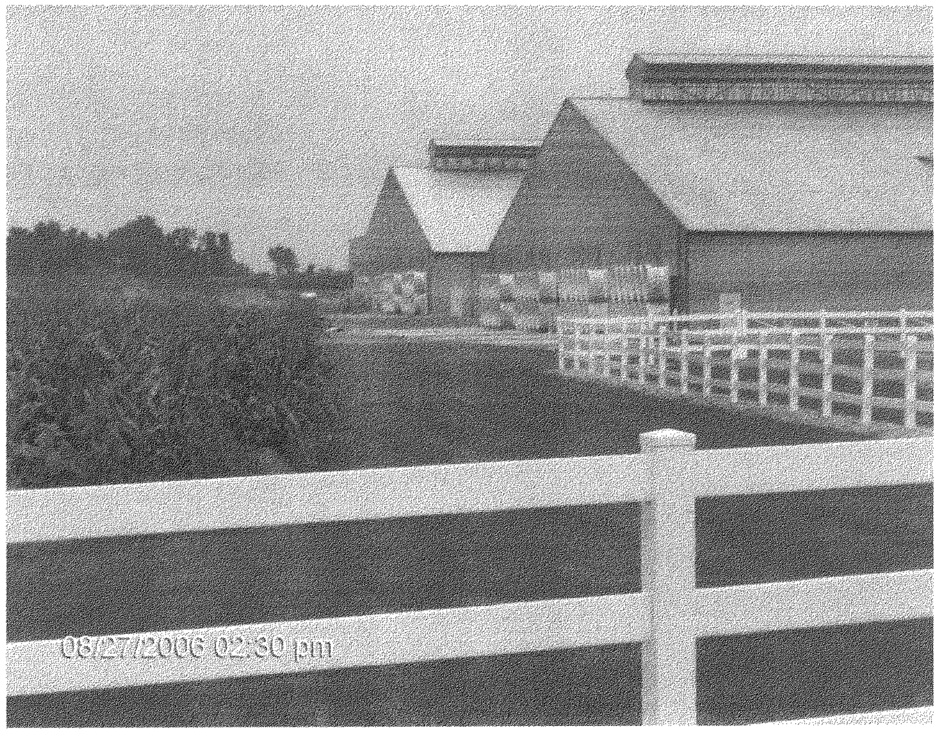


This ditch shows effects of nutrient loading from a CAFO.

This brand new and empty animal waste storage pit shows cracks before the animal waste is even put into it.

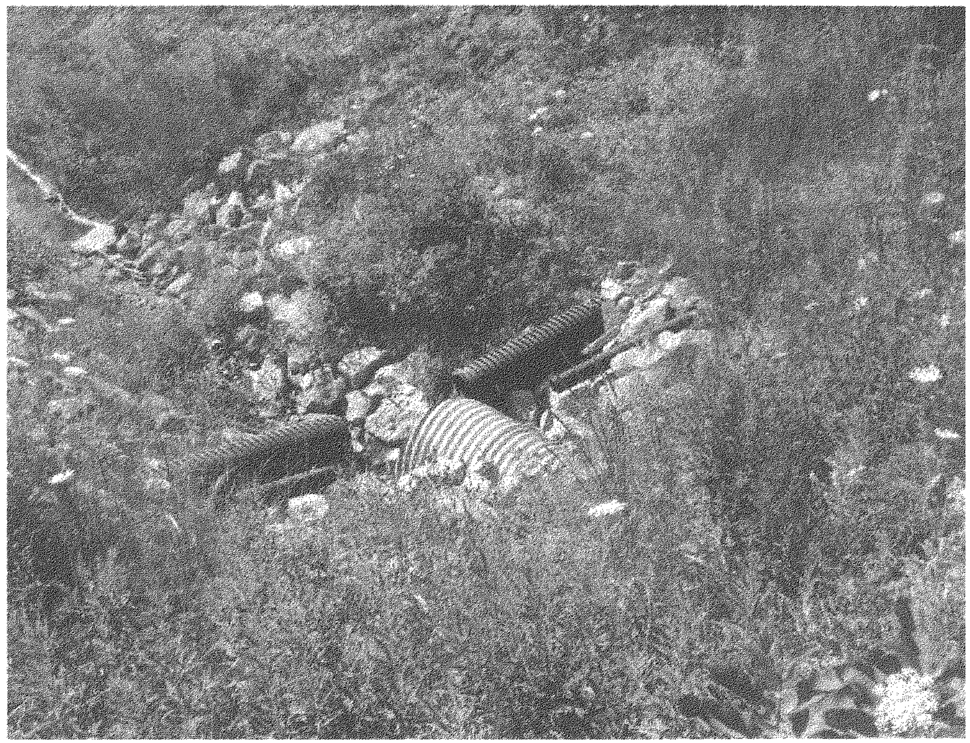


Poultry facility with dust and feathers covered with feces outside the blowers.
Water sampling showed this material got into the drainage ditch.



This is the drainage ditch outside the Poultry Facility in the previous slide.

This field drainage tile is a pathway for pollution to move from the facility production area or the field to the ditch.



This aerial image shows an open waterway flowing straight through the production area of this CAFO.

For more information
contact
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DEPARTMENT OF THE ARMY

COMPLETE STATEMENT OF

Lieutenant Colonel William J. Leady
Commander
U. S. Army Corps of Engineers, Detroit District
477 Michigan Avenue
Detroit, Michigan 48231
313-226-6762

BEFORE THE

Subcommittee on Water Resources and Environment
Committee on Transportation and Infrastructure

HOUSE OF REPRESENTATIVES

May 12, 2008

INTRODUCTION

Madam Chair and members of the Subcommittee, I am Lieutenant Colonel William J. Leady, Commander of the Detroit District of the U.S. Army Corps of Engineers. Thank you for the opportunity to testify before you today on lake levels on the Great Lakes.

In support of the nation, the U.S. Army Corps of Engineers provides technical support and expertise to monitor and forecast Great Lakes water levels. In addition, in support of the International Joint Commission (IJC), the Corps provides technical assistance in regulating the outflows of Lake Superior and Lake Ontario. Lake levels directly affect the health of the natural environment, the viability of commercial navigation and recreational boating, the stability of shoreline property, the availability of water for municipal water intakes, and many other features that affect our region's and our nation's quality of life. This testimony is meant to inform you about the causes behind the fluctuations in Great Lakes water levels and provide updated information on current conditions.

THE GREAT LAKES SYSTEM

The Great Lakes basin covers more than 94,000 square miles of water and more than twice as much land. It includes part or all of eight U.S. states and two Canadian provinces. The system begins at the Lake Superior headwaters and continues down to the Atlantic Ocean. The St. Marys River flows from Lake Superior to Lake Huron. Lakes Michigan and Huron are connected by the broad and deep Straits of Mackinac and are considered to be one lake hydraulically, with levels rising and falling together. The St. Clair and Detroit Rivers, with Lake St. Clair in between, connect Lake Huron with Lake Erie. The Niagara River then links Lake Erie with Lake Ontario, including the dramatic drop over Niagara Falls. The man-made Welland Canal also links Lakes Erie and Ontario, providing a shipping route around the falls. From Lake Ontario, water flows into the St. Lawrence River, which converges with the Ottawa River and flows on to the Atlantic Ocean.

The Great Lakes and St. Lawrence River are a dynamic system that is still evolving due to rebounding of the earth's crust, erosion and variations in climate. Ever since the last glaciers retreated more than 10,000 years ago, Great Lakes water levels and river flows have varied dramatically, as much as hundreds of feet.

Before I discuss current lake levels, I would like to briefly provide some background information on the main factors that affect lake levels. The Hydrologic Components figure (Figure 1) illustrates these components and their interactions. This figure was created using long term averages; it does not represent a specific time period.

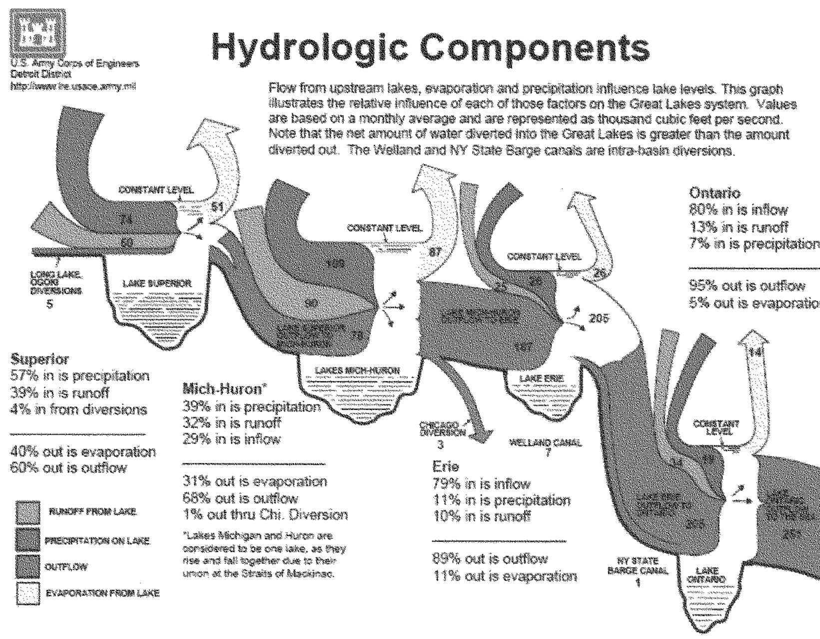

Figure 1: Hydrologic Components of the Great Lakes Basin

This figure illustrates four components: precipitation onto the lake (in red), runoff from rivers and steams that feed into the lakes (in orange), evaporation from the lakes' surface (in yellow), and outflows from the lakes (in blue). Man-made diversions are also shown. The relative importance of each of these factors shifts as water flows from the basin's headwater, Lake Superior, to the basin's outflow at the St. Lawrence River. For example, 57% of Lake Superior's inflow comes from precipitation directly onto the lake while precipitation directly onto Lake Ontario only accounts for 7% of it is inflow. Similarly, of the water that departs Lake Superior, 40% is lost to evaporation and 60% of it flows through the Saint Marys River into Lake Michigan-Huron. Of the water that departs Lake Ontario, only 5% is lost to evaporation and 95% of it flows into the St. Lawrence River. I should note that Lake Michigan and Lake Huron are, for many purposes, treated as a single lake since they are joined at the Straights of Mackinac and their levels rise and fall together.

There are five man-made diversions in the Great Lakes basin. The Long Lac and Ogoki diversions bring water into Lake Superior from the Hudson Bay watershed. The Lake Michigan Diversion at Chicago removes water from Lake Michigan for water supply, sewage disposal and commercial navigation. The Welland Canal provides a shipping route around Niagara Falls; because this diversion is internal it only affects a reach of the Niagara River, but not the Great Lakes as a whole. The New York State Barge Canal diverts a small amount of water from the Niagara River and returns the water to Lake Ontario, also not affecting the system as a whole. In all, the net amount of water diverted into the Great Lakes basin exceeds that diverted out.

The difference between the amount of water coming into a lake and the amount going out is the determining factor in whether the water level will rise, fall, or remain stable. Moisture is carried into the Great Lakes basin by continental air masses originating in the northern Pacific Ocean, tropical systems originating in the Gulf of Mexico, or Arctic systems originating in the northern Polar regions. As these weather systems move through the Great Lakes, they deposit moisture in the form of rain, snow, hail or sleet. Water enters the system as precipitation on the lake, runoff from surrounding land, groundwater inflow and inflow from upstream lakes. Water leaves the system through evaporation for the land and water surfaces, groundwater outflow, consumptive use, diversions, and outflows to downstream lakes or rivers. Evaporation is a major factor when warm lake surfaces come in contact with dry air.

The water levels on the Great lakes fluctuate in three distinct cycles: short term, annually and longer-term. Water levels fluctuate on a short-term basis, usually due to winds and changes in barometric pressure, lasting from a couple hours to several days. The effects of wind and barometric pressure, for example a high pressure on one side of a lake and a low pressure on the other side, can raise or drop a lake level several feet in a few hours.

The lakes also fluctuate on a seasonal cycle. On all the Great Lakes, water levels decline to their lowest level in the winter months because more water leaves the lakes through evaporation than enters the lakes during that period. Evaporation is greatest in the fall and early winter. As the snow melts in the spring, runoff increases and lake levels rise. Generally, evaporation is least during spring and early summer. These factors contribute to more water entering the lakes than leaving, so water levels rise to their summer peak.

Long-term fluctuations occur over periods of consecutive years. Continuous wetter than average and/or colder than average years will cause levels to rise, while warmer than average and/or dryer than average years will cause levels to decline. Ice cover has a significant effect on lake levels because ice acts as a lid preventing evaporation, which is a major source of water outflow on the Great Lakes, especially the upper lakes. Cold winters, with significant and early ice cover, limit evaporation and result in higher water levels.

The IJC, with the Corps as one of its supporting agencies, does have some ability to influence relative lake levels.

Lake Superior outflows are controlled with compensating works near the twin cities of Sault Ste. Marie, Ontario and Michigan. Lake Superior outflows have been regulated since 1921 by the IJC's Lake Superior Board of Control in accordance with conditions specified by the IJC. The IJC is an international commission charged under the Boundary Waters Treaty with impartially approving certain uses and diversions of boundary waters and waters crossing the boundary. The objective of the Lake Superior

Outflow plan is to help maintain the lake levels on both lakes in relative balance compared to their long-term seasonal averages. Regulation of Lake Superior's outflow has a small effect on the relative water levels between the lakes, but to a far lesser extent than the effects of precipitation and evaporation.

Outflow from Lake Ontario is managed by the IJC and its International St. Lawrence River Board of Control. The IJC's criteria for regulating outflows recognize the need of three major interest groups: riparian property owners, hydropower, and commercial navigation. Outflows are regulated on a weekly basis under four key objectives: maintaining Lake Ontario's water level within a four-foot range during the navigation season; maintaining adequate depths in the International Section of the River for safe navigation; maintaining adequate flows for hydropower generation; and to protect the lower St. Lawrence River below the control works from flooding.

Crustal movement, the rebounding of the earth's crust from the removed weight of the glaciers, does not change the amount of water in a lake, but rather the intersection of the water surface and the shoreline. Rebound rates vary across the Great Lakes basin, with the earth's crust rising the most in the northern portion of the basin where the ice was thickest, heaviest, and last to retreat. For those areas in the northern part of the basin, crustal rebound causes a local situation where the land surface is rising at a rate that is noticeable over decades and causes the water level to appear to be lower than it was for the same water level decades earlier.

Now I'll turn to historical water levels on the Great Lakes and current conditions. The Corps began monitoring water levels on the Great Lakes in the 19th Century and, from 1918 to the present, we have monitored and recorded basin-wide water level data that allows for consistent, accurate, basin-wide comparisons.

The Great Lakes Water Levels figure (Figure 2) graphically shows these long-term fluctuations from 1918 to the present. On these graphs, the blue line for each lake represents the actual monthly average level and the red line represents the long-term (1918-present) average, based on a lake-wide average of several water level gages situated around each lake.

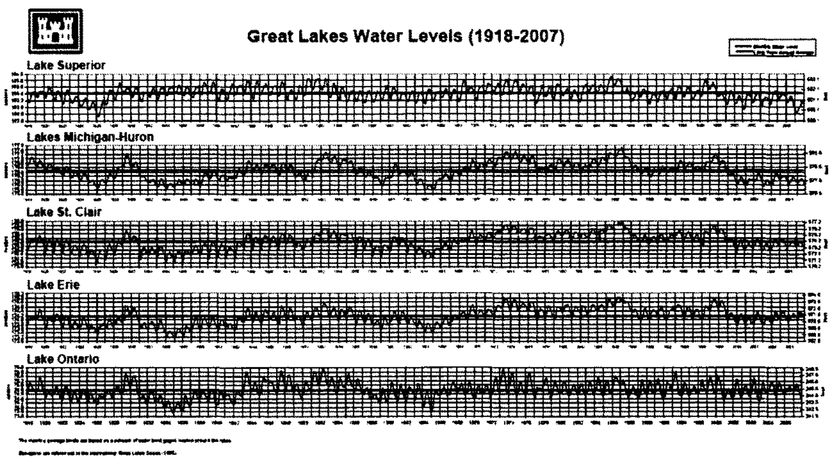

Figure 2: Great Lakes Water Levels 1918-2007

Several observations about the Great Lakes water levels become apparent when the information is presented in this format: First, the lakes are rarely at their average level. Also, even at this scale, the annual cycle with lake levels peaking in the late summer and dipping to their lowest in late winter is apparent.

The level of each lake is somewhat independent from each other. That is to say one lake may be in an extended above average period while at the same time another is in an extended below average period and a third lake is near average. For example, in the 1930s Lake Michigan-Huron, Lake Erie and Lake Ontario where all in an extended period of below average levels while Lake Superior was at slightly above average levels.

Lastly, from 1918 to the present there is not a definite or predictable pattern of level fluctuations on any of the lakes or for the system as a whole.

CURRENT CONDITIONS

For all the reasons I mentioned earlier, water levels on the Great Lakes have gone through periods of highs and lows over the past 90 years. Following a period of above average water levels during the 1970s through 1990s, the upper Great Lakes have experienced low water levels since the late 1990s. Over the past 10 years, increased water temperatures, reduced ice cover, reduced precipitation and snow pack, and increased evaporation have contributed to a decrease in water levels on the upper lakes. Lakes Superior and Michigan-Huron are currently significantly below average. In contrast, water levels on Lakes Erie and Ontario are currently above their long term averages.

But there is some good news this year. A very active 2007-2008 winter storm track has brought abundant snow to most of the Great Lakes basin. Some locations have seen two to three feet more snow than average. Temperatures have fluctuated this winter, leading to a number of snow melt runoff events. Also, ice cover began to form much earlier across the northern lakes, limiting evaporation. Soil moisture across much of the Great Lakes basin is above average. These conditions hold promise for increased water levels come spring and summer.

Lake Superior has been below its long-term average since 1998 and is currently in the longest period of below average water levels in the 1918-2007 period of record. Lake Superior set new record low monthly average water levels in August and September 2007. These new records were brought on by drought conditions across the Lake Superior basin over the previous 15 months. Precipitation in 2007 through August was three inches below average, adding to a six inch deficit from 2006. The winter of 2006-2007 had above average evaporation and below average snowfall. Forecasts made in early September showed a good chance for setting new record lows into 2008. Then in mid-September, the Lake Superior basin was inundated with heavy rain. From mid-September through October over ten inches of rain fell in the basin. The water level of Lake Superior responded by rising close to nine inches. Evaporation during the fall and winter of 2007/2008 was much less than that of 2006/2007. Snow pack across the Lake Superior basin is much greater this winter than last. Lake Superior is expected to remain below average, although levels will be 8 to 17 inches higher than last year.

Lake Michigan-Huron has been below average since January 1999 and is currently in its second longest period of below average water levels in the 1918-2007 period of record. The longest period of below average water levels was 1930-1943. The lake is currently below last year's levels. Lake Michigan-Huron is likely to remain 9 - 13 inches above its record lows and 18 -21 inches below its long-term average.

Lake St. Clair has fluctuated around average over the past two years. The March monthly average level was one inch below average and two inches above last year's level. The most probable forecast for the next six months shows the lake below average and near last year's levels, but well above its record lows.

Lake Erie has fluctuated around average over the past two years. The March monthly average level was eight inches above average, and two inches above last year's level. The most probable forecast for the next six months shows the lake will remain near or above average through May, then fall below average through September. Lake Erie will remain well above its record low levels.

Lake Ontario has fluctuated around average over the past two years, but ended 2007 below average. Since December 2007 the lake has risen significantly and the March monthly average level is now eight inches above average. The most probable forecast for the next six months shows the lake remaining above average through August and near average in September. Lake Ontario will remain about three feet above its record low levels.

ST. CLAIR RIVER

Another issue that has received recent attention as a cause for lower water levels on Lakes Michigan-Huron is the flow in the St. Clair River. There have been many alterations made to the St. Clair River since the mid 1800s, including some for commercial navigation. Congress authorized the 25 foot navigation channel throughout the system in 1930. This authorization also noted the need for the construction of works to compensate for the enlargement of the lake outlets. These works would require the approval of the U. S. and Canadian Governments and the IJC. There are no known records detailing any agreements with the Canadian Government or the IJC regarding constructing any type of underwater structure that would compensate for the dredging. Dredging was completed in 1936 and model studies were done for submerged weirs in the 1930s. Submerged weirs would compensate for the decrease in water levels caused by the dredging. However, for a variety of reasons, no weirs were constructed.

It should also be noted that private interests mined a significant amount of sand and gravel from the upper St. Clair River. During the period 1908-1925, an estimated 3.5 million cubic yards were removed. Since this was done by private commercial interests, there are minimal records about exact locations and timing. There was no compensation done.

In 1956, Congress authorized the 27 foot navigation project, which included compensating works to assure the lakes would not be adversely affected. The compensating works would offset the lowering effects on Lakes Michigan and Huron of both the proposed improvement and previous dredging of the 25 foot channel. The dredging was completed in 1962. There were many hydraulic studies for weir design carried out through 1972. This was a period when water levels were rising (reaching record highs in 1973-74, which were then surpassed in 1985-86). There was no real interest at this point in placing submerged weirs in the St. Clair River which would have raised Lake Michigan-Huron water levels even higher, so construction was not initiated. Since these compensating works were not funded for five consecutive years, they were deauthorized in 1977.

Studies completed in the past by the IJC concluded that all dredging and mining in the St. Clair River since the mid-1800s has had a lowering impact on Lakes Michigan-Huron water levels of about 14 inches in total. The 25 foot project accounted for about two inches, while the 27 foot project accounted for about five inches of that total. The other seven inches are attributed to dredging prior to 1900 and commercial sand and gravel mining in the early 1900s. The IJC also concluded that the system reached a new equilibrium soon after each project.

Water levels remained above average during the period 1969 through 1999. As levels dropped below average in 2000 for the first time in nearly 30 years, lower water levels and compensation for past dredging became an issue again. In January 2005, the Georgian Bay Association (GBA) released a report prepared by a consultant to address causes of lower water levels on Lakes Michigan-Huron. This report alleges that Lakes Michigan-Huron are being permanently and continually lowered by an increase in St. Clair River flows. GBA primarily attributes this to dredging of the navigation channels and a theory that severe and ongoing erosion of the river bottom was triggered by this dredging. The GBA and others are calling for action to be taken to compensate for this perceived erosion and subsequent alleged water loss.

In order to answer the many questions about changes in the St. Clair River over time and their impact on the rest of the system, the IJC has included these issues in their International Upper Great Lakes Study. This study will re-evaluate the regulation of Lake Superior and will investigate issues involving the St. Clair River and potential changes to water levels, whether from new regulation plans or physical changes in the St. Clair River. The Corps believes that this IJC study is the appropriate vehicle to investigate St. Clair River issues raised by the GBA report, and we are actively supporting this study.

SUMMARY

To close, I would like to thank you once again, Madam Chair, for allowing the Corps of Engineers the opportunity to appear before this subcommittee to discuss the Corps role in monitoring and forecasting lake levels in the Great Lakes. Current evidence suggests that the lake level regime is primarily due to the natural fluctuations of the hydrologic cycle; however the Corps awaits the IJC study conclusions on the St. Clair River to assess other factors.

I would be happy to answer any questions you and other Members of the Subcommittee may have.

Testimony to the U. S. House of Representatives
Committee on Transportation and Infrastructure
Subcommittee on Water Resources and Environment

Impacts of Nutrients on Water Quality in the Great Lakes

Monday, 12 May 2008
St. Clair County Administration Building
Port Huron, Michigan 48060

Professor John T. Lehman
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Members of the Subcommittee:

The underlying cause of excessive, nuisance growth of the aquatic flora known as algae is excessive abundance of plant mineral nutrients, particularly mineral phosphate. Phosphate is ubiquitous in nature because it enters waterways through erosion and weathering of rocks and soil, but its abundance is greatly amplified by human activities. These activities include landscape alterations, construction, agriculture, industrial processes, and wastewater disposal. It is customary to distinguish between two categories of phosphate sources: point sources and non-point sources. Point sources include, for instance, outfalls from sewage treatment facilities. Non-point sources are diffuse, as for instance, storm drainage from streets and parking lots.

Control of phosphate income to the Great Lakes has been a cornerstone of management strategy for water quality since the 1970s. The strategy rests on a simple principle that has been demonstrated repeatedly through experiment and observation. In order for algae to flourish to excess, they need an abundance of simple mineral building blocks from which they make their living cells. Of these, the most common are carbon, oxygen, and hydrogen, which are freely available either from the gases of the atmosphere or from molecules of water itself. Next in importance are nitrogen and phosphorus. Of these, one group of algae that is symptomatic of nuisance conditions can use nitrogen gas from the atmosphere to make its proteins. So that leaves phosphate as the critical control point for preventing nuisance conditions. Phosphate is an absolutely essential mineral, and it has no gas phase at environmental temperatures. The supply of phosphate to lakes is a fulcrum point that leverages the size of the algal crop that can develop.

Historically, the focus of regulations limiting phosphate discharges to waterways has been point sources. More recently, non-point sources have been attracting increased scrutiny. In part this may reflect the fact that each incremental gain in phosphate removal from point sources comes at accelerating cost, and that there is a belief that modest and relatively inexpensive behavioral changes, such as retaining buffer strips of vegetation along stream banks, can yield positive results. At the social and political level, there is a cost-benefit analysis in which immediate costs associated with technical improvements to phosphate removal can be quantified relatively objectively, but future benefits are necessarily prospective and theoretical.

Good environmental management decisions depend first on decision-making being informed by good environmental data and second on existence of a predictive theoretical framework to interpret the data. In the case of the Blue Ribbon Commission on Lake St. Clair that is now finalizing its report, it was fortunate that a body of data about phosphate in tributary streams exists. Those data had been collected in 2004 and 2005, recently enough to represent modern conditions. My analysis of those data caused me to conclude that the division between point source and non-point source phosphate in the Clinton River, one of the most notorious sources of nutrient pollution, is almost exactly 50-50[1]. This suggests that future management controls on either point or non-point sources are equally viable strategies.

One strategy for controlling non-point sources of phosphate that is gaining political momentum is to restrict the use of lawn fertilizers containing phosphate. Many soils, particularly those derived from sedimentary rocks, contain enough phosphate to grow grass perennially, especially if the clippings are retained on the lawn. Unfortunately, at this stage I must report that there is not enough scientific evidence to demonstrate that statutory limitations have produced a demonstrable improvement in water quality in jurisdictions that have adopted the policy. It must be acknowledged that research in this area is in its relative infancy owing to the fact that the statutes and ordinances are new and in many cases baseline data are scarce. That is not so for the U.S. streams tributary to Lake St. Clair. The existence of baseline data makes these watersheds excellent candidates for phosphate control measures that can be subject to evaluation and assessment of effectiveness. Such an assessment is currently underway nearby in the Huron River watershed of southeastern Michigan. Ordinances banning phosphate from fertilizers were predicted to produce a near-25% reduction in phosphate loading to the river. Statistical analyses indicate that it will take two years of weekly measurements, now underway, to learn whether the desired effect was achieved[2].

With respect to reducing point sources, the aging infrastructure at many wastewater treatment facilities makes them ripe for renovations and upgrades to incorporate modern phosphate removal technologies. As opposed to the present vagaries about water quality improvements that may result from non-point source controls, it is very easy to predict the reductions to phosphate loading that would result from reductions in the effluent phosphate concentrations from wastewater treatment facilities. In the case of the Clinton River, a 50% reduction in phosphate discharge will produce a 25% reduction in phosphate levels and a corresponding decrease in maximum algal biomass that can develop. Those numbers illustrate some of the insight and prediction that science can contribute to decision-making. Future water quality, however, depends ultimately on economic and political decisions, not on science alone.

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[1] J.T. Lehman. Point source and non-point source phosphorus loading to Lake St. Clair from the Clinton River, Southeast Michigan, USA. Report to the Audit Subcommittee, Blue Ribbon Commission on Lake St. Clair, 19 March 2008.

[2] J.A. Ferris & J.T. Lehman. Nutrient budgets and river impoundments: Interannual variation and implications for detecting future changes. Lake and Reservoir Management 24: in press for June 2008.

National
Center for
Water
Quality
Research

Monday, May 12, 2008

Impact of Nutrients on Water Quality in the Great Lakes

Testimony of
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to
U.S. House of Representatives
Committee on Transportation and Infrastructure
Subcommittee on Water Resources and Environment
Hearing held in Port Huron, Michigan

I have worked for the National Center for Water Quality Research (formerly the Water Quality Laboratory) at Heidelberg College since 1978; my first responsibility was to interpret data gathered by our lab as part of a major study of the nearshore zone of Lake Erie sponsored by U.S. EPA in 1978 and 1979. The Center has specialized in monitoring the major tributaries to Lake Erie since its inception in the late 1960s, with a focus on assessing total quantities, or loadings, of nutrients entering the lake from these tributaries and how these loadings have changed over time.

Nutrients enter the Great Lakes via their tributaries, via atmospheric deposition, via direct discharge from point sources such as sewage treatment plants, and via drainage from upstream Great Lakes. The total loads of nutrients entering the lake determine the concentrations of nutrients in the lake water, which support the growth of aquatic plants and algae. These in turn are the base of the "food chain" which ultimately supports the growth of fish and consumers of fish such as eagles and us. Too few nutrients leads to too few fish. Too many nutrients can lead to excess algae which die and sink to the bottom, using up oxygen, killing bottom-dwelling organisms and forcing migrations of fish. This is the classic problem with Lake Erie's Central Basin, and is the same problem now getting so much attention in the Gulf of Mexico. Too many nutrients also lead to blooms of noxious algae, which increase drinking water treatment costs and are potentially toxic to animals that drink the untreated water. Problems of this sort are commonly encountered in Lake Erie, in Green Bay on Lake Michigan, and in Saginaw Bay on Lake Huron.

In Lake Erie, the productivity of the ecosystem is managed by managing phosphorus inputs to the lake. Early in the process of returning this lake, once proclaimed "dead", to a healthy state, a target for maximum phosphorus loading from all sources of 11,000 metric tons was established, a substantial reduction from loads at the time of 20,000 metric tons and more. This target was met for the first time in the early 1980s. Loads fluctuate annually, largely because of differences in the tributary loads from year to year, determined by the weather. *We know what these loads are and how they've changed because we monitor the tributaries.* But monitoring is an unpopular activity, and the extent of monitoring of Great Lakes tributaries has declined continuously since the early

1970s. Dr. David Dolan, who for many years has assembled the data from different sources to compute these annual loads from all sources, informs us that without the detailed monitoring provided for major Lake Erie tributaries by our Center, there would be inadequate data to compute reliable load estimates. Loadings for the other Great Lakes have not been calculated since the early 1990s because there is too little data.

Monitoring provides data that reveals our progress in meeting environmental management goals. With the data that our monitoring program has provided in the last 30 years, we can document that sediment loads, and the loads of phosphorus carried on the sediment, have declined continuously in the Maumee and Sandusky Rivers, two of the most important tributaries to Lake Erie. Careful analysis of the data demonstrates conclusively that these desirable decreases in loading are due to the implementation of Best Management Practices (BMPs) in the largely agricultural watersheds of these rivers, practices like conservation tillage and the use of grassed waterways and other buffers. These practices reduce erosion or intercept runoff from fields, allowing sediment to settle out before it reaches the stream or river. These decreased loads are a major triumph for environmental management, and we have been the first group to document them at the large watershed scale, in good part because of our detailed monitoring data. Skeptics often ask "How do we know that these BMPs really do any good?". *We know because we monitor.*

Over the last decade, however, there is a disturbing trend of increasing loading of *dissolved* phosphorus in these same rivers. This occurs at the same time as Lake Erie is having renewed or intensified problems with noxious algal blooms and with oxygen deficits in the Central Basin. Research is underway to determine the causes of increased tributary loads of dissolved phosphorus and what steps can be taken to counter the increase. Ohio EPA has convened a Lake Erie Phosphorus Task Force to consider the problem and make recommendations to the state about appropriate management steps to be taken. *We know about this problem because we monitor.* If we did not monitor these tributaries, we would just now be mounting a program to investigate the causes of the renewed problems in Lake Erie. It would be a decade before we had enough data to determine if phosphorus was increasing in the tributaries, and we would never know about the substantial increases that have already occurred since the mid 1990s.

Any mention of monitoring is likely to provoke the claim "But monitoring is too expensive!" Expense is a relative thing. We operate our monitoring program, producing about 500 samples per year per tributary analyzed for nutrients and sediment and other major chemicals, for less than $35,000 per station per year. Is that expensive? We visit doctors once a year or more often to monitor blood pressure, cholesterol, and general health. That's expensive. We take our cars to the mechanic every 3,000 miles to change the oil and monitor the engine's performance. That's expensive. But we do it because the alternative can be much more expensive. What is the cost of not knowing what is going into our Great Lakes? In my view, the Great Lakes are so valuable that the potential cost of not knowing what's going into them, and trying to manage them "blindfolded", far outweighs the cost of monitoring. The current state of monitoring of Great Lakes tributaries, outside of our program, is woefully inadequate. I urge the Subcommittee to use its influence to increase monitoring efforts, which will lead to more enlightened management of this precious resource.

Thank you for the opportunity to present my views. I would welcome the opportunity for further discussions with any members of the Subcommittee.

Testimony of James W. Ridgway, P.E.,
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To:

Committee on
TRANSPORTATION AND INFRASTRUCTURE
SUBCOMMITTEE ON WATER RESOURCES & ENVIRONMENT

May 12, 2008

I am honored to be given the opportunity to address you, Chairman Oberstar. This will likely be the only time that I can directly address Congress – the only entity capable of saving the Great Lakes. I will not waste my five minutes reciting statistics and overlooking the great progress we have made in restoring the Great Lakes. I also will not sugarcoat the many challenges that prevent us from averting the demise of our lakes.

The Great Lakes will only be protected and restored with strong federal and international leadership. I understand that you staffed the drafting of the Clean Water Act in 1972. I am certain that you are immensely proud of the many successes that our country has enjoyed as a direct result of that fine legislation.

In 1972 the country looked to Congress to clean up our waters and you delivered.

Unfortunately, there is much more to do and neither the institutions, nor the funding is in place to address the current challenges.

Once again, the country looks to Congress to clean up our waters and hopes that you can deliver.

Stated simply, **nutrients are degrading our Great Lakes** and I have no reason to believe that the degradation will abate in my lifetime.

Let me begin by stating that I am speaking as a citizen of the Great Lakes and one that is eminently familiar with the workings of the Clean Water Act and other supporting laws, rules, and regulations. I am also very familiar with the challenges and responsibilities of the regulated community.

I am also speaking as the Executive Director of the Alliance of Rouge Communities (ARC), a voluntary public watershed entity currently comprised of 40 municipal governments. The ARC has taken one of the dirtiest rivers in the Great Lakes Basin and changed it into a recreational resource. While we still have work to do, we are proud of what we have accomplished.

I have spent my entire professional career addressing Great Lakes issues. I participated in the first Earth Day at the University of Michigan and subsequently received degrees from U of M in Oceanography, Environmental Engineering, and Civil Engineering. I have prepared water-related sections for environmental impact statements for major utilities, including nuclear power plants located on the Great Lakes. While working for the regional planning agency, I prepared the first watershed plans for all of the major watersheds in Southeast Michigan. As the Assistant Director for Wastewater Operations at the Detroit Water and Sewerage Department, I was responsible for the operation, maintenance, and regulatory compliance of what was then the world's largest wastewater treatment plant. As a consultant, I have provided technical advice to a variety of dischargers ranging from automakers to small farmers. Through all of this, I have also supported environmental advocacy groups and served on the boards of several non-profits, including the Alliance for the Great Lakes and Oakland Plus.

I can say that without exception, all of these entities want the Great Lakes to be clean for years to come. They are all willing to do their part. They are the "A" students. They all recognize that more must be done, but they want the regulators to bring the resources to the fight before they are asked to do even more.

At this point in the evolution of the Clean Water Act, more real work is being done at the local levels of government than at the federal and state level. The communities are proud of their accomplishments and willing to take more responsibility, but they are also looking for more support from the federal government. When I say support, I mean money. But money is only part of the problem. We are also hoping that certain efficiencies can be put in place that facilitate our work and allows us to rely on federal agencies for technical support, including enforcement.

IS THERE REALLY A PROBLEM?

Yes, there really is a problem. I won't bore you with the documented evidence of excess nutrients, but suffice it to say they ultimately prevent a water body from being "fishable and swimmable." That is an issue even before we talk about the likelihood of toxics as a result of Blue-Green Algae, "Red Tides," and botulism cases.

Excess nutrients kill lakes.

I have provided you a copy of the Google view of Michigan. I ask you to look at Saginaw Bay, Lake St. Clair, and western Lake Erie. Clearly there is an algae problem. These are not tiny areas. Ninety percent of the water that flows over Niagara Falls passes through Lake St. Clair, yet the nutrient load is high enough to overwhelm the assimilative capacity of the lake.

Lake St. Clair may not seem important to people that are looking at the entire Great Lakes. Doug Martz deemed it the heart of the Great Lakes. I say that it may not be a Great Lake but it is a damn good one.

But the point I need to make to you is that Lake St. Clair is the "canary in the coal mine." You cannot ignore it and then expect progress to be made in other parts of the Great Lakes.

The satellite view only tells part of the story. The following picture is not of some eutrophic inland lake -it is Lake St. Clair. I have hundreds of similar pictures from small lakes, rivers, and, yes, the Great Lakes. All are eutrophying in front of our eyes. Clearly they are nutrient-loaded. Clearly the citizens are outraged. Clearly something isn't working.

Lake St. Clair – Not a Great Lake but a Damn Good One!

<u>WHAT IS NOT WORKING?</u>

TOO MANY COOKS ARE SPOILING THE SOUP

While some question the efficiency of the federal government, most agencies do a fair job of fulfilling congressional mandates. Unfortunately, the responsibility for managing the Great Lakes is spread throughout numerous state and federal agencies. Thus the U.S. Army Corps of Engineers (ACOE), the U.S. Environmental Protection Agency (EPA),, the Michigan Department of Environmental Quality (MDEQ), the U.S. Fish and Wildlife Service, the U.S. Geological Service (USGS), the National Oceanic and Atmospheric Administration, the Department of Agriculture, the International Joint Commission, and a plethora of Canadian agencies all have an opinion on how best to proceed. Unfortunately, the non-profit sector is not much better at speaking in one voice.

Overlapping authority is not the concern - *the real problem is that much of the nutrients entering our Great Lakes are unregulated.* This distribution of authority means these unregulated nutrients are everybody's problem and they are no-one's problem and the discussions drag on for decades.

From a practical point of view, permitting and enforcement of nutrients is not working. Nutrients discharged from pipes are regulated by one agency while the same nutrient that drains from a similar pipe with a different owner is unregulated. Some areas have no responsibility to monitor and reduce, while others are placed under strict mandates.

As it stands, *nutrients are insufficiently monitored, under-regulated and continuing to impair our Great Lakes.*

<u>My Recommendation</u>

Assign a primary responsibility of the major federal interests to individual agencies. Thus the EPA may be responsible for all water quality regulatory programs. The ACOE could be responsible for dredging and construction-related activities. Monitoring could be headed by the USGS. Habitat and wildlife could be managed by U.S. Fish and Wildlife. In each case, the actual work could be performed by other federal, state and local agencies. The ultimate responsibility would, however, remain with the primary authority.

For example, if all environmental regulatory programs were placed under the EPA, then it could delegate those responsibilities to the states that wish to accept the responsibilities. Similarly, the states could delegate their responsibilities to the most proactive counties. Thus give the "A" students the responsibility, the authority, and the incentive to manage the resource at the local level. Frankly, I believe that this is the only way to succeed. The higher level regulatory agencies should shift their focus to an audit/enforcement function. Those communities that choose not to be proactive can answer to the state or federal authorities.

THERE IS VIRTUALLY NO MONITORING

In most areas of the Great Lakes, *we are unable to determine the severity of nutrient pollution on the Great Lakes because there is so little data collected.* Monitoring is required to determine if we are maintaining "fishable and swimmable" waters. In the late 1970s, the EPA and the MDEQ both had active monitoring programs. Funding constraints have all but eliminated them. Thus the agencies are required to rely on self-monitoring data required under the NPDES permitting process, and data collected in a fairly haphazard manner. As a result of this lack of real information, problems can go unnoticed for decades.

Southeast Michigan has been lucky enough to assemble federal, state, and local funds to oversee some massive monitoring programs. The Rouge River comprehensive monitoring data goes back almost two decades. Macomb County has been monitoring for pathogens for decades. The St. Clair River and Lake St. Clair has had extensive monitoring over the past five years. The results of these programs are not surprising – *water quality standards are violated routinely across Southeast Michigan!* These communities remain proactive and will address these challenges.

What these communities have also learned is that sharing resources and relying on technology can substantially reduce the cost of data collection. Thus monitoring that was determined to be too costly for decades, has become affordable.

As the communities of Southeast Michigan continue to invest in monitoring and water quality improvements, they naturally ask what other Great Lakes communities are doing: Are they monitoring? Are they policing their dischargers? Can we expect progress?

At this point, monitoring is not required through regulation. There is no funding available to encourage monitoring. Communities are under tremendous financial pressure. If a community does collect data and reports it to the regulatory authorities, that community is likely to be required to implement a program to rectify high levels found. As a result, too many communities prefer to ignore the obvious.

My Recommendation

1) Provide funding for monitoring and, 2) Identify a single agency that is responsible for collecting, maintaining, and disseminating water quality data. The work itself could be delegated to other federal, state, or local agencies but responsibility should be retained at one agency. We all expect the National Weather Service to monitor the weather. Why do we rely on the EPA, USGS, ACOE, and a number of sub-agencies to collect data and then never share the data with the local units of governments?

A potential provider of this unified service could be the USGS. I would ask that Congress demand that the service provider, whoever it is, make all data collected publicly available in a very short amount of time. As it currently stands, state and federal governments take so long to process the data through their quality assurance process that the data is useless for most applications.

MUCH OF THE NUTRIENTS THAT ENTER OUR WATERWAYS SLIP THROUGH THE REGULATORY CRACKS

The nutrients that enter our lakes arrive via our rivers but many of those nutrients began on the store shelves. That, however, does not mean that these nutrients are not hurting our Great Lakes.

A couple of examples:

1. When you buy laundry detergent (within the Great Lakes Basin) the manufacturer is required to limit the phosphorus content. However, you can go down the aisle and buy automatic dishwasher soap, dishwashing brighteners, and trisodium phosphate (TSP) none of which have a similar limit. Some of these products are over 25% phosphorous by weight. This is a very large source of phosphorous. At the same time that wastewater treatment plant operators are being required to limit their phosphorous discharges, citizens are dumping large amounts of phosphorous into the wastewater influent. The operators have virtually no control over the content of the products that migrate to the wastewater treatment plants.
2. Fertilizers, by design, are nutrients. When they are applied properly, they encourage high yields and healthy lawns. When applied in excess, they run directly into the lakes. Local units of governments are being required to reduce their nutrient loading by the Phase II storm water permit system. These permit holders are not legally able to limit the content of the application rate of fertilizer because in Michigan, fertilizer is regulated by the Department of Agriculture.

My Recommendation

Legislation that limits phosphorous content in detergents must be revisited to include products that were overlooked or did not exist when we implemented the phosphorous ban in the late 1970s. Products with exceedingly high phosphorous content may remove the spots on your glasses, but for many, the price is too high.

Similarly, land application of fertilizers must be revisited. I am not advocating a ban. I state only that nutrients must be properly managed whether discharged from a pipe into a river or spread on a lawn or field. Those entities that cannot manage nutrients in a manner that prevents excess runoff should no longer be authorized to discharge this chemical. At the very least, local units of governments should be given the authority to enact a local ordinance that regulates application of fertilizers. The current system is not working and shows little promise of improving any time soon.

OUR GREAT LAKES DESERVE THE FUNDING REQUIRED TO RESTORE AND PROTECT THEM

Some great work has been done by the federal, state and local governments but it is not enough to reverse our current course. EPA's *Gap Analysis* documents the financial challenges that our deteriorating infrastructure will cause. As the financially strapped communities strive to keep the existing infrastructure operable, newer, more efficient technologies will not be instituted. Wastewater treatment plants remain a tremendous source of nutrients, but most older plants cannot afford to implement recent technologies capable of lowering the nutrient concentrations in their discharge. These improvements must be made – either through regulation or financial incentive.

Funding should not be limited to civil works projects, however. The monitoring, permitting, and enforcement programs established in the original Clean Water Act remain the backbone of the environmental protection. Currently, they are under-funded and ineffective. If we are going to make progress in reducing nutrients in our Great Lakes, these programs must be revitalized at both the state and federal levels.

I am fully aware that the environmental programs have changed over the 35 years since the original Clean Water Act, but not all of those changes have been good for our Great Lakes. I know that you are working with a number of groups trying to re-establish some of the critical programs that have been diminished by recent court rulings. As you move forward, I hope that you might consider the following recommendations.

My Recommendations

Consider re-instituting the construction grants program. It is costly, but necessary. Must we wait until we have major failures in some of our older, urban areas before we can agree that federal funding for public works is a good idea? It was a good idea in the original Clean Water Act. It remains a good idea.

Similarly, as Congress works through the budget process, please see that funding is available for monitoring, permitting, and enforcement. This is not the sexy part of environmental programs, but it is the most important. The EPA has taken on more initiatives over the past 35 years, but much of it has come at the expense of the core programs.

Nutrient loading will not be reduced if these core programs are not fully funded.

I thank you again for the opportunity to address you this afternoon. I began by stating that only Congress can reduce the nutrient loadings to our Great Lakes. I truly believe it.

Once again, the country looks to Congress to clean up our waters and we hope that you can deliver.

Visual Evidence of Nutrient Loadings

Source: Google Imagery

WRITTEN TESTIMONY OF

DR. CRAIG STOW
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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

FIELD HEARING ON
NUTRITENT POLLUTION IN THE GREAT LAKES

BEFORE THE
SUBCOMMITTEE ON WATER RESOURCES AND ENVIRONMENT
COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE
U.S. HOUSE OF REPRESENTATIVES

May 12, 2008

Madame Chair, and Members of the Subcommittee, good morning, and thank you for inviting me to discuss contributions made by the National Oceanic and Atmospheric Administration (NOAA) to water quality improvement in the Great Lakes. I am Dr. Craig Stow, a physical research scientist at NOAA's Great Lakes Environmental Research Laboratory (GLERL), headquartered in Ann Arbor, Michigan.

The Laurentian Great Lakes are a major resource to North America, containing 18 percent of the world's surface freshwater and 90 percent of the surface freshwater of the U.S. They serve as the focus for a multi-billion dollar tourism and recreation industry, supply 40 million people with drinking water, provide habitat for wildlife and fish, and support transportation and diverse agricultural production. The basin is home to about 15 percent of the U.S. population and 60 percent of the Canadian population.

The Great Lakes are one of the Earth's greatest treasures and one of the Nation's most important aquatic resources from an economic, geographic, international, ecological, and societal perspective. The Great Lakes continually face extremes in natural phenomena such as storms, erosion, high waves, high and low water levels, and climate variability, all of which influence water quality and efforts to restore habitat. Population growth and changes in land use in the region will continue to increase stresses on the Great Lakes, adding to the complexity of management issues. The one thing that we can predict with near certainty is that the Great Lakes ecosystem will continue to change, and adapting to those changes poses a challenge for effective use and management.

In regard to water quality, multiple stressors directly or indirectly affect the Great Lakes ecosystem. Harmful algal blooms and low bottom water oxygen (hypoxia) are stressors to the Great Lakes ecosystem. Invasive species are perhaps the greatest challenge to a healthy Great Lakes. Add to this mix the impacts of local land use and climate change and the situation becomes very complex, making management, restoration and planning even more difficult.

In the early 1970s when Lake Erie was declared dead, the solution, based on best available science, was relatively clear: nutrient loading must be reduced. Our ecological understanding and technological know-how have significantly improved since the 1970s. The Great Lakes have a large, complex and economically important user base and are heavily impacted by human activities with resultant multiple stresses. Many parts of the lakes are highly eutrophic – the result of an enrichment in dissolved nutrients which has stimulated plant growth resulting in a depletion of dissolved oxygen when the plant life decays. Eutrophication and other stresses to the lakes have created the need for ecological prediction of oxygen deficiency, harmful algal blooms, recreational water quality, recreational and commercial fisheries production, invasive species and extreme natural events (high winds, storms, dramatic changes in water influx). Future successes will depend on a comprehensive and balanced ecosystem approach.

NOAA's ROLE IN THE GREAT LAKES

NOAA's mission is: "To understand and predict changes in the Earth's environment and conserve and manage coastal and marine resources to meet our Nation's economic, social and environmental needs." That mission statement captures the essence of one of NOAA's four primary goals: "Protect, restore and manage the use of coastal and ocean resources through ecosystem-based management." NOAA has environmental stewardship, assessment, and prediction responsibilities in the Great Lakes. NOAA conducts physical, chemical, and biotic research and environmental monitoring and modeling, providing scientific expertise and services to manage and protect Great Lakes ecosystems. The preeminent research and monitoring that NOAA conducts helps improve the understanding and prediction of Great Lakes processes, including the connections among the atmosphere, water and sediments. All of NOAA's offices play a vital role in supporting the economy of the Great Lakes through NOAA's four strategic themes — ecosystems, weather and water, climate, and commerce and transportation.

The Great Lakes ecosystem is one of the most clearly definable regions under NOAA's purview and mission responsibilities, and the region holds a long history of interagency partnerships and collaborations among States, Tribes, and other Federal partners. The partnerships in the Great Lakes region have led the Nation in innovative management strategies for decades, with efforts that have spanned thousands of miles, and provide a large-scale testing ground for new science and management.

NOAA has over 15 Congressional mandates that guide its specific responsibilities in the Great Lakes. NOAA is mandated to provide research, monitoring and coordination throughout the Great Lakes Basin on ecosystem issues such as water resources, invasive species, foodweb dynamics, pollutants, hydrology, hydrodynamics, ice, water quantity and quality and so forth. NOAA's programs in the Great Lakes work in partnership with one another, and with other federal and state agencies to provide comprehensive science, management, and technical assistance tools to foster comprehensive environmental stewardship of the area. NOAA's research, monitoring and operational services contribute to the protection and restoration of the Great Lakes ecosystem and the socio-economic health and safety of the public; most of these activities are connected to water quality.

Water quality is affected by multiple factors, and therefore improvements in water quality are dependent on a number of programs coordinated to work in an efficient way to improve overall ecosystem health. NOAA is working to address environmental issues in the Great Lakes through a regional ecosystem approach. By using an ecosystem approach, NOAA strives to use a science and policy framework that recognizes the fundamental interconnections of all ecosystem components, and emphasizes the maintenance of biological diversity, natural relationships among all species including humans, and dynamic processes that ensure ecosystem sustainability.

NOAA promotes a science-based approach to water quality improvements and restoration and NOAA's research provides critical information toward this end. Highlighted below are some of NOAA's efforts that contribute to improvement of water quality through interagency coordination, state partnerships, forecasts for Great Lakes conditions such as hypoxia, restoration planning, research and response for harmful algal blooms and aquatic nuisance species, monitoring activities, and hazardous materials response. Several of NOAA's activities in the Great Lakes specifically relate to water quality improvement and restoration. For example, NOAA:

- Predicts impacts of pollution and coastal development on sensitive habitats and resources, including the use of contaminant-monitoring sites in Green Bay, and Lakes Michigan, Huron, St. Clair, Erie and Ontario to determine contaminant trends;
- Works with states to analyze changes in coastal land cover and plan habitat restoration and conservation;
- Acts on behalf of the Secretary of Commerce as a natural resource trustee for the public to protect and restore aquatic species and their habitats, and associated services such as safe navigation and transportation, recreation, commercial fishing, shoreline stabilization, and flood control;
- Collects, analyzes and distributes historical and real-time observations, and predictions of water levels, coastal currents and other meteorological and oceanographic data;
- Leverages other assets such as the CoastWatch node in Ann Arbor to utilize NOAA environmental satellite and in-situ data to monitor the health of the ecosystem;
- Provides scientifically sound information on ecosystem processes and is developing ecosystem forecasting tools to improve management decisions, mitigate human impacts, and reduce the risks to human health;
- Develops and implements techniques and products to improve severe storm forecasting, and provides the weather and flood warnings, forecasts, and meteorological and hydrologic data used by research, environmental management, transportation, and community interests in the Great Lakes;
- Provides surveying, nautical charts, and other navigation services for safe shipping and boating;

- Monitors ice hazards to maritime shipping industry, which is the lifeblood of the industry and commerce on the Great Lakes and St. Lawrence Seaway;
- Partners with universities through the National Sea Grant College Program and GLERL to encourage stewardship of Great Lakes coastal natural resources by providing funding to, and conducting joint projects with area universities for research, education, outreach and technology transfer;
- Partners with state Coastal Zone Management Programs to work with local communities and state agencies to preserve, protect, develop, restore, and enhance coastal zone resources, providing research, education, and protection of coastal and estuarine areas by balancing state and national interests to promote conservation and responsible development; and
- Protects and provides interpretive information on approximately 160 historic shipwrecks at the 448-square mile Thunder Bay National Marine Sanctuary and Underwater Preserve, located off the coast of Alpena, Michigan in Lake Huron.

REGIONAL PARTNERSHIPS

In 2006, NOAA created eight regional teams in recognition of the unique needs of the various geographic regions of the U.S. The Great Lakes is one of these regions and I lead this effort. NOAA is well represented in the Great Lakes by over 65 physical offices and 140 programs. Applying a regional approach means that NOAA will draw upon the expertise of its regional offices and partners to champion the improved development, implementation, and delivery of products and services in the Great Lakes region. NOAA's strength and capacity derive from strong collaborative ties among its programs and with its partners and customers. Through the regional approach NOAA is improving outreach and communications to increase awareness and delivery of our services and also develop them from the bottom up to ensure they best serve the needs of the public. It is at the regional scale that NOAA can blend the place-based needs of customers and partners with its priorities and responsibilities as a federal agency. Ensuring consistent, high-value services to NOAA customers is more important than ever, especially given recent public attention to the state of the oceans, the effects of climate change, and impacts of natural disasters. Strengthening these relationships also is essential to the "one NOAA" principles of improved internal communications and efficiency.

Regional Collaboration will improve our value to customers by identifying and applying NOAA's full range of capabilities, within and across regions. It will also allow us to design the best solutions to address geographically specific problems. This effort will use existing authority and accountability structures and does not entail changes to NOAA's organizational structure. NOAA's leadership is committed to Regional Collaboration as an approach to engaging partners and customers, and delivering NOAA services. A senior leadership team has been established to guide the efforts of regional and priority area teams as they engage with external partners to develop and implement strategies that address the following priorities in the regions: hazard resilient coastal communities, integrated ecosystem assessments, and integrated water resource services.

INTERAGENCY COORDINATION

Interagency partnerships and collaborations have played a historic role in efforts to protect the Great Lakes ecosystem and improve water quality. Underpinning the foundation for collaboration in the Great Lakes is the President's U.S. Ocean Action Plan of December 17, 2004, which calls on federal agencies to work together with their partners in state, local and tribal authorities, as well as with the private sector, our international partners and other interests, to make our oceans, coasts, and Great Lakes cleaner, healthier, and more productive.

Also in 2004, President Bush established the Great Lakes Interagency Task Force through the Great Lakes Executive Order, which promotes partnership among federal agencies to help protect and restore the Great Lakes.

Currently, NOAA is also appointed as the U.S. chair to the International Joint Commission's Council of Great Lakes Research Managers. The International Joint Commission has overall water quality responsibilities for the Great Lakes. The Council of Great Lakes Research Managers has responsibilities to coordinate Great Lakes Research related to water quality.

THE ROLE OF RESEARCH IN SERVING THE PUBLIC

Research underpins NOAA's science-based mission of understanding and predicting changes in the Earth's environment and conserving and managing coastal and marine resources to meet our Nation's economic, social, and environmental needs. Robust environmental observation, assessment, and prediction capabilities provide the foundation for performing NOAA's mission. Research is the cornerstone on which to build and improve environmental forecasts that can enable ecosystem-based management and provide critical weather, climate, and water quality information for decision makers and the public. We ensure NOAA research and services meet the needs of our stakeholders by seeking regular feedback from the research community, operational users, and stakeholders. NOAA scientists and our external partners work together to improve the quality of people's lives and to meet our Nation's economic, social, and environmental needs.

Ecosystem Forecasting

NOAA conducts scientific research directed towards creating new tools and approaches for management and protection of coastal ecosystems that can also lead to improvements in water quality. To anticipate and minimize how stresses from human and natural causes will affect ecological processes, NOAA is developing ecological forecasting tools that predict the effects of biological, chemical, physical, and human-induced changes on ecosystems and their components. These tools include research on understanding ecological processes, conceptual models of ecosystem function, and statistical and process-driven prediction models. As these tools are developed in the research environment, NOAA scientists identify, consult, and collaborate with user groups representing the ultimate operators and beneficiaries to determine the most useful operational parameters, products, and delivery methods. This often requires the involvement of the operational branches of NOAA to plan for routine application and dissemination of ecological forecasts. Public workshops are conducted to identify user needs and services are developed accordingly. This model has been successfully applied by GLERL for forecasts of Great Lakes ice conditions, water levels, circulation and thermal structure, and waves, and is in the process of being applied for beach closures, harmful algal blooms, hypoxia/anoxia, and fish recruitment.

Lake Erie "Dead Zone"

An important research project is addressing the Lake Erie hypoxic or "dead" zone that has grown worse in recent years. Hypoxia has been responsible for the contamination of drinking water supplies and death of wildlife. NOAA's Center for Sponsored Coastal Ocean Research (CSCOR) in the National Ocean Service's National Centers for Coastal Ocean Science is funding a project to create, test and apply models to forecast how anthropogenic (land use, invasive species) and natural stresses (climatic variability) influence hypoxia formation and ecology in Lake Erie, with an emphasis on fish production. Currently funded projects are mapping the extent of hypoxia across Lake Erie, investigating the causes and consequences of hypoxia and forecasting alternatives for the management of nutrient loading to minimize harmful phytoplankton problems in zebra mussel-invaded habitats.

In 2005, GLERL, in collaboration with researchers from the U.S. and Canada, initiated one of the largest, most comprehensive Lake Erie research field programs ever conducted. The project, the International Field Years on Lake Erie (IFYLE), is focused on hypoxia and harmful algal blooms. Lake Erie's harmful algal blooms in the west basin, recurring low oxygen episodes ("dead zones") in the central basin, and invasive species have the potential to disrupt normal food web and ecosystem processes, and in turn, jeopardize the ability of Lake Erie to provide valued ecosystem services (e.g., recreational and commercial fish production, safe drinking water, and clean, bacteria-free beaches). The primary objectives of the IFYLE program are to evaluate the causes and impacts of hypoxia and harmful algal blooms in Lake Erie.

The IFYLE program involves approximately 40 scientists from NOAA, 17 different universities, and private institutions spread across 7 states and 4 countries. This program is integrative with involvement by numerous U.S. and Canadian universities and federal, state, and provincial agencies.

NOAA Center of Excellence for Great Lakes and Human Health

The NOAA Center of Excellence for Great Lakes and Human Health began in 2004 and focuses on understanding the inter-relationships between the Great Lakes ecosystem, water quality and human health. The Center employs a multidisciplinary approach to understand and forecast coastal-related human health impacts for natural resource and public policy decision-making, and develop forecasting tools to reduce human health risks associated with three research priority areas: beach closures, harmful algal blooms, and drinking water quality.

One example of the need for forecasting coastal-related human health impacts deals with drinking water quality. The Cleveland Water District provides drinking water to approximately 1.5 million people in 72 communities in Northeast Ohio. The water system gets its source water from the Lake Erie Central Basin through four water intakes covering approximately 27 miles of shoreline in the greater Cleveland area. In August 2006, three of the four Cleveland Water District water treatment plants were exposed to hypoxic water from Lake Erie, compromising water quality in the system. Hypoxic waters are low in pH and temperature and have a high manganese content that negatively impacts water processing. In an effort to investigate, research, and limit future water quality impacts to Cleveland's drinking water, GLERL, in collaboration with the Ohio Sea Grant Program, deployed Real-Time Coastal Observation Network (ReCON) buoys during the 2007 field year to develop mitigating solutions to the problem of hypoxic water intake. The ability to observe the onset of hypoxic waters in real-time by ReCON buoys has resulted in an early warning system allowing the Cleveland Water District the advance notice required to place alternate processing and storage techniques on standby during hypoxia events. In addition, real-time observations of Lake Erie temperature profiles provide the ability to detect deep water movement that can result in sudden changes in oxygen, pH, and temperature levels at water intakes. Future forecast plans include the prediction of these deep water movements using local wind forecasts.

The Center uses a multidisciplinary approach to translate scientific information and research into materials to aid health officials, local governments, and communities in making sound environmental decisions. Working with the end users is critical for this process to be effective. As one example, during 2006 and 2007 the Center held user needs workshops in Toledo, Bay City, and Green Bay to discuss how harmful algal blooms can affect drinking water quality. The purpose of these workshops was to bring together public health and natural resource managers and decision makers interested in harmful algal blooms to determine the extent of the harmful algal bloom issue in the region, create a venue to understand and assess existing knowledge of harmful algal blooms, and identify methods in which these blooms are monitored for and reported to the public. Stakeholders from the public health, drinking water, and beach management sectors, as well as academia, U.S. and Canadian federal, state, county and city governments, and community members participated. This type of outreach is critical to identify community needs and translate scientific information into a concise, easily understood format.

Managing Impacts of Multiple Stressors in Coastal Ecosystems

A new 5-year project was initiated in 2007 to examine the way in which multiple stressors, including watershed nutrient inputs, declining water levels, and invasive species, affect management goals and activities and economics in Saginaw Bay on Lake Huron. Project participants include GLERL, universities, state management agencies and the private sector. The state management participants will help to clarify the primary endpoints of public concern such as nuisance algae, harmful algal blooms, and sport-fish growth rates. Project participants will develop several parallel ecosystem-scale models that will describe our current understanding of the relationship between the important ecosystem stressors and the endpoints of concern, and lead to a new way to fully integrate research and management.

Harmful Algal Bloom Research and Response

A stressor that leads to reductions in water quality is the rapid proliferation of toxic or nuisance algae, called a harmful algal bloom. Harmful algal blooms include cyanobacteria, especially *Microcystis*, which can produce potent toxins; and macro algae, such as *Cladophora*, that build up on beaches, impacting tourism and recreation. In the Great Lakes, NOAA scientists have documented harmful algal bloom toxin levels that were 10 times higher than the World Health Organization recreational standards. NOAA is working with its federal partners to organize harmful algal bloom research around a suite of complementary and interconnected programs and activities that involve a mix of extramural and intramural research, long-term regional ecosystem-scale studies supported by short-term targeted studies, collaborations between academic and federal scientists, and multiple partnerships with Federal, state and tribal managers. EPA, a key partner, is working to determine whether cyanotoxins should be regulated under the Safe Drinking Water Act, but does not yet have sufficient information to make this determination.

Great Lakes Coastal Forecasting System

In April, 2006, NOAA announced the completion of the Great Lakes Operational Forecast System (GLOFS) for lakes Superior, Huron, and Ontario. This system is a NOAA automated model-based prediction system aimed at providing improved predictions (guidance) of water levels, water currents and water temperatures in the 5 Great Lakes (Erie, Michigan, Superior, Huron and Ontario) for the commercial, recreation, and emergency response communities. This system is an excellent example of how NOAA is meeting its mission responsibility through research projects that were developed in NOAA laboratories and are now being transferred to operational use. This forecast system, which is built on 15 years of solid research and testing, benefits all who use the Great Lakes – be it for recreational or commercial purposes. In addition to supporting critical economic uses, the GLOFS also enhances efforts to promote public safety by providing better navigational and coastal information to civil authorities and coastal managers involved in search and rescue missions and other emergency response operations.

NOAA's Center for Operational Oceanographic Products and Services maintains the GLOFS in an operational environment 24 hours a day, seven days a week to provide accurate information needed by the diverse user population in their day-to-day use of the lakes. GLOFS generates hourly "nowcast" guidance (analyses) for present conditions and four times daily forecast guidance (out to 30 hours) of total water level, current speed and direction, and water temperature for each of the Great Lakes. The GLOFS predictions enable users to increase the margin of safety and maximize the efficiency of commerce throughout the Great Lakes. Both the nowcasts and the forecasts use information generated by a three-dimensional hydrodynamic model that includes real-time data and forecast guidance for winds, water levels, and other meteorological parameters to predict water levels, currents, and temperatures at thousands of locations throughout the five lakes. Key products include data and animated map plots of water levels, water currents, and water temperatures; these products are available at http://tidesandcurrents.noaa.gov/ofs/glofs.html.

RESTORATION

NOAA's restoration activities in the Great Lakes region are important for the improvement of water quality because they restore habitat and clean contaminated sites. In support of the President's Great Lakes Executive Order, NOAA's FY 2008 budget request includes $1.5 million to establish a Great Lakes Habitat Restoration Program that will mobilize NOAA's restoration assets to restore Great Lakes aquatic resources and serve as a focal point for NOAA's broader restoration efforts in the region. The program will also support major restoration projects in Great Lakes Areas of Concern that achieve significant improvement in habitat function and provide community-wide human use benefits, while ensuring appropriate monitoring and feedback. Working with our partners, results will be used to apply lessons learned to other science-based restoration efforts throughout the Great Lakes basin.

NOAA's restoration role includes coordinating with remedial agencies on cleanup of contaminated sites, restoring injured resources and lost services, natural resource damage assessments and restoration in conjunction with other trustee agencies, working with states, tribes, and other partners to fund habitat restoration projects, and conducting research and monitoring activities. NOAA, through the Damage Assessment, Remediation, and Restoration Program, works with our partner agencies including states, tribes, and the U.S. Fish and Wildlife Service, to promote assessments and cleanup activities that will protect the aquatic environment, integrate restoration into clean up actions, and reduce overall injury to natural resources. By working cooperatively at sites with remedial and trustee agencies, local groups, and potentially responsible parties, NOAA decreases contaminant loads, reduces risks to protect sensitive species, and improves and restores habitat function. This can be accomplished through NOAA's trustee authority to cooperatively address liability, to assess natural resource damages, and to restore natural resources. NOAA is currently addressing cleanup and restoration at 16 hazardous waste sites in the Great Lakes region.

AQUATIC NUISANCE SPECIES RESEARCH AND RESPONSE

Aquatic nuisance species have the potential to impact water quality. For example, recent declines in water quality (e.g., harmful algal blooms, *Cladophora* outbreaks) in the Great Lakes have been attributed to the establishment of zebra and quagga mussels, prolific invasive species which have fundamentally altered ecosystem food webs and nutrient cycling. The major pathways by which aquatic nuisance species reach U.S. ecosystems all involve human activities, especially commerce and trade. Solutions to problems related to aquatic nuisance species will undoubtedly affect both the costs and policies of commerce and trade. Congress (in the *Aquatic Nuisance Prevention and Control Act of 1990* (16 U.S.C. 4701 *et seq.*)) and the White House (in Executive Order 13112) identified aquatic species invasions as a growing national problem requiring federal action.

NOAA is one of several federal agencies given joint responsibility for developing and implementing a national aquatic nuisance species response and action plan. NOAA serves as co-chair of both the national Aquatic Nuisance Species Task Force and the Invasive Species Council. The NOAA Sea Grant program, GLERL, and CSCOR are three programs that invest in research towards understanding, preventing, responding to, and managing aquatic species invasions in U.S. coastal ecosystems.

In July 2003, NOAA established the NOAA National Center for Research on Aquatic Invasive Species, a virtual center for the coordination of existing research programs throughout NOAA. The Center, administratively housed at GLERL, fosters partnerships to address prevention, early detection, rapid response, and management of invasive species, a major restoration and water quality issue for Great Lakes ecosystems.

It is safe to say that the risks associated with ballast water introductions have been reduced by the regulatory requirements imposed on vessels entering U.S. ports from beyond the Exclusive Economic Zone. GLERL, in conjunction with the Smithsonian Environmental Research Center, recently completed a scientific assessment of the effectiveness of ballast water exchange and concluded that, in the absence of effective alternative treatment technologies, the use of ballast water exchange has reduced the risk of ballast associated invasions to our coastal estuaries. In addition, new policies and regulations by both the U.S. and Canada have been established for vessels entering the Great Lakes that officially have no ballast on board (NOBOB vessels). These new requirements were based on findings of the NOBOB Research Program led by GLERL that NOBOB vessels still presented a level of invasion risk. Finally, considerable work has been done on development of new technologies to treat ballast water.

We have made progress in documenting the occurrences and spread of invasive species. Some of the best documented areas are the Great Lakes, where both Canadian and U.S. entities have played a significant role in documenting nonindigenous species occurrences. GLERL is creating a specific Great Lakes database in partnership with the U.S. Geological Survey, which will be rolled-out by the end of this calendar year. Even with baselines, though, monitoring of new introductions and invasion rates will continue to be problematic. Survey work is expensive in terms of both human and financial resources, and we cannot monitor all areas all of the time. We will continue to be dependent on observant individuals (including the general public), as illustrated by the most recent discovery of a new species in the Great Lakes: bloody red shrimp. Even though GLERL does extensive survey work, the bloody red shrimp was not found by our scientists as part of a formal survey. Instead, it resulted from an independent observation by one of our scientists at our boat docking facility near Muskegon, Michigan. The identification of new species (and ascertaining whether they are new introductions) and determining if such species are potentially invasive will continue to be an issue.

Finally, the most extensive scientific work has documented an apparent connection between zebra mussels and several deleterious impacts to the Great Lakes including toxic blue-green algal blooms, major impacts in the trophic chain with the disappearance of the benthic amphipod *Diporeia*, decreased growth of Great Lakes whitefish, and avian botulism in the Great Lakes causing thousands of water fowl deaths. Research is now being conducted to determine if there is a link between the mussels and expansion of the dead zone in Lake Erie.

SUMMARY

Water-quality improvements and restoration need to be based on the best available science and an ecosystem-based management approach is essential. NOAA's research in the Great Lakes takes a proactive approach and is focused on predicting ecosystem response to management decisions. By predicting the effects of biological, chemical, physical and human-induced changes on ecosystems and their components, decision makers will be better informed and have the tools to make economically and ecologically sound decisions.

Thank you again for inviting me to present this overview of NOAA's current contributions to water quality improvements in Great Lakes ecosystems.

I would be happy to answer any questions you might have.

Testimony before the U.S. House of Representatives
Subcommittee on Water Resources & Environment

May 12, 2008

Good afternoon: my name is Bill Parkus – I am here representing SEMCOG – the Southeast Michigan Council of Governments. SEMCOG is a regional planning agency representing 156 local units of Government in Southeast Michigan. SEMCOG performs planning and policy development on behalf of our members in the areas of transportation, community and economic development and environmental protection. A major focus of our efforts at SEMCOG is on improving the quality of life in the region.

Through our efforts in protecting water quality, it is clear that excess nutrients continue to cause impairment to our water resources. This has been highlighted in both physical stresses to our water through algae blooms and in water monitoring data. In fact, nutrients are the basis of many regulatory programs such as Total Maximum Daily Loads and the Phase II stormwater program.

Less clear is which nutrient sources cause the most damage. As local governments strive to address the issue, getting the biggest benefit for limited available resources is imperative. To date, there are as many questions as there are solutions to the nutrient issue. For example, we hear questions such as, should we support a legislative ban on phosphorus containing fertilizers? What should I spend my limited staff and financial resources on to get the biggest benefit for the dollar? What are the sources of phosphorus and at what level are the sources contributing? Is fertilizing good or bad?

A major role the federal government can play is to support data gathering and research designed to answer these questions. This includes much more extensive monitoring to better quantify sources of nutrients so that state and local governments can implement programs that achieve desired results in nutrient reduction.

However, the need for effective environmental protection control programs requires environmental monitoring that transcends the need to monitor nutrients. It also includes:

- Water column monitoring for other pollutants for improved natural resource protection,
- Source water monitoring at water intakes for purposes of emergency response, and
- Monitoring aquatic invasive species for ecological protection.

We hope that through hearings such as this, we can help define the role the federal government can play in supporting local government efforts to improve water quality.

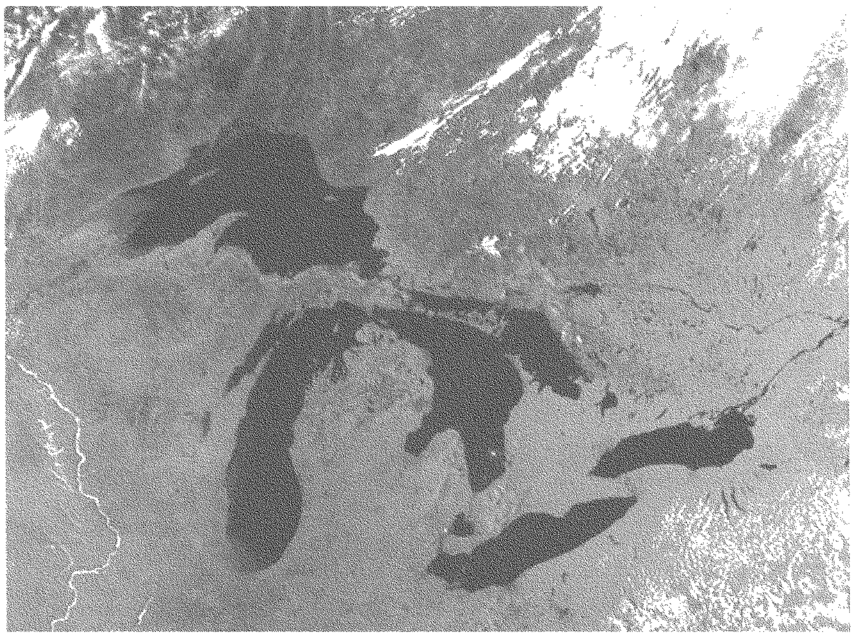
Specifically, we believe the federal government needs to remain engaged in environmental monitoring as a partner at the table. The high cost of monitoring can be managed in a partnership of local, state and federal agencies in existing watershed entities (with proven track records) such as the subwatershed groups that have formed as part of the Storm Water Permit regulatory process.

SEMCOG envisions a team approach where all participants bring some resources to the table, either fiscal, human or both. Federal agencies can bring grants as well as the technical expertise of their professional staff. Through these institutional arrangements, monitoring can be accomplished in a more affordable manner. This will help us identify the sources of nutrients, and develop effective control programs and track progress in improvement.

In closing, we welcome the committee to Southeast Michigan. Of course we view the Great Lakes as a jewel. The reality is, they are a jewel to the residents of this region, the State, and the entire country.

Thank you for your time and attention.

UNDERSTANDING GREAT LAKES WATER LEVEL FLUCTUATIONS AND CURRENT CONDITIONS



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Introduction

This document is provided as a means to help people become more informed on the science behind the fluctuations in Great Lakes water levels. Currently Lake Superior is beginning its seasonal rise, while the remaining lakes have been rising over the past few months. Water level fluctuations are primarily driven by the natural hydrologic cycle with only minor influences from what humans can do. Information is presented on the Great Lakes basin in general, the driving forces behind why the levels rise and fall, and more detailed data on recent precipitation, evaporation and river flows that play a key role in current water level conditions.

Understanding Great Lakes Water Level Fluctuations

The Great Lakes and St. Lawrence River are a dynamic system which is still evolving. Ever since the last glaciers retreated more than 10,000 years ago, Great Lakes water levels and river flows have varied dramatically. The Great Lakes basin covers more than 94,000 square miles of water and more than twice as much land. It includes part or all of eight U.S. states and two Canadian provinces as shown on Figure 1.

The profile of the system is depicted in Figure 2 and shows a series of steps leading from Lake Superior at the headwaters down to the Atlantic Ocean. The St. Marys River flows from Lake Superior to Lake Huron. Lakes Michigan and Huron are connected by the broad and deep Straits of Mackinac and are considered to be one lake hydraulically, with levels rising and falling together. The St. Clair and Detroit rivers, with Lake St. Clair in between, connect Lake Huron with Lake Erie. The Niagara River then links Lake Erie with Lake Ontario, including the dramatic drop over Niagara Falls. The man-made Welland Canal also links Lakes Erie and Ontario, providing a detour around the Falls. From Lake Ontario, water flows into the St. Lawrence River, which converges with the Ottawa River and flows on to the Atlantic Ocean.

Since the retreat of the glaciers, water levels have undergone dramatic fluctuations, as much as hundreds of feet. Figure 3 shows the water level ranges of the Great Lakes over the last 90 years, based on a lake-wide average of several water level gages situated around each lake. The Great Lakes are one of the youngest natural features on the North American continent, and remain a dynamic, evolving system due to rebounding of the earth's crust, erosion and variations in climate.

The difference between the amount of water coming into a lake and the amount going out is the determining factor in whether the water level will rise, fall or remain stable. Moisture is carried into the Great Lakes basin by continental air masses originating in the northern Pacific Ocean, tropical systems originating in the Gulf of Mexico, or Arctic systems originating in the northern Polar regions. As these weather systems move through, they deposit moisture in the form of rain, snow, hail or sleet. Water enters the system as precipitation on the lake, runoff from surrounding land, groundwater inflow and inflow from upstream lakes. Figure 4 shows the precipitation values for each lake, for the last 3 years compared to average. Water leaves the system through evaporation for the land and water surfaces, groundwater outflow, consumptive use, diversions and outflows to downstream lakes or rivers. Evaporation is a major factor when warm lake surfaces come in contact with dry air. Figure 5 shows the evaporation values for each lake, for the last 3 years compared to average.

Water levels fluctuate on a short-term basis, usually due to winds and changes in barometric pressure, lasting from a couple hours to several days. The lakes also fluctuate on a seasonal cycle. Levels decline to their lowest level in the winter months because more water leaves the lake through evaporation (greatest in the fall and early winter). As the snow melts in the spring, precipitation and runoff also increase. Generally, evaporation is least during spring and early summer. These factors contribute to more water entering the lakes than leaving, so water levels rise to their summer peak. Long-term fluctuations occur over periods of consecutive years. Continuous wet and cold years will cause levels to rise, while warm and dry years will cause levels to decline. Figure 6 shows the hydrologic components that make up the water supply to each of the lakes and the percentage they contribute.

Crustal movement, the rebounding of the earth's crust from the removed weight of the glaciers, does not change the amount of water in a lake, but rather the intersection of the water surface and the shoreline. Rebound rates vary across the Great Lakes basin, with the crust rising the most in the northern portion of the basin, where the ice was thickest, heaviest and last to retreat. There is little or no movement in the southern portion of the basin. As a result, the Great Lakes basin is gradually tipping.

There are five diversions in the Great Lakes basin. The Long Lac and Ogoki diversions bring water into Lake Superior from the Hudson Bay watershed. The Lake Michigan Diversion at Chicago removes water from Lake Michigan for water supply, sewage disposal and commercial navigation. The Welland Canal provides a shipping route around Niagara Falls and moves water from Lakes Erie to Ontario that would have naturally flowed down the Niagara River. The New York State Barge Canal diverts a small amount of water from the Niagara River and returns the water to Lake Ontario. In all, the net amount of water diverted into the Great Lakes basin exceeds that diverted out.

Lake Superior outflows are controlled near the twin cities of Sault Ste. Marie, Ontario and Michigan. The current flow control facilities consist of three hydropower plants, five navigation locks and a 16-gated control structure, called the Compensating Works. Lake Superior outflows have been regulated since 1921 by the International Lake Superior Board of Control in accordance with conditions specified by the International Joint Commission (IJC). The IJC, a bi-national agency of the United States and Canada, is responsible for oversight of the terms of the 1909 Boundary Waters Treaty between the two nations. Lake Superior's outflows are adjusted monthly, taking into consideration the water levels of lakes Superior and Michigan-Huron. The objective is to help maintain the lake levels on both lakes in relative balance compared to their long-term seasonal averages. Regulation of Lake Superior's outflow has an effect on water levels, but to a far lesser extent than natural factors.

Outflow from Lake Ontario is managed under the auspices of the IJC and its International St. Lawrence River Board of Control. The outflows have been regulated since 1960, primarily through the Moses-Saunders power dam, near Cornwall, Ontario and Massena, New York. Another dam, located near Long Sault, Ontario acts as a spillway when outflows are larger than the capacity of the power dam. The IJC's criteria for regulating outflows explicitly recognizes the need of three major interest groups: riparian (shore property owners), hydropower and commercial navigation. Outflows are regulated on a weekly basis under four key objectives: Maintain Lake Ontario's water level within a four-foot range during the navigation season; maintain adequate depths in the International Section of the River for safe navigation; maintain adequate flows for hydropower generation; protect the lower St. Lawrence River below the control works from flooding.

Current Great Lakes Water Level Conditions

Current Great Lakes water levels for 2007 and 2008 as well as forecasted levels to September 2008 are shown on Figure 7. Note that currently Lake Superior and Lake Ontario are above last year's levels while Lakes Michigan-Huron, St. Clair and Erie are below their levels of last year. Lakes Erie and Ontario are currently above their long term averages (LTA, 1918-2007). A very active 2007-2008 winter storm track has brought abundant snow to most of the Great Lakes basin. Some locations have seen 2 – 3 feet more snow than average. Temperatures have varied this winter leading to a number of snow melt runoff events. Ice cover began to form much earlier than across the northern lakes, limiting evaporation. Soil moisture across much of the Great Lakes basin is above average. The combination of these conditions is a sign of higher water levels come spring and summer.

Lake Superior set new record low monthly average water levels in August and September 2007. These new records were brought on by drought conditions across the Lake Superior basin over the previous 15 months. Precipitation in 2007 through August was 3 inches below average. The August water level was ½ inch lower than the previous record set in August 1926, while the September water level was 4 inches lower than the previous 1926 record. Neither of the new records are the lowest point on record for Lake Superior though. The lowest level occurred in April 1926 and was about 1 foot lower than September's level. Forecasts made during September showed a good chance for new record lows into 2008. Then in mid-September, the Lake Superior basin was inundated with heavy rain. From mid-September through October over 10 inches of rain fell in the basin. The water level of Lake Superior responded by rising close to 9 inches. Figure 8 shows daily water level and precipitation during September and October. Starting with the October forecast, the chances for new record lows largely diminished, however Lake Superior is expected to remain below its LTA. The current forecast shows below average levels from April 2008 through September 2008. Lake Superior has been below its long-term average since 1998 and is currently in the longest period of below average water levels in the 1918-2007 period of record. Below is a summary of hydrologic conditions in the Lake Superior basin.

- Precipitation in 2008 through March is about an inch and a half below average.
- Precipitation in 2007 was 3 inches above average.
- Precipitation in 2006 was close to 6 inches below average.
- Precipitation in 2005 was about an inch below average.
- Evaporation during the fall and winter of 2007/2008 was much less than that of 2006/2007.
- Snowpack across the Lake Superior basin is much larger this winter than last. This corresponds to a greater amount of water available for runoff. See Figure 9.

During the last 16 months, Lake Superior outflows have been reduced to the approximate flow that would have existed prior to any man made changes in the St. Marys River or at/near the minimum flow allowed by the current regulation plan. This is due to the current regulation plan trying to bring Lake Superior closer to its average levels. The major influence on Lake Superior water levels is the hydrologic cycle

Lake Michigan-Huron has been below average since January 1999 and is currently in its second longest period of below average water levels in the 1918-2007 period of record. The lake is currently below last year's levels. The most probable forecast for the next six months shows the lake 9 - 13 inches above their record lows and 18 -21 inches below its long-term average. Prior forecasts showed an increased chance for new record low water levels in early 2008, but much above average precipitation from Dec 2007 through Feb 2008 pushed the lake higher than originally forecasted. Lake Michigan-Huron has been steadily rising since December and is forecasted to continue rising though August 2008. It is expected to climb above last year's water level by July. Significant natural factors leading to the current water level conditions are:

- Precipitation in 2008 through March is 2-1/4 inches above average.
- Precipitation in 2007 was 2-3/4 inches below average.
- Precipitation in 2006 was close to 3 inches above average.
- Precipitation in 2005 was over 3-1/2 inches below average.
- Evaporation during the fall and winter of 2007/2008 was much less than that of 2006/2007.
- Inflows from Lake Superior have been reduced to the approximate flow that would have existed prior to any man made changes in the St. Marys River or at/near the minimum flow allowed by the current regulation plan.

Lake St. Clair has been above, below and near average over the past 2 years. It is currently near its long term average and about an inch above last year's levels. The most probable forecast for the next six months shows the lake below average and last year's levels, but well above its record lows. Significant natural factors include:

- Precipitation in 2008 through March is about 3-1/4 inches above average.
- Precipitation in 2007 was 3/4 inch below average.
- Precipitation in 2006 was 6 inches above average.
- Precipitation in 2005 was nearly 2 inches below average.
- Evaporation is a lesser issue for this lake, compared to the larger lakes, as it frequently freezes over, limiting evaporation.
- Inflows from Lake Michigan-Huron have been below average 95% of time for 2006 and 2007.

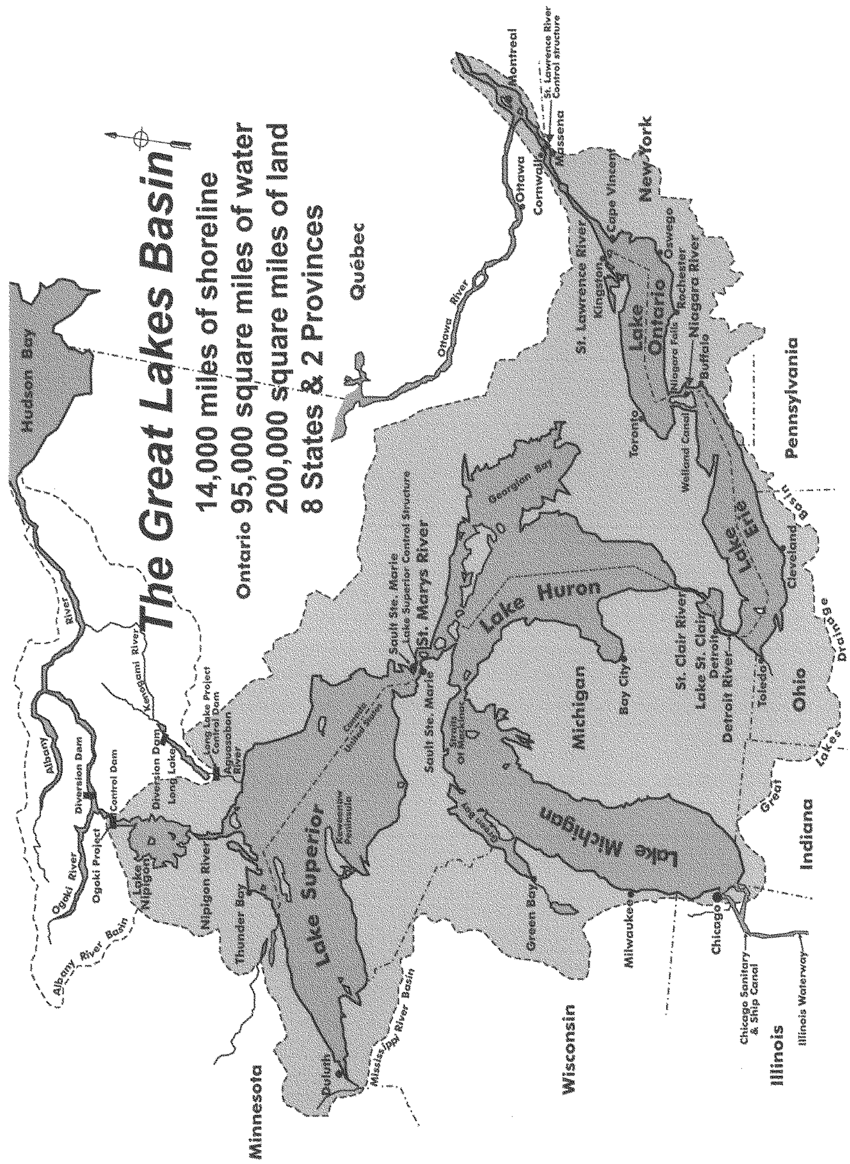
Lake Erie has been above, below and at average over the past 2 years. It is currently 8 inches above average, and 2 inches above last year's level. The most probable forecast for the next six months shows the lake will remain near or above average through May, then fall below average through September. Lake Erie will remain well above its record low levels. Significant natural factors include:

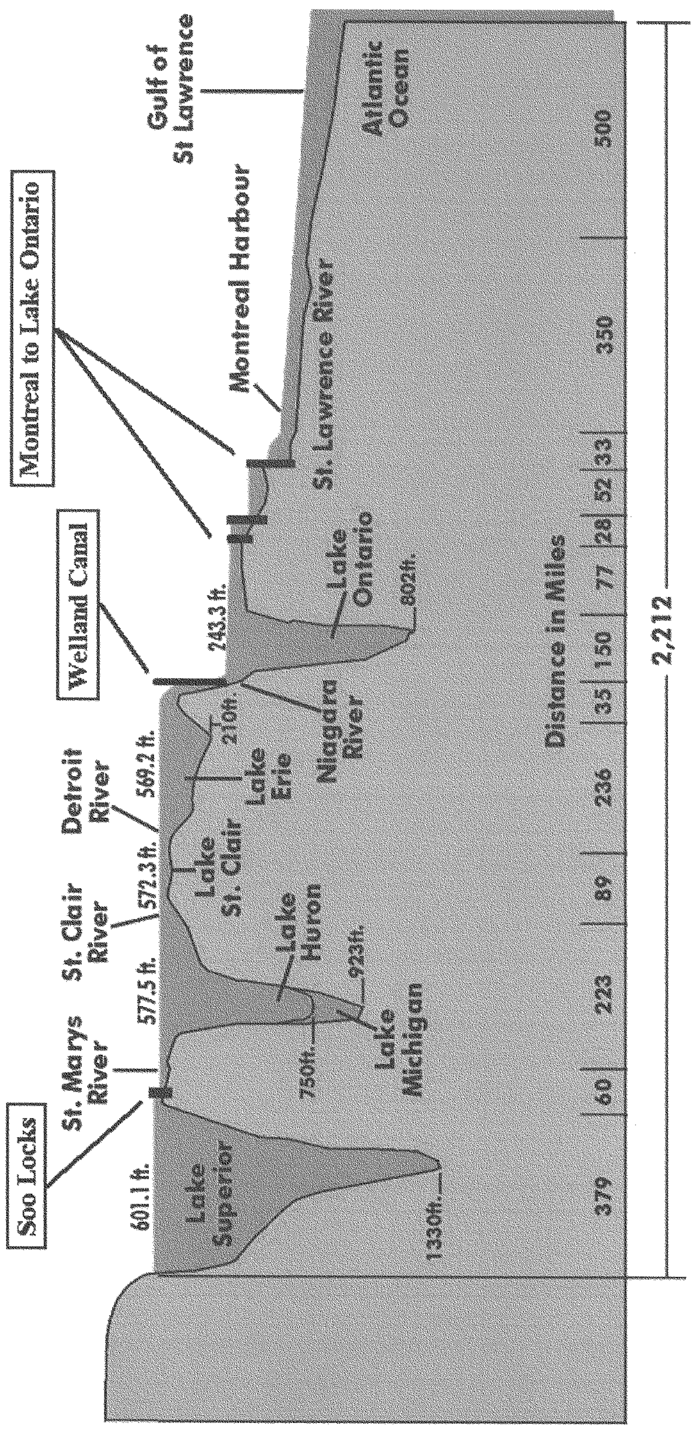
- Precipitation in 2008 through March is about 4-2/3 inches above average.
- Precipitation in 2007 was about 3/4 inch above average.
- Precipitation in 2006 was 8 inches above average.
- Precipitation in 2005 was nearly 2 inches below average.
- Evaporation is a lesser issue for this lake, compared to the larger lakes, as it frequently freezes over, limiting evaporation.

Lake Ontario has been above, below and at average over the past 2 years, but ended 2007 below average. Since December 2007 the lake has risen significantly and is now 2 inches above average. The most probable forecast for the next six months shows the lake remaining above average through May and near average in June, July and August. Lake Ontario will remain about 3 feet above its record low levels. Significant natural factors include:

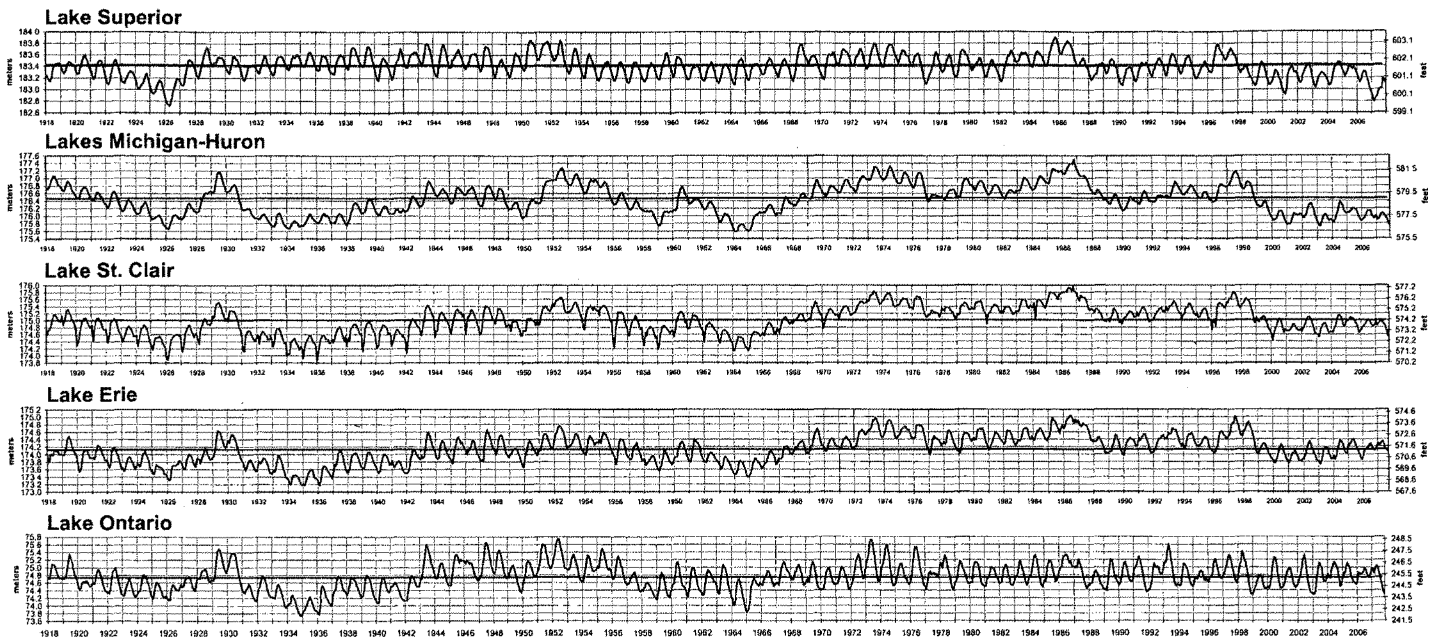
- Precipitation in 2008 through March is 2-3/4 inches above average.
- Precipitation in 2007 was about 5 inches below average.
- Precipitation in 2006 was 4-1/2 inches above average.
- Precipitation in 2005 was just over 1 inch below average.

Forecasted water levels are highly dependent on the supply of water the lakes are expected to receive over the coming months. The U.S. Army Corps of Engineers, in coordination with Environment Canada, will continue to monitor basin conditions and provide updated information on our website at http://www.lre.usace.army.mil/glhh. Additional web links of interest are listed on Figure 10.


The Great Lakes Basin
14,000 miles of shoreline
95,000 square miles of water
200,000 square miles of land
8 States & 2 Provinces
Hudson Bay
Ontario
Québec
Lake Superior
Lake Michigan
Lake Huron
Lake Erie
Lake Ontario
Georgian Bay
Lake Nipigon
Nipigon River
Thunder Bay
Duluth
Sault Ste. Marie
St. Marys River
Lake Superior Control Structure
Green Bay
Milwaukee
Chicago
Chicago Sanitary & Ship Canal
Illinois Waterway
Bay City
St. Clair River
Lake St. Clair
Detroit
Detroit River
Toledo
Cleveland
Buffalo
Niagara River
Niagara Falls
Welland Canal
Toronto
Kingston
Rochester
Oswego
Cape Vincent
St. Lawrence River
Cornwall
Massena
Montreal
Ottawa
Ottawa River
St. Lawrence River Control Structure
Ogoki River
Ogoki Project
Control Dam
Diversion Dam
Albany River
Albany River Basin
Kenogami River
Long Lake
Long Lake Project Control Dam
Aguasabon River
Mississippi River Basin
Great Lakes Drainage Basin
Minnesota
Wisconsin
Illinois
Indiana
Michigan
Ohio
Pennsylvania
New York


Soo Locks
St. Marys River
St. Clair River
Detroit River
Welland Canal
Montreal to Lake Ontario
Montreal Harbour
Gulf of St Lawrence
601.1 ft.
Lake Superior
1330ft.
577.5 ft.
750ft.
Lake Michigan
923ft.
Lake Huron
572.3 ft.
Lake St. Clair
569.2 ft.
Lake Erie
210ft.
Niagara River
243.3 ft.
Lake Ontario
802ft.
St. Lawrence River
Atlantic Ocean
379
60
223
89
236
35
150
77
28
52
33
350
500
Distance in Miles
2,212

Great Lakes Water Levels (1918-2007)



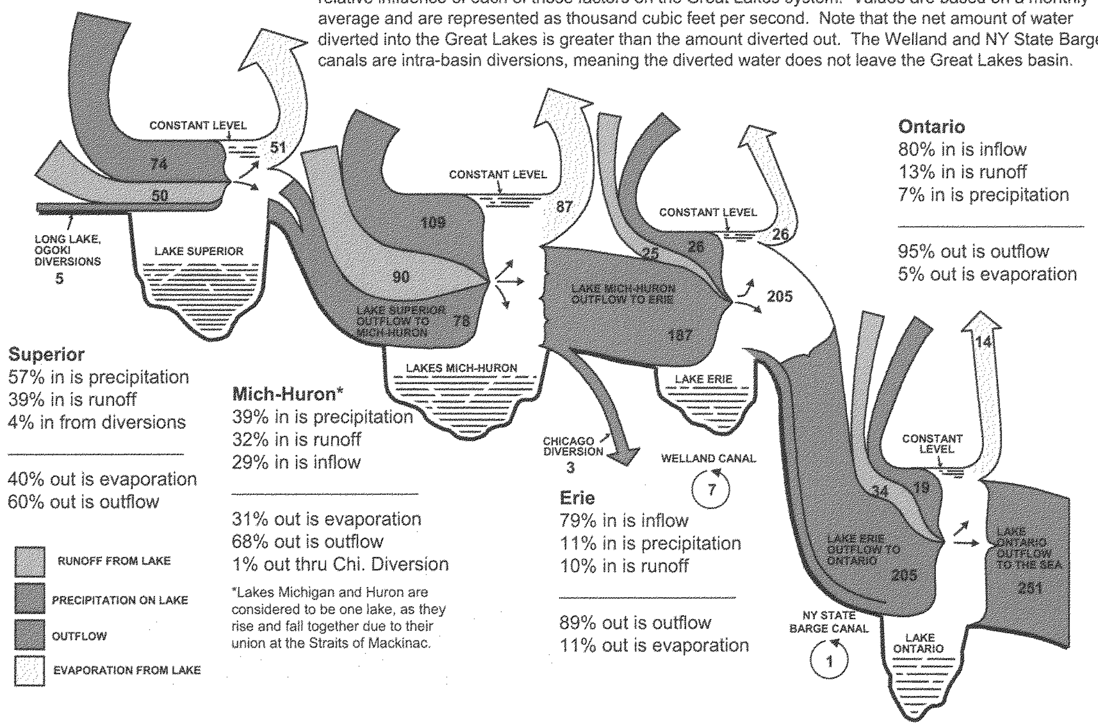
The monthly average levels are based on a network of water level gages located around the lakes.

Elevations are referenced to the International Great Lakes Datum (1985).

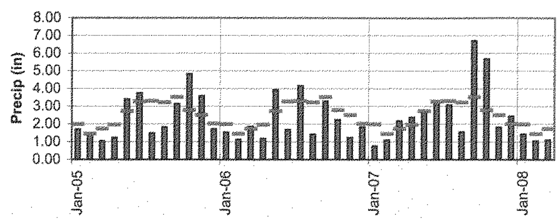
U.S. Army Corps of Engineers
Detroit District
http://www.lre.usace.army.mil

Hydrologic Components

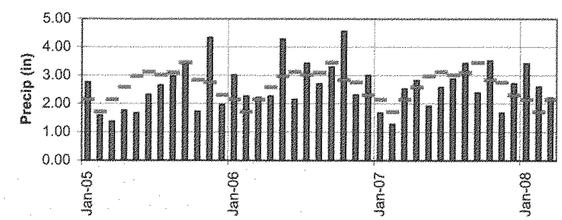
Flow from upstream lakes, evaporation and precipitation influence lake levels. This graph illustrates the relative influence of each of those factors on the Great Lakes system. Values are based on a monthly average and are represented as thousand cubic feet per second. Note that the net amount of water diverted into the Great Lakes is greater than the amount diverted out. The Welland and NY State Barge canals are intra-basin diversions, meaning the diverted water does not leave the Great Lakes basin.



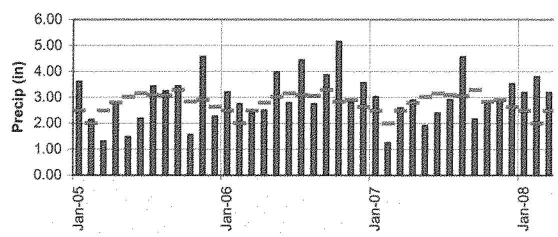
Lake Superior Precipitation (2005-2008)



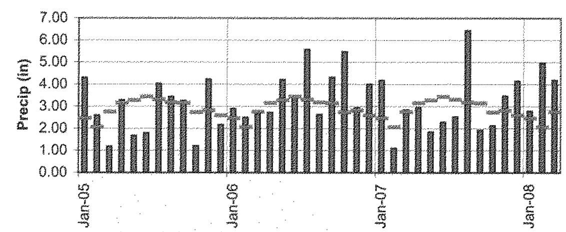
Lake Michigan-Huron Precipitation (2005-2008)



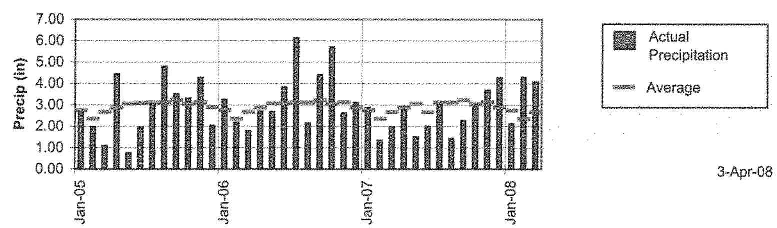
Lake St. Clair Precipitation (2005-2008)



Lake Erie Precipitation (2005-2008)



Lake Ontario Precipitation (2005-2008)



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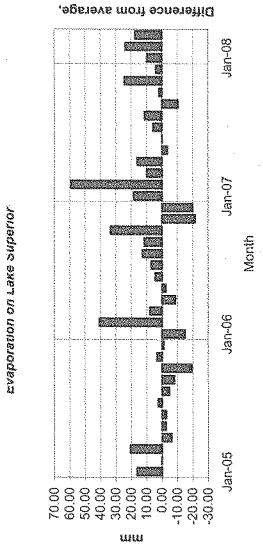
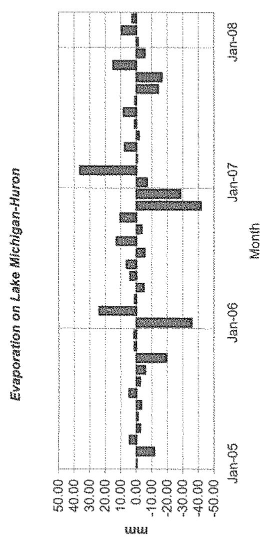
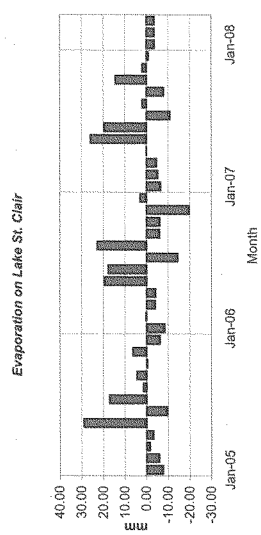
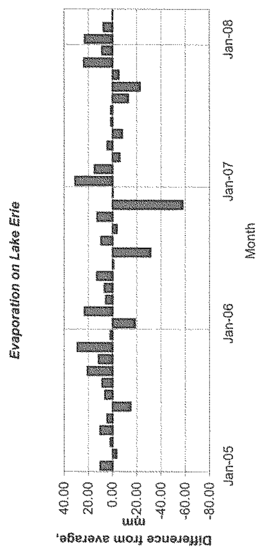
http://www.lre.usace.army.mil

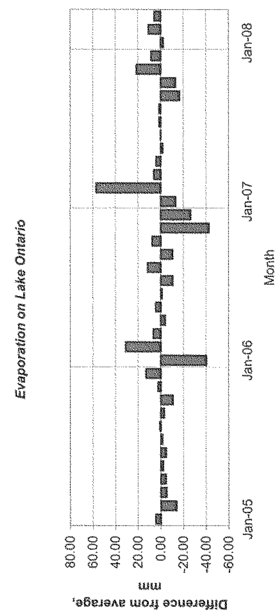
3-Apr-08











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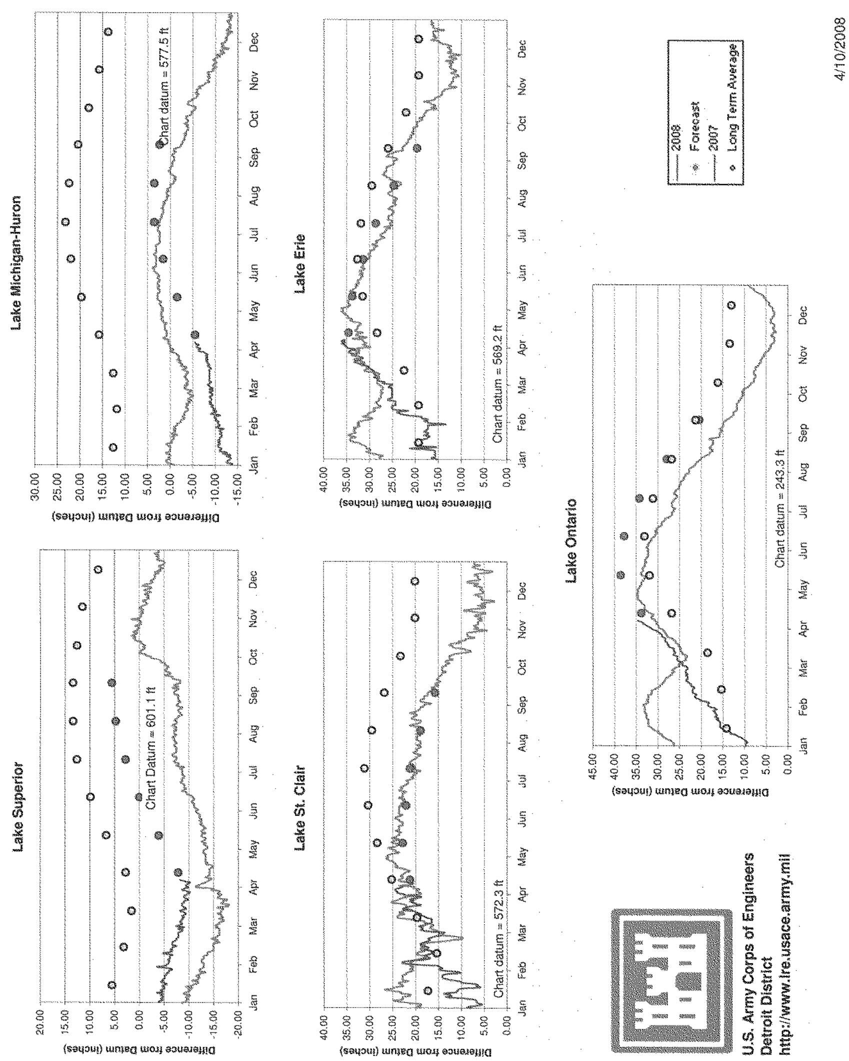
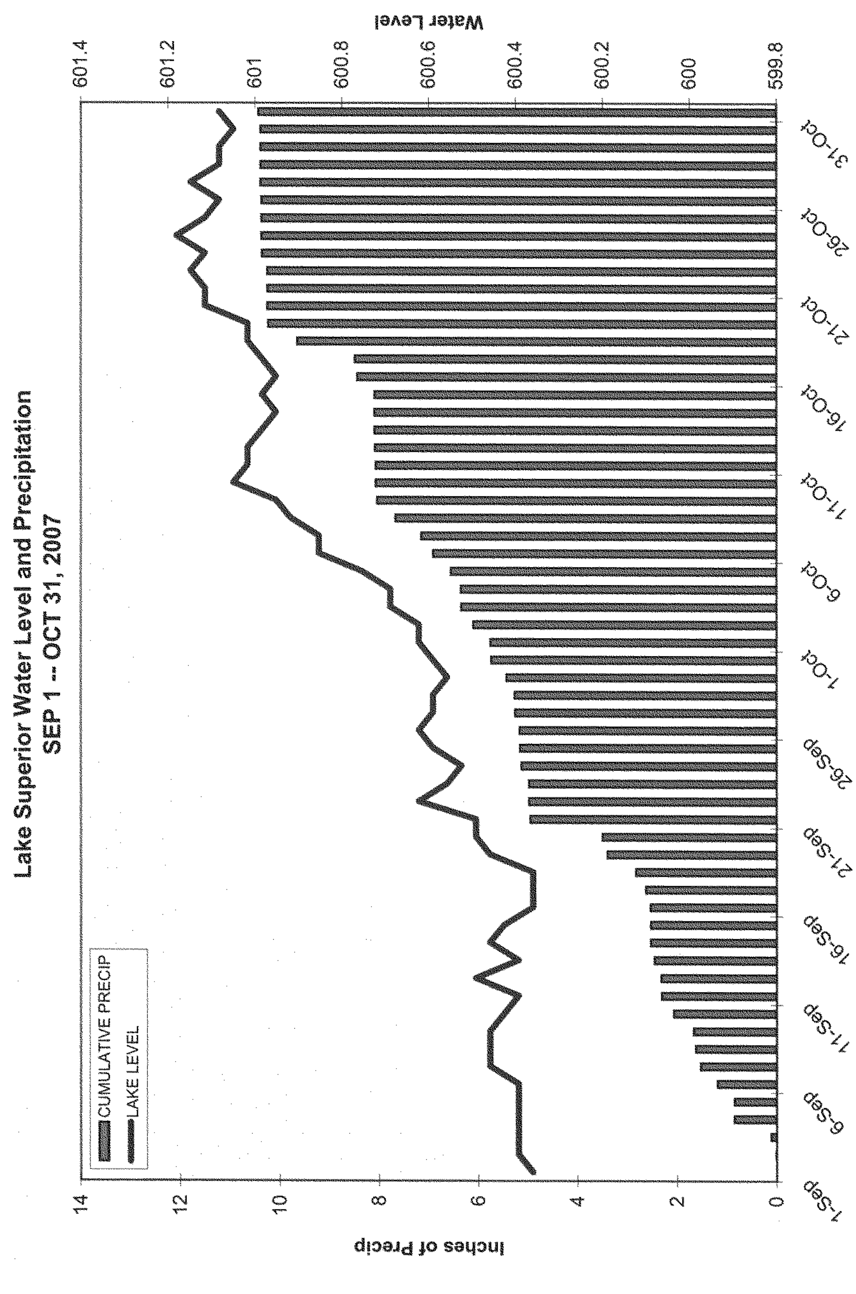
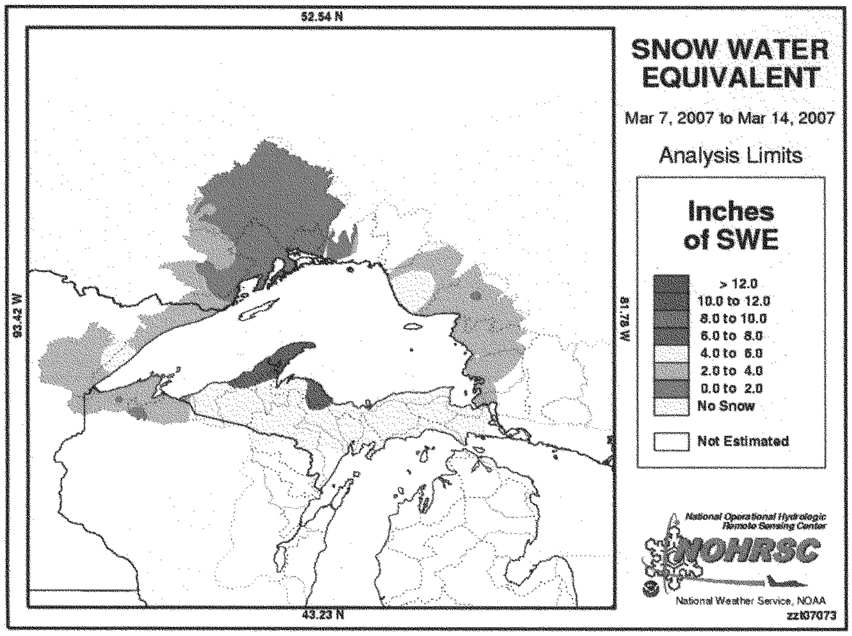
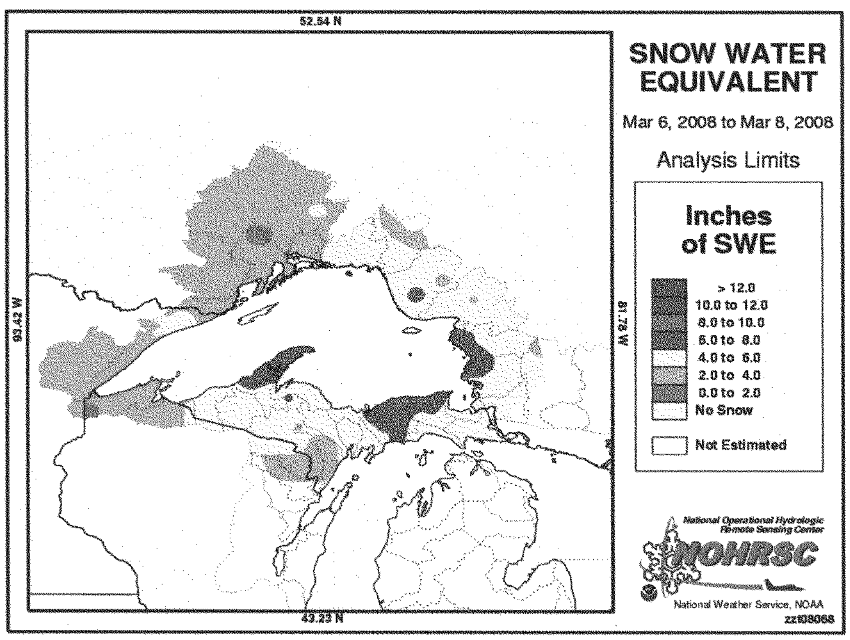
Detroit District
http://www.lre.usace.army.mil

1-Apr-08


Lake Superior
Chart Datum = 601.1 ft
Lake Michigan-Huron
Chart datum = 577.5 ft
Lake St. Clair
Chart datum = 572.3 ft
Lake Erie
Chart datum = 569.2 ft
Lake Ontario
Chart datum = 243.3 ft
Difference from Datum (inches)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
2008
Forecast
2007
Long Term Average
U.S. Army Corps of Engineers
Detroit District
http://www.lre.usace.army.mil
4/10/2008


Lake Superior Water Level and Precipitation
SEP 1 -- OCT 31, 2007
CUMULATIVE PRECIP
LAKE LEVEL
Inches of Precip
Water Level
0
2
4
6
8
10
12
14
599.8
600
600.2
600.4
600.6
600.8
601
601.2
601.4
1-Sep
6-Sep
11-Sep
16-Sep
21-Sep
26-Sep
1-Oct
6-Oct
11-Oct
16-Oct
21-Oct
26-Oct
31-Oct


52.54 N
93.42 W
81.78 W
43.23 N
SNOW WATER EQUIVALENT
Mar 7, 2007 to Mar 14, 2007
Analysis Limits
Inches of SWE
> 12.0
10.0 to 12.0
8.0 to 10.0
6.0 to 8.0
4.0 to 6.0
2.0 to 4.0
0.0 to 2.0
No Snow
Not Estimated
National Operational Hydrologic Remote Sensing Center
NOHRSC
National Weather Service, NOAA
zzt07073


52.54 N
93.42 W
81.78 W
43.23 N
SNOW WATER EQUIVALENT
Mar 6, 2008 to Mar 8, 2008
Analysis Limits
Inches of SWE
> 12.0
10.0 to 12.0
8.0 to 10.0
6.0 to 8.0
4.0 to 6.0
2.0 to 4.0
0.0 to 2.0
No Snow
Not Estimated
National Operational Hydrologic Remote Sensing Center
NOHRSC
National Weather Service, NOAA
zzt08068

Useful Great Lakes Web Addresses 2008

International Lake Superior Board of Control:	http://www.lre.usace.army.mil/IJC/Superior/index.shtml
International Niagara River Board of Control	http://www.ijc.org/conseil_board/niagara/en/niagara_home_accueil.htm
International St. Lawrence River Board of Control:	http://www.islrbc.org
International Joint Commission:	http://www.ijc.org/
International Upper Great Lakes Study	http://www.iugls.org/en/home_accueil.htm
USACE Detroit District Web Page:	http://www.lre.usace.army.mil/
USACE Buffalo District Web Page:	http://www.lrb.usace.army.mil/
Detroit District Water Level Bulletin:	http://www.lre.usace.army.mil/greatlakes/hh/ (Click on 'Forecasts' under "Water Levels")
Canadian Water Level Bulletin:	http://www.waterlevels.gc.ca/C&A/bulletin_e.html
Level News Site:	http://www.on.ec.gc.ca/water/level-news/intro-e.html
Environment Canada Water Levels Page (with links):	http://www.on.ec.gc.ca/water/levels/intro.html
Great Lakes Information Network:	http://www.great-lakes.net/
Canadian Hydrographic Service (CHS):	http://www.waterlevels.gc.ca/C&A/gs_selection_e.html
Great Lakes Nautical Charts (U.S.)	http://www.noaa.gov/charts.html
CHS - Nautical Charts (Canadian):	http://www.chs-shc.gc.ca/pub/en/
National Oceanograpic and Atmospheric Administration:	http://co-ops.nos.noaa.gov/
CHS Hourly Water Levels:	http://www.waterlevels.gc.ca/C&A/gs_selection_e.html
Environment Canada Weather Radar - Ontario:	http://weatheroffice.ec.gc.ca/radar/index_e.html?id=ont
Environment Canada Marine Weather Forecasts:	http://weatheroffice.ec.gc.ca/marine/region_08_e.html
National Weather Service	http://www.nws.noaa.gov
Environment Canada 5-Day Weather Outlooks - Ontario:	http://weatheroffice.ec.gc.ca/forecast/canada/on_e.html
NOAA Climatological Outlooks	http://www.cpc.ncep.noaa.gov/products/predictions/
Environment Canada Climatological Outlooks:	http://weatheroffice.ec.gc.ca/saisons/index_e.html
U.S. Real-Time Streamflows (U.S.G.S.)	http://waterdata.usgs.gov/nwis/rt
Canadian Real-Time Streamflows:	http://scitech.pyr.ec.gc.ca/waterweb/formnav.asp?lang=0
Crustal Movement Report:	http://www.geod.nrcan.gc.ca/pdf/pgrreportnov2001.pdf
Seaway:	http://www.greatlakes-seaway.com/en/home.html